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1. Introducción: contexto y objetivos

La reforma de 2012 a través del Real Decreto-ley 20/2012, de 13 de julio de 2012, ha sido un punto de inflexión importante para la economía española sobre todo en materia de política social. Las áreas de salud, dependencia y educación han sufrido severamente a raíz de los recortes presupuestarios introducidos. Un par de años más tarde, la pandemia ocasionada por el COVID-19 también haría estragos en el sistema sanitario y el sector de atención residencial al evidenciarse las carencias estructurales en materia de recursos y las fallas de coordinación socio-sanitaria.

En el marco de este escenario, la presente tesis tiene como objetivo explorar estas áreas críticas de la política social en España, que constituyen los pilares básicos del Estado de Bienestar, a través de tres dimensiones de análisis.

En primer lugar, el capítulo 2 está dedicado a los efectos del copago en el consumo de medicamentos. Para España, podemos analizar estos efectos tanto en un colectivo determinado como en colectivos con niveles de copago diferente. La reforma introducida el 1 de julio de 2012, que incluyó ajustes al sistema de copago de medicamentos, permitió una serie de análisis interesantes para examinar el efecto de estos cambios en el consumo farmacéutico (Puig-Junoy et al., 2013, 2014a, 2014c). En este conjunto de trabajos se argumenta que en los primeros 9 meses de aplicación de la reforma el número de recetas se ha reducido entre el 14% y 25% dependiendo de la comunidad autónoma. También se puede destacar el trabajo de Puig-Junoy, Tur-Prats y Vera Hernández (2014c) donde se explota, cuantitativamente, el cambio en el copago que acompaña a la decisión de jubilación. En el mismo encuentran que la elasticidad precio de las medicinas sujetas a receta es -0,2 para tratamiento no crónicos y -0,08 para tratamientos crónicos.

Nuestro objetivo es analizar el efecto del copago farmacéutico sobre la propensión a consumir, con y sin receta, en España usando datos cualitativos de la Encuesta Nacional de Salud (ENS) para los años 2003 a 2011-2012. En base a dicha fuente de información explotamos las diferencias en niveles de copago entre funcionarios del gobierno central y otros trabajadores, existentes antes de la reforma de 2012: 10% antes de la edad de jubilación (30% los funcionarios y 40% los trabajadores en general) y 30% después de la misma (30% los funcionarios y 0% los trabajadores en general). Dicha variación en el nivel de copago permite llevar a cabo dos ejercicios: la comparación de ambos tipos de individuos (funcionarios y no funcionarios de gobierno central) y la comparación de individuos en dos periodos de su vida, antes y después de la edad de jubilación.

En segundo lugar, el capítulo 3 se enfoca en una propuesta de política para financiar el sistema universitario español que se encuentra en delicada situación ante la falta de recursos públicos en un futuro inmediato. El modelo español de financiación universitaria (y el de muchos países europeos) depende tremendamente del ciclo político, el estado asume un riesgo financiero mucho mayor que el estudiante y podría ser más progresivo.

Proponemos una experiencia similar a la del Reino Unido, analizamos si un sistema subsidiado de préstamos de carácter progresivo puede funcionar en España. Las características principales que hacen este sistema atractivo son el repago por parte de los estudiantes una vez conseguido un empleo, el horizonte de la deuda (número de años máximo después de los cuales se condona la deuda), baja tasa de interés y un mínimo nivel de exención de ingresos donde si es por debajo de este nivel ese año no se paga la deuda.

Para analizar la aplicación en España, creamos un laboratorio de préstamos donde interactuamos con los distintos parámetros claves (distintas opciones de política) como el nivel de deuda, tasa de interés, nivel de exención de ingresos, tasa de repago y el horizonte de cancelación de la deuda y vemos sus efectos en la distribución del ingreso. Para ello simulamos los ingresos de los individuos (teniendo en cuenta sus trayectorias laborales en un mercado laboral dual como el de España) a lo largo de su vida con los datos de la Muestra Continua de Vidas Laborables (MCVL).

Por último, el capítulo 4 de esta tesis, se centra en las repercusiones de la primera ola del COVID-19 en el sector de asistencia residencial en España. La pandemia ha afectado en mayor medida a la población de riesgo como a aquellas personas con enfermedades previas y a los mayores de 65 años que son las que en general conviven en estos centros residenciales. La pandemia ha impactado de manera desigual en cada comunidad autónoma en función del grado de preparación en términos de recursos médicos, sociales, económicos y organizativo-políticos.

Para este análisis, se exploran los factores candidatos como indicadores de población, sanitarios, de atención residencial y de incidencia y prevención que podrían haber influido en la elevada mortalidad en las comunidades autónomas principalmente a través de las estadísticas del Centro Nacional de Epidemiología, Instituto Nacional de Estadísticas (INE) y el Ministerio de Sanidad, Consumo y Bienestar Social.

El tamaño medio de los centros (número medio de plazas residenciales por centro), la proporción de personal empleado por plaza residencial o el nivel de ocupación (número de personas usuarias sobre disponibilidad de plazas) juegan un papel importante a la hora de reflejar los problemas de financiación que han contribuido a la gran variación regional de las muertes en las residencias de mayores durante la primera ola de la pandemia en España.

A continuación, se expone un resumen de cada uno de los ámbitos de análisis señalados e incluidos en la presente tesis de investigación señalando los principales métodos utilizados y resultados.

2. Ámbitos de análisis y resumen de resultados

2.1. Capítulo 2: Consumo de medicamentos y copago farmacéutico en España.

Antes de la reforma que entra en vigor a partir de julio 2012 en España, los pensionistas afiliados al sistema de Seguridad Social (SS) se encontraban exentos de todo copago mientras que los no pensionistas debían pagar un 40% del precio de venta del medicamento y un 10% para los medicamentos que tratan enfermedades crónicas. Respecto de los regímenes especiales de las mutualidades públicas (como el caso de Muface), el sistema de copagos no hace distinción entre pensionistas y no pensionistas, incluso se mantiene este esquema después de la reforma.

Al momento de este análisis, los datos más actualizados a nuestro alcance eran los proporcionados por la ENS hasta la última oleada del año 2011-2012. Al mismo tiempo, el periodo de relevamiento de esta oleada se realizó entre julio 2011 y finales de junio 2012, no contemplando el impacto de la reforma. Una posterior réplica del ejercicio con las sucesivas ENS de los años 2014 y 2017 no fue posible realizarlo dado que los copagos especificados en la reforma eran asignados según tramos de ingresos que no eran posibles identificar en esta encuesta.

Para este ejercicio queremos probar la hipótesis que la condición de jubilado aumenta la propensión a consumir medicamentos en aquellos jubilados afiliados a la SS, que están exentos del copago antes de la reforma en comparación con los jubilados de Muface. Para cumplir con nuestro propósito utilizamos datos transversales. En concreto, hemos utilizado los microdatos de la Encuesta Nacional de Salud (ENS) desde el año 2003 hasta el 2011-2012 que proporcionan información anterior al impacto de la reforma.

De esta manera, es fundamental señalar que las diferencias de copago (antes de la reforma introducida el 1 de julio de 2012) entre Muface y las personas con SS son: 10% antes de la jubilación (tasa de copago del 30% para los funcionarios públicos y 40% para las personas de la SS) y 30% después de la jubilación (tasa de copago del 30% para los funcionarios públicos y 0% para las SS).

Nos centramos en un modelo de elección discreta donde la variable dependiente es de naturaleza cualitativa, definida como una variable binaria 0/1. En particular, nuestro objetivo es estimar un modelo no lineal como el modelo probit por máxima verosimilitud. Además, exploramos métodos complementarios de estimación, a saber, el método de diferencias en diferencias y el método de la regresión discontinua (Lee y Lemieaux, 2009). De esta manera, planteamos la siguiente especificación (1):

$$I_{itr}^{*} = \alpha + X_{itr}'\beta + \gamma_o R_{itr} + \gamma_1 R_{itr} AGE_{itr} + \gamma_2 R_{itr} AGE_{itr} M_{itr} + \gamma_3 R_{itr} M_{itr} + \delta M_{itr} + \eta_r + \partial_t + u_{itr} \qquad (1)$$

donde $\mathrm{I}_{\mathrm{itr}}^{*}$ es un indicador no observado que trata de aproximar la propensión a consumir medicamentos del individuo i (activo o jubilado), entrevistado en el año t (2003, 2006 y 2011-2012), en la región (comunidad autónoma) r. En cuanto a las variables explicativas del modelo, X representa un vector de características individuales (como sexo, edad, estado civil, nivel educativo, nacionalidad, tamaño del hogar, tamaño de la ciudad de residencia y condiciones de salud como obesidad, tabaquismo y estado de salud auto declarado), R significa si el individuo es jubilado, AGE corresponde a un vector de variables ficticias de rangos de edad y M denota la condición de activo o jubilado adscrito al régimen de mutualidad Muface. Por último, η_r y ∂_t son controles de región y año de entrevista.

En base al primer método de estimación, la variable M identifica el grupo de tratamiento siendo los individuos (activos o jubilados) adscritos a la Seguridad Social el grupo de control. En cuanto al segundo método, la variable R es la que identifica la variación en el nivel de copago que se produce cuando la persona es jubilada adscrita al régimen general de la Seguridad Social.

Dado que I^*_{itr} es no observable, definimos $I_{itr} = 1\ (I^*_{itr} > 0)$. Asumiendo normalidad del término de error, podemos identificar los parámetros del modelo estimando un modelo probit por máxima verosimilitud.

La muestra final de análisis (activos y jubilados) consta de 58.863 observaciones, que se refieren a 17.263 individuos para el año 2003, 24.123 individuos para 2006 y 17.477 individuos para 2011-2012. Además, el total de 58.863 observaciones se divide en 55.727 para individuos de la Seguridad Social, 95% de la muestra total y 3.136 para individuos pertenecientes a Muface, 5% de la muestra total. A nivel nacional, Muface representa el 3% de la población total de España (Muface, 2015), lo que es consistente con el tamaño de la muestra en la encuesta.

Entre los principales resultados, encontramos que la propensión a consumir medicamentos con o sin receta es significativamente mayor en el caso de individuos jubilados. En efecto, ser jubilado adscrito a la Seguridad Social aumenta la proporción a consumir medicamentos sin receta en un 13-14% y con receta un 16-18% en relación al grupo de activos. Además, el efecto de la jubilación es mayor alrededor de la jubilación anticipada (menos de 61 años) en comparación a la edad de jubilación normal, posiblemente como reflejo de un shock de salud (Negrini et al., 2013). Alternativamente, en la muestra de funcionarios de Muface el efecto de jubilado en el consumo de medicamentos con receta no es significativo, por lo que no observamos consumo de medicamentos inducido por la jubilación.

Se destacan en el análisis 5 grupos de medicamentos: (1) Medicamentos riesgo cardiovascular: para el corazón, tensión arterial, colesterol, diabetes y los medicamentos para adelgazar; (2) Medicamentos trastornos mentales: antidepresivos y tranquilizantes; (3) Problemas leves: medicinas para el catarro, gripe, garganta, bronquios, para el dolor y/o bajar la fiebre, reconstituyentes y laxantes; (4) Antibióticos; y (5) Resto medicamentos. Las diferencias en los resultados de las estimaciones por grupos de medicamentos sugieren ser tomadas en cuenta en la formulación de políticas públicas. En este sentido, establecer un buen sistema de copagos implica conocer la elasticidad-precio de cada uno de los diferentes medicamentos. Cuando más sensible sea la demanda a variaciones en el precio, mayor repercusión tendrá la introducción de copago. Es decir, se podrían establecer copagos más altos cuanto mayor sea la probabilidad de que exista riesgo moral (sobreconsumo) y más bajos cuanto mayor sea la eficacia o valor terapéutico del medicamento (Puig-Junoy, 2014b).

2.2. Capítulo 3: Préstamos universitarios contingentes a la renta: diseño y aplicación a España.

Los estudiantes en los distintos países pueden combinan distintas alternativas para financiar su educación superior: ayudas y becas, préstamos y desgravaciones fiscales. Dentro de Europa, no hay un patrón homogéneo. Por ejemplo, en el caso de los países nórdicos, el sistema de ayudas de becas es muy generoso y también hay préstamos garantizados por el gobierno. En otro grupo de países de Europa como Reino Unido y Países Bajos pero que también incluye a Estados Unidos, Australia, Canadá y Nueva Zelanda, el sistema de préstamos está difundido, aunque las ayudas son menos generosas que en los países nórdicos. También otro grupo de países como Austria, Bélgica, Rep. Checa, Francia, Irlanda, Italia, Polonia, Portugal, Suiza y España, los sistemas son menos desarrollados dado que no suelen disponer de préstamos públicos (Anghel et al., 2017).

Un sistema más desarrollado de ayudas debería contar con la posibilidad de ofrecer préstamos a los estudiantes para cubrir sus estudios universitarios. Estos países pueden establecerse como modelos de los que obtener lecciones de las políticas introducidas, la forma en que se ha hecho y los resultados que se han obtenido. Se debe tener en cuenta no obstante que cada país es específico y con una idiosincrasia particular lo que hace pensar en alternativas que sean adecuadas en ese contexto, sin aplicar recetas generales. Sin embargo, para ello es primordial contar con información disponible de estudios de impacto que evalúen estas políticas, cómo han funcionado, y aporten evidencia sobre los efectos causales de los préstamos en el logro educativo en los países que lo aplican.

Hasta el momento la evidencia en el Reino Unido sugiere que el sistema de préstamos para financiar la educación terciaria funciona razonablemente bien. Azmat y Simion (2017) han llevado a cabo un análisis de los efectos en los resultados educativos y mercado laboral y señalan que las reformas no han afectado negativamente la matrícula universitaria entre los estudiantes de grupos socioeconómicos más bajos. Además, sostienen que estas acciones para relajar las restricciones financieras y que vinculan el pago con los ingresos futuros suelen ser una forma rentable de fomentar la educación universitaria. Sin embargo, destacan que el sistema podría mejorarse para promover la participación entre los que están en la parte inferior de la distribución.

A partir de esta evidencia, nos hemos enfocado en el caso español. Ilustramos cómo funcionaría en España un sistema de préstamos similar al que implementó Reino Unido en el año 2007. Hemos adaptado a España la metodología de Deadren et al (2008) con el objetivo de crear un laboratorio para explorar diferentes políticas de préstamos y sus efectos a lo largo de la distribución del ingreso.

El experimento consiste, básicamente, en un aumento de las tasas universitarias y en la oferta de préstamos condicionados a los ingresos. Existe un umbral mínimo de ingresos, y si los prestatarios no reciben un ingreso por encima de este umbral, no tienen que devolver nada del préstamo. En el Reino Unido, este umbral es de 21.000 libras esterlinas. La tasa de interés puede ser baja si esa es la opción de política (aunque una tasa de interés más alta es un elemento clave de la progresividad), y el pago es un porcentaje de los ingresos del individuo. Si después de un período de tiempo, el prestatario no ha devuelto el dinero, el préstamo se cancela.

Para hacerlo necesitamos simular los ingresos de los individuos a lo largo de toda su vida. A través de los datos de la Muestra Continua de Vidas Laborales (MCVL), modelamos, por un lado, las transiciones laborales y por el otro, la dinámica de los ingresos. Ponemos especial atención en la dualidad del mercado de trabajo en España, dado que muchos flujos hacia el primer empleo, y desde el paro, son hacia contratos temporales. La muestra seleccionada para el análisis incluye a los individuos entre 22 y 60 años con un título universitario.

Para el primer ***modelo de las transiciones laborales***, sabemos que en cada momento en el tiempo un trabajador puede estar en uno de tres estados: desempleado (U), empleado en un contrato indefinido (P), y empleado en un contrato temporal (T). Para ello, definimos una matriz de transiciones Π que determina las probabilidades de entrar en el estado st desde el estado st−1.

$$\begin{pmatrix} P' \\ T' \\ U' \end{pmatrix} = \underbrace{\begin{pmatrix} \pi^{PP} & \pi^{PT} & \pi^{PU} \\ \pi^{TP} & \pi^{TT} & \pi^{TU} \\ \pi^{UP} & \pi^{UT} & \pi^{UU} \end{pmatrix}}_{\Pi} \begin{pmatrix} P \\ T \\ U \end{pmatrix}$$

Estimamos Π usando un modelo probit donde Yt es el logaritmo de los ingresos en t y Φ es la función de distribución acumulativa normal:

$$\pi^{s_{t-1},s_t} = \begin{cases} \Phi\left(\beta_1^y y_{t-1} + \beta_2^y y_{t-1}^2\right) & \text{if } (s_{t-1},s_t) \in \{(P,T),(P,U),(T,U)\} \\ \Phi\left(\beta_1^d dur1_{t-1} + \beta_2^d dur2_{t-1}\right) & \text{if } (s_{t-1},s_t) \in \{(U,P),(U,T)\} \\ \Phi\left(\beta_1^y y_{t-1} + \beta_2^y y_{t-1}^2 + \beta_1^d dur1_{t-1} + \beta_2^d dur2_{t-1}\right) & \text{if } (s_{t-1},s_t) \in \{(T,P)\} \end{cases}, \quad (1)$$

donde

$$\begin{aligned} dur1_t &\equiv I\{s_t = s \mid s_{t-1} = r\} \text{ and } s \neq r \\ dur2_t &\equiv I\{s_t = s \mid s_{t-1} = s\} \end{aligned}$$

se refiere si el trabajador había pasado uno o más años en el estado inicial.

Para el segundo ***modelo de la dinámica de los ingresos***, usamos el modelo estándar de dinámica de ingresos en Karahan y Ozkan (2013). Al comienzo de un período de empleo, cada trabajador dispone de un nivel de ingresos. Si no hay cambio de estado laboral, los ingresos siguen un proceso autorregresivo, específico para la edad. Sea el logaritmo de ingresos de un trabajador que permanece en el mismo estado:

$$\log Y_{iat} = \beta \underbrace{X_{iat}}_{observables} + y_{iat}, \quad (2)$$

$$\begin{aligned} y_{iat} &= \alpha_i + \gamma_i a + u_{iat} + z_{iat} & \alpha_i \sim N(0,\sigma_\alpha^2), \gamma_i \sim N(0,\sigma_\gamma^2) \quad (3) \\ u_{iat} &= \varepsilon_{iat} + \theta\varepsilon_{i,a-1,t-1} & \varepsilon_{iat} \sim N(0,\sigma_{\varepsilon,a}^2) \quad (4) \\ z_{iat} &= \rho_a z_{i,a-1,t-1} + \eta_{iat} & \eta_{iat} \sim N(0,\sigma_{\eta,a}^2) \quad (5) \\ z_{i0t} &= 0, \quad \varepsilon_{i0t} = 0 & (6) \end{aligned}$$

Siempre que haya un cambio de estado del tipo PT, TP, UT o UP, estimamos los nuevos ingresos iniciales en función de la edad, la duración del estado previo y los ingresos pasados. Sea el logaritmo de los ingresos de un trabajador que acaba de pasar del estado s al s´:

$$\log Y_t^{ss'} = \beta_1 dur1_{t-1}^s + \beta_2 dur2_{t-1}^s + \beta_2 y_{t-1}^L + \xi_t,$$

y^L_{t-1} denota el nivel de ingresos en el estado anterior s si s ∈ {P, T}, los últimos ingresos observados si s = U y el trabajador ha estado desempleado por solo 1 año, una variable ficticia que indica que falta el último nivel de ingresos en el caso que el trabajador lleve 2 años o más desempleado.

El punto de partida es un escenario base a partir del que se cambian los parámetros con el fin de adaptarlos a la situación fiscal o a las preferencias de política. Mostramos para caso a través de los percentiles de la distribución del ingreso: el valor actual neto de reembolsos por año, los años para devolver el préstamo y el subsidio como porcentaje del préstamo. En un escenario base examinamos: una deuda de 21.000 euros (cercana al coste actual para el gobierno), un tipo de interés del 0%, una tasa de reembolso de préstamos del 10% de los ingresos anuales por encima del umbral de 15.000 euros y la cancelación de la deuda a los 25 años.

Entre los resultados destacamos, que todos los escenarios siguen un patrón similar a lo largo de la distribución del ingreso. En el caso del valor actual neto de reembolsos, dado un cierto nivel de deuda, los ingresos más bajos de por vida de los percentiles más bajos de la distribución del ingreso pagan menos de su deuda, mientras que los que más ganan pagarán más. En relación a los años de repago, aquellos individuos que dispongan un ingreso menor, tendrán más años para poder devolver el préstamo y viceversa. Por último, aquellos individuos que se encuentran en la parte inferior de la distribución del ingreso reciben un subsidio mayor que las personas que se encuentran en los percentiles de ingresos más altos.

2.3. Capítulo 4: El impacto de la primera ola del COVID-19 en el sector de atención residencial en España

La primera ola de la pandemia ocasionada por el COVID-19 golpeó fuertemente a los centros residenciales en España. Según un estudio publicado por IMSERSO (2021), el número total de fallecimientos de residentes con COVID-19 confirmado y con síntomas compatibles desde inicios de la pandemia hasta la actualidad (mayo 2021), asciendió 30.233 personas. Sin embargo, la primera ola ya había generado 20.301 muertes representando un 67% de este total, lo que significa la gravedad con la que ha impactado esta pandemia en sus inicios en este colectivo.

Al momento de la primera ola, los datos publicados entre comunidades no eran completamente homogéneos porque algunas regiones diferenciaban las muertes de COVID-19 de las muertes con síntomas compatibles de la enfermedad a través de pruebas específicas, pero otras no llevaban a cabo esta distinción. Por ello, para el análisis se utilizó otra medida alternativa que reemplazara al total de muertes por COVID-19, esto es, el exceso de mortalidad. El exceso de muertes o mortalidad se calcula como la diferencia entre el total de muertes desde marzo hasta el 16 de mayo de 2020 menos el total de muertes desde marzo hasta el 16 de mayo de 2019 para cada región, información publicada por el Sistema de Vigilancia de la mortalidad diaria (MoMo).

Para analizar el impacto de la primera ola del COVID-19 en el sector de atención residencial llevamos a cabo un análisis multivariante con un máximo de 19 datos que corresponden a las 17 comunidades autónomas más las ciudades autónomas de Ceuta y Melilla. Examinamos la relación que existe entre la fracción de fallecimientos por COVID-19 en residencias en relación al exceso de mortalidad con una serie de variables explicativas como las plazas disponibles, la proporción de población mayor de 65 años o más, el nivel de cobertura (número de plazas disponibles en relación a la población de 65 años o más), la incidencia inicial del Covid-19 (muertes a 14 de Marzo), el volumen de usuarios relativo a la población mayor, el tamaño medio de los centros residenciales (número de plazas residenciales por centro), el nivel de ocupación (número de personas usuarias y plazas disponibles), el nivel de empleo en los centros residenciales respecto de las plazas disponibles y finalmente una variable dicotómica que indica si existe o no coordinación sociosanitaria.

Cuando incluimos todas las variables en el modelo, los factores explicativos más importantes son el nivel de cobertura, el volumen de usuarios relativo a la población mayor, el nivel de empleo, el tamaño medio de los centros y el nivel de ocupación. Tanto el nivel de ocupación como el nivel de empleo en residencias las utilizamos como medida de la falta de recursos y personal en los centros residenciales como un posible determinante en el aumento de la fracción de muertes en los centros residenciales respecto del exceso de muertes.

El nivel de empleo en el sector de atención residencial en relación a las plazas disponibles presenta una asociación significativa y negativa con la fracción de muertes en este sector. Esto significa que un trabajador adicional por plaza residencial en el sector reduce 0,5 puntos porcentuales la fracción de muertes en residencias. Por otra parte, a mayor nivel de ocupación en los centros de atención residencial en las regiones, mayor número de muertes en los centros residenciales como porcentaje del exceso de muertes. El nivel de ocupación aumenta en 0.013 puntos porcentuales la fracción de muertes en residencias.

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CAPÍTULO 2: Drug consumption and pharmaceutical copayment in Spain

Abstract

In this paper we estimate the effects of copayment in Spain on access to pharmaceuticals in two samples of covered workers with different levels of copayment: The Spanish Social Security system (SS) and the sample of civil servants (Muface), using data from the 2003, 2006 and 2011-12 waves of the Spanish National Health Survey (SNHS). The main results reveal that being retired, depending on the retirement age and health status, increases the proportion of consuming prescription medicine between 16% and 18% for the group covered by the SS compared to the active population; mainly fueled by the copayment exemption at the retirement decision. On the other hand, being a Muface retiree, especially among men, has less effect, not statistically significant different from zero, to whom copayment does not change upon retirement. Finally, we find distinct effects in each group of drugs, which should be considered in public policy decision-making.

Keywords: copayment, drug consumption, health insurance

JEL codes: C25, I18

1. Introduction

Medicines play an essential role in life due to their effects on health. At international level, Spain is the second largest pharmaceutical consumer per capita in the world (Laporte and Bosch, 2012). However, in recent years owing to the introduction of a series of measures to control expenditure, prescription drug consumption has slowed down markedly (Antoñanzas et al., 2014; BOE, 2012; Cortès-Franch and López-Valcárcel, 2014; Puig-Junoy, 2014). As a result, ambulatory pharmaceutical spending (which excludes drugs dispensed in hospitals) as a percentage of total health expenditure has passed from 22% in 2007 to 16% in 2012. An important exception to drug copayment is the case of pharmaceuticals consumed in hospitals, which in contrast, have been rising annually between 1% and 2%. Overall, ambulatory pharmaceutical expenditure during 2010-2013 has decreased by 16% according to the Spanish Ministry of Health. But, in relative terms, Spain is well above the figures of Central and Northern Europe (Jiménez-Martin, 2014), which means there is huge room for improvement.

Recent empirical evidence (see Puig-Junoy et al., 2013, 2014b and c) shows that one of the important mechanisms to control pharmaceutical expenditure is cost-sharing and copayment. In the Spanish case we have at least two possible ways to study the effects of pharmaceutical copayment on drug consumption. First, we can examine the effect of copayment changes for a particular group and second, we can compare the pharmaceutical consumption of groups of individuals with different levels of copayment.

As regards the first line of work, the recent copayment reform, introduced on 1 July 2012, provides new evidence to examine the impact of copayment changes for prescription medicine applied to a certain population of interest. Excellent studies of this kind can be found in Puig-Junoy et al. (2013, 2014b, 2014c). These studies have emphasized that nine months after the reform took place, the number of prescription medicines has gone down between 14% and 25% depending on the Spanish Autonomous Community. It is also worth mentioning the paper of Puig-Junoy, Tur-Prats and Vera Hernández (2014a) that provides a more quantitative analysis of the effects of the coinsurance exemption on pharmaceutical consumption upon retirement. The authors find that the price-elasticity of prescription drugs is -0.2 for non-chronic condition drugs and -0.08 for chronic conditions drugs. When revising empirical literature on copayments, a strong relationship is found between the type of copayment (usually determined by the health insurance adopted) and pharmaceutical consumption. Copayment literature goes beyond prescription medicine and also focuses on the effects on health care services (primary, specialized and ambulatory care) and equity (Kiil and Houlberg, 2014).

