Universidad de Valladolid

Escuela de Doctorado Universidad de Valladolid

PROGRAMA DE DOCTORADO EN ECONOMÍA

TESIS DOCTORAL:

Análisis Espacial del Mercado de Trabajo Español a nivel Macroeconómico: Teoría y evidencia empírica

Presentada por Jaime Cuéllar Martín para optar al grado de Doctor por la Universidad de Valladolid

Dirigida por los Profesores

Dr. Ángel Luís Martín Román

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Facultad de Ciencias Sociales

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Agradecimientos

La configuración de una tesis doctoral no resulta ser una tarea fácil. Uno de los aspectos más importantes es la ilusión con la que uno cuenta para poder afrontar todo el proceso. En mi caso, tuve claro desde el primer momento que quería dedicarme a esto de la investigación y la docencia desde que me encontré con la asignatura de Macroeconomía en el tercer curso de la carrera de Administración y Dirección de Empresas allá por el año 2012. La forma de poder comprender el comportamiento de las personas y las empresas dentro del entorno en el que vivimos siempre me ha parecido fascinante, sobre todo el tratar de razonar su comportamiento en el futuro, con todas las reservas del mundo, de acuerdo a una lógica económica.

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COMPOSICIÓN DE LA TESIS DOCTORAL

De acuerdo con la normativa vigente para la presentación y defensa de la tesis doctoral en la Universidad de Valladolid (aprobado por el Consejo de Gobierno en sesión de 3 junio de 2016. BOCyL nº114 de 15 de junio), esta tesis doctoral se presenta en la modalidad "tesis por compendio de publicaciones". En ella se incluyen un total de cuatro artículos, tres de ellos ya publicados en revistas científicas y el restante en proceso de evaluación en el momento del depósito. Los artículos 2º y 3º están publicados en revistas indexadas WOS SSCI JCR, mientras que el artículo 4º se encuentra publicado en una revista indexada SCOPUS, por lo que cumplen con los requisitos establecidos por la Comisión del Programa de Doctorado en Economía. A continuación, se incluyen los artículos que conforman la tesis doctoral, así como la revista en la que están publicados y su base indexación. Se recoge también la filiación de los coautores.

1. Martín-Román, Á. L., Cuéllar-Martín, J., & Moral, A. (2020). Natural and cyclical unemployment: A stochastic frontier decomposition and economic policy implications. *Bulletin of Economic Research* (en 3ª ronda de evaluación).

   Indexación: WOS SSCI JCR Impact Factor (2019): 0.333. Subject: Economics (Q4; 358/373).

2. Cuéllar-Martín, J., Martín-Román, Á. L., & Moral, A. (2019). An Empirical Analysis of Natural and Cyclical Unemployment at the Provincial Level in Spain. *Applied Spatial Analysis and Policy*, *12*(3), 647-696. Doi.org/10.1007/s12061-018-9262-x.

   Indexación: WOS SSCI JCR Impact Factor (2019): 1.778. Subject: Environmental Studies (Q3; 91/123); Geography (Q3; 45/84); Regional & Urban Planning (Q4; 31/39).

3. Martín-Román, Á. L., Cuéllar-Martín, J., & Moral, A. (2020). Labor supply and the business cycle: The "Bandwagon Worker Effect". *Papers in Regional Science*, Forthcoming. Doi.org/10.1111/pirs.12542.

   Indexación: WOS SSCI JCR Impact Factor (2019): 2.220. Subject: Economics (Q2; 96/373); Environmental Studies (Q3; 68/123); Geography (Q2; 37/84); Regional & Urban Planning (Q3; 23/39).

4. Martín-Román, Á. L., Moral, A., Martín-Román, J., & Cuéllar-Martín, J. (2018). Una evaluación de impacto del segundo Plan Regional de Empleo de Castilla y León. *Revista de Estudios Regionales*, (112), 177-208.

   Indexación: Elsevier. SCOPUS CiteScore (2019): 0.5. Subject: Sociology and Political Sciences (P33; 822/1.243); Development (P23; 183/239); Economics and Econometrics (P15; 537/637).

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INTRODUCCIÓN

1. Justificación y objetivos de la investigación

El análisis espacial de los mercados de trabajo regionales, desde una perspectiva macroeconómica, se ha erigido como uno de los campos de estudio que más interés despierta en los investigadores y responsables de política económica durante los últimos años (Marston 1985; Jimeno y Bentolila, 1998; López-Bazo y Motellón, 2013). Sin embargo, es en España donde esta línea de investigación toma especial relevancia por tres principales motivos. El primero de ellos se centra en las altas tasas de desempleo efectivas observadas durante los últimos 40 años en comparación con el resto de los países pertenecientes a la Unión Europea. Según Bean (1994), las condiciones estructurales y las elevadas rigideces institucionales del mercado de trabajo español (elevada indemnización por despido, generosidad del sistema de seguro de desempleo, etc.) contribuirían a explicar las diferencias en materia de desempleo entre España y varios de los países del entorno europeo, en comparación con las cifras registradas en Estados Unidos, Canadá, Japón, Australia etc. Hacia este mismo sentido, se dirigen las conclusiones obtenidas en Blanchard y Jimeno (1995), los cuales consideran que la magnitud del componente estructural del desempleo efectivo español es la clave para explicar las elevadas tasas a lo largo de los últimos años[1].

El segundo motivo hace referencia a la notable polarización observada entre el nivel de desempleo efectivo de las regiones situadas en la mitad norte en comparación con los territorios del sur del país durante los últimos años. Concretamente, López-Bazo et al. (2002) señalan una diferencia de casi treinta puntos porcentuales entre la provincia española que presenta la menor tasa de desempleo efectivo y la que presenta una mayor tasa de desempleo, un fenómeno que se mantiene prácticamente invariable durante doce años (1985-1997). Por otro lado, Bande y Karanassou (2014) ratifican la existencia de importantes disparidades en materia de desempleo entre las comunidades autónomas españolas del norte y del sur de España durante el periodo 1980-2010, fenómeno que se aceleró durante los años ochenta y noventa del siglo XX y que volvió a observarse durante la Gran Recesión de principios del siglo XXI.

Finalmente, el tercero de los motivos se basa en la elevada sensibilidad cíclica observada en algunas de las variables más importantes del mercado laboral español. Es bien sabido que el caso español se caracteriza por la existencia de ciclos económicos amplios y por el efecto que este ejerce sobre la propia tasa de desempleo en forma de una notable creación de empleo durante los periodos de expansión económica y por una gran destrucción del mismo durante las etapas de recesión (Ball et al., 2019; Bande y Martín-Román, 2018; Porras-Arena y Martín-Román, 2019).

Las elevadas cifras de desempleo en España, así como su persistencia temporal, hacen necesario estudiar cuales son los mecanismos que generan esta problemática. Este es precisamente el primer pilar de la tesis doctoral, ofrecer respuestas que permitan desentrañar el papel que los distintos componentes del desempleo efectivo ejercen sobre la formación del mismo. En base a lo anterior, consideramos que esta investigación se enmarca dentro de la literatura científica centrada en el análisis macroeconómico de los mercados de trabajo. Concretamente, tratamos de desarrollar un marco teórico que nos permita descomponer al desempleo efectivo en tres componentes principales y a priori inobservables, desempleo cíclico, desempleo estructural y desempleo friccional (Krugman, 2011; Aysun et al. 2014). Este análisis, permitirá conocer cuál es el papel del componente cíclico como natural (NRU por sus siglas en inglés) a la hora de generar las tasas de desempleo en España, tanto desde la perspectiva del conjunto del país como regional.

[1] El termino desempleo efectivo hace referencia a la tasa de desempleo sobre la que se informa en las estadísticas laborales oficiales generadas por las autoridades pertinentes en España.

El segundo pilar de esta investigación se centra en estudiar cual es el papel que ejerce el territorio, como elemento dinamizador de la actividad económica a nivel regional. En este caso, esta tesis doctoral también se inmiscuye en las cuestiones tratadas por parte del análisis espacial de los mercados de trabajo, siendo esta una línea de investigación que ha tomado una importancia capital en la ciencia económica, lo que ha contribuido a generar un elevado número de trabajos tanto desde el ámbito nacional como internacional (Blanchard y Katz, 1992; Elhorst, 2003; Bande et al., 2008). Los economistas han tratado de comprender cuál era la influencia de la geografía sobre el comportamiento y la evolución de las variables económicas más importantes dentro del área de conocimiento anterior (tasa de desempleo, tasa de actividad, nivel de acumulación de capital humano etc.), consolidando el análisis científico desde el punto de vista teórico, empírico y metodológico (Decressin y Fatás, 1997; López-Bazo et al. 2002; López-Bazo y Motellón, 2012). Entre las razones que contribuyen a explicar dicho auge, podemos destacar la consideración de las unidades territoriales como elementos que ejercen una cierta influencia sobre otras zonas geográficas, adyacentes o no, y viceversa (López-Bazo et al. 2005), observándose que los territorios interactúan unos con otros, condicionando y moldeando las dinámicas económicas existentes dentro de los mismos. Desde la literatura económica, se ha denominado como efecto desborde a este tipo de fenómenos, definiéndose como aquellas acciones económicas, originadas en un territorio determinado, que generan efectos significativos sobre otras zonas geográficas cercanas (Martin, 1997; Rey y Montouri, 1999; Cracolici et al. 2007; Elhorst, 2010).

Este efecto construye relaciones de vecindad, según los conceptos utilizados en el análisis económico espacial, debido a la existencia de elementos económicos comunes o que son compartidos por ambos territorios. El anterior argumento considera erróneo el tratar a los territorios como unidades aisladas entre sí, ya que la existencia de sinergias económicas acaba por dar lugar a un conjunto de relaciones multilaterales que acentúan la dependencia territorial de las regiones. De esta manera se generan áreas económicas integradas por unidades territoriales próximas (clústers según la economía académica), las cuales comparten una problemática económica común. De acuerdo con esto, es posible considerar a la investigación económica de los mercados de trabajo regionales como una de las líneas de investigación más consolidada e importante dentro del contexto científico social actual, trascendiendo, en numerosas ocasiones, la frontera de la investigación puramente regional.

El tercer pilar de esta tesis doctoral, se basa en el análisis macroeconómico de los efectos sociales generados por los agentes económicos a nivel territorial (personas, empresas, instituciones públicas etc.). Existen varias investigaciones que han tratado de ofrecer respuestas al intrincado proceso regional de integración económica, siendo algunas de las más importantes las de Manski (1993), Manski (2000) o Dietz (2002). Básicamente, estos autores consideran que el comportamiento de un agente económico dentro de un territorio, tiene una influencia directa sobre otro agente ubicado en un área vecina. El anterior planteamiento desemboca en la creación de redes sociales de cooperación que contribuyen a homogeneizar las decisiones económicas de los agentes que participan en ellas (participación laboral, ocupación sectorial etc.) a la par que reducen los costes derivados de buena parte de los procesos económicos a los que se enfrentan mediante la mitigación de la incertidumbre asociada a ellos (búsqueda de empleo, migración, ocio etc.).

Finalmente, el último pilar de esta investigación se centra en la evaluación de las políticas activas del mercado de trabajo (ALMP, por sus siglas en inglés) dentro de contexto regional en España. La necesidad de evaluar los resultados específicos generados por las políticas activas del mercado laboral ha ido escalando posiciones hasta convertirse en un elemento básico a la hora de considerar el éxito o el fracaso de una intervención económica por parte del sector público dentro de un contexto económico determinado (comunidad autónoma, provincia, ciudad etc.). A su vez, el análisis de las mismas constituye un elemento clave a la hora de tomar decisiones informadas por parte de los responsables de política económica. Pese a lo anterior,

en comparación con otros países del entorno europeo, la evidencia científica relativa a esta problemática no resulta ser muy abundante en España (Martín-Román et al. 2007; García-Serrano, 2007), lo que genera la necesidad de profundizar en el conocimiento en dicha línea de investigación económica. Una vez hemos expuesto los elementos centrales de análisis, es necesario mencionar que, nuestro trabajo se enfoca, siguiendo el sistema de clasificación territorial europeo, en el estudio de las unidades NUTS-2 (comunidades autónomas españolas) y en las unidades NUTS-3 (provincias españolas). Dicho lo cual, se presta una atención especial a las investigaciones que se incluyen dentro del análisis de la economía laboral, principalmente en aquellas que se centren en la descomposición de las diferentes tasas de desempleo efectivas. También, en los trabajos en los cuales se tratan temas relacionados con la existencia de dependencia espacial en las variables principales del mercado de trabajo, en estudios donde se analiza el comportamiento económico de los agentes y en los que analizan los resultados o efectos económicos que se derivan de la aplicación de distintas políticas activas centradas en incrementar el nivel de empleo o reducir el número de desempleados existente en los mercados de trabajo regionales nacionales e internacionales.

Después de enumerar los pilares por los cuales consideramos relevante la realización de esta tesis doctoral, pasaremos a detallar los objetivos que pretendemos alcanzar con la realización de la misma. El primero de los objetivos consiste en obtener una mayor información acerca de un aspecto clave dentro de la economía laboral: El estudio de las dinámicas económicas que subyacen en la formación del desempleo efectivo a nivel regional (Aysun et al. 2014). Como es bien sabido, a lo largo de la investigación económica, han existido diferentes métodos que han ofrecido estimaciones de los componentes del desempleo efectivo, posiblemente una de las herramientas más utilizadas para ello hayan sido los filtros estadísticos univariantes (Fabiani y Mestre, 2004). Dentro de la gran variedad de filtros univariantes, podemos destacar tres de los más empleados, como son el filtro de Hodrick-Prescott (Hodrick y Prescott, 1997), el filtro de Baxter-King (Baxter y King, 1999) y el procedimiento de tendencia cuadrática[2].

Sin embargo, existen varias investigaciones que cuestionan la falta de incorporación de información económica de estos procedimientos a la hora de realizar estimaciones económicas (Gómez y Usabiaga, 2001; Fabiani y Mestre, 2004). Nuestro trabajo pretende descomponer las tasas de desempleo efectivo mediante la utilización de procedimientos econométricos multivariantes que generen un mayor conocimiento de los componentes del desempleo. Para lograr este objetivo, nos basaremos, principalmente, en los trabajos de Hofler y Murphy (1989) y Aysun et al. (2014), en los cuales se obtienen estimaciones de los componentes del desempleo efectivo a través de la aplicación de la técnica econométrica de las fronteras estocásticas. Este procedimiento, que será explicado en mayor detalle en secciones futuras, nos permitirá profundizar en el conocimiento del componente natural y cíclico del desempleo efectivo, facilitando la identificación de aquellas variables económicas que resultan ser claves en su formación.

El segundo objetivo se centra en profundizar en el conocimiento acerca de la influencia del territorio sobre el mercado laboral en particular y la economía española en general. Durante las últimas décadas han surgido una gran cantidad de trabajos que han centrado su estudio en aspectos muy diversos de los mercados de trabajo regionales (Marston, 1985; Blanchard y Katz, 1997; Elhorst, 2003; López-Bazo et al. 2005; Bande et al. 2008). Sin embargo, en nuestro trabajo tratamos de aportar evidencia empírica acerca de cuál es el papel del espacio sobre aspectos poco tratados en la literatura científica, como es el análisis espacial de los componentes del desempleo o el estudio de la dependencia espacial en la sensibilidad cíclica de la participación laboral regional. Para ello, emplearemos algunas de las herramientas más conocidas dentro de la econometría espacial, como son la I de Moran global (Moran, 1948) o los

[2] Véase Hodrick y Prescott (1997) y Baxter y King (1999) para una explicación más detallada de ambos filtros.

estadísticos LISA (Anselin, 1995).

Como tercer objetivo, trataremos contribuir al desarrollo de un marco analítico que explique cuál es el papel que los efectos sociales, frecuentemente denominados en la literatura académica como peer effects, ejercen sobre la actuación de los individuos dentro del contexto macroeconómico en España. De esta forma, ligamos este tercer objetivo con los dos anteriores, ya que consideramos que las regiones españolas no operan como elementos totalmente aislados, sino que se retroalimentan entre sí a través de dinámicas económicas comunes (López-Bazo et al. 2002, 2005; Halleck-Vega y Elhorst, 2017).

Por último, como cuarto objetivo, tratamos de aportar evidencia científica que permita evaluar, de forma rigurosa, el efecto de las políticas activas del mercado de trabajo español sobre variables tan importantes como son el nivel de ocupación laboral o desempleo de las diferentes zonas territoriales en España. Consideramos que este tipo de análisis puede aportar una valiosa información para los responsables de política económica a la hora de diseñar actuaciones sobre los mercados de trabajo de un territorio en concreto, así como sobre el conjunto general del país. De acuerdo con lo anterior, pretendemos aportar luz al debate existente en torno a la utilización efectiva y eficiente de los recursos económicos, contribuyendo a la evaluación de las políticas públicas de empleo y aun mayor conocimiento de los efectos macroeconómicos que las mismas generan en las zonas en las que se aplican.

2. Estructura de la tesis doctoral

Esta tesis doctoral se compone de un total de cuatro capítulos, donde el planteamiento que los vertebra es común: El análisis macroeconómico espacial de los mercados de trabajo regionales. Sin embargo, cada uno de ellos presenta una configuración diferente, adaptándose a las necesidades de la investigación en la que se enfoca y utilizando diseños metodológicos particulares que tratan de enriquecer las aportaciones al campo de conocimiento en cuestión.

En el primero de los capítulos descomponemos a las tasas efectivas de desempleo de las diecisiete comunidades autónomas de España (NUTS-2) a lo largo del período 1982-2012, en dos componentes ampliamente diferenciados entre sí: Un componente cuyo origen se explica a través de la acción de diversos factores que configuran la oferta agregada (tasa natural de desempleo) y un segundo componente asociado a elementos relacionados con la demanda agregada o el desempleo cíclico. Concretamente, nuestro enfoque se basa en el adoptado en los trabajos de Warren (1991), Hofler y Murphy (1989) y Aysun et al. (2014), cuyo marco teórico se adhiere a la hipótesis de la compartimentalización del desempleo (Blanchard y Wolfers, 2000). Para poder realizar esta descomposición, utilizamos la técnica econométrica de las fronteras estocásticas en su versión de costes, lo que nos permite modelizar el componente natural del desempleo y también el componente de ineficiencia de la frontera estocástica. Una vez hemos estimado ambos componentes, llevamos a cabo una comparación con estimaciones obtenidas mediante la aplicación de tres filtros univariantes: Filtro de Hodrick-Prescott (1997), filtro de Baxter-King (1999) y la estimación mediante la tendencia cuadrática. Nuestros resultados muestran que el componente natural resulta ser el elemento principal a la hora de explicar a la tasa de desempleo efectivo, obteniéndose también una mayor importancia del componente cíclico en comparación con las estimaciones de los filtros univariantes.

En el segundo capítulo, empleamos la misma metodología de descomposición para calcular la relevancia del componente de oferta agregada y del componente de demanda agregada sobre la tasa de desempleo efectivo de las provincias españolas (NUTS-3) a lo largo del período 1984-2012. Posteriormente, analizamos la existencia de patrones espaciales entre las tasas efectivas de desempleo provincial y también entre los dos componentes previamente obtenidos. En este caso, empleamos algunas de las técnicas descriptivas de econometría espacial más utilizadas en la investigación en economía, como son la I de Moran global (Moran, 1948) y los estadísticos

LISA (Anselin, 1995). Por último, para completar nuestro análisis, también aplicamos técnicas de econometría espacial de datos de panel a través de un modelo espacial de Durbin (SDM).

Nuestros resultados señalan al componente de oferta agregada del desempleo efectivo como la parte más importante a la hora de justificar las altas tasas de desempleo provincial durante la Gran Recesión. También, detectamos la existencia de dependencia espacial positiva en las tasas de desempleo efectivas, la cual se explica, fundamentalmente, a través de este mismo componente. Finalmente, la evidencia empírica apunta a la existencia de dos grandes clústers territoriales, uno de alto desempleo entre las provincias del sur peninsular y uno de bajo desempleo situado en el noreste del país, lo que contribuye a explicar las disparidades territoriales en materia de desempleo entre las provincias españolas.

En el tercer capítulo investigamos los principales patrones que siguen los individuos a la hora de considerar su participación en el mercado laboral en función del estado del ciclo económico. Para ello analizamos el papel que ejercen los efectos sociales sobre las decisiones de participación de los agentes económicos (Manski, 2000; Dietz, 2002). En este caso, elaboramos un marco teórico que integra los efectos del trabajador desanimado y añadido con la influencia que el entorno ejerce sobre las decisiones de participación laboral de los individuos, ofreciendo una explicación teórica relativamente novedosa: El "Bandwagon Worker Effect". Este efecto teórico, considera que los individuos no deciden participar en el mercado de trabajo, en función del estado del ciclo económico, de forma totalmente aislada. Al formar sus preferencias, tienden a observar el entorno que les rodea para incorporar las acciones que han llevado a cabo los individuos situados en las zonas más próximas a ellos y así configurar su decisión de participación laboral. De tal manera que, si en una zona geográfica predomina el efecto del trabajador añadido (trabajador desanimado), es muy probable que se vea rodeada de otros territorios en los cuales la decisión de participación, respecto al estado del ciclo económico, sea similar.

Para testar la hipótesis anterior, nos valemos de algunas de las herramientas que nos brinda la econometría espacial y que ya han sido utilizadas previamente en el capítulo dos de la presente tesis doctoral, como son de la I de Moran global y los estadísticos LISA. También, para dotar de robustez a nuestro análisis, proponemos una serie de modelos espaciales de datos de panel, los cuales incorporan distintas variables explicativas relevantes a la hora de explicar al componente cíclico de la tasa de actividad provincial. Finalmente, nuestros resultados muestran la existencia de dependencia espacial entre las sensibilidades cíclicas de la participación laboral de las provincias españolas, por lo que se constata la existencia del Bandwagon Worker Effect. Por otro lado, es importante destacar que dichos vínculos sociales tienden a ser cada vez más intensos conforme es menor la distancia geográfica entre los territorios, viceversa para el caso contrario, hecho que es coherente con las predicciones teóricas de nuestro modelo.

Finalmente, en el cuarto y último capítulo llevamos a cabo una evaluación relativa del Segundo Plan Regional de Empleo de Castilla y León (SPRECyL). Nuestro principal objetivo se basa en calcular cual ha sido el impacto concreto que dicha política activa, dirigida al mercado laboral castellanoleonés, tuvo sobre la tasa de ocupación y la tasa de paro de las provincias de Castilla y León durante su periodo de aplicación (2001-2003). Para ello, aplicamos un enfoque cuasi-experimental basado en la metodología expuesta en Meyer (1995), el cual se desarrolla a través de la técnica econométrica del análisis de diferencias en diferencias. Este planteamiento metodológico nos permite aislar el efecto de elementos ajenos a la aplicación del SPRECyL, evaluando el efecto particular del mismo sobre la ocupación y el desempleo provincial en Castilla y León. Inicialmente, los resultados apuntan hacia un importante aumento de la tasa de ocupación junto con una reducción de la tasa de paro, en las provincias de Castilla y León durante la aplicación del SPRECyL, en comparación con lo ocurrido en los tres años anteriores.
Sin embargo, en una segunda etapa, cuando comparamos el desempeño de las provincias

castellanoleonesas con lo ocurrido en el resto de provincias del país, obtenemos unos resultados muy distintos. En este caso, la tasa de ocupación de las provincias de esta región experimenta un incremento menor que lo observado en aquellas provincias españolas con las que se lleva a cabo la comparación. Lo anterior pone de manifiesto los escasos resultados obtenidos por parte del SPRECyL en las provincias de Castilla y León durante el periodo 2001-2003. Por lo que se refiere a los resultados obtenidos para la tasa de paro se puede afirmar que las medidas destinadas a luchar contra el desempleo sí tuvieron cierto éxito relativo. De esta manera, en general, la tasa de paro evolucionó de una forma similar a la experimentada por el resto de provincias españolas durante tal periodo objeto de estudio.

Los cuatro capítulos anteriores completan la trayectoria investigadora realizada por el doctorando, los cuales, como hemos comentado con anterioridad, se integran en forma de capitulo uno, dos, tres y cuatro de la presente tesis doctoral. La anterior organización se explica de acuerdo a la necesidad de dotar a la tesis doctoral de un orden claro que ayude al lector a comprender los conceptos desarrollados con facilidad. Un elemento importante a destacar son los resultados de investigación obtenidos a partir de esta tesis doctoral. En concreto, el primer capítulo se encuentra en un periodo avanzado del proceso de publicación en la revista Bulletin of Economic Research. Esta revista esta indexada en el índice JCR (Journal Citations Report) en el cuarto cuartil de la categoría Economics según la clasificación del año 2019. Por su parte, el segundo capítulo se encuentra publicado en la revista Applied Spatial Analysis and Policy, la cual se encuentra indexada en el índice JCR (Journal Citatios Report) en el cuartil tercero, según la clasificación del año 2019, de la categoría Environmental Studies y Geography, y el cuarto cuartil en la categoría Regional and Urban Planning. El capítulo número tres, fue publicado en la revista Papers in Regional Science, revista indexada en el índice JCR en las categorías Environmental Studies (cuartil tercero), Geography (cuartil segundo), Economics (cuartil segundo) y Regional and Urban Planning (cuartil tercero) según la clasificación del año 2019. Finalmente, el cuarto y último capítulo ha sido publicado en la Revista de Estudios Regionales, indexada en el índice Scopus (Scimago Journal and Country Rank), en las categorías Development (percentil 23), Economics and Econometrics (percentil 15) y Sociology and Political Science (percentil 33) según la clasificación del año 2019.

3. Relevancia de la investigación doctoral

3.1 El análisis del mercado de trabajo: Los componentes del desempleo efectivo

Durante las últimas décadas, una parte importante de los investigadores en economía laboral han centrado sus esfuerzos en entender las mecánicas que subyacen a la formación de las tasas de desempleo (Blanchard y Portugal, 2001; Bentolila et al. 2012). Uno de los aspectos más interesantes dentro de esta línea de investigación es la que estudia a los diferentes componentes del desempleo efectivo. Una sencilla descomposición del desempleo efectivo, expuesta en algunos libros de texto, es la que se define a través de la siguiente ecuación (Krugman, 2011):

$$D_{it} = D_{it}^{F} + D_{it}^{ST} + D_{it}^{C} \quad (1)$$

donde D_{it} es la tasa de desempleo efectivo en la región i durante el instante t; D_{it}^{F} hace referencia al componente friccional; D_{it}^{ST} alude al componente estructural, mientras que D_{it}^{C} indica la magnitud del componente cíclico del desempleo efectivo.

Basándonos en lo anterior, una buena parte de la literatura *macro labor* ha considerado que, en el medio-largo plazo, incluso en ausencia de problemas relacionados con una demanda agregada insuficiente y bajo condiciones óptimas a nivel agregado, existe un cierto nivel de desempleo al que tienden las economías (Rogerson, 1997; Blanchard, 2018). A pesar de la

utilización de diversas nomenclaturas a lo largo de la historia, uno de las más empleadas podría ser la de tasa natural de desempleo (NRU), la cual, pese a no estar exenta de críticas, se ha instituido como uno de los conceptos macroeconómicos más utilizados en el ámbito de la economía laboral.

En esta línea, la tasa natural de desempleo se podría definir como la suma del desempleo friccional y del desempleo estructural, modificando la ecuación (1) de la siguiente manera:

$$D_{it} = D_{it}^{NRU} + D_{it}^{C} \quad (2)$$

donde D_{it}^{NRU} haría referencia al componente natural de la tasa de desempleo efectivo. En este punto es necesario destacar que, el anterior razonamiento se basa en la idea de que los componentes del desempleo efectivo no pueden alcanzar cotas negativas. Dicho de otra manera, tanto el desempleo efectivo como sus componentes son positivos, lo que conceptualiza a la tasa de desempleo natural como un límite inferior al que tiende el desempleo efectivo en el medio-largo plazo.

Una vez hemos descrito lo anterior, el principal problema reside en la cuantificación de los componentes del desempleo efectivo, ya que tanto el componente natural como el componente cíclico son elementos inobservables en las estadísticas laborales. Para superar este hándicap, nuestra investigación se inspira, principalmente, en los trabajos de Hofler y Murphy (1989), Warren (1991) y Aysun et al. (2014), aplicando la técnica econométrica de las fronteras estocásticas en su versión de costes para hallar una estimación de ambos componentes.

3.2 La importancia del territorio en los mercados laborales

El estudio del papel que el territorio ejerce sobre las dinámicas económicas regionales experimentó un notable impulso conforme la rama de la econometría espacial y las técnicas asociadas a esta se perfeccionaban. Buena parte del impulso investigador inicial se encontró motivado por el descubrimiento de fenómenos comunes entre las unidades de estudio (ciudades, barrios, provincias, países etc.), lo que conllevó al cuestionamiento y al tratamiento de estas como entidades ajenas a todo efecto externo. Los investigadores observaron que, en la mayoría de los países analizados, los territorios se conformaban mediante áreas económicas integradas, lo que generaba fenómenos económicos comunes en todos ellos. En otras palabras, los shocks económicos que afectaban a una zona en particular no limitaban su radio de acción a la misma, sino que se dispersaban por las áreas vecinas provocando efectos similares en ellas (Blanchard y Katz, 1992; Elhorst, 2003; Niebuhr, 2003; Halleck-Vega y Elhorst, 2017).

La conclusión que se extrae del párrafo anterior es clara, la evidencia empírica enfatiza el papel de los efectos espaciales para comprender los procesos económicos que se dan en el mundo actual. Como hemos comentado anteriormente, la inclusión del territorio generó una amplia batería de estadísticos y técnicas econométricas que contribuían a analizar los efectos económicos subyacentes, entre las que podemos destacar a los estadísticos descriptivos espaciales clásicos (I de Moran global, C de Geary, G de Getis, estadísticos LISA etc.), hasta las técnicas espaciales de panel más complejas (modelo de retardo espacial, modelo de error espacial, modelo espacial de Durbin etc.). Lo anterior contribuyó al desarrollo de numerosos campos del análisis económico, como pueden ser los procesos de convergencia económica (Rey y Montouri, 1999; Le Gallo y Chasco, 2008; Maza y Villaverde, 2009), la interdependencia de las tasas de desempleo en los mercados de trabajo regionales (Jimeno y Bentolila, 1998; Overman y Puga, 2002; López-Bazo et al. 2005; Filiztekin, 2009; Kondo, 2015; Halleck-Vega and Elhorst, 2016) o el análisis de la participación laboral en el mercado de trabajo (Möller y Aldashev, 2006; Elhorst y Zeilstra, 2007; Fogli y Veldkamp, 2011; Halleck-Vega y Elhorst, 2014).

Es precisamente en estos dos últimos campos en los que nuestra tesis doctoral trata de aportar conocimiento científico. En primer lugar, es necesario mencionar que, muchos de los artículos anteriormente reseñados, centraban su análisis en las tasas de desempleo efectivas, ofreciendo evidencia empírica de la existencia de clústers entre las tasas de desempleo regionales, detectada mediante la constatación de la existencia de autocorrelación espacial positiva entre los territorios. Conclusiones de este estilo son las que se encuentran en trabajos como los Overman y Puga (2002) en el caso del Reino Unido, López-Bazo et al. (2005) para España o Kondo (2015) para los municipios japoneses durante el periodo 1980-2005. Sin embargo, pocas investigaciones han centrado su análisis en estudiar cuáles son los componentes del desempleo efectivo que generan dicha dependencia espacial, lo que podría contribuir al desarrollo de un mayor conocimiento sobre el mismo.

En esta tesis doctoral analizamos si existe dependencia espacial en los dos componentes del desempleo comentados en la sección anterior: componente natural del desempleo y componente cíclico. Este enfoque nos permitirá comprender cuál de los dos componentes es el encargado de explicar la persistencia espacial y temporal que exhiben las tasas de desempleo a nivel regional. Por consiguiente, nuestro análisis nos permitirá conocer a los factores que actúan como motores dentro del proceso de integración territorial, pudiendo ser los elementos de oferta, incluidos en el componente natural o bien los factores de demanda agregada a través del componente cíclico.

3.3 El análisis de los efectos sociales en los mercados de trabajo regionales

Esta tesis doctoral relaciona a la economía laboral y a la investigación espacial con el estudio de los efectos sociales o peer effects (Dietz, 2002). Muchos trabajos han puesto de manifiesto la importancia que ejercen las redes sociales de contactos a la hora de moldear las decisiones que toman los individuos dentro del mercado laboral, lo que favorece la integración de los mercados laborales regionales (Collewet et al. 2017). Este es el motivo por el cual creemos que los efectos sociales juegan un rol determinante dentro de la economía regional, ya que generan comportamientos homogéneos que contribuyen a crear áreas económicas integradas en las cuales los individuos se retroalimentan entre sí a través de las acciones de su grupo de referencia (Manski, 2000).

Sin embargo, no existen muchos ejemplos en la literatura económica que centren sus esfuerzos en estudiar la acción de los efectos sociales en un ámbito tan importante como es la participación laboral de los individuos en función del estado del ciclo económico. Es cierto que existe una gran cantidad de trabajos que estudian la relación entre las tasas de actividad a nivel de país o región, focalizándose la mayoría de ellos en el nivel de estas variables (Halleck-Vega y Elhorst, 2017). Dentro de este tipo de análisis, los trabajos de Vendrik (1998) o Grodner y Kniesner (2008) sugieren la existencia de un cierto efecto arrastre en los mercados laborales, lo que conlleva a que las preferencias de los agentes se encuentren interrelacionadas, reforzando el argumento que considera que las regiones no son entidades completamente aisladas entre sí.

Es en este ámbito en el cual nuestro trabajo pretende avanzar en el conocimiento científico mediante el desarrollo de un novedoso marco teórico que contribuye al conocimiento de la economía regional a través del papel de los efectos sociales. Nuestra principal aportación reside en la acuñación de un concepto teórico (Bandwagon Worker Effect) que aúna parte de los avances de las investigaciones previamente citadas. Otro elemento a tener en cuenta es que, desde nuestro conocimiento, no existe ningún tipo de análisis regional que estudie dichos efectos en el caso de España, por lo que consideramos que nuestro trabajo puede aportar luz al fenómeno de la integración territorial de los mercados de trabajo que varias investigaciones alumbraban.

3.4 El papel de las políticas activas del mercado de trabajo a nivel territorial

La evaluación de las políticas públicas centradas en reforzar y mejorar el funcionamiento del mercado trabajo se han erigido como un elemento determinante a la hora de considerar si la acción por parte del sector público ha generado los resultados deseados. Podríamos considerar que este tipo de análisis ayudan a los responsables de política económica a la toma de sus decisiones futuras con una mayor cantidad de información disponible (Card et al, 2010; Kluve, 2010). En otras palabras, la evaluación del impacto de las políticas activas del mercado laboral trata de cuantificar cuales han sido los efectos concretos de una política económica determinada, eliminando los posibles efectos generados por otro tipo de variables sociales, políticas o económicas relevantes (García-Serrano, 2007; Toharia et al. 2008).

Pese a la existencia de una abundante evidencia empírica a nivel europeo e internacional, España destaca por ser un caso en el cual la evaluación de las políticas activas del mercado laboral no cuenta con un análisis tan extenso como en el caso de otros países. Este es precisamente otro de los objetivos de este estudio: evaluar el papel de las políticas activas del mercado laboral dentro del contexto regional español. A través de un enfoque metodológico basado en las técnicas experimentales incluidas en el trabajo de Meyer (1995), tratamos de aislar el efecto concreto sobre la ocupación y el desempleo de una política activa del mercado laboral aplicada en la región de Castilla y León durante el periodo 2001-2003 (Segundo Plan Regional de Empleo de Castilla y León (SPRECyL)).

De acuerdo a lo anterior, consideramos que nuestro análisis puede tener una doble relevancia en la investigación en economía. En primer lugar, aportamos evidencia empírica solida al análisis de los mercados de trabajo regionales en España desde una perspectiva macroeconómica, contribuyendo al análisis de la eficacia de las actuaciones del sector público sobre los mercados de trabajo y ayudando a la toma de decisiones futuras con un mayor conocimiento e información. En segundo lugar, creemos que la elección de Castilla y León como "campo de pruebas" puede ayudar a conocer en mayor medida cual es el grado de eficacia de este tipo de actuaciones públicas a nivel territorial y económico.

De acuerdo con la información aportada por el Instituto Nacional de Estadística (INE), Castilla y León es la región más extensa en España (94.224 km^2), contando con un total de nueve unidades NUTS-3: Ávila, Burgos, León, Palencia, Salamanca, Segovia, Soria, Valladolid y Zamora. A nivel europeo, la región representa en torno al 2% del territorio total (4,369,364 km^2), siendo la tercera región, dentro de las unidades NUTS-2, más extensa en Europa, excediendo incluso la extensión de algunos países como Portugal (88,847 km^2), Irlanda (70,601 km^2), Dinamarca (43,162 km^2) o Bélgica (30,668 km^2). Los datos anteriores ponen de relevancia la importancia de nuestro análisis a la hora de evaluar la efectividad de las políticas activas del mercado laboral en España.

4. Metodología

4.1. Descomposición del desempleo efectivo: Las fronteras estocásticas

La institucionalización de la técnica de las fronteras estocásticas se encuentra en los trabajos pioneros de Aigner et al. (1977) y Meeusen y van den Broeck (1977). Uno de los elementos más importantes es que, en estos estudios, se formalizan parte de los avances científicos de trabajos anteriores a la hora de generar una estructura de error compuesto, lo que es clave para la utilización de las fronteras estocásticas. Dicha técnica econométrica, nos permite estimar el límite inferior de la tasa de desempleo efectiva (componente natural), junto con la posible ineficiencia asociada al mismo (componente cíclico). Un elemento clave en este punto es la consideración adoptada en los trabajos de Hofler y Murphy (1989) y Aysun et al. (2014), en

donde se establece que todos los componentes del desempleo efectivo tienen como límite inferior el valor 0. Dicho con otras palabras, ningún componente del desempleo efectivo puede alcanzar cotas negativas

De tal manera que, si entendemos el proceso de formación de la tasa de desempleo efectiva como un fenómeno en el cual intervienen factores de oferta agregada y factores de demanda agregada, es posible hallar una descomposición del mismo a través del componente natural del desempleo y del componente cíclico. De acuerdo con esta hipótesis, la tasa natural de desempleo se constituye como un límite inferior al que la economía tenderá en el medio/largo plazo. De lo anterior se deriva que, la existencia de una tasa de desempleo efectiva superior a la tasa natural de desempleo se debe a un comportamiento ineficiente dentro del mercado de trabajo, ya que este "exceso" de desempleo, asociado al componente cíclico, podría corregirse mediante la aplicación de políticas económicas de demanda agregada. Por consiguiente, la ecuación (3) nos permite formalizar al componente natural de la siguiente manera:

$$D_{it}^{NRU} = X_{it}\beta_i + v_{it} \quad (3)$$

donde X_{it} es un vector de variables explicativas que engloba a factores de oferta agregada; β_i un vector de coeficientes que deben de ser estimados y v_{it} el componente aleatorio del error compuesto.

Como hemos mencionado anteriormente, este componente es únicamente uno de los dos que definen al desempleo efectivo, el cual se explica a través de la ecuación (4):

$$D_{it} = D_{it}^{NRU} + u_{it} \quad (4)$$

siendo $u_{it} = D_{it}^{C}$, asociando así al desempleo cíclico con el termino ineficiente mencionado anteriormente. Finalmente, agrupando las expresiones (3) y (4) obtenemos el modelo a estimar que nos permitirá descomponer al desempleo efectivo en su componente natural y en su componente cíclico mediante la aplicación de una frontera estocástica en su modalidad de costes:

$$D_{it} = X_{it}\beta_i + \xi_{it} \quad (5)$$

donde: $\xi_{it} = v_{it} + u_{it}$

Por lo que, aplicando dicho enfoque a nuestro análisis del mercado laboral, no solo podremos estimar el mínimo nivel de desempleo efectivo existente a nivel macroeconómico (componente natural), sino que también sería posible cuantificar el exceso de desempleo existente debido a la existencia de comportamientos macroeconómicos ineficientes en un entorno determinado (componente cíclico) para los distintos mercados de trabajo de las regiones españolas.

4.2. Las técnicas de econometría espacial: Conceptos clave

Una de las definiciones más completas de la econometría espacial es la que se ofrece en Elhorst (2014), donde se especifica a la econometría espacial como aquel "apéndice dentro de la econometría encargado de estudiar los efectos derivados de las interacciones espaciales entre las unidades geográficas objeto de estudio".[3] Una vez comentado lo anterior, debemos

[3] Pese a lo que pueda sugerir el término "unidades geográficas", el lector no debe limitarse a considerar dentro del mismo, únicamente, a grandes unidades administrativas, (Ej: comunidades autónomas o provincias en España). Sino que dentro de esta categoría se incluye a una gran variedad de agentes económicos sobre los que el papel de territorio puede tener una importancia capital (municipios, jurisdicciones, barrios, mercados de trabajo regionales etc.).

centrarnos en lo que se ha denominado como dependencia espacial, la cual refleja una situación en la que los valores de una variable "i" perteneciente a una unidad geográfica determinada, dependen de los valores observados en las áreas vecinas de la misma (LeSage y Pace, 2010). En este sentido, el termino vecino (neigborhood en inglés) toma una importancia capital, ya que se denomina así a los agentes económicos (ciudades, municipios, provincias etc.) que comparten una cierta vinculación económica, territorial, política, social etc. Por lo que, los fenómenos que se desarrollan en cada uno de ellos, generan efectos significativos en los agentes económicos afines o emparentados entre sí.

