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Doctorado en Economía Industrial

University education in Spain and the European Union: Economic effects and social contributions

TESIS DOCTORAL

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A mi madre

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1 Introduction

1.1 La educación universitaria y las universidades

Las universidades preservan y difunden el conocimiento, actúan como centros intelectuales de orden nacional e internacional, son un instrumento de movilidad social al facilitar que los individuos puedan mejorar sus ingresos y posición social, actúan como motores del desarrollo económico estimulando las economías locales y proporcionan además una educación de carácter general.

Las funciones que desarrollan las universidades son más importantes en las sociedades que han superado las primeras etapas de desarrollo y cuya población cuenta ya con niveles educativos básicos, dado que el paso a los estudios secundarios postobligatorios y superiores cobra en este caso una especial relevancia. Tradicionalmente las universidades han proporcionado educación y han formado a las personas en las profesiones u ocupaciones más relevantes, desarrollando una conexión directa a largo plazo con la economía y las necesidades de la sociedad. La paulatina sofisticación de la economía a causa del avance del conocimiento y la tecnología ha llevado a las universidades a proporcionar formación a un creciente y cada vez más diverso número de ocupaciones, siendo responsables en la actualidad de la formación de los ocupados más altamente cualificados de las sociedades.

En estas circunstancias, el acceso a los estudios superiores de una elevada proporción de jóvenes es el punto de partida para que el crecimiento económico pueda apoyarse en los factores de competitividad característicos de las economías más avanzadas: la mejora de la productividad mediante el empleo intenso de capital humano, la innovación y la sofisticación eficiente de los negocios.

El papel de las universidades en las transformaciones que exige un desarrollo económico y social basado en el conocimiento, y cada vez más en la digitalización, es muy relevante y sus contribuciones están siendo ya muy importantes, tanto a través de la formación de capital humano como del refuerzo de los resultados de investigación. Unas y otras actividades

mejoran la capacidad de generar conocimientos y aprovecharlos para fines productivos y de innovación. La parte del tejido empresarial más eficiente y dinámica usa cada vez con mayor intensidad estos recursos generados por las universidades, algo que sucede con más fuerza en las economías más avanzadas.

La función que la generación y el aprovechamiento del capital humano juega en el desarrollo de los países, tanto desde el punto de vista económico como para la mejora del estado de bienestar individual y colectivo, es una evidencia no cuestionada y compartida por los principales organismos internacionales y nacionales.

Así, por ejemplo, las instituciones europeas han formulado diversas estrategias para mejorar su competitividad, y en todas ha otorgado un papel destacado a la universidad, defendiendo la necesidad de cambios importantes en la educación superior y la investigación, además de establecer objetivos educativos en niveles más básicos como la reducción del abandono educativo temprano. Actualmente la estrategia Europa 2020 busca reavivar las actuaciones en esa dirección fijándose, entre otros objetivos, que el 40% de la población posea estudios superiores.

Asimismo, las últimas estimaciones del Centro Europeo para el Desarrollo de la Formación Profesional (CEDEFOP, 2017), una de las agencias descentralizadas de la UE que apoya el desarrollo de políticas de educación y formación profesionales (EFP) y que contribuye a su aplicación, señala que las oportunidades de empleo para España entre 2015 y 2025 se van a concentrar en la población con estudios superiores, un 53,2%, y con estudios secundarios postobligatorios, un 36,1%. Tan solo el 10,8% de dichas oportunidades se darán entre las personas con estudios básicos. Estas cifras no hacen más que abundar en el hecho de que la formación superior se convierte en un factor clave en el desarrollo de la carrera profesional y de la competitividad de un país.

Por su parte, el World Economic Forum (WEF, 2017) señaló —al construir su conocido índice global de competitividad (IGC)— que la competitividad

de los países con distinto nivel de desarrollo no se apoya del mismo modo en los distintos pilares que la soportan. En los más avanzados, los factores decisivos son aquellos que les permiten compensar sus mayores costes generando más valor añadido por ocupado: la sofisticación de los negocios y la innovación. Pero las economías impulsadas por las mejoras de eficiencia se apoyan de manera sustancial en la educación superior y el desarrollo tecnológico. Todos estos factores requieren un uso intensivo del conocimiento y son los que hacen posible obtener productos de mayor contenido tecnológico, más diferenciados e innovadores, por los que el mercado paga un mayor valor unitario. Es en estos pilares en los que las economías denominadas de la *innovación* muestran su principal ventaja competitiva, aunque también presentan fortalezas en el resto de factores por haberse apoyado en ellos en las etapas previas de su desarrollo y seguir haciéndolo para poder conservar su posición avanzada.

Sobre los efectos favorables que aporta disponer de una población más formada cabe referirse a la iniciativa *How's Life* de la OCDE, que realiza una medición del bienestar (o la idea de una vida mejor) en la que la dimensión educativa posee una especial relevancia. Para ello se toman variables que hacen referencia al capital humano y a los conocimientos para construir un indicador del estado de bienestar a nivel internacional. Del mismo modo, en el Informe de Desarrollo Humano de Naciones Unidas la educación se configura como uno de los tres pilares sobre los que descansa el desarrollo humano, junto a la salud y el bienestar material. Así, en la medición del progreso económico y social de las naciones, las instituciones nacionales e internacionales tienen muy en cuenta el relevante peso de las variables educativas dadas sus implicaciones de política económica.

La educación y, concretamente, la educación superior, posee un peso notable en el desarrollo económico y social de la sociedad en general, así como en el individual o personal que viene refrendado por numerosos estudios. Es por ello que la siguiente sección se ha dedicado a clasificar y ordenar los beneficios derivados de que la población disponga de estudios universitarios, distinguiendo los sociales de los privados y los monetarios de los no monetarios.

1.2 Beneficios derivados de la realización de estudios universitarios

La realización y finalización de estudios universitarios dota a las sociedades y a los individuos de beneficios que superan de forma muy amplia los costes en los que incurren, de forma que la inversión realizada tanto por el sector público como por el privado se ven ampliamente compensadas. La OCDE[1] (OCDE, 2017) estima una tasa interna de rentabilidad (TIR) privada de la educación superior de alrededor el 12% en 2013 y otra pública que se sitúa en torno al 9%.

Los beneficios derivados de la realización y finalización de los estudios universitarios se pueden clasificar atendiendo a dos dimensiones. La primera de ellas analizaría la dicotomía que se establece entre los efectos privados o individuales frente a los sociales, mientras que la segunda dimensión tendría en cuenta si los efectos son monetarios o no monetarios. Una forma de abordar la clasificación de los beneficios derivados de los estudios universitarios en base a las características señaladas es mediante la división del espacio en cuadrantes e insertando a los mismos en dicho espacio.

De este modo, el primer cuadrante vendría delimitado por los llamados beneficios sociales no monetarios, el segundo por los beneficios privados no monetarios, el tercero por sociales monetarios y el último por los privados monetarios.

Esquema 1.1. Tipología de los beneficios derivados de la educación universitaria.

1.2.1. Beneficios sociales no monetarios

En ocasiones puede resultar complicado distinguir entre los beneficios de la educación universitaria que se apropia un individuo y los efectos que repercuten también en el resto de la sociedad, pues la línea que los delimita es muy fina, sobre todo si los estudios universitarios están muy extendidos en la sociedad como suele ocurrir en los países con un elevado desarrollo económico, donde el 70% de la riqueza de los países desarrollados/ricos corresponde al capital humano (World Bank, 2018).

Seguidamente se detallan algunos de los beneficios sociales no monetarios más destacados y tratados por la literatura, como son: los incrementos en los niveles de cohesión social, confianza y tolerancia, participación en la vida política, movilidad social, capital social y reducción de los niveles de delincuencia.

Mayores niveles de cohesión social, confianza y tolerancia.

La reducción de la brecha entre los niveles de estudios superiores y básicos presenta beneficios relevantes en términos de cohesión social. Sociedades en las que los porcentajes de población con estudios universitarios son mayores presentan, en términos generales, mayores niveles de confianza y tolerancia hacia la población inmigrante que aquellos países que poseen indicadores educativos más pobres (Green *et al.*, 2003; Borgonovi, 2012). Asimismo, las universidades atraen estudiantes y profesores de muy diversos contextos étnicos y sociales, más abiertos a nuevas ideas y que cultivan la libertad de expresión, aceptan las diferencias y la diversidad (Florida *et al.*, 2006).

Aumento de la participación en la vida política

Un elevado nivel educativo en la sociedad puede tener un efecto positivo sobre la participación cívico-social y el correcto funcionamiento de la vida política, debido a que los graduados universitarios presentan una mayor probabilidad de participación en las elecciones y se sienten más implicados con la vida política que aquellos con menor nivel educativo (Bynner *et al.*, 2003). Además, la adquisición de educación universitaria se considera uno de los mayores determinantes de los niveles de democratización de los países en el contexto de los integrantes de la OCDE (Keller, 2006).

Incremento de la movilidad o ascensor social

El aumento general de los niveles educativos de un país no conduce necesariamente al aumento de los niveles de movilidad social. Sin embargo, pese a no ser una condición suficiente, la educación otorga al individuo una ventaja relativa (respecto del resto de individuos) basada en ese nivel educativo adquirido, que puede aumentar la movilidad social. Así, la equidad en el acceso a la educación y la reducción de las diferencias en el nivel de estudios completados se consideran generalmente variables que favorecen la movilidad social.

Ermisch y Francesconi (2001) constata que el nivel educativo de las madres posee una gran importancia en la cualificación que finalmente alcanzará su hijo. Si la madre posee estudios universitarios la probabilidad de que su hijo acabe siendo graduado universitario es de un 67%, mientas que si la madre posee estudios básicos, esta probabilidad se reduce hasta el 12%. El cuarto capítulo de esta Tesis doctoral se centra precisamente en analizar el efecto del nivel de estudios de los padres sobre el que alcanzarán sus hijos.

Mayor capital social

A medida que aumenta el nivel educativo de la población de un país, sus habitantes presentan una mayor probabilidad de interactuar tanto en redes sociales como en actividades de voluntariado o asociaciones benéficas, así como en los equipos de gobierno locales (Feinstein *et al*., 2008).

El capital social que se expande con el nivel de estudios de la población es el llamado *bridging* y *linking*. El primero se caracteriza por referirse a las relaciones sociales horizontales que se extienden más allá de los grupos fuertemente unidos como la familia y los amigos, y que puede incluir personas de diversos contextos culturales y étnicos. El capital social *linking* hace referencia al establecimiento de relaciones con personas e instituciones con poder y autoridad, por ello podemos denominarlas conexiones verticales.

Reducción en los niveles de delincuencia

La reducción en los niveles de delincuencia tiene un efecto significativo en el aumento de los niveles de bienestar económico y social, así como en la calidad de vida de una sociedad. La relación entre la citada reducción y la mejora de los niveles educativos es clara y ha sido evaluada en términos económicos para países como Reino Unido y Estados Unidos (Feinstein *et al.*, 2008; Lochner y Moretti, 2004). En el caso de Reino Unido se estima que un aumento de 16 puntos porcentuales en la proporción de población con estudios universitarios podría suponer un ahorro de aproximadamente

un millardo de libras esterlinas en reducir los costes de la delincuencia (Feinstein, 2002).

1.2.2. Beneficios privados no monetarios

Muchos de los beneficios que en este apartado se van a detallar tienen un amplio impacto sobre la sociedad en general, sin embargo, se catalogan como individuales o privados debido a que en primera instancia son los individuos los principales beneficiarios de ellos. Así, se pueden identificar los siguientes beneficios privados: aumento en la probabilidad de votar, en el compromiso cívico y en la participación en actividades de voluntariado, en los niveles de confianza y tolerancia, en los resultados educativos de los descendientes, en la esperanza de vida, la salud mental y general, en la adopción de cuidados preventivos en salud y hábitos de vida saludables, en la probabilidad de ser obeso, así como reducciones en la probabilidad de realizar consumos de sustancias no saludables y en general una mayor satisfacción con la vida. Además, la formación también es determinante de una menor probabilidad de cometer un delito.

Mayor probabilidad de votar

La población con estudios universitarios posee una mayor probabilidad de votar en las elecciones (OCDE, 2011 y 2012). En la mayor parte de los países considerados se observa una estrecha y positiva relación entre el nivel de estudios y la participación electoral. En el caso de España, la población con un nivel de estudios inferior a los secundarios postobligatorios presentaba una tasa de participación electoral (de la población entre 25 y 64 años) del 79,4% mientras que para el caso de los graduados universitarios aumenta hasta el 89,1%.

La diferencia entre el nivel de estudios más alto y más bajo, en la tasa de participación electoral para la población adulta, si se considera la media de los países de la OCDE, es de 14,8 puntos porcentuales. Esta diferencia crece hasta los 26,8 puntos porcentuales en el caso de la población joven (de 25 a 34 años).

Dee (2004) encuentra que en el caso de EE. UU. tener educación universitaria aumenta hasta 22 puntos porcentuales la probabilidad de participación de los votantes. En el mismo sentido Miligana *et al.*, (2004), para el caso del Reino Unido, encuentran una relación significativa entre los años de estudio y probabilidad de votar.

Mayor compromiso cívico y participación en actividades de voluntariado

Diversos autores como Ogg (2006) han comprobado que los graduados universitarios tienen más confianza en el funcionamiento del estado de bienestar, posen una actitud más positiva respecto de la inmigración y tienden a pensar con mayor probabilidad que su participación en la política tiene un destacado valor respecto de aquellos individuos con menor nivel educativo.

Asimismo, en Bynner *et al.* (2003) encuentran que los titulados universitarios son más propensos a participar en actividades de voluntariado y ONG que aquellos con inferiores niveles de estudio, concretamente 1,5 veces más que los individuos con educación secundaria postobligatoria. En el mismo sentido, Brand (2010) muestra que, en su conjunto los universitarios poseen una mayor probabilidad de involucrarse en actividades de tipo cívico y comunitarias (13%) frente a un 5% de los individuos que no poseen estudios universitarios. Del mismo modo, Borgonovi y Miyamoto (2010) comprueban para el caso europeo que, alrededor del 17% de las personas con estudios universitarios desarrollan actividades de voluntariado, y que cada año adicional de escolaridad se asocia con un aumento de 0,8 puntos porcentuales en las tasas de voluntariado.

Mayores niveles de confianza y tolerancia

Bynner *et al.* (2003) nuevamente encuentran que los titulados universitarios poseen unos mayores niveles de tolerancia respecto de la diversidad racial. Asimismo, Borgonovi y Miyamoto (2010) muestran que el hecho de que la población complete mayores niveles de estudios impacta positivamente

sobre los ciudadanos en varias dimensiones pero, especialmente en sus actitudes hacia la población inmigrante y su aceptación.

Mayor esperanza de vida

Son varios los trabajos que avalan que la población con mayor nivel de estudios disfruta también de una mayor esperanza de vida. La razón para ello es que, a mayor formación, los hábitos de vida son en promedio más saludables y por lo tanto inciden positivamente en la esperanza de vida. Se observa especialmente que entre la población con estudios terciarios se reduce significativamente los índices de obesidad (Miyamoto y Chevalier, 2010) o se reduce la probabilidad de sufrir enfermedades crónicas de alto riesgo como la diabetes o las enfermedades del corazón (Cutler y Lleras-Muney, 2006). Entre los países desarrollados de la OCDE la esperanza de vida de los hombres con estudios universitarios de 30 años es hasta 8 años superior a la de los hombres de esa misma edad que no han completado la educación secundaria (OCDE, 2012).

Menor probabilidad de ser obeso

Los graduados universitarios presentan una probabilidad menor de ser obesos, hasta un 4% menos (Cutler y Lleras-Muney, 2010) y su índice de masa corporal es, en promedio, un 3% más bajo que el de las personas con niveles educativos menores (Wilberforce, 2005). En el trabajo de Devaux *et al*. (2011) para los países de la OCDE esta menor propensión a ser obeso es más evidente entre la población femenina. La razón de ello es triple: mayor acceso a información relevante sobre la salud y mejor gestión de la misma; mayor percepción de los riesgos asociados a las elecciones de vida que realicen y mejora del auto control y preferencias a lo largo del tiempo.

Mayor probabilidad de adoptar cuidados preventivos en salud

Directamente relacionado con la mayor esperanza de vida de la población más formada, se observa que esta es también la que muestra una mayor inclinación por seguir programas de prevención y de examinar su salud con regularidad, hábitos que sin duda tienen consecuencias sobre la duración de

la vida. Fletcher y Firsvold (2009) estiman que la probabilidad de seguir cuidados preventivos se incrementa entre un 5% y un 15% para los graduados universitarios. Por otro lado, también se evidencia que el porcentaje de universitarios que practica deporte duplica al de los que poseen estudios de secundaria (Baum *et al*., 2008).

Mejor salud mental

Bynner *et al.* (2003) también ilustra que los problemas de depresión son menos comunes entre los graduados universitarios que para la población con menor nivel educativo. En particular, la probabilidad es hasta un 33% menor entre los graduados universitarios. Esta brecha en términos de salud mental se amplía en el caso de los hombres. La tasa de hombres con depresión es hasta un 55% más alta para los hombres con un nivel de formación por debajo de la terciaria. Las personas con formación universitaria se enfrentan mejor a las circunstancias de angustia o aflicción, incluso controlando por factores relacionados con el origen social. Según Mandemakers y Monden (2010) este resultado se justifica porque las personas con un nivel educativo más alto tienen mayores habilidades cognitivas.

Mejor nivel de salud general

En la referencia al trabajo de Bynner *et al.* (2003) también encontramos evidencia sobre este hecho. Los universitarios muestran una probabilidad de tener una salud excelente hasta un 70-80% mayor que los que tienen estudios más bajos. La salud autopercibida es también mayor entre la población más formada.

Mejor satisfacción con la vida

Los organismos internacionales como la OCDE o el Instituto de Estadística de Reino Unido (Office for National Statistics, ONS) disponen de múltiples trabajos que avalan que la población universitaria muestra una mayor satisfacción con la vida más allá del efecto que la educación tiene sobre el nivel de renta. La diferencia entre el porcentaje de personas satisfechas con

la vida es superior a los 10 puntos porcentuales entre los tiene educación terciaria frente a los que han cursado estudios de secundaria, distancia que se amplía a medida que descendemos en la escala educativa. Los niveles de bienestar autopercibidos o subjetivos son también más elevados entre la población más formada.

Menor probabilidad de tener consumos no saludables (bebida o tabaco)

Según Kuntsche *et al*. (2004) las personas con niveles educativos bajos tienen hasta tres veces más probabilidades de consumir alcohol en exceso que los universitarios. Esta fuerte correspondencia entre la formación y el consumo también se aprecia en el caso del tabaco. De acuerdo con el trabajo de Bynner *et al.* (2003) sobre los beneficios de la educación superior, se concluye que los no universitarios frente a los universitarios tienen entre un 50% y un 75% más de probabilidad de ser fumadores a los 30 años de edad. Por su parte, el trabajo de Walque (2004) que analiza la prevalencia del tabaco entre diferentes niveles educativos en EE. UU., concluye que entre los graduados universitarios la prevalencia del tabaco decrece a más temprana edad y más intensamente que cualquier otro nivel de formación. También es interesante destacar que Currie y Moretti (2003) encuentran que el consumo de tabaco durante el embarazo se reduce cerca de un 6% tan solo con haber cursado dos cursos formación terciaria.

Menor probabilidad de cometer un delito

Se observa una relación inversa entre cometer delitos (no violentos) y el nivel de formación alcanzado (Sabates, 2007). Esto es así para delitos menores como hurtos, robos u ofensas vinculadas al consumo de drogas. Sin embargo, esa relación no es tan patente cuando hablamos de delitos con violencia. En todo caso, aunque se observa un nivel más bajo de comisión de delitos entre la población más formada, la evidencia en relación a la población con estudios universitarios es limitada (Feinstein y Sabates, 2005).

1.2.3. Beneficios sociales monetarios

En los próximos párrafos se presenta evidencia de los beneficios monetarios de la participación de la población universitaria en la sociedad. Como en el caso de los beneficios privados es complejo distinguir entre los beneficios que se observan para las personas individuales y el efecto que, de forma agregada, tiene para el conjunto de la sociedad. Concretamente se considera la recaudación fiscal, el crecimiento económico, la productividad, la innovación, la flexibilidad del mercado de trabajo y la coordinación con áreas de política social.

Incremento de la recaudación fiscal

Son numerosos los trabajos que cuantifican los beneficios netos para el Tesoro Público derivados de los ingresos privados de los individuos. Así, por ejemplo, Walker y Zhu (2013) estima que la diferencia entre los beneficios netos para el Estado derivados del trabajo de una persona con estudios primarios frente a otra con estudios superiores es de más de 250.000 dólares en el caso de los hombres y de más de 300.000 en la comparación entre mujeres. Por su parte, el trabajo de Pérez *et al.* (2015) pone de manifiesto que los universitarios pagan más impuestos a lo largo de su vida laboral como consecuencia de unos ingresos más altos y de las mayores tasas de actividad y ocupación asociadas a este colectivo. Las estimaciones indican que para el Sistema Universitario Público Valenciano (SUPV) contribuye de forma indirecta a aumentar la recaudación fiscal de IRPF e IVA en 1.860,9 millones de euros anuales. Esta cifra es cerca de un 74% superior al presupuesto anual del SUPV.

Aceleración del crecimiento económico y de la productividad

La literatura que aborda esta cuestión muestra completo consenso sobre la relación positiva y significativa entre el capital humano y el crecimiento. La acumulación de capital humano en una economía incide directamente sobre su crecimiento económico. Los análisis llevados a cabo a partir de la base de datos Euklems[2] ponen de manifiesto este hecho, siendo el caso de Reino

Unido el más destacado, donde se observa el mayor incremento en PIB por hora trabajada y el mayor incremento en el peso de los universitarios en el total de la población activa. En definitiva, alrededor del 20% del crecimiento económico de Reino Unido entre 1982 y 2005 proviene directamente del incremento del capital humano.

Asimismo, la población universitaria incorpora importantes incrementos de productividad, lo que repercute muy positivamente en el crecimiento económico. En efecto, varios trabajos demuestran que el impacto de los universitarios sobre el crecimiento de la economía regional es muy superior al gasto realizado por las Universidades en los territorios donde se ubican (Krueger y Lindahl, 2001). También, en el trabajo de Pérez *et al.* (2015), que mide la contribución socioeconómica de las Universidades públicas valencianas, se pone de relieve que en la actualidad no hay duda alguna del papel que juega la educación en general, y la universitaria en particular, para reorientar buena parte de las actividades productivas en busca de incrementar el nivel general de productividad y la competitividad de las economías. Estas transformaciones requieren un alto nivel de formación de los ciudadanos, en particular de quienes toman las decisiones, pues las actividades hacia las que se ha de reorientar el modelo productivo son más intensivas en conocimiento, por lo que el papel de las universidades es básico para conseguir esta transformación.

En particular los trabajos de Machin *et al.* (2003), a partir de funciones de producción a nivel de industria y por regiones, estiman que un incremento de un punto porcentual en la población con estudios universitarios, conlleva un incremento del 0,5% de la productividad.

Por su parte Galindo-Rueda y Haskel (2005) a partir de información micro a nivel de empresa examinan el efecto de una plantilla formada respecto a diversos elementos como la productividad o los salarios de la empresa, los tipos de contratos o las cuestiones de género entre otras. Este trabajo revela que las empresas donde toda la plantilla es universitaria frente a otras donde no hay ningún trabajador con estudios superiores, la diferencia de productividad es del 30%. Este resultado varía en función del sector.

Moretti (2004) señala los beneficios generales sobre los salarios del conjunto de sociedad derivados de la existencia de población universitaria. Su trabajo evidencia que el incremento en un punto porcentual de la población con estudios universitarios eleva el salario de la población con estudios de secundaria en un 1,6% y del conjunto de los universitarios un 0,4%.

Mayor innovación y flexibilidad del mercado de trabajo

Las empresas más innovadoras son también aquellas que incorporan una mayor proporción de empleados con estudios universitarios. La literatura reciente (BIS, 2011) evidencia que en las empresas más innovadoras alrededor del 13% de la plantilla posee estudios superiores frente al 4% en las empresas que no son innovadoras (activamente). Florida *et al.* (2006) reflejan que la población universitaria actúa como polo de atracción del talento. Se aprecia una correlación positiva entre el peso de los estudiantes universitarios per cápita y la existencia de ocupados con estudios superiores que se emplean en ocupaciones creativas y en las denominadas altamente creativas (informática, ingeniería, arte y diseño y multimedia).

Reducción de la carga sobre las finanzas públicas a partir de una mejor coordinación con otras áreas de política social, como la salud y la prevención del delito

Varios trabajos han tratado de mostrar evidencia cuantitativa del impacto de la población con estudios superiores en la sociedad, pero en pocos casos estos intentos han conseguido monetizar este impacto, siendo estos por lo tanto reseñables. Haveman y Wolfe (1984) hace más de tres décadas concluyeron que, aun partiendo de una estimación conservadora de los efectos de no mercado de la educación (alrededor de 5.000 dólares anuales), esta estimación es de una magnitud similar que la correspondiente al valor anual de mercado de un año adicional de formación en 1975. Esto significa que el valor anual de los incrementos de formación señalados en las estimaciones standard de capital humano solo recogen en torno a la mitad del valor adicional de un año más de formación.

De forma similar Grossman (2006) estima que todo el impacto en relación a la salud de la educación terciaria, tanto sobre la salud personal como la de los hijos, pareja o la mayor esperanza de vida, colectivamente vale tanto como el 100% del incremento medio de los salarios en los EE. UU. En la misma dirección, McMahon (2009) concluye que los beneficios privados no monetarios y las externalidades sobre la sociedad se incrementaron por encima de la prima salarial media de un ocupado con estudios universitarios. Lochner y Moretti (2004) estiman que la externalidad de la educación representa entre un 14 y un 26% del retorno privado de la escolarización, sugiriendo que una parte significativa del retorno social de la educación viene en forma de externalidades, como las que supone la reducción de la tasa de delitos.

1.2.4. Beneficios privados monetarios

En las siguientes líneas se abordan los beneficios de mercado o monetarios para las personas, en sentido individual, derivados de disponer de estudios superiores, en particular los universitarios. Además de los más evidentes, como los beneficios sobre el nivel medio de ingresos, existen otros como el aumento de la productividad de estar empleados o las ganancias de productividad.

Mayor nivel de ingresos

En este sentido encontramos trabajos que analizan las ganancias a lo largo de la vida, como el trabajo de Walker y Zhu (2013). Así, un ocupado universitario a lo largo de su vida laboral ganará alrededor de 200.000 dólares más (en términos constantes), netos de impuestos, que una persona que haya completado solo hasta estudios de secundaria postobligatoria, con diferencias significativas entre hombres y mujeres. Así, el incremento en los ingresos a lo largo de la vida para un hombre se sitúa en 168.000 dólares y, hasta en 252.000 para el caso de las mujeres. Otros trabajos (BIS, 2011) cifran esta diferencia entre de 100.000 y 125.000 dólares (en función de si se consideran o no los costes de matrícula), aunque se evidencian diferentes resultados en función del área de conocimiento al que correspondan los

ocupados objeto de estudio, siendo más altas las diferencias en renta neta para los ocupados en el área de ciencias (física, química,..).

Otro aspecto desatacado en varios trabajos es la velocidad a la que se revaloriza el salario de un universitario frente al incremento medio del conjunto de los ocupados. Así, mientras en promedio un universitario puede incrementar su salario un 26% tras los tres o cuatro primeros años ocupado, en promedio este incremento es del 6,3% para el total de ocupados.

Menor exposición/tendencia al desempleo

La trayectoria en el empleo es más amplia para los titulados universitarios que para los que presentan un nivel de cualificación inferior (Walker and Zhu, 2013). Estudios recientes confirman que para los titulados universitarios se incrementa en media la probabilidad de emplearse 3,3 puntos porcentuales, porcentaje que se eleva hasta 4,2 puntos en el caso de las mujeres (BIS, 2011). Esta Tesis doctoral analiza, distinguiendo entre hombres y mujeres, el impacto de los estudios superiores en los ingresos y en los resultados en términos de empleo.

Incremento de la empleabilidad y el desarrollo de habilidades

De forma complementaria al punto anterior, las personas con formación superior poseen una mayor disposición ante el empleo. Estos aspectos son analizados en el trabajo de Hogarth *et al.* (2007). Por un lado, se enfrentan a los retos con buena actitud y con una perspectiva distinta, muestran iniciativa y una actitud proactiva, resuelven los problemas y tienen una actitud flexible. Asimilan los conocimientos con rapidez y aportan nuevas ideas y esfuerzo. De acuerdo con Bynner y Egerton (2001), los titulados universitarios alcanzan mayores incrementos de cualificación durante su vida laboral que los que disponen de menor formación, siendo esta evidencia más relevante para los titulados en informática, oratoria y salud.

Incremento de la actitud emprendedora y la productividad

Bloom *et al.* (2006) revelan que las personas con mayores niveles educativos muestran también una actitud más alta hacia el emprendimiento basándose en el Índice de actividad empresarial total que mide el peso de personas involucradas con la creación de empresas o *starts-ups*. Al mismo tiempo se observa que la educación y la formación continua mejoran la productividad el doble que el efecto que se produce sobre los salarios (Dearden *et al.* 2005). Así, un incremento de un punto porcentual en formación se asocia con un incremento del valor añadido por hora de alrededor 0,6 puntos y un incremento del salario por hora de 0,3 puntos.

1.3 Descripción de los capítulos

El análisis que en esta Tesis doctoral se ha llevado cabo ha requerido del uso y explotación de grandes bases de datos, así como de sus microdatos anonimizados, y de la utilización de diversas técnicas econométricas y estadísticas. La metodología que se ha utilizado en los diferentes capítulos se describe de forma breve en el **segundo capítulo**.

El cuerpo central de esta Tesis doctoral se circunscribe a los capítulos 3 a 6, donde se analizan algunas de las cuestiones más relevantes que en esta introducción han sido expuestas.

Se distinguen dos partes claramente diferenciadas. En la primera de ellas cobran relevancia los efectos de la educación sobre los individuos, capítulos 3 y 4. En el primero de ellos se analiza la reducción de las diferencias de género al incrementarse el nivel de estudios de los individuos, y en el segundo, la influencia de las características socio-educativas de la familia en la probabilidad de realizar estudios universitarios. En la segunda parte, capítulos 5 y 6, se analizan los aspectos más relacionados con la educación universitaria y sus efectos macroeconómicos, al considerar el dinamismo del mercado de trabajo y la generación del capital humano en el capítulo 5 y la contribución de las universidades al crecimiento económico y a la renta per cápita en el capítulo 6.

El **tercer capítulo** analiza cómo la educación, y en particular la educación universitaria, ejerce un importante efecto modulador sobre las desigualdades entre hombres y mujeres en determinados ámbitos económicos y sociales. Se centra en el efecto positivo de la educación sobre la igualdad de oportunidades entre hombres y mujeres y la reducción de la discriminación laboral por motivo de sexo. Los datos indican que el aumento del número de años de estudios alcanzado por las mujeres provoca una evolución en su comportamiento laboral que tiende a igualarlo con el de los hombres. En términos estadísticos, los hombres y mujeres con estudios universitarios completados tienden a ser indistinguibles por su comportamiento en el mercado laboral. Esto es, las tasas de actividad y empleo de los hombres y las mujeres universitarios muestran un perfil menos diferenciado, y las probabilidades de ocupación son mayores. Sin embargo, el efecto modulador de la educación no se extiende a los ingresos salariales, donde las diferencias entre hombres y mujeres son más persistentes debido, seguramente, a factores institucionales y sociales que mantienen las situaciones de discriminación salarial (Villar, 2010) y limitan la contribución de la educación universitaria a la reducción de las diferencias por sexo en los ingresos laborales.

En el **cuarto capítulo** prima la idea de que los individuos optimizan cuando toman decisiones sobre los estudios que cursan y que esta es consustancial al análisis económico. En este sentido, las características socioeconómicas de la familia y de su entorno son determinantes en el proceso de optimización del nivel educativo alcanzado por los individuos (Lazear, 1980).

El estudio de los efectos de las características socioeconómicas de la familia y del mercado de trabajo sobre la demanda de educación no se ha tratado de forma prolífica por la literatura debido a la escasez de bases de datos que combinen este tipo de información. Uno de los primeros estudios fue llevado a cabo por Willis y Rosen (1979), utilizando una base de datos de veteranos de guerra americanos. Lauer (2003) estudió el efecto de las características socioeconómicas familiares, la cohorte de nacimiento y el

nivel de educativo de los progenitores sobre el nivel de estudio de los hijos en Alemania y Francia, a través de un modelo probit ordenado.

En el caso español, Peraita y Sánchez (1998), Albert (2000) y Rahona (2006) han estudiado los efectos que el entorno socio-económico familiar, el mercado trabajo, y el entorno geográfico y cultural tienen en los niveles de estudios completados, entre otros. Todos estos estudios se basan en fuentes de información disponibles en los años 90 del siglo XX (Encuesta de Población Activa y Encuesta de Presupuestos Familiares); aunque los datos disponibles en la actualidad del Censo de Población y Viviendas de 2011 (INE, 2013) permiten actualizar estos estudios y explorar los efectos de otras variables en la probabilidad de completar estudios universitarios.

En este capítulo de la Tesis doctoral se realiza una novedosa aportación al analizar la influencia de la educación de los padres y su situación profesional como determinantes de la educación de los hijos, junto a variables como la riqueza, el tamaño del municipio de residencia o la presencia de hermanos.

En el quinto y sexto capítulo se considera que la globalización y la reciente crisis económica han puesto de relieve la necesidad no sólo de aumentar los niveles de competitividad de las empresas, sino también la reorientación de la especialización productiva de las economías hacia actividades generadoras de más valor añadido. El conocimiento es hoy en día un factor imprescindible para desarrollar innovaciones, gestionar las nuevas tecnologías o las complejas relaciones comerciales y financieras en el mundo actual. Pocos dudan del papel que juega la educación en general, y la universitaria en particular, en este proceso, pues ello requiere un alto nivel de formación de los ciudadanos ya que las actividades hacia las que se ha de reorientar el modelo productivo son las más intensivas en conocimiento.

En estas circunstancias es donde las universidades juegan un papel muy importante pues los resultados de sus tres actividades (docencia, investigación y transferencia) resultan imprescindibles para contribuir en

esta nueva etapa de desarrollo socioeconómico en las que están inmersas las sociedades avanzadas basadas en el conocimiento.

El reconocimiento de la significativa contribución de las universidades al desarrollo económico y social ha promovido la realización de estudios para medir sus aportaciones al desarrollo socioeconómico. La mayoría de estos estudios se centran en la cuantificación de los impactos a corto plazo por el lado de la demanda de la actividad universitaria en el empleo y la demanda en las empresas locales a través del propio gasto y del gasto de otros agentes asociado a la actividad universitaria. Sin embargo, estos estudios no tienen en cuenta algunas de las contribuciones por el lado de la oferta y a largo plazo de las universidades que se producen por el aumento del capital humano de sus graduados o del capital tecnológico generado a través de sus actividades de I+D (Pastor y Peraita, 2016). Asimismo, el capital humano generado por las universidades ejerce efectos positivos sobre otras variables relacionadas con el bienestar y el desarrollo de un país como el respeto a los valores democráticos, el respeto al medio ambiente, los hábitos de vida y el estado de salud de la población, la delincuencia (McMahon, 2009) o más recientemente sobre la igualdad de género (Pastor, Peraita y Soler, 2016), como se ha analizado en esta introducción.