The main contribution of this paper is to estimate the effects of copayment on the propensity to consume pharmaceuticals between two groups before and after retirement, namely: civil servants from the Central Government (Muface) and individuals covered by the Spanish Social Security System (SS). We use qualitative cross-sectional data of pharmaceutical consumption from the 2003, 2006 and 2011-12 waves from the Spanish National Health Survey (SNHS). We need to clarify that the data used in this paper is exclusively before the reform in 2012. Even when the dataset from the wave 2011-12 corresponds to the same year of the reform, in the survey methodology for the wave 2011-12 it is specified that data is collected between July 2011 and June 2012, just before the reform took place.

It is crucial to note for our analysis that copayment differences (before the reform) between Muface and SS individuals are: *10% before retirement* (30% copayment rate for civil servants and 40% for SS individuals) and *30% after retirement* (30% copayment rate for civil servants and 0% for SS individuals).

This important change in cost-sharing for prescription medicine granted to retired people is key to understand pharmaceutical consumption of SS compared to Muface individuals, to whom copayment rate does not change upon retirement. At a glance, it is perceived a remarkable difference in the propensity to consume of retired people relative to the active population covered by the SS, which is induced by the copayment exemption. In contrast, variations in consumption upon retirement are not clearly observed among retired and active individuals from Muface.

Our main result indicates that being retired increases pharmaceutical consumption, especially for retirees covered by the SS who are exempted from copayment and hence, pay zero for their prescription medicines. Indeed, being a SS retiree increases the probability of drug demand by 13-14% and by 16-18% for prescription medicine. Alternatively, we do not find important effects for individuals covered by Muface, mainly for men.

The methodology of this paper combines two complementary methods of estimation: the Difference-in-Difference approach and the Regression Discontinuity Design (see Lee and Lemieaux, 2009). Regarding the first technique, we compare the consumption of individuals to whom the only difference resides in to be a civil servant of Muface or not. In the second case, we examine the variation in the level of copayment upon retirement for the individuals covered by the SS.

The remainder of the paper is as follows. In section 2 we describe the literature about the effects of copayment on pharmaceutical consumption. In section 3 we summarize the coverage of the Spanish health system. In section 4, we describe the data and methodology. In section 5 we present estimated results of the effects of copayment on pharmaceutical consumption. Finally, section 6 summarizes the main conclusions.

2. Literature review

There are many associated factors (sociodemographic and health-related variables) affecting access to health services. Significant predictors for health care utilization are age, sex, income, level of education, individual's health status and prevalence of chronic diseases, smoking and food habits, type of insurance and place of residence. However, one of the associated factors most studied in the literature is the effect of copayment on the use of health services as well as its price-elasticity.

Empirical evidence is wide and consistent. Kiil and Houlberg (2014) review the quantitative evidence from 1990 to 2011 of the effects of copayment within the health area across a wide range of countries. The authors analyze a total of 47 studies and find that in a great majority of cases copayment discourages individual demand for prescription medicine and health care services (primary, specialized and ambulatory care).

A reference study about the effects of copayment on health is the Rand Health Insurance Experiment carried out in United States between 1974 and 1982. The purpose of this experiment was to provide health insurance to more than 5,800 individuals from 2,000 households in 6 different regions in United States (creating a representative sample of families with 62-year-old adults). The project randomly assigned health insurance plans to families, with different levels of cost-sharing, which ranged from full coverage to plans that provided almost no coverage upon a determined amount that was incurred during the year (Aron-Dine, et al., 2012).

The main findings suggest that the participants in cost-sharing plans, spent less on health care than the control group who received "free care" services (full coverage). Moreover, the copayment had no adverse effects on participant health, although in poor families with bad health status, full coverage led to improvements in hypertension, dental health, vision and selected serious symptoms. Indeed, the average price-elasticity of demand on health was estimated in -0.2 among the different services included in the experiment (Rand Health, 2006).

There are also other studies that analyze the effects of copayment on different types of medicine (Goldman, et al., 2004; Landsman, et al., 2005; Arcidiacono et al., 2013). Landsman et al. (2005) conclude that retail prescription medications within 9 therapeutic classes experience a decline when they are subjected to an increased copayment rate. However, depending on the type of medication, its price-elasticity differs. The authors find that patients are more sensitive to copayment increases in nonsteroidal anti-inflammatory drugs (NSAIDs) and triptans for the treatment of migraines and cluster headaches (the elasticity of demand ranges from -0.6 to -0.24). On the contrary, drugs for the treatment of hypertension (ACE inhibitors, ARBs) and lipid lowering (statins) are less elastic to copayment increases (the elasticity of demand ranges from -0.16 to -0.10).

Goldman et al. (2004) focus on 8 therapeutic classes of drugs and establish that antihistamines as well as NSAIDs are the most affected to copayment changes. Actually, increasing copayment levels by 100% in each therapeutic class reduce the use of NSAIDs by 45% and the use of antihistamines by 44% while the consumption of other medicines are diminished between 34% and 25%. Among patients with chronic illness and receiving ongoing care, the use of specific medicines is less responsive to copayment changes.

Arcidiacono et al. (2013) estimate the price-elasticity of demand of ulcer and reflux drugs between branded and generic drugs within and across therapeutic classes in United States. They find that if a copayment rate is imposed, the price-elasticity for branded drugs ranges from -1.5 to 5.1. They also estimate cross-price elasticities for the lansoprazole which has two branded forms and a generic option. Finally, they observe that changes in the generic product have a substantial effect on its branded form with a cross-price elasticity of 0.69 while the cross-price elasticity for branded lansoprazole is 0.10.

At the same time, other studies point out the implications of user chargers (copayment, coinsurance, deductible and reference pricing) for prescription drugs on efficiency and equity. In this line, we find the article of Gemmill et al. (2008) who review 173 studies from 15 high-income OECD countries. In general, the authors argue that there are few studies that examine the impact of these costs on health due to the difficulty of gathering long-term information. International evidence indicates that copayments affect vulnerable populations the most, jeopardizing equity of access to care. In addition, studies find that poorer people reduce their use of prescription drugs even when increases in copayment levels are very low. This could be the case of Medicaid[1] beneficiaries in United States who also face significant financial and non-financial barriers to accessing prescription drugs.

Tamblyn et al. (2001) analyze the adverse effects of a reform in the Canadian province of Quebec in 1996 on adult and disadvantaged populations. This reform intended to improve equity access to prescription medicine providing compulsory coverage for all residents. In order to finance this program, it was established a deductible and 25% coinsurance for older and poorer people who already received free medicines. After the reform implementation, it was observed that the use of essential drugs decreased by 9.12% in older people and by 14.42% in poorer people. Besides, the use of less essential drugs diminished by 15.14% and 22.39%, respectively.

Regarding the Spanish case, Puig-Junoy et al. (2011) evaluate the impact of coinsurance exemption for prescription medicine for those individuals transitioning into retirement at age 65[2] (copayment drops from 40% to 0% upon retirement until 2012 reform). According to the most conservative estimates, copayment exemptions for the elderly raise consumption on prescription medicine by 9.5% and pharmaceutical expenditure by 15.2%. Moreover, Puig-Junoy et al. (2014a) estimate the price elasticity of prescription drugs for retired individuals and find that it is -0.2 for non-chronic condition drugs and -0.08 for chronic condition drugs.

Saludas (2013) reports descriptive evidence on pharmaceutical expenditure between retired individuals covered by the SS and Muface for the years 2009 to 2011. A retiree of Muface has a coinsurance rate of 30% for prescription medicine (the same as non-retired individuals) while a SS retiree, as noted earlier, can obtain complete free access to prescription medicines. The author shows that the average pharmaceutical expenditure of a SS retiree is 62.4% (1,055.9 euro) more than the average expenditure of a Muface retiree (650.1 euro).

In sum, these studies seem to indicate that price-elasticity plays a key role in pharmaceutical consumption. Depending on the type of medication, its demand can be more or less elastic. For instance, when copayment rates are increased, the demand for medicine for acute

[1] In United States there are two types of health insurance plans aimed at a target population: Medicare and Medicaid. Medicare provides health coverage to adults above 65 years old. Medicaid offers health coverage mainly to poorer groups but also provides long-term care for older people not included in the Medicare program: available at: https://es.medicare.gov/your-medicare-costs/help-paying-costs/medicaid/medicaid.html

[2] Until the 2011 reform, the normal retirement age was 65 years old. Indeed, the recent Spanish Law modifies the extension of the legal retirement age from 65 to 67 years, by 2027.

conditions should be more elastic than the demand for drugs that treat chronic diseases. As stated in Landsman et al. (2005), patients can respond differently to copayment increases determined by the treatment received as well as the availability of alternative drug therapies that allow a substitution effect.

3. Institutional framework: health coverage in Spain

The 1986 General Health Care Act outlines the key principles for the Spanish National Health System (NHS). Later on, a set of regulations were approved to establish the whole normative regarding health protection in Spain, namely: Act on the Cohesion and Quality of the National Health System (2003), Act on Guarantees and Rational Use of Medicines (2006), General Public Health Act (2011) and Royal Decree-Law on Emergency Measures for the Sustainability of the National Health System and Improvement of Quality and Safety (2012) (Ministry of Health, 2012).

The responsibilities on health are shared between the central government and the Autonomous Communities. At central government, the main activities comprise the establishment of health basic principles and coordination, planning and training of health professionals, foreign health affairs and policy on medicines. Due to the process of decentralization that ended in 2002, each Autonomous Community is in charge of its health planning, public health and healthcare services management. The NHS, which provides universal coverage and is publicly funded, constitutes the main health insurer among the population. Therefore, understanding the institutional structure of the Spanish NHS is crucial in order to explain the consumption of health care services in Spain (Jiménez-Martin et al., 2008).

At the same time, there are other public institutions of health provision such as mutual funds for state civil servants and private health insurances. Since 1975, special schemes of the Social Security were established by Law: The General Mutual Society for Civil Servants (Muface, Law 29/1975), the General Legal Mutual Society (Mugeju, Law 16/1978) and the Social Institute for the Armed Forces (Isfas, Law 28/1975) (Sevilla, 2006). Muface concentrates a major number of persons compared to the other mutual societies. In 2015, the holders and beneficiaries of Muface reached approximately 1.5 million people, covering 3% of the total Spanish population (Muface, 2015).

Moreover, the holders and beneficiaries of the special schemes may choose to receive public (NHS) or private insurance health care. According to the Muface annual report 2015, 81%

of the total insured people has chosen private insurances and 19% has opted for the public health service. Finally, private health insurances have a significant role in Spain. According to the information from the Association of Insurance Companies in Spain-ICEA (2015), around 10.5 million people were insured by private companies in 2014, increasing 1% in relation to 2013.

4. Data and econometric specification

4.1. Data and variables

In this paper we use qualitative data of drug consumption from the 2003, 2006 and 2011-12 waves of the Spanish National Health Survey (SNHS). The SNHS, jointly conducted by The Ministry of Health, Social Services and Equality (MSSSI) and the National Statistics Institute (INE), is cross-sectional data focused on households nationwide.

The study is published every 3 years, alternating since 2009 with the European Health Survey. The main objective is to monitor the general state of health of the Spanish population though the collection of useful data on a broad range of topics. It contains information on many demographic and socioeconomic characteristics, health conditions and utilization, insurance, access to health care and health behavior. In addition, the survey has three questionnaires: a household questionnaire, an adult questionnaire and a minors questionnaire (not available in 2009). In wave 2003 21,650 adults were interviewed, 29,478 in wave 2006, 22,188 in wave 2009 and 21,007 in wave 2011-12.

For the purpose of our analysis we merged the information of household and adult questionnaires. The resulting database includes data of individuals aged 16 and over from the waves 2003, 2006 and 2011-12. In this dataset we are able to identify the retired status, the health insurance coverage and pharmaceutical consumption for each individual (apart from other relevant socio-demographic variables). In wave 2009, the information regarding health insurance is not provided and for this reason we exclude it from the final sample.

Pharmaceutical consumption in the SNHS is measured qualitatively. In the questionnaire, the interviewee is asked if he/she has consumed any type of medicine, from a list of 20 pharmaceuticals, in the last two weeks before the survey. Additionally, the interviewee should declare if the consumption is through prescription or not. Consequently, we define 3 outcome variables that equal 1 if the individual: a. consumes at least one pharmaceutical, b. consumes at least one prescription pharmaceutical and c. consumes exclusively at least one non-prescription drug.

Lastly, from the list of pharmaceuticals enumerated in the survey we construct 5 main groups of drugs defined as follows: (1) Drugs for cardiovascular system: heart, hypertension, cholesterol, diabetes, and drugs for losing weight; (2) Drugs for mental disorders: antidepressants, sedatives and tranquilizers; (3) Mild problems: pain relievers for migraine, headaches, fever, flu and throat pain, diuretics and vitamins; (4) Antibiotics; (5) Other drugs. For each group we create a dummy variable that takes value 1 when the individual consumes at least one drug of that type. Dummy variables are also created for at least one prescription drug consumed in each group of drugs.

In sum, for the purpose of estimation we are interested in a sample of retired and active individuals aged 15 years old and over (in waves 2003 and 2006, the population interviewed start at the age of 16 and in the wave 2011-12 it also includes individuals aged 15 years old) and therefore we omit the fraction of inactive population such as students, individuals fulfilling domestic tasks and other situations. As a result, our final dataset consists of 58.863 observations, which refers to 17.263 individuals for the year 2003, 24.123 individuals for 2006 and 17.477 individuals for 2012. Moreover, the total 58.863 observations are divided into 55.727 for Social Security individuals, 95% of total sample and 3.136 for Muface individuals, 5% of total sample. As mentioned before, Muface accounts for 3% of the total population of Spain, which is consistent with the sample size in the survey.

4.2. Econometric specification

We aim to analyze the effect of copayment changes in Spain on the propensity to consume pharmaceuticals for overall drugs and for the 5 main groups of drugs aforementioned. In order to fulfill this purpose, we use two complementary econometric strategies: The Difference-in-Difference approach and the Regression Discontinuity Design (Lee and Lemieux, 2009). For estimating the effects of copayment on the propensity to consume pharmaceuticals we consider two groups: the treatment group, SS individuals, and the control group, Muface individuals. For the first group copayment changes dramatically after retirement (from 40% to 0%), while for the second one, copayment rates do not change after retirement. We examine retirement at all potential ages (basically from 60 onwards), but focus on two key ages: the early retirement age and the normal retirement age. Retirement at the normal retirement age (65) is generally unrelated to health, while retirement at the early retirement age (61) can be related to health or unemployment (see Garcia-Gómez et al. (2014) for a description of retirement regulation in Spain). For that reason, we also include the self-perceived health of individuals as well as income with the purpose to control for endogeneity upon retirement[3].

In greater detail we consider the following econometric specification:

$$I_{itr}^{*} = \alpha + X_{itr}'\beta + \gamma_o R_{itr} + \gamma_1 R_{itr} AGE_{itr} + \gamma_2 R_{itr} AGE_{itr} M_{itr} + \gamma_3 R_{itr} M_{itr} + \delta M_{itr} + \eta_r + \partial_t + u_{itr} \qquad (1)$$

where I_{itr}^{*} denotes the propensity to consume pharmaceuticals for the individual i (active or retired), interviewed in year t=2003, 2006 and 2012, in region r; X denotes a vector of covariate explanatory characteristics (age, sex, civil status, education, nationality, household size, size of town of residence and health conditions such as obesity, smoking and self-reported health); R is the retirement status and M is active or retired covered by Muface (being SS the reference group). Additionally, η_r and ∂_t are time and regional fixed effects.

Moreover, our specification includes 3 dummy interactions that relate the retirement status with: age, age and Muface and Muface. The age groups we establish for these interactions are 4: 60-61 years old, 62-64 years old, 65 years old and 66-69 years old. The coefficient of the variable M measures the gap in consumption between SS and Muface for active workers. The coefficient of the variable R denotes the change in consumption associated with retirement for those individuals covered by the SS. The coefficient of the first interaction term $R_{itr}AGE_{itr}$ denotes the consumption variation when the individual is retired among the age groups. The coefficient of the triple interaction $R_{itr}AGE_{itr}M_{itr}$ measures those changes derived from the different copayment rates in SS and Muface upon retirement along with age. Finally, the coefficient of the interaction term $R_{itr}M_{itr}$ captures the effects caused by differences in copayment rates between the two schemes upon retirement (SS and Muface).

On the whole, because I_{itr}^{*} is not observable, we define $I_{itr} = 1\,(I_{itr}^{*} > 0)$. Assuming normality for the error term (u_{itr}) we can identify the parameters of the model, estimating a probit model by maximum likelihood.

[3] We use the self-reported health of individuals at the time they fill in the questionnaire. Another possibility could be the self-perceived health at the moment of retirement. Unfortunately, we do not have access to that kind of information.

4.3. Descriptive evidence

Table 1 presents the descriptive statistics of the SS and Muface samples based on the analysis of the SNHS 2003, 2006 and 2011-12. In this section we analyze the whole dataset for the three waves of the SNHS, which consists of a sample of 72.135 observations: 68.390 for the SS sample and 3.745 for the Muface sample. The SS sample accounts for 95% of total sample whereas the Muface sample accounts for the remaining 5%. As can be seen in Table 1, the most important differences between these two samples are the level of education, health and labor status. As a matter of fact, civil servants are more educated (50% of the population attains higher education) and have better self-reported health (nearly 80% of the population declares a good or very good self-reported health) and the fraction of active population is much larger in the Muface sample (approximately 60% vs. 50% in the SS sample).

Table 1: Descriptive statistics. SS and Muface samples.

SNHS 2003, 2006 and 2011-12

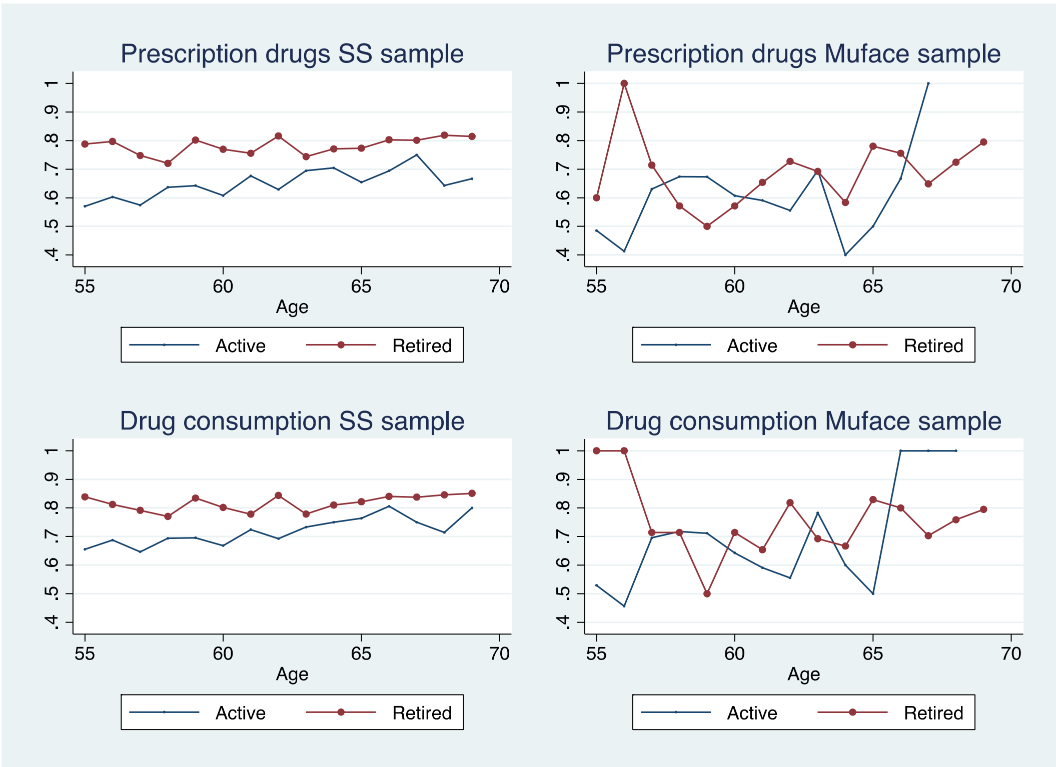
VARIABLES	SNHS 2003, 2006 and 2011-12		
	All=72.135	SS=68.390	Muface=3.745
Sex			
Women	56.8%	56.9%	52.0%
Men	43.2%	43.1%	48.0%
Age			
15-24	8.2%	8.2%	8.3%
25-54	50.2%	49.9%	55.7%
55-59	7.1%	7.0%	9.3%
60-61	2.9%	2.9%	3.2%
62-64	4.0%	4.0%	4.0%
65	1.3%	1.3%	1.2%
66-69	5.5%	5.6%	4.3%
70 and over	20.7%	21.1%	14.1%
Civil status			
Single	26.7%	26.7%	26.7%
Married	55.3%	55.0%	59.2%
Widow	12.8%	13.0%	8.6%
Education			
Lower secondary or less	61.5%	63.3%	28.6%
Upper secondary	18.0%	17.9%	21.3%
Tertiary	20.5%	18.9%	50.0%
Health status			
Very good	13.7%	13.4%	19.7%
Good	50.9%	50.6%	56.7%
Regular	25.4%	25.9%	18.0%
Bad	7.7%	7.9%	4.6%
Very bad	2.2%	2.3%	1.0%
Weight			
insufficient	5.1%	5.1%	5.6%
Normal	53.2%	53.0%	56.4%
Overweight	34.3%	34.4%	32.5%
Obesity	7.0%	7.1%	5.3%
Labor situation			
Employed	42.6%	41.7%	57.8%
Unemployed	7.1%	7.4%	2.0%
Inactive	50.3%	50.9%	40.2%
Autonomous Community			
Andalusia	9.7%	9.7%	9.1%
Aragon	7.0%	6.9%	7.1%
Asturias	3.5%	3.5%	3.7%
Balearic Islands	4.3%	4.4%	3.2%
Canary Islands	4.2%	4.2%	3.7%
Cantabria	4.3%	4.4%	2.9%
Castille-La Mancha	9.6%	9.4%	12.8%
Castille and León	4.2%	4.2%	3.8%
Catalonia	9.1%	9.2%	7.3%
Valencia	6.6%	6.7%	4.9%
Extremadura	3.5%	3.5%	3.4%
Galicia	7.9%	8.0%	7.3%
Madrid	7.7%	7.5%	10.2%
Murcia	**4.9%**	**4.9%**	**5.2%**
Navarra	4.3%	4.4%	2.7%
Basque Country	4.6%	4.6%	4.7%
La Rioja	2.8%	2.8%	2.1%
Ceuta	1.6%	1.4%	5.1%
Melilla	0.4%	0.3%	0.9%

Regarding pharmaceutical consumption, Figures 1 and 2 show the propensity to consume drugs for the elderly (55-69 years old) covered by the SS or Muface, according to some characteristics: sex, health and labor status.

Figure 1 reveals a different propensity towards drug use depending on the labor status and health insurance. We obtained interesting results. As can be seen, for those individuals covered by the SS, drug consumption increases very remarkably with age. Besides, the increase in consumption in retired people covered by the SS is much more impressive comparing to the active population. On the other hand, this behavior cannot be clearly perceived in the Muface sample. These results suggest, as in Saludas (2013), that practically at all ages the propensity to consume drugs is relatively less pronounced among retired individuals covered by Muface than in the SS sample.

Figure 1: Propensity to consume drugs according to age and labor status.

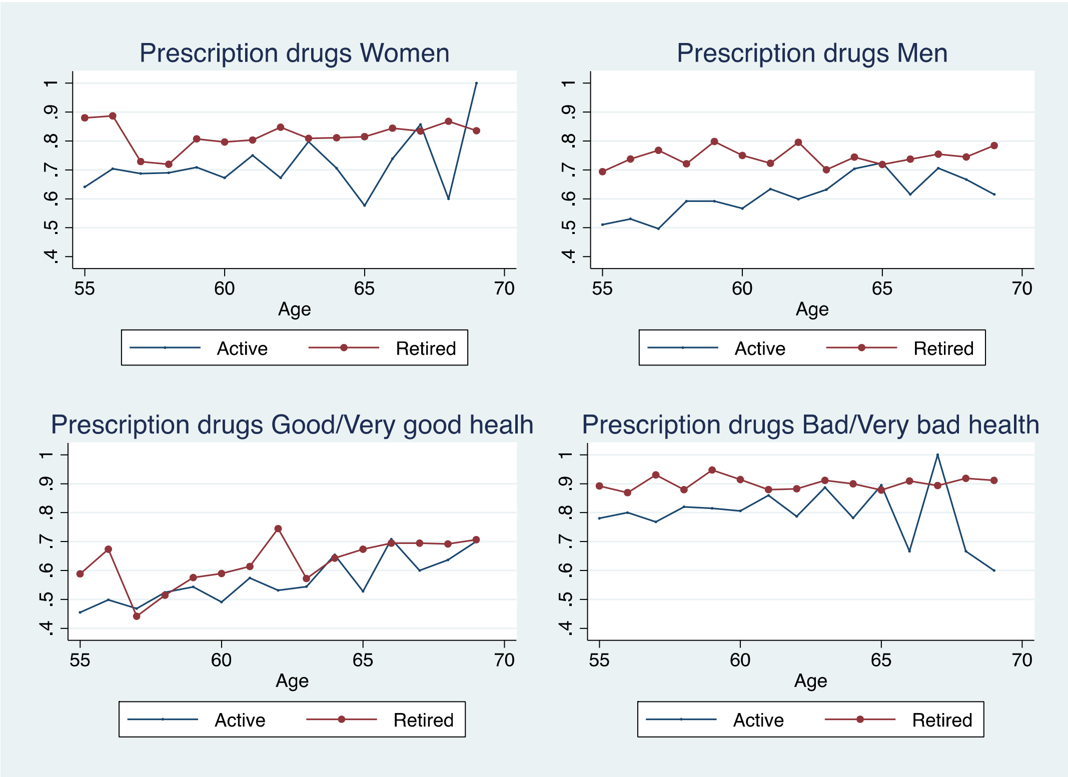
SS and Muface samples. SNHS 2003, 2006 and 2011-12



Finally, Figure 2 depicts differences in prescription drugs by sex (superior panels) and health status (inferior panels) for those individuals covered by the SS. In the superior panel the message is twofold. Women tend to consume more drugs than men but the retirement effect is much stronger on men at any age.

The inferior panel reveals that those individuals reporting poor health are more prone to consume drugs at any age. Additionally, the retirement effect can be observed on individuals reporting either good or bad health although it is much evident in the latter. In sum, the retirement effect is stronger among men irrespective of age and a poor health status can determine even more the prevalence of drug use, especially for retired individuals.