Para poder incorporar estas directrices a la vecindad de las unidades objeto de estudio, la econometría espacial emplea un término conocido como matriz de dependencia espacial (W). Este elemento alude a una matriz de dimensiones $N\,x\,N$ que se encarga de recoger las relaciones sociales, económicas, territoriales etc. que subyacen entre los elementos a analizar, transformando unidades independientes en elementos integrados entre sí (LeSage y Pace, 2010). Una vez hemos solucionado la cuestión anterior, debemos de fijar un criterio de vecindad entre las unidades espaciales para poder construir los pesos que integran a la matriz espacial W. En los artículos que integran esta tesis doctoral en los que se aplican este tipo de técnicas, hemos centrado la atención en dos de los criterios de vecindad más utilizados dentro de la econometría espacial: a) K – vecinos más cercanos y b) distancia geográfica. Ambos criterios serán expuestos en profundidad en los capítulos dos y tres de este documento.

4.2.1 Estadísticos univariantes globales: La I de Moran global

Por otra parte, dentro de las técnicas de econometría espacial empleadas para detectar la presencia de dependencia espacial en las unidades de estudio, una de las herramientas más utilizadas son los estadísticos univariantes, los cuales se clasifican en dos grandes grupos. En primer lugar, encontramos a los estadísticos globales, los cuales tratan de obtener un valor promedio de la dependencia espacial existente utilizando todo el conjunto de datos disponibles de las unidades objeto de estudio. Existen tres estadísticos descriptivos utilizados para cuantificar la existencia de dependencia espacial global: I de Moran (Moran, 1948); c de Geary (Geary, 1954) y G de Getis y Ord (Getis y Ord, 1992). De entre todos ellos, nosotros nos centraremos en exponer el primero de ellos, debido a que es el estadístico de econometría espacial empleado en los dos artículos que integran el capítulo dos y tres de este documento.

El motivo por el cual hemos decidido centrarnos y emplear dicho estadístico es debido a que el contrate basado en la I de Moran global es el estadístico más empleado en los análisis de dependencia espacial durante los últimos años. La expresión que define a la I de Moran global es la que se muestra a continuación (Moran, 1948):

$$I = \frac{n}{S_0} * \frac{\sum_{i,j}^{n} SW_{i,j}\ (x_i - \bar{x})\left(x_j - \bar{x}\right)}{\sum_{i=1}^{n}(x_i - \bar{x})^2} \qquad (6)$$

donde n es el tamaño de la muestra objeto de estudio, SW_{ij} hace referencia a los componentes de la matriz espacial empleada, x_i representa el valor de la variable x en la unidad i, x_j representa el valor de la variable x en la unidad j, S_0 es igual a $\sum_i \sum_j SW_{ij}$ y finalmente $\bar{x}$ se corresponde con la media de la muestra de los datos representados de la variable x.

A modo de generar una exposición simplificada y no excesivamente técnica del anterior concepto, diremos que los valores que la I de Moran global fluctúan dentro del intervalo [1,-1]. Si el valor obtenido es cercano a 1, la interpretación es que existirá dependencia espacial positiva entre los valores observados dentro de las unidades objeto de estudio. En otras palabras, la existencia de dependencia espacial positiva nos informará de que existen áreas con altos (bajos) valores de la variable objeto de estudio rodeadas por otras áreas cuyos valores

también resultan ser altos (bajos) para dicha variable. Por el contrario, existirá dependencia espacial negativa si los valores arrojados por la I de Moran se aproximan a -1, indicando que las áreas donde los valores objeto de estudio sean bajos (altos) se encontrarán próximas a otros territorios en los cuales los valores obtenidos son altos (bajos).

4.2.2 Estadísticos univariantes locales: La I de Moran local

A diferencia de los estadísticos globales, los estadísticos locales o LISA (Local Indicators of Spatial Association, por su nomenclatura en inglés), estudian la existencia de dependencia espacial de un subconjunto de datos (Anselin, 1995). Estos estadísticos, según lo expuesto en Anselin (1995), descomponen a las anteriores medidas globales, generando unos nuevos indicadores que cumplen dos premisas fundamentales: a) El valor LISA de cada observación indica el alcance de la significancia espacial alrededor de la observación y b) La suma de todos los LISA es proporcional al indicador global de asociación espacial. En esta línea, nos centraremos en la exposición de este concepto a través de la ecuación (7):

$$I_i = \frac{n(x_i - \bar{x})}{\sum_{j=1}^{n}(x_i - \bar{x})^2} \sum_{j=1}^{n} w_{ij}(x_j - \bar{x}) \qquad (7)$$

donde w_{ij} simboliza un elemento de la matriz de pesos espaciales W elegida. La interpretación de este estadístico es un tanto diferente a la de los estadísticos globales, en parte por su mayor especificidad a la hora de informar acerca de la existencia de dependencia espacial. En este caso, obtendremos una clasificación formada por cuatro grupos distintos: a) Alto-Alto: Valores altos de x_i y de w_{xi}; b) Bajo-Bajo: Valores bajos de x_i y de w_{xi}; c) Alto-Bajo: Valores altos de x_i y bajos de w_{xi} y d) Bajo-Alto: Valores bajos de x_i y altos de w_{xi}. Finalmente, debido a la complejidad del análisis anterior, dicha información ha sido incorporada a los capítulos de la tesis doctoral mediante un mapa provincial del territorio español en los cuales se ofrece información acerca de la localización y el grupo de clasificación de los clústeres locales de dependencia espacial detectados.

4.2.3 Características de los modelos espaciales de datos de panel

A lo largo de la tesis doctoral, empleamos técnicas econométricas de panel para comprobar la robustez de nuestros resultados y ofrecer un análisis complementario a los resultados obtenidos por parte de la I de Moran global y local. Concretamente, en nuestro análisis empleamos tres de los paneles espaciales más utilizados dentro de la econometría espacial durante el último siglo, como son el modelo espacial de retardo espacial (SAR por sus siglas en inglés), el modelo de error espacial (SEM) y finalmente el modelo espacial de Durbin (SDM).

El primero de ellos, modelo de retardo espacial (SAR), se especifica a través de la expresión (8):

$$y_{it} = \rho W y_t + X_t \beta_i + \varepsilon_t \qquad (8)$$

siendo $\varepsilon_t \sim N[0, \sigma_\varepsilon^2 I_n]$

El elemento principal de dicho modelo es el término $\rho W y_t$, informándonos acerca de si existe evidencia empírica de dependencia espacial positiva (en el caso de que su valor sea positivo) o negativa (en el caso de que obtengamos un valor negativo).

El segundo modelo empleado es el modelo de espacial del error (SEM), el cual se desarrolla mediante la siguiente ecuación (9):

$$y_{it} = X_t \beta_i + \varepsilon_t \qquad (9)$$

siendo $\varepsilon_t = \rho W \varepsilon_t + \gamma_t$, mientras que $\gamma_t \sim N[0, \sigma_\gamma^2 I_n]$.

La principal diferencia de este modelo respecto al SAR es que se incorpora al coeficiente o parámetro espacial autoregresivo (ρ) en el error estándar del modelo, debido a que la existencia de dependencia espacial puede estar presente en el modelo entre las variables que no se incluyen en el mismo. De acuerdo con lo anterior, la no inclusión de ciertas variables en el modelo generaría problemas respecto a su construcción en forma de variables explicativas omitidas, las cuales resultan ser importantes a la hora de detectar dependencia espacial entre las unidades objeto de estudio.

El último modelo espacial para datos de panel empleado es el modelo espacial de Durbin (SDM):

$$y_{it} = \rho W y_t + X_t \beta_i + \mu + W X_t \varphi + \varepsilon_t \qquad (10)$$

donde $W X_t \varphi$ captura el efecto de la variable explicativa X_t de las regiones vecinas sobre la variable dependiente (y_t) de la región en cuestión.

La novedad principal de este tipo de modelo reside en la inclusión del coeficiente espacial autoregresivo (φ). Este término, se encarga de capturar el efecto espacial que las variables exógenas ejercen sobre la variable dependiente del modelo. De esta manera, podemos testar si la dependencia espacial de nuestro modelo se debe a la acción de interacciones endógenas ($\rho W y_t$) o bien es consecuencia de efectos exógenos ($W X_t \varphi$). Debido a lo anterior, el SDM resulta ser el modelo más completo en de los tres utilizados.

4.3. Evaluación de políticas activas del mercado laboral: El análisis de diferencias en diferencias

Para conocer el efecto concreto de una política activa aplicada al mercado laboral, los economistas deben de aislar el efecto del resto de fenómenos que operan a la vez que dicha política activa (Heckman et al. 1999; Malo et al. 1999; Vooren et al. 2019). En caso contrario, podríamos caer en el error de atribuir un efecto concreto a la acción de una política determinada (por ejemplo, un plan de empleo sobre una región especifica) cuando en realidad lo que estamos observando es la suma de varios efectos económicos, sociales y políticos que operan al mismo tiempo que la política que queremos evaluar (estado del ciclo económico, coyuntura internacional etc.).

Uno de los enfoques más famosos y empleados por parte de los investigadores a la hora de evaluar las políticas activas del mercado laboral es mediante el análisis cuasi-experimental desarrollado en el trabajo de Meyer (1995). Según este análisis, la evaluación de una política determinada (tratamiento según su denominación técnica) debe de llevarse a cabo mediante la división exógena, la cual no es decidida por el investigador, de las unidades de estudio en dos grupos determinados: a) Grupo de tratamiento, el cual se encuentra formado por las unidades objeto de estudio que han recibido el tratamiento (aplicación de una política activa del mercado laboral), y b) Grupo de control, del que forman parte aquellas unidades que no han recibido el tratamiento que se pretende analizar. Este enfoque nos permitirá aislar el efecto de fenómenos que afectan de forma simultánea a los integrantes de ambos grupos y detectar cual ha sido el efecto especifico del tratamiento que pretendemos analizar.

Una vez se ha definido el enfoque a emplear, es necesario describir que técnica econométrica se va a implementar para poder llevarlo a cabo, la cual se corresponde con el análisis de diferencias en diferencias (Card y Krueger, 1994; Martín-Román, 2007). Brevemente, esta técnica se ocupa de comparar los resultados de una variable en una población tratada con los que presenta esta misma variable en otra población no expuesta al tratamiento. De esta manera es posible discernir si las diferencias observadas en las variables objetivo vienen explicadas por

la exposición del grupo tratado a la intervención exógena. Un ejemplo de la formalización del análisis de diferencias en diferencias es el que se presenta en la siguiente ecuación:

$$Y_{it} = \beta_0(i) + X_{it}\beta_1 + X_{it}Z_{it}\beta_2 + \varepsilon_{it} \quad (11)$$

donde Y_{it} indica la variable laboral estudiada, β_0 presenta el término constante, X_{it} es una variable dicotómica que toma el valor 1 para los años en los cuales se aplica el tratamiento y el valor 0 para el resto del periodo objeto de estudio y ε_{it} hace referencia al termino de error. Sin embargo, la variable esencial para analizar el impacto del tratamiento resulta de multiplicar dos variables categóricas X_{it} y Z_{it}, siendo esta última una variable que toma el valor 1 para aquellas unidades que forman parte del grupo de tratamiento y 0 para los elementos que integran el grupo de control.

5. El análisis espacial de los mercados de trabajo: Una revisión bibliográfica

5.1. La descomposición del desempleo efectivo: Estrategias empíricas

La descomposición del desempleo efectivo se ha erigido como uno de los temas centrales dentro de la rama de la economía laboral a lo largo de los últimos años. Existen varios enfoques, no siempre excluyentes, que generan distintas perspectivas en torno a cuáles son los elementos principales que componen y explican al desempleo efectivo (Bean, 1994). Uno de los enfoques más originales empleado en los últimos años ha sido el de las fronteras estocásticas, el cual se constituye como la técnica principal de descomposición del desempleo utilizada en la presente tesis doctoral. La investigación de Warren (1991) se considera como uno de los trabajos pioneros dentro de este tema de estudio. Este trabajo toma como punto de partida los modelos de emparejamiento del mercado de trabajo. En base a esto, se aplica el enfoque de los modelos de crecimiento del empleo cuando la economía se encuentra en el estado estacionario para deducir la expresión de la tasa de desempleo.

En una segunda etapa, mediante la aplicación de un modelo OLS, el autor obtiene la tasa media de desempleo para el sector manufacturero de Estados Unidos, aplicando, posteriormente, una frontera estocástica de producción para hallar el desempleo friccional. Finalmente, mediante la resta de ambas tasas estimadas, obtiene una medida de la ineficiencia de ese mercado de trabajo. Un enfoque complementario es el de Bodman (1999), el cual toma como punto de partida el modelo teórico expuesto en Warren (1991). Las principales diferencias surgen de la perspectiva regional y de la modelización del término de ineficiencia del error que se realiza siguiendo la propuesta de Battese y Coelli (1995). Sin embargo, existen dos trabajos que desarrollan un enfoque muy similar al nuestro y que se han constituido como una de las principales referencias tanto en el plano teórico como a la hora de la aplicación de las estrategias empíricas. El primero de estos trabajos es el de Hofler y Murphy (1989). Estos autores plantean un modelo para hallar el componente friccional del desempleo mediante el cual es posible descomponer a la tasa de desempleo efectiva en un componente friccional y en un componente encargado de capturar el exceso de oferta laboral existente en el mercado laboral.

A través de este marco teórico, en una primera etapa, el artículo descompone las tasas de desempleo de los cincuenta estados de EEUU, durante el periodo 1960-1979, a través de la utilización de una frontera estocástica en su modalidad de costes. Esta estrategia empírica es crucial para la investigación, ya que asocia el límite inferior estimado mediante la frontera al componente friccional, concluyendo que todo el desempleo restante es debido a la existencia de exceso de oferta laboral en el mercado de trabajo estadounidense. Finalmente, en una segunda etapa, los autores completan su análisis a través de la utilización de diferentes variables demográficas, sectoriales e institucionales para determinar cuál es el elemento clave

a la hora de explicar al componente friccional del desempleo efectivo. El segundo trabajo clave es el de Aysun et al. (2014), en donde se combinan elementos de las tres investigaciones anteriores, basándose en la premisa que establece que los componentes del desempleo efectivo nunca pueden tomar valores negativos o inferiores a cero. Por un lado, utiliza un modelo y una metodología muy similar a la observada en Warren (1991) para extraer el componente friccional del desempleo. Por otro lado, aplica una frontera costes para hallar el componente estructural de la tasa de desempleo como se hacía en Hofler y Murphy (1989), mediante una especificación de la curva de Philips con expectativas. De esta manera, los autores obtienen una medida del desempleo estructural de EEUU durante el periodo 1960-2010, que es siempre inferior al componente efectivo.

Los anteriores trabajos se configuran como el elemento crucial sobre el que construimos nuestro análisis de la descomposición del desempleo efectivo en los artículos que integran el primer y el segundo capítulo de la tesis doctoral. Sin embargo, en el primer capítulo, también empleamos otras técnicas econométricas muy utilizadas en la literatura a la hora de descomponer el desempleo efectivo: Los filtros univariantes. En este caso podemos destacar un total de tres filtros univariantes, el filtro de Hodrick-Prescott (Hodrick-Prescott, 1997), el filtro de Baxter-King (Baxter-King, 1999) y la descomposición por tendencia cuadrática. Dichas técnicas econométricas han sido frecuentemente empleadas, en un contexto laboral, a la hora de estimar relaciones empíricas tan famosas como puede ser la ley de Okun, concretamente para obtener los componentes cíclicos de las variables estudiadas (Perman y Tavera, 2005; Adanu, 2005).

5.2. Análisis de la dependencia espacial en el desempleo: Una perspectiva regional

El estudio de la importancia del territorio sobre la economía ha cobrado una gran importancia dentro del mundo científico según los investigadores iban descubriendo el crucial papel que este ejercía a la hora de entender las dinámicas económicas. Uno de los trabajos más importantes dentro de esta literatura es del de Blanchard y Katz (1992). En este trabajo centrado en los estados de EEUU, los autores ofrecen evidencia empírica acerca de los efectos que los shocks macroeconómicos ejercen sobre los diferentes territorios en un espacio temporal de cuarenta años. También, ambos autores destacan la notable importancia que la localización territorial ejerce a la hora de determinar los efectos de dichos shocks, considerándose este elemento como uno de los más importantes a la hora de explicar el devenir futuro de las regiones estadounidenses. Es en este caso donde se presta una atención especial al fenómeno de la migración de los agentes económicos como elemento crucial a la hora de explicar la disipación y absorción de los shocks.

A raíz del gran impacto de dicho trabajo y del rápido desarrollo de la economía regional, algunos autores europeos llevaron a cabo análisis similares para Europa, como por ejemplo el trabajo de Decressin y Fatás (1995). En este trabajo se comparan las dinámicas económicas de los países pertenecientes a la Unión Europea con las detectadas en EEUU, observándose notables cambios en los mecanismos de ajuste laboral (participación laboral en Europa frente a migración en EEUU). Otro elemento a destacar es el reducido papel que se le otorga al nivel de desempleo existente a la hora de actuar como estabilizador económico de ambas zonas. La casuística anterior sugiere que, los agentes económicos actúan en función del nivel de las propias tasas de desempleo natural regionales en vez de la tasa agregada cuando toman sus decisiones económicas. Es precisamente a la hora de analizar las dinámicas del desempleo regional en donde el número de trabajos existentes es notorio. Uno de los estudios clásicos más citados es el de Overman y Puga (2002). En este trabajo, centrado en Europa durante el periodo 1986-1990, se obtienen resultados que ya apuntaban a algunas de las dinámicas comentadas y tratadas en nuestra propia investigación: La polarización creciente entre regiones de alto desempleo y regiones de bajo desempleo. Estos autores apuntan a que uno de los fenómenos importantes que contribuyen a explicar la polarización existente es la existencia de contigüidad

geográfica entre las regiones, lo que denota el importante papel del territorio a la hora de considerar el desempeño del mercado laboral. Junto con el anterior trabajo, una referencia obligatoria a la hora de estudiar los mercados laborales desde una perspectiva regional es la investigación de Elhorst (2003). Este trabajo recoge los elementos esenciales de un total de cuarenta y cuatro investigaciones para trazar un marco de análisis común del mercado de trabajo a nivel regional. Por consiguiente, se reconoce el importante papel de los factores de oferta y demanda agregada a la hora de entender la formación de desempleo en las regiones europeas durante las últimas décadas, a la par que se señala a los mecanismos de formación salarial como elementos estabilizadores dentro del proceso anterior. Otras investigaciones que ponen de relevancia el fenómeno territorial en torno a la polarización del desempleo son los de Cracolici et al. (2007) para Italia, Filiztekin (2009) para Turquía o el trabajo de Kondo (2015) centrado en el caso de Japón. Estos trabajos aplican varias de las técnicas de econometría espacial comentadas en párrafos previos, generando un conocimiento cada vez más profundo del fenómeno territorial y del mercado de trabajo.

En base a lo anterior, España se ha constituido como uno de los campos de análisis más importantes de las dinámicas territoriales en torno al fenómeno del desempleo, dando lugar a un buen número de investigaciones científicas publicadas en revistas especializadas de primer nivel. Entre estos trabajos, podemos destacar los de López-Bazo et al. (2002,2005), en los cuales se emplean tanto las técnicas exploratorias como los clásicos análisis de regresión espaciales. Ambos artículos señalan la fuerte polarización de las provincias españolas en dos grupos diferenciados en función de la existencia de un "alto" (provincias del sur peninsular) y "bajo" (provincias del norte peninsular) desempleo relativo. Dentro del mismo grupo de estudios también sobresale el trabajo de Bande et al. (2008). Los resultados obtenidos en tal investigación, señalan que, durante los periodos de expansión económica, la brecha en materia de desempleo entre las comunidades autónomas españolas tiende a aumentar, viceversa en el caso de las recesiones. Finalmente, un buen ejemplo dentro de los trabajos relevantes dentro del contexto español es el de López-Bazo y Motellón (2013), donde se muestra la importancia del nivel educativo regional a la hora de explicar dicha polarización entre las tasas de desempleo y el rol que juega la participación laboral como elemento equilibrador del desempleo dentro de las regiones españolas.

5.3. Importancia macroeconómica de los efectos sociales

Durante las últimas décadas, el estudio de los efectos sociales sobre las dinámicas económicas agregadas se ha convertido en un tópico dentro de la investigación laboral debido a su importancia crucial a la hora de determinar el desempeño de algunos de los elementos claves para el funcionamiento de las economías (nivel de desempleo, estabilidad presupuestaria, efectividad de las políticas monetarias y fiscales, comprensión de las dinámicas migratorias etc.). Dentro de este campo de estudio, el análisis de los comportamientos laborales de los agentes en función de estado del ciclo económico, ha generado una gran cantidad de trabajos científicos. En primer lugar, diremos que el desarrollo de este campo de estudio ha acuñado dos de los efectos más famosos en economía: el efecto del trabajador añadido (Woytinsky, 1940; Humphrey, 1940) y el efecto del trabajador desanimado (Mincer, 1962). El primero de tales efectos pronostica una sobreestimación del desempleo existente durante las recesiones económicas, como consecuencia de la pérdida de empleo del cabeza de familia y la incorporación del resto de miembros del hogar al mercado de trabajo.

La hipótesis del trabajador desanimado opera en sentido contrario a la del trabajador añadido. Este efecto vaticina una infraestimación del desempleo efectivo verdaderamente existente durante las recesiones como consecuencia de la retirada de la fuerza laboral de ciertos individuos que consideran que poseen bajas probabilidades encontrar un empleo en el medio largo-plazo, aunque estarían dispuestos a trabajar si se les ofreciera uno. Dentro de esta literatura, algunas investigaciones han tratado de hallar qué papel tiene el territorio sobre las

decisiones de participación de los individuos. En el primero de los casos, el trabajo de Halleck-Vega y Elhorst (2016) se erige como una de las investigaciones más destacadas en la aplicación de las técnicas de econometría espacial sobre la participación laboral. Estos autores se basan en la investigación de Fogli y Veldkamp (2011), corrigiendo y extendiendo algunos de los elementos del análisis de esta investigación, para ofrecer evidencia empírica de una fuerte dependencia espacial positiva del efecto del trabajador desanimado en las regiones europeas durante el periodo 1986-2010. En una línea similar se encuadran las investigaciones de Möller y Aldashev (2006) para Alemania y Elhorst y Zeilstra (2007), ambos trabajos centrados en el contexto europeo.

Otros trabajos han estudiado cual es la importancia de los efectos sociales sobre la participación laboral en el mercado de trabajo. Varios de ellos se fundamentan en el concepto desarrollado en Manski (1993, 2000) y Dietz, (2002), los denominados como peer effects, los cuales se podrían definir como la influencia que ejerce el grupo de referencia del individuo en cuestión sobre el comportamiento de cada uno de los miembros que lo integran a la hora de determinar las preferencias o la toma de decisiones de estos dentro de un contexto determinado. Entre los estudios que analizan la existencia de efectos sociales en el mercado de trabajo, podemos destacar los de Vendrik (1998, 2003), en donde se establece claramente un razonamiento teórico que sugiere que la oferta/participación laboral de los agentes económicos no se realiza de forma aislada, sino que las decisiones de oferta/participación laboral de su grupo de referencia social también ejerce una influencia determinante en esta decisión. A raíz de las investigaciones de Vendrik, muchos otros autores han tratado de testar dichos razonamientos teóricos al ámbito empírico, como es el trabajo de Hellerstein et al. (2011), en donde los autores destacan el papel fundamental que ejercen las redes de contactos, definidas a través de la localización residencial del individuo, al momento de encontrar un empleo después de haber abandonado este estado laboral.

5.4. Evaluación de las políticas activas del mercado de trabajo en el contexto regional

La necesidad de evaluar las acciones del sector público sobre diversos aspectos del entramado económico se ha situado como uno de los principales objetivos de algunas de las instituciones económicas a nivel nacional e internacional (García-Serrano, 2007). El objetivo que persiguen dichas evaluaciones es múltiple: En primer lugar, se trata de obtener una medida certera acerca de los efectos particulares que dicho programa/política ha generado en el contexto en el cual se ha aplicado. En segundo lugar, el conocimiento del grado de efectividad de esta intervención pública contribuye a generar mejoras futuras en la aplicación de políticas similares, perfeccionando las políticas a aplicar y mejorando su implementación. Finalmente, en tercer lugar, esta revisión de los resultados permite a los responsables de política económica conocer cuáles son los puntos fuertes y débiles de las mismas, lo que podría contribuir a una gestión más eficiente de los fondos públicos, descartando las medidas menos efectivas y sustituyéndolas por aquellas que den mejores resultados (Dauth, 2020)

Pese a sus múltiples ventajas para el buen desempeño económico, en España dicha literatura no cuenta con una cantidad de ejemplos tan ingente en comparación con otros países del entorno europeo. Entre los trabajos más importantes podemos destacar que, en general, son tres los tipos de políticas activas del mercado laboral las que han sido ampliamente evaluadas: Políticas activas de formación laboral, políticas activas basadas en el desarrollo de incentivos económicos para la contratación y políticas activas basadas en la intermediación laboral por parte del sector público. Respecto al primer grupo, en la mayoría de los trabajos se aprecian efectos positivos en lo relativo al acceso al mercado de trabajo (Mato y Cueto, 2008), aunque también hay estudios donde este efecto es menos claro o reducido (Kluve, 2010).

En el caso de programas centrados en el desarrollo de incentivos a la contratación, no se encuentran efectos positivos claros (De la Rica, 2015) salvo en los trabajos de Sianesi (2008) o

Clemente et al. (2012) donde estos programas afectan positivamente sobre el mercado de trabajo. En lo relativo al tercer grupo de políticas, Malo y Cueto (2016) aportan evidencia empírica positiva acerca de los efectos de las políticas de intermediación laboral sobre el desempeño laboral de los individuos. Finalmente, dos trabajos muy interesantes son el de Card et al. (2010) y el de Kluve (2010), los cuales incluyen análisis recopilatorios basados en técnicas de meta-análisis. En líneas generales, ambas investigaciones apuntan hacia un papel preponderante de las fuentes de datos empleadas, del tipo de programa a implementar y del horizonte temporal en el que se centran las evaluaciones.

6. Contribuciones de la investigación doctoral

Desde nuestro punto de vista, creemos que el trabajo desarrollado en esta tesis doctoral tiene importantes implicaciones teóricas como prácticas. A modo de síntesis, consideramos que nuestras aportaciones científicas pueden clasificarse en cuatro ideas fuerza: análisis del mercado laboral a través de la descomposición del desempleo efectivo; análisis espacial del mercado laboral español desde una perspectiva regional; estudio macroeconómico de la influencia de los efectos sociales sobre los agentes del mercado de trabajo y evaluación cuantitativa del impacto de las políticas activas del mercado laboral español desde una óptica regional.

Inicialmente consideramos que esta tesis doctoral ha contribuido a la aplicación de procedimientos novedosos dentro del análisis de los mercados de trabajo regionales pertenecientes a la rama de la economía laboral. En concreto, nos referimos a la aplicación de las fronteras estocásticas al análisis de la composición de las tasas de desempleo regionales en España en términos absolutos y relativos. Bien es cierto, que este enfoque ya había sido utilizado en ámbitos similares, como muestran algunas de las investigaciones a las que hemos hecho referencia en líneas pasadas, pero, desde nuestro conocimiento, ninguna de estas técnicas se había aplicado para analizar al desempleo efectivo español desde una perspectiva regional como la abordada en esta tesis doctoral. La novedad anterior, permite complementar las clásicas estimaciones obtenidas mediante los filtros univariantes en su intento de descomponer al desempleo efectivo, favoreciendo el desarrollo de un marco teórico en torno al fenómeno del desempleo, el cual se encuentra, íntimamente relacionado con nuestro desarrollo empírico. Esta aportación no solo se limita al terreno de la investigación en economía, sino que permite a los responsables de política económica la toma de decisiones con un mayor nivel de conocimiento de las mecánicas sociales implicadas en el proceso a tratar.

La segunda aportación de esta investigación es la profundización en el conocimiento existente en torno de la importancia del territorio sobre la economía. En esta tesis doctoral, hemos llevado a cabo una implementación novedosa de las técnicas de econometría espacial desde varios ámbitos distintos. El primero de ellos se basa en su aplicación a componentes del desempleo efectivo regional español que nunca antes se habían analizado de forma espacial. La aplicación de los estadísticos descriptivos de la econometría espacial nos ha permitido constatar que, las dinámicas sobre las que se basa la formación del desempleo efectivo en las regiones españolas se deben, fundamentalmente, a la existencia de diferentes tasas naturales de desempleo regionales que se retroalimentan y explican entre sí.

Esta contribución, implica que el comportamiento de los territorios vecinos influye notablemente en las áreas que guardan algún tipo de dependencia espacial con ellos. En el caso de nuestra investigación, la tasa de desempleo natural de una región española no solamente se encuentra determinada por factores intrínsecos de la propia región, además, también depende del desempeño de los territorios vecinos a la misma. A su vez, desde una perspectiva similar, esta tesis doctoral aporta resultados interesantes que confirman que las dinámicas cíclicas de participación laboral no se restringen a un territorio en concreto, existiendo dependencia espacial positiva entre las sensibilidades cíclicas de la participación laboral de las provincias

españolas. De nuevo, de acuerdo a nuestro conocimiento de la literatura, esta aportación científica resulta ser del todo novedosa para el mercado de trabajo de español, ya que ninguna otra investigación había aportado evidencia empírica en torno a la existencia de este fenómeno. En este sentido, la aportación que se hace a los responsables de política económica es bastante obvia: Las políticas económicas a diseñar no deberían tener como como objetivo áreas espaciales concretas (comunidades autónomas, provincias etc.), sino que deberían enfocarse áreas espaciales que abarcasen a los territorios relacionados entre sí. También nuestro trabajo se encarga de elaborar una propuesta para un mejor tratamiento de las áreas espaciales laborales en el caso español. Concretamente, en el capítulo tres, desarrollamos una propuesta de creación de instituciones suprarregionales a nivel español encargadas de monitorizar y velar por la coordinación de las políticas económicas a aplicar en función de las áreas espaciales integradas.

En tercer lugar, nuestro trabajo destaca la importancia que los efectos sociales tienen a nivel macroeconómico sobre el funcionamiento de los mercados de trabajo regionales. A lo largo de los capítulos que conforman la tesis doctoral, identificamos y conceptualizamos diferentes efectos económicos/sociales que contribuyen a explicar algunas de las dinámicas económicas más importantes presentes en España, como son las disparidades existentes entre las tasas de desempleo de las provincias españolas o la gran persistencia que estas exhiben a lo largo de las últimas décadas. Sin embargo, tal vez la mayor contribución teórica sea la que se encuentra en el tercer capítulo de la tesis doctoral. En el artículo que integra dicho capitulo acuñamos un concepto, relativamente, novedoso: El Bandwagon Worker Effect (BWE), mediante el cual pretendemos resaltar el importante papel que ejercen los efectos sociales dentro de los mercados de trabajo regionales

Finalmente, la última contribución de nuestro trabajo se centra en evaluar científicamente los efectos que ciertas políticas activas del mercado laboral generan sobre variables tan importantes del mismo como son la ocupación y el desempleo. Pese a que, en la presente tesis doctoral, nos centramos en una región en concreta en España (Castilla y León), consideramos que los resultados que se derivan pueden ayudar a impulsar este tipo de evaluaciones científicas en el ámbito de la económica española en general y de los territorios de la misma en particular. Desde esta misma óptica, opinamos que nuestro trabajo aporta luz al debate público en torno a que acciones laborales pueden generar resultados más satisfactorios, tanto económica como socialmente, a la par que dota de herramientas empíricas a los responsables de política económica para formular y aplicar decisiones futuras a nivel territorial.

Una vez han sido comentadas las aportaciones de nuestra investigación, a continuación, incluimos como capítulos diferenciados a los cuatro trabajos que conforman el cuerpo principal de esta tesis doctoral, al final de los mismos se incluye un breve epígrafe en el que se recopilan las conclusiones generales extraídas con la realización de esta tesis doctoral.

CAPÍTULO 1

Natural and cyclical unemployment: A stochastic frontier decomposition and economic policy implications

Natural and cyclical unemployment: a stochastic frontier decomposition and economic policy implications

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ABSTRACT

This work splits effective unemployment into two components: The natural unemployment, and the cyclical unemployment. For that purpose, an estimation of stochastic cost frontier is performed. The study is focused on the 17 autonomous communities in Spain over the period 1982-2012. Results evidence a greater importance of the natural component as the principal determinant of effective unemployment. When comparing these results with those obtained applying univariate filters, the distribution in the components of the effective unemployment changes, increasing the importance of cyclical unemployment. This result indicates that the policymakers have a greater margin of action to implement aggregate demand policies.

Key words: Unemployment rate, labor market, stochastic frontiers, decomposition of unemployment.

JEL Codes: E24, J08, J64, R23

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I. INTRODUCTION.

The Spanish labor market over the last few decades has been characterized by having generated exceptionally high unemployment rates when compared to those seen elsewhere in Europe (Bentolila and Jimeno, 2003; Jaumotte, 2011). The explanations, as to the reasons, behind such high and persistent levels of unemployment have been set out in many academic papers[1]. A further issue which has been the subject of much inquiry in the literature (Jimeno and Bentolila, 1998; Bande et al., 2008; Romero-Ávila and Usabiaga, 2008; Bande and Karanassou, 2013; Porras and Martín-Román, 2018) is the enormous disparity between unemployment rates in the various regions in Spain and their persistence over time.

The objective of this paper is to put forward a methodological proposal to decompose the actual unemployment rate into two components: the natural unemployment rate and the cyclical unemployment rate. This is an issue extensively addressed in the literature studying the macroeconomics of the labor market, but in a very different way as done in this piece of research. Here, we assume that cyclical unemployment cannot take negative values since it is difficult to imagine a world with more unemployed persons than the sum of structural and frictional unemployment, even when the economy is booming. That would be the case when the Natural Rate of Unemployment (NRU, hereinafter) is considered to be the same as the notion of NAIRU. We do not follow this path in this paper. Instead, we make use of a composed error model econometric methodology to guarantee that the non-negative cyclical unemployment assumption is fulfilled. To sum up, the main aim of this paper is to estimate the NRU with the stochastic frontier (SF, hereinafter) technique and then to compare it with some of the most popular procedures to do it, such as the Hodrick-Prescott (HP, hereinafter) and Baxter-King (BK, hereinafter) filters or the Quadratic-Trend (QT, hereinafter) regression.

This paper contributes to the unemployment rate decomposition literature. In this vein, we might assert that we align ourselves within the compartmentalization view in the macroeconomics of the labor market. According to Karanassou et al. (2007, 2010) this is only one of the competing theories to explain aggregate labor markets functioning, together with the "Chain Reaction Theory (CRT) or prolonged adjustment view" and the "Hysteresis hypothesis". By assuming the unemployment compartmentalization standpoint, we would be adopting some of economic principles usually linked to a "frictionless equilibrium" in the labor market (Karanassou et al., 2007). However, the concept of NRU is far from being a clear-cut notion even within the compartmentalization literature (Rogerson, 1997). As will be discussed in greater detail ahead, our approach fits well into some of definitions of the NRU enumerated by Rogerson (1997). At the same time, HP filtering is considered by Rogerson (1997) as another conceivable definition of what the NRU actually is. In this way, we think that this article not only provides a fresh estimate of the NRU to an already extensive literature but clarifies the own NRU concept. Hence, the comparison between our SF estimation of the NRU and those of the HP, BK and QT could be thought as an appraisal of different conceptions of the NRU within the compartmentalization hypothesis

[1] The exceptional works of Blanchard and Wolfers (2000) and Blanchard (2006) highlight the role played by labor institutions when causing high unemployment rates in the face of adverse macroeconomic shocks. Another study which provides information on the topic under discussion is the work of Nickell et al. (2005).

As regards the innovation and the value added of the paper, first we should point out that the literature on SF estimation of the NRU is quite scarce compared to other sorts of NRU estimates. After the seminal work by Hofler and Murphy (1989), there are only a few additional references. To the best of our knowledge, only the works of Warren (1991), Bodman (1999) or, more recently, Aysun et al. (2014) and Cuéllar-Martín et al. (2018) could be deemed to be closely related to this article. Furthermore, and as a second innovative element, here we develop a theoretical framework to justify our empirical approach of modelling the NRU as a lower envelope by using the SF estimation (i.e. a cost frontier in the usual terminology). In the third place, we offer, for the first time as far as we know, a systematic statistical comparison of the SF estimates of the NRU with the much more standard estimates by means of time-series filtering techniques. That contrast between different econometric procedures could serve as an assessment tool for making informed decisions. It is worth mentioning that such an assessment should be carried out not in terms of goodness of prediction, since in the end the NRU concept is unobservable, but in terms of economic policy implications, as we shall explain below.

To carry out the empirical strategy, the present work takes advantage of the spatial and temporal variability of regional unemployment rates in Spain. We make use of a database which provides information on the 17 autonomous communities in Spain for the period between 1982 and 2012[2]. Regarding the main results obtained, our methodological proposal reduces the weight of the natural component of unemployment in favor of the cyclical, as compared to the NRU estimates using time-series filtering techniques. These results might have significant potential implications for economic policy as they could provide greater scope of action for policy-makers seeking to fight unemployment. More precisely, our results seem to suggest that the scope for Keynesian economic policy measures (i.e. aggregate demand stimulus policies) is greater than previously thought, as a consequence of the larger scale of the cyclical unemployment.

The remainder of the work is organized as follows. Section 2 outlines the theories on unemployment compartmentalization and reviews the literature on unemployment decomposition. Section 3 shows a formal model connecting our conceptual framework to our empirical strategy. Section 4 sets out the methodological aspects, both in terms of the SF analysis used in the decomposition as well as the univariate filters employed in the subsequent comparison. Section 5 details the database used and provides a brief explanation of the variables applied in the study. Section 6 offers the main results obtained when decomposing unemployment through the SF. Section 7 compares SF estimates with the decompositions obtained from the univariate filters. Section 8 sets out certain economic policy implications. Finally, section 9 sums up the main conclusions to emerge from the work.

[2] Spanish autonomous communities correspond to the second level (NUTS-2) of the Nomenclature of Territorial Units for statistics. For further information concerning the concept of NUTS, see: http://ec.europa.eu/eurostat/web/nuts/overview.

II. UNEMPLOYMENT COMPOSITION: THEORIES AND FACTS.

II.1. Theories on unemployment compartmentalization.

As Karanassou et al. (2007, 2010) states, there are three fundamental views of the labor market regarding the movements in unemployment: (1) the frictionless equilibrium view; (2) the hysteresis view; and (3) the chain reaction theory, or prolonged adjustment view. Besides other implications for the aggregate labor market modelling or the macroeconomic policy, that distinction entails a conception on how the actual unemployment rate might be broken down into different components, which is the main aim of this piece of research.

In the first place, the "*frictionless equilibrium view*" establishes a clear-cut distinction between two types of unemployment: natural and cyclical unemployment. Within this hypothesis, the former is assumed to be a long-run equilibrium concept, giving rise to the notion of NRU, whereas the latter is associated to short-run fluctuations. This, in turn, leads to the idea of compartmentalization, which suggests that the unemployment rate can be decomposed into its two constituent components by means of econometric procedures. This interpretation of the macroeconomics of the labor markets has been defended on the grounds of the analysis of the role of shocks and institutions (see, among others, Layard et al., 1991; Blanchard and Wolfers, 2000), of the structuralist theory of unemployment (see, for instance, Phelps, 1994; Phelps and Zoega, 2001), or from a purely institutionalist standpoint (e.g., Nickell et al., 2005). See Blanchard (2006) for an assessment of this literature.

Secondly and fairly opposed to the previous hypothesis, the "*hysteresis view"* affirms that all the short-run fluctuations automatically turn into long-run changes in the unemployment rate (Blanchard and Summers, 1986 and 1987; Røed, 1997; León-Ledesma, 2002; Raurich et al., 2006). In this way, transitory business cycle shocks bring about permanent variations in the unemployment rate. Hence, according to this theory, it is not possible to distinguish long-run equilibrium from cyclical fluctuations. In practical terms, this theory implies that the unemployment rate in a specific period of time strongly depends on its past values. From an econometric viewpoint, the above would correspond to an unemployment rate being characterized by not following a "random walk". That is, by the presence of a unit root in such a series, with a value of the autoregressive parameter equal to unity.

Thirdly, the "*prolonged adjustment view"*, or "*chain reaction theory*" of unemployment establishes that the labor market adjusts only slowly to external shocks. There are several reasons for that sluggish adjustment, among them we could highlight: (1) employment adjustment costs (e.g. firing and hiring costs, see for instance Cabo and Martín-Román, 2019 for a recent formal model on that); (2) wage staggering (Ascari, 2003; Karanassou and Sala, 2012); (3) price stickiness (Andersen, 1998); or (4) labor force participation adjustment (see Martín-Román et al., 2018 for a fresh analysis with a regional economics perspective). This hypothesis might be thought as an intermediate case between the "*frictionless equilibrium view*" and the "*hysteresis* view". Moreover, this theory addresses the idea of "frictional growth", a phenomenon that encloses the interplay of lagged endogenous variables (frictions) and growing exogenous variables (growth drivers). Thus, when the exogenous variables have nonzero long-run growth rates (e.g., capital accumulation, population growth) unemployment does not gravitate

towards its NRU. The CRT was originally developed by Karanassou and Snower (1996, 1997, 1998). In this same vein, see also Karanassou et al. (2003, 2004, 2006, 2007, 2010).