En resumen, está sobradamente demostrado por la literatura especializada que el capital humano, la investigación y el conocimiento en general, las áreas de especialización de las universidades, son trascendentales para el desarrollo a largo plazo de las sociedades actuales, caracterizadas por un uso intensivo en conocimiento. Conscientes de ellos, los agentes sociales, económicos y políticos consideran a las universidades como un instrumento de desarrollo social y económico a nivel local, regional y nacional. Es por ello, que los estudios sobre impacto económico de universidades han evolucionado a la par que esta conciencia sobre el papel que deben jugar las universidades en el desarrollo socioeconómico de sus áreas de influencia. De hecho, los más recientes estudios se han orientado a considerar la contribución de sus actividades sobre la oferta de recursos en la economía y sus externalidades sobre variables como el crecimiento económico o la

renta per cápita de su entorno, teniendo una perspectiva temporal más amplia.

Concretamente en el **quinto capítulo** se realiza una estimación de la contribución de las universidades al capital humano, la actividad y el empleo en los países de la UE entre los años 2000 y 2015. Con este objetivo se analizan los efectos por el lado de la oferta sobre estas economías, analizándose el efecto directo de las universidades a través de sus actividades educativas o docentes sobre el capital humano de los individuos, así como los efectos indirectos sobre las tasas de empleo dada la mayor participación en el mercado laboral y la mayor empleabilidad de la población con estudios superiores. Para llevar a cabo este análisis se estiman escenarios contrafactuales para cada uno de los países de la UE en los que se asumen que las universidades no existen.

En el **sexto capítulo** se analiza la contribución de las universidades al desarrollo socioeconómico de la Unión Europea y cada uno de sus 28 países miembros a lo largo del periodo 2000-2015, considerando para ello las aportaciones de las universidades tanto a través de su actividad investigadora como educativa. En esta primera actividad se considera la aportación del gasto en I+D de las universidades al stock de capital tecnológico. Para llevar a cabo el análisis se estiman para cada país escenarios contrafactuales en los que se supone que no existen las universidades. Estos escenarios contrafactuales sirven de referencia para estimar el impacto de las universidades aplicando técnicas de contabilidad del crecimiento. Los resultados obtenidos indican que las universidades son una fuente importante del crecimiento de los países de la Unión Europea, contribuyendo además a paliar los efectos adversos de los periodos de crisis. Para el conjunto de la Unión Europea las estimaciones indican que el PIB per cápita sería en la actualidad más de una quinta parte mayor que el correspondiente a una situación sin universidades. Los resultados obtenidos también muestran la existencia de diferencias de PIB per cápita entre los países de la UE de hasta un 15%, asociadas a la actividad de las universidades.

El **séptimo** y último **capítulo** recoge las principales conclusiones de los capítulos centrales de esta Tesis doctoral, así como las futuras líneas de investigación en esta materia.

NOTES:

[1] La TIR privada media de la OCDE para un hombre que ha completado estudios superiores es de un 13% y la de una mujer, del 11%. El cálculo de la TIR pública media de la OCDE para un hombre con estudios superiores es de un 10%, mientras que para una mujer es del 8%.

[2] La base de datos EUKLEMS contiene información muy detallada para quince economías europeas incluidas España sobre las variables de la contabilidad nacional por sectores y para un periodo amplio (1982-2005, 1995-2015), con el objetivo promover y facilitar el análisis de los patrones de crecimiento y evolución de la productividad en el mundo, tomando como base la denominada contabilidad del crecimiento.

2 Methodology

This chapter describes the methodology used to address the questions raised in each chapter to comply with the University of Valencia requirements in terms of the doctoral thesis structure.

As it is mentioned in the Introduction chapter, the third chapter of this thesis focuses on the inequality in relation to employment**.** The work analyses the probability differences by gender of being active, employed and having a permanent contract, all according to the education level attained. To this purpose anonymised microdata are used from the Spanish National Statistics Institute's (INE) Labour Force Survey (2012). *Probit models* are estimated to measure the probability of being active as well as of having an indefinite contract. Whereas, the Heckman model is applied to estimate the probability to be employed.

The Heckman model of sample selection is an analytical model that is used when studying the behaviour of individuals there are auto selection bias. This is the case of those equations that estimate the probability of being employed in the Labour market. In this situation, it is necessary to choose the initial sample, because not all individuals are part of the active population. The Heckman model is applied, in this case, to avoid that employment decisions from the active population sub-sample suffer from bias selection.

The method proposed by Heckman is a two-stage estimation for obtaining consistent estimators in the occupation equation. In the first stage the probability of being active is estimated (through a *probit model*) taking into consideration a group of variables which they do not directly affect to the decision of being employed and, consistent estimators with the aim to obtain an estimate of the statistic known as the *Inverse Mills ratio* or λ. In the second stage, the decision of being employed is estimated only for the active population sub-sample, including, in addition to the above variables and λ —as a further regressor—, additional variables which are contributing to explain the probability of being employed. Thus, the significance of the *Inverse Mills ratio* coefficient indicates the magnitude of

bias that would be incurred if λ had not been incorporated into the explanatory regression.

In the third section of this third chapter, an analysis of wage inequality between men and women is developed using the 2010 Structure of Earnings Survey (SES) data, conducted by the Spanish National Statistics Institute in the EU framework, in order to analyse wage structure and distribution.

The agriculture, livestock and fisheries sector and the electricity, gas, steam and air conditioning supply are not included in the SES Survey. Otherwise, we do not consider the construction sector in the final sample because of its erratic behaviour in Spanish case. The civil servants sector is not distributed by branches, hence they are all included in the "Public Administration" sector. People employed in Education and Health accounts for the majority workforce of the Public Administration sector. We have worked only with data on full time salaried workers. Keep in mind that the total gross annual wage in our sample is 22,124 euros in 2010, but up to 28,876 euros in the public administration.

The monetary return on education is estimated by the traditional Mincer equation:

$$lnW = \beta_0 + \beta_1 EDUC + \beta_2 exp + \beta_3 exp^2 + \beta_4 sex + \beta_5 estrat + \beta_6 CNAE + \varepsilon \quad (2.1)$$

where the dependent variable (W) is the logarithm of annual earnings, and the explanatory variables include dummy variables (0,1) for the educational levels achieved, experience and experience squared, calculated from the potential experience, dummy variable for sex, for the number of employees in the firm and, finally, for activity sectors. Thus, the private monetary return from progressing from compulsory secondary education to a degree would be:

$$Return_{Second-Degree} = \frac{\beta_{Degree}}{17-8} \quad (2.2)$$

Additionally, salary profiles throughout a working life allow more precise comparisons of gender differences to be made. In this case, we have estimated, in accordance with the following functional form by OLS:

$$lnW = \beta_0 + \beta_1 Age + \beta_2 Age^2 + \varepsilon\,, \qquad (2.3)$$

six salary income profiles for each of the educational levels considered in this chapter for men and women.

The **fourth chapter** of this thesis analyses the influence of parents' education and professional status on the educational level their children attain with special reference to gender differences. To this purpose, anonymised microdata from the Population and Housing Census 2011 are used, published by the Spanish National Statistics Institute (INE) in 2013. They were used in the construction and use of the variables for the estimations. This was the first time a census had been carried out under community legislation, and its results are comparable at European Union level. This census was conducted not in the usual way of compiling comprehensive data, but was based on administrative records, principally the Municipal Register, and supplemented with a large sample survey comprising 5,797,425 individuals, 12.3% of the population. This statistical operation offers a great wealth of variables, 51 of which refer to people, 13 to dwellings and 16 to buildings.

The sample selected for this analysis contains over 130,000 observations and 22 variables in several categories. The estimations use information on the characteristics of the people being studied, their parents, and the housing in which they live. The anonymised microdata format allows us to perform the econometric analyses necessary for the lines of enquiry established in the study. Further, the most prestigious statistical institution in Spain, the National Statistics Institute, guarantees the quality of the information. The sample selected for the estimations comprised the national population under the age of 28 (as most of those who started university will have finished by that age) who live in the family home, whose status in the family unit is that of son or daughter, and who are not presently studying, formally or otherwise.

In order to illustrate the econometric specification of an individual's level of education (y_i) it has been used an ordered *probit* model constructed around the following latent variable regression:

$$y_i^* = \beta x_i + \varepsilon_i \qquad (2.4)$$

where y_i^* is the unobserved dependent variable. In practice, the censored variable y_i and the level of education completed by individual i are observed.

$$y_i = 0 \quad if \quad y^* \leq u_0$$

$$y_i = j \quad if \quad u_{j-1} < y_i^* \leq u_j \qquad j = 1,2,\dots,5 \qquad (2.5)$$

where, after normalisation, $u_o = 0$. The unknown parameters u_j are estimated with β; the vector x_i contains quantifiable independent variables reflecting family background and the conditions of the reference employment market for individual i; and finally, the term ε represents some other unobservable factors.

Given the normal function associated with the random disturbance, the model is estimated using a standardised normal distribution function (probit model) with zero mean and variance equal to 1. The following expression reflects the probability of individual i attaining education level j :

$$Prob\,[y_i = j] = \left(\frac{1}{\sqrt{2\pi}}\right)\int_{-\infty}^{\alpha+\beta Xi} e^{-Z^2/2} dz \qquad (2.6)$$

Equation 2.6 is used to analyse the impact of various socio-economic characteristics on the probability distribution of the education attained. In addition, to discover the marginal effects of a significant dummy variable, the probabilities obtained when the variable takes one of its values (0 or 1) should be compared with those obtained when the remaining continuous variables are located within the sample means and the other dummy variables are omitted. Recall that the probabilities of men and women sum

to one, and therefore the marginal effects associated with a change in the regression coefficients will sum to zero.

The education levels considered and associated with each value of the dependent variables are as follows:

$y_i = 0$ if individual *i* completed primary education

$y_i = 1$ if individual *i* completed compulsory secondary education

$y_i = 2$ if individual *i* completed intermediate vocational training

$y_i = 3$ if individual *i* completed post-compulsory secondary education

$y_i = 4$ if individual *i* completed higher vocational training

$y_i = 5$ if individual *i* completed university education

The vector x_i contains two groups of explanatory variables. The first comprises the variables reflecting personal characteristics such as gender, semester of birth, number of siblings, and whether they are younger or older. The variables in the second group reflect socio-economic characteristics such as the size of the municipality where the family lives, professional status and educational level of both parents, and family wealth. As mentioned previously, the latter is a *discrete quantitative variable*, constructed from the values of four questions on primary residence in the Population and Housing Census 2011. The first variable takes the value 1 if the dwelling has a usable space in excess of 100 m²; the second refers to mortgage-free ownership of the family residence (either bought or inherited), in which case the variable takes a value of 1 and 0 otherwise. In the case of dwelling with individual or communal central heating, the variable takes a value of 1 and 0 otherwise; finally, if the dwelling has access to internet, the variable takes a value of 1 and 0 otherwise. The more items the dwelling has, the higher the value of the wealth variable, 0 being the value for a dwelling with none of these features, and 4, one with all of the items.

The **fifth chapter** presents an estimation of the contribution of Higher Education Institutions (HEIs) to the human capital, the activity and the employment of the European countries over the period 2000-2015. For this purpose, this study focuses on the universities' effects on the supply side of their national economies, and analyses the direct impact of HEIs through their educational activities on the human capital of individuals, as well as the indirect impact on employment rates given the greater labour participation and employability of people with higher education. To carry out the analysis, counterfactual scenarios that assume that HEIs do not exist are estimated for each European country and all other factors remain constant (Fearon 1996).

The procedure is to restrict the study to analysing this single explanatory variable (human capital) and to quantify the contribution of the HEIs by comparing the real situation with another hypothetical situation in which the HEIs do not exist, and maintaining everything else constant.

The Equation 2.7 calculates the average years of study of the population in country *r* (AYS_r) by computing the quotient between the years of study of the population as a whole and the number of individuals, according to the following expression:

$$AYS_r = \frac{\sum_i YS^i POP_r^i}{\sum_i POP_r^i} \ , \qquad (2.7)$$

where YS_i are the years of study required to complete the level of studies *i* and POP^i_r is the number of individuals of country *r* who have completed the level of studies *i*. Following this procedure (Pastor and Peraita, 2016), the series of years of the counterfactual study (those that the population of a country would have if their HEIs had not trained any graduates) are calculated considering that if HEIs did not exist, their graduates would have reached the level of studies before university (post-compulsory secondary studies).

Otherwise, the contribution of the HEIs to the increase of the activity rate is calculated by the estimation of a counterfactual activity rate, a rate in which

the positive impact on the activity rate of having a university degree is deducted. The difference between the counterfactual and real activity rates in each country gives us a measure of the contribution HEIs make to the increase in the activity rate. This exercise postulates a model of labour participation that includes the maximum level of education attained as a determinant. It also includes other variables related to personal characteristics that are important for this choice. Then, *probit* model of the probability of participation in 2014 are estimated for the European countries as a whole, as well as for each individual country, as:

$$ACT_{ijt} = \beta_0 + \gamma_x X_{ijt} + \varepsilon_{ijt} \,, \qquad (2.8)$$

where ACT_{ijt} is 1 if the individual i is active in period t and 0 otherwise; X_{ijt} is a vector of personal and family characteristics and ε_{ijt} is an error term. The vector of personal and family characteristics includes gender, nationality, age, and maximum level of educational attainment (as dummy variables). Data come from the EU-LFS microdata obtained from Eurostat, and the sample refers to people of working age and includes all former European Union-28 countries.

Finally, to calculate the contribution of HEIs to the increase in the employment rate, as in the previous section for activity rates, counterfactual scenarios are constructed. Specifically, a counterfactual employment rate will be computed, which reflects the effect of having a university degree on the probability of being employed. The difference between the real employment rate and the counterfactual one will reflect the contribution of HEIs to the increase in the employment rate. To estimate the total effect on employment rates, probits of the probability of employment for the entire working age population are estimated for the EU-28 as a whole as well as for each individual country as:

$$EMP_{ijt} = \beta_0 + \gamma_x X_{ijt} + \varepsilon_{ijt} \qquad (2.9)$$

where EMP_{ijt} is 1 if the individual i is employed in period t and 0 otherwise; X_{ijt} is a vector of personal and family characteristics, and ε_{ijt} is an error term. The vector of personal and family characteristics again includes

gender, nationality, age and the maximum level of educational attainment. These explanatory variables are defined as dummies. All data come from the EU-LFS microdata obtained from Eurostat. The sample refers to all working age individuals in 2014 and includes all European Union-28 countries. The reference individual is a male, national, aged between 15 and 24 and with lower secondary as the maximum level of educational attainment.

Finally, the **sixth chapter** presents an estimation of the contribution of Higher Education Institutions (HEIs) to economic growth and the Gross Domestic Product per capita of the European countries over the period 2000-2015. For this purpose, it is analysed the universities' effects on the supply side of their national economies, especially the contribution of the R&D of HEIs to technological capital of the European countries. It is proposed a methodology of counterfactual scenarios, which assume a hypothetical situation in which HEIs do not exist, to estimating the effects of HEIs, applying techniques of growth accounting.

To estimate the series of technological capital stock generated by HEIs we use the standard inventory method according to the expression:

$$KT_{i,t} = (1-\delta)KT_{i,t-1} + I_{i,t-\theta} \qquad (2.10)$$

where $KT_{i,t}$ is the capital stock of period t, δ is the rate of depreciation and I is the amount of investment in period t. Following Pakes and Schankerman (1984), the effects of investment in R&D are assumed to be incorporated into the technological stock with a delay of one year, so that the results of the R&D activities are not immediate (θ=1). The capital stock is estimated as described below:

$$KT_{i,t} = \frac{I_{i,t-\theta}}{g+\delta} \quad , \qquad (2.11)$$

g being the rate of growth of investment in R&D. Following the work of Hall and Mairesse (1995) and Pastor, Peraita and Pérez (2016), it is used a depreciation rate of 15%.

To compute the contribution made by HEIs to economic growth in European countries, we shall use a growth accounting methodology (Solow, 1957), that allows us to breakdown the economic growth of economies into the contributions corresponding to each of the factors of production, as well as to technical progress or total factor productivity (TFP). The basic idea is that assuming the existence of perfect competition and constant returns to scale, the contribution of each factor to production can be estimated through its own real growth rate multiplied by the share of that factor's income in the total income.

We consider a production function in which output (Y) in each period (t) depends on the capital used (K), the quantity of different types of labour used, aggregating them by means of weights based on the years of study of the employed population (EYS), and the technological capital accumulated (KT):

$$Yt = Ft\,(Kt, EYSt, KTt) \qquad (2.12)$$

Note that, instead of considering the number of people employed, we consider the total years of study of the employed population, $EYS=AYS \cdot L$, which is the product of the average years of study (AYS) and the number of people employed (L). This procedure allows us to collect both the contribution in terms of average years of study and the contribution in the number of people employed. The HEIs contribute to economic growth with the following three effects:

- *Quantity effect:* The impact of HEIs on the total number of people employed. To estimate this contribution, we breakdown labour (EYS) in terms of quantity (L) and quality (AYS). Furthermore, we separate the quantity of labour into those jobs associated with the existence of HEIs (L^{HEI}) and those that would have existed without their existence (L^{CF}, counterfactual employed population).

- *Quality effect:* The impact of HEIs on the generation of human capital. To estimate this contribution, we breakdown the increase in the quality of the employment of European countries (average years of study, AYS)

in the share of the growth attributable to HEIs (AYS^{HEI}), and the improvement in the average years of study of the employed population that would have occurred in the case of HEIs not existing (average counterfactual years of schooling, AYS^{CF}).

- *Technological capital effect:* The impact on the generation of technological capital. To estimate this contribution, we breakdown the growth of total technological capital (KT) in the part attributable to the existence of HEIs (KT^{HEI}) and the one that would have been accumulated without the contribution of HEIs (KT^{CF}, counterfactual technological capital).

Thus, according with growth accounting, the growth of the years of study of the employed population (EYS) in each country can be expressed as the weighted average of the total labour growth associated with the existence of HEIs (EYS^{HEI}) and the counterfactual scenario which would be observed if they did not exist (EYS^{CF}) following the expression:

$$\hat{EYS}_t = \left(\theta \hat{EYS}_t^{HEI} + (1-\theta)\hat{EYS}_t^{CF}\right), \qquad (2.13)$$

where the circumflex symbol above the variables denotes rates of variation, θ is the weight of the years of study generated by HEIs in the total, and (1- θ) is the weight of the remaining years of study in the total. Specifically,

$$\theta = EYS_{t-1}^{HEI} / EYS_{t-1}; \quad (1-\theta) = EYS_{t-1}^{CF} / EYS_{t-1} . \qquad (2.14)$$

Given that EYS is the product of the average years of study and of the number of people employed, equation (4) can be broken down, in turn, as:

$$\hat{EYS}_t = \left(\theta\left(\hat{AYS}_t^{HEI} + \hat{L}_t^{HEI}\right) + (1-\theta)\left(\hat{AYS}_t^{CF} + \hat{L}_t^{CF}\right)\right). \qquad (2.15)$$

The above expression can be expressed by approximating the rate of variation by logarithmic differences:

$$deys_t = \left(\theta\left(days_t^{HEI} + dl_t^{HEI}\right) + (1-\theta)\left(days_t^{CF} + dl_t^{CF}\right)\right). \qquad (2.16)$$

In the same way, technological capital can be broken down as follows:

$$dkt_t = \left(\psi\, dkt_t^{HEI} + (1-\psi)\, dkt_t^{CF}\right), \tag{2.17}$$

where dkt_t^{HEI} is the growth of technological capital associated with investments made by HEIs in R&D, dkt_t^{CF} is the growth of the counterfactual technological capital without HEIs, ψ is the weight of technological capital generated by HEIs in the total and (1-ψ) is the weight of the remaining technological capital. Specifically, if KT_{t-1}^{HEI}, KT_{t-1}^{CF}, and KT_{t-1} are, respectively, the technological capital of HEIs, the rest of the technological capital, and the total of technological capital in the initial year, we have that

$$\psi = KT_{t-1}^{HEI} \big/ KT_{t-1};\ (1-\psi) = KT_{t-1}^{CF} \big/ KT_{t-1}. \tag{2.18}$$

With the above expressions, the breakdown of growth can be expressed as

$$\begin{aligned} dy_t = da_t + \alpha dk_t + \beta\left[\left(\theta\left(days_t^{HEI} + dl_t^{HEI}\right) + (1-\theta)\left(days_t^{CF} + dl_t^{CF}\right)\right)\right] + \\ + \lambda\left(\psi dkt_t^{HEI} + (1-\psi) dkt_t^{CF}\right) \end{aligned} \tag{2.19}$$

This last expression is the one that allows us to breakdown Gross Domestic Product (GDP) growth (dy_t) into the contribution of capital ($\alpha\ dk_t$), the quality of labour ($\beta\ days_t$), the quantity of labour ($\beta\ dl_t$), technological capital ($\lambda\ dkt_t$), and total factor productivity (da_t), and in turn, which part of these sources of growth is associated with HEIs. Specifically, ($\beta\ \theta\ days_t^{HEI}$) measures the share of growth related to improvements in the quality of the labour factor associated with HEIs via the human capital generated, measures ($\beta\ \theta\ days_t^{HEI}$) the share of growth related to the increase in the number of people employed associated with HEIs through increases in the rate of activity and employment, and ($\lambda\ \psi\ dk_t^{HEI}$) measures the share of growth related to the technological capital generated by HEIs.

3 Higher education as modulator of gender inequalities: Evidence of the Spanish case*

ABSTRACT: Raising educational levels may help to reduce inequalities between men and women in certain social and economic aspects. Using statistics for Spain, we analyse labour market behaviours such as the rates of activity and unemployment by sex according to the educational level. The results reveal that the differences between men and women decrease as the educational level increases. In particular, the modulator effect of education is very important at the higher level, where differences in labour market behaviour between men and women with a university education almost disappear, except in terms of salaries. Nevertheless, it can be seen that the current economic crisis has reduced the modulator role of education in gender differences in Spain.

* A version of this chapter is published in Soler *et al.* (2016).

3.1. Introduction

The decisions that individuals make about the educational level that they reach are considered as human capital investment decisions (Becker, 1962) and traditionally are analysed as a process in which a series of monetary and non-monetary resources are committed in order to obtain a future yield. The benefits are classified, likewise, into monetary and non-monetary. Both have been analysed in the economic literature and, especially, the monetary benefits have been estimated with precision (Hanushek and Welch, 2006; Hanushek, Machin and Woessmann, 2011).

Economists and sociologists have always indicated in their studies that the social return to higher education may exceed the private return (Moretti, 2004) because it is clear that higher education makes a decisive contribution in many socioeconomic areas. Recognition of this influence has prompted numerous studies (Drucker and Golstein, 2007) to analyse, and in some cases quantify, the economic and social contributions of higher education graduates in several OECD countries. The non-monetary benefits of education are also varied and include widely differing contexts (McMahon, 2009) and, though they are more difficult to evaluate, it is possible to estimate their value to society. The report of the OECD (2001) and other studies (Willis, 1986; Heckman, Lochner and Todd, 2005; Behrman and Stacey, 1997; Lochner, 2011) have contributed evidence of the favourable consequences of education on well-being, health or social cohesion. Thus, people who attain higher levels of education have better health. Education also helps to improve children's quality of life, the conservation of the environment, generates more civic behaviours among the population, drives enterprise and civic participation, and increases social capital.

Additionally, the literature finds a positive relationship between greater education of the individual and greater activity, occupation and income (OECD, 2009). For example, with the growth of the university-educated population comes an increase in the number of employed persons, as

university graduates have higher rates of activity and employment, lower rates of unemployment and shorter periods of unemployment than the average for the active population. University graduates are also more productive workers due to their superior skills, and earn higher salaries than people with lower educational levels.

The increase of working-age population with higher education generates two economic effects in an economy. On the one hand, there are the positive effects of human capital on participation and employment rates (Pastor *et al.,* 2007) because university education increases occupation, since university graduates present a higher activity rate and a lower unemployment rate than the average for the total population. On the other hand, the greater human capital of university graduates and their higher productivity[1] is remunerated by firms with higher salaries than those for average workers, which in addition increase more throughout their working life than those of workers without university education. These two effects occur for both men and women with higher education and show non-monetary social and private benefits of higher education that are difficult to quantify precisely due to lack of information and estimation problems.

The central idea of this chapter is that education, and in particular higher education, exercises an important modulator effect on inequalities between men and women in certain economic and social spheres. The literature focuses on educational differences by gender but says little about differences in activity and unemployment by gender of the higher education graduates. To our knowledge, the literature has not addressed the study of the modulation effects of higher education in the differences of the behaviour of men and women in the labour market. There are only a few reports on this issue. For example, a report from the OECD (2012b) states that greater educational equality does not guarantee equality in labour market outcomes, because if workplace culture penalises women it will be difficult for them to realise their full potential in paid work. The book of Tembon and Fort (2008) is based on the research conducted in a variety of countries to establish that educating girls is one of the most cost-effective ways of spurring economic development. Like the limited literature

available, the work will focus on showing that female education is positively correlated with increased economic productivity, more robust labour markets, higher earnings, and improved societal health and well-being. However, nothing is said about the equalizing effects of higher education between men and women in the labour market of developed countries.

The readers may get a better vision of the problem if something is said about the expansion of the years of study and the evolution of the share of the working age population with university studies in Spain, comparing the evolution in Spain with other European Union countries. Table 3.1 shows that 24.2% of the Spanish population in 2010 has reached tertiary studies as highest level of education. This value is above the value of countries like France, Germany or Italy, although it is below the value of Denmark, Netherlands, United Kingdom and Belgium, with a 27.3% in the latest. It might be underlined that the growth in people with tertiary studies in Spain has been the most significant of all these countries, reaching 16.8 percentage points, followed by France with 11.1 percentage points.

In Spain the boom in higher education has been concentrated among women, such that today as in most higher-income countries, more women than men have complete tertiary education.[2] Considering the average years of total schooling, Table 3.1 shows that Spain is at the bottom in the ranking, with 10.3 years of studies, only above Italy (9.6). Nevertheless, the growth of Spain in this variable from 1990 until 2010 is one of the highest (3.3 years of increment). Only Germany leads Spain with 3.8 years of increment in the years of studies. Table 3.1 also shows the progress in the working age population with tertiary education. In Spain, 36.3% of the working age population had tertiary education, only 3.6 percentage points below Belgium, the country with the highest percentage. Countries such as Denmark, France, Germany, Italy and Netherlands show lower values. The growth in Spain has been, again, one of the highest among the countries considered.

Table 3.1. Educational attainment for total population in Spain and other EU countries

a) Percentage of population whose highest level of education attained is tertiary

Year	Denmark	France	Germany	Belgium	Italy	Netherlands	Spain	UK
1990	14.5	11.9	12.8	18.2	6.1	16.7	7.4	15.4
1995	17.6	14.9	15.6	21.2	7.7	19.3	14.0	18.8
2000	20.5	17.8	17.4	22.8	8.3	19.7	18.2	21.6
2005	24.0	18.6	18.0	24.5	9.1	22.6	22.3	23.1
2010	24.8	23.0	21.5	27.3	11.1	25.8	24.2	25.5

Source: Barro and Lee (2013)

b) Average years of total schooling

Year	Denmark	France	Germany	Belgium	Italy	Netherlands	Spain	UK
1990	9.4	7.7	8.6	9.4	7.7	10.3	7.0	9.1
1995	10.0	8.8	9.4	10.0	8.3	10.6	8.1	9.4
2000	10.8	9.8	10.1	10.3	8.8	10.8	8.9	9.9
2005	11.1	10.1	11.7	10.6	9.2	10.8	10.1	11.1
2010	11.3	10.7	12.4	10.7	9.6	11.4	10.3	12.2

Source: Barro and Lee (2013)

c) Share of working age population with tertiary education

Year	Denmark	France	Germany	Belgium	Italy	Netherlands	Spain	UK
1995	25.6	20.4	22.5	28.2	9.1	*na*	20.4	22.4
2000	24.0	24.0	23.5	32.0	11.3	24.0	26.7	26.0
2005	31.9	27.9	24.4	35.3	14.3	29.7	31.7	29.9
2010	30.3	31.7	26.3	38.9	17.0	31.4	33.5	35.6
2013	32.4	35.1	28.2	39.8	18.5	32.8	36.3	39.4

Source: Eurostat

Thus, this chapter focuses on the non-monetary effect of investments in education in Spain, the modulation of gender inequalities, i.e. the positive effect of education on equality of opportunities between men and women, and the reduction of sex discrimination in employment. Results indicate that the increase in the number of years of education achieved by women causes an evolution in their employment behaviour tending to equalise it with that of men. In statistical terms, men and women with a university education tend to be indistinguishable by their behaviour in the labour market. That is to say that the rates of activity and employment of university-educated men and women show a less differentiated profile, and the probabilities of occupation are greater. However, the modulator effect of education does not extend to salary incomes, where the differences between men and women are more persistent, due almost certainly to institutional and social factors that maintain situations of salary discrimination (Villar *et al.*, 2010) and limit the contribution of a university education to the reduction of sex differences in employment incomes.

The chapter is organised as follows. Section 3.2 analyses inequality in relation to employment activity and unemployment, and Section 3.3 studies the salary inequalities between men and women. Section 3.4 presents the conclusions.

3.2. Inequality in relation to employment

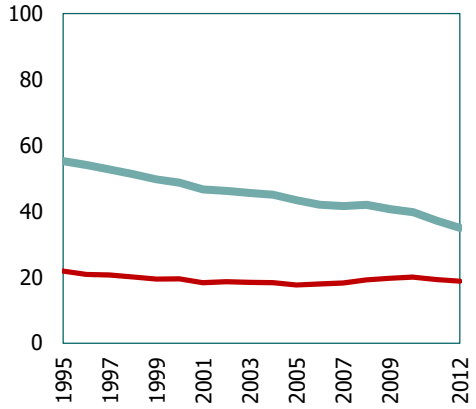
Since 1980 an increase can be noted in women's employment activity in Spain which, as in other industrialised countries, has been attributed to factors like increased education leading to an increase in women's potential incomes (Bover and Arellano, 1995). This section analyses the tendency towards equality in employment participation decisions between men and women as the level of formal education increases. Likewise, we attempt to measure the effect of the increase in educational level on the reduction of the difference between the unemployment rates of men and of women. The procedure consists of analysing activity rates and unemployment rates by educational level and by sex.

Figure 3.1.a) shows the growth of the activity rate in the period between 1995 and 2012, especially high in the case of women. However, in the female activity rate the differences between educational levels are very substantial. Thus, among the population with primary or lower level education the female activity rate is half that of males and experiences a much smaller reduction (3 percentage points as against 20 percentage points of the male activity rate) during the period analysed. In any case, the activity rate experiences reductions only among the population with primary or lower level education. The graphs show that, as the educational level increases, the gender differences in the activity rate are reduced, in the case of the university education (see Figure 3.1.d)) becoming nil between men and women from 2009.

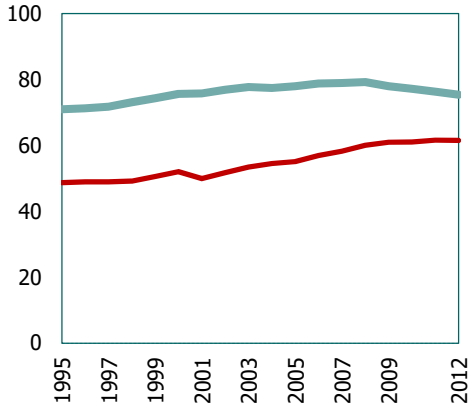
Figure 3.2 presents the differences between the activity rates of men and women for six educational levels. The differences are represented as the area between the two lines for each age of men and women. The graphs show that the area reduces as the educational level of the population increases (the vertical distance also reduces as the age of the group analysed increases). In Figure 3.2.f) it can be seen that university-educated women less than 28 years old show a higher activity rate than men. From this age onwards, men's activity rate is higher than women's, showing the influence in women's labour market participation during the period when families have children and these live at home, though the difference is less than at the other educational levels. Consequently, the employment participation profiles throughout the life cycle of men and women with university education show the least difference observed among all the educational groups analysed, being indistinguishable at the beginning and end of their working life.