Figure 2: Propensity to consume prescription drugs according to age, sex, health status and labor status. SS sample. SNHS 2003, 2006 and 2011-12



5. Results

In this section we present the estimated results of copayment effects on drug consumption for the whole sample, SS and Muface samples. Table 2 reports the estimates of the effects on drug consumption and prescription drugs obtained with the three samples. As a complementary analysis, Table 3 shows the results for a new specification that includes a health term interaction with retirement using the whole sample. Additionally, the estimated results provided in Table 3 are for drug consumption, prescription and non-prescription medicine and prescription drugs for men and women. Finally, Tables 4 and 5 depict the estimated results in each group of drugs for the whole sample. In all cases we report marginal effects.

5.1. Main results

Table 2 reports estimates of the copayment effects on drug consumption and prescription drugs for the whole sample, as well as the SS and Muface subsamples. A first thing to note is the fact that the coefficient of the variable *good health* is found negative and significant in all the specifications, which means that those in better health are less likely to consume drugs. However, our main variables of interest are those that measure the effect of retirement. The coefficient of the variable *retired* captures the change on drug consumption when individuals aged less than 61 years old transit into retirement (early retirement). The coefficient of this variable has a different meaning depending on the sample (SS or Muface). In the SS sample, the coefficient of the variable retired reflects the change on drug consumption between active and retired individuals induced by copayment variations. In other words, the fact of being retired for those individuals covered by the SS implies an automatically drop in copayment rates for prescription drugs (from 40% to 0%). In the whole sample, the coefficient of the interaction between retired and muface reflects if copayment changes have an effect on individuals covered by Muface, to whom copayment remains unchanged upon retirement (30%). The rest of coefficients value differences of these effects by age.

In particular, we find that the coefficient of the retired variable is statistically significant and positive in drug consumption (individuals at least consume one drug of any kind) and prescription drugs (individuals at least consume one prescription drug) specifications. This means that being retired increases the probability of consuming drugs by 14% and prescription medicine by 18% compared to the active population.

These estimates suggest an implicit maximum elasticity between 0.35 and 0.45[4]. As can be seen in Table 2, coefficient of the variable called *retired at age 65* (legal retirement age) has a significant and negative coefficient for prescription drugs (-3.7% in column 4 from Table 2). The interpretation is straightforward: retirement effect is much stronger on early retirement ages (before 61 years old) and probably as a health shock (Negrini et al., 2013)[5].

[4] We need actually to attenuate maximum value because part of the effect could be due to the drop in the opportunity cost when individuals retire and hence it increases their time availability.

[5] The authors discuss the motivation reasons for early retirement. They define negative and positive considerations that may influence older workers to exit the labor market before retirement age. The negative considerations are stressful working conditions, excessive workload, low wages, health concerns and work pressures. On the other hand, the positive considerations described are related to personal interests such as having more free time, leisure activities and family support, among others.

Besides, the estimations of implicit elasticities are in line with the results found in Puig-Junoy et al. (2014a) who study the retirement effect at 65 years old.

On the other hand, being a *muface retired* (less than 61 years old) decreases the probability of consuming prescription drugs by 5%. For drug consumption, the effect is almost regardless of age. For drug prescription, we find a small drop of the effect on individuals above 65 years old. As observed in Table 2, the conclusions that emerge from the whole sample are comparable to those in the SS sample.

The estimated results from the sample of civil servants are even more interesting. We also observe that the retirement effect is significant and positive for drug consumption (11%) but not for prescription medicine. However, these effects cannot be associated with the copayment exemption. As individuals covered by Muface continue to pay a 30% copayment rate upon retirement, this increase may be subject to time availability that triggers doctor visits and prescriptions. Finally, in the Muface sample, except for the previous result, the retirement effect is not significant in any case; hence we do not observe an increase of prescription drugs due to copayment changes upon retirement in this group of individuals.

Table 2: Drug consumption and prescription drugs. SS and Muface samples. Probit marginal effects. SNHS 2003, 2006 and 2011-12

VARIABLES	Drug consumption			Prescription drugs		
	All	SS	Muface	All	SS	Muface
good health	-0.243***	-0.243***	-0.251***	-0.297***	-0.296***	-0.306***
	(0.00403)	(0.00411)	(0.0202)	(0.00445)	(0.00454)	(0.0220)
retired	0.143***	0.143***	0.116**	0.183***	0.186***	0.0764
	(0.00912)	(0.00924)	(0.0455)	(0.00994)	(0.0101)	(0.0488)
retired_muface	-0.0210			-0.0471*		
	(0.0236)			(0.0248)		
retired_62-64	-0.0153	-0.0161	-0.0814	-0.0135	-0.0157	-0.0306
	(0.0179)	(0.0179)	(0.111)	(0.0192)	(0.0192)	(0.110)
retired_65	-0.0188	-0.0199	0.168	-0.0374*	-0.0394*	0.151
	(0.0195)	(0.0195)	(0.191)	(0.0208)	(0.0208)	(0.242)
retired_66-69	-0.0124	-0.0132	-0.182	-0.0202*	-0.0216*	0.0858
	(0.0108)	(0.0108)	(0.198)	(0.0116)	(0.0116)	(0.173)
retired_muface_62-64	-0.0735			-0.0744		
	(0.0987)			(0.102)		
retired_muface_65	0.132			0.0918		
	(0.160)			(0.228)		
retired_muface_66-69	-0.181			0.0282		
	(0.193)			(0.161)		
62-64_muface	0.0319		0.0323	0.0437		0.0175
	(0.0606)		(0.0722)	(0.0673)		(0.0773)
65_muface	-0.109		-0.142	-0.00485		-0.0644
	(0.240)		(0.250)	(0.237)		(0.248)
66-69_muface	0.102		0.109	-0.0305		-0.0932
	(0.124)		(0.156)	(0.160)		(0.168)
Observations	58,863	55,727	3,136	58,863	55,727	3,136

Notes: The dependent variable is whether or not the individual consumes any drugs or prescription medicine (cardiovascular, mental disorders, mild problems, antibiotics and others).

-The estimation includes common demographics regarding individual characteristics (age, sex, civil status, education, nationality, household size), health conditions (overweight and obesity, smoking, self-reported health) regional variables (size of town of residence, autonomous community) and time fixed effects.

-Reference group (in order of appearance): poor health, active, active_nonmuface, retired_60-61, retired_muface_60-61 and 60-61_muface.

-Standard errors in parenthesis. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

5.2. Changes in health status and retirement

Table 3 reports additional results using the whole sample, after controlling for changes in the health status of individuals, one of the key determinants of early retirement. As a result, we create a new interaction term that combines health and the retirement effect (where it is equal to 1 if the individual is retired and reports good or very good health and 0 otherwise). Once we control for health status, we still find a significant effect of copayment exemption on medicine consumption. Being retired increases the probability of consuming pharmaceuticals between 13% and 16% (this implies a maximum elasticity between 0.32 and 0.40)[6].

Alternatively, the effect of being muface and retired is much stronger than in the previous specification (-6.2% for drug consumption and -9.8% for prescription medicine). In fact, the net effect for this group is not significant different from zero. On the other hand, we find that the coefficient of the interaction between retired and good health, *retired_good health*, has a positive effect on drug consumption. This implies that differences of drug consumption between individuals with good and poor health become smaller after retirement. For those individuals covered by the SS (column 2), being retired with good health raises the probability of consuming any drug by almost 2% and prescription medicine by 4.2% in relation to the reference group (actives with poor health).

The estimated results when the dependent variable is restricted to non-prescription medicine reinforced the previous findings regarding the substitution effect induced by copayment changes upon retirement. As observed in column 3 in Table 3, the coefficient of the retired variable changes its sign, thus translated into negative consumption. The value of the coefficient implies that being retired diminishes non-prescription medicine by 5%. Indeed, prescription medicine displaces non-prescription pharmaceuticals after retirement.

[6] As a robustness check we consider a specification in which groups of medicines for chronic treatment are excluded because they are subject to 10% copayment rate instead of 40% before retirement. Consequently, the drop-in copayment rate for this group of drugs is from 10% to 0% after retirement. However, results are quite similar to those reported in Table 3. First, if we exclude cardiovascular drugs, being retired increases the probability of consuming pharmaceuticals by almost 16% and 18% for consuming prescription drugs. Second, if we exclude cardiovascular drugs as well as medication for mental disorders, the probability of consuming pharmaceuticals increases by 14% and prescriptions by 16%.

Table 3: Drug consumption and prescription drugs. Specification with health interaction term. Whole sample. Probit marginal effects. SNHS 2003, 2006 and 2011-12

VARIABLES	Drug consumption	Prescription drugs	Non-prescription drugs	Prescription drugs Men	Prescription drugs Women
good health	-0.250***	-0.312***	0.0287***	-0.338***	-0.274***
	(0.00521)	(0.00569)	(0.00269)	(0.00858)	(0.00752)
retired	0.132***	0.158***	-0.0497***	0.162***	0.150***
	(0.0109)	(0.0118)	(0.00574)	(0.0174)	(0.0156)
retired_good health	0.0186*	0.0430***	0.0292***	0.0378**	0.0337***
	(0.00984)	(0.0105)	(0.00691)	(0.0165)	(0.0127)
retired_muface_good health	0.0537	0.0703*	-0.0161	0.137**	0.0223
	(0.0356)	(0.0384)	(0.0171)	(0.0599)	(0.0494)
retired_muface	-0.0618*	-0.0980***	0.0528*	-0.162***	-0.0403
	(0.0369)	(0.0366)	(0.0273)	(0.0507)	(0.0448)
retired_62-64	-0.0161	-0.0154	0.000290	-0.0224	-0.0267
	(0.0179)	(0.0191)	(0.0104)	(0.0251)	(0.0286)
retired_65	-0.0198	-0.0398*	0.0234*	-0.0457	-0.0339
	(0.0196)	(0.0208)	(0.0129)	(0.0302)	(0.0263)
retired_66-69	-0.0131	-0.0219*	0.0100	-0.0307*	-0.0158
	(0.0108)	(0.0115)	(0.00673)	(0.0173)	(0.0143)
retired_muface_62-64	-0.0859	-0.0918	-0.0121	-0.0722	-0.118
	(0.0998)	(0.102)	(0.0410)	(0.127)	(0.169)
retired_muface_65	0.123	0.0731	0.934***	-0.114	0.283***
	(0.167)	(0.235)	(0.00168)	(0.323)	(0.00308)
retired_muface_66-69	-0.187	0.0190	-0.0616***	0.149	-0.169
	(0.193)	(0.162)	(0.00675)	(0.217)	(0.277)
62-64_muface	0.0325	0.0452	-0.00127	-0.0193	0.126
	(0.0607)	(0.0674)	(0.0326)	(0.0891)	(0.0796)
65_muface	-0.107	-0.000699	-0.0661***	0.164	-0.721***
	(0.240)	(0.237)	(0.00125)	(0.275)	(0.00306)
66-69_muface	0.103	-0.0281	0.147	-0.193	0.152
	(0.124)	(0.160)	(0.132)	(0.194)	(0.143)
Observations	58,863	58,863	58,863	28,534	30,329

Notes: The dependent variable is whether or not the individual consumes any drugs or prescription medicine (cardiovascular, mental disorders, mild problems, antibiotics and others).

-The estimation includes common demographics regarding individual characteristics (age, sex, civil status, education, nationality, household size), health conditions (overweight and obesity, smoking, self-reported health) regional variables (size of town of residence, autonomous community) and time fixed effects.

-Reference group (in order of appearance): poor health, active, active_poor health, active_nonmuface_poor health, active_nonmuface, retired_60-61, retired_muface_60-61 and 60-61_muface.

-Standard errors in parenthesis. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Finally, the evidence obtained by sex in Table 3 (fourth and fifth columns) reveals that the estimated results associated with retirement and health status (for those individuals covered by the SS) are similar to those in column 2. However, we actually find some differences regarding the retirement effect in the Muface sample. For men, the coefficient of the retired_muface variable is statistically significant and negative (-16.2%), offsetting the coefficient of the retired variable for those individuals in the SS sample. On the contrary, for women no statistically significant difference is found. This situation might indicate that the increase in consumption induced by more time availability is much deeper in women covered by Muface.

5.3. Different effects among pharmaceuticals

Finally, Tables 4 and 5 present the estimated results in each group of drugs (cardiovascular, mental disorders, mild problems, antibiotics and others). In drug consumption (Table 4) as well as prescription drugs (Table 5), the coefficient of the good health variable is significant and negative in each type of medicine, being medicines for treatment mild problems those with the bigger negative effect on the propensity to consume (-0.211 and -0.238 for drug consumption and -0.250 and -0.242 for prescription medicine, respectively).

Except for antibiotics, the retirement effect in the SS sample is also statistically significant and positive. The marginal effect is much larger (around 15%) for other drugs than for cardiovascular drugs, drugs to treat mild symptoms or mental disorders. On the other hand, being a Muface retired reduces the propensity to consume medicines to treat mild problems, antibiotics and other drugs by 2% and 6%. Moreover, the coefficient of the interaction term retired with good health has a positive effect on the group of cardiovascular drugs and mental disorders. However, in mild problems the coefficient is significant but negative.

Table 4: Drug consumption by type of drugs. Whole sample.

Probit marginal effects. SNHS 2003, 2006 and 2011-12

VARIABLES	Cardiovascular system	Mental disorders	Mild problems	Antibiotics	Other drugs
good health	-0.136***	-0.172***	-0.250***	-0.0354***	-0.242***
	(0.00650)	(0.00484)	(0.00613)	(0.00262)	(0.00634)
retired	0.0605***	0.0626***	0.0776***	0.00506	0.145***
	(0.00863)	(0.00580)	(0.00955)	(0.00351)	(0.00992)
retired_good health	0.0286***	0.0370***	-0.0172**	-0.00201	-0.000844
	(0.00816)	(0.00593)	(0.00817)	(0.00318)	(0.00859)
retired_muface_good health	-0.0138	-0.0293**	0.0363	0.0406*	0.0841**
	(0.0238)	(0.0128)	(0.0325)	(0.0224)	(0.0337)
retired_muface	-0.0112	0.0124	-0.0444**	-0.0149***	-0.0621***
	(0.0188)	(0.0125)	(0.0203)	(0.00564)	(0.0207)
retired_62-64	-0.0105	-0.0237***	0.00410	0.00677	-0.0150
	(0.0115)	(0.00650)	(0.0148)	(0.00628)	(0.0146)
retired_65	-0.00170	-0.0261***	-0.0374**	-0.00176	-0.0332**
	(0.0128)	(0.00681)	(0.0148)	(0.00610)	(0.0152)
retired_66-69	-0.00906	-0.0177***	-0.0127	0.00651*	-0.0113
	(0.00682)	(0.00397)	(0.00828)	(0.00361)	(0.00846)
retired_muface_62-64	-0.0231	0.00374	-0.0492	0.0136	0.0258
	(0.0634)	(0.0649)	(0.0830)	(0.0420)	(0.0929)
retired_muface_65	0.0647	0.910***	0.741***		0.0257
	(0.237)	(0.00225)	(0.00196)		(0.248)
retired_muface_66-69	0.0818	-0.0733***	-0.0111	0.967***	-0.113
	(0.161)	(0.0201)	(0.152)	(0.000821)	(0.114)
62-64_muface	0.00897	-0.0345	-0.0454	0.00250	-0.0272
	(0.0522)	(0.0348)	(0.0629)	(0.0266)	(0.0654)
65_muface	-0.0579	-0.0892***	-0.262***		0.0420
	(0.153)	(0.00144)	(0.00197)		(0.242)
66-69_muface	-0.0857	0.202	0.0227	-0.0346***	0.0948
	(0.0878)	(0.167)	(0.156)	(0.000814)	(0.161)
Observations	58,863	58,863	58,863	58,818	58,863

Notes: The dependent variable is whether or not the individual consumes any drugs (cardiovascular, mental disorders, mild problems, antibiotics and others).

-The estimation includes common demographics regarding individual characteristics (age, sex, civil status, education, nationality, household size), health conditions (overweight and obesity, smoking, self-reported health) regional variables (size of town of residence, autonomous community) and time fixed effects.

-Reference group (in order of appearance): poor health, active, active_poor health, active_nonmuface_poor health, active_nonmuface, retired_60-61, retired_muface_60-61 and 60-61_muface.

-Standard errors in parenthesis. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 5: Prescription drugs by type of drugs. Whole sample.

Probit marginal effects. SNHS 2003, 2006 and 2011-12

VARIABLES	Cardiovascular system	Mental disorders	Mild-moderate pain	Antibiotics	Other drugs
good health	-0.136***	-0.172***	-0.250***	-0.0354***	-0.242***
	(0.00650)	(0.00484)	(0.00613)	(0.00262)	(0.00634)
retired	0.0605***	0.0626***	0.0776***	0.00506	0.145***
	(0.00863)	(0.00580)	(0.00955)	(0.00351)	(0.00992)
retired_good health	0.0286***	0.0370***	-0.0172**	-0.00201	-0.000844
	(0.00816)	(0.00593)	(0.00817)	(0.00318)	(0.00859)
retired_muface_good health	-0.0138	-0.0293**	0.0363	0.0406*	0.0841**
	(0.0238)	(0.0128)	(0.0325)	(0.0224)	(0.0337)
retired_muface	-0.0112	0.0124	-0.0444**	-0.0149***	-0.0621***
	(0.0188)	(0.0125)	(0.0203)	(0.00564)	(0.0207)
retired_62-64	-0.0105	-0.0237***	0.00410	0.00677	-0.0150
	(0.0115)	(0.00650)	(0.0148)	(0.00628)	(0.0146)
retired_65	-0.00170	-0.0261***	-0.0374**	-0.00176	-0.0332**
	(0.0128)	(0.00681)	(0.0148)	(0.00610)	(0.0152)
retired_66-69	-0.00906	-0.0177***	-0.0127	0.00651*	-0.0113
	(0.00682)	(0.00397)	(0.00828)	(0.00361)	(0.00846)
retired_muface_62-64	-0.0231	0.00374	-0.0492	0.0136	0.0258
	(0.0634)	(0.0649)	(0.0830)	(0.0420)	(0.0929)
retired_muface_65	0.0647	0.910***	0.741***		0.0257
	(0.237)	(0.00225)	(0.00196)		(0.248)
retired_muface_66-69	0.0818	-0.0733***	-0.0111	0.967***	-0.113
	(0.161)	(0.0201)	(0.152)	(0.000821)	(0.114)
62-64_muface	0.00897	-0.0345	-0.0454	0.00250	-0.0272
	(0.0522)	(0.0348)	(0.0629)	(0.0266)	(0.0654)
65_muface	-0.0579	-0.0892***	-0.262***		0.0420
	(0.153)	(0.00144)	(0.00197)		(0.242)
66-69_muface	-0.0857	0.202	0.0227	-0.0346***	0.0948
	(0.0878)	(0.167)	(0.156)	(0.000814)	(0.161)
Observations	58,863	58,863	58,863	58,818	58,863

Notes: The dependent variable is whether or not the individual consumes any prescription medicine (cardiovascular, mental disorders, mild problems, antibiotics and others).

-The estimation includes common demographics regarding individual characteristics (age, sex, civil status, education, nationality, household size), health conditions (overweight and obesity, smoking, self-reported health) regional variables (size of town of residence, autonomous community) and time fixed effects.

-Reference group (in order of appearance): poor health, active, active_poor health, active_nonmuface_poor health, active_nonmuface, retired_60-61, retired_muface_60-61 and 60-61_muface.

-Standard errors in parenthesis. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

6. Concluding remarks

In this paper, we estimate the effect of copayment changes on the propensity to consume pharmaceuticals upon retirement for those individuals covered by the SS with data from the SNHS 2003, 2006 and 2011-12, before the 2012 reform. In order to control for the copayment effect, we incorporate those individuals covered by Muface, to whom retirement does not imply a change in copayment levels. We also control for health status because health shocks may affect early retirement decisions.

Our main estimates are in line with previous results obtained in the literature. We find that the retirement effect (retired individuals covered by the SS aged 61 years old or less) increases the probability of consuming drugs by 13 and 14% for drug consumption (at least consuming any drug) in relation to the active population. Because of the reduction in the copayment rate from 40% to 0% upon retirement, these estimates imply a maximum elasticity between 32 and 35%, values that are consistent with most of the recent research (for the Spanish case these results can be found in Puig-Junoy et al. (2014a)).

When we restrict the analysis to prescription drugs (those who buy at least one prescription) the increase is even larger, between 16% and 18% (which implies an elasticity between 40% and 45%), depending on whether we control for health status or not. Likewise, we observe that upon retirement the probability of consuming non-prescription drugs decreases by 5%. In sum, we find that the retirement effect is relatively stronger for those close to early retirement (before turning 61 years old), probably as a health shock, than to normal retirement age at 65 years old. As stated before, these estimates are reasonably similar to those found in Puig-Junoy et al. (2014a) regarding price-elasticity of prescription drugs upon retirement.

Our findings provide suggestive evidence of different responses to copayment changes depending on the type of drug consumed. In general, demand response of drugs for acute symptoms is much greater than that of drugs for chronic conditions. These implications should be considered a priori by policymakers in order to design an optimal copayment scheme. For instance, one possible direction would be to apply smaller copayment rates to drugs with more therapeutic value or efficacy (such as cardiovascular drugs), and larger copayment rates to certain drugs where it is observed overconsumption (moral hazard), such as antibiotics.

This study does have one limitation worth mentioning. Our results are restricted to data availability, which only permits us to analyze the propensity to consume. Clearly, more quantitative information would enhance and extend the research on price-elasticity as well as the effects of copayment on prescription drug demand in Spain.

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CAPÍTULO 3: Income contingent university loans: policy design and an application to Spain

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Abstract

In Europe, the need for additional funding coming from either budget cuts and/or increased costs due to increased competition in university quality has reopened the debate on the financing of university systems. An attractive alternative to the current general-tax-financed subsidies are *Income Contingent Loans* (ICL), a flexible scheme that puts more weight on private resources while enhancing progressivity. One challenge of the viability of ICL systems is the functioning of the labor market for university graduates. This paper offers general analysis of the economics of ICL, followed by an application to Spain. We set up a loan laboratory in which we can explore the distributional effects of different loan systems to finance tertiary education at current costs as well as to increase university funding to improve in its quality. We use simulated lifetime earnings of graduates matching the dynamics of employment and earnings in the Spanish administrative social security data to calculate the burden of introducing ICL for individuals at different points of the earnings distribution and for the government. We find that (1) our proposed structure is highly progressive under all specifications, with the top quarter of the distribution paying close to the full amount of the tuition and the bottom 10% paying almost no tuition; and (2) the share of total university education subsidized by the government is between 16 and 56 percentage points less than under the current system.

JEL Codes: I22, I23, I24

Key words: Income contingent loans, returnable fellowships, university quality, progressivity

1 Introduction

In Europe, the need for additional funding coming from either budget cuts and/or increased university quality competition has reopened the debate on the financing of tertiary education. To date, the prevailing system in the OECD relies on general-tax-financed subsidies to higher education institutions. The main advantage of this system lies on its low costs for the students, which end up bearing a small fraction of the total bill. When the main part of university resources is publicly provided, however, government budget cuts have a strong impact on the survival and quality of tertiary education institutions. This can have perverse effects such as making university quality cyclical or exposing higher education institutions to political uncertainty. In addition, tuition fees are flat across the income distribution of students and the subsidy to institutions is financed with taxes from both college and non-college educated families, making the system regressive. Attractive alternatives that circumvent the main issues of the current systems are graduate taxes or income contingent loans (see Diris and Ooghe (2018)). In this paper, we focus on *Income Contingent Loans*, which offers flexibility in different dimensions and puts more weight on private resources while enhancing progressivity with respect to the prevailing system. This paper offers a general analysis of the economics of ICL, followed by an application to Spain.

In a nutshell, an ICL can be characterized as follows. University students obtain a loan from the government to pay their fees (this could also cover maintenance costs). Repayments start upon graduation and depend on ex-post labor income and are paid at zero or low interest rates. There is a minimum exemption income level below which graduates do not need to pay. Repayments are made for a certain number of years up to a maximum established. It is worth noticing that these loans are very different to traditional students loans, which in general have no insurance aspect, payments are not dependent on actual income after graduation and market determined interest rates. To ease the introduction of this scheme, a natural starting point for the government would be to consider a zero interest rate, which is the baseline policy in our analysis. In this sense, a more appropriate name for this scheme is *Returnable Fellowships.*

We first offer a simple theoretical framework to understand how the general-tax-financed subsidies and the ICLs systems work, as well as their comparison from the government, the tax payers and the universities' points of view. This will allow us to understand government spending, subsidies in both systems and tax burdens in both systems. This simple framework allows to comprehend, among other things, why a general-tax-financed subsidies system is highly regressive, while terminating *free* universities would make the system more progressive. It would also become clear that moving from a general-tax-financed subsidies system to an ICL system would free public resources. We discuss the case in which these resources could be used for other public spending as well as the case that these could be used to increase university quality.

One challenge of the viability of ICL systems is the functioning of the labor market for university graduates. To the extent that the labor market features high unemployment rates for the youth and/or high incidence of temporary employment with low and unstable incomes, as in several European countries, a switch from a general-tax-financed subsidies system to an ICL system is non-obvious. In these dysfunctional labor markets, the high volatility that characterizes flows in and out of temporary employment poses a challenge to expected future income and repayments. In this respect, our application to the Spanish case is particularly interesting, given that the labor market shares a wide set of features with other European countries but it is more extreme.

The university system in Spain has struggled to keep up with the the increasing competition from a more globalized labor and education market. The European University Association defines the Spanish university system as *declining and under pressure*, due to a 16% decrease in public funding and an increase of 26% in enrolled students during the period 2008-2016. According to Education at a Glance (OECD (2016)), Spain is at the tail in education spending compared to other OECD countries. Moreover, the percentage allocated to scholarships and student aid is quite small, below 5% overall and 2% for tertiary education.

In contrast to Spain, the United Kingdom (UK) has been working on increasing university resources through a series of reforms implemented during the last two decades. Among other countries in Europe, the UK was one of the precursors in designing a progressive loan system subsidized by the government to finance higher education. The UK has undergone three main reforms during the last 20 years[1] that included increasing fees and designing an income-contingent-loan system. While it is still relatively early to evaluate the long-run effects, the evidence so far reveals that the system has been working reasonably well in the UK, especially in its progressive nature (Dearden et al., 2008; Azmat and Simion, 2017). Our reference application is to study how a loan system similar to that in the UK 2007 reform would work to finance higher education in Spain and study the distributional implications for lifetime income, the burden of repayments on workers, and the cost to the government.

A common feature of countries with the prevailing financing system is the lack of credit markets for university loans. Beyond the extensive participation margin, which is outside the scope of this paper,[2] the availability of borrowing against future human capital can determine

[1] In 1998, 2007 and 2012.