For the aforementioned reasons, there is currently some debate as to whether or not compartmentalization is an appropriate stylized representation of the aggregate labor market. In this sense, Karanassou et al. (2007) state that compartmentalizing the unemployment rate into its natural and cyclical components does not fit with the European (or even the US) experience since the 80's, providing theoretical arguments for their point: in a frictionless world, even allowing for imperfect competition in goods and labor markets, the short-run and long-run are separate from each other. Thus, temporary labor demand shocks generate short-run variations in unemployment, while in the long run, the NRU responds to changes in the capital stock, the labor force or the technological level. If, on the contrary, one assumes that labor market decisions are characterized by prolonged adjustments (see for instance Kunz, 2009), then the compartmentalization of the natural and cyclical unemployment rates vanishes, and is only valid under rather restrictive assumptions. Furthermore, Karanassou et al. (2010) or Bande and Karanassou (2013) maintain that under the phenomenon of "frictional growth", i.e., the interplay of growing variables with labor market lagged adjustment processes, the effective natural rate does not converge towards the NRU, and therefore the latter cannot be regarded as a reference point for policy recommendations.

At this point, we should make clear, however, that the approach proposed in this paper assumes the compartmentalization of unemployment into its natural and cyclical components. Put differently, it might be said that we align ourselves with the "*frictionless equilibrium view*" to a great extent. Although the "hysteresis" and the CRT views have challenged the "*frictionless equilibrium view*" in recent years, we still feel that the latter is still a widespread view. In this vein, a recent paper by Blanchard (2018) questions the concept of NRU itself.[3] He analyses critically the notion of NRU from both macroeconomic and microeconomic grounds. Nevertheless, and despite this criticism, Blanchard finally states that: "*Policymakers should keep the natural rate hypothesis as their null hypothesis, but also keep an open mind and put some weight on the alternatives*". Therefore, in our view, this statement reinforces the methodological approach followed here.

Furthermore, we find several motives to keep on using this interpretation on the aggregate labor market functioning. For example, all that literature analyzing the so-called gap version of the Okun's Law precisely correlates the cyclical component of the unemployment rate with the business cycle, measured usually by means of the cyclical component of the GDP time series too. This approach tacitly assumes the compartmentalization view and has produced, and still is producing, a great amount of academic work. See, for instance, Lee (2000), Freeman (2000), Cuaresma (2003), Adanu (2005), Perman and Tavera (2005), Apergis and Rezitis (2003), Villaverde and Maza (2007, 2009), Marinkov and Geldenhuys (2007), Moosa (2008), Herwartz and Niebuhr (2011), Ball et al. (2013) or Bande and Martín-Román (2018). Therefore, it could be affirmed that the compartmentalization view is implicitly adopted in this extensive research field. Secondly, and despite of the challenging approaches of the hysteresis and

[3] It is worth mentioning though that Blanchard uses the concepts of NRU and NAIRU interchangeably, which is not the case in this paper (see next subsection).

prolonged adjustment theories, the compartmentalization view is still inherent in many of the works modelling the macroeconomics of the labor markets by preeminent scholars nowadays. Some current examples of this strand of research are Daly et al. (2012) or Diamond (2013). Hence, although this second motive might be considered as an "argument from authority", we still feel it is a valid reason[4]. The third argument in favor of following the compartmentalization view has to do with the regional economics perspective of this paper. Thus, it has been quite common to make use of the compartmentalization hypothesis when analyzing the aggregate regional labor market. Some outstanding examples of this literature are Marston (1985), Partridge and Rickman (1997), López-Bazo et al. (2005), Cracolici et al. (2007). Again, an extensive strand of research is adopting implicitly the approach followed here (as in the case of the first argument). A final reason is related to economic policy objectives. In the aforementioned paper, Blanchard (2018) also states that: "*the general advice must be that central banks should keep the natural rate hypothesis (…) as their baseline*."

In any case, and despite asserting that our paper follows the mainstream view of unemployment compartmentalization, there will be several features that distinguish our approach from those other more standard empirical methodologies (e.g. filter decompositions) described in a later subsection. The most remarkable difference is that we elaborate a formal framework in which cyclical unemployment cannot be associated with negative values and, even more importantly, we employ an econometric technique to guarantee that such an assumption is fulfilled. More specifically, we apply a composed error model to break down the unemployment rate. The SF methodology has been already used previously with this purpose. Thus, the seminal work by Hofler and Murphy (1989) established the basic foundations to perform aggregate unemployment breakdown by means of this technique. Then, the works by Warren (1991), Bodman (1999) and more recently Aysun et al. (2014) have followed this path. In a later subsection, we will review this literature more in depth.

II.2. A reflection on the concept of NRU.

As is obvious from the previous discussion the NRU plays a key role in this research. However, that concept is far from being a crystal-clear idea, rather it is a polyhedral notion that has been used differently by distinct authors during the 80s and the 90s. Following Rogerson (1997), among these alternative definitions of the term we could find: (1) the average rate of unemployment (Blanchard and Fischer, 1989); (2) the equilibrium rate of unemployment (Blanchard and Fischer, 1989; Johnson and Layard, 1986); (3) the unemployment in the long run (Johnson and Layard, 1986); (4) the normal unemployment rate that results when workers and firms correctly perceive the levels and rates of change of price and wages (Hall and Lilien, 1986); (5) the steady state rate of unemployment (Mankiw, 1994); (6) the lowest sustainable rate of unemployment (Auerbach and Kotlikoff, 1995); (7) the trend component of unemployment generated by the HP filter[5] (Rogerson, 1997); (8) the efficient rate of unemployment (Clark et al., 1979) and (9) the unemployment at full employment (Hahn, 1980).

[4] We also acknowledge here that long ago, many prominent scholars criticized the usefulness of this theoretical tool, the monographic issue of the Journal of Economic Perspectives, vol. 11 (1) Winter 1997 is a good example.

[5] Actually, Rogerson (1997) attributes this definition to Christiano. Allegedly this definition was given in a private conversation between the two of them.

Although it could seem tempting to paraphrase Solow (1986): *"(…) it is not clear what we are talking about when we talk about the natural rate*", we really believe that the underlying issue is that, frequently, different economists are talking about different clear-cut concepts. In this paper we aligned ourselves with some of the aforementioned views on the NRU. We deem that our concept of the NRU fits well with definitions (6) "lowest sustainable rate of unemployment" and (8) "efficient rate of unemployment" and, to some extent, with definition (9) "unemployment at full employment", if we assume that full employment is that level associated to the best scenario regarding the state of the business cycle. Moreover, it is worth stressing that in this paper our main objective is to compare and contrast the estimates of the NRU attained with the SF technique with those of the definition (7) "trend component of unemployment generated by the HP filter". As a matter of fact, the list provided by Rogerson (1997) is rather useful to position our paper in the literature. From our standpoint, this piece of research might be thought as a methodological proposal to estimate the concept of NRU understood as an "*efficient rate of unemployment*", and then to compare such an estimate with that of the definition (7) or with those obtained by using other types of time-series filters.

At this point, one important clarification should be made concerning the terms NRU and Non-Accelerating Inflation Rate of Unemployment, or NAIRU. Although the two concepts are frequently used indistinctly, there are several differences which call into question that the NRU and the NAIRU are truly equivalent concepts. Following the work of Espinosa-Vega and Russell (1997), the two notions stem from quite differing schools of economic thought. Moreover, Tobin (1997) maintains that "*the NAIRU and the NRU are not synonyms*". The NAIRU is a relation at the macroeconomic level which, in a nutshell, relates observed unemployment to inflation. Should the effective unemployment rate exceeds the NAIRU, then the inflation rate ought to fall and vice versa. In contrast, following Grant (2002), the NRU is an equilibrium unemployment rate which is mainly determined by the institutional and demographic characteristics of the economy.

For the purposes of the present work, what is important is to realize that the concept of NAIRU is linked to a cyclical unemployment rate that could take negative values at certain periods (those in which the inflation rate rises). After all, a relatively simple estimation of the NAIRU is the intersection of an expectations-augmented Phillips curve with the "X" axis, with the effective unemployment rate being either higher or lower than said value. Hence, the notion of NAIRU proves extremely useful in order to understand inflationary pressures in macroeconomic models. Nonetheless, if we considered the NAIRU as the sum of frictional and structural unemployment (as some textbooks do), that would be equivalent to stating that such sum should be greater than effective unemployment during periods of increasing inflation. Therefore, it is easy to understand why the NAIRU is an influential macroeconomic notion. But taking a more labor-economics-oriented perspective, it is a bit complicated to conceive a labor market in which there are less unemployed persons than the sum of those unemployed workers as a consequence of structural reasons plus those unemployed individuals as a consequence of imperfect information (frictional unemployment). Put differently, if we think of a more or less conventional labor market, it is difficult to imagine a situation in which there are "negative" unemployed workers by cyclical motives, which would be the case when the NAIRU is higher than the actual unemployment rate. This is so because unemployment is always a positive number in labor market

modelling. To sum up, we recognize the value of the NAIRU as an abstraction to interpret the inflation rate movements in macroeconomic models, but we do not follow that path here. Instead, we focus on the NRU idea and suppose that all the components making up that unemployment rate have to be positive numbers. To guarantee this last assumption we make use of the SF technique. This is our methodological approach, which will be assessed by comparing our estimates with the more standard procedures to break down unemployment explained in the next subsection.

II.3. Empirical strategies to decompose the unemployment rate.

Decomposing the unemployment rate into its different types is a recurring theme in economic literature, for which a range of different methods have been used[6]. One common option when obtaining the components of effective unemployment is to use univariate statistical filters to split the unemployment rate into various elements. Two of the most widely used filters are undoubtedly the HP Filter (Hodrick and Prescott, 1997) and the BK Filter (Baxter and King, 1999). These filters are usually accompanied by decomposition through the QT decomposition, most probably due to the simplicity of its application.

The HP Filter has often been used when estimating Okun's Law in an effort to extract the natural component and the cyclical component from effective unemployment (Apergis and Rezitis, 2003; Perman and Tavera, 2005; Adanu, 2005; Villaverde and Maza, 2007, 2009; Ball et al., 2013). The QT decomposition has also been widely used in economic literature related to Okun's Law, most likely because it offers very similar results to the HP Filter (Adanu, 2005; Villaverde and Maza, 2007, 2009). Finally, there are also various studies in which the BK Filter has been used in the same context as the two previous ones (Freeman, 2000; Apergis and Rezitis, 2003; Villaverde and Maza, 2009). The economic literature has also drawn on another set of "more complex" econometric techniques in an attempt to obtain the various components of effective unemployment. Prominent amongst these are the models based on the Phillips curve to estimate the natural component of effective unemployment (Blomqvist, 1988; Hahn, 1996; Apergis, 2005), techniques based on the Kalman Filter (Moosa, 1997; Mocan, 1999; Salemi, 1999), or estimations based on structural autoregressive vectors (SVAR) (King and Morley, 2007).

However, few studies have been found which use the SF approach to decompose the effective rate of unemployment. One of the pioneering works in this sense is Warren (1991) which uses frontier estimation to obtain the frictional component of the unemployment rate. Warren (1991) takes matching models in the labor market as a starting point. With this background, he applies an approach based on a model of employment growth when the economy is in steady state to derive the expression of the unemployment rate in the steady state[7]. At a second stage, and by applying an OLS model, Warren (1991) obtains the mean unemployment rate for the US manufacturing industry between April 1969 and December 1979. A SF of production is subsequently applied to determine frictional

[6] The work of Bean (1994) provides a comprehensive review of the topic in hand.

[7] It is precisely the use of information concerning vacancies which means that in the present work we are unable to apply Warren's approach (1991). It is a well-known fact that information concerning vacancies in Spain is extremely poor.

unemployment in the manufacturing industry. Finally, by subtracting both estimated rates a measure of inefficiency for said labor market is derived.

Another study carried out along the same line is that of Bodman (1999) who takes the theoretical model set out in Warren (1991) as a starting point. The main differences emerge from the regional perspective (the analysis is carried out for all the states in Australia) and from how the inefficiency term of the error is modeled, which is estimated following the proposal of Battese and Coelli (1995). Having obtained frictional unemployment and the inefficiency of the error term, Bodman (1999) finds a positive effect on the inefficiency of Labor Party administration in most of the states analyzed.

One study more closely aligned to the approach adopted in the present research is that of Hofler and Murphy (1989). These authors draw on a database of unemployment rates containing both transversal and temporal information for the US, considering that there is a lower-envelope function which the authors link to the notion of frictional unemployment rate. They model frictional unemployment using deterministic components such as the SF in its cost version (a lower frontier), and the distance from that lower frontier to effective unemployment which they term "*excess supply unemployment*" in the labor market[8]. At a second stage, they find that it is the variables related to social transfers, the size of the youth labor force, female participation rates, educational attainment and net migration rate, which account for both the level of frictional unemployment in each state as well as the changes to occur between 1960 and 1979.

Finally, in the research carried out by Aysun et al. (2014) elements from the three previous studies are combined, using the modeling of one upper and one lower SF to decompose the unemployment rate into its various components. One the one hand, they use a model and a method which are similar to that used in Warren (1991) to extract the frictional component of unemployment. They also apply a cost SF to ascertain the structural component of the unemployment rate as was done in Hofler and Murphy (1989), using a specification of the expectations-augmented Phillips curve. The authors thus obtain a measure of structural unemployment which is always lower than the effective component.

III. THEORETICAL FRAMEWORK.

III.1. The model.

In this section we elaborate a theoretical model in order to link our conceptual setting with our methodological approach. As this model it totally instrumental to grasp the basic underlying idea in this paper, it will be constructed as the simplest model possible. To fix ideas, we define the three types of unemployment we are going to model in the same way as basic economics textbooks do (see, for instance, Krugman et al., 2011): Frictional unemployment (U^F) is unemployment due to the time workers spend in job search; Structural unemployment (U^{ST}) is unemployment that results when there are more people seeking jobs in a labor

[8] The model put forward in Hofler and Murphy (1989) to illustrate frictional unemployment corresponds to the following equation: $U_{tj} = \underbrace{\beta_0 + \beta_1 t + \beta_2 t^2 + w_{tj}}_{F_{tj}} + \vartheta_{tj}$. where U_{tj} refers to the unemployment rate during period t and state j, F_{tj} encompasses the components of frictional unemployment and ϑ_{tj} reflects excess supply. The lower SF (cost frontier) approach is used to separate w_{tj} from ϑ_{tj} and to find the lower frontier which corresponds to the frictional component of unemployment.

market than there are jobs available at the current wage; Cyclical unemployment (U^C) is a deviation in the actual rate of unemployment from the natural rate due to downturns in the business cycle. For the sake of simplicity, we begin with a constant labor force (i.e. it does not depend on any variable, particularly does not depend on the real wage rate):

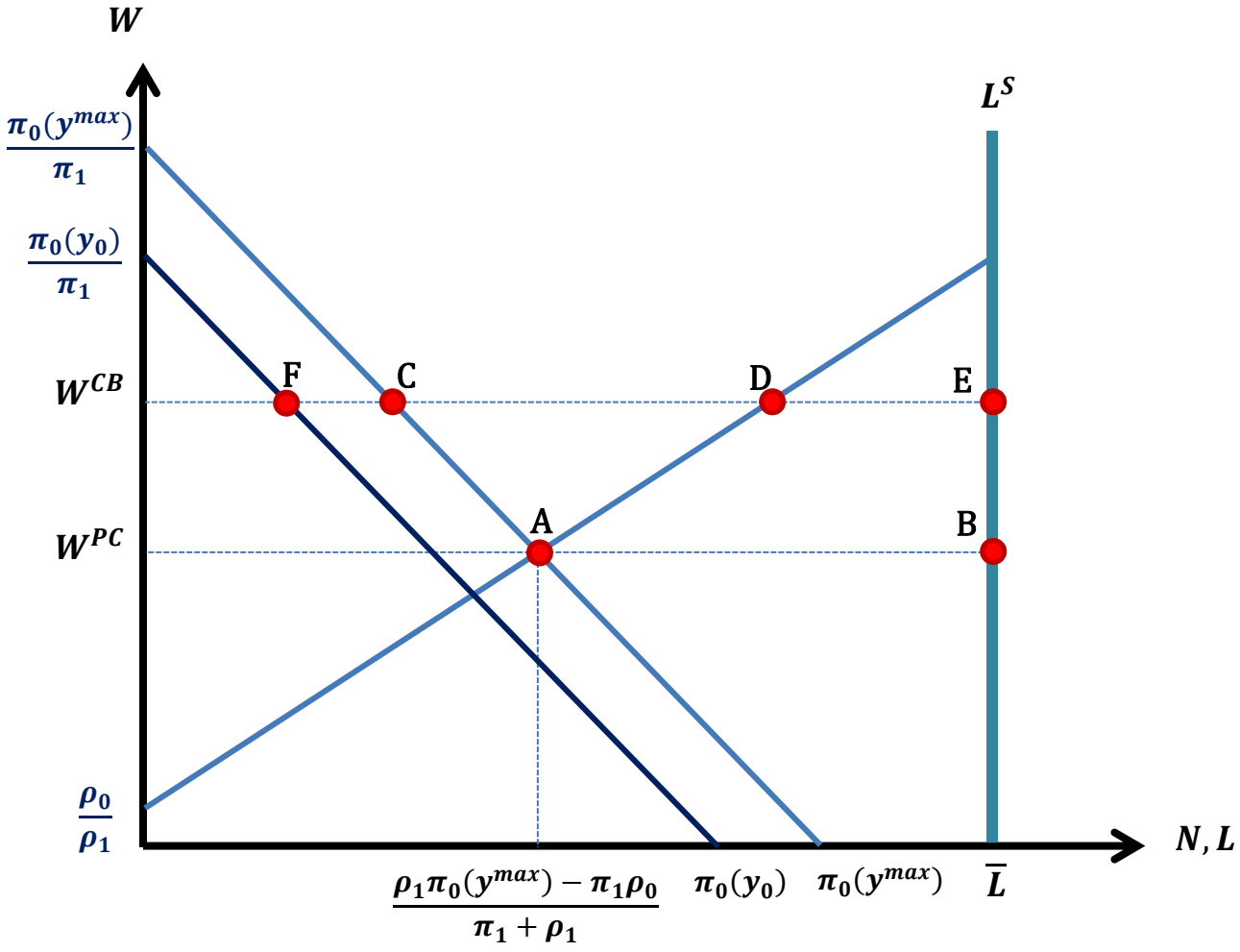
$$L^S = \overline{L} = 100 \tag{1}$$

The previous assumption normalizes the size of the labor force and allows us to pass from unemployed persons to unemployment rate straightforwardly. Then we use a quite standard upward sloping aggregate effective labor supply in the employment (N) and real wage (W) space:

$$N^S = \rho_1 W - \rho_0 \tag{2}$$

These two graphical devices are displayed in Figure 1. The difference between $L^S$and N^S highlights the fact that not all active workers are immediately available for work. As the market real wage increases, it exceeds the "dynamic" reservation wage (or that of the job-search theory) of a higher number of workers, with the latter more willing to accept the jobs they find. As a result, the distance between $L^S$and N^S is lower for higher salaries. Said horizontal difference between the two curves is what we will call later frictional unemployment (U^F).

Figure 1. Frictional, structural and cyclical unemployment.



Source: Authors' own.

To complete the system, the aggregate labor demand is also linear. However, this function will depend on the state of the business cycle (y). We will assume that if the cycle is booming the aggregate labor demand will shift outwards in a parallel way and the opposite is true when the business cycle is in a slowdown or a bust. Put in other words, and again for the sake of simplicity, we suppose that the state of the business cycle affects the position of the labor demand but not its slope. In more formal terms:

$$N^D(y) = \pi_0(y) - \pi_1 W \tag{3}$$

With these three basic relationships is rather straightforward to decompose total unemployment into three main categories, following in this sense the compartmentalization hypothesis. To illustrate this, let us first assume that the state of business cycle is at its maximum level (y^{max}), which in turn entails that the labor demand reaches its maximum level too (i.e. it is located to the rightmost possible position). If we additionally suppose that the real wage rate is at its competitive level (W^{PC}), i.e. where the effective labor supply and labor demand meet each other, the equilibrium employment $N^* = \frac{\rho_1\pi_0(y^{max})-\pi_1\rho_0}{\pi_1+\rho_1}$ is thus associated with a certain level of unemployment: $U^F_{PC} = \overline{L} - \frac{\rho_1\pi_0(y^{max})-\pi_1\rho_0}{\pi_1+\rho_1}$. This unemployment, which is displayed as the distance $U^F_{PC} = \overline{AB}$ in Figure 1, is the conventional notion of frictional unemployment since it represents workers that, despite being actively looking for a job, do not accept a job offer for such a low real wage.

If we consider an above equilibrium real wage rate like W^{CB} (as a consequence, for instance, of collective bargaining agreements), the new situation would be characterized by a lower frictional unemployment $U^F_{CB} = \overline{DE}$, as more workers are willing to accept job offers. However, a new type of unemployment would emerge as a consequence of a pure labor supply surplus $U^{ST}_{CB} = \overline{CD}$. This typology of unemployment is usually named structural unemployment, especially in a theoretical framework with homogeneous labor input (i.e. with one single real wage rate) like ours.

It is important to recall that the aforementioned scenario is linked to a labor demand at its maximum level. Nonetheless, the state of the business cycle is a variable that normally is below its maximum, which in turn brings about that labor demand is located to the left of the one related to that maximum level. In Figure 1 we depict a labor demand associated with a state of the business cycle $y_0 < y^{max}$ to illustrate this point. In such a case a new form of unemployment, other things equal, arises. That sort of unemployment is displayed as $U^C_{CB} = \overline{FC}$ in Figure 1 and will be called cyclical unemployment[9].

To recapitulate, from the previous discussion we might state that we have an unemployment function depending only on two arguments: the real wage rate and the state of the business cycle. As is obvious from Figure 1, when the real wage rate rises, the unemployment increases too. On the other hand, the business cycle

[9] We will delve into the concepts of frictional, structural and cyclical unemployment later.

shifts the labor demand outwards when booming and inwards when slowing down or busting, and, thus, unemployment is to be inversely related to the variable y:

$$U = U(W, y);\ \frac{\partial U}{\partial W} > 0; \frac{\partial U}{\partial y} < 0 \tag{4}$$

Now, for the sake of convenience, assume that the unemployment function is additive in its two arguments:

$$U(W, y) = U_1(W) + U_2(y) \tag{5}$$

Using equations (1) and (3), the additivity of the two components of the unemployment is fulfilled due to the linearity of the system defining the functioning of the labor market. We could even provide a more specific functional form for the unemployment rate function (due to the fact that total labor force has been normalized to 100 and, therefore, one percentage point is simply a worker):

$$U(W, y) = \overline{L} - \pi_0(y) + \pi_1 W \tag{6}$$

This assumption connects the present theoretical setting with the previous compartmentalization view of the unemployment rate, being the NRU the part depending on the real wage rate: $U_1(W) = U^{NR}(W)$, whereas the cyclical rate of unemployment is the part depending on the business cycle: $U_2(y) = U^C(y)$.

Being more precise, we define the NRU as the addition of frictional unemployment and structural unemployment. The NRU might be stated as total labor force minus the number of persons employed when the real wage rate is set over its competitive level and the demand for labor is calculated at its maximum size, i.e. when the state of the business cycle is $y = y^{max}$. In formal terms and making use of our theoretical setting:

$$U^{NR}(W|y^{max}) = \overline{L} - \pi_0(y^{max}) + \pi_1 W \tag{7}$$

On the other hand, the cyclical rate of unemployment might be defined, for a real wage rate over the competitive level W^{CB}, by assessing the labor demand when the business cycle is at its maximum minus the labor demand when the business cycle is measured at its actual level. Formally:

$$U^C(y) = N^D(y^{max}, W^{CB}) - N^D(y, W^{CB}) = \pi_0(y^{max}) - \pi_0(y) \tag{8}$$

III.2. From the model to the empirical strategy.

Before moving on forward, we should make a brief reflection on the role of the real wage rate. As we are implicitly considering that labor input is homogeneous in the model, there is only one single real wage rate. Nevertheless, we account for the possibility that the real wage rate is actually a variable affected by a vector of factors $X = (X_1, X_2 \dots X_n)$, such as the occupational mix, labor market institutions or demographic determinants (e.g. age or sex): $W = f(X)$. For this reason, equation (7) might be rewritten in terms of those determinants in the following way:

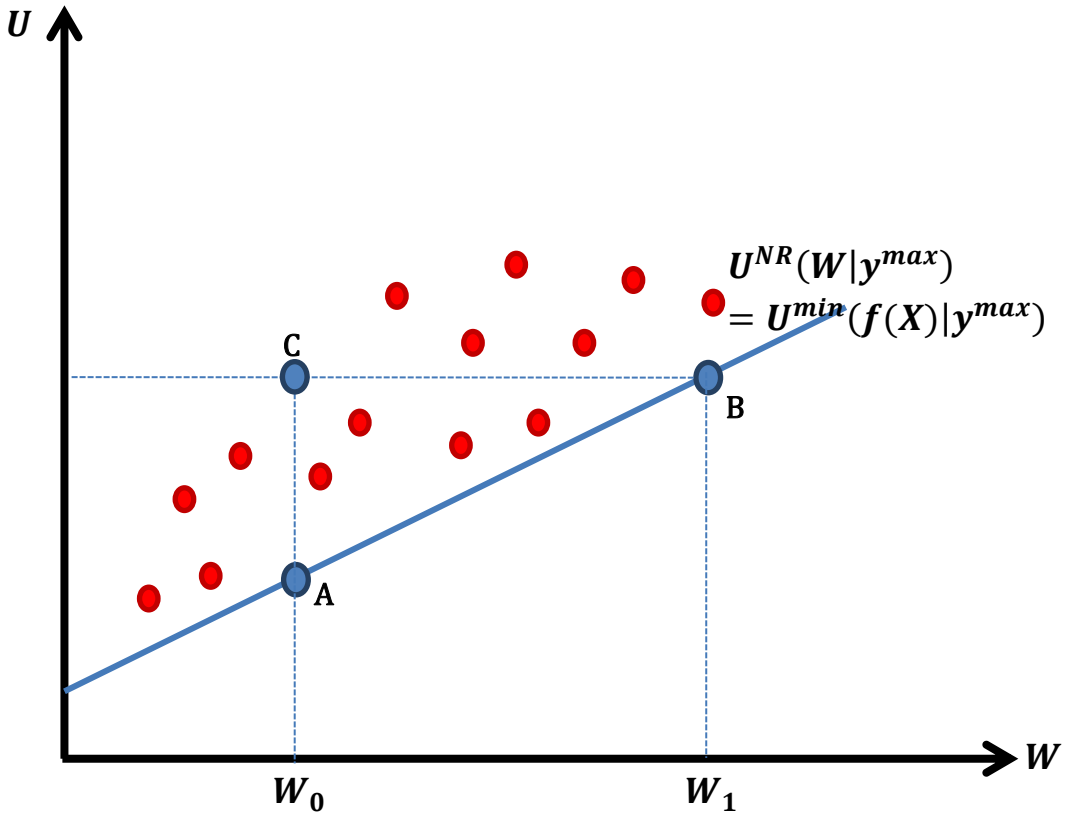
$$U^{NR}(f(X)|y^{max}) = \overline{L} - \pi_0(y^{max}) + \pi_1 f(X_1, X_2 \dots X_n) \tag{9}$$

Equation (9) relates the NRU with some determinant factors other than the business cycle, which is the main element behind cyclical unemployment. The problem with (9) is that it is to be estimated taking into consideration that the state of the business cycle ought to be at its maximum level. To overcome this difficulty, we make use of a composed error econometric model by means of a SF technique. The idea behind this approach is that when the state of the business cycle is at its maximum, then the cyclical unemployment rate should be zero by hypothesis: $U^C(y^{max}) = 0$. Following this reasoning, the NRU could be interpreted as a lower envelope of actual unemployment figures. Put in other words, the NRU could be conceptualized as a minimum unemployment rate attained when the GDP growth is maximum. In formal terms, that might be expressed by:

$$U^{NR}(W|y^{max}) = U^{min}(f(X_1, X_2 \dots X_n)|y^{max}) \quad (10)$$

This is what is displayed graphically in Figure 2. The solid line depicted in that figure reflects the NRU as a function of the real wage rate, which in turn is a summary variable for the aforementioned vector X. That line is positively sloped as it is easily to check from equation (7), and because of the reasons previously exposed.

Figure 2. Natural unemployment as lower envelope of total unemployment.



Source: Authors' own.

In order to clarify our empirical strategy, let us compare some highlighted points in Figure 2. Both at point A and point B, located just over the frontier, unemployment is totally made up of natural unemployment because the state of the business cycle is an its maximum, which implicitly entails that cyclical

unemployment is zero. We would observe in our data a lower unemployment rate at point A, $U(A) = U(W_{0,}y^{max}) = U^{NR}(W_0)$, just because the real wage rate is lower than at point B, $U(B) = U(W_{1,}y^{max}) = U^{NR}(W_1)$. On the other hand, point C would be associated to the same unemployment level as point B, however the composition would be rather different. As a matter of fact, point C would have the same amount of natural unemployment as point A, because they share the same wage rate, and the surplus over this amount would have to be considered as cyclical unemployment, according to our approach, and consistently with a state of the cycle below its maximum $U(C) = U(W_{0,}y^{0}) = U^{NR}(W_0) + U^{C}(y^{0} < y^{max})$.

As the business cycle is usually below its maximum level, most of the observations in our data would be made up of natural and cyclical unemployment. That is why the point cloud in Figure 1 (red dots) is mainly located above the line defining natural unemployment. Hence, the cyclical unemployment rate will be modelled in this paper as the unemployment exceeding that minimum natural level. Put differently, our methodological proposal sets, as pointed out above, the NRU as a lower envelope that will be estimated through a lower SF (commonly called "cost frontier"), and the cyclical unemployment as the inefficiency term that makes the actual unemployment to be above that minimum "efficient" unemployment.

III.3. From the empirical strategy to estimates.

Our theoretical setting draws a distinction between frictional, structural and cyclical unemployment. In this way, it can be stated that we aligned ourselves with the compartmentalization hypothesis. This is popular classification, which may even be found in economics handbooks[10]. In formal terms:

$$U_{it} = U_{it}^{F} + U_{it}^{ST} + U_{it}^{C} \tag{11}$$

where U_{it} is the effective rate of unemployment in region i at time t; U_{it}^{F} represents frictional unemployment; U_{it}^{ST} is structural unemployment and, finally, U_{it}^{C} reflects cyclical unemployment.

It is often felt that frictional unemployment proves extremely hard to eliminate and that there will always be some unemployment of this kind. For this reason, in Figure 1, we tacitly assumed that there was frictional unemployment even when the real wage rate was zero. This component is explained based on the "job-search theory" and stems from the existence of asymmetrical or imperfect information amongst jobseekers and employers, which in turn means that "matching" in the labor market may take some time and that there will always be a certain level of unemployment[11].

Together with frictional unemployment, it is possible to find structural unemployment in the aggregate labor market. These two types of unemployment are usually linked to aggregate supply determinants (as opposed to cyclical unemployment, which tends to be linked to aggregate demand factors). Structural

[10] See Krugman et al. (2011), for instance.

[11] This theory was developed by Mortensen (1970) and McCall (1970). See Lippman and McCall (1976a; 1976b), Mortensen (1986) and Mortensen and Pissarides (1999) for a review of the topic. A recent example of this kind of literature may be found in the works of Tatsiramos and van Ours (2012, 2014).

unemployment commonly appears to be due to imbalances between supply and demand in the job market[12]. This is the motive to model it as a labor supply surplus in Figure 1 (conditioned on labor demand being at its maximum size).

It should be stressed that a large part of the macroeconomic literature has considered that the sum of frictional unemployment and structural unemployment corresponds to a notion of equilibrium unemployment, referred to as NRU. In formal terms, this idea may be expressed through equation (12):

$$U_{it}^{NR} = U_{it}^{F} + U_{it}^{ST} \tag{12}$$

where U_{it}^{NR} refers to the NRU in region i at time t. Despite the many definitions of this component of unemployment (not all of them compatible with each other), here it will be conceptualized as the medium (or long) term equilibrium unemployment rate (a view widely accepted)[13].

Clarifying even further, the notion of the NRU seeks to reflect the idea that, even when macroeconomic conditions are optimal (from a short-run perspective) and there is no problem concerning a lack of aggregate demand, there will always be "some" level of unemployment. The NRU should therefore be associated to aggregate supply determinants in macroeconomic models. Nevertheless, during a period of low economic growth or in a recession, resulting from an adverse demand shock[14], said aggregate demand would prove "insufficient" and cyclical unemployment would have to be added to the previously mentioned components. In other words, equation (11) might be re-written as:

$$U_{it} = U_{it}^{NR} + U_{it}^{C} \tag{13}$$

As Figure 1 evidences, wage rigidity (due to institutional factors) gives rise to an excess of available labor, leading to an imbalance and sparking structural unemployment (U_{it}^{ST})[15]. Hence, structural unemployment would exist even if there were a demand for labor associated to a period of economic boom[16]. In this vein, the works of Bentolila and Jimeno (2003), Simón et al. (2006) and Bande et al. (2008) provide empirical evidence concerning the influence of the collective bargaining system on the Spanish labor market. Due to the wage rigidity, such real wages are prevented from playing their role as an equilibrium mechanism in the Spanish labor market[17]. Based on this, it may be stated that adjustment "via prices" fails to

[12] Such imbalances are due to institutional inflexibility, and are linked to downward wage rigidity (minimum wage or collective bargaining), unemployment benefits, job protection legislation, jobseeker efficiency when searching for work, labor market inflow and outflow, labor force skills, low labor productivity, the industry composition of unemployment or the demographic structure of the population, amongst other factors (Blanchard, 2017).

[13] The work of Rogerson (1997) offers several kinds of nomenclature for this term as well as varying definitions of the concept.

[14] Due, for example, to a fall in consumer confidence or business confidence. A contractive monetary policy or a cut in public spending might also account for insufficient aggregate demand, giving rise to a higher cyclical unemployment rate.

[15] Elhorst (2003) cites certain works that have studied the impact of collective wage bargaining on unemployment. In most cases, a positive effect emerges that would seem to confirm the previously posited hypothesis.

[16] A different type of structural unemployment would be that emerging from the disparities between the skills required for the job vacancies and those possessed by the unemployed workers. This kind of structural unemployment does not fit in a homogeneous labor market framework, as the one shown in figure 1. However, the basic idea that even in the best economic conditions there exist some structural unemployment remains.

[17] For a more comprehensive explanation of the phenomenon, see Jimeno and Bentolila, (1998), Garcia-Mainar and Montuenga (2003), Maza and Moral-Arce (2006), Maza and Villaverde (2009) or Bande et al. (2012).

work correctly and that, as a result, adjustments mainly come about "via quantities" in the Spanish labor market[18].

The final component in equation (11) is so-called cyclical unemployment (U_{it}^{C}). This element refers to the reduction in labor demand sparked by a lack of aggregate demand which reduces companies' sales. Given that labor demand is a derived demand, a reduction in aggregate demand in the macroeconomic goods market leads labor demand to shrink. It should be stressed that this type of unemployment should be zero (from a strictly theoretical standpoint) when the economy is undergoing an "expansion" and, in contrast, is positive during periods of "slowdown" or "recession" when labor demand shifts to the left, as can be seen in Figure 1. As is well known, this type of unemployment can be corrected in the short term through expansive aggregate demand policies.

An important idea we would like to remark here is that we consider that none of the three components that make up equation (11) can be negative (i.e. $U_{it}^{F} \geq 0$; $U_{it}^{ST} \geq 0$; $U_{it}^{C} \geq 0$). Although this assumption might seem naïve at first glance, does not always hold in other theoretical scenarios. For instance, the concept of NAIRU is associated with negative cyclical unemployment ($U_{it}^{C} < 0$) in periods of rising inflation, as the same result can be found for some of the notions of NRU previously discussed. How is it possible that there are negative unemployed persons during an economic boom for cyclical reasons? The previous scenario also implies that the sum of frictional and structural unemployment is higher than actual unemployment during expansionary periods. If that were the case, what does it mean? We find it difficult to understand those situations, unless you consider them as theoretical artifacts or pure abstractions to justify movements in the inflation rate.

As we are actually more attracted by the real aggregate labor market, we adopt the theoretical model described in this section, in which all components making up equation (11) ought to be positive. In fact, we are really interested in measuring which part of unemployment remains even when aggregate demand is at its highest level and there is consequently no lack of aggregate demand. This has important consequences from the standpoint of economic policy, since it would allow us to pinpoint, within the effective unemployment rate of each territorial unit and at each point in time, how many unemployment rate points are attributable to frictional and structural factors and how many to aggregate demand factors.

With this aim in mind, we apply the SF technique and estimate a composed-error econometric model. In this regard, we draw partially on the proposal of Hofler and Murphy (1989) and more recently Aysun et al. (2014). As noted before, we rationalize the NRU as a notion of medium (or long) term equilibrium unemployment, depending on factors which the literature has considered determinants of frictional and structural unemployment, which we denote as the vector of variables X_{it}. Thus, the natural minimum or "efficient" unemployment would be a function of said vector of variables, $U_{it}^{NR} = f(X_{it})$.

Deviations from said minimum would be deemed inefficient and would result from insufficiencies in aggregate demand, in other words cyclical

[18] Cazes et al. (2013) show how, during the "Great Recession", in Spain, labor market adjustment was mainly carried out through the external margin of adjustment (redundancies and staff cutbacks) in the labor market.

unemployment is modelled as a non-negative disturbance $U_{it}^{C} = u_{it} \geq 0$. Finally, assuming linearity, $f(X_{it}) = \beta X_{it}$, the "econometric" version of (11) would be:

$$U_{it} = \beta_1 X_{it} + v_{it} + u_{it} \tag{14}$$

where v_{it} is a random conventional disturbance. Equation (14) implicitly assumes that cyclical unemployment has a minimum value equal to 0. Otherwise, situations could emerge in which the NRU was higher than actual effective unemployment, as already pointed out[19]. In other words, the U_{it}^{NR} component acts as a limit or lower boundary for effective unemployment ($U_{it} \geq U_{it}^{NR}$).

IV. METHODOLOGY.

This section is also divided into two parts. In the first, a brief explanation is given of the SF technique used to decompose unemployment. In the second, a description is provided of the univariate filters employed to accomplish the work's second objective.

IV.1. SF analysis.

The decomposition presented in the conceptual framework is based on the assumption that all the components are positive. As a result, the NRU constitutes a minimum value below which effective unemployment cannot fall, and any deviation from this minimum is considered inefficiency that can be corrected by applying aggregate demand policies. As already pointed out in subsection III.3, this is a composed-error model which can be estimated using SF. The first econometric models to introduce this technique are to be found in the seminal papers of Aigner et al. (1977) and Meeusen and van Den Broeck (1977)[20]. In its costs version, this estimation technique allows a minimum value which is situated below the observed dependent variable to be identified.

As already pointed out, the ultimate goal is to separate the effective rate of unemployment (U_{it}) into two components: the natural unemployment (U_{it}^{NR}) and the cyclical unemployment (U_{it}^{C})[21]. However, in order to identify the two components, the starting point is to specify the natural unemployment as shown in equation (15):

$$U_{it}^{NR} = \beta_1 X_{it} + v_{it} \tag{15}$$

where X_{it} is a vector of explanatory variables, β_1 is the vector of coefficients to be estimated and v_{it} is a statistical noise deemed symmetrically and independently distributed as a $N(0, \sigma_v^2)$. This natural component constitutes a lower envelope or

[19] In the microeconomic literature, see for example Revoredo-Giha et al. (2009), Sav (2012) or Duncan et al. (2012), the "frontier cost" is the minimum possible and can never exceed the observed cost. Hofler and Murphy (1989) and Aysun et al. (2014) extrapolate this idea to the labor market to decompose the unemployment rate. We modify this interpretation slightly and apply it to the Spanish labor market.

[20] Kumbhakar and Lovell (2003) and Greene (2008) provide a highly detailed exposition of this type of econometric technique. See Burns and Weyman-Jones (1996) for an application of that technique in the case of the study of the efficiency in the electric distribution.

[21] As highlighted previously, the lack of sufficiently extensive and time-comparable information concerning existing vacancies in the labor market makes it extremely difficult to extract the frictional component (U_{it}^{F}) using the econometric techniques observed in some of the works referred to in the literature review. As a result, said component will be estimated together with the structural component of unemployment.

cost frontier below which the effective unemployment rate will never fall. However, the natural unemployment formulated econometrically in equation (15) is not observed directly. The available information corresponds to the effective unemployment rate which is greater than or equal to the natural ($U_{it} \geq U_{it}^{NR}$). The effective rate of unemployment may thus be represented as the sum of U_{it}^{NR} and a non-negative random disturbance identified with cyclical unemployment (U_{it}^{C}), through the following mathematical expression:

$$U_{it} = U_{it}^{NR} + u_{it} \tag{16}$$

where: $u_{it} = U_{it}^{C}$ and u_{it} is an error term which is expected to be positive and independently distributed. It should again be stressed that this term will always take a positive value or one equal to 0 in the best of cases (Aysun et al., 2014). Finally, by grouping equations (15) and (16), we obtain expression (17) which coincides with equation (14), previously presented:

$$U_{it} = \beta_1 X_{it} + \varepsilon_{it} \tag{17}$$

where: $\varepsilon_{it} = v_{it} + u_{it}$.