Figure 3.1. Evolution of the activity rate by educational level and sex. Spain. 1995-2012

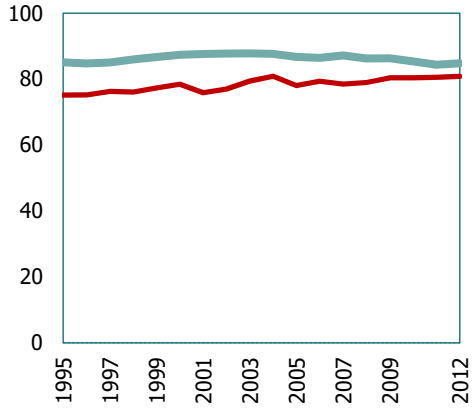
a) Population with primary education



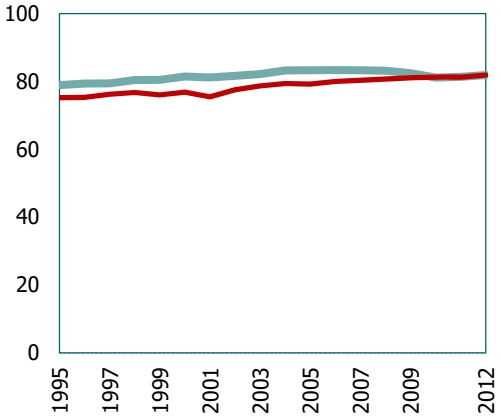
b) Population with secondary education



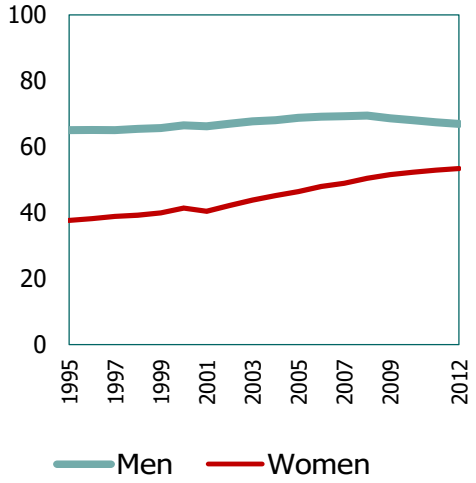
c) Population with higher grade vocational training



d) Population with university education

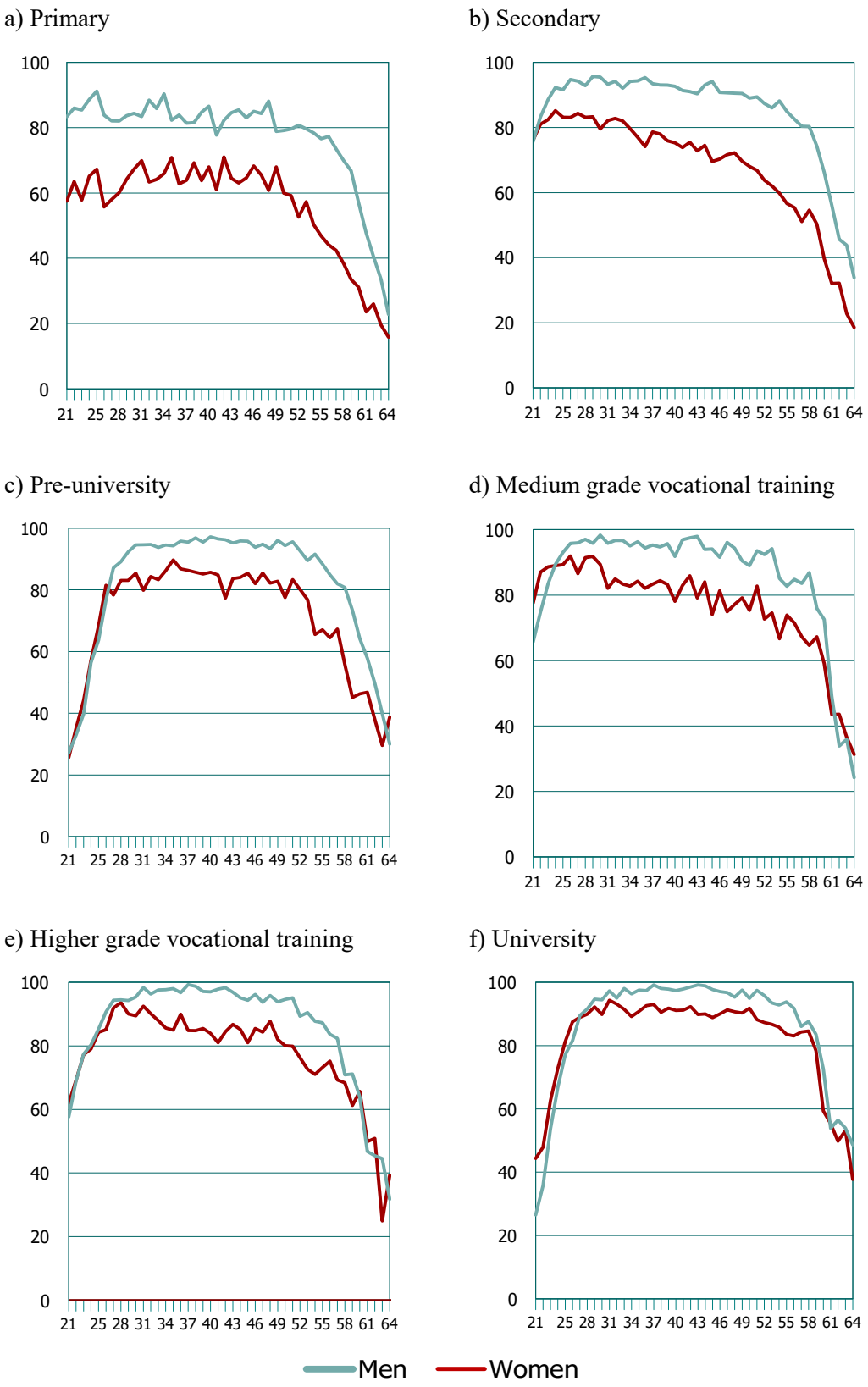


e) Total



Source: INE and own preparation.

Figure 3.2. Activity rate by educational level, age and sex. Spain. 2012



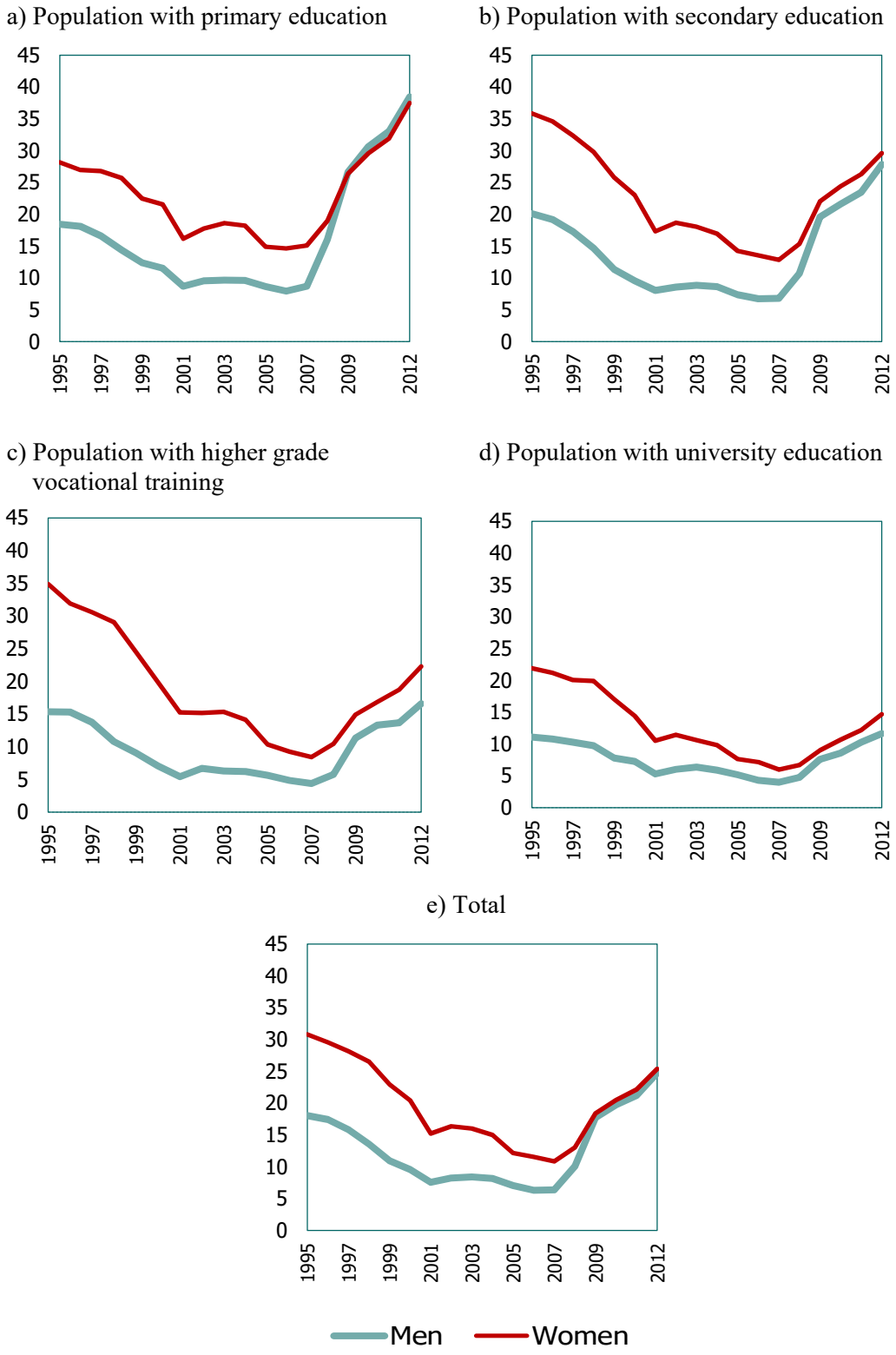
Source: INE and own preparation.

The differences in the unemployment rates by gender according to educational level are analysed using the same procedure as for activity rates. Figure 3.3 shows the countercyclical character of the unemployment rate in each of the groups analysed according to the level of education. However, the graphs show the existence of large differences: there are substantial gaps between men and women and also between educational levels. Thus, the population with the lowest level of education suffers to a greater extent the problem of unemployment, the unemployment rate gradually reducing as the population's educational level increases. With regard to the gender gap, a clear decreasing trend is observed during the period 1995-2012. Starting with a difference in the unemployment rate between women and men of 13 percentage points, from 2009 the gap practically disappears, due fundamentally to the massive destruction of jobs in sectors of mainly male employment (construction).

Figure 3.4 analyses the unemployment rate by ages, sex and educational level. Figure 3.4.f) presents very small differences between men and women with university education for all age groups and, additionally, shows that these men and women of any age have the lowest unemployment of all the educational levels considered. That is to say that increased education reduces the differences in the unemployment rates of men and women, but also permits greater social integration by decreasing unemployment irrespective of the sex of the individual. We can also appreciate how the sensibility to the economic cycle is lower as the educational level increases. In other words, if we draw the Okun[3] curve (Okun, 1962) for the educational levels considered, it shows less slope when the educational level is higher. Once again we observe the intense positive effect of university education on the reduction of inequalities between men and women.

Using the conventional Heckman's model (1979) for being employed, and a probit estimation for participation and have a permanent contract, with data from the 2012 Survey of Active Population in Spain, Table 3.2 presents the difference in the probability that a woman with different levels of education will (a) participate in the labour market, (b) be employed and (c) have a

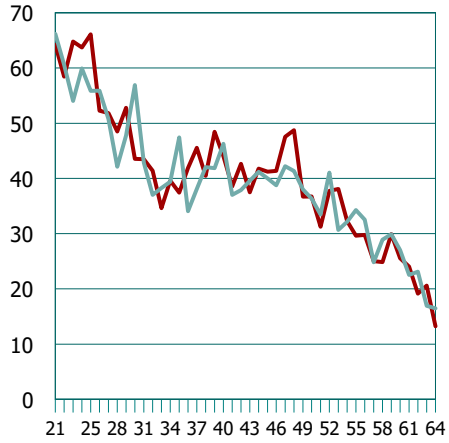
Figure 3.3. Evolution of the unemployment rate by educational level and sex. Spain. 1995-2012



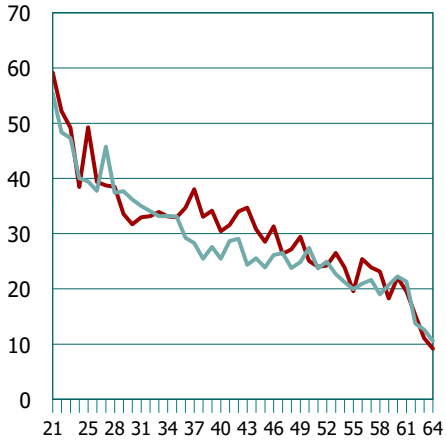
Source: INE and own preparation.

Figure 3.4. Unemployment rate by educational level, age and sex. Spain. 2012

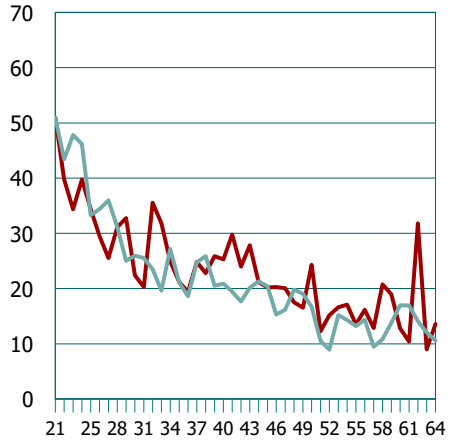
a) Primary



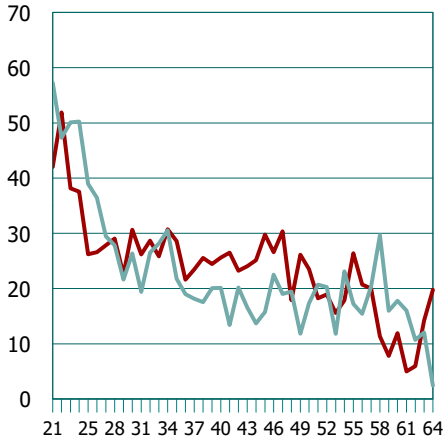
b) Secondary



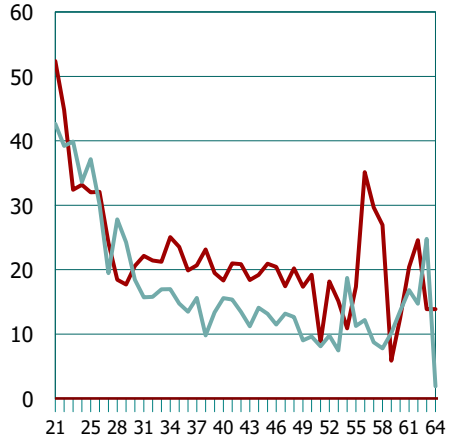
c) Pre-university



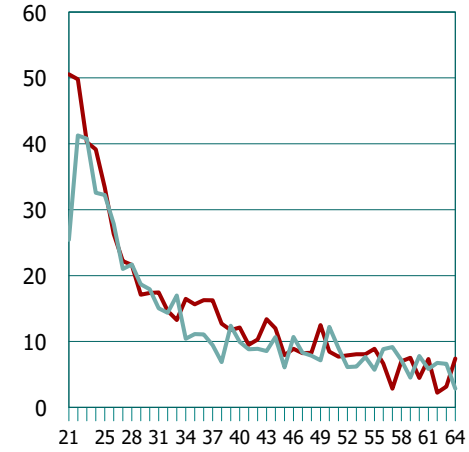
d) Medium grade vocational training



e) Higher grade vocational training



f) University



Source: INE and own preparation.

permanent contract, compared to a man with the same personal and social characteristics (The results of probit estimations for the three situations are detailed in the Appendix, Tables A.3.1, A.3.2 and A.3.3).

Table 3.2 shows that the increased educational level ensures a reduction in the difference between women's probability of activity and that of men in the same conditions. Women with the lowest educational level present a smaller difference in the probability of being active (approximately 10 percentage points) than that of women with a university education. However, no clear reduction is observed in the difference in probability of employment of women from that of men in the same condition, as women with low educational levels present similar differences in the probability of being employed to those of women with university levels of education. Likewise, the increase in educational level does not seem to positively reduce the difference in probability of obtaining a permanent contract compared with that of men.

Table 3.2. Difference in probability between men and women. Spain. 2012

	Be active	Be employed	Have permanent contracts
Primary	-14.0	-7.0	0.0
Lower secondary	-19.1	-2.3	-1.6
Upper secondary	-11.7	-4.5	-2.8
Higher grade vocational	-9.5	-4.3	-4.3
University	-4.4	-5.1	-3.7

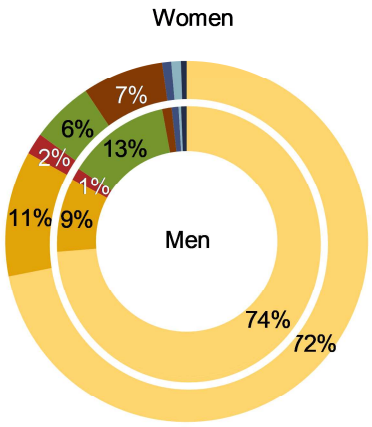
Source: INE and own preparation.

In consequence, the increased educational level of women in Spain acts as a modulator of the gender inequalities in the labour market in two aspects: labour participation (greater social cohesion) and, to a lesser extent, unemployment (less social exclusion). Figure 3.5 shows the contribution of a university education to the reduction of inequalities between men and women in the labour market. Among the university-educated population, the difference between men and women in the percentage employed is 2 percentage points, whereas it reaches 15 percentage points among the

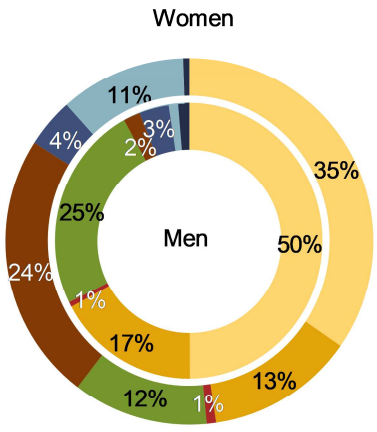
population without a university education. As well as a higher percentage of unemployed among the population without a university education, we also observe that the gender difference is greater, though in this case, it is because more than 50% of the women are inactive; the highest percentage of unemployed corresponds to men. In the case of the population with university education, a very similar percentage of unemployed by sex is observed, the small percentage difference being favourable to men. Thus, while approximately 83% of university-educated men and women are active, with no difference according to sex, between men and women without a university education there is a difference of 19 percentage points in the activity rate, unfavourable to the women.

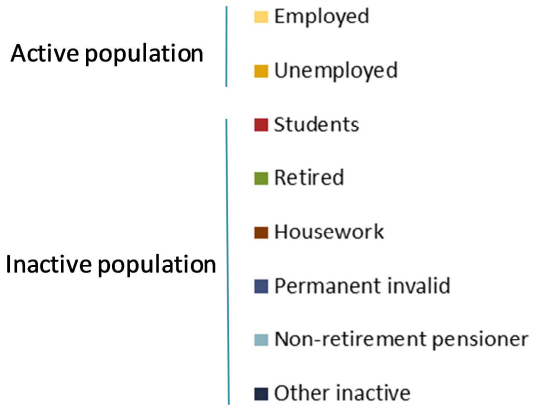
Figure 3.5. Population by relation to activity, sex and educational level. Spain. 2012

a) Population with university education



b) Population without university education





Source: INE and own preparation.

3.3. Salary inequality

The differences in salaries between men and women are analysed in this section with data from Spain's Salary Structure Survey, a quadrennial survey available since 1995, developed in the EU framework by the National Statistics Institute of Spain, in order to analyse wage structure and distribution. The sectors excluded in this survey are (1) agriculture, livestock and fisheries, (2) electricity, gas, steam and air conditioning supply. In the sample we do not consider the construction sector because of its erratic behaviour (Spanish specific fact) and the civil servants sector is not distributed by branches, it is included in the "Public Administration" sector (see Appendix, Table A.3.4). We have worked only with data on full time salaried workers, and the total gross annual wage in our sample is 22,124 euros in 2010 (28,876 euros in the public administration).

The monetary return on education is estimated by the traditional Mincer equation:

$$lnW = \beta_0 + \beta_1 EDUC + \beta_2 exp + \beta_3 exp^2 + \beta_4 sex + \beta_5 estrat + \beta_6 CNAE + \varepsilon$$

where the dependent variable (W) is the logarithm of annual earnings, and the explanatory variables[4] include dummy variables (0,1) for the educational levels achieved, experience and experience squared, calculated from the potential experience, dummy variable for sex, for the number of employees in the firm and, finally, for activity sectors (See Appendix, Table A.3.4 for complete results of the econometric estimation of the Mincer equation). Thus, the private monetary return from progressing from compulsory secondary education to a degree would be:

$$Return_{Second-Degree} = \frac{\beta_{Degree}}{17 - 8}$$

Table 3.3. Educational monetary returns. Spain. 2010

	National population			Foreign population		
	Total	Men	Women	Total	Men	Women
Secondary	1.86	2.01	1.67	0.93	2.30	-1.28
Pre-university	4.00	4.17	3.76	1.34	1.66	0.83
Medium grade vocational training	3.99	4.48	3.36	2.32	3.88	0.02
Higher grade vocational training	4.51	4.83	3.98	3.19	3.84	2.26
First cycle university degree	5.68	5.69	5.50	4.27	4.46	3.79
Second cycle university degree	6.41	6.38	6.37	5.68	6.12	5.05

Source: INE and own preparation.

Table 3.3 presents the results of the estimations made. The first group of results refers to the Spanish population, while the second refers to the foreign population residing in Spain. Within each group three estimations were made, the first for the whole sample, and the remaining two for the samples of men and women respectively. The smallest differences of return between men and women are observed at the pre-university level and at the two levels of university education, the gender gap even disappearing completely among graduates. The return on education is substantially less for foreigners resident in Spain than for the population of Spanish nationality. The greatest difference between the returns on education according to nationality is found among individuals with pre-university education, and the least among university graduates. Foreign women present returns clearly below those of the national population.

Lower returns on education for Spanish women than those for men indicate that the proportional increase in salary income among women on reaching a higher educational level (compared to the educational level of the reference individual) is lower than that for men. Salary profiles throughout a working life allow more precise comparisons of gender differences to be made. In this case, we have estimated, in accordance with the following functional form:

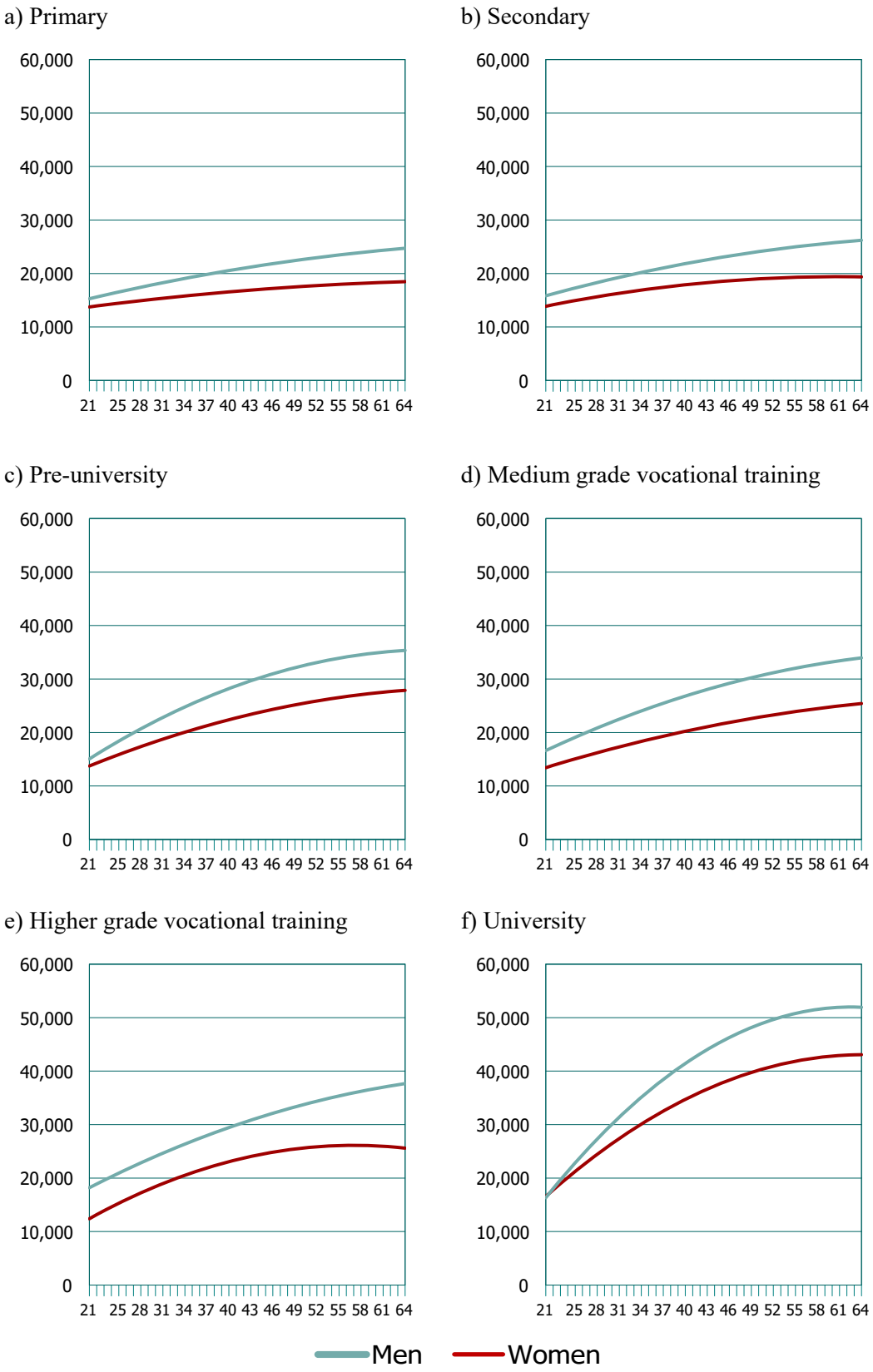
$$lnW = \beta_0 + \beta_1 Age + \beta_2 Age^2 + \varepsilon \,,$$

six salary income profiles for each of the educational levels considered in this article for men and women.

In summary form, the comparison of the pairs of profiles appearing in Figure 3.6 indicates that: (1) as the educational level increases, so do annual earnings; (2) annual earnings increase with age up to a maximum and from that point onwards begin to fall slightly; (3) men's earnings are systematically higher than women's; and (4) the annual earnings differences between men and women reduce in the course of a working lifetime as the educational level increases. Therefore, the difference in the return per year of studies between the total samples of men and women is 19.39% unfavourable for women (see Table A.3.4). This unfavourable difference in the return per year of studies for women compared to men is also listed for all levels of study and does not disappear when the level of education increases (see Table 3.3, Table A.3.4, and Figure 3.6). Therefore, this would be a failure in the modulatory effects of education on the differences between men and women.

As in other studies that report estimates of the "college premium" for higher education graduates across successive cohorts from large cross-section datasets in a period when the higher education participation rate increased dramatically (Walker and Zhu, 2008), this work finds the same wage differences among education levels and also confirms the fact that there is no significant fall for men and women regarding income inequality among higher educated workers. Thus, Figure 3.6.f) permits us to appreciate that women have a "glass ceiling" in their salary incomes whereas university-educated men do not suffer this upper limit (De la Rica, Dolado and Llorens, 2008). The differential observed between men and women with university education seems to be due to the fact that women are concentrated in occupations where the average remuneration is lower, or in other words, may be because men with university education occupy categories with higher salary remuneration than those occupied by women with university education. Thus, the study of Blau and Kahn (2000)

Figure 3.6. Annual earnings by educational level, age and sex. Spain. 2010

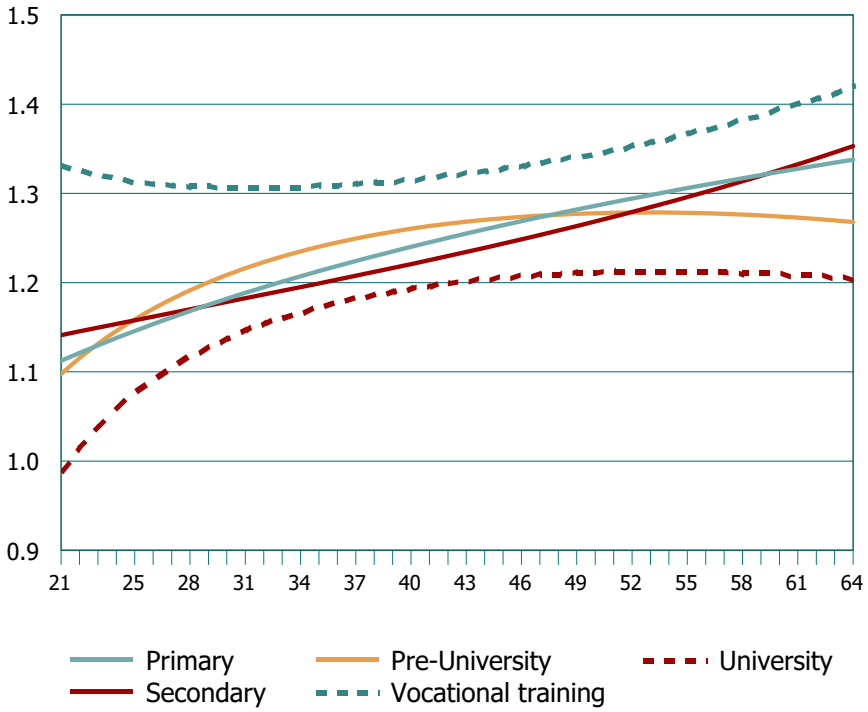


Source: INE and own preparation.

indicates that —besides gender specific factors— the discrimination, the overall wage structure and the rewards for skills and employment in particular sectors, importantly influence the gender pay gap.

Studies that examine the effects of increasing the level of education of the population have a common idea: increasing the supply of highly educated workers reduces income inequality over time (Goldin and Katz, 2009). However, Figure 3.7 presents the evolution of the annual earnings ratio between men and women over their lifetimes according to the educational level reached. The income inequality between men and women with university education is observed to be the lowest of all the educational levels. Furthermore, although the trend over a lifetime is for income differences between men and women to increase at all educational levels, the gender difference remains constant among the population with university education over 40 years of age.

Figure 3.7. Annual earnings by educational level and age. Men over women ratio. Spain. 2010



Source: INE and own preparation

3.4. Conclusions

This chapter aims to offer empirical evidence of the importance of university education as a factor reducing the inequalities between men and women in the labour market. University education has a modulating effect on gender inequalities in labour activity, occupation, and the probability of suffering unemployment situations. University education generates an equalising effect on the behaviour of men and women in the labour market, and thus also has a positive effect on a more equalitarian division of domestic labour between men and women.

The effects of higher education discussed at this work are important and although it is difficult to make a quantitative assessment, especially in monetary terms, they must be taken into account in decisions on investment in higher education. This work contributes to the discussion of the social effects of education, highlighting that the implications of the modulatory role of university education in certain social inequalities are important for social policy. Thus, if these effects represent non-monetary social benefits, they must all be taken into account when calculating the impacts of the activity of universities in society and when considering the increase of social return on investment in higher education.

As the educational level increases, the differences in activity rates by sex are observed to reduce, the difference between men and women with university educations being nil. Also, the problems of unemployment are less acute among the population with a higher educational level, though in this case, the equalisation of the unemployment rate may be due basically to the fact that the destruction of employment has been concentrated mostly on the male population that was occupied in the sector most affected by the current economic crisis (construction).

The data indicate that the increase in women's average educational level has not been enough to close the annual earnings gap between men and women. It is beyond doubt that the increased educational level generates monetary returns that as the educational level rises are more equal between

men and women. However, the discrimination and segregation of the labour market determine that the contribution of a university education to an equalisation of salary incomes between men and women is not so significant. Women seem to face a salary incomes curve bounded by a glass ceiling that does not appear in the case of men.

The results obtained confirm the findings of different studies in OECD countries on the social effects of the increased level of education of the population. Higher education would be recognized as a key tool for social problems due to its contribution to the reduction of gender inequalities.

The approach proposed in this chapter shows how important it is to pay attention to a broader range of university education contributions, and try to quantify them reasonably, since in today's society what we measure typically affects what we think or even, sometimes what appears not to be measured. In that sense, focusing only on the immediate and obvious effects of higher education, for example, wages or the unemployment rate of recent higher education graduates, underestimates their total benefits to individuals and society. Also, monetary measures of the impacts of higher education in society underestimate the positive effects that university activities have for citizens, as some of them are not monetary but yet important. The university policy must take into account both the social and private returns, and therefore also the monetary effects.

In summary, the findings presented in this work allow to notice that the contribution of higher education goes beyond what occurs in the economy. The contribution of higher education is very positive in relevant areas of social welfare, for example, reducing labour and social inequalities between men and women. We recommend further future research in this direction: the analysis of how higher education can help reduce other inequalities such as racial, ethnic, class, or nativity inequalities.

NOTES:

[1] There is evidence (Acemoglu and Autor, 2010) to show that higher levels of human capital in economies cause intensive technological progress in human capital that favours increased productivity.

[2] Becker, Hubbard and Murphy (2010) present a model that explains the increase in higher education, particularly among women, in terms of a market for college graduates in which the supply of college graduates is function of the distribution of the costs and benefits of higher education across individuals, but it appears that differences in the total costs of college for women and men, primarily due to differences in the distributions of non-cognitive skills for women and men, explain the overtaking of men by women in higher education. Similarly, Jacob (2002) finds that higher non-cognitive skills and college premiums among women account for nearly 90 percent of the gender gap in higher education.

[3] In economics Okun's law is an empirically observed relationship between an economy's unemployment rate and its gross national product growth.

[4] The reference categories are as follows: For educational level, primary education; for sex, male; for size of firm, from 1 to 49 workers; for the firm's sector of activity, commerce. The years of education, necessary for calculating potential experience, are imputed as follows: No education and primary education, 4.5 years; Compulsory secondary Education, 8 years; Pre-university education, 12 years; Medium grade vocational training, 10 years; Higher grade vocational training, 12 years; University Diploma, 15 years; University Degree, 17 years.