[2] Azmat and Simion (2017) show that in the UK the increase in university fees together with the intro-

the earnings distribution of the skilled workers by improving the allocation of talent. An example relevant to a case like Spain would be geographical mobility.

Indeed, the main objective of this study is to set up a *loans laboratory* to explore different loan policies and the effects along the income distribution. As mentioned above, one challenge of this exercise will be adding the specifics of the dysfunctional labor market in Spain. In this sense, unlike previous literature, a contribution of this paper is to model permanent and temporary contracts separately.

There is a substantive literature on university funding (see for instance García-Peñalosa and Walde (2000), Diris and Ooghe (2018) and references within) and also several studies have looked into university financing in Spain.[3] Of those, very few have analyzed alternative arrangements to the general-tax-financed status quo. The analysis of the impact of education loans in Spain has been limited to one paper, which focuses on the specific case of loans-to-masters that was implemented in 2007 and lasted only until 2011 (see Collado Muñoz et al. (2017)).[4]

A fundamental element in our loan laboratory are the dynamics of earnings over life. In our analysis, we use simulated lifetime earnings of graduates matching the dynamics of employment and earnings, as well as the earnings cross-sectional distribution, in the Spanish administrative social security data (Muestra Continua de Vidas Laborales y el Módulo Fiscal). Employment transition probabilities are modeled using probit regressions on a set of covariates, including past income and contract duration.

Our framework can replicate the dynamics of employment and earnings in Spain. We use the simulated profiles to calculate the burden of introducing public loans for individuals at different points of the earnings distribution and for the government under different combinations of the aforementioned parameters. We find that (1) our proposed structure is highly progressive under all specifications, with the top quarter of the distribution paying close to the full amount of the tuition and the bottom 10% paying almost no tuition; and (2) the share of total university education subsidized by the government is between 16 and 56 percentage points less than under the current system.

The rest of the paper is organized as follows. In Section 2 we offer a theoretical frame-

duction of ICL did not affect the participation margin.

[3]See, among others, de la Fuente and Jimeno (2011); Beneito et al. (2016); Mora et al. (2002); Escardibul and Perez-Esparrells (2014).

[4]The loans-to-masters program did not prove to be very successful, partly due to the lack of consistency of the conditions (interest rate, repayment horizon, and the like) across years. There was also a grace period stipulated independently of the income level and a monthly fixed repayment, which imposed a heavy burden to graduates at the lower end of the income distribution.

work for thinking about the economics of ICLs. In the rest of the paper we analyze the distributional implications of introducing ICLs to Spain. We discuss the simulation of the life-cycle earnings of graduates in Section 3 and then analyze different settings of ICLs in the loan laboratory in Section 4. In Section 5 we offer a discussion of our findings in terms of policy and conclude.

2 The Burden of University Financing: A Theoretical Framework

In this section, we propose a simple theoretical framework to understand the impact of ICLs on public and universities finances, as well as the implied cost for families. We begin by laying out a generic framework in which the government, universities, and individuals interact with each other. We then use that framework to compare the burden of different higher-education financing schemes, starting with the prevailing general-tax-financed subsidies, the intermediate case of a a graduate income tax, and finally the ICLs in more detail.

In addition to the share of the cost born by public and private agents, we will compare the different systems along two dimensions: (1) *between-group progressivity*, or the extent to which these shift the cost of higher education to skilled and away from unskilled workers; and (2) *within-group progressivity*, referring to redistribution across the income distribution of future university graduates.

2.1 Agents

Three types of agents compose our economy: the government, the public university sector, and workers.[5] Figure 1 summarizes the main features of this section and makes the link between agents explicit. While the earnings dynamics of the workers play a central role, the policy will be evaluated in terms of present values.

Workers

There are two kinds of workers: skilled (s) and unskilled (u), with a mass of N^s and N^u, respectively. Skilled workers are those who have finished college. All individuals live for $T + 1$ periods: period $t = 0$ is mapped into the 4 years of schooling for the skilled agents.

Resources. Within each group, workers are heterogeneous in their earnings. These earnings are exogenous and evolve in a stochastic fashion. Let y_{it}^j denote the individual earnings of a

[5] We abstract from unemployed individuals for the moment since the relevant burden measures are not affected by their presence. In the empirical section, workers will be allowed to become unemployed.

worker i of type j ($j = s, u$) in period t. The specific dynamics of earnings will be discussed in detail in the next section. For this section, it suffices to assume that the average skilled earnings are higher than the average unskilled earnings at all times. Unskilled workers begin receiving earnings in period 0, while skilled workers have to wait until period 1 to receive wages. Depending on the specific financing scheme, skilled workers can receive transfers from the government during the schooling years, denoted by g_H^E, in the form of grants or loans to cover fees and maintenance. We assume these transfers are the same for all university graduates. Similarly, unskilled workers can receive transfers g^{-E} from the pool of public resources that are not devoted to financing higher education.

Expenses. All workers pay income taxes. We assume workers in the same group face the same proportional income tax and that $\tau^s > \tau^u$, which captures the progressive nature of the tax code in a simplified manner. In addition, skilled workers' expenses include college fees f whenever they are in college and loan repayments whenever applicable. Workers *eat* everything left after covering fees, loan, and tax payments. We denote this residual consumption of the numeraire good as c_i.

Government

Resources. The only public resources are the income taxes paid by the workers, as described in subsection 2.1. The total resources of the government are therefore given by

$$T = \tau^s Y^s + \tau^u Y^u, \tag{1}$$

where $Y^j = \sum_{t=1}^{T} Y_t^j$ and $Y_t^j = \int_{i \in \mathcal{S}} y_{it}^j$, for $j = s, u$, where $\mathcal{S}$ is the set of skilled workers. That is, Y^j denotes aggregate lifetime earnings of workers of type j.

Expenses. Let G denote total public spending. We decompose G into two components:

$$G = G^E + G^{-E}, \tag{2}$$

where G^E denotes public spending devoted to financing public higher education and G^{-E} all other public spending. It will be useful to further decompose the amount of government spending in education G^E into payments directly made to institutions G_I^E and transfers to households $G_H^E = N^s g_H^E$.

We assume the government runs a balanced budget:

$$T = G^{-E} + G_I^E + G_H^E. \tag{3}$$

Using equations (2) and (3), and given our assumption that income taxes are proportional to earnings, we can also decompose the resources T into those that are used for higher education and those that are not as follows:

$$T = (\tau_e^s + \tau_{-e}^s)Y^s + (\tau_e^u + \tau_{-e}^u)Y^u, \tag{4}$$

where τ_e^j and τ_{-e}^j $(j = s, u)$ are artificial taxes that will depend on the actual income tax rate and the specific higher education financing scheme. This accounting distinction will be useful to define the burden of public financing on individuals.

University Sector

Resources. Public universities get funding from the government (G_I^E) as well as out of pocket fees paid for by the individuals directly $F = N^s f$.

Expenses. Universities need a minimum payment of C in the form of running costs. C can be thought of as including current professor salaries, maintenance, and the like. In addition, universities could shift extra resources to improve quality. Let $I(Q)$ denote the investment in university quality. We assume there is a basic level of quality $\underline{Q}$ achieved by simply running the university and paying C. That is, $I(\underline{Q}) = 0$. As a result, $I(Q)$ is the amount of university resources, in addition to the maintenance costs, that achieves a level of quality equal to $Q > \underline{Q}$. Higher quality will result in skilled earnings that are $A(Q)$ times higher.

The university budget constraint is therefore given by

$$G_I^E + F = C + I(Q) \tag{5}$$

Using this theoretical framework, we next proceed to introduce the specifics of different higher-education financing systems. For illustration, we will make the following the assumptions when comparing the different systems: (1) We keep quality at its base level so that $I(\underline{Q}) = 0$, which can be understood as $\underline{Q}$ being the current level of value added of university education. (2) The total cost of universities is fixed at $\bar{C}$. (3) Total public spending is fixed at $\bar{G}$ and the budget of the government is balanced, so the resources $\bar{T}$ are fixed as well. (4) We take the earnings streams $\{y_{ia}^s\}_{i\in\mathcal{S},a=1,\ldots,T}$ and $\{y_{ia}^u\}_{i\in U,a=1,\ldots,T}$ as given. Assumptions (3) and (4) also impose fixed total income taxes $\bar{\tau}^u$ and $\bar{\tau}^s$. These assumptions mean we will be evaluating the impact of revenue neutral policy changes in terms of burden shifts between agents.

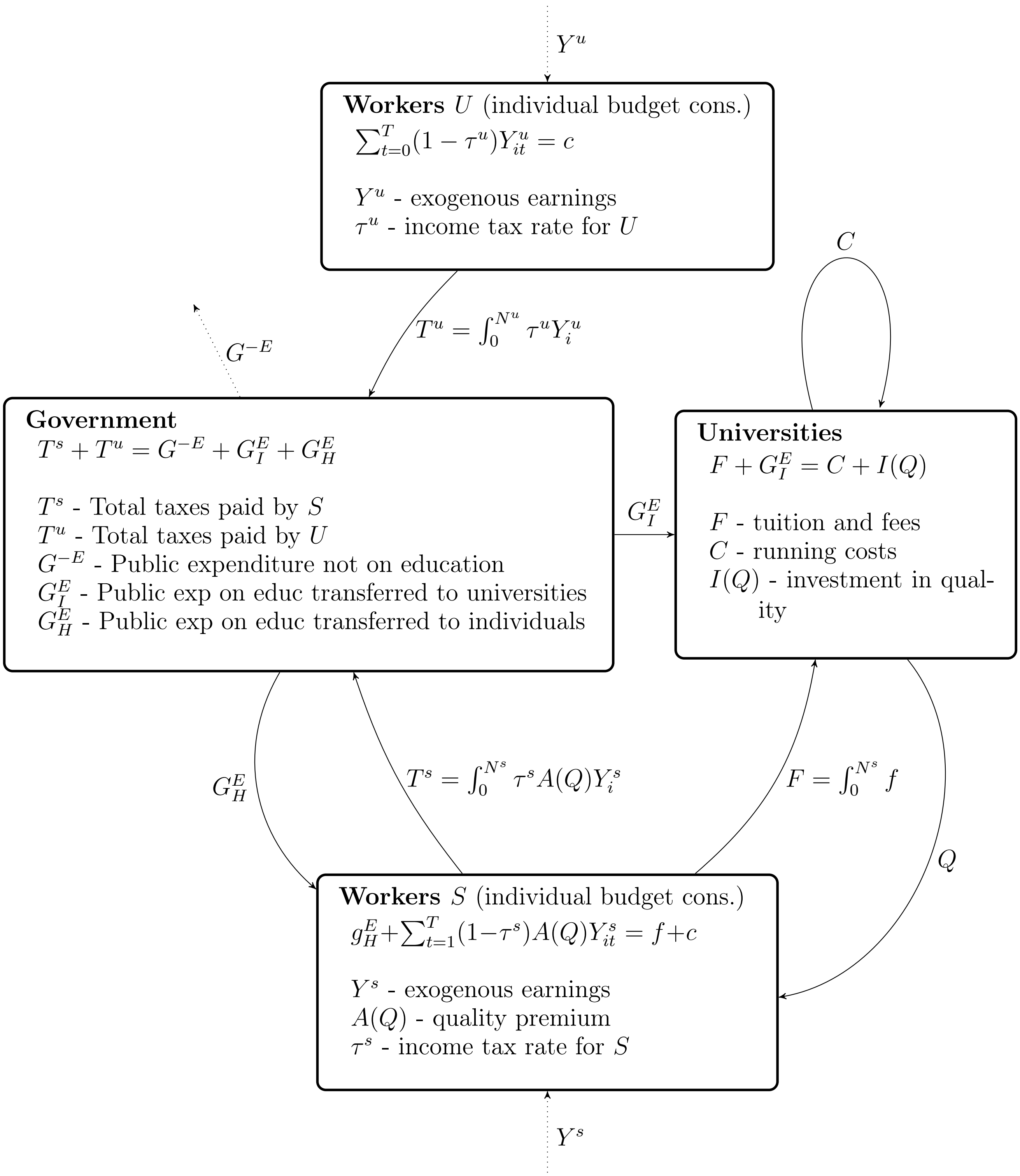


Figure 1: Theoretical Framework Summary

More specifically, the different financing systems are going to be compared in terms of how they shift the total cost of higher education $\bar{C}$ between the public and private sector, how much of the public burden is paid by non-university graduates, and the degree of redistribution within university graduates. Table 1 summarizes the key dimensions for such comparison that we analyze in detail in the next subsections. Whenever comparing systems, to clearly differentiate the different variables corresponding to each scheme, we define $F(system)$, $\tau_e^j(system)$, and $\tau_{-e}^j(system)$ as the level of fees, taxes to finance education, and remaining taxes, under each system GTF, GT, ICL.

2.2 General-tax-financed subsidies

We begin by discussing the system that is currently in place, in which university resources come predominantly from direct subsidies from the government, covering around 80% of the total cost of universities. The remaining 20% is paid for by the users at the time of paying tuition. This is the prevalent system in Europe.[6] The public subsidies are financed similarly to any public service using general taxes, hence its name. While the government offers some grants and fellowships to students, they are very small and the big part of the subsidy comes from the direct transfers to institutions. For illustrative purposes, we will assume public transfers to individuals for the purpose of paying for higher education are zero. Using the general framework developed above, that means $G_H^E = 0$ and $G^E = G_I^E$.

Therefore, the total cost of higher education $\bar{C}$ is split between the government and the university-graduates: $\bar{C} = G^E + F$. Given a level of fees F, $G^E = \bar{C} - F \geq 0$ is financed with general education resources $\tau_e^s Y^s + \tau_e^u Y^u$. In other words, everybody, independently of whether they attended university or not, contributes to university resources through the general income tax. In addition to their share of income taxes, skilled workers pay the full amount of fees for attending university, which is the same for all university-graduates.

2.3 Graduate Tax

Before moving on to our proposed ICL policy, it is worth discussing the case of the graduate tax. This type of system is used by some public universities in Uruguay. A graduate tax consists of shifting the total cost of higher education entirely to those that benefit from it through deferred payments in the form of a tax upon graduation and until retirement.

In that sense, the total cost of higher education $\bar{C}$ is financed entirely by the university-graduates through an income tax (in addition to the regular income tax) ϕ, without upfront

[6]Countries such as England and The Netherlands have transitioned to an ICL scheme, but the majority of the European countries still maintain this system.

Table 1: Comparison of the Three Systems: Summary

GTF

Fees (upfront)	$F(GTF)$ (given)		
G^E	$\bar{C} - F(GTF) > 0$		
Public Savings	0		
Financing $\bar{C}$	**Gen.-Tax**	+	**Out of Pocket**
$Burden^u_e$	$\tau^u_e(GTF)Y^u$	+	0
$Burden^s_e$	$\tau^s_e(GTF)Y^s$	+	$F(GTF)$
Within-Group Prog.	**Gen.-Tax**	+	**Out of Pocket**
$Burden^s_{e,p10}$	$\frac{G^E}{\bar{G}}\bar{\tau}^s = \tau^s_e(GTF)Y^u$	+	$F(GTF)$
$Burden^s_{e,p90}$	$\tau^s_e(GTF)Y^s$	+	$F(GTF)$
Ratio	$\frac{\tau^s_e(GTF)Y^s_{p90}+F(GTF)}{\tau^s_e(GTF)Y^s_{p10}+F(GTF)}$		

GT

Fees (upfront)	$F(GT) = 0$		
G^E	$\bar{C} - \Phi = 0$		
Public Savings	$\Phi - F(GTF) = \bar{C} - F(GTF)$		
Financing $\bar{C}$	**Gen.-Tax (G^E)**	+	**Out of Pocket**
$Burden^u_e$	0	+	0
$Burden^s_e$	0	+	ϕY^s
Within-Group Prog.	**Gen.-Tax (G^E)**	+	**Out of Pocket**
$Burden^s_{p10}$	0	+	ϕY^s_{p10}
$Burden^s_{p90}$	0	+	ϕY^s_{p90}
Ratio	$\frac{Y^s_{p90}}{Y^s_{p10}}$		

ICL

Fees (upfront)	$F(ICL) = \bar{C}$		
G^E	$\bar{C} - \int_{i \in S} \sum_a^{\bar{a}_i} P_{ia} > 0$		
Public Savings	$\int_{i \in S} \sum_a^{\bar{a}_i} P_{ia} - F(GTF)$		
Financing $\bar{C}$	**Gen.-Tax (G^E)**	+	**Out of Pocket**
$Burden^u_e$	$\tau^u_e(ICL)Y^u$	+	0
$Burden^s_e$	$\tau^s_e(ICL)Y^s$	+	$\int_{i \in S} \sum_a^{\bar{a}_i} P_{ia}$
Within-Group Prog.	**Gen.-Tax (G^E)**	+	**Out of Pocket**
$Burden^s_{p10}$	$\frac{G^E(ICL)}{\bar{G}}\bar{\tau}^s = \tau^s_e(ICL)Y^u_{p10}$	+	$\int_{i \in p10} \sum_a^{\bar{a}_i} P_{ia} = \epsilon$
$Burden^s_{p90}$	$\tau^s_e(ICL)Y^s_{p90}$	+	$\int_{i \in p90} \sum_a^{\bar{a}_i} P_{ia} \approx \bar{C}$
Ratio	$\frac{\tau^s_e(ICL)Y^u_{p90}+\bar{C}}{\tau^s_e(ICL)Y^u_{p10}+\epsilon}$		

or tuition payments. We can think of this as the government paying for the cost $\bar{C}$ initially and then recovering the full amount in the future, so that, in present value $G^E = \bar{C} - \Phi = 0$, where $\Phi = \phi Y^s$ denotes the total revenue from the graduate-tax. A consequence of $G^E = 0$ is that income taxes of the unskilled workers are never used to subsidy higher education, or $\tau_e^u = 0$. In addition to their share of income taxes $\bar{\tau}^s$, skilled workers pay the graduate tax, adding up to a total burden for university graduates of $(\bar{\tau}^s + \phi)Y^s$. Notice that this amount is again the same for all university-graduates. Given that we are assuming fixed $\bar{C}$, it has to be the case that:

$$\begin{aligned}
\bar{C} = \Phi = \phi Y^s &= F(GTF) + \tau_e^s(GTF)Y^s + \tau_e^u(GTF)Y^u \\
\phi &= \frac{F(GTF) + \tau_e^s(GTF)Y^s + \tau_e^u(GTF)Y^u}{Y^s} \qquad (6)
\end{aligned}$$

2.4 Income Contingent Loans

We propose an income contingent loan (ICL) system. ICLs have become a popular alternative to general-tax-financed (GTF) subsidies among developed countries.[7] This system is in spirit similar to the Graduate-Tax, but its structure is more complex and flexible, allowing for varying degrees of cost shifting, as will become clear in the subsequent discussion. The key feature of ICLs is the combination of private contributions, in the form of repayments contingent to future income; and government subsidies, given directly to the individuals in the form of debt write-off and repayment exemptions.

For the purpose of this description, we will focus on the extreme case where the fees cover the total cost of education in present terms, which makes it comparable to the GT case discussed above: $F = \bar{C} = \Phi$. This implies that $G_I^E = 0$ and $G^E = G_H^E = F = \bar{C}$. We will briefly comment on intermediate cases in the discussion below. We begin by introducing the elements that characterize the loans and repayments and then proceed to discuss the implied burdens.

A Rich Set of Instruments

An attractive feature of ICLs is the flexibility in its design compared to other progressive financing alternatives, such as a graduate tax. A rich number of instruments are combined to achieve varying degrees of public savings and progressivity:

[7] In Europe, Hungary, the Netherlands, and the United Kingdom adopted ICLs in the last decade, see (Diris and Ooghe, 2018). Outside Europe, Australia and New Zealand have been pioneers of this scheme.

$d-$ Principal: total tuition fees over all years + maintenance (maybe)

$p-$ Repayment rate: fraction of gross earnings that is used for repayment

$x-$ Exemption level above which workers start repaying debt

$m-$ Write-off year after which the debt is canceled

$r-$ Interest rate of debt

University students obtain a loan d from the government during schooling years to pay their fees and, possibly, room and board. Repayments start upon graduation and are a fraction p of ex-post labor income and are paid at low interest rates (r). There is a minimum exemption income level x below which graduates do not need to pay. Repayments are made for a certain number of years up to a maximum established (m). Because of the nature of this repayment scheme, it will be useful to adopt a life-cycle perspective and think of a period as an age year, denoted by a. In the remaining of this section, we discuss the main elements of debt repayment in detail.

Income-Contingent Repayment. Repayment is contingent on income and the first x euros are exempt for everyone. That means that those who earn less than x do not repay in a given year, and the rest pay a fraction of their income above x. We define non-exempt earnings for individual i at age a as:

$$Y_{i,a}^{NE} = \max\left\{Y_{i,a} - x, 0\right\}$$

Let $\bar{a}_i$ be the full-repayment age of individual i. Annual payments for individual i at age a are therefore calculated as

$$P_{i,a} = \begin{cases} pY_{i,a}^{NE} & \text{if } a < \bar{a}_i \\ \min\left\{(1+r)D_{i,a-1}, pY_{i,a}^{NE}\right\} & \text{if } a = \bar{a}_i \\ 0 & \text{if } a > \bar{a}_i \end{cases} \tag{7}$$

where $D_{i,a-1}$ is the outstanding debt of individual i at the beginning of age a and, therefore, predetermined in period $a-1$. Equation (7) states that repayment is fixed and proportional to the non-exempt amount of earnings, resembling a graduate tax. Notice that the only dependence of payments on the outstanding debt $D_{i,a}$ appears in the last period of debt repayment and simply to indicate that, should the fixed payment of pY^{NE} exceed the remaining debt plus interests, then only the remaining debt has to be paid.

Full-repayment age. Graduates pay for a maximum of m years unless they have been able to pay their complete debt before in which case their full-repayment age is when their last payment pays is able to cover their outstanding debt

$$\bar{a}_i = \min \left\{ m, \widetilde{a} \text{ s.t. } \sum_{a=1}^{\widetilde{a}} P_{i,a} \geq D_{i,\widetilde{a}} \right\} \tag{8}$$

Debt. Starting from $D_{i,0} = d$, outstanding debt is calculated at the end of each period as $D_{i,a} = (1+r)D_{i,a-1} - P_{i,a}$ until the repayment age. A full description of the repayment structure and explicit formulas for $D_{i,a}$ and $\bar{a}_i$ can be found in Table 2 and equation (8) below.

Therefore, the total cost of higher education $\bar{C}$ is split between the government and the university-graduates: $\bar{C} = G^E + \int_{i \in \mathcal{S}} \sum_{t=1}^{\bar{a}_i} P_{it}$. A useful way to think about public financing in this system is to assume university-graduates pay the full amount of fees and can obtain a loan for the same amount immediately. As a result, the fees cancel in the government budget and G^E covers the part of the fees that university-graduates are not able to repay: $G^E = \bar{C} - F + F - \int_{i \in \mathcal{S}} \sum_{t=1}^{\bar{a}_i} P_{it} > 0$. In addition to their share of income taxes, skilled workers pay a share of the loan given by their income history, which is different for each university-graduate, adding up to a total burden for university graduates of $\bar{\tau}^s Y^s + \int_{i \in \mathcal{S}} \sum_{t=1}^{\bar{a}_i} P_{it}$. Notice that, similarly to GTF, and in contrast to GT, $G^E \geq 0$ is financed with general education resources $\tau_e^s Y^s + \tau_e^u Y^u$. We will discuss in the next subsection how $\tau_e^u(GTF)$ and $\tau_e^u(ICL)$ compare, as well as the conditions under which ICLs imply a public savings compared to GTF and the advantages over GT.

2.5 Comparing the Three Systems

Next, we will use all the information in subsections 2.2, 2.3, and 2.4 to summarize the distributional implications of each system in two results. For the sake of clarity, we relegate the calculations and details to Appendix A.

Result 1: *Between-group progressivity (the ratio of the burden for non-university- and*

Table 2: ICL Repayment Scheme

Period	Initial debt	Resources	Payments: Educ related	Payments: Other	Outstanding debt	Eat
$a=0$ (College)	0	d (principal)	f (tuition and fees)	0	$D_0 = d$	$c_0 = d - f$
$a=1$	$(1+r)D_0$	Y_1	$P_1 = pY_1^{NE}$	$\tau^s Y_1$	$D_1 = (1+r)D_0 - P_1$ $= (1+r)d - pY_1^{NE}$	$c_1 = Y_1 - pY_1^{NE} - \tau^s Y_1$
$a=2$	$(1+r)D_1$	Y_2	$P_2 = pY_2^{NE}$	$\tau^s Y_2$	$D_2 = (1+r)D_1 - P_2$ $= (1+r)^2 d - p\left[(1+r)Y_1^{NE} + Y_2^{NE}\right]$	$c_2 = (1-\tau^s)Y_2 - p(Y_2 - x)$
$\vdots$						
$\vdots$						
a	$(1+r)D_{a-1}$	Y_a	$P_a = pY_a^{NE}$	$\tau^s Y_a$	$D_a = (1+r)D_{a-1} - P_a$ $= (1+r)^a d - p\sum_{j=1}^{a}\left[(1+r)^{a-j}Y_j^{NE}\right]$	$c_a = (1-\tau^s)Y_a^s - p(Y_a - x)$
$\vdots$						
$a=\bar{a}$ (Full repayment)	$(1+r)D_{\bar{a}-1}$	$Y_{\bar{a}}$	$P_{\bar{a}} = \min\left\{(1+r)D_{\bar{a}-1}, pY_{\bar{a}}^{NE}\right\}$	$\tau^s Y_{\bar{a}}$	$D_{\bar{a}} = 0$	$c_{\bar{a}} = (1-\tau^s)Y_{\bar{a}}^s - P_{\bar{a}}$
$T \geq a > \bar{a}$	0	Y_a	0	$\tau^s Y_a$	0	$c_a = (1-\tau^s)Y_a^s$

university-graduates) is highest (lowest) under the GT system and, provided a minimum level of debt repayment under ICL, lowest (highest) under GTF.

We focus on the total burden of each system for the workers, defined as $Burden^j$ ($j = u, s$), that measures the cost of financing the public sector $\bar{G}$, including the financing of the university sector G^E, the non-university-sector G^{-E}, plus possible out of pocket spending on the payment of fees. At this point, it is necessary to make an assumption about the use of the resources shifted out of the public sector when moving away from the GTF system. One option is to think of it as investment in other public services, such as primary public education, which could benefit both types of workers. For simplicity and without affecting our main results, we will assume that the extra amount of G^{-E} will entirely be used as transfers to low-income families. For comparison, we take fees in the GTF as given by the status quo and write the formulas as a function of these, as well as of previously defined fixed policy parameters.