Taking account of the final specification of equation (17), and the presence of a composed error econometric model, u_{it} and v_{it} are assumed to be independent of each other and identically distributed across observations. Then, we maximize the log-likelihood function of a stochastic frontier model by using the Newton–Raphson method, and the estimated variance covariance matrix is calculated as the inverse of the negative Hessian. This type of estimation allows us to obtain the two error components separately and to calculate the variance of each. It is thus possible to apply a statistical test to determine the existence of the frontier and whether it is a production or a cost frontier. As it will be shown, in our case, a lower SF (cost frontier) is estimated which, according to our approach, coincides with the natural unemployment (U_{it}^{NR}) and implies a lower limit for U_{it}.

Nevertheless, in order to estimate u_{it}, which is here identified with U_{it}^{C}, it is necessary to make assumptions about the distribution of the two error components of ε_{it} (Jondrow et al., 1982). In the case of the v_{it} component, there would appear to be no problem since there seems to be a strong consensus in the empirical literature that said component is distributed in the form $N(0, \sigma_v^2)$, as we state before. The main problem emerges when it is needed to consider the distribution of the u_{it} term. Here, several distributions are proposed in the econometric literature: Normal Truncated (Stevenson, 1980), Semi-Normal (Aigner et al., 1977), Exponential (Meeusen and van Den Broeck, 1977) and Gamma (Greene, 1990). For the present study, and as occurs in the works of Hofler and Murphy (1989) and Aysun et al. (2014), Semi-Normal distribution is chosen for this error component.

IV.2. Univariate filters.

In order to put our proposed decomposition into perspective it is useful to compare it to other alternative methods used in the literature. To achieve this, three univariate filters are used which also allow effective unemployment to be

decomposed, the HP Filter, the QT decomposition, and finally, the BK Filter[22]. These filters have been widely used when analyzing time series and enable any time series (K_t) to be broken down into its two components: the trend (T_t) and the cycle (C_t).

At this point, it should be stressed that several of the studies cited previously in this text and which use these filters link the trend component to the concept of the NRU and the NAIRU, and make no "clear" distinction between the two (Perman and Tavera, 2005; Adanu, 2005; Villaverde and Maza, 2007, 2009; Ball et al., 2013). In a similar line, the work of Blanchard and Katz (1997) defines the NRU as follows: *"(…) The natural rate of unemployment is typically interpreted as the rate of unemployment consistent with constant (non-accelerating) inflation"*, referring to the context of the Phillips curve and establishing no differences between NRU and NAIRU. Based on this, we are able to compare our estimations of the NRU with those obtained using the HP Filter, with the QT decomposition or with the BK Filter. This comparison is also carried out for the cyclical component.

Applying these filters to our effective unemployment series at a regional scale yields the following equations:

$$U_{it} = U_{it}^{HPT} + U_{it}^{HPC} \tag{18.1}$$

$$U_{it} = U_{it}^{QTT} + U_{it}^{QTC} \tag{18.2}$$

$$U_{it} = U_{it}^{BKT} + U_{it}^{BKC} \tag{18.3}$$

where U_{it} is the effective unemployment in region i at time t; U_{it}^{HPT}, U_{it}^{QTT} and U_{it}^{BKT} refer to the trend component of the effective unemployment obtained through the HP Filter, the QT decomposition, and the BK Filter, respectively, for each region i at time t. Finally, U_{it}^{HPC}, U_{it}^{QTC} and U_{it}^{BKC} refer to the cyclical components obtained through each filter for region i in year t.

V. DATABASE

The data used in the present study were obtained from the Spanish Labor Force Survey (Encuesta de Población Activa, EPA) published by the National Statistics Institute (Instituto Nacional de Estadística, INE), the Statistic of Collective Bargaining Agreements (Estadística de Convenios Colectivos de Trabajo, ECCT), the Statistic of Labor Court Issues (Estadística de Asuntos Judiciales Sociales, EAJS), the Official State Gazette (Boletín Oficial del Estado, BOE), the BD-MORES Regional Database and the Valencian Institute of Economic Research (Instituto Valenciano de Investigaciones Económicas, IVIE). All the variables used have an annual frequency for the period between 1982 and 2012 and are

[22] See Hodrick and Prescott (1997) for a more detailed explanation of the HP Filter. For a more extended definition of the BK Filter, see Baxter and King (1999) and Pizarro (2001). The QT decomposition is a purely deterministic procedure, the aim being to model the element to be decomposed through a quadratic trend process: $Z_{it} = \delta_0 + \delta_1 T + \delta_2 T^2 + \omega_{i,t}$ In this case, Z_{it} is the variable to be decomposed, δ_0 is the constant term of the equation, T and T^2 are the components of the quadratic trend, and finally $\omega_{i,t}$ is the error term. However, in the literature using QT decomposition, this latter term would, in turn, reflect the cyclical component of the variable we aim to decompose.

disaggregated for the 17 Spanish autonomous communities[23]. A summary of the variables used in this study, how they have been defined and their source may be found in table A1 in the Appendix.

The first part of the empirical analysis involves decomposing the regional unemployment rate. As a result, this is the dependent variable and the central one in our empirical work. In order to carry out the decomposition, different explanatory variables which might affect the evolution of the unemployment rate are used (Hofler and Murphy, 1989; Aysun et al., 2014). The two first explanatory variables contained in table A1 in the Appendix have a demographic component. The first of these is the female activity rate and reflects the impact of women's labor participation in the effective rate of unemployment[24]. According to Elhorst (2003), the influence of this variable on the unemployment rate gives rise to diverse results. The second of the explanatory variables is the percentage represented by the population of 16 to 24 year-olds with regard to the total in each autonomous community. This variable is included as there is empirical evidence of a positive correlation between the weight of the youth population and the unemployment rate (Johnson and Kneebone, 1991; Murphy and Payne, 2003). This might be due to the fact that the young, as a result of their limited work experience, are less skilled when it comes to finding jobs than their older counterparts. Their having less specific human capital might also prove to be a determining factor when accounting for high youth unemployment rates. Based on this, younger people tend to suffer longer periods out of work[25].

The second group of regressors is made up of a series of variables reflecting the industry composition of regional employment. The extant literature would seem to point to one of the causes of the differing unemployment rates at a regional scale being the industry composition of labor in each region[26]. Differences in wages, job skills or competitiveness are key factors influencing the impact which the industry composition has on unemployment levels[27]. In a context where the Spanish regions evidence substantial differences in terms of industry composition, this is expected to be a determining factor underlying regional differences in unemployment rates. Another regressor is the share of net capital stock out of the total number of employed in real terms. This variable is included to compute the regional level of capitalization in each territory (Bande and Karanassou, 2013; Bande and Karanassou, 2014)[28].

Finally, we include three variables in order to capture the effect of labor market institutions on the evolution of the effective unemployment[29]. The first of

[23] The autonomous cities of Ceuta and Melilla have been excluded from the research due to the scant representativeness of some of the variables used.

[24] Lázaro et al. (2000), Azmat et al. (2006) and Bertola et al. (2007) point to some of the driving factors behind the recurring female unemployment rates.

[25] In Maguire et al. (2013), some references explaining the reasons underlying the high rates of unemployment amongst youngsters in Spain (16-24 year olds) over the period 2007-2013 may be found.

[26] See Elhorst (2003).

[27] See Summers et al. (1986).

[28] For a more detailed definition about the construction of the net capital stock, see http://web2016.ivie.es/wp-content/uploads/2017/02/Metodolog%C3%ADa_basedatos_stockcapital_ED.pdf.

[29] Furthermore, we also computed the so-called unemployment benefit coverage rate, defined as the ratio of unemployment benefit recipients to unemployed persons, aiming at controlling for the effects of an institution like unemployment insurance. However, we are not confident about the meaningfulness of the results due to the obvious endogeneity problems in that econometric regression (since unemployed workers can be found on the left-hand side and on the right hand side of the equation). As instrumental variables procedures in SF estimation are not straightforward to implement, we finally made the decision of no reporting these results. It is worth

these variables is the Kaitz Index (Kaitz, 1970), which attempts to account for the influence of minimum wage legislation. It is defined as the ratio of the minimum to the average wage. The advantage of this index is that it shows cross-regional variation despite the fact that in Spain there is a single national minimum (Pérez-Dominguez et al., 2002; Galán and Puente, 2015).

In the second place, the Employment Protection Legislation (EPL) in Spain, as in the case of the minimum wage, exhibits no cross-regional variation since there exists a single national regulation. Thus, in order to account for the effects of this institution we draw on a growing literature studying the impact of judicial rulings over labor market variables and its relationship with firing costs (Gabuthy and Lambert, 2008; Goerke and Pannenberg, 2010; Martín-Román et al., 2013; Jimeno et al., 2015). The underlying idea is that labor courts located in a specific region ruling systematically more likely in favor of employees increase firing costs for employers operating in that area. A formal proof of this statement can be found in Martín-Román et al. (2013). To take into account this effect, we include in the econometric specification the percentage of dismissal cases ruled (totally or partially) in favor of employees as a measure of the EPL[30].

The third institutional variable intends to measure the influence of the collective bargaining structure over effective unemployment. The seminal work of Calmfors and Driffill (1988) and the survey of Flanagan (1999) pose different effects over the unemployment rate depending on the type and the level of centralization of collective bargaining. Other studies look into whether these different structures have distinct impacts on the wages of the workers covered (Dahl et al. 2013). For the Spanish case, Bande et al. (2007, 2008) focus their attention on the wage setting mechanism at a regional level and its influence on the evolution of the Spanish regional unemployment. In the current paper, we use the share of workers covered by a firm-level agreement as a variable accounting for the role of collective bargaining in the wage setting process. Table A2 in the Appendix shows some descriptive statistics of the variables referred to earlier which reflect the interregional differences between them.

VI. RESULTS.

The first part of this section involves the decomposition of the effective rate of unemployment into the natural unemployment (U_{it}^{NR}) and the cyclical unemployment (U_{it}^{C}) through the use of the SF. The second part tests the robustness of the results by modelling the inefficiency component and by using an alternative estimator that exploits the first difference transformation.

VI.1. Decomposition of effective unemployment.

Having introduced the SF technique as a decomposition mechanism for effective unemployment, the results corresponding to the SF estimations are now presented. This is where the present work differs slightly from the proposal put forward by

mentioning though that overall outcomes were robust regardless the inclusion or not of that covariate. These results are available upon request to the authors.

[30] To have an idea of the sizeable cross-regional variation found in labor court rulings concerning labor disputes over layoffs in Spain, see Martín-Román et al (2015).

Hofler and Murphy (1989), since we opt for a more comprehensive parameterization of the frontier[31].

In this regard, five different econometric specifications have been used in the estimates carried out, which are the specific versions of the general equation (17). Equation (19) is the benchmark specification (specification 1), we include, as control covariates, the demographic features (X_{it}) (percentage of youth population and female participation rate), industry composition (Z_{it}) (percentage of people employed in agriculture, manufacturing, services and energy) together with a dichotomous variable ($D2001$) which takes the value 1 after 2001 and 0 in the previous years[32].

We also employed seven additional specifications to test the robustness of the results. Equation (20) adds a lineal trend (T) to the previous control covariates (specification 2). Expression (21) decomposes the service industry in two components: Retailing (SRI_{it}) and non-retailing industry ($SNRI_{it}$), so Z'_{it} is a vector that represent the previous industry decomposition with this separation in the services industry (specification 3)[33]. Equation (22) incorporates the share of net capital stock out of the total number of employed in real terms (RKS_{it}) (specification 4). Finally, expression (23) includes as institutional variables (I_{it}) the Kaitz Index, the percentage of dismissal cases ruled (totally or partially) in favor employees and the share of workers covered by a firm-level agreement (specifications 5, 6, 7 and 8).

It should also be pointed out that fixed regional effects have been used in all the specifications to reflect unobservable heterogeneity at a territorial scale (μ_i) In this case both, β_0 and μ_i are fixed constants and additional restrictions to estimate them are required. One way to do that is to introduce the restriction $\sum_{i=1}^{n} \mu_i = 0$. Then, the fixed effect μ_i represents deviations from the mean intercept β_0[34]. Finally v_{it} is assumed to be independently $N(0, \sigma_v^2)$ distributed over the observations, and u_{it} are independently $N^+(0, \sigma_v^2)$ distributed with truncation point at 0:

:

$$U_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + \beta_3 D2001 + v_{it} + \mu_i + u_{it} \quad (19)$$

$$U_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + \beta_3 D2001 + \beta_4 T + v_{it} + \mu_i + u_{it} \quad (20)$$

$$U_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z'_{it} + \beta_3 D2001 + v_{it} + \mu_i + u_{it} \quad (21)$$

$$U_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + \beta_3 D2001 + \beta_4 RKS_{it} + v_{it} + \mu_i + u_{it} \quad (22)$$

$$U_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + \beta_3 D2001 + \beta_4 I_{it} + v_{it} + \mu_i + u_{it} \quad (23)$$

[31] This greater parameterization of the frontier relates to an interest in capturing some important determinant factors of the NRU. It has to be taken into account that the Hofler and Murphy (1989) approach considers only the frictional unemployment to be part of the frontier, whereas in our proposal the frontier is made up of both the frictional and the structural unemployment.

[32] This dummy variable is introduced due to the fact that in 2001 methodological changes were made which affect how unemployment is measured. The methodological changes made may be seen at http://www.ine.es/epa02/meto2002.htm.

[33] For a more detailed explanation about the services in the retailing and non-retailing industry, see http://web2011.ivie.es/downloads/caphum/series-2013/metodologia-series-capital-humano-1964-2013.pdf.

[34] Hsiao (2014).

Table A3 in the Appendix shows the results obtained for the eight SF estimations. Broadly speaking, it can be seen a great similarity between the coefficients obtained. It can also be seen that in all cases, it can be accepted that there is a cost frontier at a 1% level of statistical significance with the exception of specifications 6 and 8 (which are statistically significant at a 10% level).

A close look at the variables used when modeling the frontier yields the following conclusions. The female activity rate has a positive and significant effect on NRU at a regional scale, an effect reinforced when a trend is included in the model. This result seems to indicate that the gradual incorporation of women into the labor market since the early 1980s has led to an increase in regional NRUs, due mainly to the fact that female unemployment rates are higher than those of men. With regard to the second demographic variable, a positive and significant effect of the percentage of young people on regional NRUs can also be seen. This effect is common to all specifications and has a greater coefficient than that of the female activity rate is found[35]. These results are consistent with the hypotheses formulated earlier concerning the youth population and reflect the importance of youth unemployment when determining aggregate unemployment levels[36].

The second group of control covariates included in the model concern the industry composition. As with the previous case, all display a positive and highly significant effect in all specifications, reflecting the fact that, ceteris paribus, all the industries evidence a higher NRU than the one used as a reference. Given that the variable excluded is the percentage of workers in the construction industry, it may be concluded that the remaining industries display higher levels of unemployment and that it is the percentage of workers in the energy industry and in the service industry which are the most relevant variables when explaining unemployment levels. The previous result also holds when we decomposed the service industry especially for the non-retailing industry (specification 3).It can also be seen how manufacturing and construction are the industries which have had the least impact on the dependent variable. One tentative explanation to account for these results might be found in the great weight which low-skilled jobs have in the service industry. In agreement with the literature, times of crisis cause long periods of unemployment amongst low-skilled workers, which increases their own rate of structural unemployment[37]. If we add to this the fact that in the service industry there is high job turnover and that in many instances firms offer little or no training[38], we are left with a low-skilled workforce with low employability. As for the dichotomous variable reflecting the methodological change in how unemployment is measured after 2001, it has a negative and highly significant effect on all specifications. This result indicates that the new methodology adopted by the INE contributes towards lowering the effective rate of unemployment. On the other hand, the linear trend included in specification 2 does not prove to be significant and the share of net capital stock in the specification 4 displays a positive value over the effective unemployment. The last group of control variables

[35] López-Bazo et al. (2005) also report a positive effect of the percentage of the youth population (16-25) on unemployment, and establish that said variable contributes significantly to explaining regional disparities in unemployment.

[36] Dolado et al. (1999, 2000) and Dolado et al. (2002) show some of the causes and consequences of the "inefficient" functioning of the labor market for young people in Spain.

[37] Using a panel that includes 21 OECD countries, Oesch (2010) offers empirical evidence concerning which variables most impact on low-skilled worker unemployment rates.

[38] A good example for the case of Spain might be certain jobs in the tourist industry.

is those related to the labor market institutions. The Kaitz Index is included in specifications 5 and 8, and exhibits a negative but not statistically significant coefficient. One possible explanation for this result is the relative low levels for the minimum wage in Spain during the time period considered in our database, which exerts a limited pressure over the wage distribution. In the case of the EPL indicator (percentage of dismissal cases ruled totally or partially in favor of workers) we obtain positive and highly significant effect in the specifications 6 and 8. This means that higher percentages of dismissal cases ruled in favor of workers tend to increase the level of unemployment in the economy[39]. Finally, the share of workers covered by a firm-level agreement also shows a negative and not statistically significant coefficient in the specifications 7 and 8.According to the results in table A3 and following the AIC and the BIC criteria, the best estimate is achieved with specification 4. Following that specification, predictions are made regarding the values of the frontier and inefficiency. It is thus possible to obtain the decomposition of the effective unemployment rate in the components previously referred to: U_{it}^{NR} and U_{it}^{C}. The estimations of U_{it}^{NR} have been obtained by standard linear predictions through the coefficients and the variables employed to model the frontier. In the case of U_{it}^{C}, the technique produces estimates via $E(u_{it}|\varepsilon_{it})$ that is defined as follow (Jondrow et al., 1982):

$$E(u_{it}|\varepsilon_{it}) = \sigma_* \left[\frac{f(\varepsilon\lambda/\sigma)}{1 - F(\varepsilon\lambda/\sigma)} - \left(\frac{\varepsilon\lambda}{\sigma}\right) \right] \tag{24}$$

Where f and F represent the standard normal density and cumulative distribution function respectively, $\varepsilon_{it} = v_{it} + u_{it}$, $\lambda = {\sigma_u}/{\sigma_v}$, $\sigma_* = {\sigma_u{}^2 \sigma_v{}^2}/{\sigma^2}$ and $\sigma^2 = \sigma_u{}^2 + \sigma_v{}^2$

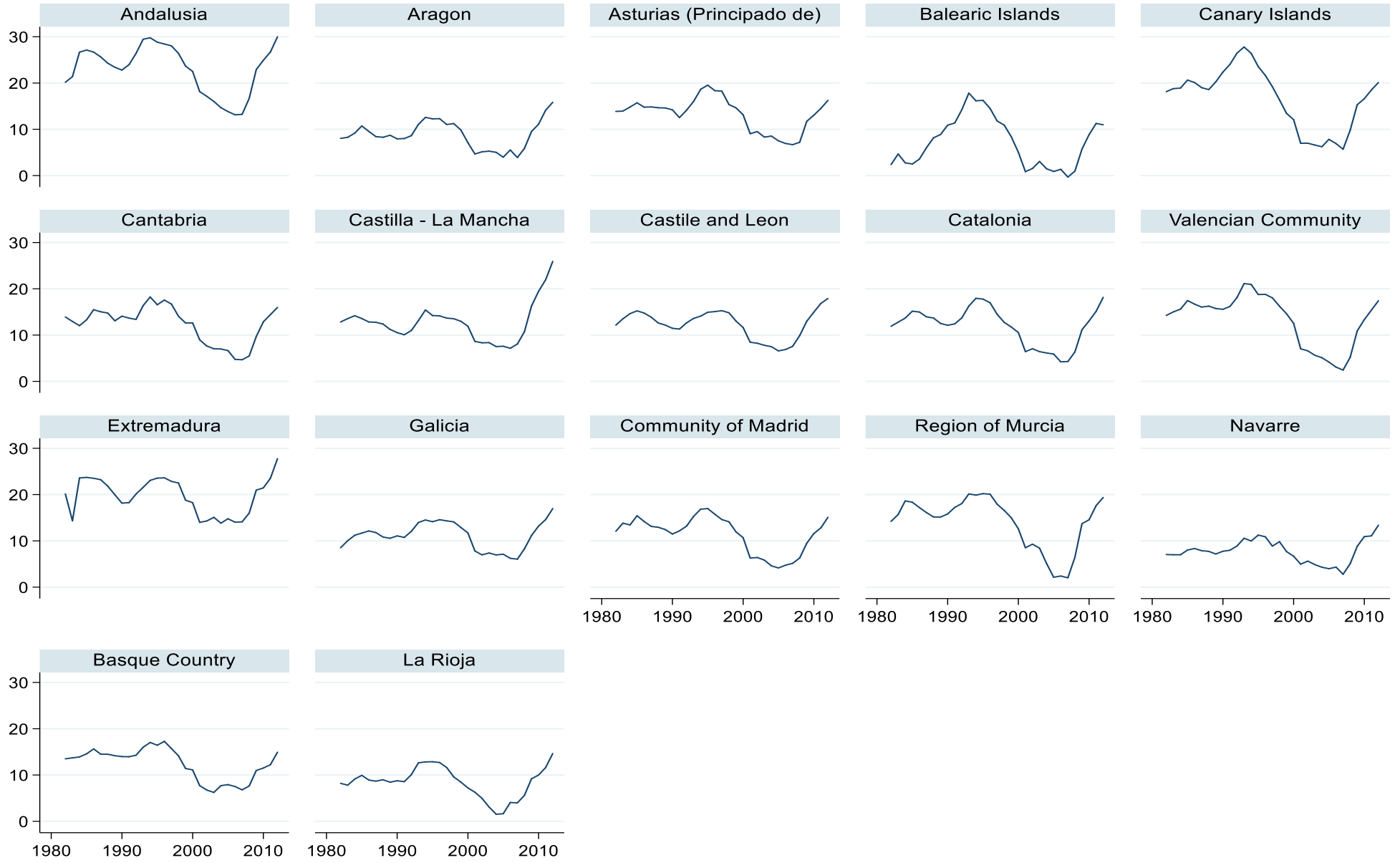
Figure 3 shows the evolution of the NRU (U_{it}^{NR}) for all the autonomous communities[40]. The mean value of this component throughout the whole period is 12.72 percentage points. Above the mean, we find certain extreme mean values such as Andalusia (23.00%), Extremadura (19.70%) and the Canary Islands (16.62%). The regions which evidence a lower mean U_{it}^{NR} value are the Balearic Islands (7.19%), Navarre (7.76%) and La Rioja (8.45%)[41]. A different set of insights comes from the relative values, i.e. the importance of U_{it}^{NR} when explaining overall levels of effective unemployment. It is once again the regions displaying the highest levels of NRU which account for the greatest percentage of effective unemployment. Specifically, this component explains about the 90% of the effective unemployment in Andalusia, 84% in Extremadura and around the 82% in the Canary Islands. In the case of the regions in which the U_{it}^{NR} has less weight on effective unemployment, these are the Balearic Islands (58.36%), Navarre (70.24%) and La Rioja (74.31%), although Aragon with a rate of 74.95% joins the list. Finally, it is worth reflecting briefly on the similarity in the profile displayed by the evolution of this component of unemployment in all the autonomous communities. Said similarity is less clear at the start of the period but becomes more intense after the mid-90s, displaying a noticeable "U" shape. Specifically, there is a sharp drop until the mid-2000s followed by a marked increase coinciding with the "Great Recession".

[39] Similar results can be found in Okudaira (2018).

[40] Estimations have been performed based on specification 4. We have also carried out a similar analysis using the other three specifications giving very similar results with values of the correlation coefficient around the 0.99. These results are available upon request from the authors.

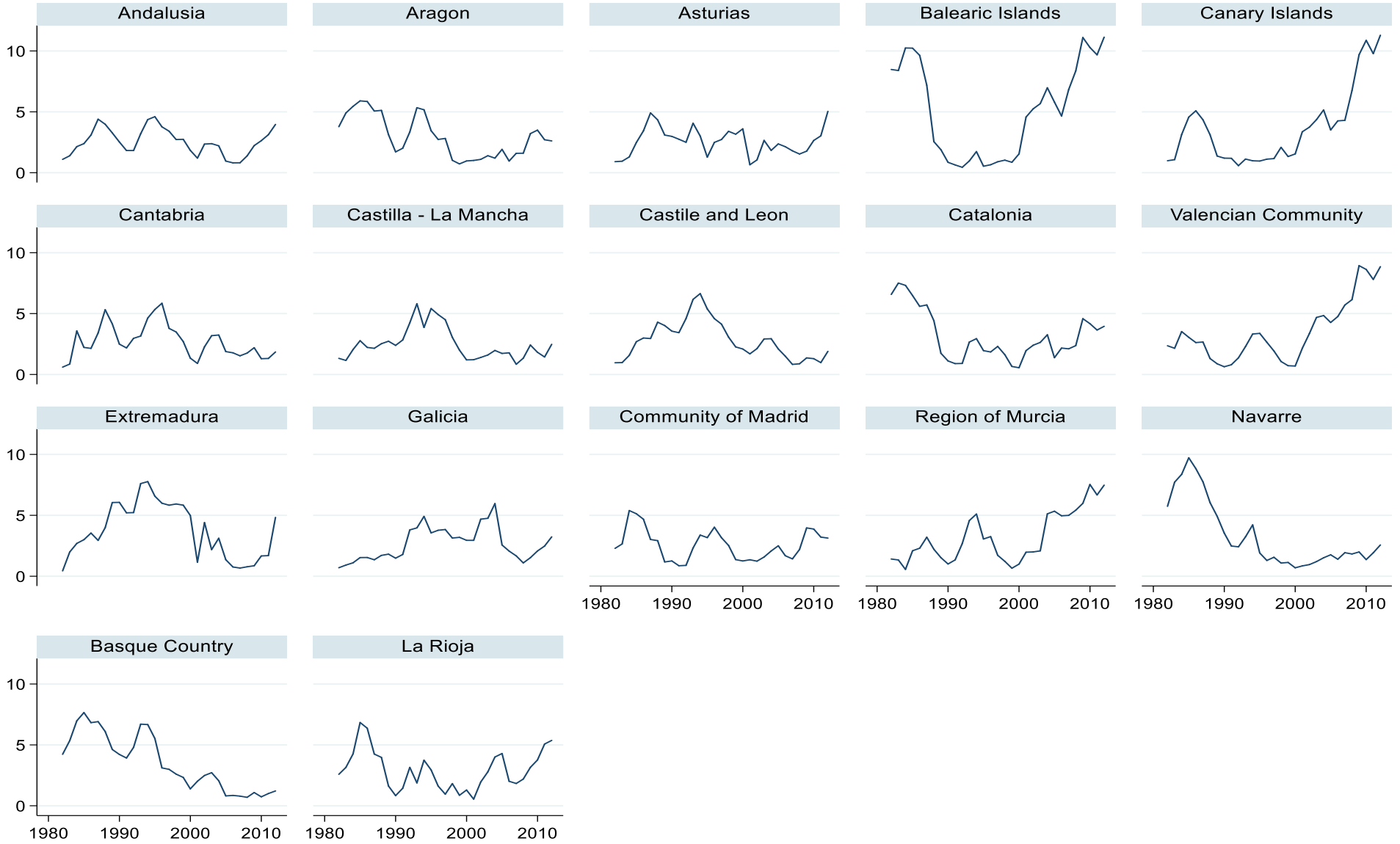
[41] Detailed results are available to those interested upon request from the authors.

Figure 3. Natural unemployment (U_{it}^{NR}) by autonomous community (1982-2012).



Source: Authors' own.

Figure 4. Cyclical unemployment (U_{it}^{C}) by autonomous community (1982-2012).



Source: Authors' own.

Figure 4 shows the cyclical unemployment (U_{it}^{C}) at a regional scale[42]. In aggregate terms, the mean value for this component is 3.13 percentage points, which represents one quarter of NRU. The regions which most exceed this value are the Balearic Islands (5.13%), Extremadura (3.71%) and the Basque Country (3.52%), although the Canary Islands, the Valencian Community and the Region of Murcia are also above the mean. In contrast, the regions showing the lowest mean value of the cyclical unemployment are Castilla-La Mancha (2.48%), Andalusia (2.53%) and the Community of Madrid (2.57)[43]. In this second case, no comments need to be made concerning the relative importance of this component on the effective unemployment rate since both components are complementary and therefore, where natural unemployment displays a greater weight, cyclical displays less, and vice versa. With regard to the time evolution of this component in all the autonomous communities, certain similarities among them are also in evidence, with a slight final peak coinciding with the period linked to the "Great Recession".

VI.2. Robustness check.

To test the robustness of the results we are going to follow two different approaches. Firstly, we re-estimate specifications 1 to 4 by modelling the inefficiency component in the SF analysis. Secondly we will put into place a technique following the methodology proposed by Chen et al. (2014) to find a consistent estimator

VI.2.1. Inefficiency modelling.

As we explained before, the nature rate of unemployment is associated with aggregate supply determinants and the cyclical unemployment rate is related to the aggregate demand determinants. Previous estimations only include supply factors when modelling the frontier because we were only interested in the global decomposition. However, the SF technique allows to identify which variables might influence the inefficiency component of unemployment. In line with Battese and Coelli (1995), the effects of inefficiency might be explained based on a vector S of variables, applying the following expression:

$$u_{it} = S_{it}\varphi + \omega_{it} \tag{25}$$

In (25), φ is the vector of parameters to be estimated and ω_{it} is a set of random variables assumed to be independent and equally distributed which come from the distribution chosen for u_{it}. In this case, the aggregate demand component included in S to model the cyclical unemployment is the growth rate of the GDP as defined in Table A1 in the Appendix. This modelling seems also necessary because of the cyclical pattern that can be seen in the estimation of the inefficiency component presented in figure 4.

Table A6 in the appendix presents the results for the four specifications (equations 19-22) including the GDP growth rate as exogenous variable in the inefficiency component. The sign and the magnitude of the coefficients in the frontier are similar to those obtained before. Regarding the GDP coefficient, we

[42] Estimations have been performed based on specification 4. We have also carried out a similar analysis using the other three specifications giving very similar results with values of the correlation coefficient around the 0.90. These results are available upon request from the authors.

[43] Detailed results are available upon request from the authors.

find that as the economy grows the cyclical component of the unemployment rate falls. The last two lines in table A6 present the correlation between the frontier and the inefficiency components in previous estimations and those obtained after modelling inefficiency. The results show the robustness of the predictions with a correlation close to one in the frontier component and higher than 0.75 in the inefficiency.

VI.2.2. Maximum Likelihood Estimation based on deviations from means.

Maximum likelihood estimation treating the unit-specific intercepts as parameters (Greene, 2005) may be subject to the "incidental parameters problem" because the number of parameters grows with the number of regions. This approach leads to inconsistent variance estimates, especially in short panels. To solve that problem Chen et al. (2014) and Belotti and Ilardi (2018) propose an alternative estimator exploiting the first difference transformation. This approach removes the individual effects by the usual within transformation and achieves consistent estimations.

Although in this case the panel is not short, we follow the proposal of Chen et al. (2014) in order to obtain a consistent estimation. The results of these estimations for the four specifications used are shown in table A7. In general, the sign of the variables and similarity in the magnitude of the coefficients are confirmed as well as the existence of a cost frontier. Finally, the last two rows confirm the high correlation between the estimates made with this procedure and those previously obtained. In all cases, the correlation coefficients exceed the 95%, which again reinforces the robustness of the results.

VII. COMPARISON WITH FILTER DECOMPOSITION.

In this section, the results of the natural unemployment (U_{it}^{NR}) and cyclical unemployment (U_{it}^{C}) obtained by means of the SF estimations (specification 4) are compared to those obtained using the univariate filters defined previously[44]. In figures 5 and 6 we present that comparison by means of the scatter plots between the SF estimations and the results of each filter for the both types of unemployment.The three graphs in figure 5 show a strong correlation between the different estimations of the natural unemployment and present a higher concentration of points below the 45 degrees line. This means that the values obtained by the SF estimations are lower and the HP Filter, the QT decomposition and the BK Filter lead to a "mean overestimation" of the natural unemployment. Figure 5 also present two types of points, the blue points represent the years of economic expansion and the red points those of recession[45]. In the case of the QT decomposition the results also confirm that the "overestimation" is stronger in the growth period because the blue points are situated further away from the bisector in comparison with the red points (in HP and BK Filters this relation is not so evident).

[44] We have followed the recommendations of Ravn and Uhlig (2002), to establish the value for the "λ" parameter with regard to the HP Filter. In the case of the BK Filter, the following values have been established in line with the recommendations of Pizarro (2001).

[45] We have employed the HP filter to estimate the natural component of the effective unemployment in Spain for the period 1982-2012. In line with this, we consider that when the effective unemployment rate is lower than its natural component; the business cycle is in its expansive phase. On the other hand, if the effective unemployment prevails over the natural unemployment the business cycle is in its recessive phase.

Figure 5. Comparison of the natural unemployment by estimation method (1982-2012).

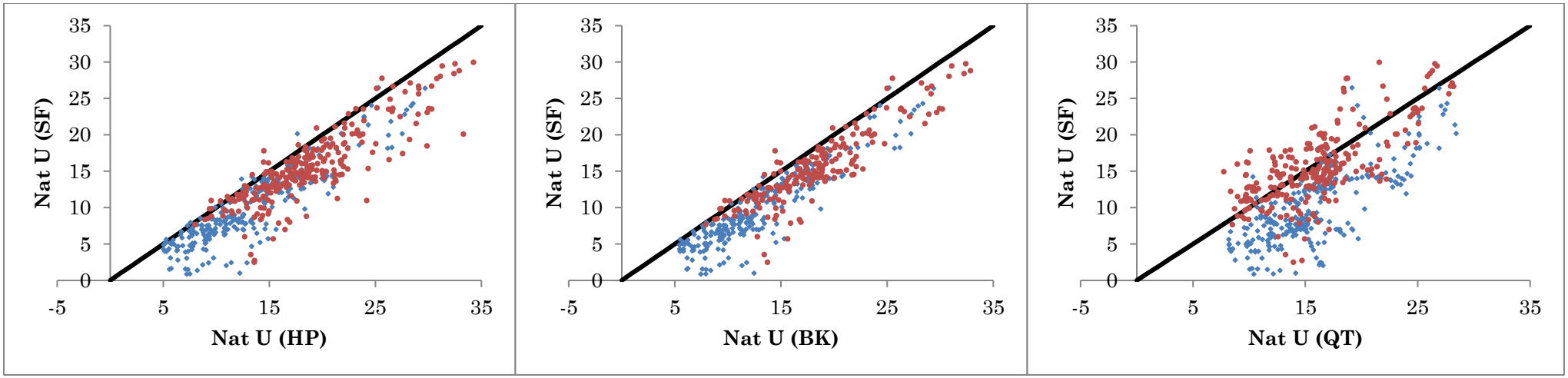
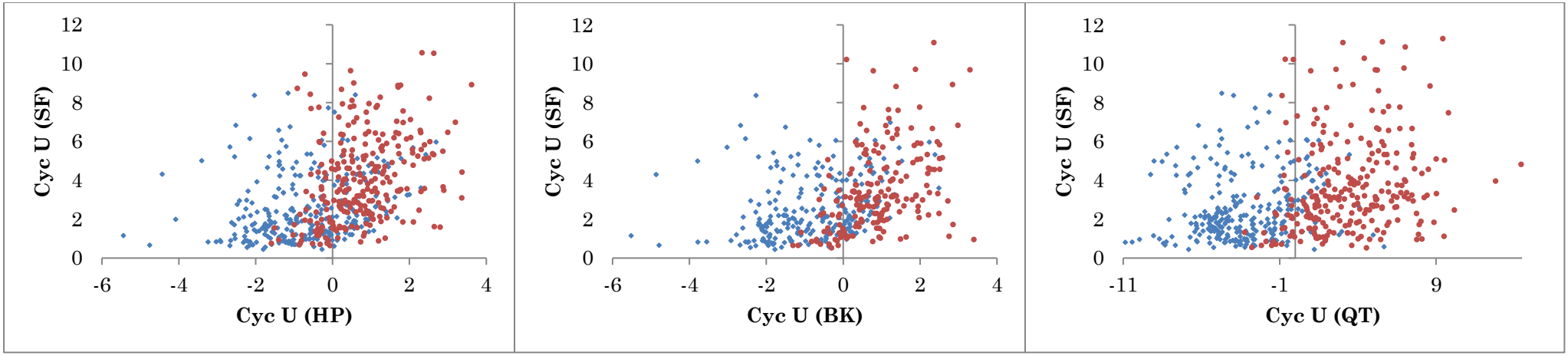


Figure 6. Comparison of the cyclical unemployment by estimation method (1982-2012).



Notes: The blue points refer to the years in which the effective unemployment, at the aggregate level, is lower than the aggregate natural unemployment. The red dots represent the years in which the effective unemployment, at the aggregate level, is higher than the aggregate natural unemployment.
Source: Authors' own.

In the same vein, scatter plot graphs in figure 6 compare the results for the cyclical unemployment. In this case all the points are located in the first and fourth quadrant which proves that the cyclical values of the univariate filters are lower in relation with the cyclical values of the SF estimations. In this case we can see that the blue points are located on the left of the red points. This indicates that the "underestimation" of the cyclical unemployment is more pronounced during the expansive phases than in the recessive phases of the business cycle.

Those results are supported by the descriptive statistics of the natural and cyclical unemployment in tables A4 and A5, and by the figures A1 and A2 in the Appendix. Figure A1 shows how the evolution of the estimations obtained are very similar, except for the case of the QT decomposition. All of them display great variations in comparison with the QT estimations, which display greater cyclical behavior; this result is also in evidence when observing the data corresponding to the standard deviation in table 4 of the Appendix. Figure A2 represents the cyclical unemployment estimated using various methods. Now the estimations obtained by means of the HP Filter and the BK Filter are very similar and resembles the SF estimations more closely.

VIII. ECONOMIC POLICY IMPLICATIONS.

In our view, the SF estimations of NRU and, consequently, of the cyclical unemployment are quite appealing from an economic policy viewpoint. From our econometric work three key features that might be useful for economic policy outcomes can be drawn.

Firstly, in the previous sections it has been shown up that when estimating the natural unemployment (U_{it}^{NR}) and the cyclical unemployment (U_{it}^{C}) differences emerge depending on which method is used. The HP Filter, the QT decomposition and the BK Filter, are univariate filters that use the past values of the variable to be decomposed. These filters are based on purely statistical criteria and therefore do not employ economic variables when estimating the various components of observed unemployment (Gómez and Usabiaga, 2001). A further issue to arise when positing the use of these filters is that the results are sensitive to the choice of the statistical parameters required to carry them out. In this way, different estimations may be obtained depending on the choice made by the researcher concerning these parameters (Fabiani and Mestre, 2000). On the other hand, the SF estimations incorporate multivariate information based on economic theory. Such methodological differences mean that the SF proposal is likely to yield results that differ from those obtained using the univariate filters. From an economic policy point of view, knowing the determining factors behind the NRU might allow the policymakers acting directly on them with the aim of reducing natural unemployment.

The second issue to be highlighted is that the evolution of the SF estimations of natural unemployment can be affected by the business cycle too, since a certain "cyclical influence" can be seen in this component of unemployment. Aysun et al. (2014), which is the closest paper to ours, reach a similar conclusion when examining the cyclical pattern of their measure of structural unemployment. The theoretical support for this empirical observation can be found, for instance, in Blanchard (2018). When discussing the fulfillment of the so-called "independence

hypothesis" and the difference between "persistence" and "permanence", this author states that all relevant models imply an effect of aggregate demand shocks on potential output and on the natural rate that will last for some time. According to this idea, the NRU is affected by economic ups and downs in the labor market and there are some motives for that[46]. Apart from aggregate demand considerations, it is likely that some labor market institutions (e.g., unemployment benefits, employment protection legislation, etc.) change over the business cycle triggering pro-cyclical movements in the NRU. Being aware that also the NRU is affected to some extent by the business cycle is important from an economic policy standpoint. This observation should encourage policymakers to act counter-cyclically with the aim of diminishing the cyclical variations not only of the cyclical unemployment but the natural unemployment too.

Finally, according to the SF estimations, there is greater scope for action for aggregate demand policies when reducing cyclical unemployment compared to the estimations offered by the univariate filters. This statement is true for all Spanish regions since, in line with table 5 of the Appendix, the SF estimations show positive mean values for the whole period unlike the values given by the univariate filters. Put it another way, provided that cyclical unemployment still remains positive, fiscal and monetary economic policies have room for maneuver. This result is confirmed by the coefficient of the GDP variation obtained when modelling inefficiency in the robustness analysis section.

IX. CONCLUSIONS.

The present work pursues two objectives. The first is to present a proposal to decompose the effective unemployment rates of the 17 autonomous communities in Spain over the period 1982-2012 into two components: the so-called natural unemployment (U_{it}^{NR}) and the cyclical unemployment (U_{it}^{C}). To do this, we construct a simple theoretical model which conceptualizes the natural component as the minimum unemployment rate reached when the GDP growth is maximum (NRU), and the cyclical component as a non-negative element that makes the actual unemployment to be above that minimum "efficient" unemployment. To ensure that our formal framework is fulfilled, we apply the stochastic cost frontier methodology following the approach of Hofler and Murphy (1989) and later developed in Warren (1991), Bodman (1999) and Aysun et al. (2014). The results underscore the fact that the bulk of effective unemployment is due to factors associated to the natural more than to the cyclical unemployment. It can also be seen how it is natural unemployment which mainly accounts for the rise of effective unemployment during the "Great Recession".