APPENDIX:

Table A.3.1. Probit estimation to be active. Spain. 2012

a) Primary

		Coefficient		Marginal effect
Ref: Man	Woman	-0.4705	***	-0.1399
Ref: 16-24	25-34	0.8553	***	0.3064
	35-44	0.8721	***	0.3120
	45-54	0.8288	***	0.2911
	Over 54	-0.8686	***	-0.2859
Ref: Foreign	National	-0.3872	***	-0.1259
	Constant	0.2842	***	
N		179,143		
Log Pseudolikelihood		-17,721,843		

b) Lower secondary

		Coefficient		Marginal effect
Ref: Man	Woman	-0.5604	***	-0.1911
Ref: 16-24	25-34	1.4824	***	0.3481
	35-44	1.3194	***	0.3405
	45-54	1.1171	***	0.2999
	Over 54	-0.0782	***	-0.0269
Ref: Foreign	National	-0.1908	***	-0.0621
	Constant	0.1837	***	
N		150,223		
Log Pseudolikelihood		-19,392,154		

c) Upper secondary

		Coefficient		Marginal effect
Ref: Man	Woman	-0.3676	***	-0.1170
Ref: 16-24	25-34	1.4881	***	0.3302
	35-44	1.6215	***	0.3579
	45-54	1.4207	***	0.3151
	Over 54	0.0681	***	0.0215
Ref: Foreign	National	-0.1758	***	-0.0540
	Constant	0.0103	***	
N		108,851		
Log Pseudolikelihood		-14,551,763		

d) Higher grade vocational

		Coefficient		Marginal effect
Ref: Man	Woman	-0.4328	***	-0.0950
Ref: 16-24	25-34	0.8729	***	0.1507
	35-44	0.8484	***	0.1527
	45-54	0.6279	***	0.1062
	Over 54	-0.9506	***	-0.2776
Ref: Foreign	National	0.1728	***	0.0396
	Constant	0.6300	***	
N		41,998		
Log Pseudolikelihood		-4,160,177		

e) University

		Coefficient		Marginal effect
Ref: Man	Woman	-0.2053	***	-0.0438
Ref: 16-24	25-34	1.1598	***	0.1851
	35-44	1.4061	***	0.2281
	45-54	1.2371	***	0.1762
	Over 54	-0.3405	***	-0.0820
Ref: Foreign	National	0.2907	***	0.0708
	Constant	0.0589		
N		95,260		
Log Pseudolikelihood		-9,888,255		

***, **, *:significant to 1%, 5% y 10%, respectively

Source: INE and own preparation

Table A.3.2. Probit estimation to be employed. Spain. 2012

a) Primary

		Coefficient		Marginal effect
Ref: Man	Woman	-0.2025	***	-0.0703
Ref: 16-24	25-34	0.8436	***	0.3230
	35-44	0.9564	***	0.3652
	45-54	0.9698	***	0.3684
	Over 54	0.3921	***	0.1278
Ref: Foreign	National	0.0745	***	0.0253
	Constant	-0.9764	***	
N		179,143		
Log Pseudolikelihood		-25,000,000		

b) Lower secondary

		Coefficient		Marginal effect
Ref: Man	Woman	-0.0647	***	-0.0230
Ref: 16-24	25-34	0.5026	***	0.1625
	35-44	0.6790	***	0.2151
	45-54	0.8035	***	0.2468
	Over 54	1.0090	***	0.2919
Ref: Foreign	National	0.1092	***	0.0396
	Constant	-0.2181	***	
N		150,223		
Log Pseudolikelihood		-35,900,000		

c) Upper secondary

		Coefficient		Marginal effect
Ref: Man	Woman	-0.1252	***	-0.0451
Ref: 16-24	25-34	0.9393	***	0.2844
	35-44	1.1254	***	0.3311
	45-54	1.1914	***	0.3360
	Over 54	0.9989	***	0.2908
Ref: Foreign	National	0.3309	***	0.1240
	Constant	-0.6300	***	
N		108,851		
Log Pseudolikelihood		-26,200,000		

d) Higher grade vocational

		Coefficient		Marginal effect
Ref: Man	Woman	-0.1665	***	-0.0429
Ref: 16-24	25-34	0.4645	***	0.1073
	35-44	0.6550	***	0.1487
	45-54	0.7801	***	0.1550
	Over 54	0.8502	***	0.1550
Ref: Foreign	National	0.5170	***	0.1568
	Constant	-0.0546	***	
N		41,998		
Log Pseudolikelihood		-8,695,157		

e) University

		Coefficient		Marginal effect
Ref: Man	Woman	-0.1571	***	-0.0506
Ref: 16-24	25-34	1.0457	***	0.2761
	35-44	1.3793	***	0.3546
	45-54	1.4291	***	0.3217
	Over 54	0.3618	***	0.1082
Ref: Foreign	National	0.3589	***	0.1256
	Constant	-0.6284		
N		95,260		
Log Pseudolikelihood		-18,200,000		

***, **, *:significant to 1%, 5% y 10%, respectively

Source: INE and own preparation

Table A.3.3. Probit estimation to have permanent contracts. Spain. 2012

a) Primary

		Coefficient		Marginal effect
Ref: Man	Woman	0.0072	***	0.0024
Ref: 16-24	25-34	0.5017	***	0.1491
	35-44	0.6539	***	0.1899
	45-54	0.8753	***	0.2552
	Over 54	1.2803	***	0.3634
Ref: Foreign	National	0.2754	***	0.0960
	Constant	0.4959	***	
N		17,472		
Log Pseudolikelihood		-3,002,471		

b) Lower secondary

		Coefficient		Marginal effect
Ref: Man	Woman	0.0486	***	-0.0159
Ref: 16-24	25-34	0.5273	***	0.1557
	35-44	0.7370	***	0.2144
	45-54	0.9694	***	0.2642
	Over 54	1.2959	***	0.2739
Ref: Foreign	National	0.3591	***	0.1259
	Constant	0.4162	***	
N		51,733		
Log Pseudolikelihood		-7,970,295		

c) Upper secondary

		Coefficient		Marginal effect
Ref: Man	Woman	-0.0951	***	-0.0281
Ref: 16-24	25-34	0.8755	***	0.2170
	35-44	1.1246	***	0.2742
	45-54	1.3975	***	0.3014
	Over 54	1.6495	***	0.2571
Ref: Foreign	National	0.5302	***	0.1741
	Constant	-0.7037	***	
N		45,701		
Log Pseudolikelihood		-6,819,200		

d) Higher grade vocational

		Coefficient		Marginal effect
Ref: Man	Woman	-0.1584	***	-0.0429
Ref: 16-24	25-34	1.0320	***	0.2334
	35-44	1.3922	***	0.3122
	45-54	1.7359	***	0.2841
	Over 54	1.9882	***	0.2140
Ref: Foreign	National	0.6495	***	0.2128
	Constant	-0.9528	***	
N		23,569		
Log Pseudolikelihood		-3,033,921		

e) University

		Coefficient		Marginal effect
Ref: Man	Woman	-0.1517	***	-0.0373
Ref: 16-24	25-34	1.0549	***	0.2087
	35-44	1.6899	***	0.3328
	45-54	2.0744	***	0.3034
	Over 54	2.3214	***	0.2319
Ref: Foreign	National	0.4345	***	0.1262
	Constant	-0.9591		
N		57,244		
Log Pseudolikelihood		-7,152,429		

***, **, *:significant to 1%, 5% y 10%, respectively

Source: INE and own preparation

Table A.3.4. Mincer equation. Spain. 2010

	Explanatory variables	National population			Foreign population		
		Total	Men	Women	Total	Men	Women
Ref: Primary	Secondary	0.0653 ***	0.0704 ***	0.0585 ***	0.0325 **	0.0804 ***	-0.0449 **
		(0.00602)	(0.00764)	(0.00960)	(0.01603)	(0.02079)	(0.02275)
	Pre-university	0.3001 ***	0.3128 ***	0.2823 ***	0.1004 ***	0.1247 ***	0.0619 **
		(0.00809)	(0.01100)	(0.01196)	(0.02321)	(0.03280)	(0.03132)
	Medium grade vocational training	0.2193 ***	0.2463 ***	0.1849 ***	0.1278 ***	0.2134 ***	0.0014
		(0.00728)	(0.00991)	(0.01082)	(0.02974)	(0.04063)	(0.03401)
	Higher grade vocational training	0.3380 ***	0.3626 ***	0.2983 ***	0.2396 ***	0.2877 ***	0.1693 ***
		(0.00779)	(0.01010)	(0.01224)	(0.05303)	(0.07665)	(0.06347)
	First cycle university degree	0.5960 ***	0.5972 ***	0.5779 ***	0.4483 ***	0.4688 ***	0.3975 ***
		(0.00871)	(0.01284)	(0.01234)	(0.04177)	(0.05391)	(0.05942)
	Second cycle university degree	0.8010 ***	0.7976 ***	0.7962 ***	0.7101 ***	0.7648 ***	0.6312 ***
		(0.00814)	(0.01078)	(0.01243)	(0.04439)	(0.06945)	(0.04103)
	Potential experience	0.0285 ***	0.0298 ***	0.0270 ***	0.0201 ***	0.0230 ***	0.0151 ***
		(0.00071)	(0.00101)	(0.00093)	(0.00343)	(0.00478)	(0.00420)
	Potential experience^2	-0.0003 ***	-0.0003 ***	-0.0004 ***	-0.0003 ***	-0.0004 ***	-0.0003 **
		(0.00001)	(0.00002)	(0.00002)	(0.00007)	(0.00009)	(0.00010)
Ref: Man	Woman	-0.1939 ***			-0.0915 ***		
		(0.00401)			(0.01508)		
Ref: 1-49 workers	50-199 workers	0.1574 ***	0.1651 ***	0.1440 ***	0.1290 ***	0.1324 ***	0.1231 ***
		(0.00451)	(0.00569)	(0.00736)	(0.01425)	(0.01806)	(0.02145)
	Over 199 workers	0.2589 ***	0.2552 ***	0.2645 ***	0.1703 ***	0.1961 ***	0.1424 ***
		(0.00414)	(0.00542)	(0.00643)	(0.01564)	(0.02159)	(0.02028)
Ref: Trade	Mining and quarrying	0.2582 ***	0.2361 ***	0.5481 ***	0.2464 ***	0.2612 ***	0.3331 ***
		(0.04636)	(0.04794)	(0.20423)	(0.07510)	(0.08256)	(0.06672)

Table A.3.4. Mincer equation. Spain. 2010 (cont.)

	Explanatory variables	National population			Foreign population		
		Total	Men	Women	Total	Men	Women
Ref: Trade	Water supply	0.1037 ***	0.1021 ***	0.0679 **	0.0757 **	0.0707 *	0.1012
		(0.01224)	(0.01379)	(0.03063)	(0.03644)	(0.04200)	(0.09151)
	Manufacturing	0.1054 ***	0.1008 ***	0.0952 ***	0.1043 ***	0.1227 ***	0.0590 *
		(0.00625)	(0.00842)	(0.00934)	(0.02213)	(0.02904)	(0.03069)
	Accommodation and food service activities	-0.0125	-0.0400 *	0.0194	0.0121	-0.0028	0.0080
		(0.01401)	(0.02191)	(0.01647)	(0.02817)	(0.04311)	(0.03261)
	Transport and communication	0.0694 ***	0.0509 ***	0.1104 ***	0.0269	0.0505	-0.0470
		(0.00899)	(0.01160)	(0.01429)	(0.03616)	(0.04471)	(0.05295)
	Insurance and financial activities	0.2751 ***	0.2823 ***	0.2691 ***	0.2444 ***	0.2683 ***	0.2235 ***
		(0.00969)	(0.01323)	(0.01424)	(0.06441)	(0.09208)	(0.08165)
	Enterprises services	-0.0557 ***	-0.0663 ***	-0.0396 ***	-0.0805 ***	-0.0710 **	-0.0957 ***
		(0.00722)	(0.01017)	(0.01023)	(0.02326)	(0.03276)	(0.02997)
	Education	-0.0852 ***	-0.1690 ***	-0.0282 *	-0.0804	-0.0606	-0.1122 *
		(0.01280)	(0.01958)	(0.01711)	(0.05740)	(0.09265)	(0.06505)
	Health	0.0273 ***	-0.0077	0.0566 ***	-0.0729 **	-0.0375	-0.0784 **
		(0.00757)	(0.01268)	(0.00999)	(0.03038)	(0.06377)	(0.03454)
	Other services	-0.0972 ***	-0.0834 ***	-0.1001 ***	-0.1297 ***	-0.1326 ***	-0.1471 ***
		(0.00935)	(0.01441)	(0.01228)	(0.02966)	(0.04396)	(0.03620)
	Public Administration (civil servants)	0.0544 ***	0.0448 ***	0.0697 ***	-0.1107	-0.0203	-0.2259 *
		(0.00831)	(0.01194)	(0.01150)	(0.07440)	(0.08013)	(0.12673)
	Constant	9.2239 ***	9.1944 ***	9.1087 ***	9.3495 ***	9.2734 ***	9.4016 ***
		(0.01065)	(0.01444)	(0.01407)	(0.04500)	(0.06222)	(0.05289)
	N	111,424	66,498	44,926	6,162	3,857	2,305
	R^2	0.486	0.451	0.511	0.393	0.390	0.406
	F	1,867	994	910	59	41	29

***, **, *:significant to 1%, 5% y 10%, respectively. Standard errors in brackets
Source: Encuesta de Estructura Salarial 2010 and own preparation.

4 Gender differences in the intergenerational transmission of education in Spain: The role of parents' professional status and education

ABSTRACT: This article examines the influence of parents' education and professional status on the educational level their children attain with special reference to gender differences. The study analyses what determines the probability of Spanish young people completing a university education. A sample with 132,421 observations of people under the age of 28 who were not in any type of training or education was selected using anonymised microdata from the most recent Population and Housing Census, and an ordered probit model was used to capture the effect of various socio-economic, environmental and cultural variables on the advancement and attainment of educational level according to gender. Results show that the most important variable in academic progress is parents' educational level, and that level of the mother's education has a greater influence. Additionally, parental employment instability is the variable that most inhibits children's academic progress.

4.1. Introduction

The notion that individuals optimise when taking decisions about their education is intrinsically bound up with economic analysis, since they adapt the costs of the education to its expected benefits. The family's socio-economic background and environment therefore play a determining role in optimising the level of education individuals reach in their aim to maximise wealth (Lazear, 1980).

The effects of the socio-economic characteristics of the family and the labour market on demand for education have not received a great deal of research attention due to the paucity of databases that combine this type of information. One of the first studies was by Willis and Rosen (1979), who used a database of US war veterans and concluded that lifetime expected earnings together with family background indicators influence the decision to go to university. More recently, Lauer (2003) used an ordered probit model to study the effect of family socio-economic characteristics, birth cohort and parental education on the level of education of children in Germany and France, and Smith *et al.* (2016) study the effect of family background and formation in young adults' school-work transitions using logistic regressions.

In Spain Peraita and Sánchez (1998), Albert (2000) and Rahona (2006) have studied the effects that family socio-economic background, labour market, and geographical and cultural environment have on levels of completed education, among others. All these studies are based on data sources available in the 1990s (Economically Active Population Survey and Household Budget Survey); however, data now available from the Population and Housing 2011 Census (INE, 2013) allow researchers to update this research and explore the effects of various other variables on the probability of completing a university education.

The present study uses the latest Spanish Population and Housing Census, making an innovative contribution as the first study to analyse the influence of parental education and professional status as determinants of their children's education, together with variables such as wealth, size of

municipality of residence, and presence of siblings. The analysis was performed for Spain with a large number of variables and observations from the 2011 census. The size of the sample ensures that the results obtained are robust and reliable, as the statistics from the estimations show.

Ordered logit models were estimated from microdata taken from the 2011 Population and Housing Census to analyse the effects of families' socio-economic, cultural and environmental background on the level of education attained by young Spaniards under the age of 28. The use of an ordered multinomial model is justified, as the dependent variable analysed is ordinal, because the levels of education attained are sequential over time. The analysis particularly focuses on the effects of parental education level and professional status, and municipality size on the probability of completing university education according to gender, a variable that turns out to be determinant in the analysis.

The chapter is organised as follows. Section 4.2 describes data and information source. Section 4.3 shows the ordered probit model used to estimate the educational level. Section 4.4 presents the results of the estimations and section 4.5, the probability distribution of levels of competed education. Finally, section 4.6 presents the conclusions.

4.2. Data and information source

Anonymised microdata from the Population and Housing Census 2011, published by the Spanish Statistical Office (INE) in 2013, were used in the construction and use of the variables for the estimations. This was the first time a census had been carried out under community legislation, and its results are comparable at European Union level. This census was conducted not in the usual way of compiling comprehensive data, but was based on administrative records, principally the Municipal Register, and supplemented with a large sample survey comprising 5,797,425 individuals, 12.3% of the population. This statistical operation offers a great wealth of variables, 51 of which refer to people, 13 to dwellings and 16 to buildings.

The sample selected for this analysis contains over 130,000 observations and 22 variables in several categories. The study uses information on the characteristics of the people analysed, their parents, and the housing in which they live. The anonymised microdata format allows us to perform the econometric analyses necessary for the lines of enquiry established in the study. Further, the most prestigious statistical institution in Spain, the National Statistics Institute, guarantees the quality of the information. The sample selected for the estimations comprised the national population under the age of 28 (as most of those who started university will have finished by that age) who live in the family home, whose status in the family unit is that of son or daughter, and who are not presently studying, formally or otherwise.

Table 4.1 presents the descriptive statistics for the population sample used in the estimations. The sample comprises 132,421 sample observations, which correspond to 1,419,385 population observations. By gender, 57.7% were men and 42.3%, women. In terms of completed education, the largest group, 32.9% of the sample, were those who had finished compulsory secondary education, followed by primary education (16.2%), post-compulsory secondary school and university education (14.9%), and intermediate and higher vocational training (12.2% and 8.8%, respectively).

Parental educational level is the main long-term determinant of children's educational success; in other words, the progenitors' level of education has the greatest bearing on the level of education the next generation will attain, as several studies have verified (Haveman and Wolfe, 1995; Huang, 2013) and as confirmed in this research. Data in our sample for this variable show that mothers reached the highest levels of education, the largest group having completed secondary education (63.2% in the case of mothers, and 52%, fathers), followed by primary education (18.8%, mothers and 16.1%, fathers). Finally, 8.7% of the mothers and 7.3% of the fathers had completed tertiary studies.

Table 4.1. Target population's descriptive statistics

		Sample	
		Number of observations	Percentage
Sex			
	Male	76,423	57.7
	Female	55,998	42.3
	Total	132,421	100.0
Educational attainment level			
	Primary	21,512	16.2
	Lower secondary	43,625	32.9
	Vocational secondary education	16,207	12.2
	Upper secondary	19,725	14.9
	Short-cycle tertiary vocational education	11,633	8.8
	University	19,719	14.9
	Total	132,421	100.0
Mother's educational attainment level			
	Non applicable	6,589	5.0
	Illiterate and without studies	5,651	4.3
	Primary	24,906	18.8
	Secondary	83,735	63.2
	Tertiary	11,540	8.7
	Total	132,421	100.0
Father's educational attainment level			
	Non applicable	27,113	20.8
	Illiterate and without studies	4,844	3.7
	Primary	21,300	16.1
	Secondary	69,326	52.0
	Tertiary	9,838	7.3
	Total	132,421	100.0
Mother's professional status			
	Non applicable	6,589	5.1
	Employer	4,602	3.4
	Self-employed	8,138	6.1
	Permanent salaried staff	48,746	36.7
	Temporary salaried staff	33,593	25.4
	Inactive	30,753	23.3
	Total	132,421	100.0

Table 4.1. Target population's descriptive statistics (Cont.)

		Sample	
		Number of observations	Percentage
Father's professional status			
	Non applicable	27,113	20.5
	Employed	11,850	8.9
	Self-employed	14,551	11.0
	Permanent salaried staff	59,042	44.6
	Temporary salaried staff	19,865	15.0
	Total	132,421	100.0
Wealth (number of items)			
	0	7,523	5.7
	1	25,728	19.4
	2	43,733	33.0
	3	42,058	31.8
	4	13,379	10.1
	Total	132,421	100.0
Older siblings			
	0	94,151	71.1
	1	34,275	25.9
	2	3,606	2.7
	3	329	0.2
	4 or more	60	0.0
	Total	132,421	100.0
Younger siblings			
	0	67,098	50.7
	1	53,219	40.2
	2	10,329	7.8
	3	1,390	1.0
	4 or more	385	0.3
	Total	132,421	100.0
Semester of birth			
	1st	65,389	49.4
	2nd	67,032	50.6
Total	Total	132,421	100.0
Municipality size			
	20.000 inhabitants or less	67,117	50.7
	Over 20.000 inhabitants	65,304	49.3
	Total	132,421	100.0

Source: Own elaboration based on Spanish Population and Housing Census 2011 (INE, 2013).

Regarding *parental professional status*, employees with a permanent contract represented the largest group in the sample of men and women. Those in employment represented the largest category, although mothers in the unemployed category accounted for around 20% of the sample and population observations.

The variable *wealth* is a discrete variable taking the values 0 to 4, according to how many of the four selected items apply to the dwelling. These four items were usable space in excess of 100 m², mortgage-free ownership, central heating, and internet in the home. The majority of the dwellings, 33%, had two of the four characteristics, followed by 31.8% with three items, and 19.4% with one. Families in dwellings with all four of the items defining the wealth variable made up 10.1% of the total, whereas 5.7% had none of the items.

The variable *number of siblings* is also a discrete variable taking the values 0 to 4 according to the number of siblings the person has. The sample differentiates between older and younger siblings: 71.1% of the population have no older sibling and 25.9% have just one, while 50.7% have no younger sibling and 40.2% have just one; 7.8% have two younger siblings.

Size of municipality is a dummy variable that takes a value of 1 if the population is over 20,000 inhabitants and zero otherwise. Approximately 50% of the sample lives in municipalities with more than 20,000 inhabitants (65.1% of the population).

Finally, because students born in the same year are of different ages, a dichotomous variable was included that takes values 0 or 1, depending on the semester in which the person was born, in order to examine whether this variable has any effect on educational success. Approximately 50% of the sample was born in the first semester.

4.3. The ordered probit model for estimating education level

To illustrate the econometric specification of an individual's level of education (y_i) we use an ordered probit model constructed around the following latent variable regression:

$$y_i^* = \beta x_i + \varepsilon_i \tag{4.1}$$

where y_i^* is the unobserved dependent variable. In practice, the censored variable y_i and the level of education completed by individual i are observed.

$$y_i = 0 \quad if \quad y^* \leq u_0$$

$$y_i = j \quad if \quad u_{j-1} < y_i^* \leq u_j \qquad j = 1,2,\dots,5 \tag{4.2}$$

where, after normalisation, $u_o = 0$. The unknown parameters u_j are estimated with β; the vector x_i contains quantifiable independent variables reflecting family background and the conditions of the reference employment market for individual i; and finally, the term ε represents some other unobservable factors.

Given the normal function associated with the random disturbance, the model is estimated using a standardised normal distribution function (probit model) with zero mean and variance equal to 1. The following expression reflects the probability of individual i attaining education level j :

$$Prob\,[y_i = j] = \left(\frac{1}{\sqrt{2\pi}}\right)\int_{-\infty}^{\alpha+\beta Xi} e^{-Z^2/2}dz \tag{4.3}$$

Expression 4.3 is used to analyse the impact of various socio-economic characteristics on the probability distribution of the education attained. In addition, to discover the marginal effects of a significant dummy variable, the probabilities obtained when the variable takes one of its values (0 or 1) should be compared with those obtained when the remaining continuous variables are located within the sample means and the other dummy

variables are omitted. Recall that the probabilities of men and women sum to one, and therefore the marginal effects associated with a change in the regression coefficients will sum to zero.

The education levels considered and associated with each value of the dependent variables are as follows:

$y_i = 0$ if individual *i* completed primary education

$y_i = 1$ if individual *i* completed compulsory secondary education

$y_i = 2$ if individual *i* completed intermediate vocational training

$y_i = 3$ if individual *i* completed post-compulsory secondary education

$y_i = 4$ if individual *i* completed higher vocational training

$y_i = 5$ if individual *i* completed university education

The vector x_i contains two groups of explanatory variables. The first comprises the variables reflecting personal characteristics such as gender, semester of birth, number of siblings, and whether they are younger or older. The variables in the second group reflect socio-economic characteristics such as the size of the municipality where the family lives, professional status and educational level of both parents, and family wealth. As mentioned previously, the latter is a *discrete quantitative variable*, constructed from the values of four questions on primary residence in the Population and Housing Census 2011. The first variable takes the value 1 if the dwelling has a usable space in excess of 100 m²; the second refers to mortgage-free ownership of the family residence (either bought or inherited), in which case the variable takes a value of 1 and 0 otherwise. In the case of dwelling with individual or communal central heating, the variable takes a value of 1 and 0 otherwise; finally, if the dwelling has access to internet, the variable takes a value of 1 and 0 otherwise. The more items the dwelling has, the higher the value of the wealth variable, 0 being the value for a dwelling with none of these features, and 4, one with all of the items.

4.4. The results of the estimations

Table 4.2 presents the results of estimating the ordered probit model by gender. The table shows that the signs of the variables align with those obtained in the literature on levels of completed education for the variables analysed in this study. In order to perform a detailed analysis of the probabilities we must calculate the associated marginal effects, since the estimated coefficients provide little information except in relation to the sign.

The first column of Table 4.2 reports the joint estimation for both genders; the variable gender is significant, and the estimation can therefore be differentiated by gender. The coefficient associated with the *male* category in the gender variable presents a negative sign and is statistically significant, indicating that male status, *ceteris paribus*, reduces the probability of educational success. Similarly, the coefficient associated with the father's professional status (self-employed or employee with a permanent contract), presents a positive sign and is statistically significant, indicating that, *ceteris paribus*, children whose fathers are in stable employment, as opposed to on temporary contracts, are more likely to reach higher levels of education. In the case of the mother's professional status, the same conclusions hold as for the father, but in addition unemployed mothers have a more positive influence on their children's level of education than that of mothers employed on temporary contracts. In sum, precarious parental employment status negatively affects the level of education children attain. The explanation for this finding may be that unstable employment tends to be linked to low household income, which also affects children's educational success.

Table 4.2. Educational attainment level: ordered probit model analysis. Coefficients

Dependent variable: Educational attainment level (y= 0, 1,...,5)								
		Total		Male		Female		
Sex. Reference: Female	Male	-0.451	***					
Father's professional status. Reference: Temporary salaried staff	Non applicable	0.240	***	0.285	***	0.182	***
	Employer	0.179	***	0.172	***	0.193	***
	Own-account workers	0.178	***	0.145	***	0.229	***
	Permanent salaried staff	0.183	***	0.196	***	0.168	***
Mother's professional status. Reference: Temporary salaried staff	Non applicable	0.336	***	0.395	***	0.258	***
	Employer	0.106	***	0.088	***	0.134	***
	Own-account workers	0.093	***	0.099	***	0.093	***
	Permanent salaried staff	0.095	***	0.100	***	0.088	***
	Inactive	0.068	***	0.075	***	0.062	***
Siblings Reference: no siblings	Older	-0.162	***	-0.130	***	-0.205	***
	Younger	-0.054	***	-0.056	***	-0.050	***
Wealth Reference: no items	Wealth	0.193	***	0.184	***	0.207	***

Table 4.2. Educational attainment level: ordered probit model analysis. Coefficients (Cont.)

Dependent variable: Educational attainment level (y= 0, 1,...,5)								
		Total		Male		Female		
Sex. Reference: Female	Male	-0.451	***					
Semester of birth. Reference: I semester	II semester	0.005		-0.008		0.022	**	
Father's educational attainment level. Reference: Illiterate and without studies	Primary	0.048	**	0.062	**	0.028		
	Secondary	0.296	***	0.326	***	0.256	***	
	Tertiary	0.647	***	0.743	***	0.531	***	
Mother's educational attainment level. Reference: Illiterate and without studies	Primary	0.145	***	0.141	***	0.150	***	
	Secondary	0.480	***	0.514	***	0.437	***	
	Tertiary	0.798	***	0.907	***	0.670	***	
Municipality size. Reference 20.000 inhabitants or less	Over 20.000 inhabitants	0.090	***	0.131	***	0.034	***	
μ_1		-0.124	***	0.377	***	-0.169	***	
μ_2		0.960	***	1.500	***	0.853	***	
μ_3		1.294	***	1.840	***	1.183	***	
μ_4		1.771	***	2.312	***	1.668	***	
μ_5		2.126	***	2.720	***	1.976	***	
Log-likelihood		-2,257,928		-1,277,393		-976,307		
N		132,421		76,423		55,998		
χ^2		16,373	***	8,269	***	5,336	***	
R^2-pseudo		0.0613		0.0556		0.0448		

***, **, *: significant at 1%, 5% y 10% respectively.
Source: Own elaboration based on Spanish Population and Housing Census 2011 (INE, 2013).

The coefficient associated with the variable for siblings is negative and statistically significant, indicating that having siblings may suppose an obstacle to reaching higher levels of education. The higher coefficient value in the case of older siblings shows a particularly marked negative influence if siblings are older. This result coincides with findings from studies by Black *et al.* (2004), Booth *et al.* (2009) and De Haan (2010). The positive and significant sign associated with the wealth variable suggests that the greater the family wealth, the more likely children are to reach higher levels of education. Finally, semester of birth is not significant in the estimation and therefore does not appear to be a relevant variable.

The variable parental educational level has the greatest impact on the probability of children completing university, reaching a higher level of education, or being successful in their studies. The explanation for this finding may be that parents with higher levels of education tend to place greater value on education and probably encourage their children to study to a higher level. Studies that analyse educational performance with PISA data find that children's academic performance is higher, the higher the parental level of education; this is due to the better quality and quantity of parental support for children's school work from university educated parents. In addition, the effect of the mother's level of education on the probability of children going to university is higher than that of the father, a result that coincides with findings in the previous literature (Duncan, 1994; Kodde and Ritzen, 1994; Lauer, 2003; Holmlund *et al.*, 2011). Similarly, educational expansion has been responsible for a great share of increasing social fluidity in women (Gil-Hernández *et al.,* 2017).

Finally, as expected, a positive relationship was found between municipality size and attaining a higher level education. This result can be explained by the greater access to centres of education (wider range of schools, colleges, universities; better transport links, etc.) that enable people to complete their studies more easily if they live in larger municipalities.

Columns 2 and 3 display the estimations of the ordered probit model for the subsample of men and women, respectively. The comments referring to the

joint estimation of the two genders are all valid, except in reference to the gender variable, as it does not appear in these two estimations.

Table 4.3 reports the marginal effects of the estimation of the ordered probit model for level of completed education and gender. In the case of the lowest level of completed education, primary studies, men have a 9.5% higher probability than women of having reached this level only. The parental professional status most closely associated with children reaching primary education level is being an employee with temporary contract, since the sign for all the other professional status alternatives is negative in this completed education category. Having older siblings increases the probability of achieving a lower level of education by 3.5%, whereas the increase is 1.2% if siblings are younger. The wealth variable lowers the probability of completing only primary education by 4.2%, and parental educational level above illiterate or no education reduces this probability by between 1% and 10.2% in the case of fathers and between 3% and 11.8% in the case of mothers, depending on their level of completed education. Finally, residence in municipalities with populations over 20,000 reduces the probability of completing only primary education by 2% compared to municipalities with fewer inhabitants.

In general terms, as the predicted level of completed education rises, the variable gender shifts to a negative sign, meaning that women are more likely to reach a higher level of education. The shift to positive signs as the predicted level of completed education rises shows how the family's unstable employment situation (employee on temporary contract category in the professional status variable) is an obstacle to children advancing to higher levels of education. Similarly, having siblings, whether older or younger, may also be a hurdle to reaching higher levels of education, particularly when siblings are older. As expected, family wealth facilitates the achievement of higher levels of education. With higher parental education levels, the sign of the marginal effect changes as the predicted level of education rises, such that the higher the parents' educational level, the greater the probability that children will complete a higher level of education. Size of the municipality of residence also has determinant effect,

Table 4.3. Ordered probit estimation. Marginal effects by sex and educational attainment level

		Primary			Lower secondary			Vocational secondary education		
		Total	Male	Female	Total	Male	Female	Total	Male	Female
Sex. Reference: Female	Male	0.095 ***			0.084 ***			-0.007 ***		
Father's professional status. Reference: Temporary salaried staff	Non applicable	-0.049 ***	-0.068 ***	-0.029 ***	-0.047 ***	-0.045 ***	-0.040 ***	0.003 ***	0.010 ***	-0.004 ***
	Employer	-0.036 ***	-0.041 ***	-0.029 ***	-0.035 ***	-0.027 ***	-0.043 ***	0.002 ***	0.006 ***	-0.005 ***
	Own-account workers	-0.036 ***	-0.035 ***	-0.034 ***	-0.035 ***	-0.022 ***	-0.051 ***	0.002 ***	0.006 ***	-0.006 ***
	Permanent salaried staff	-0.040 ***	-0.050 ***	-0.028 ***	-0.033 ***	-0.027 ***	-0.036 ***	0.003 ***	0.009 ***	-0.003 ***
Mother's professional status. Reference: Temporary salaried staff	Non applicable	-0.062 ***	-0.085 ***	-0.037 ***	-0.070 ***	-0.071 ***	-0.057 ***	0.000	0.009 ***	-0.008 ***
	Employer	-0.022 ***	-0.022 ***	-0.021 ***	-0.020 ***	-0.013 ***	-0.029 ***	0.001 ***	0.004 ***	-0.003 ***
	Own-account workers	-0.019 ***	-0.024 ***	-0.015 ***	-0.018 ***	-0.015 ***	-0.020 ***	0.001 ***	0.004 ***	-0.002 ***
	Permanent salaried staff	-0.020 ***	-0.026 ***	-0.015 ***	-0.017 ***	-0.014 ***	-0.019 ***	0.002 ***	0.004 ***	-0.002 ***
	Inactive	-0.014 ***	-0.019 ***	-0.010 ***	-0.013 ***	-0.010 ***	-0.013 ***	0.001 ***	0.003 ***	-0.001 ***
Siblings Reference: no siblings	Older	0.035 ***	0.034 ***	0.034 ***	0.029 ***	0.017 ***	0.044 ***	-0.003 ***	-0.006 ***	0.003 ***
	Younger	0.012 ***	0.014 ***	0.008 ***	0.010 ***	0.007 ***	0.011 ***	-0.001 ***	-0.003 ***	0.001 ***
Wealth Reference: no items	Wealth	-0.042 ***	-0.047 ***	-0.035 ***	-0.035 ***	-0.025 ***	-0.044 ***	0.004 ***	0.008 ***	-0.003 ***
Semester of birth. Reference: I semester	II semester	-0.001	0.002	-0.004 **	-0.001	0.001	-0.005 **	0.000	0.000	0.000 **
Father's educational attainment level. Reference: Illiterate and without studies	Primary	-0.010 **	-0.016 **	-0.005	-0.009 **	-0.009 *	-0.006	0.001 **	0.003 **	0.000
	Secondary	-0.065 ***	-0.084 ***	-0.043 ***	-0.053 ***	-0.043 ***	-0.054 ***	0.006 ***	0.015 ***	-0.004 ***
	Tertiary	-0.102 ***	-0.137 ***	-0.066 ***	-0.141 ***	-0.150 ***	-0.118 ***	-0.010 ***	0.004 ***	-0.022 ***
Mother's educational attainment level. Reference: Illiterate and without studies	Primary	-0.030 ***	-0.035 ***	-0.024 ***	-0.028 ***	-0.021 ***	-0.033 ***	0.002 ***	0.006 ***	-0.003 ***
	Secondary	-0.111 ***	-0.140 ***	-0.079 ***	-0.078 ***	-0.057 ***	-0.089 ***	0.012 ***	0.026 ***	-0.004 ***
	Tertiary	-0.118 ***	-0.157 ***	-0.078 ***	-0.175 ***	-0.187 ***	-0.147 ***	-0.017 ***	-0.002	-0.030 ***
Municipality size. Reference 20.000 inhabitants or less	Over 20.000 inhabitants	-0.020 ***	-0.034 ***	-0.006 ***	-0.016 ***	-0.017 ***	-0.007 ***	0.002 ***	0.006 ***	-0.001 ***

Table 4.3. Ordered probit estimation. Marginal effects by sex and educational attainment level (cont.)

		Upper secondary			Short-cycle tertiary vocational education			University		
		Total	Male	Female	Total	Male	Female	Total	Male	Female
Sex. Reference: Female	Male	-0.037 ***			-0.037 ***			-0.097 ***		
Father's professional status. Reference: Temporary salaried staff	Non applicable	0.019 ***	0.028 ***	0.008 ***	0.020 ***	0.027 ***	0.011 ***	0.053 ***	0.047 ***	0.054 ***
	Employer	0.014 ***	0.017 ***	0.007 ***	0.015 ***	0.016 ***	0.012 ***	0.040 ***	0.028 ***	0.058 ***
	Own-account workers	0.014 ***	0.015 ***	0.008 ***	0.015 ***	0.014 ***	0.014 ***	0.040 ***	0.023 ***	0.070 ***
	Permanent salaried staff	0.016 ***	0.020 ***	0.008 ***	0.015 ***	0.018 ***	0.011 ***	0.038 ***	0.029 ***	0.048 ***
Mother's professional status. Reference: Temporary salaried staff	Non applicable	0.023 ***	0.035 ***	0.008 ***	0.027 ***	0.038 ***	0.015 ***	0.081 ***	0.074 ***	0.080 ***
	Employer	0.009 ***	0.009 ***	0.005 ***	0.009 ***	0.008 ***	0.008 ***	0.023 ***	0.014 ***	0.040 ***
	Own-account workers	0.008 ***	0.010 ***	0.004 ***	0.008 ***	0.009 ***	0.006 ***	0.020 ***	0.016 ***	0.027 ***
	Permanent salaried staff	0.008 ***	0.010 ***	0.004 ***	0.008 ***	0.009 ***	0.006 ***	0.020 ***	0.015 ***	0.025 ***
	Inactive	0.006 ***	0.008 ***	0.003 ***	0.006 ***	0.007 ***	0.004 ***	0.014 ***	0.011 ***	0.018 ***
Siblings Reference: no siblings	Older	-0.014 ***	-0.014 ***	-0.010 ***	-0.014 ***	-0.012 ***	-0.013 ***	-0.033 ***	-0.019 ***	-0.058 ***
	Younger	-0.005 ***	-0.006 ***	-0.003 ***	-0.005 ***	-0.005 ***	-0.003 ***	-0.011 ***	-0.008 ***	-0.014 ***
Wealth Reference: no items	Wealth	0.017 ***	0.019 ***	0.010 ***	0.016 ***	0.017 ***	0.014 ***	0.040 ***	0.027 ***	0.058 ***
Semester of birth. Reference: I semester	II semester	0.000	-0.001	0.001 **	0.000	-0.001	0.001 **	0.001	-0.001	0.006 **
Father's educational attainment level. Reference: Illiterate and without studies	Primary	0.004 **	0.006 **	0.001	0.004 **	0.006 **	0.002	0.010 **	0.009 **	0.008
	Secondary	0.026 ***	0.034 ***	0.013 ***	0.025 ***	0.030 ***	0.017 ***	0.061 ***	0.048 ***	0.072 ***
	Tertiary	0.031 ***	0.052 ***	0.006 ***	0.047 ***	0.068 ***	0.026 ***	0.175 ***	0.164 ***	0.175 ***
Mother's educational attainment level. Reference: Illiterate and without studies	Primary	0.012 ***	0.014 ***	0.006 ***	0.012 ***	0.013 ***	0.009 ***	0.031 ***	0.022 ***	0.044 ***
	Secondary	0.044 ***	0.054 ***	0.025 ***	0.040 ***	0.046 ***	0.029 ***	0.093 ***	0.071 ***	0.118 ***
	Tertiary	0.031 ***	0.055 ***	0.001	0.055 ***	0.079 ***	0.029 ***	0.225 ***	0.212 ***	0.226 ***
Municipality size. Reference 20.000 inhabitants or less	Over 20.000 inhabitants	0.008 ***	0.014 ***	0.002 ***	0.008 ***	0.012 ***	0.002 ***	0.018 ***	0.019 ***	0.010 ***

***, **, *: significant at 1%, 5% y 10% respectively.

Source: Own elaboration based on Spanish Population and Housing Census 2011 (INE, 2013)

changing from negative to positive sign when intermediate vocational training (IVT) is reached and increasing in value as predicted levels of education rise.