We first define $PublicSavings$ is defined for each system with respect to the current GTF system:

$$
\begin{aligned}
PublicSavings(GTF) &= 0 && (9)\\
PublicSavings(GT) &= \Phi - F(GTF) = \bar{C} - F(GTF) && (10)\\
PublicSavings(ICL) &= \int_{i \in \mathcal{S}} \sum_{a=1}^{\bar{a}_i} P_{ia} - F(GTF). && (11)
\end{aligned}
$$

We can now concisely define the ratio that characterizes between-group progressivity:

$$
\frac{Burden^u(system)}{Burden^s(system)} = \frac{\bar{\tau}^u Y^u - PublicSavings(system)}{\bar{\tau}^s Y^s + F(GTF) + PublicSavings(system)} \tag{12}
$$

Assuming the repayment share in the ICL case is sufficiently large so that Result 1 holds, it is easy to see that

$$
PublicSavings(GT) \geq PublicSavings(ICL) > PublicSavings(GTF) \tag{13}
$$

with equality if there is full repayment, which concludes our discussion of Result 2.

Result 2: *Within-group progressivity (redistribution between university graduates) is zero under GTF and GT, beyond the progressivity of the income tax code.*

Let $Burden^s_{prc}$ denote the corresponding burden for a subgroup of skilled workers in the percentile prc of the earnings distribution. We will define within-group progressivitiy as the ratio of the burden for those university-graduates on the top 10% of the income distribution (group $p90$) and the burden for those university-graduates on the bottom 10% of the income distribution (group $p10$) , as follows:

$$\frac{Burden^s_{p90}(GTF)}{Burden^s_{p10}(GTF)} = \frac{\bar{\tau}^s Y^s_{p90} + F(GTF)}{\bar{\tau}^s Y^s_{p10} + F(GTF)} \tag{14}$$

$$\frac{Burden^s_{p90}(GT)}{Burden^s_{p10}(GT)} = \frac{\bar{\tau}^s Y^s_{p90} + \Phi}{\bar{\tau}^s Y^s_{p10} + \Phi} = \frac{(\bar{\tau}^s + \phi) Y^s_{p90}}{(\bar{\tau}^s + \phi) Y^s_{p10}} = \frac{Y^s_{p90}}{Y^s_{p10}} \tag{15}$$

$$\frac{Burden^s_{p90}(ICL)}{Burden^s_{p10}(ICL)} = \frac{\bar{\tau}^s Y^s_{p90} + \int_{i \in p90} \sum_a^{\bar{a}_i} P_{ia}}{\bar{\tau}^s Y^s_{p10} + \int_{i \in p10} \sum_a^{\bar{a}_i} P_{ia}} \approx \frac{\bar{\tau}^s Y^s_{p90} + \bar{C}}{\bar{\tau}^s Y^s_{p10} + \epsilon}, \tag{16}$$

where $Y^s_{prc} \equiv \int_{i \in p10} Y_i$, for $prc = p10, p90$, and ϵ is used to denote a small amount, always smaller than $F(GTF)$. The last relation in equation (16) follows from our empirical results in the next section for all reasonable parameter combinations.

It is very easy to see in equations (14) and (15) that there is no redistribution from top to bottom earners under the GTF and GT systems, beyond the intrinsic differences in income and income taxes. Looking at the same part of equation (16) for ICL, however, the top earners end up paying nearly the full amount of the cost of universities while the bottom earners pay even less than in the GTF case.

We conclude this section by discussing both the importance of the combination of the between-group and within-group progressivities in each system. To make our point, we take the extreme case of the US higher education system, where fees cover the total cost and commercial banks offer classic loans. As mentioned in the introduction, these traditional loans are very different to income contingent loans as repayments are not a function of future income nor they allow for write-offs or exemptions. Moreover, these traditional loans are repaid at the market rate. In this sense, as mentioned before, our proposed system resembles more a scheme of *Returnable Fellowships*, provided a zero interest rate, which is our baseline scenario. This system does feature total between-group progressivity, similarly to the GT, but they do not have any progressivity component within the university graduates. Actually, within-progressivity tends to be negative because higher earning graduates repay their loan faster and thus paying less in terms of accumulated interests than the lower earning graduates, who end up accumulating large amounts of debt over time. This example highlights the importance of considering both kinds of redistributions and, while this case is more extreme, is reminiscent of the case of the GT, where the within-group component is not negative but it is close to zero. In this sense, the ICL offers a balanced combination of both between and within progressivity through a rich set of instruments.

In the rest of the paper we analyze the distributional implications of introducing ICLs to Spain. In other words, the degree of within-progressivity of different specifications of ICLs. In order to do so, we first need to simulate the life-cycle earnings of graduates using a model of earnings dynamics and employment transitions. We do so in the next section.

3 Simulating Life-Cycle Earnings Dynamics

While many of the elements of our ICL design are policy instruments that will be analyzed within the context of our application, there is one element that needs empirical discipline: the life-cycle dynamics of earnings. We simulate these using a estimated model that combines employment transitions and earnings dynamics.

3.1 The Data: Social Security and Tax Records

We use administrative data from the Continuous Sample of Working Histories (MCVL hereafter, for its acronym in Spanish) on earnings and working histories of Spanish workers. The data is provided by the Spanish Social Security Administration in cooperation with the IRS counterpart in Spain. In this section we give an overview of the data source and a description of our sample. For the database specifics and more details we refer to Section 2 in Bonhomme and Hospido (2013).

The MCVL consists of a 4% representative random sample of all workers affiliated with the social security administration within a given year between 2004 and 2015. We use data starting in 2005, when the sample has a panel design: all individuals present in each wave subsequently remain in the sample. Retroactive information on the whole working history is provided as early as 1962 for work variables and 1980 for earnings. Bonhomme and Hospido (2013) show that the sample is representative at least since the late 1980s. The information from the Social Security records can be obtained at a daily frequency, but earnings are often top-coded at a preset industry-specific threshold. We complement the earnings data with an IRS supplement matched to the Social Security records. The tax supplement contains non-top-coded information on annual earnings. Our baseline frequency will therefore be annual.

Sample Selection

We select college graduates that are at least 22 and at most 60 years old.

Main Variables

Earnings. The earnings data are extracted from the "Annual summary of retentions and payments for the personal income tax on earnings, economic activities, awards, and income imputations" (known as *Modelo 190*). All employers are required to fill out *Modelo 190* with the total compensation paid to each of their employees during the year, independently of whether or not they pay labor income taxes. To obtain a measure of total annual labor earnings, we add all the incomes that correspond to each worker during the reference year. All amounts are deflated to 2011 euros. We exclude self-employment income.

Annual Employment Status. Given that our period of observation is one year, it is not uncommon to find workers that hold different simultaneous jobs or that change jobs within the same year. In some cases, some of those contracts are temporary and some permanent. This poses a challenge when defining employment spells at the annual level. We define employment status in terms of share of annual time spent in each kind of job: permanent, temporary, or none. Workers who have zero annual earnings or earn less that the corresponding amount to a month minimum-wage salary are considered unemployed.

Lifetime Earnings Quantiles. Using our longitudinal data we calculate lifetime earnings for every individual assuming no discount rate. This in turn determines in which quantile of the lifetime earnings distribution every individual is. We group individuals according to this variable to understand progressivity in our loan laboratory.

3.2 Employment Transitions

We adapt the framework of Dearden et al. (2008) for the Spanish labor market. A key contribution of this paper is to allow for differentiated levels of labor market attachments to capture realistic job transitions in two-tier markets, as it is the case in Spain.

At each point in time, a worker can be in one of three statuses: unemployed (U), employed in a permanent contract (P), and employed in a temporary contract (T). Let Π be the transition matrix that determines the probabilities of entering status s_t from status s_{t-1}.

$$\begin{pmatrix} P_t \\ T_t \\ U_t \end{pmatrix} = \underbrace{\begin{pmatrix} \pi_t^{PP} & \pi_t^{PT} & \pi_t^{PU} \\ \pi_t^{TP} & \pi_t^{TT} & \pi_t^{TU} \\ \pi_t^{UP} & \pi_t^{UT} & \pi_t^{UU} \end{pmatrix}}_{\Pi_t} \begin{pmatrix} P_{t-1} \\ T_{t-1} \\ U_{t-1} \end{pmatrix}, \tag{17}$$

where

$$\pi_t^{jk} \equiv Pr\left(s_t = k \mid s_{t-1} = j\right) \text{ for } i, j = P, T, U$$

We estimate[8] these transitions using probit regressions by regressing a dummy variable that takes 1 in the case of a transition on a constant, a quartic in age, and additional covariates depending on the type of the transition. In particular,

$$\pi^{s_{t-1},s_t} = \begin{cases} \Phi\left(\beta_1^y y_{t-1} + \beta_2^y y_{t-1}^2\right) & \text{if } (s_{t-1}, s_t) \in \{(P,T),(P,U),(T,U)\} \\ \Phi\left(\beta_1^d dur1_{t-1} + \beta_2^d dur2_{t-1}\right) & \text{if } (s_{t-1}, s_t) \in \{(U,P),(U,T)\} \\ \Phi\left(\beta_1^y y_{t-1} + \beta_2^y y_{t-1}^2 + \beta_1^d dur1_{t-1} + \beta_2^d dur2_{t-1}\right) & \text{if } (s_{t-1}, s_t) \in \{(T,P)\} \end{cases}, \tag{18}$$

where

$$\begin{aligned} dur1_t &\equiv I\left\{s_t = j \mid s_{t-1} = k \text{ and } j \neq k\right\} \text{ for } i, j = P, T, U \\ dur2_t &\equiv I\left\{s_t = j \mid s_{t-1} = k \text{ and } j = k\right\} \text{ for } i, j = P, T, U \\ y_t &\equiv \text{ log earnings in } t \\ \Phi &\equiv \text{ Normal distribution } cdf \end{aligned}$$

denotes whether the worker had spent one of more years in the initial state. For example, in the case of a transition from unemployed to permanent $(s_{t-1}, s_t) = (U, P)$, $dur1_{t-1} = 1$ if the worker was unemployed only for one period last year, and $dur2 = 1$ if the worker had been unemployed for two or more periods last year. All specifications include a constant and a quartic in age in the set of regressors, that we have omitted for the sake of exposition.

At the beginning of an employment spell within a contract, each worker draws a level of earnings determined by its previous status and age. This type of transition earnings will be

[8] The estimation is performed separately for female and male college graduates.

explained in detailed below.

3.3 Earnings Dynamics

Transition Earnings

Whenever the worker changes status, we estimate the new initial earnings as a function of age, duration of previous spell, and past earnings.

More specifically, let

$$y_t^{ss'} \equiv y\left(s_t = s' | s_{t-1} = s\right)$$

denote log earnings at t of a worker who just moved from status s to s'.

We pose the following specification for the log of earnings in the first year at the new status:

$$\log Y_t^{ss'} = \beta_1 dur1_{t-1}^{s} + \beta_2 y_{t-1}^{L} + \xi_t,$$

where y_{t-1}^{L} denotes the level of earnings in the previous status s if $s \in \{P, T\}$, the last earnings observed if $s = U$ and the worker has been unemployed for only 1 year, or a dummy that equals 1 indicating that the last level of earnings is missing in the case of $s = U$ and the worker has spent 2 or more years unemployed. $dur1$ has been defined above. A constant and a quartic in age are also included in the set of regressors.

Continuation Earnings

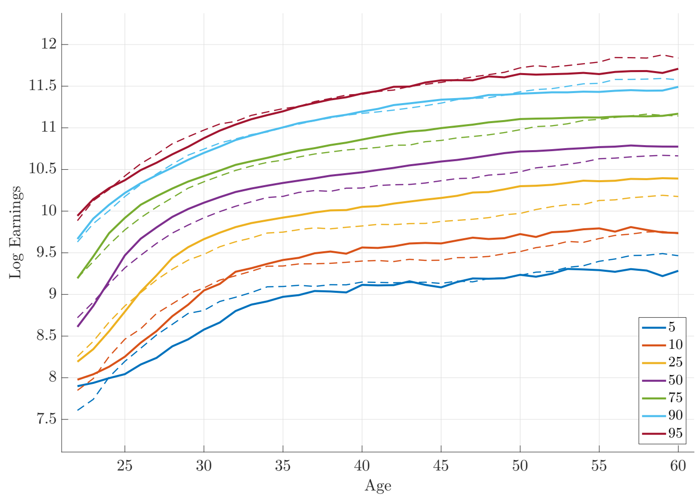
If the worker remains in the same job status, earnings follow a flexible age-dependent autoregressive process. The basic statistical framework follows Karahan and Ozkan (2013) and emphasizes the age dynamics of persistence and volatility of earnings. In particular, we borrow the specifics and estimates from our companion paper Cabrales et al. (2018), where we show the importance of allowing the type of contract – temporary or permanent – to influence uncertainty, and earnings dynamics in general, in the case of a fragmented labor market like the Spanish one.

In a nutshell, continuation earnings follow an ARMA(1,1) stochastic process with fixed effects and profile heterogeneity. To capture the evolution of uncertainty over life, the persistence of the AR(1) component and the variance of both idiosyncratic shocks are functions of age and contract. We introduce contract-specific uncertainty by separately estimating the process for a sample of workers that have spent most of their life linking temporary contracts. The idea is to capture that continuation within temporary contracts entails more uncertain earnings than continuation within permanent contracts. The parameters are estimated by minimizing the distance between the empirical and the model-implied covariance matrix using Generalized Method of Moments with efficient weighting matrix.

Simulation Fit

We combine the employment transitions and earnings dynamics estimates to simulate the earnings of 20,000 individuals between the ages of 22 and 60. Figure 2 compares the data (solid) and the simulated (dashed) cross-sectional distribution of earnings at each age. More specifically, Figure 2 plots different percentiles of the earnings distribution, for a given age, and therefore characterizes the evolution of the cross-sectional distribution of earnings for the purpose of comparing the fit to the data. Overall, our statistical model does a good job matching the distribution of earnings at all ages.

Figure 2: Quantiles of Log earnings: Data (solid) vs. Simulation (dashed)



4 Loans Laboratory

We next use the panel of simulated lifetime income profiles $\left\{\{Y_{i,a}\}_{a=22}^{60}\right\}_{i=1}^{N}$ to study the implications of introducing a menu of public income-contingent loans in Spain. Remember the basics of our model: fees can be deferred until starting to work, repayments will depend on ex-post labor income and minimum exemption, and there will be a debt write-off and low interest rates.

We start describing the current general-tax-financed subsidies in Spain in the next subsection. Then, in subsection 4.2, we consider several policy experiments modifying the different parameters of the ICLs. Finally, in subsection 4.3, we consider the effects of using the potential additional resources generated by ICLs to increase university quality.

4.1 Current Subsidies in Spain

The current university financing system in Spain is basically characterized mostly by subsidies to universities coming from general income taxes.The following are the key figures of the current costs and subsidies in Spain (see de la Fuente and Boscá (2014)). For 2010, average total expenditure by the government across different universities and programs in Spain is around $8,900$ million euros. That year, households spent around 2,600 million euros in higher education. This means that the share of public resources in public education in Spain, or the subsidy defined in equation (24) below, is around 80%. We will use this benchmark in our policy experiments in the next subsection.

4.2 Policy Experiments

For each of the parameters defined in Section 2.4, we evaluate different sets of values that can be thought of as reflecting different fiscal scenarios and/or political preferences. For every policy experiment, we will show the following outcomes:

- Burden of the cost of education: As explained in our theoretical framework, the burden of the cost of education is the sum of taxes paid that finance education as well as the repayment of loans in the case of ICLs; or the fees in the case of GTF (see equations (14) and (16), respectively). In terms of the within-group progressivity that each financing system generates, the key lies in the repayments and fees rather than the taxes. We therefore consider two measures of the burden, with and without the taxes. In this quantitative section of the paper, we introduce time discounting denoted as β. The corresponding individual burden in each system, that is, net present discounted value of all repayments: is:

$$
\begin{aligned}
NPV_i(ICL) &= \sum_{a=1}^{\bar{a}} \beta^a P_{i,a} && (19)\\
NPV_i^{total}(ICL) &= \sum_{a=1}^{\bar{a}} \beta^a P_{i,a} + \sum_{a=1}^{T} \beta^a \underbrace{\tau_e^s(ICL)}_{\frac{G^E}{G}\bar{\tau}^s} y_{i,a} && (20)\\
NPV_i(GTF) &= f && (21)\\
NPV_i^{total}(GTF) &= f + \sum_{a=1}^{T} \beta^a \underbrace{\tau_e^s(GTF)}_{\frac{G^E}{G}\bar{\tau}^s} y_{i,a} && (22)
\end{aligned}
$$

- Public subsidy, as defined by share of higher-education financed with public resources. We find the share more appropriate for the empirical section than the G^E that we used in Section 2 given that the total aggregate amounts will be sensitive to the specifics of the simulation.

$$
\begin{aligned}
Sub(ICL) &\equiv \frac{G^E}{\bar{C}} = \frac{\bar{C} - \int_{i\in\mathcal{S}} \sum_a^{\bar{a}_i} \beta^a P_{i,a}}{\bar{C}} && (23)\\
Sub(GTF) &\equiv \frac{G^E}{\bar{C}} = \frac{\bar{C} - F(GTF)}{\bar{C}} && (24)
\end{aligned}
$$

  In addition, for the case of the ICL, we define an individual counterpart of equation (23) in order to capture the distributional differences implied by the repayments structure. The share of the total cost for the university-graduates not repaid by individual i is defined as:.

$$
Sub_i = \frac{d - \sum_a^{\bar{a}_i} \beta^a P_{i,a}}{d} \qquad (25)
$$

- Repayment year, as defined by equation (8).

In what follows, we present the individual measures in equations (19) to (25) aggregated by percentiles of the lifetime income distribution, and the aggregate ones in equations (23) and (24) as reference flat lines. We will display these outcomes in three different graphs. In all experiments shown, we assume time discounting is equal to $\beta = 0.978$, which corresponds to a discounting interest rate of 2.2%.[9]

[9] Following Dearden et al. (2008), we set $\beta = 1/1 + dr$, where dr is the discounting interest rate, set to 2.2% to approximate the interest rate the government faces when borrowing.

4.2.1 Baseline (2007 UK Reform)

We start with our baseline scenario which follows broadly the 2007 UK reform. In particular, we set:

$$\begin{aligned} d &= 21,000 \text{ euros} \\ r &= 0\% \\ p &= 10\% \text{ annual earnings} \\ x &= 15,000 \text{ euros} \\ m &= 25 \text{ years} \end{aligned}$$

A level of debt of 21,000 euros is close to the current cost for the government of degrees that last 3 years in Spain. We assume for now that the loan interest rate is 0% (i.e. a returnable fellowship) and that the repayment rate is 10%. There is an exemption income level at 15,000 euros. This means that university graduates pay 10% of their earnings once income is above 15,000 euros. Finally, the debt write-off is such that there is a maximum of 25 years of repayment. If after 25 years the loan has not been fully returned, then the university graduate does not need to pay any more.

First, we display the *net present value of repayments* in the top graph in Figure 3 with and without the taxes paid to finance general education. Let's focus first on the ICL repayments. As expected, the NPV of repayments (without taxes) is an increasing and concave function of income, with the lowest percentile paying around 1,000 euros in total, while the median pays around 13,000 euros and the top percentile pays near 18,000 euros. Notice that there is a subsidy for everyone, including the lifetime-richest. This is due to an *interest rate subsidy*, or the presence of time discounting when interest rates are 0. The repayment with taxes displays a similar profile, which is shifted upwards for all income levels. Note that the shift is a bit higher the higher the income reflecting the nature of the progessive income tax.[10] This shows that the bulk of the progressivity in the ICLs comes from the repayments to the debt rather than income taxes devoted to higher education. We next look at the profile for GTF. The NPV of repayments without taxes are simply the university fees which are flat. The NPV of repayments with taxes show a slight disproportionate increase for the richest, which shows that the only source of progressivity in the GTF system is inherited from the progressivity of the income tax. Besides being overall smaller, the rate at which it increases with the level of income is very slow, indicating that the flatness of the fees dominates for most of the distribution. Overall, we confirm result 3, that the bulk of the progressivity of

[10]To mimic the Spanish tax code, we have proxied income taxes with a step function with 5 income thresholds.

the ICLs comes from the repayments without taxes. In the next ICL experiments we will therefore concentrate on the NPV if repayments without taxes.

Next, we display the *public subsidy* in the bottom panel in Figure 3. The solid line is the subsidy coming from the ICLs by income levels. As expected, it is decreasing in lifetime income, as the higher-percentile workers are able to repay a larger amount of the loan. The two flat lines correspond to the average (or aggregate, given that the size of the population is normalized). It is clear to see that the average subsidy after introducing the ICLs (dashed line) is about half ot the current subsidy under GTF (dotted blue line), which, as already pointed out, is around 80%.

Finally, we display the *years to repay the loan* since graduation in the middle panel in Figure 3. This indicator is useful to understand the individual burden from a different point of view. As expected, it is decreasing with income. Overall, the range of years we observe for this baseline case ranges from 25 years to 15 years and only the bottom 17% is unable to repay its debt.

In the following subsections we consider different levels of debt, exemption levels, debt write-off years, repayment rates, as well as different loan interest rates. For each case, we vary one parameter at a time, leaving the remaining values fixed at the baseline level.

4.2.2 The impact of the total amount of debt (fees)

In this subsection, we consider five different levels of debt, keeping everything else constant. Different levels of debt can be thought of as different levels of fees and/or allowing for the loan to cover maintenance costs. We leave the discussion of what can be done with the additional resources for section 4.3. The different levels of debt considered are: (i) 5,000 euros, which is close to the current level of total fees for a degree; (ii) 21,000 euros, which is our baseline and is close to the current level of total cost; and (iii) 40,000 euros, which can be can be thought of as a loan that covers fees and maintenance. We also consider intermediate cases of 10,000 euros and 30,000 euros, but, for ease of exposition, we highlight the former three in Figure 4 (the others are included with a light grey color).

The main finding from this experiment is that the NPV of repayments, the repayment years and the subsidy all follow similar patterns along the income distribution for the different levels of debt. As expected, we find that the repayments, the number of years to repay and the subsidy are increasing with the level of debt (given that the repayment rate is constant).

Figure 3: Baseline

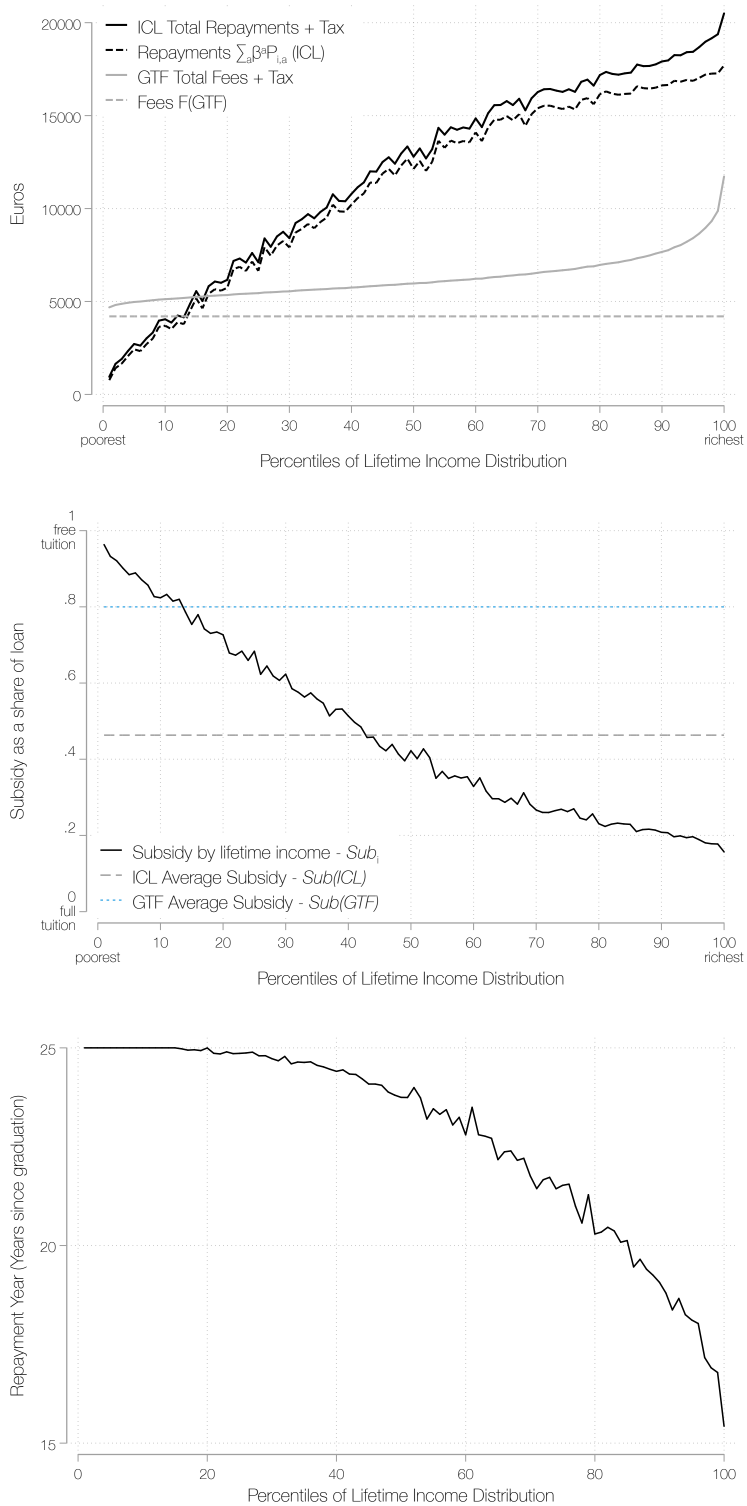
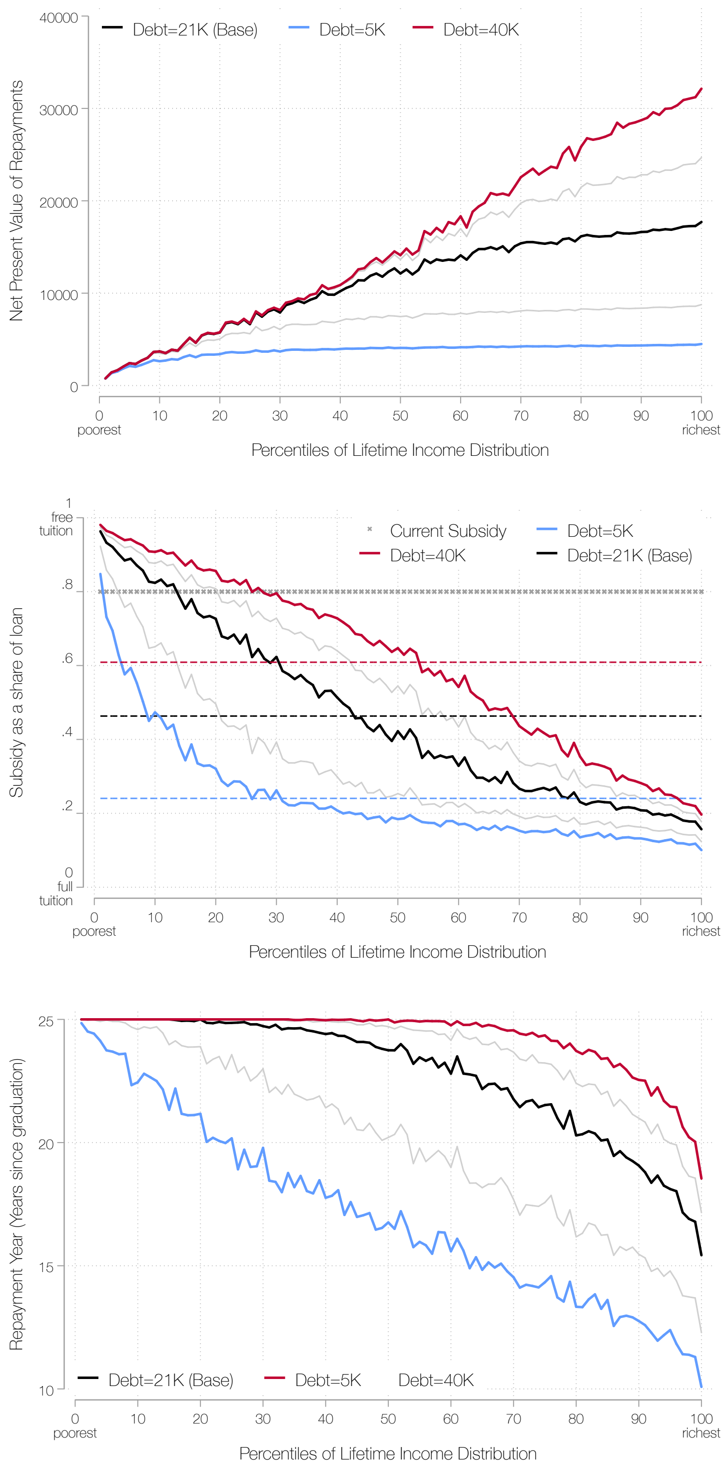


Figure 4: Different debt levels



4.2.3 The impact of the exemption level

In this subsection, we consider four different exemption levels, keeping everything else constant. The different exemption levels considered are: (i) 10,000 euros; (ii) 15,000 euros, which is our baseline; and (iii) 25,000 euros. We also consider an intermediate case of 20,000 euros, but, for ease of exposition, we highlight the former three in Figure 5 (the other is included with a light grey color).