Our second objective is to compare and contrast the stochastic frontier estimations of the natural component with the estimates obtained using three types of time-series filters: the HP Filter, the BK Filter, and the QT decomposition. In this way, we base the comparison on the work of Rogerson (1997), which includes some definitions of the NRU that can be linked with the aforementioned econometric techniques. Our findings bring to light the existence of differences in the estimations between the various techniques applied. The above mentioned differences might have important implications for economic policy. Firstly, and according to our methodological proposal, natural unemployment is overestimated

[46] This finding has already been supported for the case of regional labor markets in Spain by García-Cintado et al. (2015).

for the period 1982-2012 when applying the HP Filter, the QT decomposition and the BK Filter if compared to the SF estimations. Thus, policymakers' decisions might be flawed if the scale of natural unemployment is not identified correctly. In the same way, erroneous or inefficient economic policies may be applied. However, our study also points out that cyclical unemployment might be understated when it is computed by means of the popular HP Filter, BK Filter and QT decomposition according to our SF estimations. This result indicates that the policymakers have a greater margin of action to implement aggregate demand side policies.

Also from an economic policy perspective, the results set out in the present work might help policymakers when making the decision to implement economic policies affecting the labor markets. Regardless of the method used, natural unemployment is the principal cause of high rates of effective unemployment. In this way SF estimations also seem to point to the same conclusion. Although it should also be pointed out that all in all the SF estimations for the NRU over the whole business cycle are lower than those of the univariate filters.

Based on this, the insistence should be on measures which focus on aggregate supply policies. Some such measures might be aimed at enhancing workers' human capital. This would help reduce natural unemployment in its structural component. Fostering interregional worker mobility and introducing changes in collective wage bargaining mechanisms (amending the system for reviewing wages in accordance with work productivity) would help curb natural unemployment in its structural component. On the other hand, introducing improvements in public employment services and in the way information is provided concerning vacancies would help reduce jobseekers job-search time. This would improve matching efficiency in regional labor markets and cut natural unemployment in its frictional component. Finally, our results show that there is room for implementing more active monetary and fiscal policies, since cyclical unemployment could be higher than previously thought.

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APPENDIX

Table A1. Description of variables and data sources.

Variable	Definition	Source
Unemployment rate (U_{it})	$U_{it} = \frac{UNEM_{it}}{AP_{it}} * 100$ $UNEM_{it}$: Total number of those unemployed. AP_{it} : Total active population	Labor Force Survey (EPA), published by the National Institute of Statistics (INE)
Female activity rate (FAR_{it})	$FAR_{it} = \frac{AFP_{it}}{FPOP\ 16-65_{it}} * 100$ AFP_{it} : Total active female population $FPOP\ 16-65_{it}$: Female population of working age.	Labor Force Survey (EPA), published by the National Institute of Statistics (INE)
Percentage of youth population (PYP_{it})	$PYP_{it} = \frac{YOUNG_{it}}{POP_{it}} * 100$ $YOUNG_{it}$: Total population of 16 to 24 year-olds. POP_{it} : Total population	Labor Force Survey (EPA), published by the National Institute of Statistics (INE)
Number of employed in the agricultural industry ($Agri_{it}$)	$Agri_{it} = \frac{AGRI_{it}}{TEmp_{it}} * 100$ $AGRI_{it}$: Total number of those employed in the agricultural industry $TEmp_{it}$: Total number of employed	Valencian Institute of Economic Research (IVIE)
Number of employed in the manufacturing industry (Man_{it})	$Man_{it} = \frac{MAN_{it}}{TEmp_{it}} * 100$ MAN_{it}: Total number of those employed in the manufacturing industry. $TEmp_{it}$: Total number of employed.	Valencian Institute of Economic Research (IVIE)
Number of employed in the service industry ($Serv_{it}$)	$Serv_{it} = \frac{SERV_{it}}{TEmp_{it}} * 100$ $SERV_{it}$: Total number of those employed in the service industry $TEmp_{it}$: Total number of employed.	Valencian Institute of Economic Research (IVIE)
Percentage of employed in the services in the retailing industry (SRI_{it})	$SRI_{it} = \frac{Serv\ Ret\ Ind_{it}}{TEmp_{it}} * 100$ $Serv\ Ret\ Ind_{it}$: Total number of those employed in the services (retailing industry). $TEmp_{it}$: Total number of employed.	Valencian Institute of Economic Research (IVIE)
Percentage of employed in the services in the non-retailing industry ($SNRI_{it}$)	$SNRI_{it} = \frac{Serv\ Non\ Ret\ Ind_{it}}{TEmp_{it}} * 100$ $Serv\ Non\ Ret\ Ind_{it}$: Total number of those employed in the services (non-retailing industry) $TEmp_{it}$: Total number of employed.	Valencian Institute of Economic Research (IVIE)
Number of employed in the energy industry ($Ener_{it}$)	$Ener_{it} = \frac{ENER_{it}}{TEmp_{it}} * 100$ $ENER_{it}$: Total number of those employed in the energy industry. $TEmp_{it}$: Total number of employed.	Valencian Institute of Economic Research (IVIE)
Share of net capital stock (in real terms) out of the total number of employed (RKS_{it})	$RKS_{it} = \frac{NKS_{it}}{TEmp_{it}}$ NKS_{it}: Net capital stock (in real terms) (base year: 2010). $TEmp_{it}$: Total number of employed.	Valencian Institute of Economic Research (IVIE)

Table A1. (continuation)

Gross Domestic Product growth rate (ΔGDP_{it})	$\Delta GDP_{it} = \frac{GDP_{it} - GDP_{it-1}}{GDP_{it}}$ GDP_{it}: Real Gross Domestic Product.	BD.MORES Regional Database (2008 bases)
Kaitz Index (KI_{it})	$KI_{it} = \frac{MW_t}{AW_{it}} * 100$ MW_t: Minimum nominal wage that a worker receives for a working journey. AW_{it}: Average nominal wage of the workers.	Official State Gazette (BOE) BD-MORES Regional Database (2008 bases)
Percentage of judicial rulings favorable and partially favorable to the workers in dismissal matters (JS_{it})	$JS_{it} = \frac{SFPF_{it}}{TJJ_{it}} * 100$ $SFPF_{it}$: Sum of judicial sentences that are favorable and partially favorable to the workers in dismissal matters. TJJ_{it}: Total number of judicial sentences in dismissal matters.	Statistic of labor court issues (EAJS)
Share of workers with labor agreement at firm level ($SWFA_{it}$)	$SWFA_{it} = \frac{TWFA_{it}}{TLA_{it}} * 100$ $TWFA_{it}$: Total number of workers with labor agreement at firm level TLA_{it}: Total number of workers with labor agreement.	Statistic of collective bargaining agreements (ECCT)

Table A2. Mean value and deviation of the variables used in the estimation.

	U_{it}	FAR_{it}	PYP_{it}	$Agri_{it}$	Man_{it}	$Serv_{it}$	SRI_{it}	$SNRI_{it}$	$Ener_{it}$	RKS_{it}	ΔGDP_{it}	KI_{it}	JS_{it}	$SWFA_{it}$
Andalusia	25.54	35.75	18.76	13.06	12.07	62.93	46.55	16.37	0.82	136.28	2.57	28.93	41.32	7.58
	(6.52)	(9.23)	(3.59)	(4.57)	(2.52)	(6.90)	(5.25)	(1.98)	(0.09)	(19.15)	(2.54)	(3.28)	(7.67)	(1.37)
Aragon	11.76	37.76	14.36	10.72	23.14	56.18	41.57	14.61	1.15	153.81	2.29	24.51	41.85	17.08
	(4.44)	(8.81)	(2.63)	(4.91)	(2.58)	(6.45)	(4.88)	(1.75)	(0.42)	(23.29)	(2.36)	(1.75)	(13.79)	(3.00)
Asturias	15.85	35.51	14.05	11.99	16.69	57.10	43.56	13.54	4.58	143.40	1.37	24.39	42.51	26.89
	(4.47)	(5.43)	(3.25)	(6.56)	(2.47)	(10.03)	(7.34)	(3.02)	(2.29)	(27.70)	(2.62)	(1.44)	(4.84)	(8.94)
Balearic Islands	12.32	45.23	15.92	4.13	11.95	70.24	59.26	10.97	1.10	167.38	2.40	25.71	37.43	4.66
	(4.58)	(9.33)	(2.64)	(3.29)	(4.29)	(6.91)	(5.82)	(1.39)	(0.39)	(21.39)	(3.01)	(1.94)	(8.87)	(2.06)
Canary Islands	20.30	42.03	18.97	7.62	7.03	72.95	56.90	16.05	1.04	149.62	2.48	27.85	38.34	9.59
	(6.44)	(8.39)	(4.57)	(4.34)	(1.80)	(6.26)	(4.87)	(2.00)	(0.27)	(19.93)	((2.83)	(2.11)	(4.44)	(3.18)
Cantabria	15.00	36.89	15.43	11.38	20.42	56.94	43.07	13.87	0.86	152.66	1.77	26.17	45.52	22.00
	(4.95)	(7.54)	(3.36)	(7.01)	(3.19)	(8.83)	(7.01)	(2.13)	(0.20)	(20.35)	(3.07)	(2.85)	(4.89)	(5.38)
Castilla-La Mancha	15.20	33.28	16.56	14.78	18.74	52.18	36.84	15.33	0.96	144.54	2.55	27.87	46.22	6.92
	(4.78)	(9.22)	(2.68)	(7.62)	(2.12)	(8.26)	(5.23)	(3.13)	(0.17)	(29.88)	(3.41)	(2.87)	(8.80)	(1.56)
Castile and Leon	15.14	35.60	14.95	15.03	16.89	55.70	39.99	15.71	1.88	153.83	1.91	25.80	46.98	13.58
	(4.09)	(6.91)	(3.26)	(7.81)	(0.92)	(7.90)	(5.50)	(2.54)	(0.73)	(30.50)	(1.81)	(1.64)	(10.91)	(3.38)
Catalonia	15.07	44.42	15.58	3.58	28.12	58.23	48.37	9.85	0.87	162.38	2.39	22.79	34.20	11.87
	(5.37)	(8.29)	(3.16)	(1.50)	(6.07)	(6.97)	(5.98)	(1.25)	(0.22)	(14.72)	(2.45)	(1.48)	(9.11)	(16.17)
Valencian Community	16.83	41.14	16.54	7.16	24.22	58.25	47.01	11.24	0.54	155.59	2.29	27.80	51.96	5.01
	(5.38)	(7.55)	(3.27)	(3.75)	(4.66)	(6.89)	(5.86)	(1.42)	(0.10)	(14.93)	(2.59)	(2.54)	(12.82)	(0.51)
Extremadura	23.42	33.47	17.21	18.81	9.75	57.64	38.13	19.51	0.87	146.06	2.70	30.58	42.54	4.59
	(5.92)	(7.83)	(2.91)	(7.68)	(0.64)	(7.26)	(3.54)	(3.98)	(0.23)	(22.41)	(3.73)	(3.42)	(7.54)	(2.07)
Galicia	13.73	42.58	14.94	23.27	16.02	50.01	37.84	12.16	0.74	114.67	1.89	27.56	45.05	14.03
	(3.67)	(3.09)	(3.10)	(12.94)	(1.64)	(11.10)	(7.87)	(3.27)	(0.13)	(32.74)	(2.23)	(1.63)	(7.34)	(2.70)
Community of Madrid	13.96	42.68	16.69	1.01	16.37	73.14	56.19	16.94	1.01	165.64	2.84	22.86	38.52	12.33
	(4.92)	(10.66)	(3.64)	(0.31)	(5.08)	(5.08)	(6.44)	(1.93)	(0.19)	(13.36)	(2.66)	(1.76)	(9.89)	(2.92)
Region of Murcia	17.21	39.33	18.64	14.58	18.05	56.05	42.47	13.58	0.81	143.29	3.00	30.69	34.55	3.88
	(5.65)	(8.22)	(3.41)	(3.75)	(3.84)	(6.02)	(4.73)	(1.72)	(0.30)	(18.65)	(2.93)	(3.34)	(14.93)	(1.59)
Navarre	11.05	40.10	15.47	7.84	29.72	52.96	39.63	13.32	0.60	166.29	2.30	23.87	40.49	15.43
	(4.29)	(9.15)	(3.30)	(3.48)	(3.39)	(5.63)	(4.85)	(1.24)	(0.16)	(26.20)	(2.75)	(1.59)	(7.80)	(3.84)
Basque Country	15.91	40.72	15.47	2.96	29.52	59.03	46.35	12.68	0.69	150.91	1.96	22.47	41.61	19.50
	(5.87)	(7.53)	(4.24)	(1.65)	(5.76)	(6.86)	(5.58)	(1.57)	(0.14)	(18.72)	(2.35)	(2.26)	(8.53)	(4.36)
La Rioja	11.37	37.01	14.87	10.96	30.02	49.65	36.58	13.06	0.34	152.13	2.26	24.88	41.23	13.52
	(4.21)	(9.29)	(2.57)	(4.53)	(3.42)	(6.20)	(5.59)	(1.44)	(0.20)	(22.14)	(2.62)	(1.42)	(8.87)	(3.22)
Total	15.86	39.03	16.14	10.52	19.34	58.78	44.72	14.05	1.11	150.50	2.29	26.16	41.78	12.26
	(6.35)	(8.84)	(3.58)	(8.12)	(7.81)	(10.10)	(8.91)	(3.23)	(1.11)	(25.64)	(2.73)	(3.38)	(10.20)	(8.26)

Notes: Information provided by the INE and the IVIE. In brackets the standard deviations of the variables.
Source: Authors' own.

Table A3: Econometric specifications.

	Specification 1	**Specification 2**	**Specification 3**	**Specification 4**	Specification 5	Specification 6	Specification 7	Specification 8
C	-154.398***	-150.980***	-149.781***	-115.578***	-154.393***	-152.730***	-154.195***	-151.758***
	(-19.12)	(-17.16)	(-17.86)	(-14.59)	(-19.10)	(-19.02)	(-19.08)	(-18.80)
FAR	0.161***	0.188***	0.164**	0.114**	0.161***	0.190***	0.160***	0.191***
	(3.08)	(3.21)	(3.13)	(2.50)	(3.08)	(3.66)	(3.07)	(3.68)
PYP	1.297***	1.199***	1.247***	1.388***	1.297***	1.270***	1.299***	1.261***
	(8.09)	(6.35)	(7.76)	(10.25)	(8.08)	(7.70)	(8.11)	(7.76)
Agri	1.310***	1.263***	1.300***	0.981***	1.311***	1.240***	1.309***	1.279***
	(16.84)	(13.81)	(16.70)	(13.17)	(15.21)	(15.09)	(16.86)	(14.47)
Man	1.241***	1.198***	1.184***	0.712***	1.242***	1.172***	1.239***	1.205***
	(12.42)	(10.92)	(11.39)	(6.93)	(11.72)	(11.39)	(12.39)	(11.33)
Serv	1.819***	1.823***		1.034***	1.819***	1.778***	1.817***	1.791***
	(22.16)	(22.20)		(10.29)	(21.73)	(21.11)	(22.18)	(20.98)
SRI			1.715***					
			(17.42)					
SNRI			1.934***					
			(18.76)					
Ener	1.954***	1.925***	1.921***	1.572***	1.954***	2.012***	1.986***	2.030***
	(8.54)	(8.35)	(8.39)	(8.00)	(8.51)	(8.55)	(8.29)	(8.32)
D2001	-2.735***	-2.728***	-2.724***	-2.567***	-2.732***	-3.251***	-2.729***	-3.088***
	(-4.81)	(-4.80)	(-4.83)	(-5.66)	(-4.67)	(-5.18)	(-4.80)	(-4.98)
T		-0.101						
		(-0.96)						
RKS				0.158***				
				(11.04)				
KI					-0.001			-0.101
					(-0.02)			(-1.29)
JS						0.061***		0.069***
						(3.29)		(3.54)
SWFA							-0.014	-0.013
							(-0.47)	(-0.45)
Log Likelihood	-1300.3252	-1299.8609	-1298.5787	-1247.5825	-1300.325	-1294.6218	-1300.2125	-1293.7429
σ_v^2	1.623	1.615	1.582	1.267	1.622	1.973	1.625	1.929
σ_u^2	4.056	4.062	4.093	3.952	4.057	3.420	4.052	3.488
Cost Frontier	7.64***	7.69***	8.01***	16.32***	7.58***	1.88*	7.86***	2.19*
	(0.003)	(0.003)	(0.002)	(0.000)	(0.003)	(0.085)	(0.003)	(0.069)
AIC	2652.65	2653.722	2651.157	2549.165	2654.65	2643.244	2654.425	2645.486
BIC	2763.598	2768.936	2766.372	2664.38	2769.864	2758.458	2769.639	2769.235
No. of obs	527	527	527	527	527	527	527	527

Notes: The dependent variable is the aggregate unemployment rate in each autonomous community. Cost Frontier refers to the value of the likelihood ratio test of the variances of the two error components, which determines whether a cost frontier exists or not. This is a test of the null hypothesis $H_0: \sigma_u^2 = 0$ In this case, because the test lies on the boundary of the parameter space of σ_u^2 , the standard likelihood-ratio test is not valid, and a one-sided generalized likelihood-ratio test is constructed. AIC and BIC refers to the Akaike's and Schwarz's Bayesian information criteria, respectively. *, ** and *** indicate significance at 10%, 5% and 1%, respectively. In brackets the value corresponding to the "t" statistic. The results associated to fixed effects are not shown.

Source: Authors' own.

Table A4: Descriptive statistics of the natural unemployment of the autonomous communities (1982-2012).

Autonomous Community	Mean values				Standard deviation			
	SF	HP	QT	BK	SF	HP	QT	BK
AND	23.00	25.54	25.54	25.19	5.23	5.88	2.09	5.84
ARA	8.81	11.76	11.76	10.99	3.01	3.93	2.08	3.65
AST	13.27	15.85	15.85	15.74	3.64	3.95	1.69	4.01
BAL	7.19	12.32	12.32	11.23	5.37	4.00	2.40	2.66
CAN	16.62	20.30	20.30	19.23	6.65	5.97	2.61	5.24
CANT	12.31	15.00	15.00	15.16	3.92	4.47	2.52	4.69
CLM	12.71	15.20	15.20	14.32	4.15	4.33	1.40	3.18
CLE	12.33	15.14	15.14	15.04	3.08	3.69	1.54	3.77
CAT	11.93	15.07	15.07	13.96	4.13	4.75	3.47	4.27
VAL	13.36	16.83	16.83	15.89	5.53	4.76	1.82	4.16
EXT	19.70	23.42	23.42	23.42	3.93	5.23	1.96	5.12
GAL	11.08	13.73	13.73	13.82	2.93	3.21	1.26	2.79
MAD	11.38	13.96	13.96	13.32	3.94	4.31	2.44	4.31
MUR	13.99	17.21	17.21	16.45	5.61	5.07	1.31	4.57
NAV	7.76	11.05	11.05	10.28	2.51	3.99	3.20	3.80
BAC	12.38	15.91	15.91	15.80	3.43	5.59	4.64	5.76
RIO	8.45	11.37	11.37	10.61	3.32	3.64	1.78	3.14

Notes: AND: Andalusia. ARA: Aragon. AST: Asturias. BAL: Balearic Islands. CAN: Canary Islands. CANT: Cantabria. CLM: Castilla-La Mancha. CLE: Castile and Leon. CAT: Catalonia. VAL: Valencian Community. EXT: Extremadura. GAL: Galicia. MAD: Community of Madrid. MUR: Region of Murcia. NAV: Navarre. BAC: Basque Country. RIO: La Rioja. "SF", refers to the SF estimations. "HP", refers to estimations obtained from the HP Filter. "QT", refers to estimations obtained from the QT decomposition. "BK", refers to estimations obtained from the BK Filter.
Source: Authors' own.

Table A5: Descriptive statistics of the cyclical unemployment of the autonomous communities (1982-2012).

Autonomous Community	Mean values				Standard deviation			
	SF	HP	QT	BK	SF	HP	QT	BK
AND	2.53	6.01e-11	5.38e-08	-0.08	1.09	1.59	6.17	1.63
ARA	2.94	6.01e-09	8.99e-08	-0.07	1.68	1.27	3.92	1.34
AST	2.57	1.97e-08	8.89e-09	-0.04	1.13	1.43	4.14	1.58
BAL	5.13	6.25e-09	4.06e-08	-0.15	3.86	1.55	3.89	1.60
CAN	3.67	-8.35e-09	5.67e-08	-0.06	3.09	1.58	5.88	1.68
CANT	2.69	-2.76e-09	-5.77e-09	-0.06	1.36	1.36	4.26	1.41
CLM	2.48	-3.62e-08	-3.51e-08	-0.14	1.30	1.15	4.57	1.26
CLE	2.80	3.44e-08	5.49e-08	-0.03	1.57	1.03	3.78	1.12
CAT	3.14	-5.70e-08	8.70e-08	-0.11	2.00	1.57	4.10	1.59
VAL	3.47	-5.17e-08	2.31e-08	-0.11	2.48	1.53	5.06	1.58
EXT	3.71	1.11e-08	6.06e-08	-0.04	2.24	1.86	5.59	1.74
GAL	2.64	-8.46e-09	1.20e-08	-0.07	1.35	1.10	3.44	1.18
MAD	2.57	-4.37e-08	-1.54e-08	-0.06	1.24	1.32	4.27	1.36
MUR	3.21	-3.08e-08	-2.12e-08	-0.08	2.09	1.51	5.50	1.57
NAV	3.28	8.56e-09	5.58e-08	-0.02	2.69	0.97	2.84	1.02
BAC	3.52	-5.53e-09	-1.35e-08	0.00	2.29	1.08	3.59	1.12
RIO	2.92	1.93e-08	-1.08e-07	-0.02	1.62	1.33	3.81	1.38

Notes: AND: Andalusia. ARA: Aragon. AST: Asturias. BAL: Balearic Islands. CAN: Canary Islands. CANT: Cantabria. CLM: Castilla-La Mancha. CLE: Castile and Leon. CAT: Catalonia. VAL: Valencian Community. EXT: Extremadura. GAL: Galicia. MAD: Community of Madrid. MUR: Region of Murcia. NAV: Navarre. BAC: Basque Country. RIO: La Rioja. "SF", refers to the SF estimations. "HP", refers to estimations obtained from the HP Filter. "QT", refers to estimations obtained from the QT decomposition. "BK", refers to estimations obtained from the BK Filter.
Source: Authors' own.

Table A6: SF analysis where inefficiency is modelled.

	Specification 1	Specification 2	Specification 3	Specification 4
Frontier				
C	-127.469*** (-14.51)	-125.558*** (-13.42)	-123.428*** (-13.66)	-98.779*** (-11.94)
FAR	0.098* (1.89)	0.116** (1.98)	0.103** (2.02)	0.061 (1.34)
PYP	1.133*** (7.42)	1.078*** (6.30)	1.093*** (7.41)	1.208*** (9.10)
Agri.	1.093*** (12.78)	1.065*** (10.92)	1.087*** (12.80)	0.876*** (11.15)
Man.	1.048*** (9.63)	1.021*** (8.79)	0.993*** (8.99)	0.660*** (6.60)
Serv.	1.582*** (17.14)	1.585*** (17.36)		0.939*** (9.12)
SRI			1.484*** (14.01)	
SNRI			1.698*** (15.41)	
Ener.	1.841*** (7.73)	1.824*** (7.64)	1.799*** (7.56)	1.531*** (7.03)
D2001	-3.544*** (-5.50)	-3.529*** (-6.11)	-3.537*** (-6.23)	-3.057*** (-6.16)
T		-0.062 (-0.60)		
RKS				0.143*** (10.03)
Inefficiency				
GDP Var.	-0.374 (-1.20)	-0.372* (-1.96)	-0.370*** (-2.24)	-0.349*** (-5.17)
Log Likelihood	-1279.2	-1279.1	-1277.6	-1233.8
σ_v^2	2.323	2.318	2.302	2.107
σ_u^2	2.370	2.378	2.401	2.145
Observations	527	527	527	527
Rho – Frontier	0.993	0.993	0.992	0.993
Rho – Inefficiency	0.765	0.768	0.769	0.756

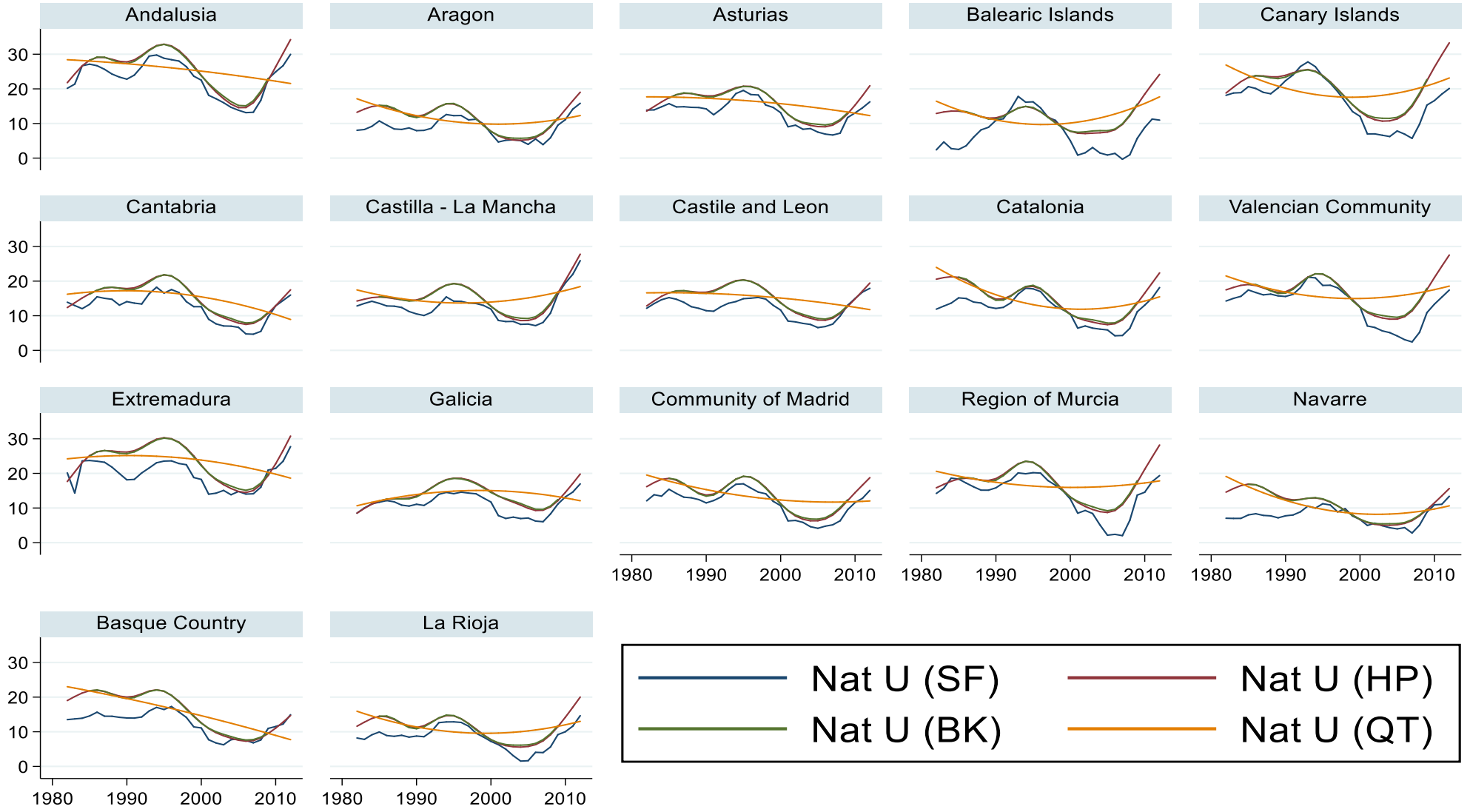
Notes: The dependent variable is the aggregate unemployment rate by region and year. Rho: Correlation coefficient between the estimations obtained with each specification and those presented in figures 2 and 3. *, ** and *** indicate significance at 10%, 5% and 1%, respectively. t-statistic in brackets.
Source: Authors' own

Table A7: Maximum Likelihood Estimation based on deviations from means.

		Specification 1	**Specification 2**	**Specification 3**	**Specification 4**
			Frontier		
FAR		0.153*** (2.90)	0.181*** (3.01)	0.155*** (2.95)	0.108** (2.32)
PYP		1.258*** (7.60)	1.162*** (6.01)	1.208*** (7.25)	1.367*** (9.76)
Agri.		1.323*** (16.69)	1.276*** (13.68)	1.314*** (16.52)	0.989*** (13.02)
Man.		1.250*** (12.19)	1.206*** (10.74)	1.192*** (11.15)	0.718*** (6.88)
Serv.		1.830*** (21.91)	1.834*** (21.93)		1.040*** (10.09)
SRI				1.728*** (17.19)	
SNRI				1.947*** (18.38)	
Ener.		1.990*** (8.48)	1.963*** (8.32)	1.956*** (8.34)	1.587*** (7.82)
D2001		-2.868*** (-4.81)	-2.858*** (4.80)	-2.870*** (-4.82)	-2.591*** (-5.45)
T			-0.101 (-0.94)		
RKS					0.158*** (10.78)
Log Likelihood		-1662.0	-1661.6	-1660.4	-1611.5
σ_v^2		3.339	3.318	3.244	1.957
σ_u^2		14.881	14.913	15.039	15.001
Observations		527	527	527	527
Rho	Frontier	0.997	0.997	0.996	0.994
	Inefficiency	0.990	0.990	0.989	0.978

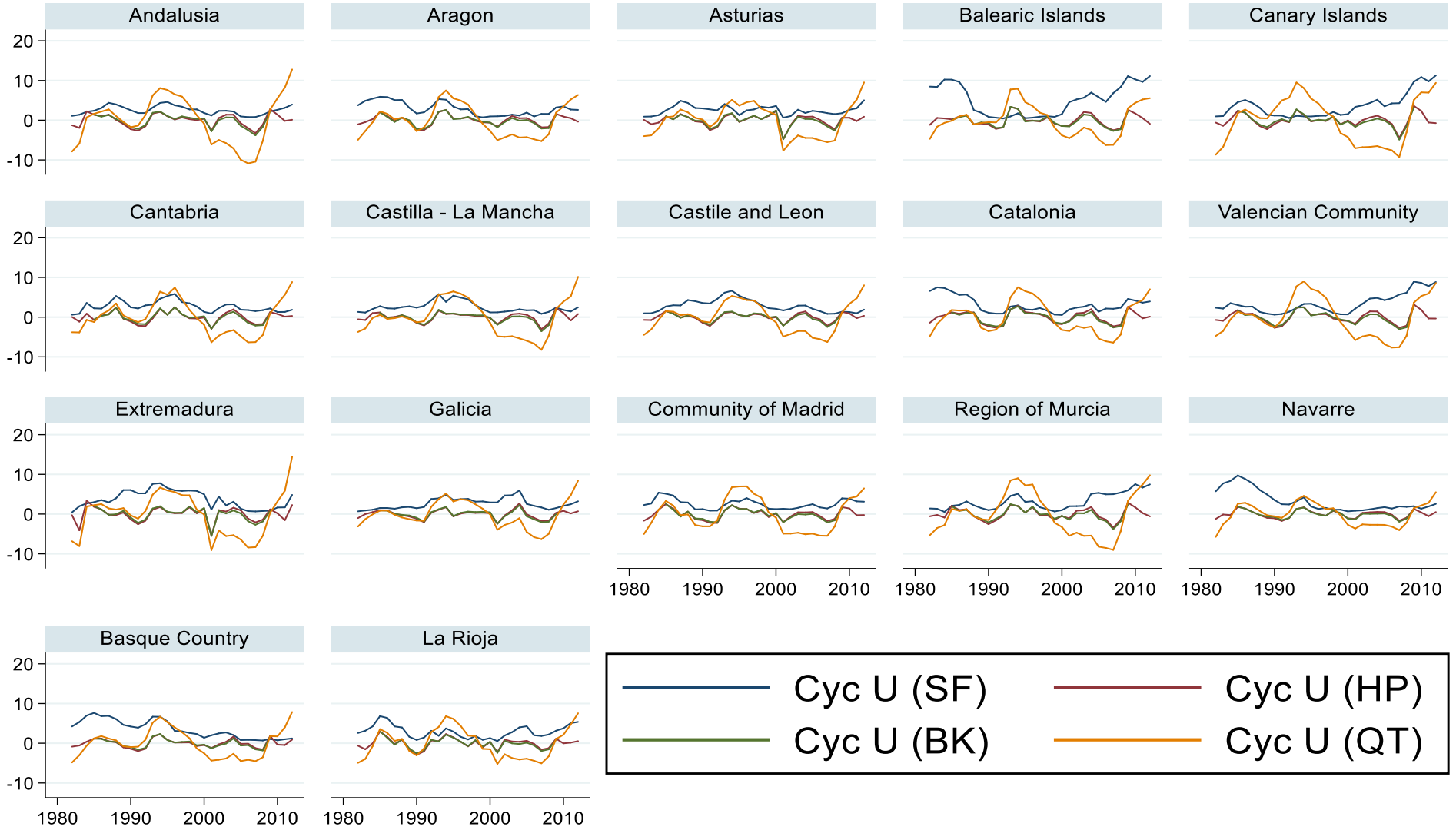
Notes: The dependent variable is the aggregate unemployment rate by region and year. Rho: Correlation coefficient between the estimations obtained with each specification and those presented in figures 2 and 3. *, ** and *** indicate significance at 10%, 5% and 1%, respectively. t-statistic in brackets.
Source: Authors' own.

Figure A1. Natural unemployment by estimation method and autonomous community (1982-2012).



Notes: "Nat U (SF)", refers to the SF estimations. "Nat U (HP)", refers to estimations obtained from the HP Filter. "Nat U (QT)", refers to estimations obtained from the QT decomposition. "Nat U (BK)" refers to estimations obtained from the BK Filter.
Source: Authors' own.

Figure A2. Cyclical unemployment by estimation method and autonomous community (1982-2012).



Notes: "Cyc U (SF)", refers to the SF estimations. "Cyc U (HP)", refers to estimations obtained from the HP filter. "Cyc U (QT)", refers to estimations obtained from the QT decomposition. "Cyc U (BK)" refers to estimations obtained from the BK Filter.
Source: Authors' own

CAPÍTULO 2

An empirical analysis of natural and cyclical unemployment at the province level in Spain

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An Empirical Analysis of Natural and Cyclical Unemployment at the Provincial Level in Spain

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Abstract Differences in regional unemployment rates, as well as their formation mechanism and persistence, have given rise to many papers in recent decades. The present work contributes to this strand of literature from two different perspectives. In the first part of our work, we follow the methodological proposal put forward by Hofler and Murphy (1989) and Aysun et al. (2014). We use a stochastic cost frontier to break down actual Spanish provincial unemployment (NUTS-3) into two different estimation components: the first associated with aggregate supply side factors, and the other more related to aggregate demand side factors. The second part of our research analyses the existence of spatial dependence patterns among Spanish provinces in actual unemployment and in the two above-mentioned components. The decomposition carried out in the first part of our research tells us what margin policymakers have when dealing with unemployment reductions by means of aggregate supply and aggregate demand policies. Finally, spatial analysis of unemployment rates in Spanish provinces may also have significant implications from the standpoint of economic policy since we find common formation patterns or clusters of unemployment.

Keywords Unemployment · Local labour markets · Spatial dependence

JEL Classification E24 · J64 · R11

Introduction

In recent years the number of scientific works analysing local and regional disparities in unemployment rates has grown substantially, underpinning the importance of the topic.

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In this kind of analysis, the case of Spain proves particularly appealing given the regional disparities in the unemployment rate and the extent to which these have persisted over the years (Jimeno and Bentolila 1998; Bande et al. 2008; Romero-Ávila and Usabiaga 2008; Sala and Trivín 2014).

The objective of this paper is twofold. Firstly, we decompose the actual unemployment rate into two different components: the natural rate of unemployment and the cyclical rate of unemployment. Secondly, we test whether there is spatial dependence between provincial figures in the two types of unemployment. In doing so, the present work goes a step further within the above-mentioned strand of literature.

The added value of this research is that it offers a more enlightened vision of the disparities among actual local unemployment rates in Spain, at the same time identifying which mechanisms lie behind such a rate. The econometric technique used to break down the unemployment rate is the so-called the stochastic frontier method, which is also an innovation in this kind of analysis for the case of Spain.[1] Actual unemployment decomposition heralds a significant advance in this type of analysis since it is a relatively novel and, at the same time, useful contribution towards understanding the dynamics underlying the formation of disparities among actual unemployment rates in the local Spanish context. As well as identifying the factors that underlie the components causing actual unemployment, this decomposition sheds light on which variables impact most on unemployment rates at a local level, and which exert the greatest influence on its progression over time. This may prove extremely useful vis-à-vis gaining an insight into how much manoeuvring space policymakers have when devising and implementing economic policy measures at a territorial level.

The second part of the empirical work (spatial analysis) also has added value. To the best of our knowledge, previous literature on local labour markets has explored spatial dependence between levels of what we call actual unemployment, but not between natural or cyclical unemployment rates in the different spatial units. This feature adds novelty to the paper. Moreover, spatial analysis might also offer a guide to policymakers when taking decisions. In order to undertake this analysis, we first examine the existence of spatial dependence at an overall level based on the values of Moran's I statistic (Moran 1950). These statistics allow us to compare the existence or lack of correlation at a global scale but do not allow us to evaluate the local structure of spatial correlation. For this reason, we go one step further and build local statistics LISA ("*Local Indicators of Spatial Association*").[2] It is thus possible to decompose the global statistic and to locate any possible clusters associated to the actual provincial unemployment rate. As a measure of robustness, various alternative definitions of neighbourhood are also applied.

In this paper, we check two main hypotheses. The first concerns the higher unemployment levels observed in the Spanish economy, even during boom periods. We test whether the structural and frictional components (i.e. natural unemployment) constitute the main part of actual or total employment. Put differently, we test whether natural

[1] This methodology is applied to a database which provides information on the 50 Spanish provinces for the period between 1984 and 2012. The 50 Spanish provinces correspond to the third level (NUTS-3) of the Nomenclature of Territorial Units for statistics. For further information concerning the concept of NUTS, see: http://ec.europa.eu/eurostat/web/nuts/overview.

[2] See the work of Anselin (1995) for an explanation of that type of analysis and the work of Posada et al. (2017) for an application of this analysis for the Spanish case.

unemployment is more important than cyclical unemployment in Spain, both during average as well as recession years. The second hypothesis is based on the idea of a non-random distribution of unemployment rates among the different NUTS3 spatial units in Spain. In this second case, we aim to test whether there is spatial correlation among the unemployment rates of a specific Spanish province and the unemployment rates of its neighbouring provinces, and whether such a correlation is mainly driven by the natural component of actual unemployment.

The remainder of the work is organised as follows. Section "Literature review" offers a review of the literature related to the topic in hand. Section "Conceptual framework" examines the conceptual framework on which the decomposition of actual provincial unemployment rates is based. Section "Database" sets out the method used in the econometric analysis. Section "Results" provides a brief description of the databases employed and defines the variables used. Section "Conclusions" presents and explains the results, both with regard to the decomposition of actual provincial unemployment rates as well as in the progression and spatial analysis of their components. Finally, last section sums up the most relevant conclusions to emerge from the research and posits some economic policy measures.

Literature Review

Since the present work presents two clearly differentiated blocks, the bibliographical review is also conducted in two distinct sub-sections. A first sub-section thus addresses studies which, from the perspective of unemployment decomposition, adopt the stochastic frontier approach, whilst the second sub-section includes some of the research which has explored the issue of regional unemployment from a range of perspectives.

Decomposition of Unemployment

Decomposing unemployment into its different components is a common theme in economic literature, and a variety of techniques has been employed for this purpose.[3] One of the most widely used options involves applying univariate statistical filters.[4] Few works, however, adopt the econometric approach of stochastic frontiers.

One of the pioneering works in this technique was Warren (1991). Said work uses the stochastic frontiers technique to decompose the unemployment rate, also drawing on information concerning vacancies.[5] Using the number of vacancies and the number of persons unemployed, an efficient matching function is estimated through an upper stochastic frontier. Based on this, the author determines the frictional component of unemployment for the USA for the period stretching from April 1969 to December 1979. Another work which follows the same line is that of Bodman (1999) who takes

[3] The work of Fabiani and Mestre (2000) sets out some of these techniques applied to the case of the European Union.

[4] The Hodrick-Prescott filter (Hodrick and Prescott 1997) and the Baxter-King filter (Baxter and King 1999) are some of the most widely used in the literature.

[5] It is precisely this use of information concerning vacancies which makes it impossible for the present paper to adopt the technique used by Warren (1991). It is well known that information concerning vacancies in Spain is extremely poor.

the model set out by Warren (1991) as a starting point, and models the inefficiency term of the error following the proposal of Battese and Coelli (1995).

One work which follows a closer line to the approach adopted in the present research is that of Hofler and Murphy (1989) where the authors posit a model for ascertaining the frictional component of unemployment in which the unemployment rate is split into one frictional component and another that captures an excess of aggregate supply in the labour market. Hofler and Murphy (1989) estimate a stochastic cost frontier using the unemployment rate of the fifty US states for the period 1960–1979. They find great variability in the frictional component of unemployment and an increase for most states during the period analysed.