Turning to level of university education, the results show that men are 9.7 percentage points less likely complete university studies than women. Any category of the parental professional status variable other than temporary contract has advantages for completing university level education. Percentages range from 4% in the case of a self-employed father to 2.3% in the case of mothers who run their own businesses, as compared to temporary contracts. Having siblings implies a reduction in the probability ranging from 3.3% if the sibling is older to 1.1% if they are younger. Residence in a municipality with a population of over 20,000 increases the probability by 1.8% over municipalities with fewer inhabitants. However, the variable with the greatest influence on children completing university is their parents' educational level. The children of a father with a university education are 17.5% more likely to complete university than those whose fathers are illiterate or have no schooling. This probability rises to 22.5% in the case of the mother.

Looking at all the levels of education in sequence clearly shows the evolution of the marginal probability effects on the control variables. With regard to gender, women have an advantage over men in their level of qualifications, while men have a differential probability of 9.5% of attaining the lowest level of education (primary). This percentage drops to 8.4% in the case of compulsory secondary education and becomes negative in the case of IVT (-0.7%). From post-compulsory secondary school upwards, women have a clear advantage over men, with percentages ranging from 3.7% at this level to 9.7% at university level.

The evolution of parental professional status is also clear: lower levels of completed education (primary and compulsory secondary) are associated with parents on temporary contracts, whereas at higher educational levels, any professional status other than employee with temporary contract is an advantage. Parents' employment instability therefore obstructs progress

along the course of young people's education. This inverse relationship between family size and the level of education children complete coincides with results of studies conducted in other countries (Rosenzweig and Wolpin, 1980; Bauer and Gang, 2001; Lee, 2008). Having siblings therefore emerges as an obstacle to completing higher levels of education, and in the case of older siblings this effect is more extreme (reduced probabilities of up to 3.5% more than young people with no siblings), whereas having younger siblings can lead to a drop in probability of 1.2%.

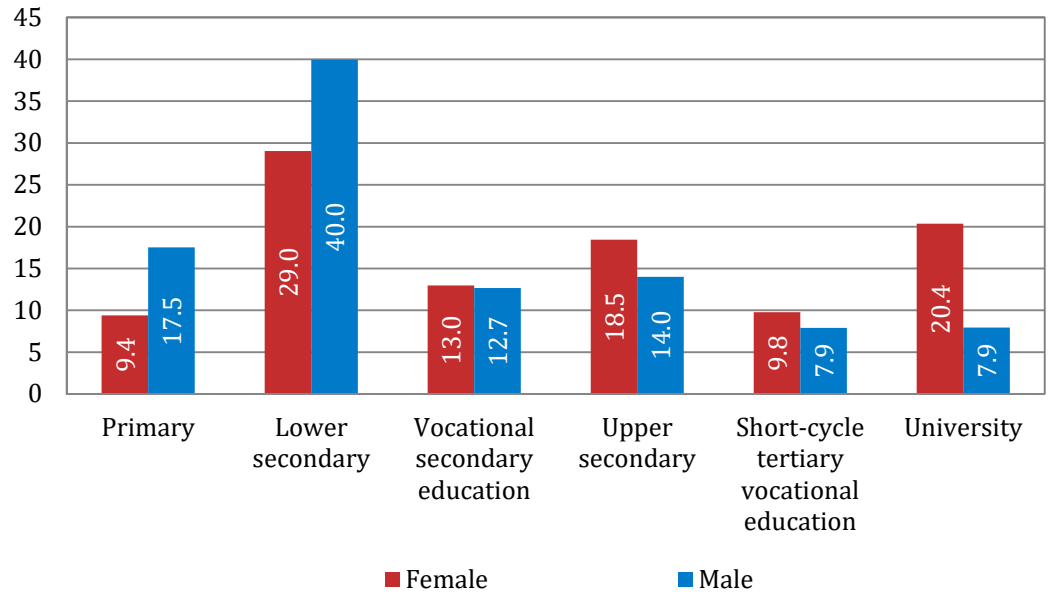
Similarly, although in the reverse direction, family purchasing power, represented by the wealth variable, facilitates young people's educational development. Thus, higher household income can imply a rise of up to 4% in the probability of completing increasingly higher levels of education. Results for place of residence follow a similar pattern: living in municipalities with populations over 20,000 can increase the probability of completing higher levels of education by 2%.

The variable parental educational level has the greatest influence, although the effect of the mothers' higher educational level is stronger than of the fathers' (Korupp *et al.*, 2002; Erola *et al.*, 2016). Hence, if the father completed primary education only, the increase in the probability of his children going on to higher levels of education will be 1% more than the baseline reference (illiterate and no studies); however, if the mother completed only primary education, this percentage increases to 3%. If the father finished secondary school, the probability that his children will complete a higher level of education rises to 6.5%, whereas the same calculation for the mother is more than 11%. Finally, a father with a higher or tertiary level of education increases his child's probability by up to 17.5%, a probability that rises to 22.5% in the case of a mother with tertiary education.

4.5. Probability distribution of levels of completed education

The probability distribution predicted by the model for the levels of completed education for men and women is presented in Figure 4.1. A comparison of the values for men and women reveals how the probability distribution for women shifts to the right, indicating that women have a greater probability of completing higher levels of education than men. The highest predicted probabilities of completed education in the case of women are for compulsory secondary education (29%), followed by university education (20.4%). Men are also most likely to reach compulsory secondary education (40%), followed by primary education (17.5%), while university education, together with IVT, register the lowest values at 7.9% of predicted probability.

Figure 4.1. Probabilities by gender and educational attainment level



Source: Own elaboration based on Spanish Population and Housing Census 2011 (INE, 2013).

Based on the predicted probabilities, and introducing some changes in the categories of the regression variables, we estimate the probability of individuals with different personal, economic and educational characteristics completing a certain level of education. Figure 4.2 displays the predicted probabilities of completing compulsory education and

university for men and women, for the variables of parental completed educational level and professional status.

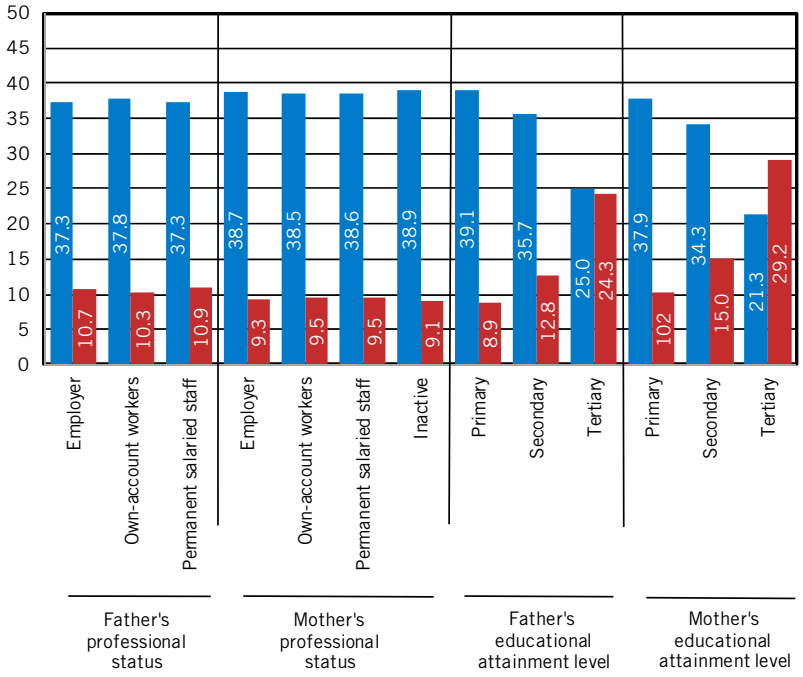
The Figure 4.2 shows a notable difference between men and women. This is because the predicted probability started with a difference of 12.5 percentage points in favour of women in the case of university education, and 11 percentage points in favour of men when compulsory secondary education is considered.

Thus, if instead of having a temporary contract the father is a self-employed business person, the probability that his child will complete university education rises to 10.7% and that the child will complete just compulsory secondary education falls to 37.3%. If this change is applied to the mother, the probability rises only to 9.3% in the case of university education and drops to 38.7% for compulsory secondary education.

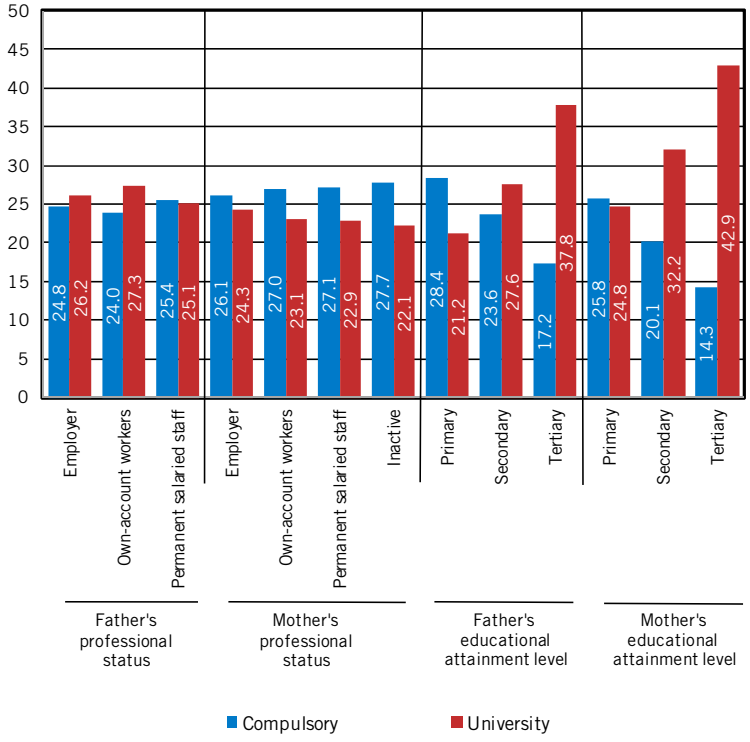
The largest differences are seen in parental levels of education: in the case of men, the probability of completing university education increases to 24.3% if the father finished tertiary education, and up to 29.2% if the mother reached that level. In the case of completing compulsory secondary education, there is a fall of around 15 percentage points in the predicted probability as the level of parents' completed education rises. In the case of women, the fall in the predicted probability of completing compulsory secondary education as parental educational level rises is lower, since they start from considerably lower values than men do with reductions of around 11%. The increase in the predicted probability associated with women completing university education if the father has tertiary studies stands at 37.8%, which although higher than the figure for men, is lower than the value of 42.9% when the mother completed tertiary education. As shown by studies based on data for liquidity constraints facing households (see Checchi *et al.*, 2013, for the Italian case and Chevalier and Lanot, 2002, for Great Britain), it would seem logical to suppose that this positive relationship between the levels of education of parents and children will be lower if the impact of liquidity constraints facing parents with lower levels of education is incorporated.

Figure 4.2. Probabilities of completing compulsory and university education by parental characteristics (Percentage)

a) Male



b) Female



Source: Own elaboration based on Spanish Population and Housing Census 2011 (INE, 2013).

4.6. Conclusions

This study has explored the influence that parental educational level and professional status have on the level of education completed by their children. Specifically, we estimated the probability of young Spaniards completing university education according to certain family characteristics. Using anonymised microdata from the Population and Housing Census 2011, a sample was selected of people under the age of 28 who were not in any type of education or training. The study presents estimations of ordered probit models in order to capture the effect of various socio-economic, environmental and cultural variables on the attainment and advancement of educational level according to gender. The variable gender turned out to be very important in the analysis. Results show that the variable parental education has the greatest impact on the advancement of children's level of completed education, and that the mother's level of completed education has a higher influence. Parents' employment instability, represented by temporary employment contracts, is one of the variables with the greatest negative effect on level of education reached by the children.

The results of the analysis on the level of education completed by Spanish young people show that, *ceteris paribus*, women are far more likely to complete university education than men are. The positive effect of the mother's level of education on the probability that her children will finish university is much greater than same effect in the case of the father. Likewise, the influence of parents' professional status on the probability that their children will finish university is lower than the influence of parental educational level, although there are important differences between the effects of the father's and the mother's professional status. We found that the positive effect of professional status on the level of education children complete is higher in the case of the father than of the mother. However, the effect of parental education is reversed: the positive effect of the mother's educational level on her children's education is higher than that of the father.

The analysis of other family characteristics show that, for example, number of siblings has a negative effect on the probability of completing university education, and that having older rather than younger siblings has a greater impact, particularly for the women in the sample. The effect of the family's wealth on the probability of completing university education is positive and, as with the previous variable, is much greater for the women in the study than the men. Finally, the size of the municipality where the family live is the variable that has the least positive impact of all those considered on the probability of young people completing university, although in this case the effect is greater for men.

The probability that children will finish university increases as the father's professional status rises to a higher level than the mother. However, in the case of parental educational level, the effect of the mother's level of education on the probability that her children will complete university is much higher than that of the father. Finally, the study estimated the probabilities of men and women completing compulsory secondary education and university according to the effects of the father's and the mother's professional status and level of education. The differences between men and women are considerable. In Spain, our estimations suggest that women are approximately 12 percentage points more likely to complete university than men are, when family characteristics backgrounds are held constant. However, the probability of men completing compulsory secondary education only is 11 percentage points higher than the probability for women.

The results of the study have some important policy implications in several fields. First, with regard to gender policies they reveal the continuing importance of women's role as mothers in the educational success of their children, highlighting that in many households the essential support children need with their schoolwork falls largely to women. Secondly, in relation to education policies, the results show that access to higher education in Spain is far from equal for everyone, and reveal that family socio-economic status or background is a determinant factor in educational success. These results therefore underline the need to design policies that

guarantee educational success regardless of gender, nuclear family size, income level or size of the municipality of residence. These policies need to be properly designed to balance information policies with scholarships; grants or tax incentives that improve the conditions of those in the worst position (larger families, with low-income levels, or who live in smaller municipalities). Only in this way can we build a society that guarantees equality of opportunity for all its citizens.

5 The contribution of higher education institutions to human capital, activity and employment in European countries

ABSTRACT: This paper attempts to analyse the contribution of Higher Education Institutions (HEIs) to the human capital, the activity and the employment of the European countries in the period 2000-2015. In particular, the paper focuses the analysis on the role played by HEIs in increasing the human capital of people and its effect on participation and employability in the labour market. To carry out the analysis, counterfactual scenarios that assume that HEIs do not exist are estimated for each European country. The main results suggest that tertiary education generated by HEIs explains about 7.2 percent of the human capital accumulation of working people, while indirectly contributes to the general European employment rate for 2.5 percentage points. The paper shows also that there are significant disparities between countries in the evolution of these impacts over the period.

5.1. Introduction

Knowledge is an indispensable factor in the development of innovation, the management of new technologies and the complex financial and commercial relations in our world today. Few doubt the role that higher education plays in this process since a high level of training by individuals is required given that the activities towards which the productive model is reoriented are the most knowledge intensive. Therefore, the Higher Education Institutions (HEIs) play a very important role since the results of their teaching activities are essential to contribute to this new stage of development of knowledge-based societies.

In such circumstances, the generation of human capital is one of the HEIs most important contributions to society because there is a positive relationship between greater education of the individual and greater labour participation, occupation and income (OECD, 2009). Therefore, the increase of the working-age population with tertiary education generated by the HEIs has a positive effect on the employment rate of the economy given that people with higher education present a greater labour participation and employability and a lower unemployment rate than the average for the total population. In others words, by educating university graduates, the HEIs indirectly increase the degree of exploitation of the human capital that they has directly generated and contributes to the increase of employment.[1]

This significant contribution made by HEIs to the employment has been measured in a range of studies that focus on the economic impact of universities on the regional economy. Most of these studies focus on quantifying the impacts in the short term by the demand side of HEIs activities in employment and the demand in local companies through their own spending as well as the spending of other agents related to university activity. However, these studies do not take into account the HEIs contributions by the supply side and in the long term that are produced by the increase in the human capital of their graduates, and those who analyse these impacts do so in the context of a regional or national economy.

This paper presents an estimation of the contribution of HEIs to the employment in 28 European countries over the period 2000-2015. For this purpose, we focus on the universities' effects on the supply side of their national economies, and we analyze the direct impact of HEIs through their educational activities on the human capital of individuals, as well as the indirect impact on activity and employment rates. To carry out the analysis, we estimated counterfactual scenarios that assume that HEIs do not exist for each European country following the methodology developed by Pastor *et al.* (2016a).

The paper is organised as follows. Section 2 briefly outlines the long-term effects of human capital generated in HEIs on the labour market. Section 3 analyses and estimates the direct contribution of HEIs to the generation of human capital and the indirect contributions to increasing activity and employment rates in European countries. The last section concludes.

5.2. The long-term socioeconomic effects of HEIs' educational activities

The generation of human capital is one of the most important contributions of the HEIs' teaching activities. The analysis of the relationship between higher education and economic development confirms that HEIs play a central role in national economies (Lane and Johnstone, 2012) through the positive effects of greater education of the individual on activity, occupation and income. For example, all studies of the impacts of HEIs on regional development find evidence that employment growth rates are higher in regions with many and good HEIs (Lendel, 2010).

In a recent study, Valero and Van Reenen (2016) analyse data on almost 15,000 universities in 78 countries for the period 1950-2010 and find that there is a strong positive impact of HEIs expansion on regional economic growth. They show that the more important quantitative part of this effect is due to the fact that HEIs are producers of human capital and innovation that promote the growth. The studies of Gennaioli *et al.* (2012 y 2013) show the importance of human capital in accounting for regional differences in

activity, employment and economic development. Multiple studies (Belenzon and Schankerman, 2013; Toivanen and Väänänen, 2016; Acemoglu *et al.*, 2016) show from other perspectives and approaches the positive effect of the increase of years of education on activity, employment and income, in short, on the economic growth of countries.

Most studies on the economic impact of the HEIs use different methodologies to estimate the direct and indirect effects of the HEIs' activities on their national economies. There are short-term demand-side economic impact studies (Siegfried *et al.*, 2007) that analyse the effects of HEIs' spending, investment and employment on income and occupation in the economy of their countries. Nevertheless, the short-term effects of HEIs' activities by the demand side do not address the major contributions of HEIs, their direct contributions to the supply of human and technological capital and the spillover effects of the activity of these institutions. On the contrary, other studies take into account the HEIs' long-term socioeconomic contributions via the supply side of their regional economies.

In these studies on the long-term contributions of HEIs, we can distinguish between two types of approaches. Studies on the direct impact of HEIs by the supply side (Drucker and Goldstein, 2007), which analyse the role of HEIs as incubators of technological innovation and quantify their contribution to the creation of human and technological capital through their teaching, research and transfer activities and their subsequent economic effects. The contribution of HEIs is established in terms of the increase in the level of studies, technological capital, wage returns, increases in activity and employment rates or their contribution to economic growth. Studies on the economic and social spillover effects of HEIs (McMahon, 2009; Pastor *et al.,* 2016a), which review the non-quantifiable private and social benefits directly associated with university activity (quality of life, health, respect for the environment, child rearing, social capital, gender equality, etc.). Of course, all these impacts of higher education represent social and private non-monetary benefits that are difficult to quantify.

Whatever the approach adopted in these studies, the regularity observed confirms that HEIs have a role to play in local and regional development. The variables that are most used in studies to highlight the contribution of HEIs to their environment are human capital and research. In our study, we focus on HEIs' teaching activities, and we estimate the direct and indirect effects of their production of human capital on the employment rate of their national economies. The HEIs produces university graduates and increase the available human capital of their countries (the education level of their working-age populations). It therefore generates positive impacts on activity rate because HEI graduates present higher labour participation that the average for the total population. Similarly, the HEI graduates present greater employability in the labour market than the average of total population. Therefore, the HEIs educational activities increase the employment rate in their countries.[2]

5.3. The contributions of HEIs through the generation of human capital

The generation of human capital through teaching is one of the most direct and visible contributions of HEIs. In addition to the intellectual enrichment of the graduates, their greater human capital increases their employability, their participation in the labour market, their functional and geographical mobility and their productivity, having a positive impact on the labour activity, on the employment, and the economic growth. This section quantifies the contributions of HEIs in European countries generated directly through their teaching activities. Specifically, the contribution of HEIs to the increase in the population's human capital of each of the 28 European countries is estimated, as well as the indirect contribution of this increase in the rates of activity and employment that this human capital produces.

The quantitative estimation of the human capital of individuals, and by extension, of a society as a whole, is a complicated task in that human capital includes diverse aspects such as acquired knowledge, mental and

physical capacity and work experience. If it is accepted that the ultimate goal of education is to acquire knowledge and skills, it is reasonable to assume that human capital increases as students complete educational levels. This is why most of the human capital measures used in studies are based on formal and regulated education statistics. Thus, it is common practice to approximate human capital using the level of studies completed by the individuals. Similarly, when we want to estimate the human capital of the population of a country, it is done through the percentages of population in each of the educational levels or through the synthetic indicator of the population's average years of study.

5.4. Direct contribution of HEIs to the human capital

If the average years of study of a country's population is taken as an indicator of their human capital, the contribution of HEIs can be quantified by the increase of this indicator that is a direct consequence of the teaching activities of HEIs. In our paper, the contribution of HEIs is calculated based on the difference between the average years of study of the population in each country and the average years of the counterfactual study, that is, those that the population of each country would have in the case of HEIs not having formed any graduate. Therefore, the HEIs' effects on human capital are estimated using a hypothetical situation in which the HEIs do not exist. In the use of this counterfactual scenario, it should be noted that all other factors remain constant. The procedure is to restrict the study to analysing this single explanatory variable (human capital) and to quantify the contribution of the HEIs by comparing the real situation with another hypothetical situation in which the HEIs do not exist, and maintaining everything else constant.

Fearon (1996), in a study about counterfactuals and hypothesis testing in political and social science, says that propositions, like the one in this paper, "If there were no Higher Education Institutions in European countries", play a necessary and fundamental role in the efforts of political scientists to assess their hypotheses about the causes of the phenomena they study. In

this paper we follow the strategy proposed by Fearon based on counterfactual scenarios that is an extensively technique used in the social sciences to analyse diverse topics and are applied in a wide range of fields where real experiments cannot be performed. Thus, we measure the impacts of the HEIs in increasing the human capital of people and its effect on participation and employability in the labour market by comparing the real situation with another hypothetical situation in which the HEIs do not exist, and maintaining everything else constant.

Equation 5.1 calculates the average years of study of the population in country *r* (AYS_r) by computing the quotient between the years of study of the population as a whole and the number of individuals, according to the following expression:

$$AYS_r = \frac{\sum_i YS^i POP_r^i}{\sum_i POP_r^i} \quad , \tag{5.1}$$

where YS_i are the years of study required to complete the level of studies *i* and POP^i_r is the number of individuals of country *r* who have completed the level of studies *i*. Following this procedure (Pastor and Peraita, 2016), the series of years of the counterfactual study (those that the population of a country would have if their HEIs had not trained any graduates) are calculated considering that if HEIs did not exist, their graduates would have reached the level of studies before university (post-compulsory secondary studies).

Table 5.1 shows the evolution of the actual years of study along with the counterfactual years of the working-age population in European countries during the period 2000-2015. Over the analysed period, the average years of study of the working age population in the European countries have increased by 11.5%. The value of this indicator in 2015 was 11.2 years, compared to 10.0 years in 2000. However, without the contribution of HEIs, the average years of study would have been 10.4 in 2015, and therefore the human capital directly generated by HEIs represents 0.8 years per person of working age. That is, HEIs are responsible for 7.2% of the human capital endowments of the European countries' working age

population. The Table 5.1 also shows the evolution of the actual years of study and the counterfactual ones of the European active population over the period 2000-2015. Over the analysed period, the average years of study of the active population in the 28 European countries have increased by 10.9%. The European active population had 11.9 average years of study in 2015, compared to 10.7 years in 2000. In 2015, without the contribution of HEIs, the active population would have had 10.9 years of study. This means that the human capital directly generated by HEIs amounts to one year per active person. In other words, HEIs are responsible for the human capital per capita being 8.8% higher in the European countries.

Table 5.1. Mean years of schooling. Real and counterfactual. 2000-2015. European Union-28

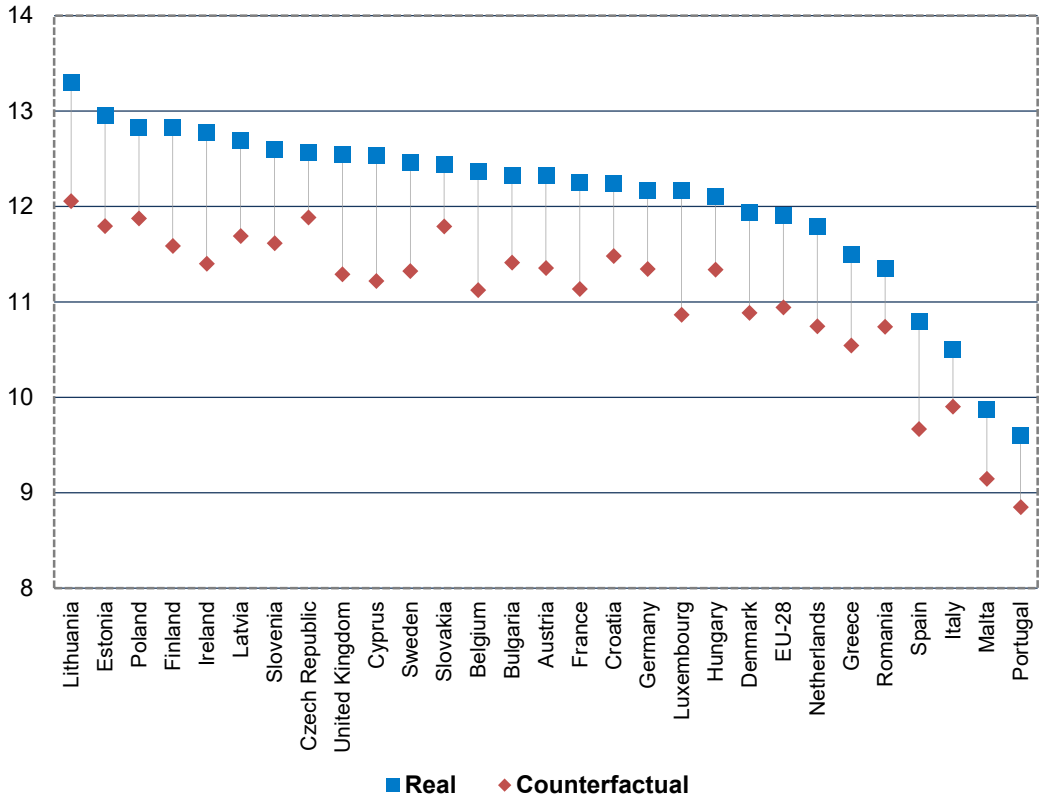
	Real	Counterfactual	Real	Counterfactual
	Working age population (aged 15-64)		Active population (aged 15-64)	
2000	10.03	9.52	10.73	10.10
2001	10.02	9.51	10.78	10.14
2002	10.08	9.56	10.85	10.20
2003	10.17	9.63	10.92	10.24
2004	10.29	9.72	11.04	10.33
2005	10.39	9.81	11.14	10.41
2006	10.45	9.85	11.19	10.45
2007	10.52	9.90	11.25	10.49
2008	10.60	9.96	11.32	10.54
2009	10.67	10.01	11.40	10.60
2010	10.76	10.07	11.49	10.65
2011	10.87	10.16	11.57	10.71
2012	10.96	10.23	11.66	10.77
2013	11.06	10.30	11.76	10.84
2014	11.11	10.33	11.83	10.90
2015	11.18	10.38	11.91	10.94

Source: Eurostat and own elaboration

Figure 5.1 presents a country-by-country analysis of the actual years of study along with the counterfactual years of the active population in European countries in 2015, and reveals that human capital generated by HEIs is considerable in countries such as Malta (36.5% of cumulative growth), Portugal (33.2%), and Ireland (21.4%). The greatest differences

between real and counterfactual years of schooling are in Ireland, Spain, Luxembourg, Cyprus and the United Kingdom, where contributions of HEIs to the generation of human capital are responsible for increases of more than 11%. On the contrary, the lowest contributions are in Romania, Czech Republic, Italy and Slovakia where they do not reach 6 % of the total human capital.

Figure 5.1. Mean years of schooling. Real and counterfactual. 2015. European Union-28



Source: Eurostat and own elaboration.

5.5. Contribution of HEIs to the activity rate

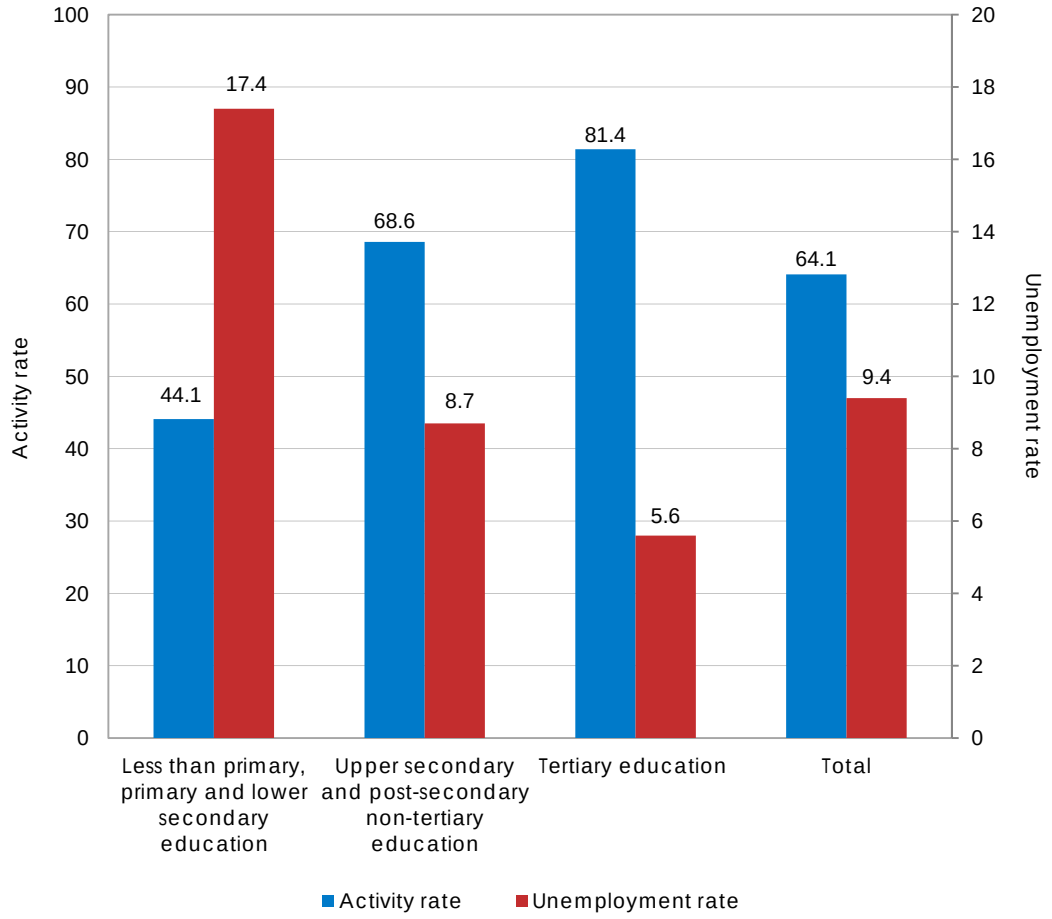
The human capital of the population only have effects on economic growth of countries when is used for productive purposes. It is necessary for individuals to show their willingness to participate in the labour market and to find employment. Therefore, a distinction should be made between potentially available human capital (that of the working age population), the human capital actually available (that of the working population) and the human capital actually employed (that of the employed population). Empirical evidence shows that individuals with higher educational levels have higher activity rates, regardless of other factors such as age, sex or nationality. This greater willingness to participate in the labour market on the part of individuals with more human capital occurs because the opportunity cost in terms of income lost from their inactivity is higher than that of individuals with lower levels of study. Consequently, the greater the available human capital of individuals in a society, the greater the human capital actually available to society, given that, ceteris paribus, society will have more active people and, in turn, each of them will have more human capital.

The previous section showed the important direct contribution of the HEIs to the human capital endowments of European countries. Accordingly, the HEIs indirectly contribute to increasing activity rates in their countries through the higher activity rate of the graduates they train. This section focus quantifies the indirect contribution of human capital generated by HEIs to the activity rates of European countries.

The Figure 5.2 shows the activity rates by study levels in 2015, and allows us to observe the significant differences in activity rates between the various levels of educational attainment[3] and, above all, that the higher the educational level of an individual, the greater their activity rate is. The activity rate of the European population as a whole was 64.1%, compared with 81.4% for individuals with tertiary education. On the contrary, the activity rates of people with less than primary, primary and lower secondary education were 44.1%, 37.3 percentage points lower than individuals with

tertiary education. The above figures show that individuals with a higher level of education participate to a greater degree in the labour market, and we can conclude that through the generation of human capital HEIs contribute indirectly to the increase in the activity rate of European countries.

Figure 5.2. Activity and unemployment rate by educational attainment level. European Union-28. 2015 (Percentage)



Source: Eurostat and own elaboration.