Again, we find that the NPV of repayments, the repayment years and the subsidy all follow similar patterns along the income distribution for the different exemption levels. This can be visualized in Figure 5. As expected, the higher the exemption level, the higher probability not to fully repay and thus the higher the subsidy.

4.2.4 The impact of the debt write-off year

In this subsection, we consider four different debt write-off years, keeping everything else constant. The different write-off years considered are: (i) 15 years; (ii) 25 years, which is our baseline; and (iii) 30 years. We also consider an intermediate case of 20 years, but, for ease of exposition, we highlight the former three in Figure 6 (the other is included with a light grey color).

Once again, we find that the NPV of repayments, the repayment years and the subsidy all follow similar patterns along the income distribution for the different debt write-off years. This can be visualized in Figure 6. As expected, the higher the number of write-off years, the lower is the amount of the loan that will be returned and thus the higher the subsidy will be.

4.2.5 The impact of the repayment rate

In this subsection, we consider four different repayment rates, keeping everything else constant. The different repayment rates considered are: (i) 5 percent; (ii) 10 percent, which is our baseline; and (iii) 15 percent. We also consider an intermediate case of 8 percent, but, for ease of exposition, we highlight the former three in Figure 7 (the other is included with a light grey color).

Once again, we find that the NPV of repayments, the repayment years, and the subsidy all follow similar patterns along the income distribution for the different repayment rates. This can be visualized in Figure 7. As expected, the higher the repayment rate, the higher is the amount of the loan that will be returned and thus the lower the subsidy will be.

Figure 5: Different exemption levels

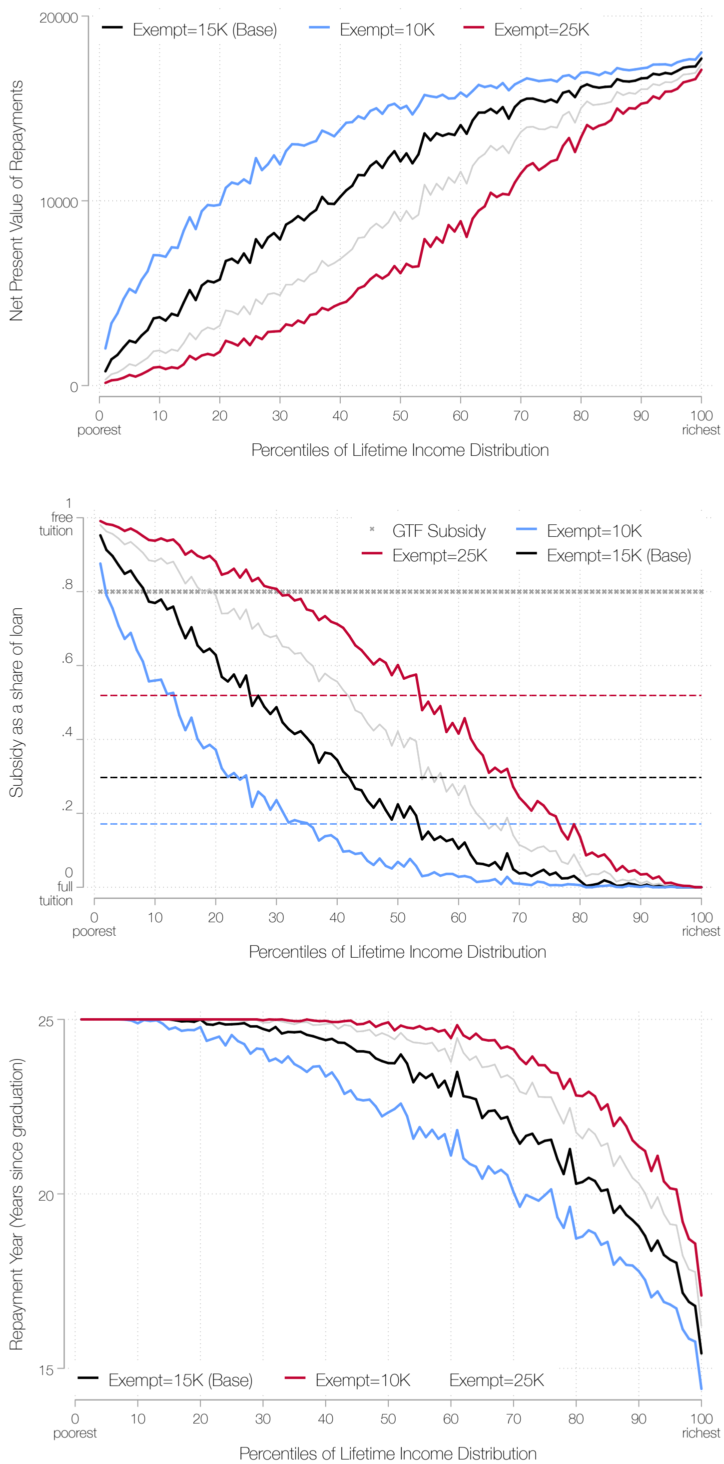


Figure 6: Different debt write-off years

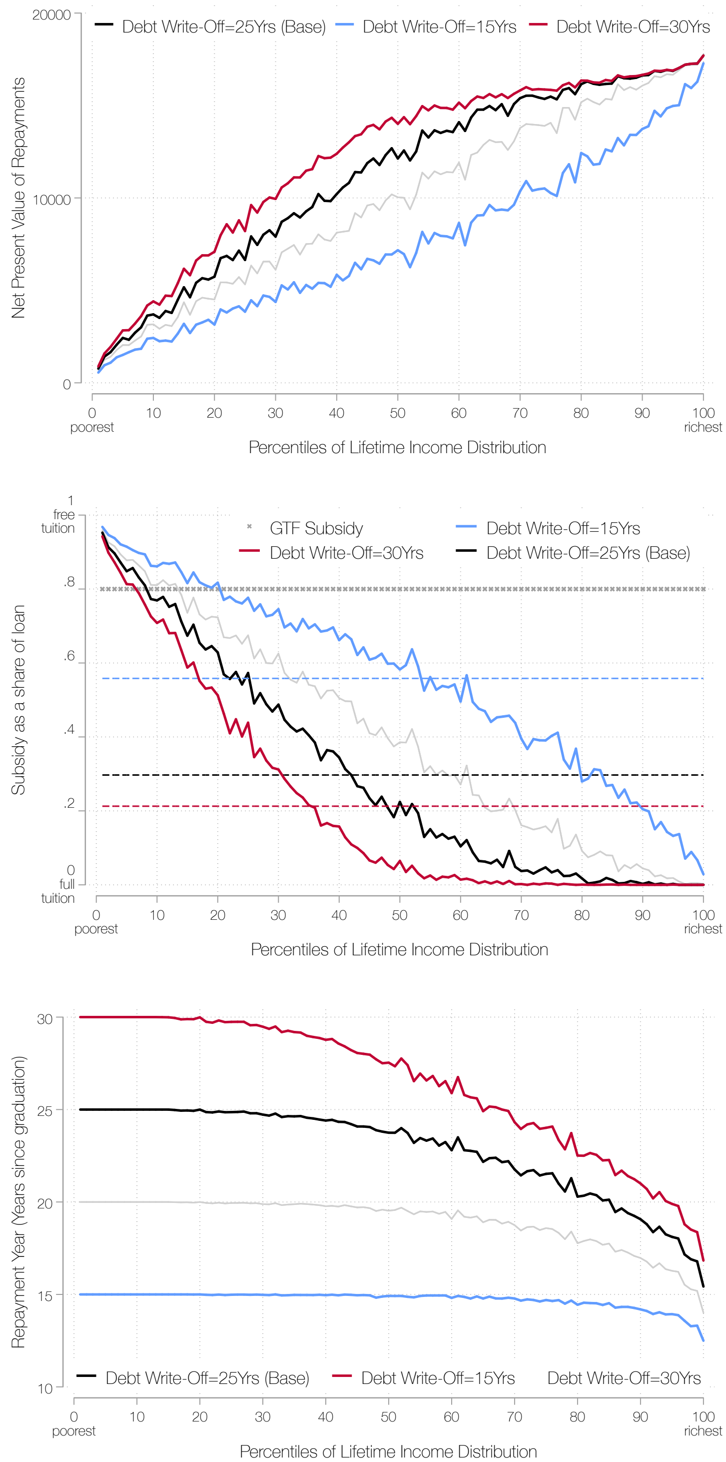
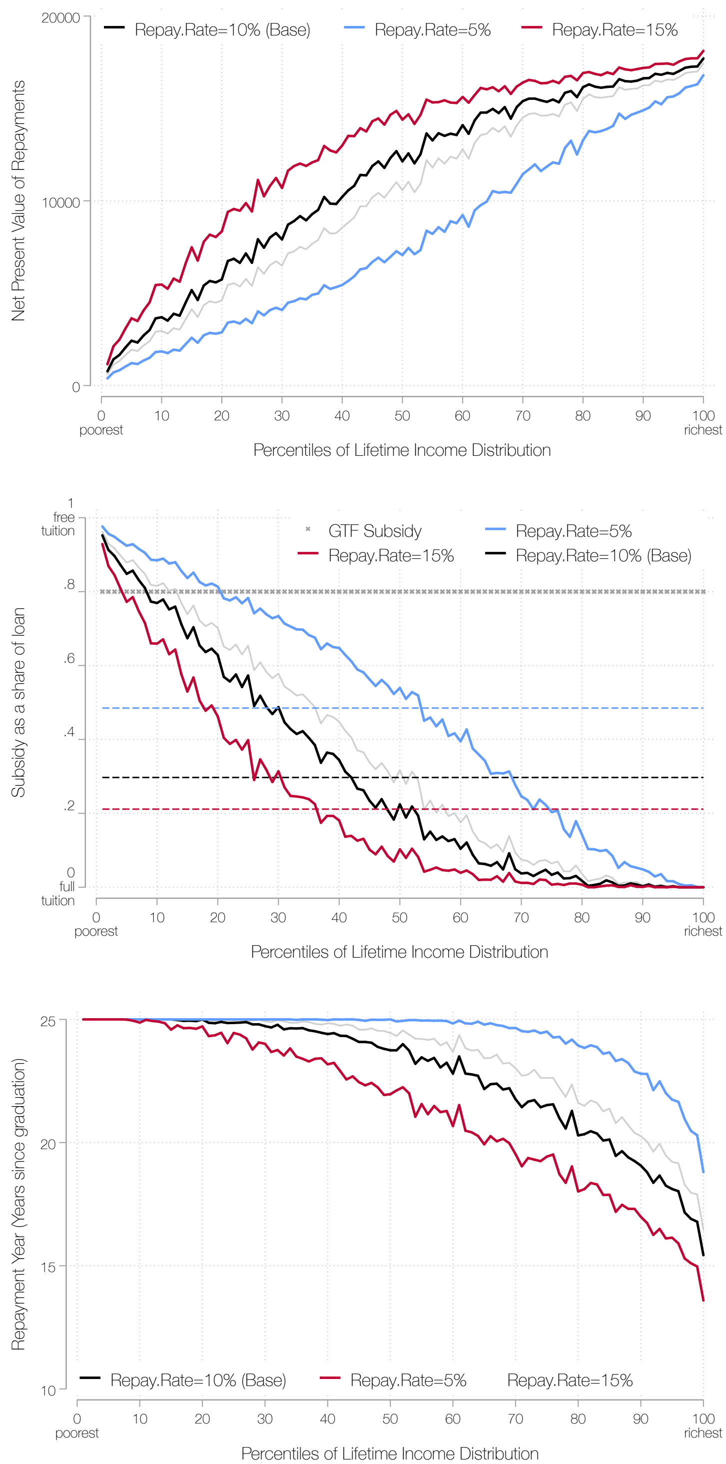


Figure 7: Different repayment rates

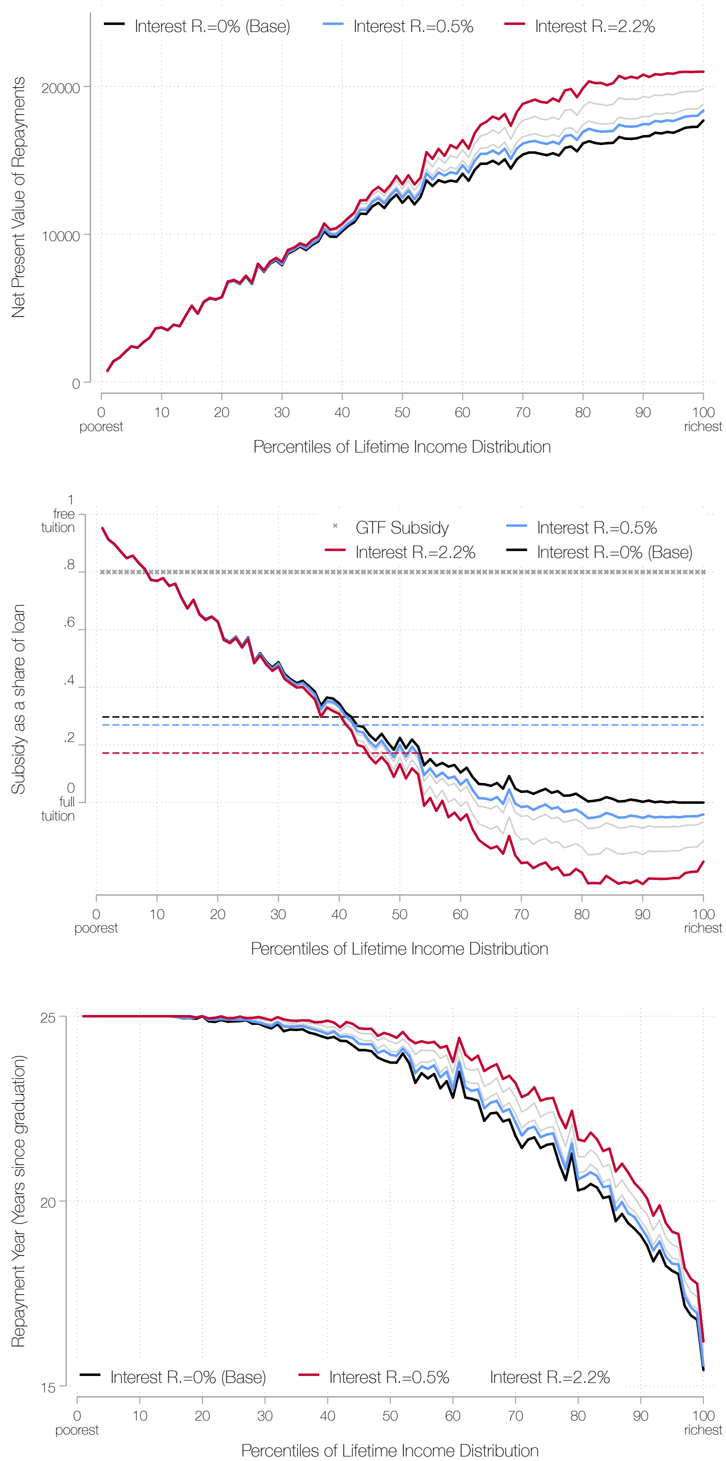


4.2.6 The impact of the interest rate

Last but not least, in this subsection, we consider five different levels of the interest rate. This is a policy variable that receives high attention. The different interest rates considered are: (i) 0 percent, which is our baseline; (ii) 0.5 percent; and (iii) 2.2 percent. We also consider intermediate cases of 0.8 and 1.5 percent, but, for ease of exposition, we highlight the former three in Figure 8 (the others are included with a light grey color).

Once again, we find that the NPV of repayments, the repayment years, and the subsidy all follow similar patterns along the income distribution for the different interest rates. This can be visualized in Figure 8. It is worth remembering that the repayments are independent of the interest rate, they are just a share of worker's income. However, a higher interest rate means that the debt generated is higher and therefore in general it takes longer to repay the loan. So, in general, we find that the higher interest rates imply a higher NPV of repayments, it takes more years to repay and thus that the subsidy will be lower. However, it is worth highlighting that, as opposed to the general perception, higher interest rates does not increase the burden of the debts for the lower part of the income distribution given the other parameters. This is because the total debt to be repaid in these cases is bounded by the exemption level and the debt write-off. That is, lower income individuals do not get to pay the increased debt due to the higher interest rates because they reach the debt write-off. Our findings are comparable to those in Dearden et al. (2008).

Figure 8: Different interest rates



4.3 Using Resources to Increase Quality

In the theoretical framework of Section 2, we briefly discussed alternative uses for the potential increase in university resources under the ICL system. Of particular interest to us is the option to channel those resources to university quality increases. In this Section, we evaluate the implications of such a policy for loan repayment, the public subsidy to higher education, and the income distribution net of debt.

We assume that the increase of university resources lead to higher quality of education. This could be interpreted as either a larger investment to the university (better faculty, R&D, etc.) or as a way of financing geographical mobility that could lead to better student-university matching. Ichino and Terlizzese (2013) studies this channel in the context of Italy and highlights that ICLs, by giving the economic means directly to students allows them to choose which university to attend, which in turn would reward the best universities and penalize the worst ones. Coupled with the ability of universities to increase fees, as well as to redesign their programs, this means the ICLs can improve the quality of the university system.

We model an increase in higher education quality as a uniform and permanent increase in the productivity of skilled workers. We denote the new earnings at age a for individual i with Y^Q, given by

$$Y_{ia}^{Q} = A(Q)Y_{ia},$$

where $A(Q)$ can be understood as the private internal rate of return (IRR) for a young person attaining tertiary education, which is basically the interest rate that an individual can expect to receive on the investment made by spending time and money to obtain an education. We use the data and methodology from the OECD and set $A(Q)$=10% (OECD, 2013). In the remaining of this section, we incorporate this quality improvement in our baseline specification and compare the average subsidy with the case without quality improvement. In general, the conclusions regarding the three outcomes that we focused on the previous section extend to this case. This is straightforward, as the earnings increase is uniform along the income distribution. There are, however, two points worth noting.

First, given the higher earnings of the skilled workers, the repayment ability of individuals increases, therefore decreasing the government subsidy. This decrease is disproportionally born by the lower part of the distribution, particularly by those who were not able to repay before. This point can be easily seen in Table 3. Second, notice that the fact that the average subsidy is lower as quality increases is an important result, since this means a multiplying effect on the university surplus that can translate into further quality increases over time.

Finally, considering increases in quality would make the median voter more likely to support a policy in the style of the one proposed in this paper.

Table 3: Average Subsidy

	All	Lower 10%	Top 10%
No Quality Improvements	46.33%	88.71%	18.95%
Quality Improvements	41.40%	84.74%	17.75%

5 Discussion and Conclusion

Table 4 summarises the effects of the different policy experiments undertaken above. Columns 1 to 3 indicate the case being considered. Column 4 displays the average subsidy for the total population, that was represented as a flat horizontal line in the graphs. Columns 5 to 7 display the total average repayments, as well as the total repayments for the workers in the lower 10% of the lifetime income distribution and the total repayments for the workers in the top 10% of the lifetime income distribution. These three columns are complementary to the graphs and do not add new information. Columns 8 and 9, display the within-group progressivity for both the GTF and the ICL systems, as defined in equations (14) and (16). As expected, within-group prorgressivity for the GTF does not change with the ICL parameters. A special case is the case of different levels in the principal (d) as we have imposed that the total amount given in the form of ICL adds up to the total cost of higher education. To make things comparable, fees are adjusted accordingly. Therefore higher debt translates into higher fees which makes the GTF less progressive as the flat component of the burden becomes more important. Finally, column 10 offers a comparison of the ICL progressivity with respect to the baseline case, that is, the difference between each case in column 9 with the baseline, i.e., the first line of such column.

Table 4 highlights that there are many different ways to achieve a higher subsidy and/or more progressivity. Within each experiment, both the average subsidy and the progressivity measure are monotonous to changes in the parameter of interest. Furthermore, increases in the average subsidy are associated to increases in progressivity. The largest changes in progressivity are found in changes in the level of exemption. Overall, increases in the repayment rate and the debt write-off year have regressive effects and the savings from the lower subsidy could be achieved by increasing the interest rate. Despite its unpopular nature, the interest rate has redistributive effects at a very low cost for the taxpayers. Finally, increasing the debt can have large effects, but they are concentrated at the top of the lifetime income distribution.

To conclude, we want to go back to one of our lead questions: Would the introduction of an ICL system be feasible in a dysfunctional labor market like the one in Spain? Our concern here was that low and unstable earnings among university graduates could make the repayments of loans insufficient. However, in this respect, we have found that for a wide set of reasonable parameter values, it would be feasible. In particular, in all our experiments, the subsidy paid by the government under the ICLs is lower than the current subsidy at 80%. Therefore, the government saves in the new system. This could translate into lower taxes, or investment in other public goods or in improvements in university quality.[11] Given that the Spanish labor market is an extreme case in terms of the high levels of unemployment and high incidence of temporary contracts among OECD countries, this an important lesson for countries with similar labor markets.

Looking at the other agents in the economy, universities cannot be worse off with the implementation of ICLs, as they could have more resources. Individuals without a university degree would be better off as they would pay lower taxes as a result of the lower subsidy. Finally, regarding university graduates it would depend on their position in income distribution. Those at the lower tail would be better off, as they could benefit from a better university and/or lower income taxes at no education additional cost compared to the prevailing system. Moving up in the income distribution means that the subsidy received is lower and it becomes less obvious that the benefits can compensate the costs. A good point of reference is whether the median voter would favor or not this policy. Given that the share of non-college graduates is 64%[12] in Spain, whom we have argued unambiguously gain, and that, from our different simulations, roughly the bottom 20% of the university graduates pay less than in the current case, it is not unreasonable to think that the median voter would support ICLs. We acknowledge that the final answer would ultimately depend on the human capital and university quality increases after the introduction of ICLs.

It would appear strange that given the savings we anticipate for the median voter, there is not a large demand for ICLs to be introduced in most developed countries. The next two paragraphs discuss two justifications for this. One issue is that the ICL are perceived as traditional loans. But as we have discussed, all in all, the ICLs are isomorphic to *returnable*

[11] Moen (1998) shows how ICLs can help restore optimal levels of investment in human capital in the presence of search frictions and wage bargaining.

[12] OECD (2018).

fellowships of different amounts in the sense that the sum of repayments does not exceed the fees except for the case where interest rate is above zero. Also, Diris and Ooghe (2018) offer a discussion from the political economy literature on this exact question. They explain that the transition from a general-tax-financed subsidy to ICL generates winners and losers and therefore it is not obvious to have a majority for the change; also, other key aspects for a majority include the relative usage of higher education versus the relative tax contribution of users and non-users, the presence of private education as well as the importance of risk aversion on future labor market outcomes. Diris and Ooghe (2018) conclude that it is likely that support for ICL comes from parents of talented poor and middle income families. This highlights an interesting aspect that we would like to highlight: that ICLs break the link between parents and children in tertiary education financing because repayments are set as function of children's future earnings, independently of family background. This, in turn, implies that, unlike other social policies, ICL systems represent a transfer from the older cohorts to the younger cohorts. Moreover, it is the richer older cohorts that would finance university the poorer younger cohorts, thus potentially enhancing intergenerational mobility.

Another possible explanation for the lack of ICL support is ignorance by the voters. But given that the example of countries where they exist is quite notorious, and its analysis in Dearden et al. (2008) is about a decade old, it is surprising that no political entrepreneur has used it to move up the political ladder. A more intriguing explanation would rely on the fact that real politics are multidimensional, and a coalition of the winner in this issue could have formed with those of other issues on a stable platform. Levy (2005) is an example of how this explanation could work. She models a society in which there are two issues, public education and redistribution. She then shows that when the cohort size of the young is not too large, a coalition between the rich and the young segment of the poor can form with public education used as a political compromise. Future research could explore whether another coalition might have formed around public funding for higher education.