Finally, Aysun et al. (2014) propose a method for estimating the structural component of the unemployment rate for the USA from 1960 to 2010. This article merges elements from the three previous studies. A very similar approach to the one employed in Warren (1991) is initially used to extract frictional unemployment. Secondly, and by applying a stochastic cost frontier, they estimate the structural component of the unemployment rate by using a specification of the expectation augmented Phillips curve. By adopting this procedure, Aysun et al. (2014) calculate a measure of structural unemployment which is always below the actual component.

Analysis of Unemployment from a Regional Perspective

In recent years, economists have shown increasing interest in how labour markets function at a regional level, which has given rise to a large number of studies. Overman and Puga (2002) report results for some European regions for the period 1986–1996. Their study points to an ever-growing polarisation between "high" unemployment and "low" unemployment regions, depending on the spatial influence exerted by their neighbours. Patacchini and Zenou (2007) explore the existence of imbalances in unemployment for the UK and find a strong positive spatial dependence between relative local unemployment rates. Their study points to an increase in spatial dependence over time, which is explained to a large degree by flows of individuals between local areas.

Cracolici et al. (2007) adopt a very similar approach to Overman and Puga (2002). The main innovation provided in their work is its contribution to the empirical evidence concerning spatial and temporal persistence for the 103 Italian provinces between 1998 and 2003. The explanation given by the authors for this process of "clustering" is due to factors which fit in with the hypothesis of imbalance (Marston 1985) for 1998. However, for 2003 the factors leading to this "clustering" are far more closely linked to elements related to the equilibrium hypothesis (Marston 1985). Finally, they stress the influence of labour demand factors as the key dynamic underlying the polarisation of unemployment between provinces in the north ("low" unemployment) and the south ("high" unemployment).

Filiztekin (2009) reports a strong spatial dependence of regional unemployment rates in Turkey. The author finds that the factors which most contribute to shaping the distribution of unemployment are the growth in employment in 1980 and human capital in the year 2000. Basile et al. (2009) also underpin the role played by the imbalance between labour supply and demand as well as the "brain drain" which occurs through migration. These two elements prove to be the most determinant when accounting for the provincial differences in unemployment in Italy in the period 1995–2007.

Kondo (2015) conducts a slightly different analysis to those employed in the above-mentioned works. His research provides empirical evidence related to the persistent unemployment rates in certain Japanese municipalities over the period 1980–2005. Using spatial econometrics, the author finds clusters in municipal unemployment rates with positive spatial dependence. The study also shows the existence of major differences in terms of sex and age with regard to the spatial dependence of unemployment rates. It also reflects how municipalities with "high" unemployment tend to remain in this situation throughout the time period studied. Halleck-Vega and Elhorst (2016) employ a "simultaneous model" and try to account for serial dynamics, spatial dependence and common factors using data on overall unemployment for 12 regions in the Netherlands over the period 1973–2013. They find empirical evidence concerning the existence of strong and weak spatial dependence in their data.

As regards the analysis of differences in the issue of unemployment between the various Spanish regions, the works of López-Bazo et al. (2002, 2005) use exploratory techniques at the spatial level merged with classical spatial regression analysis. Both studies highlight the strong polarisation of Spanish provinces into two groups ("high" and "low" relative unemployment). Adopting a different perspective, Huertas et al. (2006) apply the model introduced in the work of Blanchard and Katz (1992) to determine the degree of persistence of unemployment in Andalusia and Extremadura over the period spanning from the third quarter of 1976 to the fourth of 2004. The authors conclude that a positive shock in labour demand at the provincial level triggers a permanent impact on labour force participation in Andalusia and the unemployment rate in Extremadura, and they highlight the scant worker mobility in the two regions.

The study by Bande et al. (2008) focuses on the 17 autonomous communities (NUTS-2) in Spain over the period 1980–2000. The findings point to a greater disparity of relative unemployment rates in Spanish autonomous communities during upturns, and to a reduction thereof during periods of economic recession. The explanation given is based on a strong "mimicking effect" in the wage bargaining mechanism in Spanish regions. Said effect is heightened due to the change in this mechanism's level of centralisation and coordination, giving rise to a worsening in terms of unemployment in regions with lower productivity.

More recent works such as those of Azorín (2013) provide conclusions evidencing a strong polarisation reflected in the group of Spanish provinces displaying "high" unemployment rates in the southern half of the country and a group of provinces with noticeably "low" unemployment rates in the northern half of the country. López-Bazo and Motellón (2013) adopt an approach based on the use of microdata for Spanish autonomous communities in 1999, 2004 and 2009. Their study finds that regional disparities between unemployment rates persist over time. The authors also highlight the determinant role played by variables related to the educational features of the population in regions with "high" and "low" unemployment.

Conceptual Framework

This section is also made up of two blocks. The first block sets out and explains the different components involved in the actual unemployment rate. The second block

presents some of the social and economic phenomena found in the literature, and which contribute to the formation of clusters in unemployment.

Components of the Actual Unemployment Rate

It has been common in economic literature to break down aggregate unemployment into different components, as shown in Eq. (1)[6]:

$$U_{it} = U_{it}^{F} + U_{it}^{ST} + U_{it}^{C} \tag{1}$$

where U_{it} is the actual unemployment rate in province i at time t; U_{it}^{F} is the frictional unemployment rate; U_{it}^{ST} is the structural unemployment rate and, finally, U_{it}^{C} represents the cyclical unemployment rate.

In line with the "job search theory", the existence of asymmetric or imperfect information amongst job-seekers and employers means that labour market matching takes some time and that there will always be some people unemployed. This is what leads to frictional unemployment.[7] Structural unemployment is commonly assumed to be linked to aggregate supply factors (as opposed to U_{it}^{C}, which is considered to be linked to aggregate demand factors).[8] Imbalances between labour supply and demand cause situations in which there are both people unemployed and unoccupied vacancies in firms, thus leading to unemployment.[9]

Based on the above, macroeconomic literature has established that the sum of frictional unemployment and structural unemployment gives rise to the so-called "natural rate of unemployment" or "NRU".[10] This "natural rate of unemployment" acts as equilibrium unemployment in the long or medium term for the unemployment observed and is expressed formally through Eq. (2):

$$U_{it}^{NR} = U_{it}^{F} + U_{it}^{ST} \tag{2}$$

where U_{it}^{NR} is the natural rate of unemployment in province i at time t.

The natural rate of unemployment is related to aggregate supply determinants at a macroeconomic level, and explains that there will always be "some" level of unemployment.[11] Nevertheless, during times of "low" economic growth, or during recessions

[6] Even in textbooks like Krugman et al. (2011), this classification can be found.

[7] This theory was developed by Mortensen (1970) and McCall (1970). See Lippman and McCall (1976a, b), Mortensen (1986) and Mortensen and Pissarides (1999), for a review of the issue in question. One recent example of this type of literature is the work of Tatsiramos and van Ours (2014).

[8] The same happens with the frictional component (U_{it}^{F}).

[9] These imbalances arise as a result of a certain amount of institutional rigidity, linked to the downward rigidity of wages (minimum wage, collective bargaining, etc.) or employment protection, amongst others. Other factors which also impact strongly on the imbalances between supply and demand are: inflow and outflow in the labour market, labour force skills, low labour productivity, the industry composition of employment or the demographic structure of the population, to name but a few (Jackman and Roper 1987; Blanchard and Jimeno 1995; Blanchard 2017).

[10] Rogerson (1997) provides a number of explanations, definitions and nomenclature of the concept.

[11] Even when macroeconomic conditions reach optimal levels and there are no problems of insufficient aggregate demand.

sparked by adverse demand shocks, aggregate demand would also be "insufficient".[12] As a result, a further element, which we already identified as cyclical unemployment, must be added to the previous factors. This idea may be expressed by means of Eq (3):

$$U_{it} = U_{it}^{NR} + U_{it}^{C} \tag{3}$$

Cyclical unemployment (U_{it}^{C}) is the final component in Eq. (1) and in Eq. (3). Insufficient aggregate demand leads to a drop in sales in business. This in turn, sparks a reduction in labour demand due to the fact that it is derived demand (in Appendix 2, Fig. 9 depicts a very simple labour market graphically illustrating what was pointed out previously).

At this point, an important clarification should be made concerning the aims of the present work between the notion of the natural rate of unemployment (NRU) and the non-accelerating inflation rate of unemployment (NAIRU). The two concepts are often used indistinctly, and yet various studies question whether the NRU and NAIRU are interchangeable concepts.

Tobin (1997) establishes that the NAIRU and NRU are not one and the same. On the one hand, the NAIRU reflects a relation at a macroeconomic level, whereas the NRU is a rate of unemployment equilibrium influenced by institutional demographic features of the economy, and refers to aspects that are far more microeconomic in nature (Grant 2002). The NAIRU is associated with negative cyclical unemployment at certain periods (when the inflation rate rises). This leads to the sum of frictional unemployment and structural unemployment being greater than actual unemployment. In our view, this situation is somewhat "striking" for labour economics models which tend to have more of a microeconomic basis. These models consider that actual unemployment comprises three components of Eq (1), although none of them should be negative (in other words, $U_{it}^{F} \geq 0$; $U_{it}^{ST} \geq 0$; $U_{it}^{C} \geq 0$).

In the current work, we are more interested in the concept of NRU than NAIRU, since inflation plays no relevant role here. Based on the above, we seek to measure how much unemployment remains when there is no problem of insufficient aggregate demand. It is thus possible to quantify how much unemployment is attributable to aggregate supply factors and how much to aggregate demand factors for each province and year. Said minimum level of unemployment can be obtained as a stochastic cost frontier based on estimating a composite error econometric model. As a result, we partially follow the proposal put forward by Hofler and Murphy (1989) and more recently by Aysun et al. (2014), set out earlier.

Factors Generating Spatial Dependence in Unemployment

In our work, we also try to test for the presence of spatial dependence in actual unemployment rates and in its two components. For this reason, this section explores some of the phenomena whose characteristics display certain social and economic features that help us to explain why similar rates of unemployment can be found in certain neighbouring areas.

[12] Due, for example, to a fall in consumer or business confidence. A contractive monetary policy or a cut in public spending might explain the existence of insufficient aggregate demand.

1. "**Peer Effect**"**:** the first of these phenomena is the so-called "peer effect" which, according to Dietz (2002), emerges when "the behaviour of an individual has a direct influence on the behaviour of every other individual in the neighbourhood".[13] The influence of the previous effect may be seen through two different channels:

    1.1 "Social Network Peer Effect": the first relates to the effect caused by individuals' "social networks" or "employment networks". From this standpoint, in areas of "low" unemployment, most people join networks whose members are working. Nevertheless, in areas of "high" unemployment, networks tend to comprise people who are out of work. The employment situation of the members of the "social network" which a person forms part of affects their likelihood of finding a job, positively in the case of areas of "low" unemployment and negatively in areas of "high" unemployment (Topa 2001; Conley and Topa 2002; Calvo-Armengol and Jackson 2004; Cingano and Rosolia 2012). These networks can go beyond provincial limits, extending their influence to bordering provinces and generating spatial dependence.

    1.2 "Social Cost Peer Effect": the second channel addresses the social and psychological cost of being unemployed. In areas of "low" unemployment, the psychological and social cost for those who are unemployed is high since most of their neighbours are working. This situation drives unemployed persons to engage in a more intense job search (Hedström et al. 2003), thereby enhancing their chances of finding work. In contrast, in areas of "high" unemployment, the psychological and social cost for those who are unemployed is lower. This is because the reference group (neighbours) are in a similar situation (Hedström et al. 2003; Clark 2003), which discourages a more intense job search. As in the previous case, this group may not be restricted to a specific province, and may include some of the neighbouring areas.

These two channels generate a positive spatial dependence in unemployment rates and the persistence of "high" ("low") unemployment (Calvo-Armengol and Jackson 2004; Bramoullé and Saint-Paul 2010).[14]

2. "**Commuting Effect**"**:** another phenomenon which leads to the creation of spatial clusters and spatial dependence in general terms, concerns the geographical mobility of workers around the areas adjacent to where they live. It should be borne in mind that the geographical areas where individuals work need not necessarily coincide with the areas where they live. In certain instances, these commuting areas may even belong to different provinces. In other words, the "commuting effect" leads to the unemployment rates in nearby or adjacent areas displaying a certain spatial dependence.[15] This assumption is justified since individuals seek

[13] This type of effect has also been used in microeconomics under the name "Bandwagon effect". See Topa and Zenou (2015) and Ioannides and Datcher Loury (2004) for a more detailed explanation.
[14] Topa (2001) and Conley and Topa (2002) show how the spatial patterns evident in unemployment are due to the exchange of information amongst individuals through different channels (geographical, ethnical etc.).
[15] Elhorst (2003) refers to commuting as one of the factors to be taken into account when explaining regional unemployment rates.

employment and work in the areas closest to where they live. This helps create an interrelation amongst areas and as a consequence we find that unemployment rates could be spatially correlated (Patacchini and Zenou 2007).

3. "**Migration Effect**"**:** the next aspect concerns people's decision to move to nearby provinces or regions rather than to those which are further away. This decision to move away is closely linked to uncertain job prospects (based on imperfect information) and to the growing cost as distance increases (Tassinopoulos and Werner 1999).[16] Such factors cause a greater spatial dependence between nearby areas than between areas which are further apart, given that the benefit derived from migrating diminishes as distance increases.
4. "**Spillover Effect**"**:** the fourth effect is the so-called "Spillover Effect". This phenomenon arises when the effects (in an economic sense) generated in one area, have been caused by the actions occurring in other nearby areas (neighbouring areas). As pointed out earlier, there is an economic influence amongst neighbouring areas, which can contribute to developing common patterns. A wide variety of spillover effects have been addressed by the literature, although we focus on two specific channels[17]:

    4.1 "Standard Spillover Effect": this effect is caused by each area's productive structure. There are areas that "spill over" activity to neighbouring locations, thereby generating similarities between their industrial composition, despite them being spatially different areas. This gives rise to major trade links that bring about an analogous productive specialisation between neighbouring areas. This situation generates resemblances between their labour market structures that might also lead to them displaying similar unemployment rates.[18]

    4.2 "Fiscal Policy Spillover Effect": the latter phenomenon concerns the existence of a certain spillover effect caused by the action of a fiscal policy that might give rise to aggregate demand shocks, in the short run, in areas adjacent to those in which the policy has been applied, also impacting on its unemployment rate.[19] For instance, if the national government decides to build a road in a certain province "i" (as part of the state's general budget fiscal policy), it might cause a positive aggregate demand shock (negative) in neighbouring province "j" (because some of the labourers might be living in that bordering province) thus helping to reduce (increase) unemployment in both areas due to their spatial relation.[20] The previous effect strongly depends on the area in which it is

[16] The growing cost as distance increases not only concerns purely monetary costs (transport costs, accommodation costs) but also costs associated to other factors (family, friends etc.).

[17] See among others del Barrio-Castro et al. 2002; Moreno et al. 2005; López-Bazo et al. 2005.

[18] There might be adjacent areas which display determinant economic features that function poorly. Here, the "spillover" which occurs in adjacent areas proves relatively inefficient from the economic standpoint, generating a negative Spillover Effect. For example, large-scale redundancies in a given area might trigger depressive economic effects in adjacent areas. See Martin (1997).

[19] See Solé-Ollé (2003); Brueckner (2003); Costa et al. (Costa et al. 2015); and López et al., (2017) among others to provide a detailed explanation about similar effects in the public sector.

[20] For example, increasing public spending on infrastructures in area "i" gives rise to a reduction in unemployment both in area "i" and adjacent area "j", leading to the unemployment rates being similar in the two areas. In the case of a negative aggregate demand shock (for example, a cut in public spending), the opposite would occur. In other words, there would be an increase in unemployment in the two neighbouring areas.

applied, the type of fiscal policy and, amongst others, the sign of the policy (expansive or contractionary). Thus, with this effect we are not referring to the fiscal policy implemented by one specific Spanish province (which has a very limited ability to do so due to its restricted fiscal budget) but local implementation of national fiscal policy through the state's general budget. Based on this, the effects generated by this type of spillover effect could be less redundant in time and space. In other words, the effects of the "Fiscal Policy Spillover Effect" could be expected to occur in the short run and with great variability in the neighbouring areas (i.e. while national fiscal policy is being implemented). Finally, we can say that a certain positive spatial dependence might be expected and, therefore, a similarity between unemployment levels in adjacent areas.

Methodology

As commented on in section "Components of the actual unemployment rate", the decomposition of the unemployment rate posited in the present work is based on the concept of the "NRU" and on the non-negativity of its components. Given this assumption, the method best suited to our goals is that known as stochastic frontiers. This technique first appeared in the works of Aigner et al. (1977) and Meeusen and van Den Broeck (1977) and has become widespread in efficiency analysis when seeking to obtain maximum production or minimum costs. Its practical application in the cost version allows a value to be obtained which acts as a lower limit for the target variable.[21] This minimum value is identified in the present work as medium (long) term equilibrium unemployment, and the deviation from this minimum is considered to be an inefficiency associated to insufficient aggregate demand. In more analytical terms, the lower frontier coincides with the sum of frictional unemployment (U_{it}^{F}) and structural unemployment (U_{it}^{ST}), in other words, the natural rate of unemployment (U_{it}^{NR}). The difference between this and the actual unemployment rate (U_{it}) is referred to as cyclical unemployment (U_{it}^{C}).

As pointed out, the natural rate of unemployment depends on variables that affect structural and frictional unemployment, such that it may be expressed as $U_{it}^{NR} = f(X_{it})$. Equation (4) shows the econometric specification of this natural rate of unemployment, assuming linearity in the model[22]:

$$U_{it}^{NR} = \beta_1 X_{it} + v_{it} \tag{4}$$

where β_1 is a vector of the coefficients, X_{it} is a vector of explanatory variables and v_{it} is a random error of mean 0 and variance σ_v^2. U_{it}^{NR} acts as a theoretical unobserved lower bound. Our information comes from the actual unemployment rate, which is greater than or equal to this component ($U_{it} \geq U_{it}^{NR}$). In this way, the actual unemployment rate may be represented

[21] Greene (2008) and Kumbhakar and Lovell (2003) provide a highly detailed explanation of this kind of econometric technique.

[22] The lack of information which is sufficiently ample and comparable over time concerning existing vacancies in the labour market makes it extremely difficult to extract the frictional component (U_{it}^{F}) in line with the approach adopted in Warren (1991), Bodman (1999) and Aysun et al. (2014), such that said component is estimated together with structural unemployment.

as the sum of the natural rate of unemployment and a non-negative random disturbance (u_{it}). which is identified with cyclical unemployment (U_{it}^{C}) through the following expression:

$$U_{it} = U_{it}^{NR} + u_{it} \tag{5}$$

where u_{it} is an error term expected to be positive and independently distributed taking the form $N\left(\mu, \sigma_v^2\right)$. The strategy adopted in the present research is based partially on the approach presented by Aysun et al. (2014), where cyclical unemployment is also felt to have a minimum value equal to 0. By merging Eqs. (4) and (5), expression (6) is obtained:

$$U_{it} = \beta_1 X_{it} + \varepsilon_{it} \tag{6}$$

where: $\varepsilon_{it} = v_{it} + u_{it.}$

As a result, in accordance with expression (6), we are dealing with an econometric specification that has a composed error. In such instances, and provided that the disturbances and regressors are independent, Ordinary Least Squares estimation (OLS) provides non-biased, consistent and efficient estimators. Nevertheless, there is inconsistency in the constant term and it is not possible to separate the variances of the two disturbances. This causes problems since conducting tests that validate the existence of inefficiency requires having information concerning the variance associated to each disturbance. In order to overcome all of these deficiencies, it is necessary to resort to other more appropriate estimation methods such as maximum likelihood estimation. It should, however, be borne in mind that to carry out this kind of estimation, a distribution for each of the two error components ε_{it} (Jondrow et al. 1982) must be assumed. In the case of the component v_{it}, there would be no problem, since there seems to be strong consensus in the empirical literature that said component is distributed in the form $N\left(0, \sigma_v^2\right)$. The main problem arises when we need to consider the distribution of the term u_{it}.[23] In this case, and as in Hofler and Murphy (1989) and Aysun et al. (2014), we opt to use semi-normal distribution.

Taking Eq. (6) as a starting point, our baseline model is depicted by expression (7). In this case, the frontier incorporates a vector of variables reflecting the industry composition of labour (I_{it}), a vector of demographic variables (Y_{it}) that contains the female participation rate (FPR_{it}) and the percentage of youth population in the province ($PYPP_{it}$), as well as a vector of independent variables that includes two additional covariates for human capital (Z_{it}). These variables are commonly used as determinants of regional differences in unemployment (e.g. see Elhorst 2003). We have also included a dichotomous variable ($D2001$) taking the value 1 after the year 2001 and 0 otherwise,[24] whilst μ_i are the provincial fixed effects reflecting unobservable heterogeneity at the provincial level:

$$U_{it} = \beta_0 + \beta_1 I_{it} + \beta_2 Y_{it} + \beta_3 Z_{it} + \delta D2001 + \mu_i + v_{it} + u_{it} \tag{7}$$

With the estimates from Eq. (7), we can compute for each province and year, the two components of the actual unemployment rate. Using the coefficients for the explanatory variables, we can calculate the value of the frontier, which we identify here with the

[23] In this case, several distributions have been proposed in the econometric literature: Normal truncated (Stevenson, 1980), Semi-Normal (Aigner et al., 1977), Exponential (Meeusen and van Den Broeck, 1977) and Gamma (Greene, 1990).

[24] This dichotomous variable is introduced due to the fact that in 2001 a methodological change was implemented which affected how unemployment was measured. These methodological changes may be seen in http://www.ine.es/epa02/meto2002.htm.

natural rate of unemployment. In addition, this method also provides the corresponding value of the inefficiency term associated with cyclical unemployment in this paper.

Having decomposed the actual provincial unemployment rate, the next step in the econometric analysis is to study whether or not there is spatial dependence in the actual provincial unemployment rate and in each of its components. To identify these spatial patterns, a matrix of weights indicating what neighbourhood criterion we are using must first be defined. The literature has used various alternatives such as the existence of a common frontier, the matrix of K nearest neighbours (knn) or matrices of distances. After choosing a criterion, the existence of spatial dependence may be determined by using a given overall spatial dependence statistic. In the current work, we use the statistic known as Moran's I (Moran 1948).[25]

Having analysed the presence of overall spatial dependence, it might prove interesting to pinpoint specific clusters or areas where the target variable behaves in a given manner. To achieve this objective, a local spatial dependence analysis is also performed using Moran's *Ii* local statistic (Anselin 1995)[26]:

> Finally, it should be pointed out that in order to check the robustness of our results we opted to conduct the analysis employing various alternative spatial weight matrices (*W*). It is thus possible to control for the different definitions of according to geographical and socioeconomic criteria.

Database

The data used in the present work are taken from the Labour Force Survey (Encuesta de Población Activa, EPA) drawn up by the National Statistics Institute (Instituto Nacional de Estadística, INE), the Valencian Institute of Economic Research (Instituto Valenciano de Investigaciones Económicas, IVIE) and the Labour Situation Survey (Encuesta de Coyuntura Laboral, ECL), conducted by the Ministry of Labour and Social Security. These data are annual and are disaggregated for the 50 Spanish provinces (NUTS-3) for the period 1984–2012,[27] except for information obtained from the ECL (annual data for the 17 Spanish NUTS2 spatial units for the period 1991–2012). In order to provide a graphical representation of the dynamics referred to in the introductory section, Fig. 1 shows the provincial distribution of actual provincial unemployment in 1984 and 2012 through two maps of quartiles.

Data reveal the presence of substantial differences between actual provincial unemployment rates, which is reflected in the scale of the quartiles. A certain geographical pattern also emerges in the colour distribution. The highest rates are found in the southernmost provinces and in the Canary Islands, whilst the provinces with the lowest rates are located in the north and northeast of the Iberian Peninsula. Finally, the similarity between

[25] Cliff and Ord (1981) confer this statistic with an advantage over other spatial dependence indices. Moran's scatterplot diagrams (Anselin 1995) provide a more comprehensive view of the existence of overall spatial dependence.

[26] For a more detailed explanation of this kind of statistics, see Moreno and Vayá (2002).

[27] Ceuta and Melilla have been excluded from the analysis due to their scant representativeness together with the scarce availability of some of the data used.

the two maps in Fig. 1 is clear evidence of the persistence in the provinces which experience most (and fewest) problems of unemployment during the period analysed.[28]

Table 3 of Appendix 1 provides a summary of the variables used in the work and of their calculation procedure. The central variable in this study is the actual provincial unemployment rate, and is the one which acts as the dependent variable and the one we seek to decompose. To achieve this decomposition, a series of independent variables will also be used which reflect the structural aspects and which explain their progression over time. The first seven explanatory variables, in Table 3 of Appendix 1, refer to the industry composition of employment in each province. According to Elhorst (2003), industry composition proves a key factor when explaining differing unemployment rates at a territorial scale. The greater or lesser weight of certain industries is reflected in wage differences, skilled labour or competitiveness, and therefore emerges as a determinant feature vis-à-vis accounting for the rate of unemployment from a territorial perspective.[29]

Other important variables for explaining the actual provincial unemployment rate are the female participation rate and the percentage represented by the 15 to 24 year old age group out of the total population. As regards the former, Elhorst (2003) considers that this variable might lead to dissimilar results when explaining the actual unemployment rate.[30] The latter variable is purely demographic and tends to impact positively on unemployment rates (Johnson and Kneebone 1991; Murphy and Payne 2003). One initial explanation for such a phenomenon might be that youngsters "seek worse employment" than those who are older. They possess fewer job-seeking skills and are less efficient than their older counterparts. As a result, the young tend to remain unemployed for longer periods than those who are older.[31] Another explanation for this effect might be that, in general, younger people possess less specific capital due to having little work experience, which has a negative impact on their labour market matching.[32]

We also include variables that capture the level of human capital in the province. Following the work of Elhorst (2003), such variables are expected to have a negative impact on unemployment. It would seem logical to assume that those with higher educational attainment might develop skills that would enable them to adapt far more quickly and effectively to technological changes. This would make them more productive than those with lower educational attainment, as well as more desirable from the point of view of being hired in addition to affording them greater work stability.[33] In this case, we have incorporated the percentage of the active population who have completed secondary education, and the percentage of the active population who have completed tertiary education in each province.[34]

[28] The inverse situation can be found in the work of Galiani et al. (2005). In this research, the authors show that the persistence of unemployment in the regions of Argentina is very low compared to the situation in Spain or the UK.

[29] In Summers et al. (1986) a more detailed explanation of the phenomenon may be found.

[30] Lázaro et al. (2000), Azmat et al. (2006) and Bertola et al. (2007) provide explanations and hypotheses regarding high female unemployment rates.

[31] Maguire et al. (2013) provides a thorough explanation of this phenomenon.

[32] See Eichhorst and Neder (2014) for a broader explanation of the problems related to the "school-work" transition in certain European Mediterranean countries.

[33] See López-Bazo and Motellón (2012) for a more comprehensive explanation of regional differences in the matter of human capital, its impact on the labour market and on wages.

[34] For a more detailed definition of educational variables, see http://www.ivie.es/downloads/caphum/series-2013/metodologia-series-capital-humano-1964-2013.pdf

Two more independent variables that could be considered as factors affecting frictional and/or structural unemployment in a province have been used. The first is the amount of net capital stock (in real terms) divided by the total number of employed persons in each province. This variable seeks to measure the level of capitalization of the economy in each area (Bande and Karanassou 2013; Bande and Karanassou 2014).[35] The second variable is the percentage of temporary employment over total employment. Several works have addressed the effect of temporary work on the labour market in different countries, with mixed evidence about the effects on different elements of this market (Booth et al. 2002; Dolado et al. 2002; Kahn 2010; Bentolila et al. 2012).

In order to provide more detailed information concerning the variables used, Appendix 1 (Table 4) offers some descriptive statistics.

Results

This section is divided into three blocks. The first shows the results of decomposing the unemployment rate. The second examines the existence of the spatial dependence of the actual unemployment rate and its components. Finally, the third block discusses the implications of the results to emerge.

Decomposing the Actual Unemployment Rate

In this section, we present the results of our baseline specification, which is explained in Eq. (7) and which we refer to as specification 1. Several additional specifications are also examined in order to test said benchmark specification. For instance, specification 2 modifies the vector of the industry composition of labour and decomposes the service industry into retailing (SRI_{it}) and non-retailing industries ($SNRI_{it}$).[36] Specification 3 incorporates another covariate which is the amount of net capital stock (in real terms) divided by the total number of employed persons in each province. The fourth specification adds another regressor, this one being the percentage of temporary employment over total employment ($Temp_{it}$).[37] Specification 5 only incorporates time fixed effects to the baseline specification. Moreover, we carried out our analysis for two different subperiods (specification 6 and specification 7), using the benchmark model as the reference. The first subperiod starts in 1987 and ends in 1999, the second subperiod covers from 2000 to 2012. Our two subperiods incorporate a full business cycle for the Spanish economy.

[35] For a more detailed definition about the construction of net capital stock, see http://web2016.ivie.es/wp-content/uploads/2017/02/Metodolog%C3%ADa_basedatos_stockcapital_ED.pdf

[36] For a more detailed explanation about services in the retailing industry (SRI_{it}) and services in the non-retailing industry ($SNRI_{it}$), see http://web2011.ivie.es/downloads/caphum/series-2013/metodologia-series-capital-humano-1964-2013.pdf

[37] As regards the impact of temporary employment, we searched for data with provincial disaggregation but failed to find a database covering our whole period. Therefore, we built the percentage of temporary employment over total employment for each NUTS2 spatial unit (autonomous community) in Spain, and applied these figures to each province (NUTS3 spatial unit) depending on the autonomous community to which it belongs. Given the lack of adequate data, we have also been forced to carry out the empirical work for the period from 1991 to 2012).

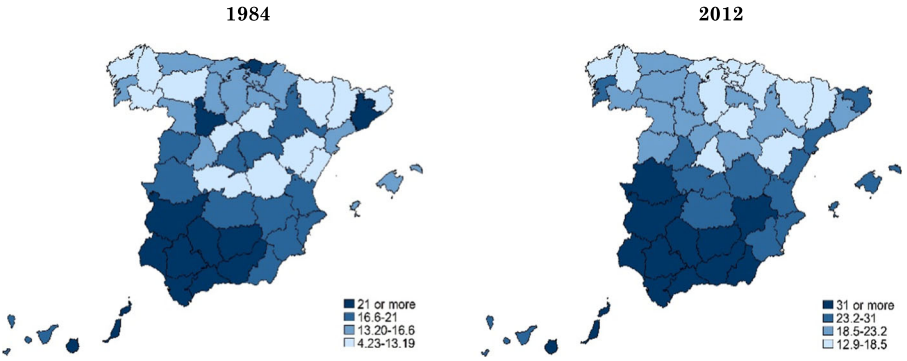


Fig. 1 Distribution of actual provincial unemployment rates. Source: Authors' own

Table 1 presents the results obtained for each specification. Firstly, it should be pointed out that all specifications display a stochastic cost frontier at a 1% level of significance,[38] except specifications 4 and 6, whose statistical significance is 10%. If we commence by analysing industry variables, it can be seen how all the independent variables show positive and significant values, except the agriculture industry in specification 5, indicating that, generally, all industries give rise to higher natural rates of unemployment compared to the reference industry, the construction industry. It can also be seen that the greatest effect on structural unemployment, for all specifications, corresponds to the service industry and the energy industry, both of which display similar values. This result might be due to the weight which certain low-skilled jobs have in the service industry. Low-skilled workers are subject to higher turnover rates and are given little training by firms.[39] This leads to a low-skilled labour force with low employability and also triggers structural unemployment in this industry.[40] The demographic variables (FPR_{it} and $PYPP_{it}$) also display a positive sign for all specifications. In line with the above, it should be mentioned that for specifications 2 and 7 the percentage of the youth population is not statistically significant. The coefficient of the FPR_{it} implies that female integration into the labour market has helped to raise actual unemployment rates at an aggregate level, partly due to the fact that their unemployment rates are almost higher than men's. For its part, the coefficient related to the weight of the youth population in general bears out the hypothesis posited earlier that the young are less skilled at job-seeking than their more mature counterparts. It also reflects the difficulty said group has in finding work as a result of their possessing "less" specific capital. Finally, it highlights the importance of youth unemployment when explaining the natural rate of unemployment.[41]

The results of the variables of human capital are consistent with the hypothesis put forward earlier and evidence a reducing effect on natural unemployment. As the human capital of employed persons increases, the less likely they are to become unemployed

[38] The test of maximum likelihood rejects the notion that variance of the disturbance measuring inefficiency is zero.

[39] A good example for the case of Spain might be certain jobs in the tourism industry.

[40] Using a panel including 21 OECD countries, Oesch (2010) provides empirical evidence concerning which variables most impact on unemployment among low-skilled workers.

[41] The works of Dolado et al. (1999 and 2000) and Dolado et al. (2002) offer some explanations of the "deficient" functioning of the labour market for the case of young people in Spain.

(Nickell and Bell 1996). It can also be seen that individuals with tertiary education are less likely to be unemployed than other who only have secondary education.[42] The *RKS* variable displays a positive sign (specifications 3 and 4). The percentage of temporary employment over total employment ($Temp_{it}$) presents a negative sign, such that when the proportion of employees with a temporary contract rises, natural unemployment falls (specification 4). It can also be stated that methodological changes implemented by the INE in 2001 had a negative impact. This indicates that the new method adopted by the INE contributed to reducing provincial unemployment. Finally, specification 5, with time fixed effects, offers very similar results to those previously commented on.

Having verified the robustness of the benchmark model, the estimates obtained have been used to compute the figures concerning the frontier (natural unemployment) and the inefficiency term (cyclical unemployment). Based on these estimates, the relationship between the actual unemployment rate and its components, the natural rate of unemployment and cyclical unemployment at a provincial level, are presented in the scatter plots of Figs. 2 and 3.[43] In Fig. 2, it can be clearly seen that the relationship between these elements is positive and significant. High values of actual unemployment are associated with high values of the natural unemployment rate with a correlation equal to 0.893 and an R^2 equal to 0.798. When focusing our attention on the relationship between the actual unemployment rate and the cyclical component (Fig. 3), we notice there is a clear positive association, albeit weaker than in the previous case. The statistical correlation (0.440) and R^2 (0.193) value are also weaker.

Complementing the previous analysis, Fig. 5 in Appendix 1 depicts the progression of the natural rate of unemployment for all Spanish provinces during the period 1984–2012.[44] The mean of that component for the whole period reaches a value of 13.29 although there is considerable interterritorial variability, as the value of its variance indicates (44.60). The provinces displaying the highest mean value are Cadiz (27.35), Cordoba (23.45) and Seville (23.30), and those which behave best are Lleida (4.13), Soria (5.73) and Huesca (6.24).[45] Figure 5 in Appendix 1 also shows that the profile of the natural component is quite similar for all provinces. At the start of the period, it seems to remain fairly stable and at the end evidences a "U" shaped figure spanning the late 1990s and early part of the twenty-first century. As a result, there is a reduction in the natural rate of unemployment at the turn of the twenty-first century which, more or less, comes to an end with the onset of the economic crisis for the vast majority of provinces. Figure 6 in Appendix 1 shows the estimations of cyclical unemployment (U_{it}^{C}) at a provincial scale.[46] In aggregate terms, this component shows a mean value equal to 2.96, which represents approximately one fifth of the natural

[42] The previous result is maintained when we use the percentage of employed persons with secondary education and the percentage of employed persons with tertiary education in each province, rather than the share of the active population with secondary education (SE_{it}) and the share of the active population with tertiary education (TE_{it}).

[43] Some negative values have been obtained when estimating the natural rate of unemployment for certain provinces. Despite this, said values account for only a very small part compared to the total number of estimations, and in all cases are below 2% of the total number of estimations obtained.

[44] Estimations were performed based on the basic specification. Tests were carried out using the rest of the specifications and the results are very similar. These results are available from the authors upon request.

[45] Detailed results are available upon request from the authors.

[46] Estimations of cyclical unemployment have also been conducted using the basic specification. Tests were carried out using the rest of the specifications with the results being very similar. These results are available from the authors upon request.

Table 1 Econometric specifications

	Specification 1	Specification 2	Specification 3	Specification 4	Specification 5	Specification 6	Specification 7
C	−84.510 (−15.84)	−72.280*** (−13.21)	−73.640*** (−14.87)	−56.380*** (−9.36)	−2.478 (−0.53)	−67.448*** (−7.86)	−111.580*** (−14.52)
Agri	0.726*** (14.28)	0.680*** (13.52)	0.612*** (13.07)	0.585*** (9.87)	−0.151*** (−3.06)	0.224*** (2.75)	1.343*** (18.27)
Man	0.772*** (12.76)	0.658*** (10.75)	0.456*** (7.89)	0.268*** (3.96)	0.063 (1.21)	0.247*** (2.59)	0.884*** (10.39)
Serv	1.397*** (29.53)		1.004*** (20.64)	0.759*** (12.90)	0.279*** (5.69)	0.792*** (8.93)	1.591*** (28.60)
SRI		1.192*** (22.18)					
SNRI		1.685*** (28.18)					
Ener	1.273*** (9.48)	1.197*** (9.07)	1.175*** (9.86)	1.044*** (5.66)	0.234** (2.26)	1.055*** (5.09)	2.117*** (6.92)
FPR	0.162*** (6.03)	0.172*** (6.55)	0.167*** (7.00)	0.211*** (6.70)	0.164*** (6.63)	0.133*** (2.62)	0.270*** (5.83)
PYPP	0.294** (2.41)	0.052 (0.43)	0.488*** (4.32)	0.803*** (6.13)	0.637*** (6.10)	1.742*** (7.38)	0.037 (0.18)
SE	−0.081*** (−4.36)	−0.085*** (−4.64)	−0.093*** (−5.53)	−0.049*** (−2.59)	−0.068*** (−3.94)	0.031 (1.08)	−0.152*** (−5.22)
TE	−0.731*** (−13.38)	−0.840*** (−15.04)	−0.787*** (−15.44)	−0.509*** (−8.03)	−0.521*** (−11.28)	−0.349*** (−4.47)	−0.553*** (−6.97)
RKS			0.108*** (17.66)	0.094*** (14.03)			
Temp				−0.262*** (−9.52)			

Table 1 (continued)

	Specification 1	Specification 2	Specification 3	Specification 4	Specification 5	Specification 6	Specification 7
PFE/TFE	YES/NO	YES/NO	YES/NO	YES/NO	YES/YES	YES/NO	YES/NO
Cost Frontier	0.000*** 11.97	0.000*** 13.46	0.000*** 19.01	0.056* 2.53	0.000*** 12.05	0.055* 2.54	0.000*** 12.51
N°. of obs	1450	1450	1450	1100	1450	650	650

The dependent variable is the actual unemployment rate in each province. All specifications, except specification 6, include the dichotomous variable D2001. The results associated to this variable are not shown. "Cost Frontier" refers to the test of maximum likelihood for determining whether a cost frontier exists or not. *, ** and *** indicate significance at 10%, 5 and 1%, respectively. In brackets, the value corresponding to the "z" statistic. Results associated to the provincial fixed effects and the time fixed effects are not shown

Source: Authors' own

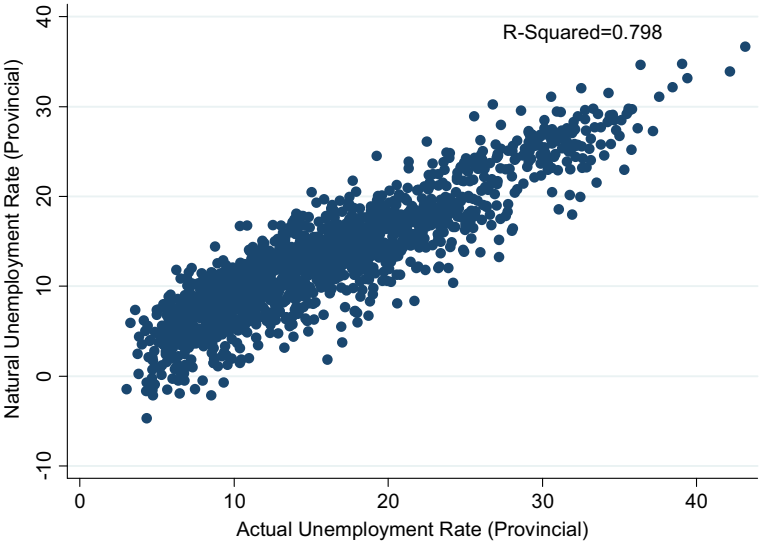


Fig. 2 Scatter plot of actual and natural unemployment rates (1984–2012). Source: Authors' own

component. As occurred earlier, cyclical unemployment also displays significant interprovincial diversity, with the variance of this component being equal to 2.35 in this case. Girona (3.55), Castellon (3.43) and Guadalajara (3.40) are the provinces with the highest mean values, and Navarra (2.63), Burgos (2.64) and Pontevedra (2.68) those with the lowest. Below the mean, we also find Madrid, Alava and Biscay.[47] Finally, certain similarities can also be found in the progression of all of them, with a final upturn coinciding with period linked to the Great Recession.