We have calculated the contribution of the HEIs to the increase in the activity rate by the estimation of a counterfactual activity rate, a rate in which the positive impact on the activity rate of having a university degree is deducted. The difference between the counterfactual and real activity rates in each country gives us a measure of the contribution HEIs make to the increase in the activity rate. We postulate a model of labour

participation that includes the maximum level of education attained as a determinant. It also includes other variables related to personal characteristics that are important for this choice. Then, probit model of the probability of participation in 2014 are estimated for the European countries as a whole, as well as for each individual country, as:

$$\mathrm{ACT_{ijt}} = \beta_0 + \gamma_x \mathrm{X_{ijt}} + \varepsilon_{ijt}\ , \qquad (5.2)$$

where ACT_{ijt} is 1 if the individual i is active in period t and 0 otherwise; X_{ijt} is a vector of personal and family characteristics and ε_{ijt} is an error term. The vector of personal and family characteristics includes gender, nationality, age, and maximum level of educational attainment (as dummy variables). Data come from the EU-LFS microdata obtained from Eurostat, and the sample refers to people of working age and includes all former European Union-28 countries.

Table 5.2. Probit of the probability of activity. European Union-28. 2014

	Coefficient	Marginal effects
Female	-0.394***	-0.104
Foreigner	-0.039***	-0.010
Upper secondary education	0.582***	0.154
Tertiary education	0.896***	0.236
Age 25-34	1.051***	0.277
Age 35-44	1.243***	0.328
Age 45-54	1.160***	0.306
Age 55 and higher	-0.454***	-0.120
Constant	-0.376***	
Number of observations	3,470,079	
Log pseudolikelihood	-199,636	
Pseudo R^2	0.308	

*** Significant at 1%. The individual reference is a male between 16 and 24 years old, national, with lower secondary education (compulsory education. ISCED 2) as maximum.
Source: Eurostat and own elaboration.

Table 5.2 shows the results of the probit model of the probability of participation in the labour market and the estimated marginal effects by education levels and for all European countries as a whole (see Table A.5.1 of the Appendix with data for each European country). Females have,

ceteris paribus, a lower probability of participation than males, as do foreigners compared to nationals, and the age shows an inverted-U pattern characterized by lower probability for the younger and, especially, older people. The dummies for upper secondary and tertiary education capture the effect of post-compulsory education. Both dummies are significant, indicating a positive effect on the participation in the labour market. People with upper secondary education have 15.4 percentage points more probability of being active than those with only compulsory schooling or less. Tertiary education has an additional positive effect. The probability of an individual with higher education being active is 23.6 percentage points higher than in the case of someone with only compulsory education.

Especially important for our aims, tertiary education has an additional positive effect compared to upper secondary education in all countries. That is, in the European countries as a whole, maintaining certain personal characteristics, those individuals with tertiary education are 8.3 percentage points more likely to be active than those with upper secondary education.

The first two columns in the Table 5.3 show the evolution of the real activity rate along with the counterfactual activity rate in European countries during the period 2000-2015. The counterfactual activity rate would be the activity rate if HEIs had not trained any university students and, consequently, their graduates would have the same probability of being active as individuals with the immediately preceding level of education. The figures of Table 5.3 allow us to observe that the greater probability of university graduates being active has a positive impact on the activity rate of countries. The European countries' activity rate in 2015 was 72.8%. If HEIs had not trained any university students, the activity rate would have been 70.8% (counterfactual activity rate). Consequently, HEIs contribute by two percentage points to the increase in the European countries' activity rate, i.e. without the training of HEIs then the activity rate would be 2.8% lower. The contribution of HEIs to the increase in the activity rate, represented by the difference between the two rates is growing along time in European countries as a whole, and this circumstance is associated with

the increase of the population with university studies in the European countries during the period analysed.

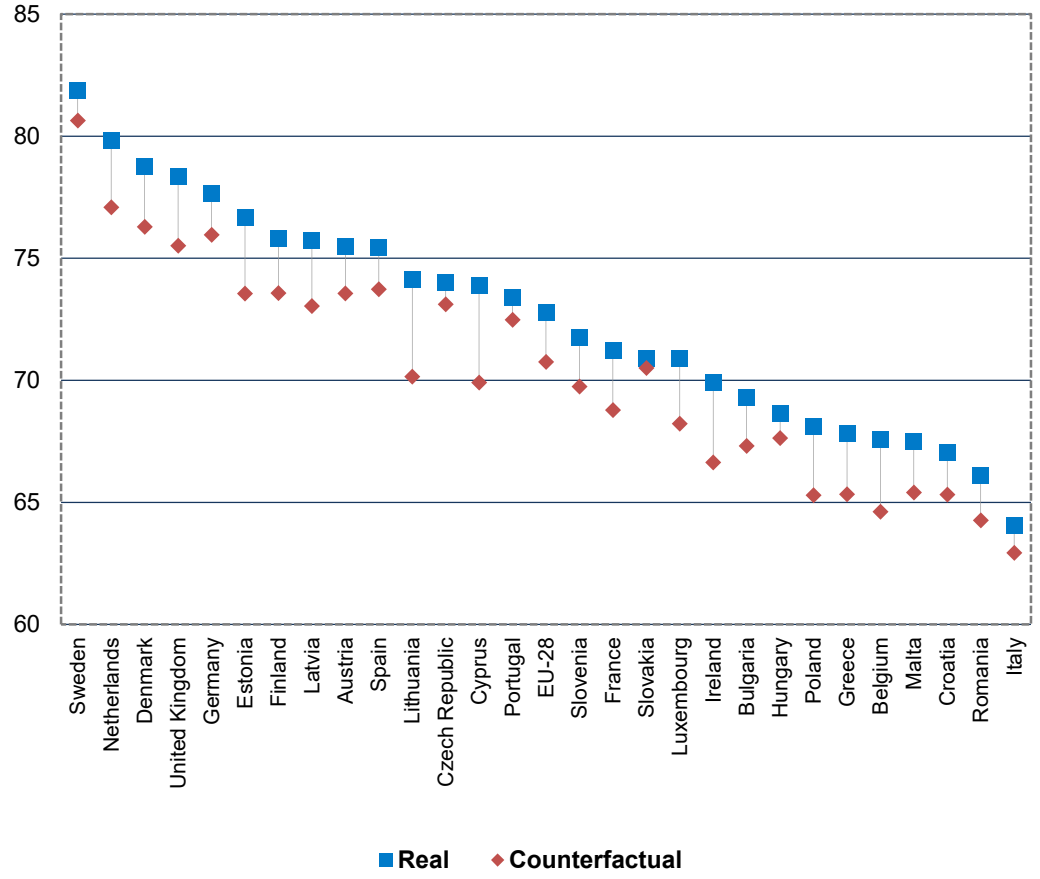
This greater probability of university graduates being active has a positive impact on the activity rate of each of the European countries as is showed in the Figure 5.3. Thus, this figure shows the activity rate and the counterfactual rate, which would be the case if HEIs had not trained any university students and, consequently, their graduates would have the same probability of being active as individuals with the immediately preceding level of education. The Figure 5.3 shows that the contribution of HEIs to the increase in the activity rate, represented by the difference between the two rates is growing in most countries over the analysed period. In some countries, the contribution is very significant such as Lithuania, where the activity rate would be 5.4% lower than the current one, as well as Cyprus (5.4%), followed by Ireland (4.7%) and Belgium (4.4%).

Table 5.3. Higher education contribution to activity and employment rates. Real and counterfactual. 2000-2015. European Union-28

	Real	Counterfactual	Real	Counterfactual
	Activity rate		Employment rate	
2000	69.80	68.52	63.21	61.64
2001	69.01	67.72	62.94	61.37
2002	69.12	67.81	62.81	61.22
2003	69.43	68.06	63.08	61.40
2004	69.75	68.32	63.26	61.51
2005	70.19	68.71	63.86	62.05
2006	70.61	69.09	64.78	62.91
2007	70.84	69.29	65.73	63.82
2008	70.98	69.37	65.97	64.00
2009	71.08	69.41	64.68	62.63
2010	71.23	69.50	64.34	62.22
2011	71.63	69.84	64.66	62.45
2012	72.22	70.35	64.58	62.29
2013	72.53	70.60	64.56	62.19
2014	72.55	70.58	65.02	62.60
2015	72.78	70.76	65.83	63.34

Source: Eurostat and own elaboration.

Figure. 5.3. Higher education contribution to activity rate. 2015



Source: Eurostat and own elaboration.

5.6. Contribution of HEIs to the employment rate

This chapter has emphasized in the importance of distinguishing between the human capital which is potentially available on the part of society (that of the working-age population), the human capital actually available (that of the active population), and the human capital actually used (that of the employed population). In fact, not only do societies need to increase the educational levels of the population (increase the human capital potentially available), but also a large share of this should become available in the labour market through high activity rates which mean that most of the potentially available human capital is effectively available. Furthermore,

the largest share of it is not untapped from an economic point of view by being linked to unemployed people through low unemployment rates.

The previous section showed that human capital has a positive effect on the activity rate. Nevertheless, this is not the whole story. One of the reasons higher education fosters participation is that it increases employability in the labour market. It is expected that people with higher education increase their productivity and, therefore, higher education should lead to a greater likelihood of being employed for those who choose to participate in the labour market. This section demonstrates that human capital also has a reducing effect on the unemployment rate. In fact, university students have acquired specific skills that make them more productive in the short term and generic competences that give them greater functional mobility, enabling them to adapt more easily to changes in the productive process or in the functional organization chart of companies, as well as greater geographical mobility. In these circumstances, better-trained individuals are more attractive and employable for companies and thus HEIs indirectly contribute to reducing unemployment rates in European countries through the lower unemployment rate of the graduates they generate. This section quantifies the indirect contribution of human capital generated by HEIs to employment rates in the labour markets of the European countries.

The previous Figure 5.2 also showed the unemployment rates by levels of study in 2015, and allows us to see differences in the unemployment rates between the various levels of education and above all, that the higher the educational level, the lower the unemployment rate. The unemployment rates of individuals with tertiary education in 2015 were 5.6% compared with 9.4% of the general unemployment rate or 17.4% of those with compulsory education as maximum. That is, the unemployment rate of individuals with tertiary education is 11.8 percentage points lower than those with compulsory education and 3.8 percentage points lower than the general unemployment rate. Although not shown in the Figure 5.2, it is interesting to note that this higher relative employability of university students compared to groups with lower educational levels is more intense in countries such as Slovakia, where the unemployment rate of university

students is 31.6 percentage points lower than that of people with less than primary, primary and lower secondary education. Similar results are obtained for Lithuania (22.6 percentage points) and Bulgaria (21.1 percentage points). However, in countries such as Romania, Portugal and Denmark the unemployment rate of university students is only 4-5 percentage points lower than people with compulsory education or less.

To calculate the contribution of HEIs to the increase in the employment rate, we shall proceed as in the previous section for activity rates, constructing counterfactual scenarios. Specifically, a counterfactual employment rate will be computed, which reflects the effect of having a university degree on the probability of being employed. The difference between the real employment rate and the counterfactual one will reflect the contribution of HEIs to the increase in the employment rate. To estimate the total effect on employment rates, probits of the probability of employment for the entire working age population are estimated for the EU-28 as a whole as well as for each individual country as:

$$\mathrm{EMP}_{ijt} = \beta_0 + \gamma_x \mathrm{X}_{ijt} + \varepsilon_{ijt} \qquad (5.3)$$

where EMP_{ijt} is 1 if the individual i is employed in period t and 0 otherwise; X_{ijt} is a vector of personal and family characteristics, and ε_{ijt} is an error term. The vector of personal and family characteristics again includes gender, nationality, age and the maximum level of educational attainment. These explanatory variables are defined as dummies. All data come from the EU-LFS microdata obtained from Eurostat. The sample refers to all working age individuals in 2014 and includes all European Union-28 countries. The reference individual is a male, national, aged between 15 and 24 and with lower secondary as the maximum level of educational attainment.

Table 5.4 shows the complete results of each variable on the probability of employment for the European countries as a whole (see Table A.5.1 of the Appendix with data for each European country). The marginal effects should be always interpreted as the differential effects with respect to the

reference individual. Thus, females have, ceteris paribus, a lower probability of employment (9 percentage points less than males), as do foreigners (4 percentage points less than nationals). The age dummies are highly significant showing again an inverted-U pattern, with a lower probability for older and younger people. The total effect of educational attainment on the likelihood of being employed is both significant and positive. In comparison with someone with lower secondary education as the maximum level attained, the probability of employment is, ceteris paribus, 17.7 percentage points higher for individuals with upper secondary and 27 percentage points higher for those with tertiary education. It should be highlighted that both effects are higher than those previously estimated for the probability of participation (15.4 percentage points and 23.6 percentage points respectively). Therefore, tertiary education again has an additional positive effect compared to upper secondary education (9.4 percentage points). In this case, the effect is higher than the one obtained previously for the participation choice (8.3 percentage points).

In summary, estimates indicate that, maintaining certain characteristics such as sex, age and nationality, an individual with tertiary education is 9.3 percentage points more likely to be employed than one with upper secondary education. This higher probability of HEI graduates being employed has a positive impact on the employment rate in the EU. The previous Table 5.3 shows now the evolution of the real employment rate along with the counterfactual employment rate in European countries during the period 2000-2015. As with the activity rate, it is observed that the contribution of HEIs to the increase in the employment rate, represented by the difference between the two rates, is growing. Table 5.3 shows that the employment rate in the EU in 2015 was 65.8% whereas without the contribution of HEIs the rate would have been 63.3%.

Table 5.4. Probit of the probability of employment. European Union-28. 2014

	Coefficient	Marginal effects
Female	-0.327***	-0.095
Foreigner	-0.135***	-0.039
Upper secondary education	0.610***	0.177
Tertiary education	0.934***	0.270
Age 25-34	0.923***	0.267
Age 35-44	1.156***	0.335
Age 45-54	1.149***	0.333
Age 55 and higher	-0.259***	-0.075
Constant	-0.681***	
Number of observations	3,470,079	
Log pseudolikelihood	-217,870	
Pseudo R^2	0.257	

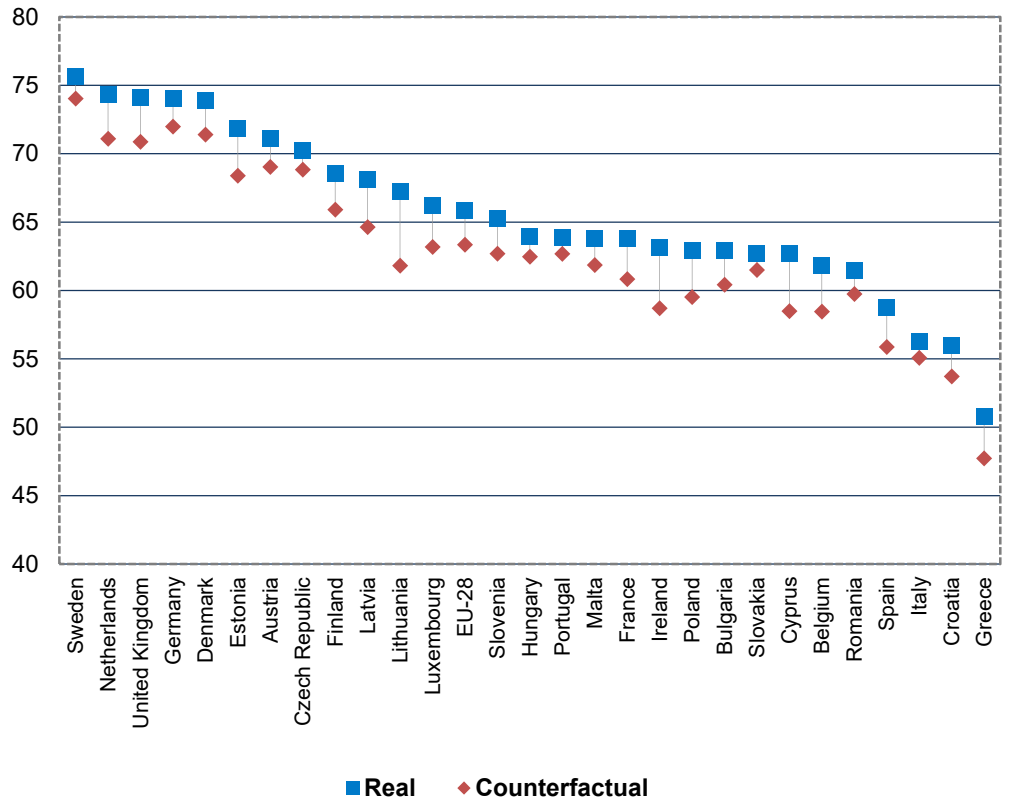
*** Significant at 1%. The individual reference is a male between 16 and 24 years old, national, with lower secondary education (compulsory education, ISCED 2) as maximum.

Source: Eurostat and own elaboration.

Figure 5.4 presents the higher education contribution to employment rate for each of the European countries analysed (see Table A.5.2 of the Appendix with data for each European country). In all European countries, post-compulsory education has a positive and significant effect. Ceteris paribus, people with upper secondary education have more probability of being employed than people with only compulsory schooling or less. This effect varies from 6.7 percentage points in Greece to 29.9 percentage points in Lithuania. The probability of an individual with tertiary education being employed is even higher. The range of estimated values for the differential effect compared to someone with only compulsory education goes from 17.2 percentage points in Luxembourg to 46.2 percentage points in Lithuania. In fact, tertiary education has an additional positive effect compared to upper secondary education in all countries. Furthermore, it should be stressed that the difference between tertiary and upper secondary is greater than the one previously obtained for only participation except in Malta and Romania. Nevertheless, this differential effect between tertiary and upper secondary education is quite heterogeneous, in that it is lower in countries such as Sweden (4.8 percentage points), Portugal (6 percentage

points) and Slovakia (6.6 percentage points), and higher in other countries such as Lithuania (16 percentage points) and Poland (14 percentage points).

Figure 5.4. Higher education contribution to employment rate. 2015



Source: Eurostat and own elaboration.

The evidence shows that HEIs have not only contributed significantly to the increase in human capital in European countries, but also to their degree of availability and use through direct and indirect contributions. As we have shown in this analysis, the *direct contribution* of HEIs increases the available human capital of the population of their countries. Estimates indicate that HEIs in the European countries are directly responsible for 7.2% of the human capital endowments of the European countries working age. Further, the *indirect contribution* of HEIs increases the human capital effectively available in their countries through the willingness of their graduates to participate in the labour market.[4] Estimates indicate that HEIs

contribute 2 percentage points to the increase in the European Union-28 activity rate, i.e., without the training activity of HEIs, the activity rate would be 2.8% lower. Furthermore, HEIs contribute to increasing the use of human capital in their countries through the greater employability of their graduates. Estimates indicate that HEIs contribute 2.5 percentage points to the increase in the European Union-28 employment rate, i.e. without HEIs the employment rate would be 3.8% lower.

5.7. Conclusions

Higher Education Institutions make a significant contribution to the socioeconomic development of European countries. This study has reviewed and quantified some of the most relevant economic contributions by the supply side of HEIs. With this objective, exercises have been designed to quantify the direct contribution to the increase of human capital of people, as well as the indirect contributions to increasing the participation and employability in the labour market of the European countries

HEIs train part of the population and this activity means their human capital endowments and productive capacities increase, which results in the higher employability of these graduates. These positive microeconomic effects for individuals tend to drive aggregate employment rates. The activity of HEIs fosters participation in the labour market, thus increasing the activity rate and due to higher employability, reducing the risk of unemployment and unemployment rates. The result is an increase in employment rates, with a greater proportion of working-age people employed in the economies of the European countries.

This work has attempted to estimate the positive effects of higher education on the employment rates for the 28 countries belonging to the European Union, covering the period 2000-2015. For this objective, a counterfactual scenario was estimated in which HEIs did not exist. In this alternative scenario without the human capital generated by HEIs, higher education

graduates are assigned a level of human capital, participation in the labour market and employability like individuals of similar characteristics with post-compulsory studies. The imputation is based on the results of specific probit models for the probability of being active and for the probability of employment for each country using EU-LFS anonymized microdata. The impact of higher education is obtained by comparing it with the counterfactual scenario in terms of differences in human capital used in labour markets of European countries.

The estimates obtained highlight the relevance of the economic effects of higher education on the employment in European countries. The main results indicates that HEIs are directly responsible for 7.2% of the human capital endowments of the working population age over the period 2000-2015, that HEIs contribute by two percentage points to the increase in the European countries' activity rate, and have an indirect contribution of 2.5 percentage points to the general European employment rate. That is to say, without the training of HEIs then the employment rate would be 3.8% lower. Furthermore, our study shows that there are significant disparities between European countries in these contributions of HEIs over the period, revealing the importance of higher education to understand differences in the evolution of national employment rates.

APPENDIX:

Table A.5.1. Probits of the probabilities of activity and employment. Educational level marginal effects. 2014

	Activity		Employment		Number of observations
	Upper secondary education	Tertiary education	Upper secondary education	Tertiary education	
European Union-28	**0.154*** **	**0.236*** **	**0.177*** **	**0.270*** **	**3,470,079**
Belgium	0.141***	0.232***	0.156***	0.259***	83,686
Bulgaria	0.208***	0.291***	0.244***	0.348***	30,248
Czech Republic	0.213***	0.259***	0.246***	0.317***	36,045
Denmark	0.138***	0.219***	0.145***	0.227***	94,774
Germany	0.170***	0.242***	0.187***	0.272***	418,027
Estonia	0.268***	0.362***	0.282***	0.386***	19,965
Ireland	0.181***	0.269***	0.182***	0.301***	161,595
Greece	0.072***	0.169***	0.067***	0.187***	209,372
Spain	0.098***	0.152***	0.133***	0.222***	90,555
France	0.139***	0.219***	0.149***	0.247***	69,019
Croatia	0.169***	0.257***	0.178***	0.294***	32,403
Italy	0.178***	0.249***	0.188***	0.267***	525,335
Cyprus	0.123***	0.232***	0.122***	0.237***	34,241
Latvia	0.262***	0.357***	0.287***	0.410***	36,318
Lithuania	0.271***	0.391***	0.299***	0.462***	52,043
Luxembourg	0.080***	0.155***	0.085***	0.172***	11,358
Hungary	0.200***	0.248***	0.220***	0.291***	219,283
Malta	0.144***	0.259***	0.173***	0.282***	21,947
Netherlands	0.126***	0.216***	0.137***	0.243***	61,613
Austria	0.119***	0.188***	0.137***	0.211***	152,193
Poland	0.229***	0.344***	0.237***	0.377***	297,450
Portugal	0.121***	0.165***	0.117***	0.176***	144,727
Romania	0.105***	0.226***	0.098***	0.211***	207,391
Slovenia	0.088***	0.164***	0.101***	0.196***	54,237
Slovakia	0.223***	0.244***	0.291***	0.357***	85,029
Finland	0.205***	0.268***	0.216***	0.290***	23,934
Sweden	0.170***	0.207***	0.197***	0.246***	227,392
United Kingdom	0.207***	0.282***	0.220***	0.306***	69,899

*** Significant at 1%. The individual reference is a male between 16 and 24 years old, national, with lower secondary education (compulsory education, ISCED 2) as maximum.

Source: Eurostat and own elaboration.

Table A.5.2. Higher education contribution to employment rates. 2015

	Real	Counterfactual	Difference
European Union-28	**65.83**	**63.34**	**2.48**
Belgium	61.80	58.45	3.35
Bulgaria	62.91	60.41	2.50
Czech Republic	70.23	68.83	1.40
Denmark	73.91	71.40	2.51
Germany	74.00	71.97	2.03
Estonia	71.86	68.39	3.47
Ireland	63.16	58.69	4.47
Greece	50.78	47.72	3.06
Spain	58.72	55.87	2.85
France	63.82	60.82	2.99
Croatia	55.98	53.71	2.27
Italy	56.29	55.07	1.22
Cyprus	62.67	58.48	4.19
Latvia	68.08	64.62	3.46
Lithuania	67.23	61.81	5.42
Luxembourg	66.22	63.18	3.04
Hungary	63.94	62.47	1.48
Malta	63.83	61.85	1.97
Netherlands	74.31	71.08	3.23
Austria	71.11	69.03	2.07
Poland	62.92	59.51	3.41
Portugal	63.90	62.67	1.23
Romania	61.44	59.73	1.71
Slovenia	65.22	62.68	2.54
Slovakia	62.73	61.49	1.24
Finland	68.54	65.90	2.64
Sweden	75.67	74.03	1.65
United Kingdom	74.09	70.86	3.23

Source: Eurostat and own elaboration.

NOTES:

[1] Of course, there is also an effect of income. The greater human capital and productivity of university graduates is remunerated by firms with higher salaries than those for average workers, which in addition increase more throughout their working life than those of workers without a university education (Pastor and Peraita, 2016).

[2] Brown and Heaney (1997) consider that the economic impact of HEIs is overestimated by not taking into account the potential effects of migration on the localization of human resources. In fact, since university graduates are more geographically mobile, if the environment is not favourable to employment and working conditions in general, they are less likely to reside in the community and, therefore, to contribute to the HEIs environment.

[3] The proxy used to control for tertiary education level is the number of years of education acquired, without considering the field of study because this information is not available in the data. We are aware that taking into account the field of study is relevant since evidence suggest that the effects of higher education on labour market participation, employability and earnings are different among the different fields of study (for example, those effects are greater for STEM degrees).

[4] We could also speak of an additional induced contribution. Several studies indicate that the income and level of education of the parents are two relevant variables in the decisions of their children to follow university studies (Tejedor, 2003; Rahona, 2009). The higher level of education and income of a generation induces greater investments in human capital through its positive effect on the decisions of later generations regarding university studies. Since HEIs increase the level of education and income of their graduates, additional increases in human capital are likely in the future and, therefore, higher rates of future activity. It should be noted that neither this type of induced effects (intergenerational) on human capital nor the positive influence on academic performance and school failure induced by human capital generated by HEIs are considered in this paper.

6 Higher education institutions, economic growth and GDP per capita in the European countries*

ABSTRACT: This chapter presents an estimation of the contribution of Higher Education Institutions (HEIs) to economic growth and the Gross Domestic Product per capita of the European countries over the period 2000-2015. For this purpose, we analyse the universities' effects on the supply side of their national economies, especially the contribution of the R&D of HEIs to technological capital of the European countries. We proposed a methodology of counterfactual scenarios, which assume a hypothetical situation in which HEIs do not exist, to estimating the effects of HEIs, applying techniques of growth accounting. The results obtained indicate that these effects are a significant source of growth in European countries, contributing to mitigating the adverse effects of the periods of crisis. The estimates show that GDP per capita would currently be more than 11% higher than that corresponding to a scenario without HEIs. The results obtained also show significate differences in GDP per capita between European countries associated with the activity of HEIs.

* A version of this chapter is published in Soler *et al.* (2018)

6.1. Introduction

Globalization and the recent economic crisis have made it clear that there is a need not only to increase levels of company competitiveness, but also to the reorientation of the productive specialization of economies towards activities that generate more value added. Knowledge is a crucial factor nowadays in the development of innovation, the management of new technologies and the complex financial and commercial relations. Therefore, higher education plays a relevant role since all knowledge-intensive production activities require highly qualified workers.

In this new stage of socioeconomic development in which the knowledge-based societies are immersed, the role of Higher Education Institutions (HEIs) is very important because the results of their teaching, research and transfer activities are essential in this global process. The awareness of the contributions made by HEIs has led to studies where their impacts to economic and social development are measured. Nevertheless, most of these studies focus on quantifying the impacts in the short term by the demand side of HEIs activities in employment and the demand in local companies through their own spending as well as the spending of other agents related to HEIs activities. These studies do not take into account the HEIs contributions by the supply side and in the long term, which are produced by their teaching, research and transfer activities.

The central idea of Sudmant's (2009) study is that the economic impacts of HEIs are different from those attributable to other organizations because, as well as the 'static impact' on the economy, universities also have a 'dynamic impact' that increases the productive capacity of the economy. Thus, the argument is that HEIs' educational activities increase the human capital available in the economy, which has a positive impact in employment and income, as university graduates have higher activity and employment rates, and have higher productivity and earn higher salaries than people with lower educational levels. Further, HEIs' research and transfer activities generate scientific and technological knowledge, which increase the technological capital. All of these impacts are more important

than impacts on the demand side because their effects last much longer. Additionally, the increase of both human and technological capital generates positive impacts on the growth of the economy and their Gross Domestic Product.

In sum, human capital, research, and knowledge in general (the areas of HEIs' specialization) are crucial for the long-term development of societies today, characterized by a knowledge-intensive use in all daily activities (Eriksson and Forslund, 2014). Therefore, we can consider HEIs as an instrument for social and economic development at country level. Our study focuses on the contribution of HEIs activities to the supply of resources in the European economies and their spillover effects on the economic growth and the Gross Domestic Product per capita (GDPPC) of the European countries, taking a broader time perspective (over the period 2000-2015). To carry out the analysis and quantification of the long-term impacts of HEIs in 28 European countries, we estimate counterfactual scenarios that assume that HEIs do not exist for each European country following the methodology developed by Pastor, Serrano and Soler (2016), and applying techniques of growth accounting.

The paper is organized as follows. The second section briefly outlines the long-term effects of HEIs' activities. The third section presents the impacts of HEIs on human capital. The fourth section shows the contribution of HEIs to the creation of technological capital. The fifth section describes the models used to estimate the contribution of HEIs to economic growth and presents estimates of its impacts on economic growth and on per capita income. Finally, the sixth section concludes.

6.2. The literature on the long-term effects of Higher Education Institutions

It is recognised that the expansion of higher education has had a positive effect on economic growth around the world and yet there is little research on the economic impact of universities. In a recent study, Valero and Van Reenen (2016) analyse data on almost 15,000 universities in about 1,500

regions in 78 countries for the period 1950-2010 and find that there is a strong positive impact of university expansion on regional economic growth. They estimate fixed effects models and show that the effect of universities on growth of GDP is not simply driven by the direct expenditures related with the universities, the part quantitative more important of this effect is due to the fact that universities are producers of human capital and innovation, and universities are institutions that promote the growth (increasing democratic attitudes).

The studies of Gennaioli *et al.* (2012 y 2013) show the importance of human capital in accounting for regional differences in economic development, and also that regional growth is shaped by similar factors as national growth, such as geography and human capital. Belenzon and Schankerman (2013) study how geography affects university knowledge spillovers and find that is strongly localised. Toivanen and Väänänen (2016) find in Finland a positive effect of engineering education on the propensity to patent and their counterfactual calculation show that establishing new technical universities resulted in a high increase in the number of patents. Acemoglu *et al.,* (2014) provide evidence that democracy has a significant positive effect on GDP. Their results suggest that democracy increases future GDP by encouraging investment, increasing schooling, and inducing economic reforms, improving public good provision, and increasing the social capital.

Most of the studies on the short-term economic impacts of HEIs activities that focus on the demand side through the HEIs' spending or the expenditure they induce in other agents do not address the major contributions of HEIs on the supply side of the economy. These studies do not take account the direct long-term contributions of HEIs activities to the supply of human and technological capital and the spillover effects (e.g. no market benefits and transformation of productive structures). These contributions have other crucial impacts on the national economies, such as the generating of economic growth and their positive impact on income. Thus, all studies of the impacts of HEIs on regional development find

evidence that employment growth rates are higher in regions with many and good HEIs (Lendel, 2010; Pugh, Hamilton, Jack and Gibbons, 2016).

In the studies on the long-term contributions of HEIs, we can distinguish between two types of analyses. First, there are studies on the direct impact of HEIs by the supply side (Drucker and Goldstein, 2007), where HEIs are considered as instruments of socioeconomic development in their respective regions. These studies analyse the role of HEIs as incubators of technological innovation and quantify their contribution to the creation of human and technological capital through their teaching and research activities and their subsequent economic effects. Their contribution is established in terms of the increase in the level of studies, technological capital, wage returns, increases in activity and occupation rates or their contribution to economic growth and national income. Second, there are studies on the economic and social spillover effects of HEIs (McMahon, 2009; Soler *et al*., 2016), which review the non-quantifiable private and social benefits directly associated with HEIs activities (quality of life, health, respect for the environment, social capital, gender equality, etc.).

Many studies provide data on the activities developed by HEIs and show the relationship between these HEIs activities and various socioeconomic variables at local and regional level. It is certainly difficult to determine a causal link between university activities and the economic outcomes in their environment (Drucker and Goldstein, 2007). However, the regularity observed confirms that universities have a role to play in local and regional development (Comunian, Taylor and Smith, 2014). Undoubtedly, the variables that are most used in studies to highlight the contribution of HEIs to their environment are human capital and research.

Goldstein and Renault (2004) analyse the research and technology activities for the top fifty universities in the United States, suggesting that with the reorientation towards a knowledge-based economy, university activities have become increasingly important and, consequently, have more important dissemination impacts which can be internalized and generate economic growth in the regional environment. Similarly, Anselin *et al.*

(1997) analysed the degree of "spatial diffusion" between university research and high technology innovations for the case of the United States. They used Griliches-Jaffe knowledge production function (Griliches, 1979; Jaffe, 1989) both at state and metropolitan levels, to estimate the effects of spatial diffusion between different US states. Other important contributions refer to the role of universities as entrepreneurial and knowledge transfer universities.[1] Bramwell and Wolfe (2008) analyse the impacts of the University of Waterloo in Ontario including an excellent summary of the literature on the mechanisms of knowledge transmission from universities to the economy. Sudmant (2009) studies the economic impact of the University of British Columbia (UBC) in Vancouver incorporating concepts adapted from the literature on the economics of education, innovation and economic growth.

Sudmant (2009) considers that the economic impact of HEIs is different from those of other institutions because, along with the "static impact" on the economy, there is also a "dynamic impact" (long-term). This dynamic or long-term impact refers to the role of HEIs in the creation and transmission of knowledge, an impact on the supply side insofar as it increases the productive capacity of the regional economy. Four economic impacts are estimated in this study: direct expenditure, those induced by expenditures that are not specific to the university but would not take place if they did not exist, the impact on the level of education of the labour force and the impact of the new knowledge created or transmitted by universities. This study stresses the importance of this dynamic impact on the supply of resources and calculates the impact of the research activities of the UBC on the economy, the so-called dynamic multiplier effect, using total factor productivity (TFP).

The consultancy BiGGAR Economics (2015) carried out a study to analyse the role of universities belonging to the League of European Research Universities (LERU) to assess the contribution of the 21 member universities of LERU in Europe. The study is very broad and analyses both short and long-term economic impacts derived from the core activities of the member universities of LERU across Europe. As noted in the study

itself, "an important limitation of traditional approaches to economic assessment of value is that they do not take into account the long-term effects on the economy". This is because much of the activity undertaken by HEIs focuses on the long-term results that often take some time to manifest themselves.

Similarly, the study of Pastor, Peraita and Pérez (2016) quantifies the contributions by the supply side of the Spanish University System with a new methodology to estimate HEIs' long-term economic impacts. We propose the same methodology, a counterfactual scenario where the question is: if the European HEIs had not existed, then what would have been their contribution on the European countries' economies. Therefore, this study identifies the channels through which universities contribute to the long-term growth of GDP of the EU countries and presents a methodological proposal where the HEIs' supply-side economic impacts are estimated using a counterfactual scenario and growth accounting (Solow, 1957). We evaluate the impacts of universities on human capital, salaries and occupation, on generation of technological capital and, finally, on the GDP per capita of the EU countries in the period 2000-2015. The contribution of HEIs in the EU countries is estimated by comparing the current situation and a hypothetical one in which human and technological capital generated by universities are not present in productive activities.