Finally, while in this paper we are focusing on the gains associated to more resources and higher progressivity, there are both limitations and benefits of the ICL system that we find worth mentioning but fall beyond the scope of this paper. On the one hand, our approach is limited in the sense that it ignores endogenous responses to the policy changes. Two prominent examples of these limitations are: (1) Workers close to the top of the distribution might be deterred from working if that means paying a larger fraction of their fees back if the substitution effect is strong enough. Given the income distribution in Spain, we find this case to be unlikely. Looking at table 4, the top 10% of the distribution pays almost the full amount under all scenarios. Working a few hours less would decrease income but not the burden of paying for college. It is also important to remember that these are workers for whom work yields direct utility rather than a mere source of income. (2) While the introduction of ICLs could, for given a earnings distribution, lead to lower university enrollment because students would have a higher cost for the same education; it is also true that the introduction of ICLs will likely change the earnings distribution and lead to an increase in enrollment if individuals anticipate that the return of human capital will increase with ICL. On the other hand, additional benefits of moving away from the GTF system that have not been explicitly analyzed in this paper that we find of particular interest include: (1) The ICL scheme also features an insurance component through the exemption level, the debt write-off, and the repayment factor. While this is partly captured by our measures of within-group progressivity, in the context of a highly volatile and uncertain labor market like the one in Spain, this is likely to provide additional benefits to the workers to the extent that lower uncertainty affects consumption and savings decisions. (2) When the main part of university resources is publicly provided, government budget cuts have a strong impact on the survival and quality of tertiary education institutions. This can have perverse effects such as making university quality cyclical or exposing higher education institutions to political uncertainty and the business cycle. We leave these questions for future research.

Table 4: Cases Comparison

Case	Value	Units	Avge. Subsidy (%) (Sub_i)	Repayment of ICL ($\sum P/C$) Total	Top 10%	Lower 10%	Within-group Progressivity GTF $\left(\frac{\tau_e^s Y_{p90}+F}{\tau_e^s Y_{p10}+F}\right)$	ICL $\left(\frac{\tau_e^s Y_{p90}+\int_{i\in p90}\sum_a \beta^a P_{ia}}{\tau_e^s Y_{p10}+\int_{i\in p10}\sum_a \beta^a P_{ia}}\right)$	Comparison ICLs with baseline
Baseline			46.33	70.30	99.84	14.78	1.77	7.05	0.00
Interest R.									
r	0.5	%	44.45	73.06	104.88	14.78	1.77	7.36	0.30
r	0.8	%	43.30	74.75	108.11	14.78	1.77	7.56	0.50
r	2.2	%	37.86	82.82	125.40	14.78	1.77	8.63	1.57
Debt									
d	5000	Euros	24.05	91.86	100.00	50.86	3.17	2.37	-4.69
d	10000	Euros	32.75	84.42	99.99	30.40	2.38	3.80	-3.25
d	40000	Euros	60.90	52.95	98.41	7.76	1.44	11.67	4.62
Exempt									
x	10000	Euros	35.24	82.87	99.95	31.41	1.77	3.56	-3.50
x	20000	Euros	56.20	58.41	99.50	7.02	1.77	12.39	5.34
x	25000	Euros	64.44	48.09	98.54	3.46	1.77	18.01	10.95
Debt Write-Off									
m	15	Years	63.71	44.17	87.35	8.92	1.77	8.80	1.75
m	20	Years	52.83	59.84	98.25	12.15	1.77	7.92	0.87
m	30	Years	41.64	78.73	99.99	18.36	1.77	6.10	-0.95
Repay.Rate									
p	5	%	62.04	51.52	98.11	7.39	1.77	11.24	4.18
p	8	%	51.17	64.74	99.69	11.82	1.77	8.38	1.33
p	15	%	38.37	78.86	99.94	22.10	1.77	5.00	-2.06

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Appendix

A Comparing the Three Systems: Further Results and Details

In this section, we provide further details on and complementary results to the calculations shown in Section 2.5 to support our statement in Result 2.

Detailed calculations behind equations (12).

$$
\begin{aligned}
Burden^u(GTF) &= \bar{\tau}^u Y^u && (26)\\
Burden^s(GTF) &= \bar{\tau}^s Y^s + F(GTF) && (27)\\
Burden^u(GT) &= \bar{\tau}^u Y^u - \underbrace{(\bar{C} - F(GTF))}_{PublicSavings(GT)} && (28)\\
Burden^s(GT) &= (\bar{\tau}^s + \phi) Y^s \\
&= \bar{\tau}^s Y^s + F(GTF) + \underbrace{\frac{G^E(GTF)}{\bar{G}} [\bar{\tau}^s Y^s + \bar{\tau}^u Y^u]}_{=(\bar{C}-F(GTF))=PublicSavings(GT)} \\
&= \bar{\tau}^s Y^s + \bar{C} && (29)\\
Burden^u(ICL) &= \bar{\tau}^u Y^u - \underbrace{(\int_{i \in S} \sum_{a=1}^{\bar{a}_i} P_{ia} - F(GTF))}_{PublicSavings(ICL)} && (30)\\
Burden^s(ICL) &= \bar{\tau}^s Y^s + \underbrace{\int_{i \in S} \sum_{a=1}^{\bar{a}_i} P_{ia}}_{=PublicSavings(ICL)+F(GTF)}, && (31)
\end{aligned}
$$

Burden (cost) of financing G^E. Besides the total cost in the form of out of pocket expenses and total general tax financing, we look at the burden directly associated to financing universities. Let $Burden_e^j$ $(j = u, s)$ denote the cost of financing higher education for each type of private agent, both out of pocket and in the form of taxes that are used to subsidy the public spending on higher education.

As a first step, we show that the public subsidy to higher education is lowest under the GT system and, as long as there is a minimum level of ICL debt repayment, highest under GTF. Formally, this states, that $G^E(GTF) > G^E(ICL) > G^E(GT) = 0$, where the last equality follows directly $G^E(GT) = \bar{C} - \Phi = 0$. To understand the last inequality, it suffices to make the plausible assumption that there is not full repayment of the ICL. For the first inequality, we need a minimum level of ICL repayment sufficient to cover at least for the GTF level of fees. Formally, $\int_{i\in\mathcal{S}} \sum_{a=1}^{\bar{a}_i} P_{ia} > F(GTF)$. While this is a empirical question that will be at the core of out loan laboratory, we can anticipate it is a very plausible assumption and feasible under various ICL parameter configurations.

Next, we calculate and compare the burden of public higher education for the different agents under the different systems.

$$
\begin{aligned}
Burden_e^u(GTF) &= \tau_e^u(GTF)Y^u = \frac{G^E(GTF)}{\bar{G}}\bar{\tau}^u Y^u && (32)\\
Burden_e^s(GTF) &= \tau_e^s(GTF)Y^s + F(GTF) && (33)\\
Burden_e^u(GT) &= 0 && (34)\\
Burden_e^s(GT) &= \phi Y^s = F(GTF) + \tau_e^s(GTF)Y^s + \tau_e^u(GTF)Y^u \\
&= F(GTF) + \frac{G^E(GTF)}{\bar{G}}\left[\bar{\tau}^s Y^s + \bar{\tau}^u Y^u\right] && (35)\\
Burden_e^u(ICL) &= \tau_e^u(ICL)Y^u = \frac{G^E(ICL)}{\bar{G}}\bar{\tau}^u Y^u && (36)\\
Burden_e^s(ICL) &= \tau_e^s(ICL)Y^s + \int_{i\in S}\sum_{a=1}^{\bar{a}_i} P_{ia} \\
&= \frac{G^E(ICL)}{\bar{G}}\bar{\tau}^s Y^s + \int_{i\in S}\sum_{a=1}^{\bar{a}_i} P_{ia} && (37)
\end{aligned}
$$

Essentially, in the GT system, the total education burden of the unskilled is absorbed by the skilled workers. In the case of the ICL, the portion of the fees that is not repaid is financed by both the skilled an unskilled similarly to the GTF case, with the difference that now $G^E(ICL) < G^E(GTF)$. Therefore, the burden for the unskilled is lower.

CAPÍTULO 4: Fatal underfunding? Explaining COVID-19 mortality in Spanish nursing homes

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Abstract

The COVID-19 pandemic has exerted a disproportionate effect on older European populations living in nursing homes. This paper provides an exploratory ('hypothesis-generating') empirical analysis of the regional variation in nursing home fatalities during the first wave of the COVID-19 pandemic in Spain, one of the European countries with the highest number of nursing home fatalities. We draw on descriptive and multivariate regression analysis to examine the association between fatalities and measures of nursing home organisation, capacity and coordination plans alongside other characteristics. We document a correlation between regional nursing homes fatalities (as a share of excess deaths), and a number of proxies for underfunding including nursing home size, occupancy rate and lower staff to a resident ratio (proxying understaffing). Our preliminary (non-causal) estimates predict a 0.44 percentual point reduction in the share of nursing home fatalities for each additional staff per place in a nursing home consistent with a chronic underfunding explanation. However, further analysis might be required when data becomes available.

Keywords*:* nursing homes, care coordination, long term care financing, understaffing, institutional size, COVID-19, Spanish regions.

1. Introduction

It is well known that the exposure to COVID-19 increases with age. Eight out of ten COVID-19 deaths have been on adults over 65 (CDC, 2020). Older individuals are more vulnerable to the COVID-19 risk given their weaker immune system, lower physiological reserve and, more generally, the higher prevalence of multi-morbidities among older age compared to younger individuals (Montecino-Rodriguez *et al*, 2013). In some European countries such as Spain, the risk of death from COVID-19 is estimated at 4.6% among individuals aged 60 to 70 years of age, yet such number increases to 13.6% among individuals aged 70 to 80, and to 21% among those 80 and over. Indeed, 87% of COVID-19 deaths in Spain are among individuals aged 70 and above (Spanish National Network for Epidemiological Monitoring, 2020).

A significant share of COVID-19 fatalities has taken place in nursing homes. Publicly reported evidence suggests that 22,373 people (or 55 per cent of all those who died from COVID-19) died in nursing homes as of November 2020(Ministry of Health, 2020). To put this evidence in context, *13% of all nursing home residents died from COVID-19 in the first wave of the pandemic in Spain*. Such figure rises to 22% of nursing home residents over the age of 80. However, we still know little about the reasons for such large number of fatalities in nursing homes compared to age-matched controls in the community. This paper attempts to shed some light on this question focusing on Spain.

Spain is one of the countries that have been heavily exposed to austerity cuts in the 2008-2013 period, which entailed a significant reduction in long term care funding available, and as we argue in the paper, might have magnified the effects of a pandemic in nursing homes. More specifically, given that COVID-19 has not affected nursing homes equally across the entire country, it is possible to appreciate important differences across regions in nursing home fatalities. Whilst in some regions (such as Madrid), 18% of nursing home residents died from March to May, in other regions (in Andalusia), the figure is three to four times lower (and exhibit a 5% fatality rate) (Ministry of Health, 2020). However, what explains such regional differences in nursing home deaths? Are there any specific features of the way nursing homes are organised, which could underpin such large regional differences in nursing home fatalities?

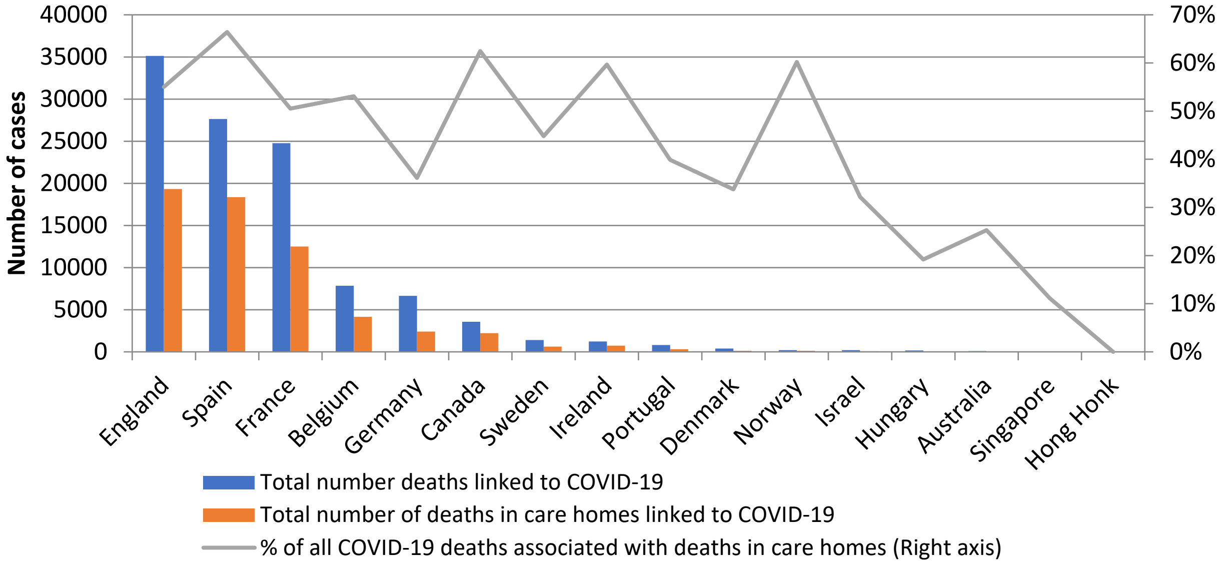
We provide a hypothesis generating analysis of the regional variation in nursing home organisation to examine whether underfunding alongside other explanations influenced nursing home fatalities during the first wave of the COVID-19 pandemic. More specifically, we examine whether proxy measures of nursing home underfunding, including understaffing (staff to places ratio) correlate with nursing home fatalities (relative to excess deaths). Furthermore, we control for other measurers of nursing home underinvestment such as the average nursing home size (regions that exhibit larger nursing homes might not guarantee access to protective equipment), and especially, the average regional nursing home occupancy rate (as occupancy plays a role in limiting the availability of spare rooms for self-isolation). Finally, we control for the role played by the existence of regional health and long-term care coordination plans which might play a crucial role in preventing fatalities during a pandemic (larger nursing homes might not guarantee access to protective equipment).

Our empirical analysis reports the results of both descriptive and multivariate analysis of nursing home fatalities in the first wave (March to May 2020) of the COVID-19 pandemic in Spain. We test whether a number of regional nursing home characteristics, and especially nursing home under-staffing, are associated with nursing home fatalities. The rest of the article is organised as follows: the next section provides international evidence on nursing home deaths. Section three examines chronic underfunding in nursing homes and considers the role of safety equipment and coordination both between health and social care and between governments. Section four examines the evidence on COVID-19 and excess mortality in nursing homes in Spain. A final section concludes.

2. International Evidence on COVID-19 deaths in nursing homes

Figure 1 shows that whilst in some countries we barely find any nursing home fatality, in some EU deaths numbers exceeded 10,000 already in May 2020 (with the notable exception of Germany and Denmark). Indeed, in many European countries, nursing home deaths are about 50 per cent of COVID-19 deaths. In Spain, the figure is 66 per cent of the total deaths attributable to COVID-19 in mid-May as reported in Figure 2. The rest of the paper will focus on examining evidence from Spain, to spell out the main underlying explanations for the higher-than-average number of cases in the country.

Figure 1. Nursing home deaths in selected countries



Source: Own elaboration and International Long Term Care Policy Network https://ltcCOVID.org/international-reports-on-COVID-19-and-long-term-care/, Sweden: COVID-19 deaths refers to the Stockholm region.

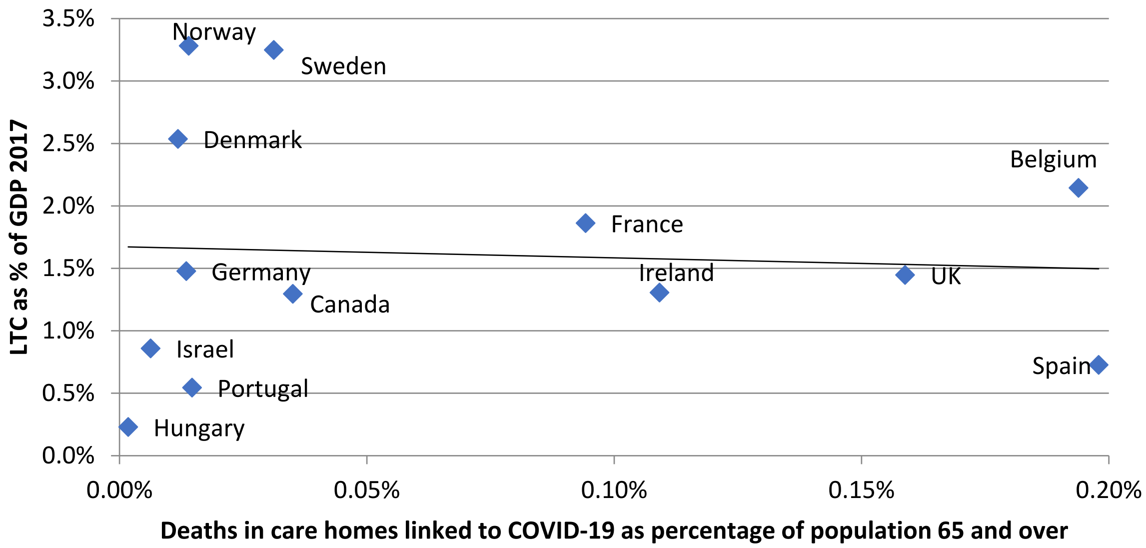
3. Chronic underfunding

Chronic underfunding reflects in understaffing when a care unit systematically operate at the limit of its capacity, hence lacking sufficient spare human resources (and other inputs) to perform its duties at its expected quality. As a phenomenon, understaffing has been especially pervasive in the provision of long-term care services in many Southern European countries after the great Recession. Austerity reforms a gave rise to spending cuts in 2012-13 which, reduced by an average of 20% available long-term care funding (Costa-Font *et al*, 2018, Costa-Font, Jimenez-Martin and Vilaplana, 2016). Although many European countries have expanded their funding for long term care over time, spending growth has not kept in line with the increasing needs of the elderly population, and facilities providing care commonly face staff shortages, and lack contingency plans and training to use protective personal equipment (PPE) to the serve needs of care in a pandemic (MSF, 2020).

Limited long-term care funding engenders waiting lists in the access of long-term care (the percentage of applications still waiting for a place in a nursing home is as high as 30% of the total in Spain). However, underfunding reduces the quality of care through other channels too. For instance, in high occupancy facilities, there are frequently no spare rooms available to implement social distancing. A reaction to underfunding is the reduction in the hiring of permanent staff, and the reliance of temporary staff that work in different facilities, or that would take up different jobs. This might have exacerbated nursing home cases, and fatalities.

Certainty, underfunding is not specific to Spain, and other studies suggest it is a common in other countries too (Werner et al, 2020). Figure 2 displays evidence of some negative correlation between the number of nursing home deaths in a country, and its LTC spending as a share of GDP. Although, the evidence only suggests some moderate correlation, Figure 1 reveals that there are important outliers and the association is mainly driven by evidence from the UK, and especially Spain.

Figure 2. Total number of deaths in care homes linked to COVID-19 as % of population 65 and over and LTC as % of GDP 2017. Selected OECD countries.

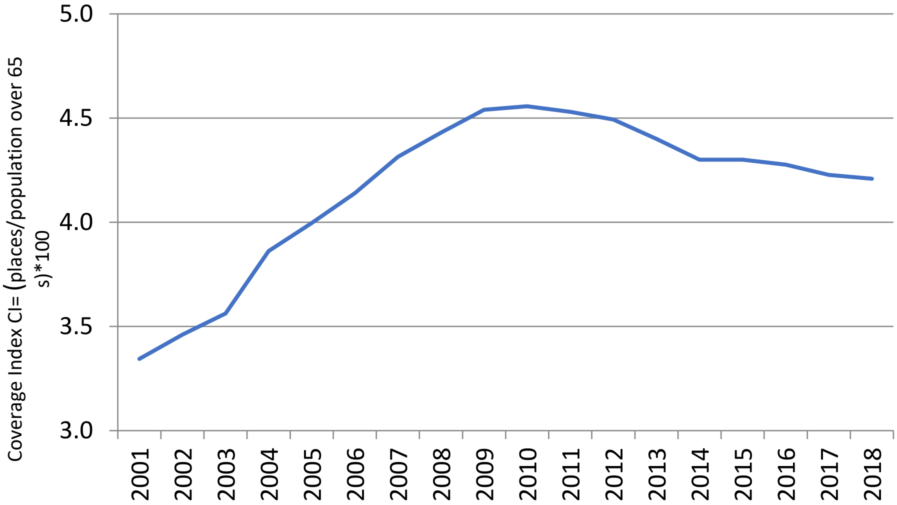


Source: International Long-Term Care Policy Network and OECD Health Statistics 2019, https://www.oecd.org/els/health-systems/long-term-care.htm

Note: Sweden: COVID-19 deaths refer to the Stockholm region.

Figure 3 reveals that the percentage of nursing home places as a share of the population over 65 (coverage index) exhibits a declining trend since 2008. As a reaction to the excess demand of nursing home places, Spain has seen an expansion of both nursing home size, and especially its occupancy rate. As we show below, both measures correlate with nursing home fatalities (as a share of excess deaths).

Figure 3. Nursing home beds as a share of population over 65 (2001-2018)



Source: IMSERSO, https://www.imserso.es/imserso_01/documentacion/estadisticas/ssppmm_esp/index.htm.

Population data from: local census, several years.

4. Other Explanations

4.1 Coordination Failures and safety

Underfunding can be made worst by the presence of coordination failures. Health and long-term care services in Spain have traditionally been subject to several types of 'coordination failures' both between health and social care services, and between different levels of government. Pandemics such as the COVID-19 exacerbate health and social care coordination failures, which put a strain on the efficiency of contingency plans and were responsible for delays in the transfer of residents into a hospital and, reduced the access to PPE. Coordination plans for health and social care have been limited to a few regions. Only eight of seventeen regions in Spain had developed health and social care coordination plans[1] which slow are even halt patient transfer to hospitals. In fact, evidence from before the wave of the pandemic suggests that limited coordination between health and social has led to additional hospitalizations (Costa-Font et al, 2018).

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[1] These refer to Asturias, Balearics, Canary Islands, Cantabria, Castilla Leon, Catalonia, Community of Madrid and the Basque Country. On the other hand, 5 regions (Aragon, Castilla La Mancha, Valencian Community, Extremadura and La Rioja) have socio-sanitary plans.

During a first wave of the pandemic, after the state of emergency was declared in Spain on Saturday 14th of March, health care stewardship of the health system was returned to the central government, which lead to an additional coordination problem between levels of government as social care responsibilities which include the regulation of nursing homes, remained as a regional responsibility. This explains that on average, most regions took between 26-31 days to report a case.

Finally, coordination failures took place together with other safety failures. Indeed, protocols in nursing home facilities only requested symptomatic cases to self-isolate, but not those in close contact with them.

4. 2 Health system preparedness

Certainly, not all countries were equally prepared to face the health care consequences of the first wave of the COVID-19 pandemic. European countries exhibited significant differences in the availability of critical intensive care beds to treat new cases (Germany 29.2, Portugal 4.2)[2]. However, the availability of critical care beds is only one of the ways to prepare for additional health care needs during a pandemic, as pandemics constrain access to emergency health care[3]. Already, before the pandemic, hospital admissions were slower among nursing homes residents compared to community equivalent populations (Robins et al, 2013; Lee et al, 2003).

Some organisations have documented evidence that a significant number of emergency hospital referrals in Spain were slowed down during the peak of the pandemic increasing the share of positive patients in a nursing home (MSF, 2020). In some regions, older age patients were refused emergency health care from major hospitals[4], as clinical guidelines explicitly stated *not to admit older patients residing nursing homes*[5]. Finally, health systems facing capacity restrictions engage in rationing by age. That is, older age individuals tend to receive a lower priority in the management of hospital waiting lists (Venkatapuram et al, 2017).

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[2] Furthermore, such differences were not be fully explained by differences in the relative investment in health (as a proportion of GDP), but by other public policy preferences (Rhodes *et al*, 2012).

[3] Previous studies already document a mortality spike to what it is normally observe after nursing home admissions (Aneshensel *et al*, 2000).

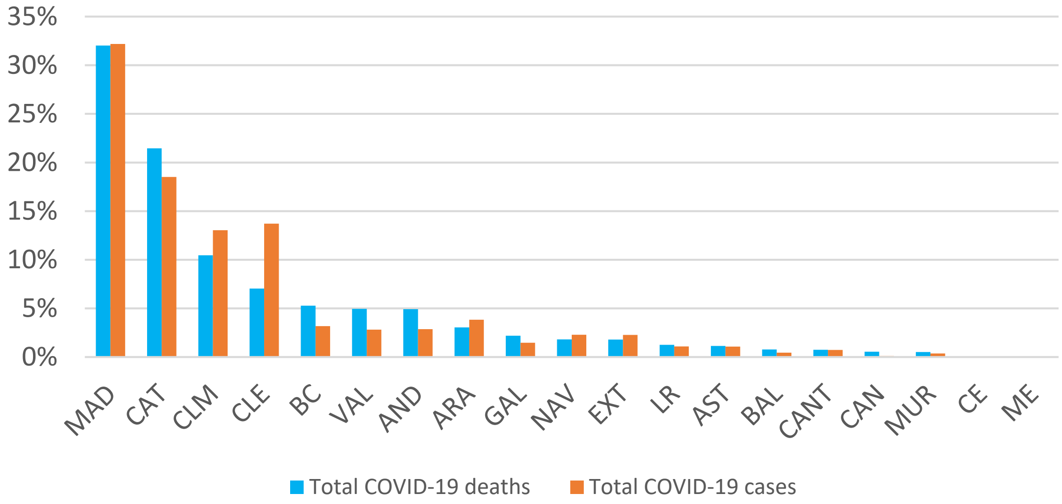
[4] https://www.niusdiario.es/sociedad/sanidad/coronavirus-COVID-19-madrid-protocolo-decidir-ancianos residencias-hospital_18_2948670305.html

[5] https://www.eldiario.es/sociedad/Comunidad-Madrid-Primaria-COVID-19-trasladarse_0_1032397623.html

4.3 Community infections

Finally, one of the additional explanations refers to the rate of infections in the community. Accordingly, regional differences in COVID-19 cases in Spain are depicted in Figures 4 and 5. Figure 4 indicates that as of May 16, 2020 nearly 64% of total COVID-19 deaths were concentrated in a few regions, namely in Community of Madrid, Catalonia and Castilla La Mancha, being the Community of Madrid the region with the highest number of cases and fatalities.

Figure 4. Regional distribution of total COVID-19 deaths and cases (May 16 2020).