At this point, it seems logical to dedicate a few lines to examining what happened in the above-mentioned Great Recession years, which had important implications for the Spanish labour market. The substantial increase in actual unemployment in the Spanish provinces could be explained to a greater extent by the progression of the natural rate of unemployment than by the progression of the cyclical rate of unemployment. Put differently, and in line with our theoretical framework, the results obtained in this paper seem to suggest that the sizeable increase in the actual unemployment rates is better explained by aggregate supply factors than by aggregate demand factors.[48]

To conclude this section, we would like to reflect on potential endogeneity problems in our model. According to econometric theory, there are three possible sources of endogeneity: measurement errors, omitted variables bias, and the simultaneity problem. This could generate some correlation among the regressors of the model and the two components of the error term in the econometric model. Controlling for spatial fixed effects (as we do in this paper) alleviates the omitted variable bias problem and possible measurement errors.

With regard to simultaneity, since we have two different error terms, each should be discussed separately. In the case of possible correlation among the regressors and the inefficiency term, we feel that it should not really be a problem based on theoretical grounds.

[47] Detailed results are available upon request from the authors.

[48] See Jimeno and Santos (2014) for a more comprehensive explanation about the effects of this period in the case of Spain.

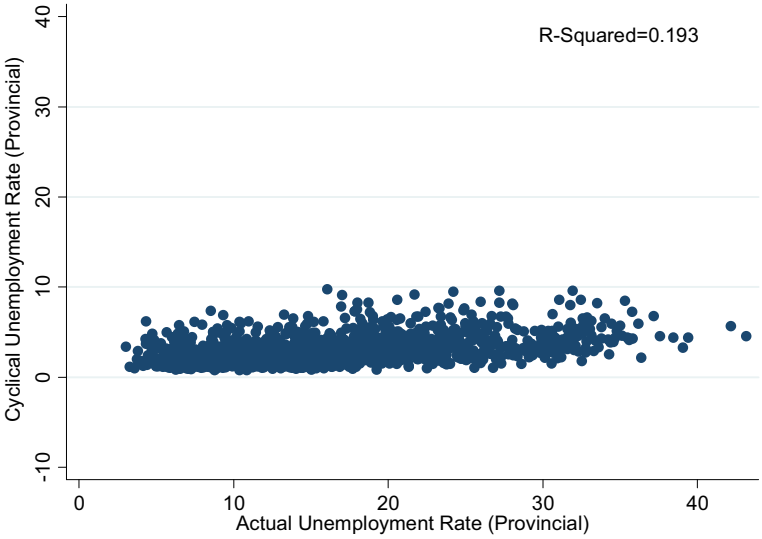


Fig. 3 Scatter plot of actual and cyclical unemployment rates (1984–2012). Source: Authors' own

This is because the two components that make up actual unemployment differ in "nature": natural unemployment is determined by aggregate supply side variables, whereas cyclical unemployment is determined by aggregate demand side factors. Consequently, all the variables included in the frontier are intended to capture supply side determinants and should theoretically be orthogonal with cyclical unemployment. In this sense, we closely follow the same approach as Summers et al. (1986), Hofler and Murphy (1989), and Aysun et al. (2014), who include covariates such as industry composition, demographic variables or certain measures of human capital to explain both frictional and structural unemployment.

The other source of potential endogeneity might be the possible correlation between the regressors and the random error (v_{it}). In our view, the variables most likely to be affected by the double directionality problem would be the female activity rate and human capital measures. In order to check whether this is actually an issue, we tested whether eliminating the previously mentioned variables from our baseline regression would substantially modify the estimates of natural and cyclical unemployment. Results did not alter significantly. Therefore, given the robustness of the results in the different alternative specifications, it seems logical to assume that endogeneity is not a major concern in our model.

Spatial Analysis of the Actual Unemployment Rate and its Components

Having performed the decomposition, the next step involves analysing the spatial dependence of each component. In order to achieve this goal, it is necessary to start by defining the matrices. This work uses four different spatial matrices. The first considers the five nearest neighbours to each province (Knn = 5).[49] The second is an inverse distance matrix which penalises the spatial units that are furthest away from one another with an alpha (α) parameter equal to 1 (Inv).[50] The third is also an inverse distance matrix, but is based on an

[49] This type of spatial matrix is also used in Basile et al. (2009).

[50] This type of spatial matrix is also used in Akçagün (2017).

alpha parameter which adopts the value 2; in this case the penalisation is greater compared to the second matrix (Inv2). Finally, the fourth is an administrative matrix which considers only provinces belonging to the same autonomous community to be neighbours (Admin).

Table 2 shows the values corresponding to Global Moran's I. Data evidence a strong positive spatial dependence both in the actual provincial unemployment rates as well as in their natural component, for all the spatial matrices. The actual unemployment rate shows positive and significant values at a 1% level over the whole period. Even though the values are highly stable they appear to increase over time, albeit only slightly. This phenomenon is observable for all the spatial matrices used in this research. What was stated earlier indicates that actual unemployment rates resemble those of their neighbours as time passes. These results are borne out by the diagrams corresponding to section A of Fig. 7 of Appendix 1 (for the five nearest neighbours' matrix). Results evidence a strong positive dependence which is reflected in the greater concentration of points in the first and third quadrant, particularly in the final year of the sample.[51] The results corresponding to the spatial analysis of the natural rate of unemployment are very similar to those presented for the actual unemployment rate. All the values of Global Moran's I are positive and significant at a 1% level. In this case, mean values are on average lower (except in the case of the administrative matrix) and display less variability, evidencing greater stability of Moran's I over the whole period. The Moran's I scatterplot diagrams for the five nearest neighbours' matrix shown in section B of Fig. 7 of Appendix 1 once again bear out all the results mentioned.[52]

In all the years presented, a strong positive spatial dependence can be seen, with significant concentrations of points in the first and third quadrants. In the case of cyclical unemployment, the situation is not as clear. Global Moran's I points to a positive spatial dependence although, except for the administrative matrix, this only occurs as of 1996 in a generalised way for the rest of the spatial matrices. It can also be seen how the value of Global Moran's I is lower than for the two previous cases. This lower spatial dependence is also evident when observing the diagrams shown in section C of Fig. 7 of Appendix 1, for the five nearest neighbours' matrix.[53] The points no longer display such a clear pattern and are distributed over the four quadrants.

Having verified the existence of the positive spatial dependence of the unemployment rate and its components, the next step is to determine where the areas of "high" and "low" unemployment are situated and whether these persist over time. The three panels of Fig. 4 show the results obtained using the local statistics of Moran's I for the unemployment rate and its components, and

[51] The diagrams obtained for the remaining spatial matrices also point to the existence of spatial dependence for the actual unemployment rate in a way similar to that observed in the five nearest neighbours' matrix. Detailed results are available upon request from the authors.

[52] As noted in the previous case, the remaining spatial matrices also point to the existence of spatial dependence regarding the natural rate of unemployment.

[53] Again, the diagrams obtained with different spatial matrices seem to indicate the existence of spatial dependence for the cyclical rate of unemployment (except for the administrative matrix).

for the four years in the sample.[54] In panel A), corresponding to the actual unemployment rate, two clearly defined geographical areas emerge. First, there is a cluster of "high" unemployment located in the south of Spain, which remains very stable over the four years studied, and which includes most of the provinces in Andalusia as well as Badajoz (in addition to Ciudad Real in 2012).

Second, there is an area of "low" unemployment in the north of Spain and which shifts over time towards the Basque Country, Navarre and Aragón, particularly after the second half of the 1990s. These results are also confirmed based on the local scatterplot diagrams presented in section A) of Fig. 8 of Appendix 1.

The same results obtained in panel A for the actual unemployment rate also hold true in panel B for the natural rate of unemployment. The cluster of very stable "high" unemployment found in the provinces of the southern half of the country is seen to remain. There is also another cluster of "low" unemployment that emerges in the north-east of the peninsula. That cluster changes over time and finally, in 2012, also appears in the north-east of the peninsula. Once again, this result is consistent with what is shown in section B in Fig. 8 which appears in Appendix 1. In the case of cyclical unemployment, the situation is far more erratic. There are clusters of "high" and "low" unemployment, but without any kind of territorial consistency in the years shown. This lack of any pattern is also apparent in section C of Fig. 8 of Appendix 1, with greater randomness in the distribution of the points.

Finally, one goal of this paper is to identify and measure spatial dependence both in the natural and the cyclical components of actual unemployment. To do this, we closely follow previous literature on unemployment decomposition by means of stochastic frontier procedures (e.g. Aysun et al. 2014), in a first step, so as to obtain the figures of both components. However, when analysing spatial dependence of aggregate regional unemployment, standard practice has sought to correct such a spatial dependence by including the spatial lag of the dependent variable and the spatial lags of the independent variables in the econometric specification (e.g. Elhorst 2014). Although our initial aim was not to follow this path, we carried out an additional specification in which we include the previously mentioned spatial lags. The results of this empirical exercise can be found in Appendix 3. As a general comment, it can be said that the estimates of natural and cyclical unemployment rates are very similar to those obtained in our baseline econometric specification.

Implications of the Results

The previous results highlight the existence of two well-defined clusters of unemployment: one of "high" actual unemployment in the southern half of

[54] The results shown have been obtained using the Knn = 5 matrix. Nevertheless, tests have been carried out using the remaining spatial matrices and the conclusions are similar. The results of these tests are available upon request from the authors. Tests were also conducted after removing the islands. The values of the statistics did not alter substantially.

Table 2 Global Moran's I

	Knn = 5						Inv						Inv2
	$U_{i,\,t}$		$U_{i,t}^{NR}$		$U_{i,t}^{C}$		$U_{i,\,t}$		$U_{i,t}^{NR}$		$U_{i,t}^{C}$		$U_{i,\,t}$
Year	I	z (I)	I	z (I)	I	z (I)	I	z (I)	I	z (I)	I	z (I)	I
1984	0.532***	6.918	0.706***	9.102	0.021	0.533	0.170***	9.303	0.228***	12.103	−0.012	0.439	0.360***
1985	0.559***	7.376	0.639***	8.262	−0.004	0.209	0.172***	9.337	0.196***	10.547	−0.011	0.449	0.366***
1986	0.637***	8.232	0.604***	7.853	−0.018	0.035	0.178***	9.669	0.182***	9.894	−0.017	0.198	0.385***
1987	0.673***	8.699	0.668***	8.623	0.027	0.606	0.201***	10.801	0.204***	10.952	−0.008	0.607	0.434***
1988	0.654***	8.458	0.620***	8.016	0.121*	1.879	0.189***	10.202	0.193***	10.377	0.014*	1.792	0.413***
1989	0.657***	8.487	0.678***	8.725	0.171**	2.483	0.200***	10.715	0.218***	11.573	0.029**	2.465	0.426***
1990	0.653***	8.434	0.697***	8.953	0.130**	1.998	0.200***	10.725	0.227***	12.018	0.031***	2.659	0.425***
1991	0.672***	8.694	0.666***	8.602	0.125*	1.859	0.214***	11.434	0.219***	11.682	0.026**	2.298	0.449***
1992	0.705***	9.082	0.641***	8.269	−0.019	0.023	0.228***	12.104	0.213***	11.361	−0.011	0.482	0.471***
1993	0.664***	8.576	0.714***	9.217	0.063	1.047	0.219***	11.681	0.238***	12.614	−0.003	0.857	0.450***
1994	0.664***	8.636	0.721***	9.370	0.102	1.536	0.219***	11.718	0.238***	12.678	0.019*	1.925	0.453***
1995	0.667***	8.674	0.710***	9.220	0.077	1.221	0.225***	12.025	0.231***	12.324	0.016*	1.758	0.458***
1996	0.684***	8.852	0.772***	9.991	0.152**	2.172	0.231***	12.269	0.245***	13.030	0.026**	2.251	0.467***
1997	0.707***	9.131	0.737***	9.547	0.284***	3.821	0.242***	12.804	0.242***	12.850	0.069***	4.367	0.492***
1998	0.739***	9.596	0.729***	9.429	0.184***	2.571	0.239***	12.718	0.250***	13.212	0.034***	2.685	0.488***
1999	0.736***	9.523	0.714***	9.203	0.233***	3.180	0.238***	12.667	0.250***	13.157	0.049***	3.409	0.495***
2000	0.749***	9.681	0.738***	9.491	0.327***	4.358	0.248***	13.124	0.251***	13.221	0.082***	5.008	0.512***
2001	0.663***	8.730	0.674***	8.752	0.070	1.238	0.217***	11.813	0.217***	11.642	0.000	1.092	0.444***
2002	0.654***	8.593	0.616***	8.009	−0.096	−0.955	0.215***	11.662	0.213***	11.433	−0.018	0.121	0.436***
2003	0.651***	8.444	0.654***	8.484	−0.047	−0.335	0.216***	11.546	0.220***	11.730	−0.022	−0.059	0.437***

Table 2 (continued)

	Knn = 5						Inv						Inv2
	$U_{i,\,t}$		$U_{i,t}^{NR}$		$U_{i,t}^{C}$		$U_{i,\,t}$		$U_{i,t}^{NR}$		$U_{i,t}^{C}$		$U_{i,\,t}$
Year	I	z (I)	I	z (I)	I	z (I)	I	z (I)	I	z (I)	I	z (I)	I
2004	0.631***	8.213	0.575***	7.482	0.127*	1.882	0.203***	10.963	0.189***	10.221	0.032***	2.595	0.415***
2005	0.732***	9.491	0.612***	7.924	0.143**	2.078	0.244***	12.967	0.204***	10.909	0.041***	3.036	0.484***
2006	0.798***	10.279	0.596***	7.743	0.107	1.624	0.267***	14.024	0.193***	10.404	0.021**	2.037	0.526***
2007	0.785***	10.097	0.588***	7.619	0.173**	2.476	0.284***	14.813	0.189***	10.179	0.036***	2.780	0.551***
2008	0.819***	10.477	0.669***	8.657	0.061	1.060	0.321***	16.564	0.241***	12.790	0.011	1.590	0.616***
2009	0.804***	10.253	0.739***	9.523	0.231***	3.184	0.322***	16.576	0.274***	14.358	0.064***	4.133	0.607***
2010	0.792***	10.118	0.758***	9.750	0.206***	2.845	0.322***	16.584	0.284***	14.837	0.055***	3.678	0.605***
2011	0.776***	9.913	0.731***	9.391	0.144**	2.095	0.316***	16.304	0.282***	14.719	0.040***	2.994	0.592***
2012	0.810***	10.315	0.749***	9.639	0.131*	1.896	0.329***	16.863	0.291***	15.167	0.015*	1.732	0.614***

	Inv2					Admin					
	$U_{i,\,t}$	$U_{i,t}^{NR}$		$U_{i,t}^{C}$		$U_{i,\,t}$		$U_{i,t}^{NR}$		$U_{i,t}^{C}$	
Year	z (I)	I	z (I)	I	z (I)	I	z (I)	I	z (I)	I	z (I)
1984	7.457	0.467***	9.552	−0.014	0.120	0.689***	7.624	0.870***	9.566	−0.065	−0.487
1985	7.557	0.410***	8.438	−0.000	0.406	0.689***	7.606	0.694***	7.676	−0.058	−0.417
1986	7.938	0.383***	7.936	−0.011	0.191	0.745***	8.209	0.689***	7.648	−0.052	−0.353
1987	8.898	0.421***	8.651	0.005	0.512	0.862***	9.481	0.714***	7.888	0.135*	1.704
1988	8.506	0.392***	8.073	0.073*	1.946	0.755***	8.340	0.629***	6.961	0.091	1.269

Table 2 (continued)

	Inv2					Admin					
	$U_{i,\,t}$	$U_{i,t}^{NR}$		$U_{i,t}^{C}$		$U_{i,\,t}$		$U_{i,t}^{NR}$		$U_{i,t}^{C}$	
Year	z (I)	I	z (I)	I	z (I)	I	z (I)	I	z (I)	I	z (I)
1989	8.732	0.447***	9.144	0.088**	2.199	0.745***	8.221	0.835***	9.163	0.080	1.106
1990	8.727	0.462***	9.409	0.088**	2.261	0.705***	7.788	0.802***	8.800	0.071	1.032
1991	9.210	0.449***	9.196	0.062	1.637	0.731***	8.082	0.804***	8.855	−0.014	0.074
1992	9.620	0.433***	8.870	0.001	0.447	0.770***	8.476	0.747***	8.233	−0.044	−0.266
1993	9.226	0.484***	9.889	0.051	1.401	0.738***	8.153	0.876***	9.643	0.046	0.714
1994	9.340	0.481***	9.912	0.101**	2.376	0.794***	8.798	0.864***	9.574	−0.027	−0.069
1995	9.436	0.470***	9.683	0.073*	1.834	0.806***	8.926	0.892***	9.872	−0.023	−0.025
1996	9.572	0.507***	10.401	0.074*	1.865	0.826***	9.116	0.998***	10.999	0.004	0.267
1997	10.052	0.494***	10.139	0.166***	3.668	0.857***	9.438	0.984***	10.844	0.139*	1.717
1998	10.046	0.507***	10.371	0.065*	1.675	0.787***	8.730	0.887***	9.787	0.034	0.592
1999	10.135	0.497***	10.137	0.123***	2.810	0.812***	8.976	0.796***	8.769	0.186**	2.220
2000	10.465	0.503***	10.238	0.207***	4.470	0.900***	9.919	0.883***	9.696	0.191**	2.273
2001	9.274	0.450***	9.271	0.038	1.256	0.829***	9.284	0.801***	8.864	−0.052	−0.363
2002	9.087	0.429***	8.845	−0.003	0.344	0.875***	9.769	0.700***	7.776	−0.103	−0.896
2003	8.985	0.435***	8.953	−0.041	−0.408	0.795***	8.789	0.786***	8.686	0.077	1.046
2004	8.597	0.397***	8.200	0.134***	3.085	0.651***	7.260	0.722***	8.003	0.137*	1.723
2005	9.943	0.419***	8.600	0.118***	2.760	0.738***	8.195	0.703***	7.761	0.171**	2.083
2006	10.720	0.399***	8.231	0.049	1.381	0.768***	8.488	0.710***	7.856	0.178**	2.158
2007	11.190	0.387***	7.984	0.075*	1.904	0.942***	10.339	0.633***	7.012	0.091	1.221
2008	12.408	0.474***	9.721	0.042	1.269	0.978***	10.684	0.839***	9.249	−0.023	−0.030

Table 2 (continued)

	Inv2					Admin					
	$U_{i,\,t}$	$U_{i,t}^{NR}$		$U_{i,t}^{C}$		$U_{i,\,t}$		$U_{i,t}^{NR}$		$U_{i,t}^{C}$	
Year	z (I)	I	z (I)	I	z (I)	I	z (I)	I	z (I)	I	z (I)
2009	12.198	0.534***	10.877	0.157***	3.515	0.937***	10.217	1.007***	11.038	0.198**	2.362
2010	12.163	0.551***	11.201	0.139***	3.139	0.906***	9.896	0.992***	10.877	0.172**	2.075
2011	11.934	0.541***	10.980	0.086**	2.119	0.969***	10.567	0.912***	9.995	0.088	1.179
2012	12.304	0.559***	11.351	0.061	1.590	0.984***	10.696	1.058***	11.582	0.067	0.942

All the estimations include the observations of the 50 Spanish provinces. The null hypothesis refers to the absence of spatial dependence. z (I), indicates the value of the z statistic. *, ** and *** indicate significance at 10%, 5 and 1% respectively

A) Actual unemployment

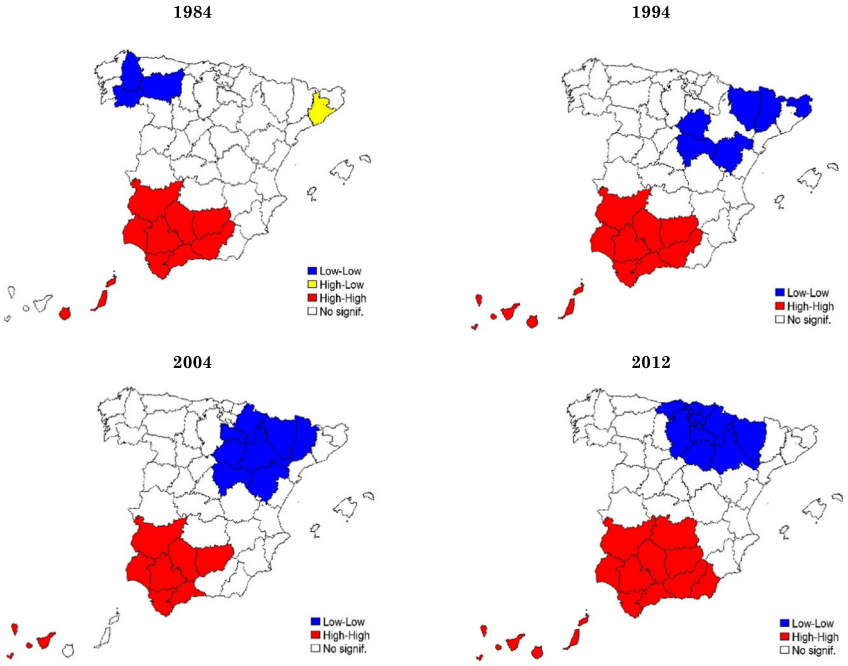


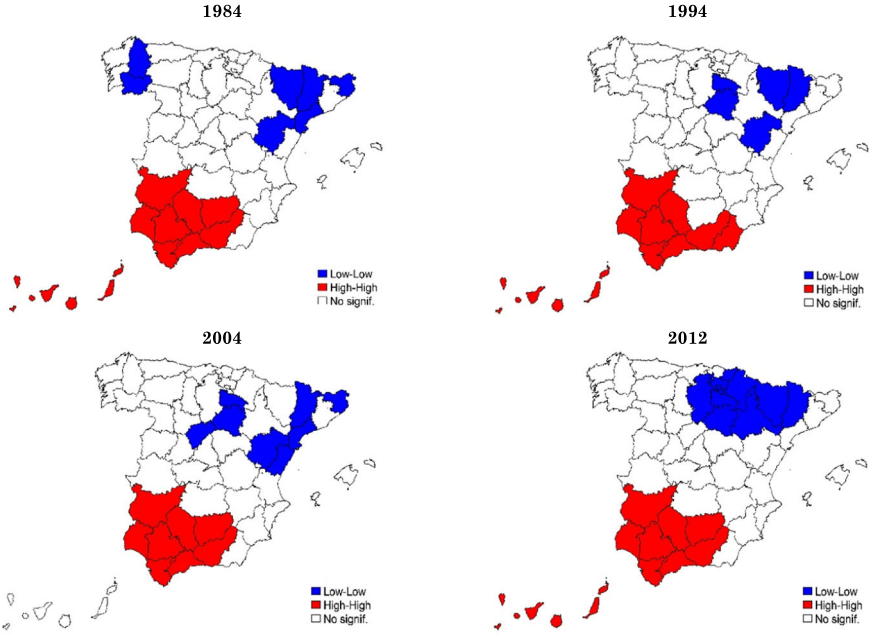
Fig. 4 Local spatial dependence statistics (matrix Knn = 5)

the peninsula, and another of "low" actual unemployment in the north-east of the peninsula. There is also evidence that these patterns are basically explained through the natural component of unemployment, where "spatial persistence" is much more palpable than in the cyclical component.[55]

Section "Factors generating spatial dependence in unemployment" already set out some of the social and economic phenomena which might provide a tentative explanation for the existence of unemployment clusters. Bearing in mind that the spatial dependence of the unemployment rate is the result of the natural rate of unemployment, attention should initially focus on which factors affect its components. One such component is frictional unemployment (U_{it}^{F}) which is accounted for by matters related to the job search theory. Of the aspects reflected in section "Factors generating spatial dependence in unemployment", those more closely linked to intensity and job search are the "Peer Effect" (through the "Social Network Peer Effect" and the Social Cost Peer Effect"), the "Commuting Effect", and the "Migration Effect". The previous factors generate a strong spatial persistence, cause effects to emerge that are maintained in the long run. These effects partly modify individuals' social behaviour by developing a new framework of social relationships that strongly affects the natural unemployment rate in the long run through frictional

[55] Cracolici et al. (2007) define the notion of spatial persistence based on the situation which leads "adjacent provinces to display unemployment rates that are similar over a spatial area and at different periods".

B) Natural unemployment



C) Cyclical unemployment

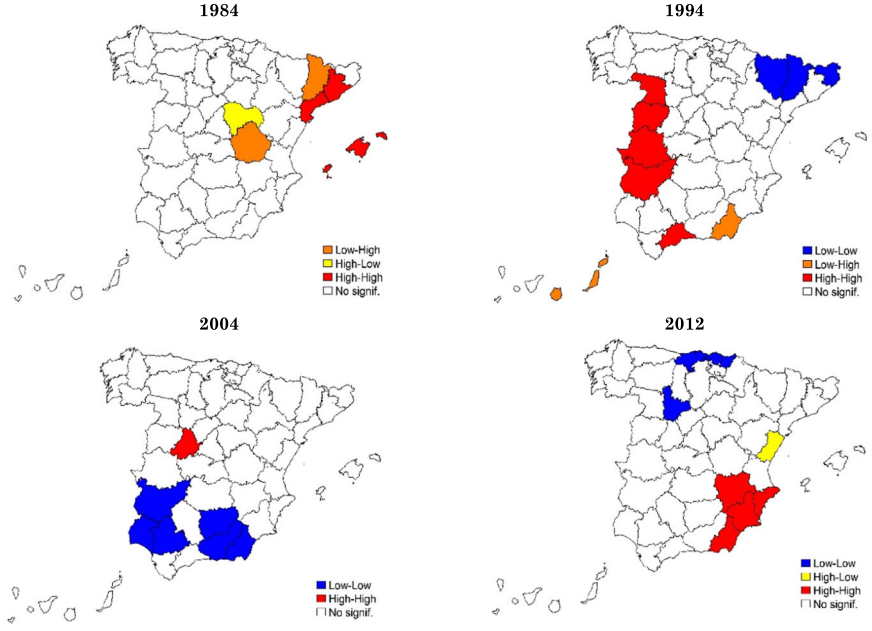


Fig. 4 (continued)

unemployment. The other component is structural unemployment (U_{it}^{ST}), which is partly explained by an area's productive structure. The factor which might be generating spatial dependence in this component of natural unemployment is the "Standard Spillover Effect". This phenomenon leads to neighbouring areas developing a similar productive structure, which, depends on their dynamism, and positively or negatively affects their natural unemployment rates through structural unemployment. As in the previous case, the changes caused by this effect are persistent and remain in the long term. As a result, it is these factors ("Social Network Peer Effect", "Social Cost Peer Effect", "Commuting Effect", "Migration Effect" and " Standard Spillover Effect") which might be causing spatial dependence in the natural rate of unemployment and, therefore, also in the actual unemployment rate. Since they generate persistent effects at both a time and a spatial dimension, the clusters found in the north-east and south of the peninsula could be explained by the actions of these phenomena. As regards the clusters observed in the cyclical component of actual unemployment, their limited temporal persistence might be due to the phenomenon referred to in section "Factors generating spatial dependence in unemployment" as "Fiscal Policy Spillover Effect". It should be taken into account that the fiscal policy of aggregate demand is applied in a given area and at a particular moment. In other words, we can say that the effects are transitory in time, meaning that its effects are mainly felt in the short run. As pointed out before, the effect of a local policy strongly depends on the area in which it is implemented. Not all areas apply fiscal policies at the same time, and not all areas have the same resources to execute such action (they might face different fiscal constraints). Furthermore, the fiscal policies they implement at the provincial level might also have different signs. This is why clusters vary so much in terms of time, sign and place and the spatial dependence found in the cyclical component is weaker in comparison to the spatial dependence we found in the natural component.

Conclusions

At the start of the present work, two specific objectives were posited: to decompose the actual unemployment rate of the 50 Spanish provinces during the period 1984–2012 and to ascertain the existence or otherwise of spatial dependence, both in unemployment rates as well as in their components. With regard to the first objective, and through the use of the stochastic frontier technique, we have been able to divide the actual unemployment rate of the Spanish provinces (NUTS-3) into a natural component, which in turn is the sum of frictional unemployment and structural unemployment (U_{it}^{F} and U_{it}^{ST}), and a cyclical component (U_{it}^{C}).

The results obtained point towards a greater impact of the natural component on actual unemployment and less relevance of the cyclical component. It has also been seen that the period known as the Great Recession seems to have been due, to a greater extent, to the natural component, although the influence

of the cyclical component should not be overlooked. As regards the second objective, the presence of overall positive spatial dependence has been evident both in actual unemployment rates at a provincial scale as well as in the natural component. In the case of the cyclical component, a certain spatial dependence has also been apparent, although it is neither as persistent nor as significant. All of this points to neither actual unemployment nor its components being distributed randomly in the spatial context. The results also point to the creation of two large clusters for actual unemployment and its natural component; one of "low" unemployment in the north-east of the Iberian Peninsula and another of "high" unemployment in the south. Nevertheless, the behaviour of the cyclical component would appear to be more erratic, and there does not seem to be any consistency in the clusters it generates. This process involving the formation of unemployment clusters seems to be due to a number of reasons. On the one hand, the action of the "Peer Effect" (through the "Social Network Peer Effect" and the "Social Cost Peer Effect"), the "Commuting Effect" and the "Migration Effect" might be explaining the spatial dependence through frictional unemployment. On the other hand, the "Spillover Effect" (through the "Standard Spillover Effect") might also trigger spatial patterns through structural unemployment. Finally, the erratic behaviour of the clusters observed in the cyclical component might be accounted for by what we refer to as the "Fiscal Policy Spillover Effect".

The present work seeks to provide a tentative explanation for the spatial patterns found in unemployment (and its components) as well as their temporal persistence. We have been able to pinpoint factors which play a role among individuals in the labour market, already highlighted in previous studies, and which provide social and economic support to the notion of cluster formation. Determining the relative importance of each component of actual unemployment is key to understanding how much manoeuvring room the authorities have when applying aggregate demand or aggregate supply policies and to gauging the possible impact each might have. All of this highlights the need to undertake urgent labour reform (Blanchard et al. 2014). For its part, pinpointing the clusters of the components of actual unemployment and shedding light on which factors drive their creation might help those in charge of economic policy to gain an insight into the dominant dynamics underlying actual unemployment.

A better understanding of the mechanisms which underlie the formation of the actual unemployment rate and the factors which generate spatial patterns is key to achieving the objective of convergence in low levels of unemployment. This will help to eliminate the disparities which exist at a provincial scale between areas of "high" and "low" unemployment and which are basically due to their natural rates of unemployment.

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APPENDIX 1: Tables and Figures

Table 3 Description of variables and data sources

Variable	Definition	Source
Actual unemployment rate in province i in year t (U_{it})	$U_{it} = \frac{UNEM_{it}}{AP_{it}}^{*}100$ $UNEM_{it}$: Total number of those unemployed in province i in period t. AP_{it}: Total active population in province i in period t.	Labour Force Survey (EPA), published by the National Institute of Statistics (INE)
Percentage of employed in the agricultural industry in province i in year t ($Agri_{it}$)	$Agri_{it} = \frac{AGRI_{it}}{TEmp_{it}}^{*}100$ $AGRI_{it}$: Total number of those employed in the agricultural industry in province i in period t. $TEmp_{it}$: Total number of employed in province i in period t.	Valencian Institute of Economic Research (IVIE)
Percentage of employed in the manufacturing industry in province i in year t (Man_{it})	$Man_{it} = \frac{MAN_{it}}{TEmp_{it}}^{*}100$ MAN_{it}: Total number of those employed in the manufacturing industry in province i in period t. $TEmp_{it}$: Total number of employed in province i in period t.	Valencian Institute of Economic Research (IVIE)
Percentage of employed in the service industry in province i in year t ($Serv_{it}$)	$Serv_{it} = \frac{SERV_{it}}{TEmp_{it}}^{*}100$ $SERV_{it}$: Total number of those employed in the service industry in province i in period t. $TEmp_{it}$: Total number of those employed in province i in period t.	Valencian Institute of Economic Research (IVIE)
Percentage of employed in services in the retailing industry in province i in year t (SRI_{it})	$SRI_{it} = \frac{Serv\ Ret\ Ind_{it}}{TEmp_{it}}^{*}100$ $Serv\ Ret\ Ind_{it}$: Total number of those employed in services in the retailing industry in province i in period t. $TEmp_{it}$: Total number of those employed in province i in period t.	Valencian Institute of Economic Research (IVIE)
Percentage of employed in services in the non-retailing industry in province i in year t ($SNRI_{it}$)	$SNRI_{it} = \frac{Serv\ Non\ Ret\ Ind_{it}}{TEmp_{it}}^{*}100$ $Serv\ Non\ Ret\ Ind_{it}$: Total number of those employed in services in the non-retailing industry in province i in period t. $TEmp_{it}$: Total number of those employed in province i in period t.	Valencian Institute of Economic Research (IVIE)

Table 3 (continued)

Variable	Definition	Source
Percentage of employed in the energy industry in province i in year t ($Ener_{it}$)	$Ener_{it} = \frac{ENER_{it}}{TEmp_{it}}^{*} 100$ $ENER_{it}$: Total number of those employed in the energy industry in province i in period t. $TEmp_{it}$: Total number of those employed in province i in period t.	Valencian Institute of Economic Research (IVIE)
Percentage of employed in the construction industry in province i in year t ($Const_{it}$)	$Const_{it} = \frac{CONST_{it}}{TEmp_{it}}^{*} 100$ $CONST_{it}$: Total number of those employed in the construction industry in province i in period t. $TEmp_{it}$: Total number of those employed in province i in period t.	Valencian Institute of Economic Research (IVIE)
Female participation rate in province i in year t (FPR_{it})	$FPR_{it} = \frac{AFP_{it}}{FPOP\ 16{-}65_{it}}^{*} 100$ AFP_{it}: Total active female population in province i in period t. $FPOP\ 16-65_{it}$: Female population of working age in province i in period t.	Labour Force Survey (EPA), published by the National Institute of Statistics (INE)
Percentage of youth population in province i in year t ($PYPP_{it}$)	$PYPP_{it} = \frac{YOUNG_{it}}{POP_{it}}^{*} 100$ $YOUNG_{it}$: Total population of 15 to 24 year-olds in province i in period t. POP_{it}: Total population in province i in period t.	Labour Force Survey (EPA), published by the National Institute of Statistics (INE)
Percentage of active population with secondary education in province i in year t (SE_{it})	$SE_{it} = \frac{SEC_{it}}{POP\ 16{-}65_{it}}^{*} 100$ SEC_{it}: Total number of active workers with secondary education in province i in period t. $POP\ 16-65_{it}$: Population of working age in province i in period t.	Valencian Institute of Economic Research (IVIE)
Percentage of active population with tertiary education in province i in year t (TE_{it})	$TE_{it} = \frac{TERT_{it}}{POP\ 16{-}65_{it}}^{*} 100$ $TERT_{it}$: Total number of active workers with tertiary education in province i in period t. $POP\ 16-65_{it}$: Population of working age in province i in period t.	Valencian Institute of Economic Research (IVIE)
Share of net capital stock (in real terms) out of the total number of employed in province i in year t (RKS_{it})	$RKS_{it} = \frac{NKS_{it}}{TEmp_{it}}$ NKS_{it}: Net capital stock (in real terms) in province i in period t (base year: 2010). $TEmp_{it}$: Total number of those employed in province i in period t.	Valencian Institute of Economic Research (IVIE)

Table 3 (continued)

Variable	Definition	Source
Percentage of temporary employment over the total number of employed in autonomous community i in year t ($Temp_{it}$)	$Temp_{it} = \frac{Fixed\ Term\ Emp_{it}}{TEmp_{jt}}^{*} 100$ $Fixed\ Term\ Emp_{it}$: Total number of those employed who have a fixed term contract in autonomous community i in period t. $TEmp_{jt}$: Total number of those employed in autonomous community j in period t.	Survey of Labour Situation (ECL), published by the Ministry of Labour and Social Security.