6.3. The contributions of Higher Education Institutions through the generation of human capital

HEIs train part of the population and its educational activities increase their human capital endowments. Similarly, the HEIs' research and transfer activities generate scientific and technological knowledge, which increase the technological capital in the economy. In this section, we present the contributions of HEIs to the human capital available in the economy. The increase of human capital endowments of the population results in a higher participation in the labour market and an increase in employment rates, with a greater proportion of working-age people employed (labour quantity

effect). In addition, part of the employed population has higher levels of human capital thanks to higher education (labour quality effect).

Therefore, HEIs have contributed directly to the increase in available human capital of the population in the European countries, and have contributed indirectly to the increase in the human capital effectively available in the European countries through the willingness of their graduates to participate in the labour market. We follow the calculations of the study developed by Pastor *et al*. (2016b), where they take into account the direct and indirect impacts of higher education on the human capital of European economies. To carry out the study, counterfactual scenarios that assume that HEIs do not exist are estimated for each European country. In order to do that, using EU-LFS microdata we estimate a probit model of the probability of employment for each European country including as explanatory variables educational attainment and other personal characteristics. We are able to obtain the direct impact of HEIs through their educational activities on the human capital of individuals, as well as the indirect impact on employment rates given the greater labour participation and employability of people with higher education.

Unfortunately, social scientists cannot conduct true experiments and they have no choice but to rely on counterfactual assertions in one way or another. Fearon (1996), in an excellent paper about counterfactuals and hypothesis testing in political and social science, essential reading for any counterfactual study, says that propositions, like the one in this paper, "If there were no Higher Education Institutions in European countries", play a necessary and fundamental role in the efforts of political scientists to assess their hypotheses about the causes of the phenomena they study. In this paper we follow the strategy proposed by Fearon based on counterfactual scenarios that is an extensively technique used in the social sciences to analyse diverse topics and are applied in a wide range of fields where real experiments cannot be performed. Thus, we measure some long-term economic impacts of the HEIs by comparing the real situation with another hypothetical situation in which the HEIs do not exist, and maintaining everything else constant.

The combination of the two contributions mentioned has a significant effect on the human capital used in Europe (see Table 6.1). The total years of study of the employed population in the European countries would have been, on average for period 2000-15, 11.2% higher than in the counterfactual scenario without HEIs. In addition, the magnitude of the difference attributable to HEIs increased from 9.5% in 2000 to 13.2% in 2015.

Table 6.1 shows that the two contributions of HEIs to the relative increase of total years of study of employed population are logically positive in all European countries, although there is considerable heterogeneity in their magnitude. The average values for the period 2000-2015 range from 5.7% in Czech Republic to 16.6% in Ireland. Thus, the impact is especially relevant in Ireland, Cyprus, Lithuania, Spain, Belgium, Estonia, the United Kingdom, Finland, Greece, France, Netherlands and Luxembourg. In all these countries, the difference with respect to the scenario without higher education exceeds 13%. However, in Czech Republic, Slovakia, Romania, Italy and Austria the average difference does not reach 8%. There are also significant disparities between countries in the evolution of this impact over the period, although in most of them it is increasing. In 2015 the estimates indicate that the total impact of HEIs' contribution would have increase the years of study of the employed population, ranging from around 8%, as in Slovakia and the Czech Republic, to levels close to 20%, as in Ireland, Cyprus, Lithuania and Spain.

Part of the effect of higher education to additional human capital, as mentioned earlier, is due to changes in employment rates associated with better education levels. For the European Union-28, this effect would mean that the total years of study of the employed population would be, for the 2000-15 period, 3.1% higher over the period analysed than in the counterfactual scenario. This pattern is generally repeated in almost all European countries, with a positive and increasing effect, albeit with

Table 6.1. Higher education contribution to additional human capital. Relative increase of total years of schooling of employed population. International comparison. 2000 y 2015 (Percentage)

	2000			2015			Difference* 2015-2000			Average 2000-2015		
	Employment rate	Years of schooling per worker effect	Total	Employment rate	Years of schooling per worker effect	Total	Employment rate	Years of schooling per worker effect	Total	Employment rate	Years of schooling per worker effect	Total
European Union-28	**2.5**	**7.0**	**9.5**	**3.8**	**9.4**	**13.2**	**1.3**	**2.3**	**3.7**	**3.1**	**8.1**	**11.2**
Belgium	4.1	10.5	14.6	5.6	11.8	17.4	1.5	1.3	2.8	4.9	11.1	16.0
Bulgaria	3.1	6.9	10.0	4.1	8.5	12.6	0.9	1.6	2.6	3.5	7.5	11.0
Czech Republic	1.0	3.3	4.3	2.0	5.8	7.9	1.0	2.5	3.5	1.4	4.3	5.7
Denmark	2.3	7.2	9.5	3.5	9.9	13.4	1.1	2.7	3.9	3.0	9.0	12.0
Germany	2.7	7.2	9.8	2.8	7.5	10.3	0.1	0.4	0.5	2.7	7.3	10.0
Estonia	4.1	8.4	12.6	5.0	10.0	15.0	0.8	1.6	2.4	4.6	9.2	13.9
Ireland	3.5	8.4	11.9	7.3	12.8	20.1	3.8	4.4	8.3	5.6	11.0	16.6
Greece	3.0	7.5	10.5	6.2	10.6	16.8	3.2	3.1	6.3	4.3	9.0	13.3
Spain	3.3	11.0	14.3	5.0	13.3	18.3	1.7	2.3	4.0	4.0	12.1	16.2
France	3.2	8.1	11.3	4.8	10.6	15.4	1.6	2.5	4.1	3.9	9.3	13.2
Croatia	2.7	5.0	7.7	4.1	7.4	11.6	1.5	2.4	3.9	3.1	6.0	9.1
Italy	1.2	4.5	5.7	2.2	6.8	9.0	1.0	2.3	3.3	1.7	5.6	7.3
Cyprus	4.0	9.5	13.4	6.9	12.5	19.4	2.9	3.0	6.0	5.3	11.0	16.2
Latvia	3.2	5.8	9.1	5.2	9.1	14.3	2.0	3.3	5.3	4.1	7.3	11.4
Lithuania	10.0	12.3	22.3	8.4	10.9	19.3	-1.6	-1.4	-3.0	7.0	9.2	16.2
Luxembourg	2.3	7.0	9.3	4.7	12.4	17.1	2.4	5.4	7.8	3.5	9.6	13.1
Hungary	1.5	4.8	6.3	2.3	7.1	9.5	0.9	2.3	3.2	2.0	6.0	8.0
Malta	1.0	4.1	5.1	3.1	9.1	12.3	2.2	5.0	7.2	2.4	7.7	10.1
Netherlands	3.0	7.9	10.9	4.4	10.4	14.8	1.4	2.5	3.9	3.8	9.3	13.1
Austria	1.3	4.5	5.9	3.0	8.7	11.7	1.6	4.2	5.8	1.8	5.7	7.4
Poland	2.3	4.0	6.4	5.6	8.5	14.1	3.2	4.5	7.7	4.1	6.4	10.5
Portugal	0.7	5.0	5.7	1.9	9.3	11.3	1.3	4.3	5.6	1.2	7.0	8.2
Romania	1.3	3.2	4.6	2.8	6.2	9.0	1.5	3.0	4.5	2.1	4.6	6.7
Slovenia	2.0	5.1	7.1	4.0	8.8	12.8	2.0	3.7	5.7	2.8	6.7	9.4
Slovakia	1.0	3.2	4.2	2.0	5.8	7.8	1.0	2.6	3.6	1.5	4.5	5.9
Finland	3.0	9.6	12.6	3.9	10.9	14.8	0.9	1.3	2.2	3.3	10.0	13.3
Sweden	1.8	8.4	10.2	2.2	10.1	12.3	0.4	1.7	2.1	1.8	8.5	10.3
United Kingdom	2.9	9.1	12.1	4.5	11.4	15.9	1.5	2.3	3.8	3.6	9.9	13.5

*In percentage points. *Source:* Eurostat and author's elaboration.

different intensity. In all countries, the impact has increased except in Lithuania, although the relative increase is more intense in countries such as Malta, Poland, Portugal, Austria, Slovakia and Romania and weaker in Germany, Sweden and Estonia.

The effect of the increase in the number of years of education per worker associated with the existence of higher education is even more intense. In the case of the European Union-28 as a whole, it would represent a difference of 8.1% on average over the period with respect to the counterfactual scenario. The magnitude of the effect increased from 7% in 2000 to 9.4% in 2015. Again, there is a marked inequality between countries. While this impact has exceeded 10% on average during the period in certain countries (Spain, Belgium, Ireland, Cyprus, Finland and the United Kingdom), in others it is between 4% and 6% (Romania, the Czech Republic, Slovakia and Italy). With the exception of Lithuania, the intensity of this impact increased in all countries, albeit at a different pace.

In general, the direct impact for most of the European countries is larger than the indirect impact associated with the improvement of employment rates. For the European Union-28 and for the average 2000-2015, 72.3% of the total impact would correspond to the direct impact and 27.7% to the impact via the labour market. In addition, this distribution is very stable throughout the period analysed. The individual behaviour of European countries is also characterised by high stability throughout the period, but within a heterogeneous pattern in terms of the importance of each factor in the total impact. Finally, we can see that in some countries, the direct impact is of particular relative importance compared to the employment rate impact.

6.4. The contribution of Higher Education Institutions to the creation of technological capital

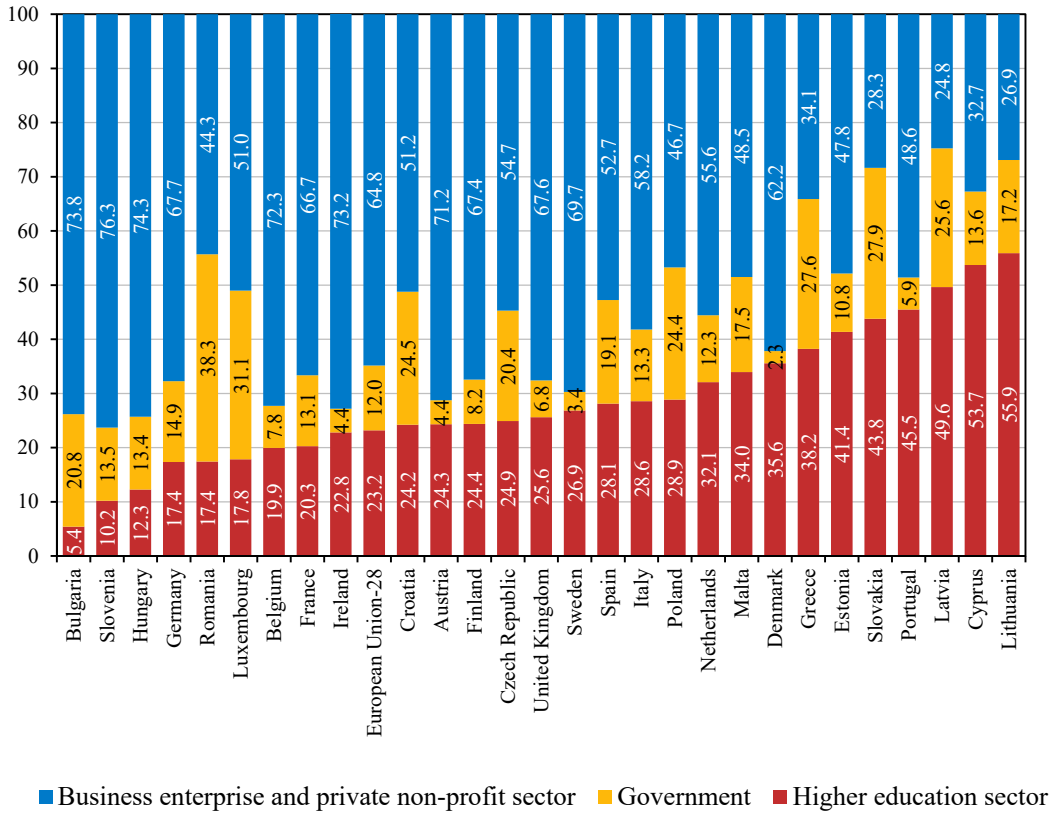
Research and development (R&D) activities and those of transfer are two important missions of HEIs in advanced societies. And although they may not be as visible as teaching activities, the fact is that through R&D and transfer activities, HEIs contribute to the socioeconomic development of their respective environments, generating, developing and transferring knowledge to companies and institutions in their national economies. The universities devote funds to research which provide the basis for technologies that are subsequently used by firms (BiGGAR Economics, 2015). The development of such technologies and the transfer of knowledge between HEIs and industry are fundamental for the long-term competitiveness of their economies. In some cases, HEIs have led to the development of large-scale innovation centres that are important drivers of regional economic growth.

Figure 6.1 presents the total intramural R&D expenditure (GERD) undertaken by the three sectors for which Eurostat provides disaggregated data (European Union Labour Force Survey): Government, higher education sector, and business enterprise and private non-profit sector. As can be observed, the participation of HEIs in total intramural R&D expenditure is very significant in European countries as a whole and increases over time representing 20.9% in 2000 and 23.2% in 2015. In most countries HEIs are the second most important agent of expenditure on R&D, and in some cases the first, as in Greece, Slovakia, Latvia, Cyprus and Lithuania.

However, the fact that the contribution through the R&D of HEIs to the economy is produced in the long term makes it complicated to capture by the traditional methods of economic impact analysis. The results of R&D activities of HEIs, unlike teaching, are more difficult for society to visualize and their achievements tend to be undervalued. This section therefore offers a quantitative assessment of the contribution that HEIs make to generating technological capital in the economies of European countries via the

important weight of HEIs' R&D expenditure[2] in the total. Technological capital is defined as the knowledge asset resulting from the accumulation of staff payment flows, inputs and investments in equipment, as well as the facilities which are necessary for R&D activities.

Figure 6.1. Total intramural R&D expenditure (GERD) by sectors of performance. International comparison. 2015 (Percentage)



Source: Eurostat and authors' elaboration.

To estimate the series of technological capital stock generated by HEIs we use the standard inventory method according to the expression:

$$KT_{i,t} = (1-\delta)KT_{i,t-1} + I_{i,t-\theta} \qquad (6.1)$$

where $KT_{i,t}$ is the capital stock of period t, δ is the rate of depreciation and I is the amount of investment in period t. Following Pakes and Schankerman (1984), the effects of investment in R&D are assumed to be incorporated

into the technological stock with a delay of one year, so that the results of the R&D activities are not immediate (θ=1). The capital stock is estimated as follows:

$$KT_{i,t} = \frac{I_{i,t-\theta}}{g+\delta} \quad , \qquad (6.2)$$

g being the rate of growth of investment in R&D. Following the work of Hall and Mairesse (1995) and Pastor *et al.* (2016a), we use a depreciation rate of 15%.

Table 6.2 presents the percentage of technological capital generated by HEIs and other sectors in 2000 and 2015. At the end of the analysed period, the total technological capital in the European Union-28 countries was 1.64 trillion euros, of which HEIs would have contributed 378 billion, or 23.1% of the total. The importance of HEIs in total technological capital is not homogeneous, however, with significant differences between countries.

Those countries where the technological capital generated by HEIs is more significant are Lithuania (53.1%), Cyprus (49.6%), Latvia (44.3%) and Greece (40.8%). It is important to note that the effects of the economic crisis and the budget cuts in R&D are reflected in the accumulation of technological capital that reduces its growth from 2008 in all countries without exception. These effects of the crisis are even more visible in the technological capital generated by HEIs. Thus, in countries such as Greece, the annual growth rate until 2007 was 8 times the post-crisis rate. Similarly, in countries such as Italy, Hungary, Romania, Lithuania, Cyprus and the United Kingdom, pre-crisis growth rates are 2 to 5 times higher than those following the crisis.

Table 6.2. Technological capital. Higher education and other sectors. International comparison. 2000 and 2015 (Percentage)

	2000		2015		HE. Difference* in weight. 2015-2000	Growth rate. Techno-logical capital
	Higher education (HE)	Other sectors (OS)	Higher education (HE)	Other sectors (OS)		
European Union-28	**20.0**	**80.0**	**23.1**	**76.9**	**3.0**	**44.6**
Belgium	20.4	79.6	21.1	78.9	0.7	59.7
Bulgaria	12.0	88.0	8.6	91.4	-3.4	227.4
Czech Republic	12.0	88.0	23.5	76.5	11.4	223.7
Denmark	16.2	83.8	30.7	69.3	14.6	84.0
Germany	15.6	84.4	17.3	82.7	1.7	56.1
Estonia	56.1	43.9	39.0	61.0	-17.1	745.3
Ireland	19.5	80.5	24.4	75.6	4.9	153.2
Greece	55.2	44.8	40.8	59.2	-14.4	100.7
Spain	30.2	69.8	28.1	71.9	-2.1	117.4
France	18.2	81.8	20.2	79.8	2.1	23.9
Croatia	45.4	54.6	29.5	70.5	-16.0	36.5
Italy	32.1	67.9	29.4	70.6	-2.7	40.1
Cyprus	19.7	80.3	49.6	50.4	30.0	237.0
Latvia	34.6	65.4	44.3	55.7	9.8	266.8
Lithuania	32.4	67.6	53.1	46.9	20.7	361.2
Luxembourg	0.1	99.9	11.6	88.4	11.5	53.0
Hungary	30.8	69.2	17.7	82.3	-13.1	192.7
Malta	56.6	43.4	34.9	65.1	-21.7	429.4
Netherlands	31.9	68.1	33.6	66.4	1.7	36.9
Austria	30.9	69.1	25.1	74.9	-5.8	118.7
Poland	32.4	67.6	31.5	68.5	-0.9	218.2
Portugal	35.1	64.9	39.7	60.3	4.6	152.2
Romania	10.4	89.6	19.6	80.4	9.2	170.7
Slovenia	19.9	80.1	12.1	87.9	-7.8	165.6
Slovakia	6.4	93.6	33.6	66.4	27.2	221.0
Finland	15.7	84.3	20.6	79.4	4.9	17.2
Sweden	18.4	81.6	25.2	74.8	6.8	23.7
United Kingdom	18.9	81.1	25.6	74.4	6.7	33.9

* In percentage points

Source: Eurostat and authors' elaboration.

6.5. Contribution of Higher Education Institutions to economic growth

To compute the contribution made by HEIs to economic growth in European countries, we shall use a growth accounting methodology (Solow, 1957), that allows us to breakdown the economic growth of economies into the contributions corresponding to each of the factors of production, as well as to technical progress or total factor productivity (TFP). The basic idea is that assuming the existence of perfect competition and constant returns to scale, the contribution of each factor to production can be estimated through its own real growth rate multiplied by the share of that factor's income in the total income.[3]

To briefly illustrate the methodology, we consider a production function in which output (Y) in each period (t) depends on the capital used (K), the quantity of different types of labour used, aggregating them by means of weights based on the years of study of the employed population (EYS), and the technological capital accumulated (KT):

$$Yt = Ft\ (Kt,\ EYSt,\ KTt)\ . \qquad (6.3)$$

Note that, instead of considering the number of people employed, we consider the total years of study of the employed population, $EYS=AYS \cdot L$, which is the product of the average years of study (AYS) and the number of people employed (L). This procedure allows us to collect both the contribution in terms of average years of study and the contribution in the number of people employed. The HEIs contribute to economic growth with the following three effects:

- *Quantity effect:* The impact of HEIs on the total number of people employed. To estimate this contribution, we breakdown labour (EYS) in terms of quantity (L) and quality (AYS). Furthermore, we separate the quantity of labour into those jobs associated with the existence of HEIs (L^{HEI}) and those that would have existed without their existence (L^{CF}, counterfactual employed population).

- *Quality effect:* The impact of HEIs on the generation of human capital. To estimate this contribution, we breakdown the increase in the quality of the employment of European countries (average years of study, AYS) in the share of the growth attributable to HEIs (AYS^{HEI}), and the improvement in the average years of study of the employed population that would have occurred in the case of HEIs not existing (average counterfactual years of schooling, AYS^{CF}).

- *Technological capital effect:* The impact on the generation of technological capital. To estimate this contribution, we breakdown the growth of total technological capital (KT) in the part attributable to the existence of HEIs (KT^{HEI}) and the one that would have been accumulated without the contribution of HEIs (KT^{CF}, counterfactual technological capital).

Thus, according with growth accounting, the growth of the years of study of the employed population (EYS) in each country can be expressed as the weighted average of the total labour growth associated with the existence of HEIs (EYS^{HEI}) and the counterfactual scenario which would be observed if they did not exist (EYS^{CF}) following the expression:

$$E\hat{Y}S_t = \left(\theta E\hat{Y}S_t^{HEI} + (1-\theta)\, E\hat{Y}S_t^{CF}\right), \tag{6.4}$$

where the circumflex symbol above the variables denotes rates of variation, θ is the weight of the years of study generated by HEIs in the total, and (1- θ) is the weight of the remaining years of study in the total. Specifically,

$$\theta = EYS_{t-1}^{HEI} / EYS_{t-1}; \quad (1-\theta) = EYS_{t-1}^{CF} / EYS_{t-1}. \tag{6.5}$$

Given that EYS is the product of the average years of study and of the number of people employed, equation (4) can be broken down, in turn, as:

$$E\hat{Y}S_t = \left(\theta\left(A\hat{Y}S_t^{HEI} + \hat{L}_t^{HEI}\right) + (1-\theta)\left(A\hat{Y}S_t^{CF} + \hat{L}_t^{CF}\right)\right). \tag{6.6}$$

The above expression can be expressed by approximating the rate of variation by logarithmic differences:

$$deys_t = \left(\theta\left(days_t^{HEI} + dl_t^{HEI}\right) + (1-\theta)\left(days_t^{CF} + dl_t^{CF}\right)\right). \quad (6.7)$$

In the same way, technological capital can be broken down as follows:

$$dkt_t = \left(\psi dkt_t^{HEI} + (1-\psi)dkt_t^{CF}\right), \quad (6.8)$$

where dkt_t^{HEI} is the growth of technological capital associated with investments made by HEIs in R&D, dkt_t^{CF} is the growth of the counterfactual technological capital without HEIs, ψ is the weight of technological capital generated by HEIs in the total and (1-ψ) is the weight of the remaining technological capital. Specifically, if KT_{t-1}^{HEI}, KT_{t-1}^{CF}, and KT_{t-1} are, respectively, the technological capital of HEIs, the rest of the technological capital, and the total of technological capital in the initial year, we have that

$$\psi = KT_{t-1}^{HEI} / KT_{t-1};\ (1-\psi) = KT_{t-1}^{CF} / KT_{t-1}. \quad (6.9)$$

With the above expressions, the breakdown of growth can be expressed as

$$dy_t = da_t + \alpha dk_t + \beta\left[\left(\theta\left(days_t^{HEI} + dl_t^{HEI}\right) + (1-\theta)\left(days_t^{CF} + dl_t^{CF}\right)\right)\right] + \\ + \lambda\left(\psi dkt_t^{HEI} + (1-\psi)dkt_t^{CF}\right) \quad (6.10)$$

This last expression is the one that allows us to breakdown Gross Domestic Product (GDP) growth (dy_t) into the contribution of capital ($\alpha\ dk_t$), the quality of labour ($\beta\ days_t$), the quantity of labour ($\beta\ dl_t$), technological capital ($\lambda\ dkt_t$), and total factor productivity (da_t), and in turn, which part of these sources of growth is associated with HEIs. Specifically, ($\beta\ \theta\ days_t^{HEI}$) measures the share of growth related to improvements in the quality of the labour factor associated with HEIs via the human capital generated, measures ($\beta\ \theta\ dl_t^{HEI}$) the share of growth related to the increase in the number of people employed associated with HEIs through increases in the

rate of activity and employment, and ($\lambda\ \psi\ dk_t^{HEI}$) measures the share of growth related to the technological capital generated by HEIs.

Table 6.3 presents the growth accounting results of European Union-28 countries for the period 2000-2015 and breaks it down into the contribution of productive factors, showing the contributions of HEIs to the economic growth of each country. Additionally, Table 6.3 offer also the growth accounting of European countries as a whole for the periods 2000-2007 and 2007-2015, distinguishing between the period before and after 2007 to analyse possible changes associated with the past economic crisis.[4] When assessing the contributions of HEIs, it should be noted that the intensity of this impact depends on its effect on the growth rate of the quantity, and quality, of employment and technological capital. Thus, this effect will tend to be more significant in countries where education, although less developed, has increased more strongly during the period analysed in relative terms.

Table 6.3 shows that HEIs would have boosted European growth, with a contribution of 0.35 percentage points to the average growth rate of the European Union-28 (0.29 percentage points for the quantity and quality of human capital, and 0.06 percentage points for their contribution to the increase of technological capital). The contribution is positive in all countries, albeit the differences are notable. In Germany it is only 0.15 percentage points while in Malta it is 0.83 percentage points, and in Spain and Austria it stands at around 0.5 percentage point. With the exception of a few cases, the growth impulse from HEIs occurs more through the contribution of human capital than through R&D capital. Furthermore, most of the increase in human capital associated with higher education corresponds to the direct impact of improving labour quality.

Table 6.3. Economic growth sources. Universities economic growth contribution. 2000-2015 (Percentage)

	GVA	Physical capital	Labour							R&D Capital			TFP
			Total	Universities			Counterfactual			Total	Universities	Counter-factual	
				Total	Quantity	Quality	Total	Quantity	Quality				
EU-28 (2000-2015)	**1.27**	**0.40**	**1.00**	**0.29**	**0.16**	**0.13**	**0.71**	**0.36**	**0.35**	**0.20**	**0.06**	**0.14**	**-0.33**
EU-28 (2000-2007)	**2.27**	**0.53**	**1.49**	**0.29**	**0.18**	**0.10**	**1.20**	**0.87**	**0.34**	**0.20**	**0.06**	**0.14**	**0.05**
EU-28 (2007-2015)	**0.40**	**0.29**	**0.58**	**0.30**	**0.14**	**0.15**	**0.28**	**-0.08**	**0.36**	**0.19**	**0.06**	**0.14**	**-0.67**
Belgium	1.41	0.26	1.09	0.29	0.17	0.12	0.80	0.36	0.44	0.25	0.06	0.19	-0.19
Bulgaria	3.36	1.81	0.59	0.19	0.10	0.09	0.40	0.13	0.27	0.63	0.05	0.58	0.33
Czech Republic	2.61	0.76	0.53	0.20	0.11	0.10	0.33	0.20	0.13	0.63	0.17	0.46	0.69
Denmark	0.58	0.28	0.29	0.24	0.12	0.12	0.05	-0.04	0.09	0.33	0.15	0.17	-0.31
Germany	1.18	0.19	0.75	0.10	0.07	0.03	0.66	0.53	0.13	0.24	0.05	0.19	0.00
Estonia	3.31	2.09	0.41	0.16	0.09	0.07	0.25	0.18	0.07	1.14	0.43	0.71	-0.33
Ireland	2.86	1.33	1.30	0.47	0.25	0.22	0.84	0.35	0.48	0.50	0.14	0.35	-0.26
Greece	-0.09	0.33	0.24	0.27	0.11	0.16	-0.03	-0.55	0.52	0.37	0.10	0.27	-1.04
Spain	1.48	0.81	1.54	0.41	0.23	0.18	1.13	0.52	0.61	0.41	0.11	0.30	-1.28
France	1.16	0.45	1.21	0.35	0.20	0.16	0.86	0.44	0.42	0.11	0.03	0.08	-0.61
Croatia	1.45	0.84	0.84	0.28	0.15	0.13	0.56	0.25	0.31	0.17	-0.02	0.19	-0.39
Italy	0.01	0.31	0.97	0.24	0.13	0.11	0.72	0.28	0.44	0.18	0.04	0.14	-1.45
Cyprus	1.38	0.99	1.65	0.42	0.25	0.17	1.23	0.78	0.45	0.65	0.37	0.28	-1.91
Latvia	3.76	1.02	0.08	0.23	0.11	0.13	-0.15	-0.28	0.13	0.69	0.32	0.37	1.97
Lithuania	4.01	1.68	-0.18	-0.07	-0.05	-0.02	-0.11	-0.22	0.11	0.82	0.48	0.34	1.69
Luxembourg	2.64	1.25	2.02	0.59	0.35	0.24	1.44	1.07	0.36	0.23	0.07	0.16	-0.86
Hungary	1.95	0.85	0.70	0.22	0.12	0.10	0.48	0.32	0.17	0.57	0.08	0.50	-0.18
Malta	2.94	0.82	2.53	0.57	0.32	0.25	1.95	0.91	1.04	0.89	0.26	0.63	-1.30
Netherlands	1.18	0.35	0.70	0.29	0.15	0.14	0.41	0.13	0.28	0.17	0.07	0.10	-0.04
Austria	1.39	0.42	1.10	0.41	0.22	0.19	0.69	0.44	0.25	0.42	0.08	0.33	-0.54
Poland	3.53	1.39	0.94	0.39	0.21	0.18	0.55	0.31	0.24	0.62	0.20	0.42	0.59
Portugal	0.33	0.31	1.27	0.48	0.23	0.25	0.79	-0.37	1.16	0.49	0.20	0.30	-1.74
Romania	3.59	1.45	-0.20	0.22	0.09	0.12	-0.42	-0.74	0.32	0.53	0.13	0.40	1.82
Slovenia	2.10	0.45	0.82	0.40	0.20	0.20	0.42	0.10	0.33	0.52	0.04	0.48	0.31
Slovakia	3.98	0.91	0.70	0.19	0.11	0.09	0.51	0.43	0.08	0.62	0.27	0.35	1.75
Finland	0.97	0.40	0.54	0.20	0.10	0.10	0.34	0.01	0.33	0.08	0.04	0.04	-0.06
Sweden	2.05	0.66	0.85	0.20	0.12	0.08	0.64	0.47	0.18	0.11	0.06	0.05	0.43
United Kingdom	1.71	0.36	1.53	0.37	0.22	0.15	1.17	0.74	0.42	0.16	0.07	0.08	-0.34

Source: Eurostat and authors' elaboration.

The share related to the improvements in the employment rate associated with having higher education is markedly more moderate in all countries. The contribution of HEIs via technological (R&D) capital is especially significant in the Baltic republics. The improvement of the human capital per capita of the employed population associated with HEIs has had an impact which also shows a high heterogeneity. These are contributions of greater importance than those linked to the increase in the rate of employment induced by higher education.

Another question refers to the lags between the university output and GDP growth. It is possible that the impact of research activity on economic growth has a longer time lag than the impact of human capital. Our fifteen-year observation period (2000-2015) may be too short to full account for favourable longer term impacts of the research activity on GDP. However, the method used in this paper to estimate the effects on GDP through innovation capitalises these R&D investments in a stock of technological capital under the assumption that the results of the R&D activities are not immediate. The effects of investment in R&D are assumed to be incorporated into the technological stock with a delay of one year. This method allows, to some extent, to take into account the possible time lag between research activity and GDP growth.

In the European Union-28 countries as a whole, there is an increase in contributions linked to the increase in the human capital per capita of the employed population and the employment rate. On the contrary, the contribution through R&D capital remains stable. Consequently, one aspect to be highlighted is the different behaviour of the contribution of higher education to growth. The crisis generally affected all sources of growth. The contribution of physical capital went from 0.53% prior to the crisis to 0.29%. The contribution of the labour factor estimated for the counterfactual scenario without higher education would have fallen from 1.20% to 0.28%, mainly due to the quantity impact that would have gone from 0.87% to -0.08%. The TFP would also have performed worse than in the pre-crisis period. However, the estimates obtained for the impact associated with higher education far from being reduced would have been

maintained (R&D capital) or even increased (quality and quantity labour effects). In total, while but the GVA's growth rate suffered a great fall, from 2.27% to 0.40%, the contribution of education would have remained at a stable rate of 0.35% per year between 2000 and 2015.

The robustness of the economic impact generated by Higher Education Institutions in their national economies is reinforced by the universal nature of the positive economic contributions observed. The estimated total effect is positive for the EU as a whole and each of the 28 European countries included in the analysis. In addition, the estimated effect is positive for each of the three considered channels (labour quality, labour quantity and R&D capital) among which the economic impact on GDP can be disaggregated. That is, the results of this study include an individualized analysis of each of the 28 EU countries from their own statistical data with specific econometric estimates for each of the European countries. For example, using the EU-LFS microdata, we have estimated a probit model of the probability of employment for each European country, which includes the educational achievement and other personal characteristics corresponding to each country as explanatory variables.

These results indicate that higher education would have contributed to partially alleviating the negative impact of the crisis on the overall economic growth in Europe. However, the overall contribution of education, while remaining positive, would have worsened after the crisis in certain countries (see Table A.6.1 and Table A.6.2 in Appendix). In short, the contribution of higher education to growth is very relevant in all European countries. It is undoubtedly one of the main sources of economic growth and also contributes to a more stable growth, with better performance during the crises than other growth engines.

Our results show that the impact of human capital is higher than the impact from R&D. Nevertheless, given that institutions of higher education are multiproduct firms, education and research are to some extent interconnected and the quality of education is dependent on the quality of

research. As a result, part of the human capital effect is indeed linked to the research activity at HEIs.

6.5.1. Contribution of Higher Education to the increase in per capita income

The impact of HEIs on technological capital and the human capital endowments used do indeed affect growth, as we have seen, and therefore influence the relative levels of GDP per capita of the different countries at a given moment in time. By applying growth accounting methods, the contributions of each input can be estimated through the differences in the levels of output or output per capita between two periods. These comparisons can be made between two different scenarios for the same economy. Let these two observations be A and B (real and counterfactual scenarios), the approximation would be:

$$log\left(\frac{Y_A}{Y_B}\right) = log\left(\frac{TFP_A}{TFP_B}\right) + \frac{\alpha_A + \alpha_B}{2} log\left(\frac{K_A}{K_B}\right) + \frac{\lambda_A + \lambda_B}{2} log\left(\frac{KT_A}{KT_B}\right) + \frac{\beta_A+\beta_B}{2} log\left(\frac{EYS_A}{EYS_B}\right), \quad (6.11)$$

were TFP is Total Factor Productivity, K is physical capital, KT is technological capital, EYS is human capital (total years of education of employed population), α_i the share of physical capital income in the total income of i, λ_i that of technological capital income and β_i that of human capital (labour income). The contribution of each input is given by the relative variation in the use of the input multiplied by its share in total income.

Higher education has an influence through its effect on technological capital and human capital endowments. Human capital is modified because human capital per capita varies and because the number of people employed changes. Thus,

$$\frac{\beta_A+\beta_B}{2} log\left(\frac{EYS_A}{EYS_B}\right) = \frac{\beta_A+\beta_B}{2} log\left(\frac{AYS_A}{AYS_B}\right) + \frac{\beta_A+\beta_B}{2} log\left(\frac{L_A}{L_B}\right), \quad (6.12)$$

where AYS_i is the years of study per capita of the employed population (labour quality effect) and L_i the quantity of labour (labour quantity effect). In the later analysis, the hours worked were used as a variable representing the quantity of labour input.