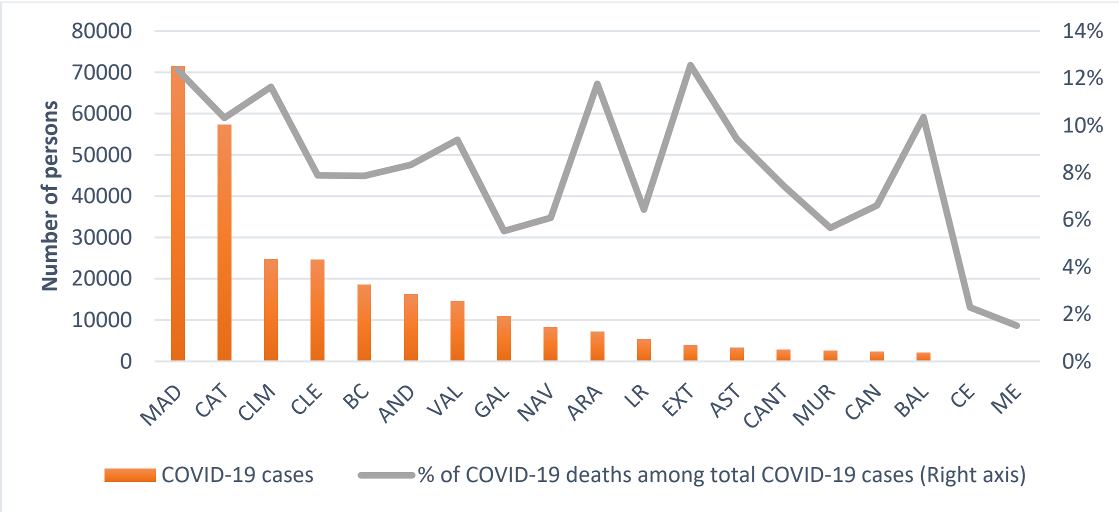


Source: Ministry of Health.

Region names are: MAD = Community of Madrid, CAT = Catalonia, CLM = Castilla La Mancha, CLE = Castilla Leon, BC = Basque Country, VAL = Valencian Community, AND = Andalusia, ARA = Aragon, GAL = Galicia, NAV = Navarra, EXT = Extremadura, LR = La Rioja, AST = Asturias, BAL = Balearics, CANT = Cantabria, CAN = Canary Islands, MUR = Murcia, CE = Ceuta and ME = Melilla.

However, when we turn to examine the fatality rate, we find a different picture. Figure 5 depicts the severity of the pandemic against the fatality ratio as of May 16, 2020 defined as the number of deaths attributed to COVID-19 divided by the number of cases (number of people that have tested). Although some regions report low number of cases such as Aragon, Extremadura and Balearics, fatality rate reveals a more even picture except in two territories in Africa (Ceuta and Melilla). Suggesting that in part the differences in fatalities in the community do not just match the regional differences in nursing home fatalities as discussed in the next section.

Figure 5. Total COVID-19 cases and infection fatality rate by region (May 16 2020).



Source: Ministry of Health.

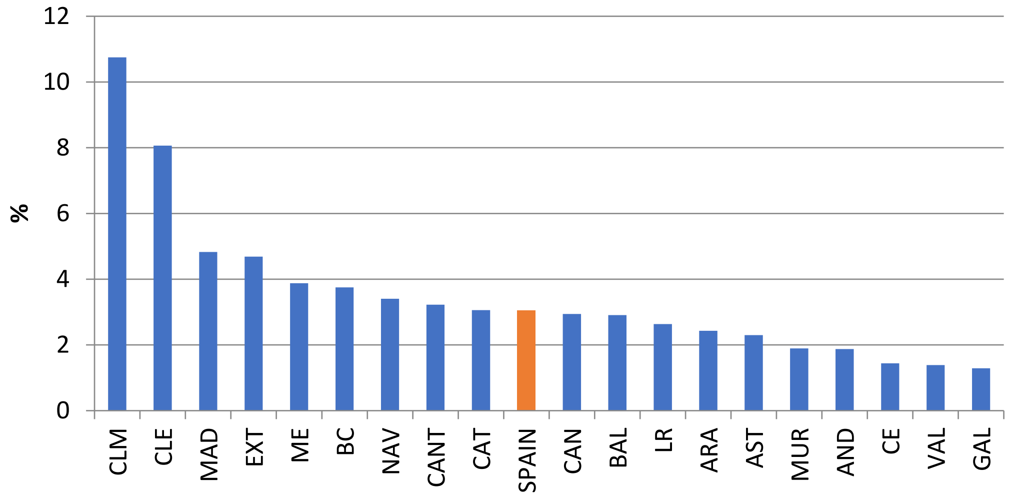
Region names are: MAD = Community of Madrid, CAT = Catalonia, CLM = Castilla La Mancha, CLE = Castilla Leon, BC = Basque Country, VAL = Valencian Community, AND = Andalusia, ARA = Aragon, GAL = Galicia, NAV = Navarra, EXT = Extremadura, LR = La Rioja, AST = Asturias, BAL = Balearics, CANT = Cantabria, CAN = Canary Islands, MUR = Murcia, CE = Ceuta and ME = Melilla.

5. Evidence on COVID-19 deaths in nursing homes in Spain.

5.1 Measuring nursing home fatalities

Figure 6 reveals, that on average 3% of the population reside in nursing homes. However, official estimates suggest that 18,400 (66%) of the total of 27,709 COVID-19 fatalities took place in nursing homes (RTVE, 05/19/2020). However, such estimates are largely heterogeneous across regions, ranging from less than 2% in Galicia to 11% in Castilla-La Mancha.

Figure 6. Share of population in nursing homes by region in 2018 (or nearest available).



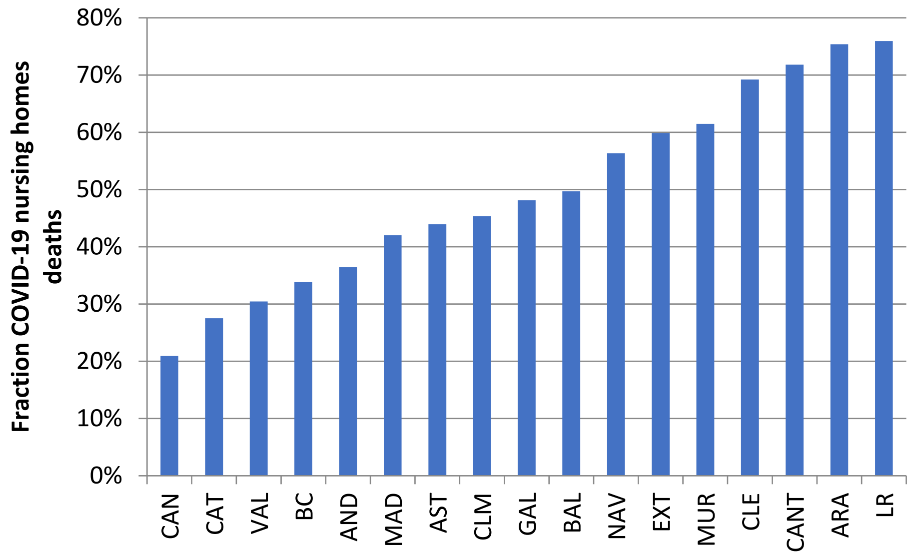
Source: IMSERSO, https://www.imserso.es/imserso_01/documentacion/estadisticas/ssppmm_esp/index.htm.

Region names are: MAD = Community of Madrid, CAT = Catalonia, CLM = Castilla La Mancha, CLE = Castilla Leon, BC = Basque Country, VAL = Valencian Community, AND = Andalusia, ARA = Aragon, GAL = Galicia, NAV = Navarra, EXT = Extremadura, LR = La Rioja, AST = Asturias, BAL = Balearics, CANT = Cantabria, CAN = Canary Islands, MUR = Murcia, CE = Ceuta and ME = Melilla.

Note: Aragon, Canar and Extremadura, data from 2016. Galicia, data from 2017.

Consistently, Figure 7 displays the regional variation in nursing home deaths as a share of excess deaths. Excess deaths are computed as the difference between total deaths from March to May 16th, 2020 minus total deaths from March to May 16th, 2019 for each region, information published by the Spanish National Network for Epidemiological Monitoring (MoMo). Such new estimates suggest a different share of nursing home deaths, though indicates significant regional variation (Figures A1 and A2 in the appendix display the difference with estimates from reported COVID-19 deaths).

Figure 7. Nursing homes deaths as a share of excess deaths (May 16 2020).



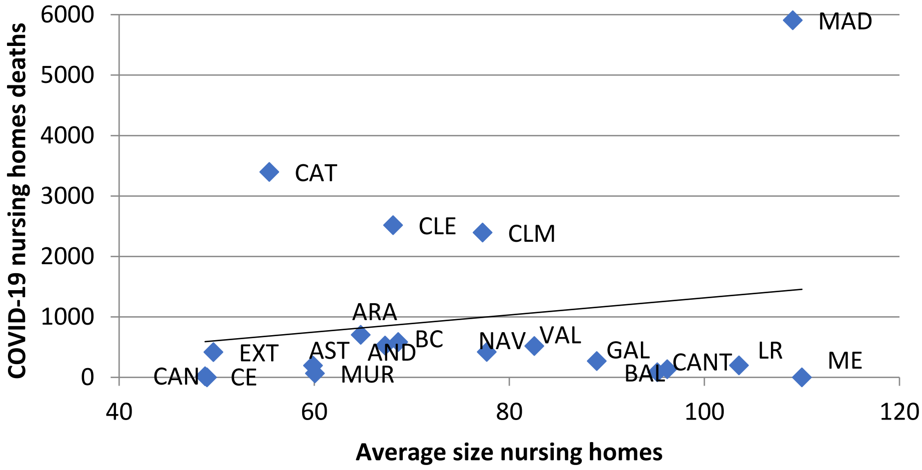
Source: RTVE and MoMo.

Region names are: MAD = Community of Madrid, CAT = Catalonia, CLM = Castilla La Mancha, CLE = Castilla Leon, BC = Basque Country, VAL = Valencian Community, AND = Andalusia, ARA = Aragon, GAL = Galicia, NAV = Navarra, EXT = Extremadura, LR = La Rioja, AST = Asturias, BAL = Balearics, CANT = Cantabria, CAN = Canary Islands, MUR = Murcia, CE = Ceuta and ME = Melilla.

5.2 Nursing home size.

Consistently with the paper's argument, it is possible to identify important differences in regional nursing home fatalities as displayed in Figure 8. *Regions where nursing homes bed capacity exceed 100 beds such as the Community of Madrid and La Rioja have experienced higher than average death rates. In contrast, regions such as Catalonia, Extremadura, and the Canary Islands where the average size was about half (closer to 50)* reveal the lowest mortality.

Figure 8. Average size of nursing homes (number of beds/number of homes) and COVID-19 nursing home deaths by region.



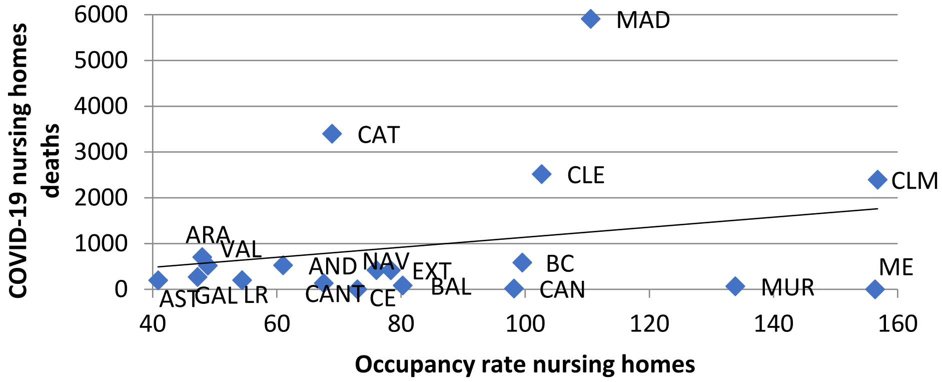
Source: RTVE and IMSERSO.

Region names are: MAD = Community of Madrid, CAT = Catalonia, CLM = Castilla La Mancha, CLE = Castilla Leon, BC = Basque Country, VAL = Valencian Community, AND = Andalusia, ARA = Aragon, GAL = Galicia, NAV = Navarra, EXT = Extremadura, LR = La Rioja, AST = Asturias, BAL = Balearics, CANT = Cantabria, CAN = Canary Islands, MUR = Murcia, CE = Ceuta and ME = Melilla.

5.3 Nursing Home Occupancy

Another potential explanation for nursing home fatalities refers to its high occupancy rate. Figure 9 shows that regions where nursing homes were near full capacity seem to have exhibited a larger number of deaths. This is consistent with an underfunding explanation; whereby higher occupancy reduced the availability of spare rooms for self-isolation purposes.

Figure 9. Average occupancy rate (number of users/number of beds) and COVID-19 nursing home deaths by region.



Source: RTVE and IMSERSO.

Region names are: MAD = Community of Madrid, CAT = Catalonia, CLM = Castilla La Mancha, CLE = Castilla Leon, BC = Basque Country, VAL = Valencian Community, AND = Andalusia, ARA = Aragon, GAL = Galicia, NAV = Navarra, EXT = Extremadura, LR = La Rioja, AST = Asturias, BAL = Balearics, CANT = Cantabria, CAN = Canary Islands, MUR = Murcia, CE = Ceuta and ME = Melilla.

Note: Data of users (IMSERSO): Aragon, Canary Islands and Extremadura, data from 2016. Galicia, data from 2017. Rest of regions 2018.

6. Multivariate Regression Analysis.

Given that some of the descriptive determinants presented in the previous section are potentially correlated, in this section we report evidence from multivariate regression analysis examining the association between regional nursing home deaths as a share of excess mortality in the first wave of the COVID-9 pandemic. Given the small number of observations we have only included a small list of variables as covariates in each of the specifications, and out analysis at this stage is only exploratory given that a small number of observations. We specifically examine the influence of a number of covariates such as the regional supply of nursing home beds, the share of the total population over 65, the regional nursing home size, the regional nursing home occupancy rate and the staff to resident ratio. We use the latter as a measure of understaffing.

Table 1. Descriptive statistics of variables in the analysis

Variable	Mean	Std. Dev.	Min	Max
NH places	20061	18997	196	64093
NH	287	293	2	1157
Population 65+	476610	460869	8876	1442630
COVID-19 deaths until March14	7	19	0	86
COVID-19 deaths until May16	1455	2267	2	8826
COVID-19 NH deaths	966	1540	0	5909
Coverage: NH places / pop65+	0.043	0.018	0.014	0.079
Excess death	2339	4070	3	14065
Employment in NH	15202	13894	247	45640
Occupancy rate	84	35	41	157
Size Nursing Home places	75	20	49	110
Employment in NH / NH places	0.989	0.620	0.512	3.195
Coordination	0.421	0.507	0	1
Nursing Homes users/ pop65+	0.035	0.024	0.013	0.107
Total Observations		**19**		

Note: this table reports the mean, standard deviation of the variables used in the multivariate analysis.

Table 1 reports a description of the variables employed. It suggests that that the average region in Spain has 20,061 nursing home places, 287 nursing home facilities. On average there are about half a million people over 65 in each of the regions and COVID-19 deaths in nursing homes amount 966 at the time of the study, which compares to 1455 COVID-19 deaths which is slightly lower than excess deaths of 2339. On average, there is nursing home place for every 20 individuals over the age of 65 in a nursing home. Importantly, we estimate the average ratio of the total regional staff employed in nursing homes in a region (as measured by the Survey of Active population in 2020) to the number of nursing home places. The estimate takes the average value of 0.99, but such estimate exhibits a large regional variation[6]. About 42% of regions have some coordination plan, and the average size of a nursing home is of 75 paces. Finally, the average occupancy rate is 84%, consistent with the hypothesis of long-term care underfunding.

Table 2 reports the regional correlates of nursing home deaths relative to excess deaths and given the small number of observations we use a stepwise analysis whereby we add additional variables to the analysis. Consistent with the paper hypothesis, we find that larger sized nursing home exhibit higher fatalities relative to excess deaths. More specifically, our coefficients suggest a 0.6 percentual point (pp) increase per an additional place in each nursing home. Similarly, *we*

[6] By staff we mean any member of staff referring mainly to care workers, but it includes nurses, managers and others, mostly full time although in some cases such as doctors or cleaners they might well be employed part time.

predict a 0.44pp reduction in nursing homes fatalities per additional staff per place in a nursing home. However, these estimates come from a small number of observations and report adjusted association that cannot be interpreted as causal estimates.

Finally, we estimate a significant association between nursing home occupancy and nursing fatalities relative to excess deaths, which is sensitive to the inclusion of the share of nursing homes per older population. These results indicate that regions *with higher nursing home occupancy rate have higher nursing home death as a share of excess deaths*. All the other determinates are not significant, or its effect not robust. Hence, although these results need to be taken with caution, they suggest early cross-section evidence that under-resourced and understaffed nursing homes exhibit higher nursing home mortality.

Table 2. Dependent Variable: COVID-19 nursing homes deaths as a fraction of excess death

CONTROL VARIABLES	1	2	3	4	5	6	7	8	9
Nursing homes places (thousands)	0.00818	-0.0152	-0.0162	-0.0117	-0.0101	-0.00857	-0.00229	0.00128	0.0176
	(0.00654)	(0.00948)	(0.0101)	(0.0110)	(0.0117)	(0.0136)	(0.0146)	(0.0115)	(0.0129)
Population 65+	-0.000373	0.000512	0.000532	0.000357	0.000264	0.000208	-1.66e-05	-7.28e-05	-0.000778
	(0.000270)	(0.000369)	(0.000384)	(0.000421)	(0.000462)	(0.000530)	(0.000564)	(0.000441)	(0.000472)
Coverage: Nursing Homes places / pop65+		13.13***	13.42**	14.38***	11.93*	11.46	8.553	20.24**	
		(4.388)	(4.585)	(4.679)	(6.448)	(6.972)	(7.395)	(7.194)	
Deaths until March14			0.995	1.289	1.302	1.444	-0.259	-4.248	-3.109
			(2.643)	(2.658)	(2.730)	(2.899)	(3.263)	(2.938)	(3.785)
Nursing Homes users/ pop65+				-2.955	-2.312	-2.410	-2.605	-22.00**	-8.343
				(2.927)	(3.211)	(3.367)	(3.340)	(7.583)	(7.580)
Staff NH / NH places					-0.0642	-0.0720	-0.135	-0.502**	-0.448*
					(0.113)	(0.122)	(0.133)	(0.170)	(0.220)
Coordination						-0.0287	-0.0442	-0.0812	-0.117
						(0.114)	(0.114)	(0.0902)	(0.116)
Size Nursing Home places							0.00332	0.00725**	0.00673*
Occupancy rate								0.0129**	0.00494
								(0.00474)	(0.00494)
Constant	0.460***	-0.0507	-0.0597	-0.00532	0.150	0.189	0.131	-0.705	0.348
	(0.0773)	(0.182)	(0.189)	(0.197)	(0.340)	(0.387)	(0.387)	(0.431)	(0.277)
Observations	19	19	19	19	19	19	19	19	19
R-squared	0.107	0.441	0.446	0.486	0.500	0.503	0.556	0.757	0.543

Notes: This table provides the coefficients of a linear regression analysis of the main determinants of regional nursing home deaths. We specifically examine the association of nursing home fatalities relative to excess death and nursing home places, occupancy, nursing home size, population over the age of 65, the supply of nursing home beds relative to the regional population over 65, the total number of deaths and the Nursing home staff to places ratio. ** Reflects significance at 5%, *** Reflects significance at 1%.

7. Conclusion

Unlike previous pandemics, COVID-19 has encompassed a large number of fatalities in nursing homes. However, to date we know little about what the underlying explanations are driving such large fatality rate. This paper provides descriptive and exploratory ('hypothesis generating') multivariate analysis of the first wave of COVID-19 nursing home fatalities in the in Spain, one of the European countries fatality rate.

We examine the association between nursing home fatalities relative to excess death and a number of nursing home characteristics and specifically proxies of underfunding such as understaffing (staff to resident ratio), occupancy rate and we include other controls for the supply of nursing home care. Although no causal analysis is possible to date with the existing data, evidence from the association between regional variation in nursing home organisation and fatalities might be suggestive of phenomena to be confirmed with further data, and ideally, from other countries exposed to the COVID-19 pandemic.

Our estimates suggest evidence consistent with the hypothesis that regions with lower investment in nursing home care, and specifically with lower staff to nursing home places exhibit a higher nursing home fatality relative to excess deaths. Although our estimates are retrieved from a small sample, we predict a 0.44pp reduction in the regional nursing home fatalities per excess death for each additional staff per place available in a nursing home available in each region. This is especially relevant given that austerity reforms entailed significant spending cuts in long term care spending after 2012.

Limited investment in long term care compared to other more technology intensive social services such as health care seems to play a role in preventing nursing home fatalities during a pandemic. Our estimates are consistent with the idea that region that exhibit larger nursing home places, occupancy, larger sized nursing homes but less staff to place ratio, are responsible for a higher number of fatalities per excess deaths. *Consistently, regions have staffed nursing homes exhibit a lower death rate.* However, we don't find robust evidence across the board that differences in health and social care coordination explain COVID-19 fatalities, or that other characteristics of nursing homes plat a role.

In addition to understaffing, other explanations include the role of weak contingency plans limiting hospital admissions of nursing home residents into emergency care appear to have contributed to higher COVID-19 fatalities. These results suggest that although nursing homes can cope with underinvestment during normal times, at time of a pandemic it has fatal consequences consistently without hypothesis. However, our estimates refer to cross -sectional regional data, and hence should be treated with some caution. More research should be carried out to document these effects available data becomes available, given our analysis does not address some of the other fundamental issues in prediction of mortality, specifically demographic characteristics and comorbidities in the nursing home resident populations.

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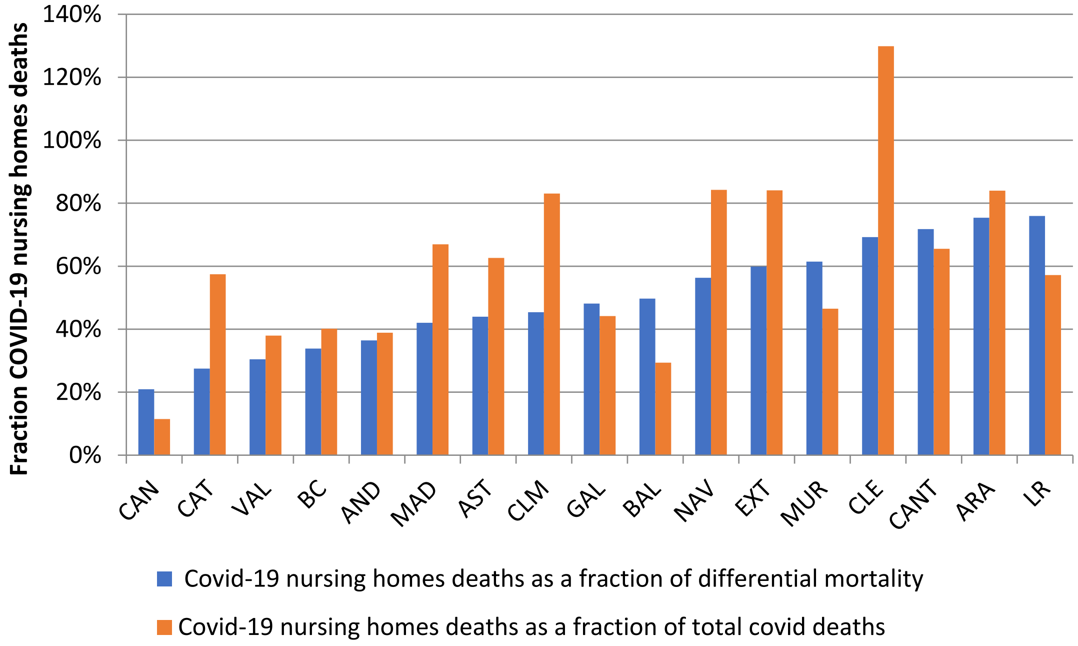
RTVE (2020). Data of COVID-19 nursing home deaths, https://www.rtve.es/noticias/20200702/radiografia-del-coronavirus-residencias-ancianos-espana/2011609.shtml. Data extracted May 19 2020.

Appendix

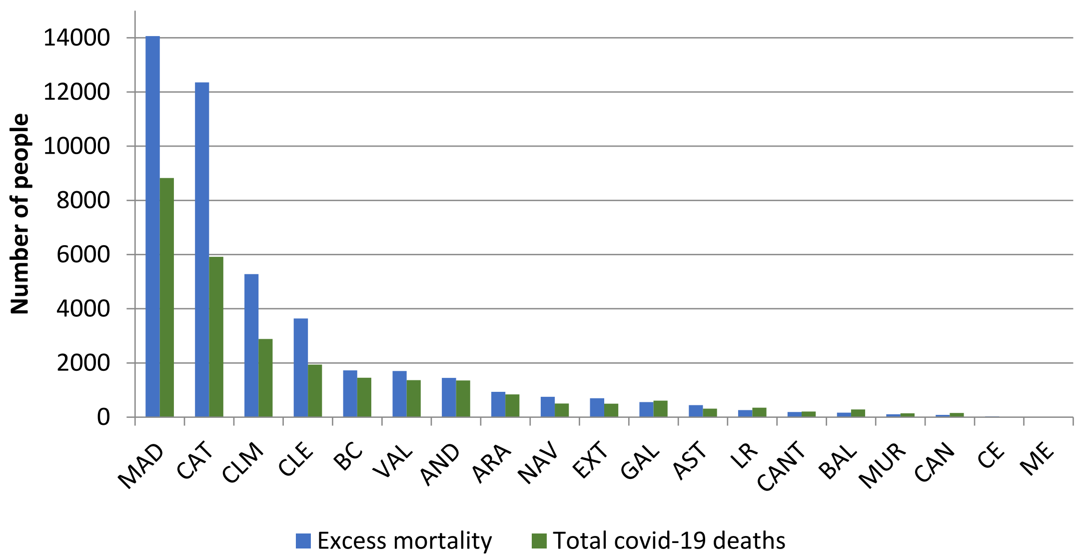
Figure A1. Nursing homes deaths as a share of excess deaths and total COVID deaths. As of May 16 2020.



Source: Momo and Spanish Ministry of Health.

Region names are: MAD = Community of Madrid, CAT = Catalonia, CLM = Castilla La Mancha, CLE = Castilla Leon, BC = Basque Country, VAL = Valencian Community, AND = Andalusia, ARA = Aragon, GAL = Galicia, NAV = Navarra, EXT = Extremadura, LR = La Rioja, AST = Asturias, BAL = Balearics, CANT = Cantabria, CAN = Canary Islands, MUR = Murcia, CE = Ceuta and ME = Melilla.

Figure A2. Excess mortality and total COVID-19 deaths by region.



Source: Momo and Spanish Ministry of Health.

Region names are: MAD = Community of Madrid, CAT = Catalonia, CLM = Castilla La Mancha, CLE = Castilla Leon, BC = Basque Country, VAL = Valencian Community, AND = Andalusia, ARA = Aragon, GAL = Galicia, NAV = Navarra, EXT = Extremadura, LR = La Rioja, AST = Asturias, BAL = Balearics, CANT = Cantabria, CAN = Canary Islands, MUR = Murcia, CE = Ceuta and ME = Melilla.