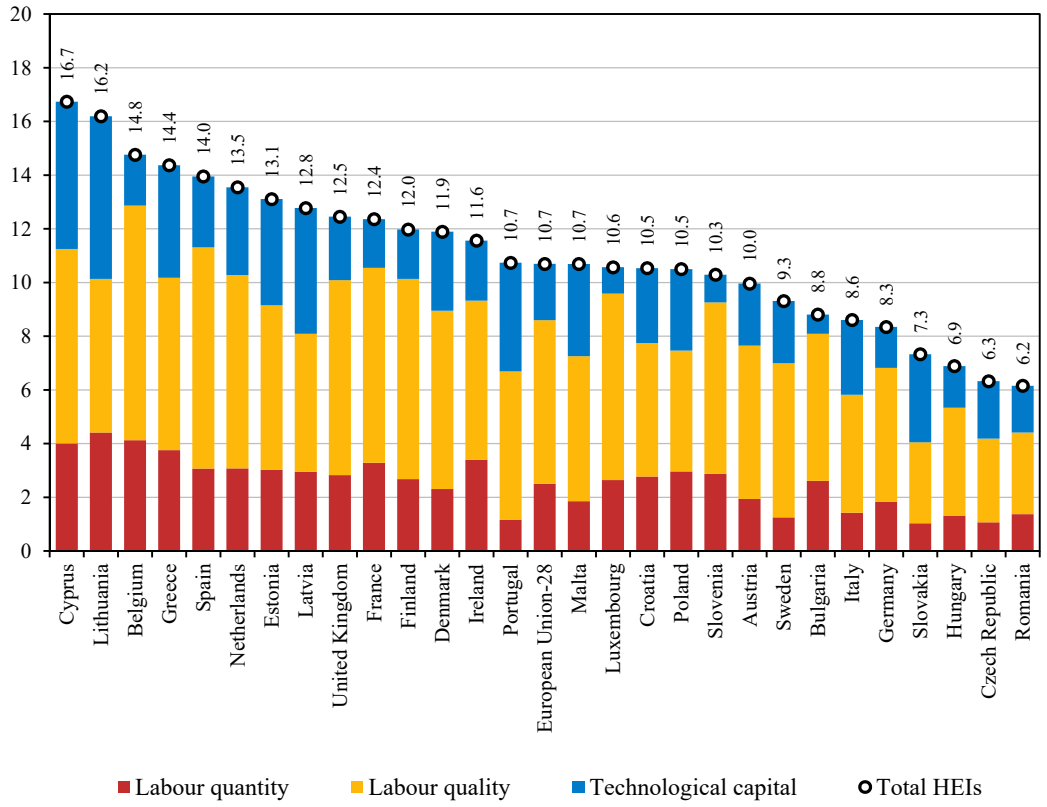
This approach can be used to estimate the contribution of higher education to GDP per capita in each European country by comparing actual results (A) with those corresponding to the counterfactual scenario without higher education (B). For each country, it is assumed that the weight of income of each factor in the total income in the counterfactual scenario (B) is the same as that observed (A).

Figure 6.2 shows the estimated impact of higher education provided by HEIs in 2015 on the GDP per capita for the 28 European countries. The total contribution is considerable, standing at 10.7% for the whole of the European Union-28, indicating that GDP per capita is one-tenth higher than it would have been in the absence of higher education. The contribution via human capital endowments (8.6%) would be somewhat higher than that produced via technological capital (2.1%), but both are relevant. The impact of human capital would occur mainly through the improvement in the average years of labour per capita (labour quality effect) with a contribution of 6.1%. Although to a lesser degree, there would also be a significant labour quantity effect due to the increase in the employment rates associated with higher education levels (with a contribution of 2.5%). As can be seen, significant positive effects are estimated for all countries, although their magnitude varies from one case to another. The channels through which these impacts materialize also differ from country to country.

In Cyprus, Lithuania, Belgium, Greece, Spain, the Netherlands, Estonia, Latvia, the UK, France, Finland, Denmark, Ireland and Portugal, the relative impact of higher education would be above the European average, with total contributions ranging from 10.7% to 16.7%. The impact through technological capital is especially intense in Cyprus, Lithuania, Latvia, Portugal and Greece with values between 4% and 6%. The improvement in

human capital per capita represents 7-8% more GDP per capita in Belgium, Spain, Finland, France, the UK, Cyprus and the Netherlands. Table 6.4 shows that the increase in employment rates plays a smaller role in all countries in quantitative terms. Finally, the different magnitude between countries in terms of higher education contributions means that the relative situation of European countries is different from that which would have existed in the counterfactual scenario without HEIs.

Figure 6.2. Higher education contribution to GDP per capita. 2015 (Real vs. counterfactual scenario without tertiary education)



Source: Eurostat and authors' elaboration.

Table 6.4. Higher education contribution to GDP per capita 2015. Real vs. counterfactual scenario without tertiary education (Percentage)

	Labour quantity	Labour quality	Technological capital	Total Universities
European Union-28	**2.50**	**6.09**	**2.10**	**10.70**
Belgium	4.13	8.74	1.90	14.76
Bulgaria	2.61	5.48	0.72	8.81
Czech Republic	1.07	3.11	2.14	6.32
Denmark	2.31	6.64	2.94	11.89
Germany	1.84	4.99	1.52	8.35
Estonia	3.03	6.12	3.96	13.11
Ireland	3.40	5.93	2.24	11.56
Greece	3.76	6.42	4.19	14.37
Spain	3.07	8.24	2.64	13.95
France	3.29	7.26	1.81	12.36
Croatia	2.77	4.97	2.79	10.54
Italy	1.43	4.40	2.78	8.61
Cyprus	4.01	7.24	5.49	16.74
Latvia	2.95	5.15	4.68	12.78
Lithuania	4.42	5.72	6.06	16.20
Luxembourg	2.64	6.95	0.98	10.57
Hungary	1.32	4.02	1.55	6.89
Malta	1.86	5.40	3.43	10.69
Netherlands	3.08	7.20	3.27	13.55
Austria	1.94	5.71	2.31	9.96
Poland	2.96	4.51	3.03	10.50
Portugal	1.16	5.53	4.04	10.74
Romania	1.37	3.04	1.74	6.16
Slovenia	2.88	6.38	1.03	10.29
Slovakia	1.04	3.02	3.28	7.33
Finland	2.68	7.46	1.84	11.98
Sweden	1.25	5.74	2.32	9.31
United Kingdom	2.83	7.26	2.37	12.45

Source: Eurostat and authors' elaboration.

Finally, we are aware of the debate on the economic contributions of the HEIs compared to their costs. A comparison between our estimates for the long-term impact of HEIs on GDP with the expenditure on tertiary education institutions (including R & D activities) as a percentage of GDP may be useful. In 2014, the last year for which data are available for all the EU countries (OECD, 2017); the total expenditure of EU countries on HEIs (from public and private sources of funds) represents 1.3% of their GDP. A rough calculation between the previous percentage and the 10.7% contribution of tertiary education to GDP per capita (see Table 6.4) shows that the quantitative impact of HEIs would be on average eight times higher compared to their annual cost in terms of GDP of the EU countries. This calculation is highly simplified, but the results obtained by Valero and Van Reenen (2016) when they consider the expansion of universities in the United Kingdom are similar. In their approximation, the benefits of university expansion are five times as large as the costs. We note that their effect is a "marginal impact" of university expansion on a consolidated university system, whereas our calculation is an "average impact" for all the already existing university systems of the countries of the EU. The relative costs and benefits of HEIs would vary by country. For example, Germany's expenditure on tertiary education is 1.2% of GDP, in France 1.5% and in the United Kingdom 1.8%. Following the corresponding data of Table 6.4, the impacts of HEIs on their GDP per capita would be, respectively, seven, eight and seven times as large as their costs.

6.6. Conclusions

Higher Education Institutions make a significant contribution to the economies of European countries. Our study has reviewed and quantified some of the most relevant economic contributions by the supply side of HEIs. With this objective, exercises have been designed to quantify these contributions as accurately as possible. The direct contribution to the generation of human capital and technological capital has been quantified, as well as the indirect contributions to increasing activity and employment rates, to economic growth and to increasing Gross Domestic Product per capita.

The teaching activities of HEIs increase the human capital endowments and productive capacities of population. The increase of human capital endowments of the population results in a higher participation in the labour market and an increase in employment rates, with a greater proportion of working-age people employed (labour quantity effect). In addition, part of the employed population has higher levels of human capital thanks to higher education (labour quality effect). We have presented the estimations of the contribution of HEIs to the human capital available in the European economies.

The HEIs carry out a considerable part of research and development activities in European countries. The HEIs' research and transfer activities generate scientific and technological knowledge, which increase the technological capital in the economy. Therefore, much of the accumulation of technological capital corresponds precisely to Higher Education Institutions (R&D capital effect), which also leads to greater economic development in European economies.

In short, because of the existence of HEIs, technological capital increases, as well as the labour input used and its quality. This study has attempted to estimate the positive effects of higher education on the levels of production and income per capita for the European Union-28 countries, covering the period 2000-2015. For this objective, a counterfactual scenario was

estimated in which HEIs did not exist. In this alternative scenario without higher education graduates and R&D of HEIs, the impact of higher education is obtained by comparing it with the counterfactual scenario in terms of differences in human capital used and technological capital, as well as differences in GDP per capita and economic growth rates. To compute the contribution made by HEIs to economic growth in European countries, we used a growth accounting methodology that allows us to breakdown the economic growth of economies into the contributions corresponding to each of the factors of production, as well as to technical progress or total factor productivity.

The estimates obtained highlight the relevance of the contributions of HEIS. At present it would mean a 13% increase in the human capital used in the European countries and 23% in technological capital. The results of the growth accounting exercise indicate that HEIs would have boosted European growth, with a contribution of 0.63 percentage points to the average growth rate of the European Union-28 (0.57 percentage points for the quantity and quality of human capital, and 0.06 percentage points for their contribution to the increase of technological capital). In fact, estimates indicate that the contribution of higher education to the European Union's overall growth would have increased after the crisis, unlike that of other sources of growth.

The estimated impact of higher education provided by HEIs on the GPD per capita for the 28 European countries in 2015 is considerable, standing around 11% for the whole of the European Union-28. The contribution via human capital endowments would be somewhat higher than that produced via technological capital, but both are relevant. In sum, the results obtained indicate that the activities of HEIs are a significant source of growth in European economies, contributing to mitigating the adverse effects of the periods of crisis.

NOTES:

[1] The study of Mian (1996) on university technology parks concludes that business incubators have a very positive impact on the creation and development of new technology-based companies. O'Shea *et al.* (2005) analyse the success of universities in generating technological spin-off companies based on a set of determinants.

[2] We use the definition of R&D expenditure established in 2002 by the OECD's Frascati Manual (OECD, 2015), which states that all R&D expenditures are understood to be creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of that stock to devise new applications. This manual is the basic reference in the development of R&D statistics.

[3] This implies assuming that each factor is remunerated in accordance with its productivity marginal. The share of production growth that is not explained by the contribution of each factor; i.e. the residue of Solow, also called growth of total factor productivity, is attributed to technical progress.

Tables A.6.1 and A.6.2 in Appendix offer the complete growth accounting results of each one of the 28 European countries analysed for the periods 2000-2007 and 2007-2015, respectively. The tables show that there are common features regarding the contribution of higher education in both periods. Both the effect through R&D capital, as well as the quality and quantity labour effects of higher education are positive with a few exceptions. Furthermore, the relative importance of the labour quality impact is constant, and is more significant than the R&D capital impact or the labour quantity impact in both periods.

APPENDIX:

Table A.6.1. Economic growth sources. HEIs economic growth contribution. 2000-2007 (Percentage)

	GVA	Tangible capital	Labour							Technological Capital			TFP
			Total	HEIs			Counterfactual			Total	HEIs	Counter-factual	
				Total	Quantity	Quality	Total	Quantity	Quality				
European Union-28	**2,27**	**0,53**	**1,49**	**0,29**	**0,18**	**0,10**	**1,20**	**0,87**	**0,34**	**0,20**	**0,06**	**0,14**	**0,05**
Belgium	2,12	0,32	1,36	0,30	0,18	0,12	1,05	0,51	0,55	0,21	0,05	0,16	0,24
Bulgaria	5,89	1,96	1,38	0,17	0,11	0,05	1,21	0,86	0,35	0,58	0,05	0,53	1,98
Czech Republic	4,52	0,94	0,61	0,11	0,06	0,05	0,50	0,36	0,14	0,65	0,14	0,51	2,32
Denmark	1,32	0,45	0,06	0,22	0,11	0,10	-0,16	0,11	-0,26	0,34	0,14	0,20	0,46
Germany	1,62	0,22	0,89	0,04	0,04	-0,01	0,85	0,75	0,10	0,24	0,04	0,19	0,28
Estonia	7,07	3,12	0,91	0,15	0,11	0,04	0,76	0,73	0,03	1,39	0,56	0,83	1,65
Ireland	4,87	2,14	2,63	0,58	0,37	0,22	2,05	1,59	0,46	0,51	0,17	0,34	-0,41
Greece	3,73	0,84	1,67	0,35	0,21	0,14	1,32	0,83	0,49	0,46	0,17	0,29	0,77
Spain	3,47	1,28	3,63	0,56	0,40	0,16	3,07	2,36	0,72	0,52	0,14	0,38	-1,96
France	1,84	0,55	1,46	0,31	0,19	0,12	1,15	0,83	0,32	0,12	0,03	0,09	-0,30
Croatia	4,51	1,10	1,85	0,21	0,14	0,07	1,64	1,38	0,26	0,22	0,01	0,21	1,34
Italy	1,14	0,58	1,54	0,26	0,15	0,11	1,29	0,83	0,45	0,22	0,06	0,15	-1,20
Cyprus	3,90	1,32	3,18	0,55	0,37	0,17	2,63	2,08	0,56	0,87	0,42	0,45	-1,47
Latvia	8,47	2,33	0,78	0,15	0,10	0,06	0,63	0,68	-0,05	0,88	0,38	0,50	4,48
Lithuania	7,76	2,17	-0,20	-0,51	-0,25	-0,26	0,31	0,31	0,00	1,02	0,60	0,42	4,77
Luxembourg	3,94	1,38	1,68	0,46	0,27	0,19	1,22	1,00	0,22	0,30	0,02	0,28	0,58
Hungary	3,61	1,22	0,66	0,21	0,11	0,10	0,45	0,17	0,28	0,69	0,14	0,55	1,04
Malta	1,54	0,93	2,62	0,74	0,39	0,35	1,88	0,65	1,22	1,10	0,31	0,79	-3,12
Netherlands	1,99	0,46	1,28	0,38	0,21	0,17	0,90	0,54	0,36	0,16	0,07	0,09	0,09
Austria	2,33	0,50	0,77	0,14	0,09	0,06	0,63	0,50	0,12	0,48	0,09	0,40	0,58
Poland	4,04	0,94	1,05	0,42	0,22	0,19	0,63	0,33	0,30	0,44	0,14	0,30	1,62
Portugal	1,23	0,66	1,31	0,40	0,20	0,20	0,91	0,09	0,82	0,48	0,16	0,32	-1,21
Romania	6,02	1,12	-0,17	0,22	0,10	0,13	-0,39	-0,99	0,60	0,71	0,15	0,56	4,35
Slovenia	4,46	0,81	1,58	0,39	0,22	0,17	1,20	0,86	0,34	0,48	0,04	0,44	1,58
Slovakia	6,16	1,38	1,11	0,17	0,10	0,07	0,94	0,81	0,12	0,43	0,16	0,27	3,25
Finland	3,00	0,55	0,86	0,16	0,10	0,06	0,70	0,38	0,32	0,11	0,05	0,06	1,48
Sweden	2,98	0,69	0,86	0,07	0,06	0,01	0,79	0,69	0,10	0,14	0,05	0,08	1,29
United Kingdom	2,66	0,40	2,10	0,30	0,21	0,09	1,80	1,30	0,50	0,18	0,09	0,09	-0,02

Source: Eurostat and authors' elaboration

Table A.6.2. Economic growth sources. HEIs economic growth contribution. 2007-2015 (Percentage)

	GVA	Tangible capital	Labour							Technological Capital			TFP
			Total	HEIs			Counterfactual			Total	HEIs	Counter-factual	
				Total	Quantity	Quality	Total	Quantity	Quality				
European Union-28	**0,40**	**0,29**	**0,58**	**0,30**	**0,14**	**0,15**	**0,28**	**-0,08**	**0,36**	**0,19**	**0,06**	**0,14**	**-0,67**
Belgium	0,78	0,21	0,86	0,27	0,15	0,12	0,59	0,23	0,35	0,29	0,06	0,22	-0,57
Bulgaria	1,14	1,67	-0,11	0,21	0,09	0,12	-0,32	-0,51	0,19	0,68	0,05	0,63	-1,11
Czech Republic	0,94	0,60	0,47	0,29	0,15	0,14	0,18	0,06	0,12	0,61	0,19	0,41	-0,74
Denmark	-0,06	0,12	0,49	0,26	0,12	0,14	0,22	-0,17	0,39	0,32	0,16	0,15	-0,98
Germany	0,79	0,16	0,64	0,15	0,09	0,06	0,49	0,33	0,16	0,24	0,05	0,19	-0,25
Estonia	0,03	1,19	-0,02	0,16	0,07	0,09	-0,19	-0,30	0,11	0,92	0,32	0,60	-2,06
Ireland	1,11	0,62	0,14	0,36	0,15	0,22	-0,23	-0,73	0,50	0,49	0,12	0,37	-0,13
Greece	-3,44	-0,11	-1,01	0,20	0,03	0,17	-1,22	-1,76	0,55	0,30	0,05	0,25	-2,62
Spain	-0,27	0,39	-0,29	0,27	0,08	0,19	-0,56	-1,09	0,53	0,32	0,08	0,24	-0,69
France	0,56	0,36	0,98	0,39	0,20	0,19	0,60	0,09	0,51	0,11	0,04	0,07	-0,88
Croatia	-1,22	0,61	-0,03	0,35	0,15	0,19	-0,38	-0,74	0,36	0,12	-0,05	0,17	-1,91
Italy	-0,98	0,08	0,46	0,23	0,11	0,12	0,23	-0,20	0,44	0,15	0,02	0,13	-1,67
Cyprus	-0,83	0,70	0,31	0,31	0,13	0,17	0,00	-0,35	0,35	0,46	0,33	0,13	-2,29
Latvia	-0,35	-0,12	-0,53	0,30	0,11	0,19	-0,83	-1,12	0,29	0,53	0,27	0,25	-0,23
Lithuania	0,74	1,25	-0,16	0,31	0,13	0,18	-0,47	-0,68	0,21	0,64	0,38	0,26	-0,99
Luxembourg	1,50	1,14	2,32	0,69	0,42	0,28	1,63	1,14	0,49	0,17	0,11	0,06	-2,13
Hungary	0,49	0,53	0,74	0,23	0,13	0,09	0,52	0,45	0,07	0,47	0,02	0,45	-1,25
Malta	4,16	0,72	2,45	0,43	0,26	0,17	2,02	1,14	0,89	0,70	0,22	0,48	0,29
Netherlands	0,48	0,26	0,20	0,21	0,09	0,11	-0,01	-0,23	0,22	0,17	0,06	0,11	-0,16
Austria	0,58	0,35	1,39	0,65	0,33	0,31	0,74	0,38	0,36	0,36	0,08	0,28	-1,51
Poland	3,09	1,79	0,85	0,36	0,19	0,17	0,48	0,30	0,18	0,77	0,25	0,52	-0,31
Portugal	-0,46	0,00	1,24	0,55	0,25	0,30	0,69	-0,77	1,45	0,51	0,24	0,27	-2,21
Romania	1,47	1,73	-0,23	0,21	0,09	0,12	-0,44	-0,51	0,07	0,38	0,11	0,27	-0,40
Slovenia	0,04	0,13	0,16	0,41	0,19	0,23	-0,26	-0,57	0,32	0,56	0,04	0,52	-0,81
Slovakia	2,07	0,50	0,35	0,21	0,11	0,10	0,13	0,09	0,04	0,79	0,37	0,42	0,43
Finland	-0,81	0,26	0,27	0,24	0,10	0,13	0,03	-0,30	0,33	0,06	0,04	0,03	-1,40
Sweden	1,24	0,64	0,84	0,32	0,18	0,15	0,52	0,27	0,25	0,09	0,07	0,03	-0,33
United Kingdom	0,88	0,33	1,04	0,43	0,23	0,20	0,61	0,25	0,36	0,13	0,06	0,08	-0,61

Source: Eurostat and authors' elaboration.

7 Conclusions

Esta Tesis doctoral se compone de cuatro capítulos principales, del tercero al sexto, escritos en inglés, lengua no oficial de la Universitat de València. Por ello, además de la introducción, se ha optado por escribir este último capítulo en castellano que, siguiendo la normativa de la Universitat de València, tiene como objetivo presentar, de forma abreviada, los principales fines y los resultados más significativos que se han derivado de esta Tesis doctoral.

La sociedad española ha experimentado una transformación sin precedentes en las últimas décadas desde diferentes puntos de vista, siendo uno de los más relevantes el significativo aumento del nivel educativo medio de sus ciudadanos. En efecto, los años medios de estudio de un individuo representativo han pasado de 7,1 a 11,5 entre 1980 y 2017. Este dato agregado responde tanto a una reducción hasta mínimos históricos de la población analfabeta -prácticamente inexistente en la actualidad-, como a un aumento 22 puntos porcentuales en el porcentaje de población con estudios universitarios, llegando al 29,7% en 2017. Esta última circunstancia es la que motiva todos los análisis desarrollados en los capítulos previos en busca de evidencia empírica del papel que efectivamente juega la educación universitaria en el desarrollo de las sociedades y en particular de la española.

Una primera cuestión que centra muchos de los debates recientes es la existencia de desigualdades entre hombres y mujeres en el mercado laboral. En este contexto, los resultados obtenidos en el capítulo tercero de esta Tesis ofrecen evidencia sobre la importancia de la educación universitaria como un factor modulador de las desigualdades de género en relación al mercado de trabajo. En efecto, los análisis realizados confirman que la educación universitaria tiene un efecto reductor de las desigualdades de género en la actividad laboral, la ocupación y la probabilidad de sufrir situaciones de desempleo. La educación universitaria genera un efecto igualador sobre el comportamiento de hombres y mujeres en el mercado laboral, y por lo tanto también tiene un efecto positivo en una división más igualitaria del trabajo doméstico entre hombres y mujeres. Los efectos de la educación superior discutidos en el documento son significativos y, aunque

es difícil realizar una evaluación cuantitativa, especialmente en términos monetarios, sí deben tenerse en cuenta en las decisiones sobre inversión en educación superior y en el diseño de políticas educativas y de género.

Los análisis realizados muestran que las diferencias en las tasas de actividad por sexo se reducen a medida que aumenta el nivel educativo, siendo nula la diferencia de tasas de actividad entre hombres y mujeres con educación universitaria. Además, los problemas de desempleo son menos agudos entre la población con un nivel educativo más alto, aunque en este caso, la igualación de la tasa de desempleo puede deberse básicamente al hecho de que la destrucción del empleo se ha concentrado principalmente en la población masculina que estuvo ocupada en el sector de la construcción, el más afectado por la actual crisis económica.

Con todo, los datos analizados en esta Tesis revelan que el aumento en el nivel educativo promedio de las mujeres no ha sido suficiente para cerrar la brecha de ingresos entre hombres y mujeres. Por lo tanto, se concluye que la contribución de la educación universitaria a la equiparación de los ingresos salariales entre hombres y mujeres no es tan significativa y no permite eliminar la segregación del mercado de trabajo. Las mujeres se enfrentan a una curva de ingresos salariales limitada por un "techo de cristal" que no existe en el caso de los hombres. Sin embargo, el enfoque propuesto en este documento muestra cuán importante es prestar atención a un rango más amplio de contribuciones de la educación universitaria, y tratar de cuantificarlas razonablemente, ya que centrarse únicamente en los efectos inmediatos y obvios de la educación superior, por ejemplo, los salarios o la tasa de desempleo de los graduados de la educación superior reciente, subestima sus beneficios totales para los individuos y la sociedad. Las medidas monetarias de los impactos de la educación superior en la sociedad habitualmente consideradas subestiman los efectos positivos no monetarios que las actividades universitarias tienen para los ciudadanos en particular, y la sociedad en general. Esta subestimación sucede en tanto que la formación terciaria representa beneficios sociales no monetarios. Estos deben tenerse presente a la hora de cuantificar el verdadero impacto de la actividad de las universidades en la sociedad, al considerar el aumento del

bienestar social de la inversión en educación superior y, en definitiva, a la hora de diseñar la política universitaria, que debe considerar tanto los rendimientos sociales como los privados.

Esta Tesis no solo analiza efectos hacia adelante de la formación universitaria como los comentados en los párrafos anteriores, sino que también considera los determinantes que conducen a los individuos a cursar estudios universitarios.

En particular el capítulo cuarto de la Tesis se dedica a explorar la influencia que el nivel educativo de los padres y su situación profesional tienen sobre el nivel de formación completado por sus hijos. Específicamente, se estima a partir de un modelo probit ordenado la probabilidad de que los jóvenes españoles completen la educación universitaria de acuerdo con ciertas características familiares. Este capítulo presenta estimaciones de modelos probit ordenados para capturar el efecto de diversas variables socioeconómicas, ambientales y culturales sobre el logro y el avance del nivel educativo del hijo distinguiendo además por la influencia del género. Los resultados obtenidos indican que la variable sexo posee una gran relevancia en este análisis. Los resultados muestran que la educación parental es la variable que tiene el mayor impacto en el avance del nivel educativo de los hijos, y que además es la formación completada por la madre la que ejerce el papel más sobresaliente. Por otro lado, la inestabilidad laboral de los padres, representada por contratos de trabajo de carácter temporal, es una de las variables con mayor efecto negativo en el nivel educativo alcanzado por los descendientes. Los resultados revelan, además, que para los jóvenes españoles, *ceteris paribus*, las mujeres tienen más probabilidades de completar la educación universitaria que los hombres. Adicionalmente, conviene destacar que la influencia del estado profesional de los progenitores sobre la probabilidad de que sus hijos terminen la universidad es menor que la influencia ejercida por el nivel educativo, aunque en esta ocasión el efecto es más acusado para los padres que para las madres.

Son otras muchas características familiares las que juegan un papel relevante sobre la probabilidad de completar estudios superiores. Así, el número de hermanos tiene un efecto negativo, que se acentúa en el caso de que estos sean mayores. Por otro lado, las circunstancias económicas de la familia también constituyen un factor determinante de la probabilidad de completar los estudios universitarios. Finalmente, el tamaño del municipio donde reside la familia también incide positivamente si bien tiene, relativamente, el menor impacto positivo de todos los considerados sobre la probabilidad de que los jóvenes completen los estudios universitarios.

Sin duda, los resultados extraídos de este trabajo tienen implicaciones políticas importantes en varios campos. Primero, con respecto a las políticas de género, revelan la importancia continua del papel de la mujer, como madre, en el éxito educativo de sus hijos, destacando que en muchos hogares el apoyo esencial que los niños necesitan con su trabajo escolar recae en gran medida en las mujeres, debido tanto a razones económico-laborales como socioculturales. En segundo lugar, en relación con las políticas educativas, pues los resultados muestran que el acceso a la educación superior en España dista de ser igual para todos, y revelan que el estado socioeconómico o los antecedentes familiares son un factor determinante del éxito educativo. Estos resultados, por lo tanto, subrayan la necesidad de diseñar políticas que garanticen el éxito educativo independientemente del género, el tamaño de la familia nuclear, el nivel de ingresos o el tamaño del municipio de residencia. Estas políticas deben diseñarse adecuadamente para equilibrar la información sobre la políticas de becas; las subvenciones o incentivos fiscales que mejoran las condiciones de aquellos que se encuentra en una situación menos favorable (familias más grandes, con bajos niveles de ingresos o que viven en municipios más pequeños). Sólo de esta manera será posible construir una sociedad equitativa y sostenible que garantice la igualdad de oportunidades educativas para todos sus ciudadanos.

Esta tesis doctoral no podía dejar de poner el foco en la contribución de las instituciones de educación superior (IES), tanto de forma directa sobre la producción de egresados con estudios universitarios como sobre el

desarrollo y el crecimiento económico de los países, en particular de los europeos.

En las economías europeas, las instituciones de educación superior destacan por su contribución al desarrollo del tejido económico y social. El quinto capítulo de la Tesis se centra precisamente en la revisión y la cuantificación de algunas de las contribuciones más relevantes desde el lado de la oferta de las instituciones de educación superior. En este sentido, los ejercicios llevados a cabo miden la contribución directa de la generación de capital humano, así como las contribuciones indirectas que se reflejan en el incremento de las tasas de actividad promedio así como las tasas de empleo.

Las instituciones de educación superior forman a parte de la población y como resultado de ello se elevan las dotaciones y capacidades de su capital humano lo que repercute en una mayor empleabilidad de sus graduados. Los efectos positivos del análisis microeconómico para los individuos generan al mismo tiempo incrementos a nivel agregado de las tasas de empleo de un país. La actividad de las instituciones de educación superior no solo repercute positivamente en los niveles de participación en el mercado laboral, lo que se traduce en un aumento de las tasas de actividad, sino que a su vez, gracias a la mayor empleabilidad de una población más formada se reducen también los riesgos a nivel individual de encontrarse en desempleo y a nivel agregado las tasas de desempleo. Todo ello lleva a elevar las tasas de empleo de los países europeos, es decir que cuentan con una mayor proporción de personas en edad de trabajar ocupadas.

El capítulo analiza estos efectos para los 28 países integrantes de la UE para el periodo 2000-2015. En la metodología aplicada, un análisis contrafactual, el escenario de referencia estimado es aquel en el que no existen instituciones de educación superior. El impacto de la educación superior se obtiene al compararla con el escenario contrafactual en términos de diferencias en el capital humano empleado en el mercado laboral de los países europeos. En el escenario alternativo, aquel en el que no existe capital humano generado por las instituciones de educación superior, a los graduados de educación superior se les asigna un nivel de capital humano,

participación en el mercado laboral y empleabilidad, como les correspondería a los individuos de características similares con estudios postobligatorios. La imputación se basa en los resultados de modelos *probit* específicos para la probabilidad de ser activo y la probabilidad de estar ocupado para cada país.

Las estimaciones obtenidas destacan la relevancia de los efectos económicos de la educación superior sobre el empleo en los países europeos. Los resultados indican que las instituciones de educación superior (IES) son directamente responsables del 7,2% de las dotaciones de capital humano de la población activa en el período 2000-2015. Asimismo, se concluye que las IES contribuyen en dos puntos porcentuales al aumento en la tasa de actividad de los países europeos, y tienen una contribución indirecta de 2,5 puntos porcentuales a la tasa de empleo europea global. Es decir, sin la formación que proporcionan las IES, la tasa de empleo sería un 3,8% menor. Además, este capítulo también muestra que existen importantes disparidades entre los países en estas contribuciones de las IES durante el período, lo que revela la importancia de la educación superior para comprender las diferencias en la evolución de las tasas de empleo de cada país y, en definitiva, de la trayectoria de cada una de las economías de la Unión.

El capítulo sexto de la Tesis está dedicado a revisar y cuantificar algunas de las contribuciones económicas más relevantes por el lado de la oferta de las IES a partir de ejercicios rigurosos y comparables. Se ha cuantificado la contribución directa a la generación de capital humano y capital tecnológico, así como las contribuciones indirectas al crecimiento económico y al aumento del producto interno bruto per cápita.

La idea que sustenta este capítulo tiene su base en que las actividades docentes de las IES aumentan las dotaciones de capital humano y las capacidades productivas de la población. A su vez, este aumento de la dotación de capital humano de la población como consecuencia de la actividad de las IES da como resultado una mayor participación en el mercado de trabajo y un aumento en las tasas de empleo, con una mayor

proporción de personas en edad de trabajar empleadas (efecto de la cantidad de mano de obra). Además, parte de la población ocupada tiene niveles de capital humano más altos gracias a la educación superior (efecto de la calidad del trabajo). Pero la contribución de las IES no se limita a las actividades docentes, sino que también tienen un papel muy activo en las tareas de investigación. En el capítulo sexto se pone en valor el papel que juegan las IES en relación a la I+D+i, pues realizan una parte considerable de las actividades de investigación y desarrollo en los países europeos. Las actividades de investigación y transferencia de las IES generan conocimiento científico y tecnológico, lo que aumenta el capital tecnológico en la economía. Por lo tanto, gran parte de la acumulación de capital tecnológico corresponde precisamente a las instituciones de educación superior (efecto capital de I + D), lo que también conduce a un mayor desarrollo económico en las economías europeas.

En este sentido, en este capítulo se concluye que debido a la existencia de instituciones de educación superior aumenta tanto la oferta de mano de obra cualificada como el capital tecnológico. En este capítulo se cuantifican los efectos positivos de la educación superior en los niveles de producción e ingresos per cápita para los países de la Unión Europea para los primeros tres lustros del siglo XXI. La aplicación de la metodología de contabilidad de crecimiento permite desglosar el crecimiento económico de las economías en las contribuciones correspondientes a cada uno de los factores de producción, así como al progreso técnico o productividad total de los factores.

Las estimaciones obtenidas resaltan la relevancia de las contribuciones de las IES. En la actualidad, suponen un aumento del 13% en el capital humano utilizado en los países europeos y del 23% en capital tecnológico. Las estimaciones indican que la contribución de las IES al crecimiento general de la Unión Europea ha aumentado después de la crisis, a diferencia de otras fuentes de crecimiento. El impacto estimado de la educación superior proporcionado por las IES sobre el PIB per cápita para los 28 países europeos en 2015 es considerable, situándose en torno al 11% para el conjunto de la Unión Europea 28. La contribución a través de dotaciones de

capital humano sería algo mayor que la producida a través del capital tecnológico, pero ambas son relevantes. En resumen, los resultados obtenidos indican que las actividades de las IES son una importante fuente de crecimiento en las economías europeas, lo que contribuye a mitigar los efectos adversos de los períodos de crisis.

A modo de síntesis, podemos señalar que los individuos más educados poseen mayores niveles de confianza en las instituciones y en la población en general, están más comprometidos con la política, la cultura y la ayuda a terceros a través de las actividades de voluntariado. También presentan estilos de vida más saludables y se preocupan más por su salud y, como consecuencia de ello, están más sanos, tienen una mayor esperanza de vida y, en definitiva, sienten una mayor satisfacción con la vida.

Desde un punto de vista económico, su nivel de ingresos es más elevado, y su exposición al desempleo y, consecuentemente, a la pobreza es menor. Poseen mayores habilidades profesionales y ocupacionales, así como mayor productividad y tendencia al emprendimiento.

Asimismo, las sociedades más educadas derivan en sociedades más tolerantes, más abiertas al cambio, con mayor movilidad social de sus ciudadanos, con mayores niveles de confianza donde la conciencia de la equidad es mayor y los problemas derivados de la inseguridad son menores. En estas sociedades la recaudación impositiva es mayor, así como el crecimiento económico y la productividad, la innovación y la flexibilidad del mercado de trabajo, reduciéndose la carga soportada por las finanzas públicas derivada de la menor presión de las políticas sociales, la salud y la prevención del delito.

En resumen, los análisis realizados en esta Tesis sobre diversos aspectos relacionados con los efectos de la educación universitaria confirman su papel nuclear en el desarrollo de las sociedades modernas, no solamente desde una perspectiva económica, sino también desde una perspectiva social.

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