Source: Authors' own

Table 4 Mean value and deviation of the variables used in the estimation

	U	Agri	Man	Serv	SRI	SNRI	Ener	FPR	PYPP	SE	TE	RKS	Temp
Alava	13.40	4.41	34.93	53.49	38.38	15.11	0.37	43.71	13.94	54.60	18.47	164.69	28.02
	4.72	2.55	4.56	6.49	5.28	1.89	0.19	8.19	3.30	10.85	5.88	6.14	4.98
Albacete	18.11	13.19	19.31	56.16	38.84	17.31	0.66	37.91	15.04	49.60	13.71	122.58	38.88
	6.84	6.74	3.06	7.82	4.43	3.79	0.31	8.49	2.21	13.27	5.45	28.94	6.35
Alicante	18.00	6.10	23.89	59.33	48.63	10.69	0.46	43.14	14.58	52.57	12.43	166.50	34.13
	5.54	2.75	5.46	6.82	5.33	1.97	0.18	5.00	2.69	13.90	4.84	14.98	5.97
Almeria	18.86	25.03	6.09	56.64	43.95	12.69	0.63	41.16	15.96	42.79	12.58	128.66	41.17
	6.78	7.11	1.40	6.48	5.97	1.84	0.25	10.74	2.23	13.02	2.87	18.64	5.97
Asturias	15.99	11.36	16.37	58.11	44.19	13.92	4.36	35.93	12.63	51.03	16.76	146.43	31.66
	4.59	6.31	2.22	9.55	7.16	2.72	2.21	5.37	2.72	12.62	5.73	25.97	4.24
Avila	14.67	18.85	11.68	54.46	37.53	16.92	0.46	31.60	12.62	49.19	13.70	165.80	31.23
	5.18	8.44	2.18	6.47	5.10	2.07	0.27	7.33	2.00	15.66	3.72	33.51	4.25
Badajoz	26.34	17.33	10.18	59.82	39.69	20.13	0.64	34.08	14.97	49.55	13.26	129.11	40.47
	6.88	5.75	1.05	5.71	2.66	3.44	0.28	8.25	1.79	16.71	4.41	25.29	4.68
Balearic Islands	12.31	3.54	11.55	71.10	59.97	11.12	1.08	46.17	14.15	55.78	12.13	169.95	35.21
	4.70	2.49	4.14	6.26	5.32	1.29	0.40	8.88	2.34	14.49	3.47	19.60	5.40
Barcelona	15.98	1.19	30.16	59.81	50.19	9.62	0.77	45.34	13.90	53.43	17.30	156.18	27.87
	6.08	0.31	7.01	6.78	6.28	0.89	0.21	8.02	2.93	8.06	5.15	17.40	4.43
Biscay	17.44	2.31	24.42	63.69	50.32	13.37	0.94	40.53	13.47	52.76	22.93	150.74	28.02
	6.15	1.30	5.20	5.95	5.14	1.39	0.26	7.01	3.41	7.49	6.26	17.20	4.98
Burgos	12.88	11.04	25.91	53.21	39.79	13.41	0.67	37.92	13.10	52.16	16.19	156.59	31.23
	3.80	5.65	2.07	5.53	4.74	1.60	0.24	8.24	2.50	10.95	5.19	21.56	4.25
Caceres	19.95	18.65	8.96	56.93	37.26	19.67	1.24	34.49	14.09	46.00	13.99	178.19	40.47

Table 4 (continued)

	U	Agri	Man	Serv	SRI	SNRI	Ener	FPR	PYPP	SE	TE	RKS	Temp
	5.12	9.10	1.03	7.76	3.63	4.40	0.48	6.41	2.02	18.13	5.10	16.79	4.68
Cadiz	30.52	9.05	12.66	65.76	45.81	19.94	1.36	35.38	16.48	45.99	12.71	137.00	41.17
	7.52	4.05	3.41	7.04	5.51	2.62	0.35	8.83	2.79	13.18	4.14	14.95	5.97
Cantabria	15.17	10.48	20.02	58.04	43.83	14.21	0.84	37.61	13.55	55.24	16.16	155.00	32.09
	5.08	6.28	2.88	8.03	6.59	1.74	0.20	7.25	2.71	12.46	4.71	18.86	5.15
Castellon	12.06	10.68	26.37	52.24	41.79	10.45	0.67	41.85	13.96	55.21	12.33	167.87	34.13
	6.00	5.94	3.57	6.77	5.79	1.33	0.21	7.59	2.22	18.47	3.72	20.16	5.97
Ciudad Real	16.49	13.21	15.16	54.56	38.25	16.31	1.68	31.68	14.61	48.19	12.71	151.92	38.88
	5.28	5.43	1.72	6.16	3.42	3.04	0.55	7.88	1.71	12.94	3.86	36.37	6.35
Cordoba	26.33	15.69	15.02	58.29	42.12	16.17	1.14	35.34	15.18	46.14	13.28	132.18	41.17
	6.05	4.59	2.08	5.90	3.80	2.52	0.53	8.83	2.07	14.07	4.13	23.62	5.97
Corunna	14.28	17.40	15.27	55.73	41.89	13.84	1.18	40.74	13.45	46.63	15.44	123.80	35.53
	3.36	10.16	1.73	8.82	6.10	2.95	0.26	5.50	2.81	16.15	6.72	27.90	6.18
Cuenca	12.70	25.90	12.51	48.45	33.68	14.76	0.58	28.94	13.17	46.16	11.79	150.50	38.88
	4.20	10.46	1.73	8.11	4.87	3.67	0.33	7.43	1.82	13.16	3.31	38.69	6.35
Girona	10.79	6.19	23.63	57.55	47.57	9.98	0.49	49.72	13.56	56.02	13.06	179.41	27.87
	4.66	2.73	4.25	6.10	4.94	1.54	0.16	6.39	2.21	13.53	4.13	13.85	4.43
Granada	24.93	13.43	9.60	64.77	46.00	18.77	0.57	35.30	15.61	44.78	17.20	138.25	41.17
	6.70	4.79	1.45	6.02	4.75	1.86	0.20	8.48	2.47	12.21	4.88	19.34	5.97
Guadalajara	13.21	8.78	18.56	58.46	40.64	17.81	1.60	36.02	13.15	45.24	17.51	207.22	38.88
	4.35	4.52	4.03	9.02	8.03	2.40	0.45	11.42	1.96	13.52	4.39	22.59	6.35
Guipuzcoa	13.84	2.68	32.69	56.95	45.68	11.26	0.41	42.21	13.51	53.09	19.80	150.58	28.02
	6.44	1.49	5.36	6.53	5.48	1.39	0.16	7.17	3.53	9.59	7.25	26.32	4.98
Huelva	25.81	17.31	13.10	56.21	40.11	16.09	1.60	35.65	15.57	48.93	11.60	166.77	41.17

Table 4 (continued)

	U	Agri	Man	Serv	SRI	SNRI	Ener	FPR	PYPP	SE	TE	RKS	Temp
	6.74	2.81	4.34	6.30	4.72	2.67	0.44	9.29	2.29	16.01	3.88	18.10	5.97
Huesca	9.06	17.49	17.00	53.21	38.16	15.05	1.11	36.68	12.14	51.16	16.20	209.08	30.10
	3.26	6.23	1.95	7.17	5.71	2.47	0.55	9.01	1.82	13.19	4.36	27.93	4.17
Jaen	24.09	18.67	16.34	53.96	37.29	16.66	0.52	32.27	15.36	46.94	12.34	120.02	41.17
	6.24	6.19	3.45	7.77	4.87	3.14	0.19	7.90	1.90	13.67	4.11	23.05	5.97
Leon	14.61	15.99	11.78	56.18	41.91	14.26	5.76	36.67	12.81	51.03	15.93	164.53	31.23
	3.95	9.90	1.56	10.36	7.17	3.35	2.78	4.26	2.37	12.62	4.34	35.86	4.25
Lleida	7.28	15.80	15.86	55.36	41.93	13.42	0.75	40.77	12.97	48.17	14.73	161.12	27.87
	3.49	6.10	1.93	6.18	3.92	2.74	0.42	8.46	1.99	13.23	3.79	20.75	4.43
Lugo	10.24	37.87	10.49	42.90	31.37	11.53	0.48	45.04	11.60	45.72	10.93	110.28	35.53
	3.19	14.45	1.84	11.62	7.92	3.85	0.20	3.19	1.75	17.90	4.72	40.71	6.18
Madrid	13.85	0.96	15.94	73.58	56.73	16.84	1.00	43.61	14.70	50.13	25.23	166.41	27.37
	5.05	0.24	4.97	4.96	6.30	1.96	0.19	10.39	3.09	5.49	6.94	13.47	3.24
Malaga	25.25	6.44	8.99	71.19	56.92	14.27	0.44	39.40	15.34	48.23	13.22	158.19	41.17
	8.04	2.91	2.64	5.80	5.05	2.02	0.17	7.16	2.73	12.81	3.91	15.68	5.97
Murcia	17.30	13.96	17.60	56.95	43.19	13.75	0.78	40.23	15.86	49.47	13.89	145.05	37.46
	5.83	2.99	3.54	5.08	3.94	1.64	0.29	7.70	2.63	11.76	4.39	17.93	5.93
Navarre	10.83	7.38	29.42	53.58	40.03	13.55	0.61	40.98	13.59	52.31	20.18	168.98	30.36
	4.30	3.09	3.29	5.26	4.75	0.92	0.15	8.80	2.69	9.69	5.68	24.89	3.13
Ourense	12.08	25.53	14.79	48.32	34.52	13.79	0.56	42.36	11.73	42.62	12.89	121.97	35.53
	4.51	17.78	3.35	13.93	9.44	4.70	0.26	3.09	1.99	17.45	5.76	45.21	6.18
Palencia	14.91	13.83	18.87	55.48	38.73	16.74	2.32	34.06	13.00	45.06	16.04	164.59	31.23
	5.05	4.30	1.72	5.75	3.88	2.63	0.89	7.64	2.15	11.14	4.19	33.49	4.25
Palmas (Las)	20.93	6.11	7.32	74.93	58.92	16.01	0.97	43.46	16.47	51.21	13.02	140.40	39.82

Table 4 (continued)

	U	Agri	Man	Serv	SRI	SNRI	Ener	FPR	PYPP	SE	TE	RKS	Temp
	7.33	3.24	2.66	6.18	5.31	1.71	0.25	8.18	3.53	13.81	2.70	15.15	5.32
Pontevedra	16.37	18.13	20.19	51.20	40.10	11.10	0.33	44.05	14.59	51.25	12.53	114.62	35.53
	4.13	10.46	1.48	9.57	7.35	2.32	0.11	3.40	3.00	16.58	4.96	25.93	6.18
Rioja (La)	11.39	10.45	29.64	50.33	37.06	13.27	0.34	37.62	13.29	48.39	17.02	154.72	27.99
	4.36	4.21	3.20	5.81	5.46	1.22	0.21	9.30	2.20	13.21	4.73	20.42	4.13
Salamanca	18.26	13.60	11.32	62.75	42.72	20.02	0.95	35.75	13.39	42.41	20.88	157.28	31.23
	5.15	6.87	1.94	7.38	4.25	3.78	0.32	7.72	2.57	11.58	7.64	27.57	4.25
Saragossa	12.69	6.93	25.15	59.36	44.91	14.45	0.56	40.01	13.22	50.25	19.12	137.41	30.10
	5.15	3.31	3.32	5.44	4.17	1.51	0.18	8.19	2.46	9.59	6.09	20.24	4.17
S C Tenerife	19.83	7.83	6.45	72.43	55.63	16.79	1.04	42.37	15.60	47.98	14.86	164.04	39.82
	6.11	4.03	1.05	5.37	4.39	1.73	0.38	7.82	3.17	11.28	3.93	25.39	5.32
Segovia	11.36	16.94	15.39	56.19	39.25	16.94	0.44	38.48	13.25	47.21	17.50	155.70	31.23
	3.22	7.24	2.07	7.05	5.64	2.88	0.25	6.66	2.31	11.67	4.67	31.99	4.25
Seville	26.04	9.30	13.21	67.18	49.68	17.50	0.74	37.91	15.97	49.93	16.27	130.57	41.17
	6.89	3.99	2.57	6.23	4.90	1.75	0.21	8.98	2.83	13.26	5.41	17.77	5.97
Soria	8.64	17.59	21.21	50.94	32.26	18.68	0.73	36.23	11.91	49.02	17.47	161.08	31.23
	2.90	6.88	2.24	4.54	3.14	2.02	0.42	9.04	1.89	16.15	4.08	19.60	4.25
Tarragona	12.75	9.62	18.32	56.72	45.50	11.21	1.86	43.46	13.83	52.89	12.69	203.17	27.87
	4.45	4.55	1.70	5.97	4.40	2.02	0.71	8.39	2.35	11.28	3.59	13.00	4.43
Teruel	9.29	18.26	18.26	47.48	30.61	16.87	4.62	32.77	11.87	47.88	14.43	198.24	30.10
	3.65	6.65	2.03	6.66	4.33	2.90	2.48	9.42	1.29	14.89	3.42	33.38	4.17
Toledo	13.85	11.68	23.82	49.41	35.47	13.93	0.45	35.01	14.14	49.02	10.93	143.32	38.88
	5.10	6.81	3.82	9.07	6.35	2.87	0.21	10.06	1.79	15.27	4.23	27.75	6.35
Valencia	17.14	6.14	23.18	60.30	48.23	12.07	0.55	41.29	14.41	53.23	16.49	148.74	34.13

Table 4 (continued)

	U	Agri	Man	Serv	SRI	SNRI	Ener	FPR	PYPP	SE	TE	RKS	Temp
	5.76	3.31	4.62	6.49	6.08	1.12	0.12	8.58	2.73	12.12	5.02	16.13	5.97
Valladolid	18.18	6.75	22.17	60.19	44.26	15.92	0.57	39.47	14.26	51.01	19.46	145.61	31.23
	5.86	3.29	4.39	7.17	5.46	2.29	0.24	8.66	3.35	11.13	6.48	26.94	4.25
Zamora	16.28	25.17	10.12	51.96	35.74	16.21	0.66	28.99	12.07	37.12	13.83	162.02	31.23
	4.51	9.56	2.10	6.80	4.54	2.84	0.32	5.54	1.91	9.01	3.97	40.00	4.25
Total	**16.25**	**12.84**	**17.62**	**57.64**	**42.74**	**14.89**	**1.07**	**38.63**	**13.95**	**49.21**	**15.30**	**154.06**	**34.36**
	7.48	**9.69**	**7.65**	**9.84**	**8.66**	**3.69**	**1.26**	**8.99**	**2.74**	**13.60**	**5.69**	**33.21**	**7.03**

The first value refers to the mean value and the second value to the standard deviation

Source: Authors' own. Information provided by the INE, IVIE and the ECL

Fig. 5 Natural unemployment (U_{it}^{NR}) by province (1984–2012). Source: Authors' own

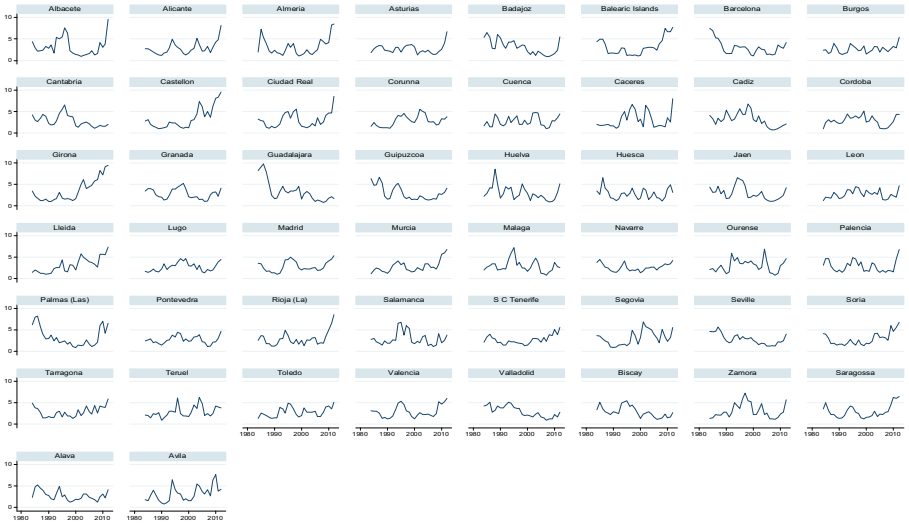


Fig. 6 Cyclical unemployment (U_{it}^{C}) by province (1984–2012). Source: Authors' own

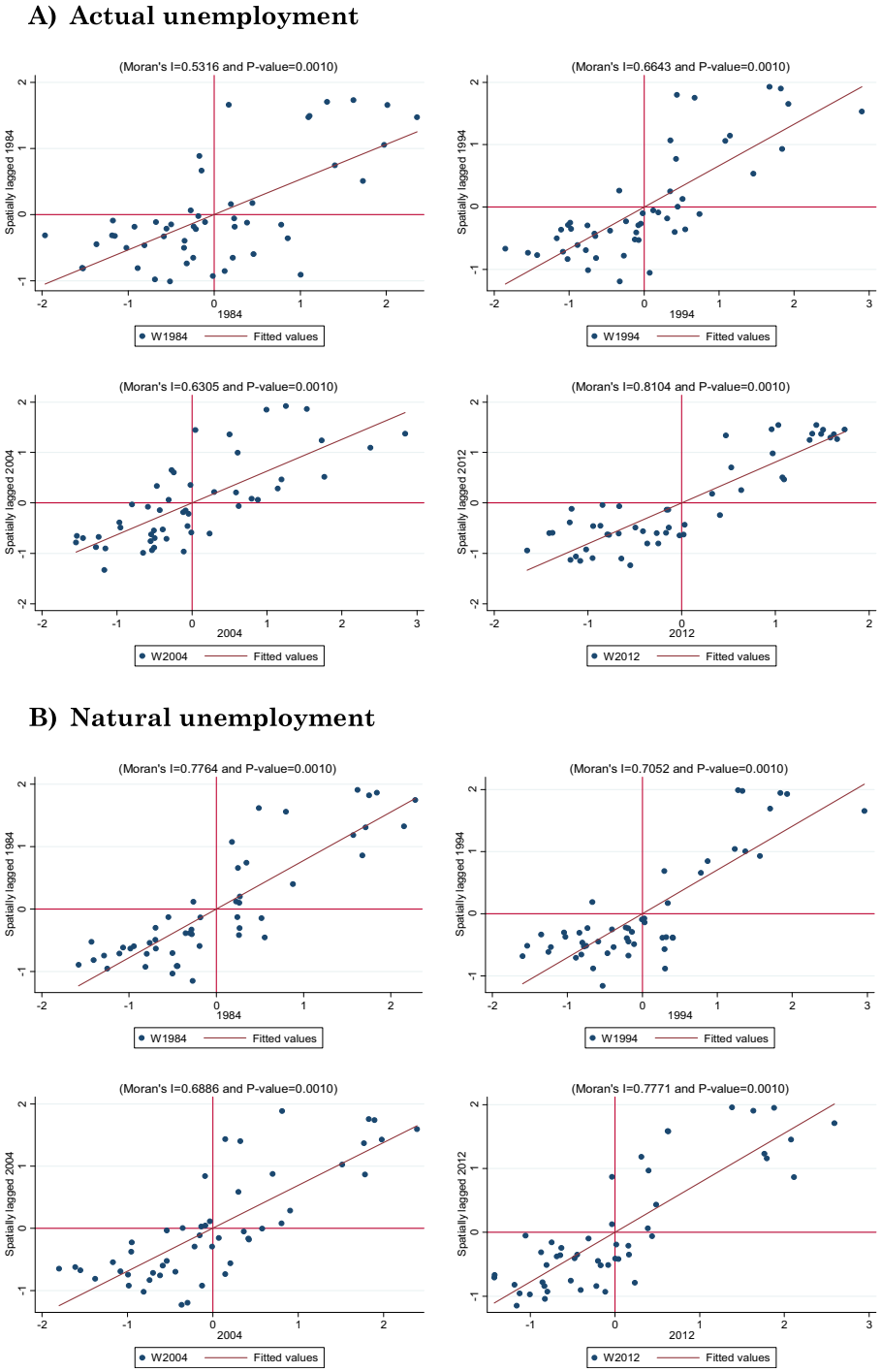


Fig. 7 Global scatterplot diagrams of Moran's I (Knn = 5). Source: Author's own

C) Cyclical unemployment

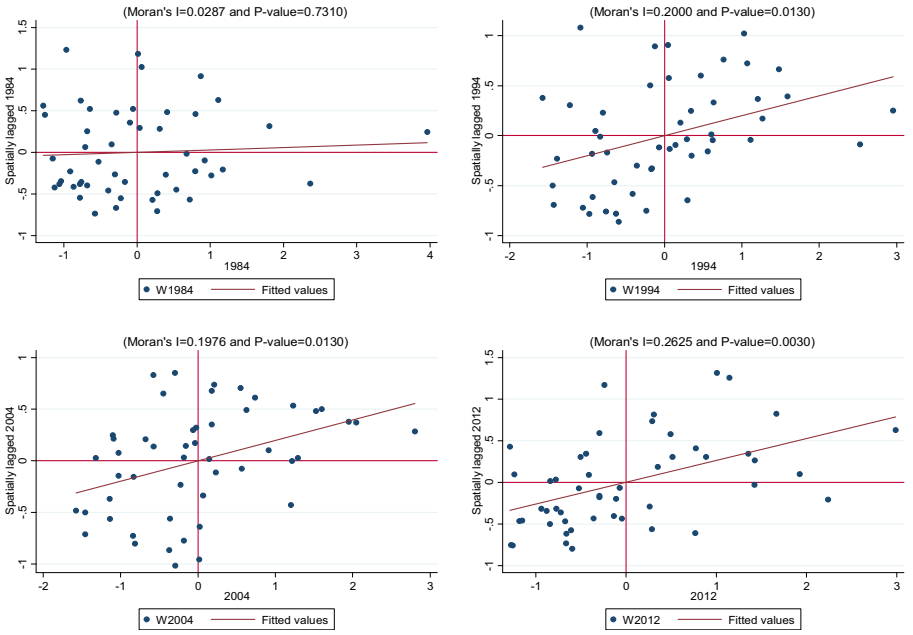


Fig. 7 (continued)

A) Actual unemployment

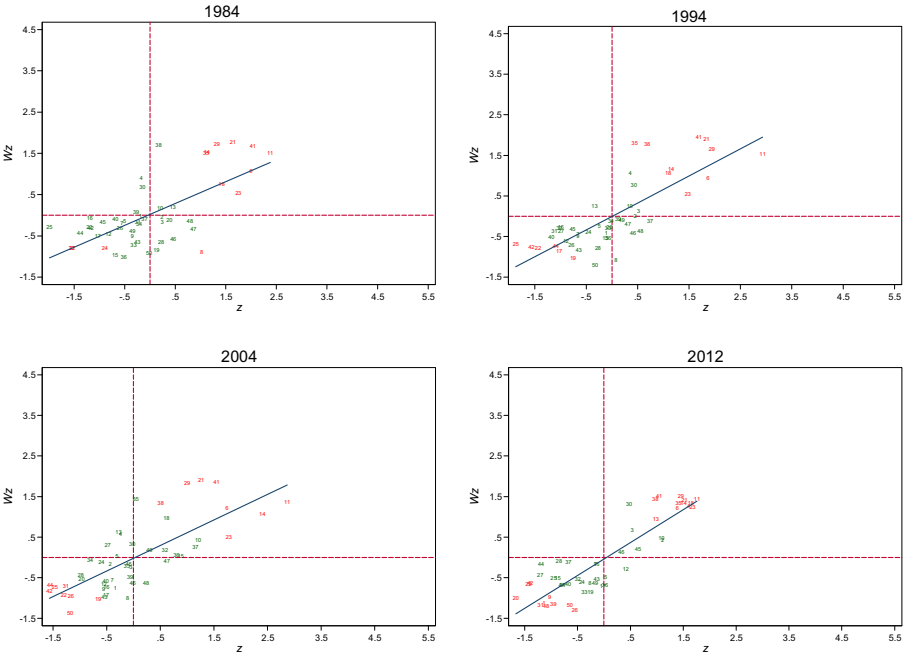
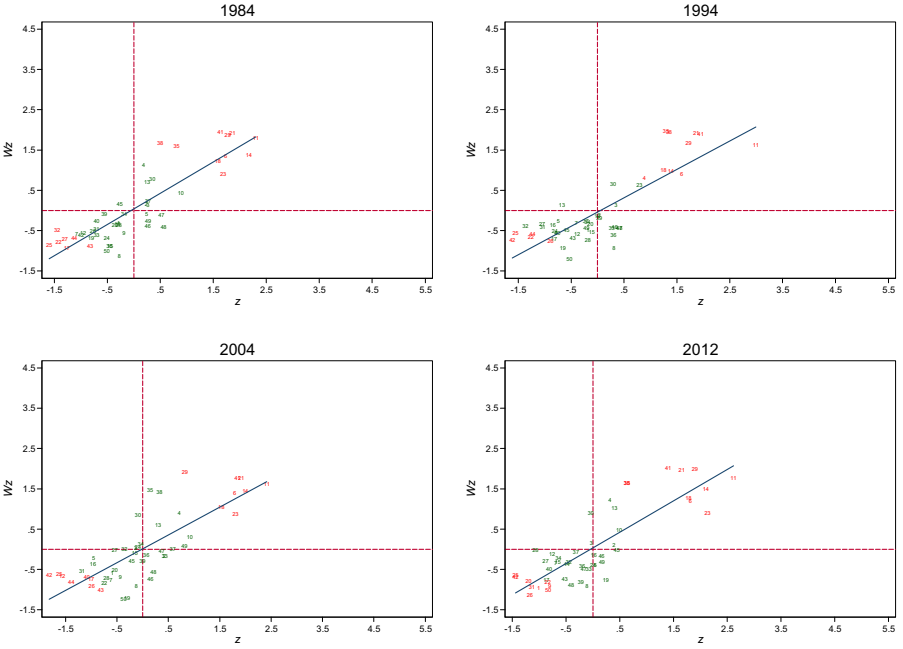


Fig. 8 Local scatterplot diagrams of Moran's ii (Knn = 5). Source: Authors' own

B) Natural unemployment



C) Cyclical unemployment

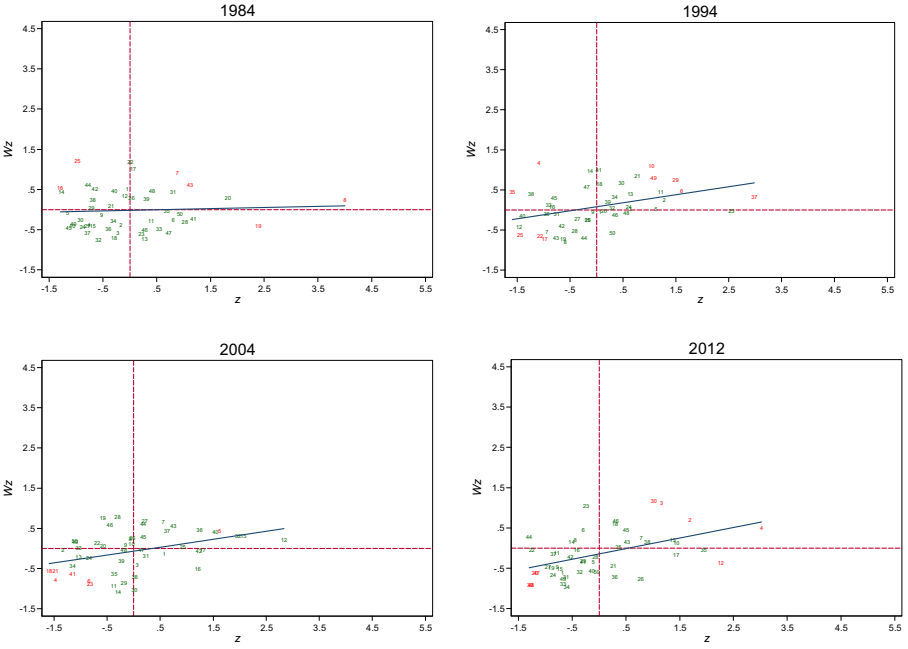


Fig. 8 (continued)

APPENDIX 2: Elements of actual unemployment

Figure 9 illustrates the different components of the actual unemployment rate. The curve L_{it}^{S} is the labour force and displays a positive slope. This is because, as the market wage increases (w_{it}), more individuals join the labour market given that their "static" reservation wage (or that of the choice model between consumption and leisure) is lower than the market wage.

The curve N_{it}^{S} shows the actual labour supply. The difference between L_{it}^{S} and N_{it}^{S} establishes that not all active workers are immediately available for work. As the market wage increases and rises above the "dynamic" reservation wage (or that of the job search theory), more workers will accept the jobs they find. For this reason, the distance between L_{it}^{S} and N_{it}^{S} is lower for higher wages. This difference between the two previously mentioned curves is frictional unemployment (U_{it}^{F}).

Figure 9 also shows two situations of the demand for employment, depending on how aggregate production stands. Situation (y_0) represents economic expansion, whereas situation (y_1) reflects an economic recession. Point "A" shows how, in a situation in which production is booming and the market wage is at its equilibrium level, with a $L_{i,t}^{D}(y_0)$ demand of work, there are unemployed workers due to the presence of frictional unemployment.

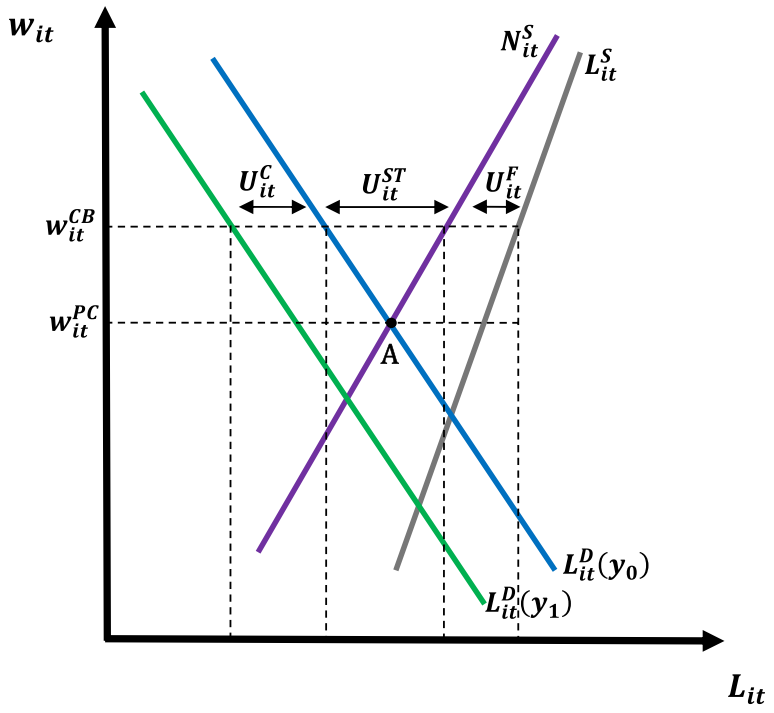


Fig. 9 Frictional, structural and cyclical unemployment. Source: Authors' own

In addition, the existence of a collective bargaining system impacts on the mechanism for establishing wages by fixing a "collective bargaining" (w_{it}^{CB}) wage which is above the competitive equilibrium wage (w_{it}^{PC}). This is one example of institutional inflexibility which leads to an excess of labour supply, and triggers structural unemployment (U_{it}^{ST}).[56] As in the previous case, some structural unemployment would also exist even if demand for work were $L_{i,t}^{D}(y_0)$, which is associated to an economic boom. Several studies (Bentolila and Jimeno 2003; Simón et al. 2006; Bande et al. 2008) point out that the "inflexibility" of wages prevents these from acting as an equilibrium mechanism in the Spanish labour market.[57] In line with this, "via price" adjustment does not function "correctly", thus leading to adjustments in the labour market occurring "via quantity.[58]

Finally, in Fig. 9, cyclical unemployment is reflected in the horizontal distance between curves $L_{it}^{D}(y_0)$ and $L_{it}^{D}(y_1)$. This kind of unemployment may be corrected in the short term by applying expansive aggregate demand policies.

APPENDIX 3: Model with spatial lags

This additional specification seeks to correct spatial dependence in the estimation. To do this, we incorporate the spatial lag of the dependent and independent variables into the baseline model. In this case, we perform a specification based on the idea of the Spatial Durbin Model (SDM)[59] as shown in the following expression:

$U_{it} = \beta_0 + \rho WU_{it} + \beta_1 X_{it} + \beta_2 Y_{it} + \beta_3 Z_{it} + \delta D2001 + \gamma_1 WX_{it} + \gamma_2 WY_{it} + \gamma_3 WZ_{it} + \nu_{it} + \mu_i$ where W is the spatial weight matrix (Knn = 5); WU_{it} is the spatial lag of the dependent variable; WX_{it} captures the effect of the industry composition of labour in neighbouring provinces; WY_{it} are the spatial interactions of the demographic variables and WZ_{it} is a vector of spatial lags for the human capital of the active population. We compute this new specification so as to test whether spatial dependence in our model is a consequence of endogenous or exogenous interaction effects.

The results of the estimated model are presented in table 5. The spatial lag of the dependent variable shows a positive and statistically significant coefficient as well as the majority of the spatial lags of the independent variables. This implies that the values of the dependent and independent variables in the neighbouring provinces capture part of the variability in the unemployment rate.[60] In a second step, we carried out the same spatial dependence analysis as in the baseline model within the main text, with results still pointing to the presence of positive spatial correlation. It can therefore be

[56] Elhorst (2003) cites some works which have explored the effect of collective bargaining on unemployment. Most report a positive effect, which would seem to confirm the previously posited hypothesis.

[57] For a more comprehensive explanation of the issue, see Jimeno and Bentolila (Jimeno and Bentolila 1998), García-Mainar and Montuenga-Gómez (García-Mainar and Montuenga 2003), Maza and Moral-Arce (2006), Maza and Villaverde (2009) or Bande et al. (2012).

[58] Cazes et al. (2013) show how in Spain, during the Great Recession, labour market adjustment mainly occurred through the external margin of adjustment (layoffs and downsizing) in the labour market.

[59] See Elhorst (2014) for a more complete explanation about the Spatial Durbin Model.

[60] The estimations of the natural component and the cyclical component are similar to the results shown in Figs. 5 and 6 of Appendix 1. Detailed results are available upon request from the authors.

concluded that spatial dependence also seems to be caused by factors different from those variables considered in this paper.

Table 5 Spatial lags model

C	−72.921*** (−7.46)
Agri	−0.055 (−1.11)
Man	0.141** (2.56)
Serv	0.403*** (8.11)
Ener	0.341*** (3.03)
FPR	0.168*** (6.77)
PYPP	0.471*** (4.25)
SE	−0.073*** (−3.97)
TE	−0.543*** (−10.86)
WU_{it}	0.128*** (17.14)
$WAgri_{it}$	0.109*** (6.24)
$WMan_{it}$	0.088*** (3.92)
$WServ_{it}$	0.084*** (4.31)
$WEner_{it}$	0.143*** (2.57)
$WFPR_{it}$	−0.021** (−2.20)
$WPYPP_{it}$	0.080** (2.14)
$WUSE_{it}$	0.004 (0.80)
WTE_{it}	0.100*** (5.80)
PFE/TFE	YES/NO
Cost Frontier	0.000*** (22.07)
N°. of obs	1450

The dependent variable is the actual unemployment rate in each province. "Cost Frontier" refers to the test of maximum likelihood for determining whether a cost frontier exists or not *, ** and *** indicate significance at 10%, 5 and 1%, respectively In brackets, the value corresponding to the "z" statistic. The results associated to fixed effects are not shown. Source: Authors' own

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CAPÍTULO 3

Labor supply and the business cycle: The "Bandwagon Worker Effect"

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FULL ARTICLE

Labor supply and the business cycle: The "bandwagon worker effect"

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Abstract

The relationship between labour force participation and the business cycle is a common topic in economic literature. However, few studies have examined if the cyclical sensitivity of labour force participation is influenced by social effects. In this paper, we construct a theoretical model defining a relatively new hypothesis, the bandwagon worker effect (BWE). We use spatial econometrics techniques to test the existence of the BWE in the local labour markets in Spain. Our results reveal a positive spatial dependence in the cyclical sensitivity of labour force participation that decreases as we fix a laxer neighbourhood criterion, which verifies the existence of the BWE.

KEYWORDS
bandwagon effect, business cycle, labour force participation, regional labour markets, spatial dependence

JEL CLASSIFICATION
C23; D03; E32; J21; R23

1 | INTRODUCTION

The aim of this paper is to analyse how the relationship between the business cycle and labour force participation (LFP) may be influenced by social effects.[1] The so-called bandwagon effect (BE) is now a useful element to better

[1]By social effects in this paper we mean the social influence over an individual's behaviourbehaviour of the perceived average behaviourbehaviour of his/her peers. Manski (1993, 2000) and Dietz's (2002) name them social interactions or neighborhood effects and account for the different types of social effects (i.e. endogenous effects or peer effects, correlated effects and exogenous effects). Martín-Román, Moral de Blas, and Martínez-Matute (2015) delve into that issue from a spatial analysis perspective.

understand the demand for goods and services (Leibenstein, 1950). Because the labour supply is, ultimately, demand for leisure, we deem that the BE might also operate in the labour market. Notably, some studies have already explored this possibility (Blomquist, 1993; Grodner & Kniesner, 2006, 2008; Vendrik, 1998). Additionally, papers have investigated the influence of social influence over individuals' decisions to participate in the labour market (e.g., Clark & Summers, 1982; Kapteyn & Woittiez, 1987; Romme, 1990; Vendrik, 1998; Neumark & Postlewaite, 1998). Or more closely related to this research, because they have explicitly adopted a spatial approach, we refer to Fogli and Veldkamp (2011) and Halleck-Vega and Elhorst (2017).[2]

However, no one has studied the effect of that social influence on the cyclical sensitivity of the aggregate labour supply. Our research links this social effect to the cyclical properties of LFP and coins a relatively new hypothesis, the bandwagon worker effect (BWE). The relationship between the business cycle and LFP has produced much academic work. This body of research has produced two key concepts: added worker effect (AWE) and discouraged worker effect (DWE). Here, we develop a theoretical framework in which the BWE interacts with the AWE and DWE to better understand cyclical movements in the labour supply. In a second step, we test empirically whether the BWE is a significant factor when considered together with the AWE and the DWE. According to our review of the literature, we are the first to present and discuss this hypothesis.[3] This is the value added of the paper.

The critical assumption of this research is that an individual's labour supply decisions are conditioned to a certain extent by his/her neighbours' decisions regarding their labour market activity. To formalize that idea, in our conceptual framework, individuals emulate to some degree their neighbours' behaviour with regard to their labour supply decisions. The aforementioned social effect may also be interpreted by an aggregation process, as a positive spatial correlation among the spatial units considered. Thus, the previous discussion implies that the participation rate (PR) of a spatial unit surrounded by high-level PR spatial units would higher than otherwise and vice versa. This positive spatial correlation between the levels of labour PRs can be translated into a positive spatial correlation between the cyclical sensitivity of those PRs. Hence, we assume that a geographical neighbourhood is a tool to capture the degree and the intensity of the social effects, as will be explained in greater detail later.[4] We assume global spatial correlation for four reasons. First, from a conceptual point of view, we posit that the social phenomenon analysed should cause feedback effects because of its nature. Second, the literature on this topic indicates the same direction (Fogli & Veldkamp, 2011). Third, our theoretical setting also assumes a global spatial dependence. Finally, econometric reasons, discussed later, support this view.

We use Spanish data because the amplitude of the Spanish business cycle is larger than that of most of the developed countries. Furthermore, it is possible to find a sufficiently long time series and with an appropriate spatial disaggregation to conduct feasible a study such as this.[5] In addition, Spain is made up of 50 provinces (NUTS 3 regions),[6] which allows us to apply spatial econometric techniques with a high degree of reliability and accuracy.

The results obtained show a positive, significant global spatial dependence in the cyclical sensitivity of the LFP in the Spanish provinces. According to our theoretical approach, this finding proves that the BWE is a key phenomenon to help understand the overall functioning of the aggregate labour market. Moreover, we find that as the neighbourhood definition becomes laxer, the strength of the social effect diminishes. This outcome is consistent with the theoretical framework developed here.

[2]There are a number of papers analyzing some spatial aspects of the aggregate labor markets, published recently (e.g., Cracolici, Cuffaro, & Nijkamp, 2007; Halleck-Vega & Elhorst, 2014, 2016; Overman & Puga, 2002), that are somehow related to this research too.

[3]Fogli and Veldkamp (2011) do build a theoretical model to account for social effects on female LFP from a geographical perspective and test that hypothesis by using spatial econometrics techniques, as we do in this research. Nevertheless, neither the theoretical setting nor the empirical strategy is the same as ours. Moreover, the aim of their investigation differs from ours.

[4]See, for instance, Martín-Román, Moral de Blas & Martínez-Matute (2015).

[5]In this vein, Ball, Leigh, and Loungani (2017), Bande and Martín-Román (2018), and Porras-Arena and Martín-Román (2019) have provided empirical evidence of the large size of the Spanish business cycle, particularly with regard to the labour market outcomes.

[6]The 50 Spanish provinces correspond to the third level (NUTS 3) of the Nomenclature of Territorial Units for statistics, see: http://ec.europa.eu/eurostat/web/nuts/overview.

The remainder of the work is organized as follows. Section 2 offers a review of the literature related to the topic. Section 3 develops the theoretical model. Section 4 presents the methodology used to study the relationship between the labour PRs and the business cycle and to test the BWE. Section 5 describes and explains the results obtained in the cyclical sensitivity analysis and in the spatial dependence analysis. Section 6 includes extensions to the empirical analysis and sensitivity checks. Section 7 offers economic policy implications. Finally, Section 8 sums up the most relevant conclusions.

2 | LITERATURE REVIEW

Based on the discussion in Section 1, several strands of literature are relevant to our inquiry. First, the research on the LFP pattern over the business cycle constitutes the conceptual basis on which we build our approach. Spatial analysis is also at the core of this research because our theoretical framework predicts a spatial relationship that affects the LFP reaction to the business cycle and because such a relationship is then tested by means of spatial econometrics' techniques. Thus, the literature that has analysed spatial labour markets' functioning is also of interest. The last strand of literature has examined the influence of social effects on labour market outcomes, and we pay particular attention to research that has used spatial analysis to determine the influence of such social effects.

The relationship between the LFP and the business cycle has been an active research topic for decades. The interest is probably because of its crucial implications on the correct measurement of actual unemployment and, as a consequence, on the correct intensity of the monetary and fiscal policies to be implemented. The two key concepts in the relationship between the business cycle and the LFP are the AWE (Humphrey, 1940; Woytinsky, 1940) and the DWE (Long, 1953; Mincer, 1962) hypotheses.

According to the conventional view of the AWE (Woytinsky, 1940), some breadwinners lose their jobs during an economic downturn. As a consequence, their spouses would experience a reduction in non-labour income, reducing their reservation wage, and at an aggregate level, increasing the labour force. The opposite would be true in an economic boom. Hence, this effect establishes an overestimation of the unemployment rate during downturns and recessions and vice versa during strong economic growth periods.

The original idea of the DWE (Long, 1953, 1958) holds that when the likelihood of finding a job decreases, some workers cease their active job searches (i.e., they become inactive), and that the opposite occurs when the likelihood of finding a job increases. The rationale behind this is that as the expectations of finding a job decrease, the transaction costs linked to the search process could exceed the benefits expected. In summary, through this effect, the LFP exhibits a pro-cyclical pattern of an underestimation of the unemployment rate in booming periods and an overestimation during downturns and recessions.

As these two hypotheses predict opposite patterns for LFP changes throughout the business cycle, determining which prevails over the other is an empirical question. The observed evidence on these two effects is mixed: Some studies have demonstrated a prevalence of AWE over DWE, and others have demonstrated that DWE is stronger than AWE, depending on various factors of the labour market analysed (e.g., geographical location, gender). For instance, Wachter (1972, 1974) and Tano (1993) have demonstrated that both effects offset each other.

Specifically, in Maloney (1987) and Emerson (2011), the AWE has dominated in the United States. Del Boca, Locatelli, and Pasqua (2000) and Ghignoni and Verashchagina (2016) have identified the same effect for Italy. Parker and Skoufias (2004) detect empirical evidence of a prevailing AWE in Mexico, and Gałecka-Burdziak and Pater (2016) do the same for Poland. In the Spanish case, this effect is dominant in Prieto-Rodríguez and Rodríguez-Gutiérrez (2000, 2003), and partially in Congregado, Golpe, and Van Stel (2011).

Regarding the research to find a prevailing DWE, the pioneering work by Long (1958) and Clark and Summers (1981), Leppel and Clain (1995), or Benati (2001) have demonstrated that this effect predominates in the United States. In Darby, Hart, and Vecchi (2001), the DWE is predominant for the case of women between 45 and 54 years old in Japan, France, and the United States. Similarly, empirical evidence of a noticeable DWE, in net terms,

has been provided by Lenten (2001) and O'Brien (2011) for Australia, Österholm (2010) for Sweden, and Martín-Román and Moral de Blas (2002) and partially Congregado, Carmona, Golpe, and Van Stel (2014) for Spain.

We easily imagine from the aforementioned discussion that spatial analysis of the regional labour markets will be a key element in this research. Some seminal works in this area have been provided by Marston (1985), Blanchard and Katz (1992), Decressin and Fatas (1995), or Taylor and Bradley (1997). More specifically, the role played by space in the analysis of different topics concerning the labour market at the macro level has attracted much attention. For instance, studies have analysed the differences in the unemployment rates among territories (e.g., countries, regions) and their persistence in time (Molho, 1995; Jimeno & Bentolila, 1998; Overman & Puga, 2002; López-Bazo, Barrio, & Artis, 2002; López-Bazo, Barrio, & Artís, 2005; Filiztekin, 2009; Kondo, 2015; Halleck-Vega & Elhorst, 2016; Cuéllar-Martín, Martín-Román, & Moral de Blas, 2019). Furthermore, other studies have focused on the role that space plays in the process of matching individuals in the labour market (Haller & Heuermann, 2016).

In any case, this paper intends to advance the analysis of the cyclical properties of the LFP. We consider that social effects, proven to influence several economic outcomes, play a critical role in explaining cyclical variations in the LFP. The influence of social group behaviour on an individual's decisions has been labelled in the literature as social effects, or in some cases, peer effects (Dietz, 2002; Manski, 1993, 2000).

In the case of economics (i.e., microeconomics), a type of social effect has been named BE for the demand for goods and services. This effect establishes that the behaviour of an individual is determined by his/her personal features and influenced by the actions and decisions of his/her peers (Granovetter & Soong, 1986; Leibenstein, 1950; Pollak, 1976; Van Herpen, Pieters, & Zeelenberg, 2009). Because the labour supply is a demand for leisure, we deem that the BE might operate in labour markets too.

Thus, we are interested in studies that have applied the social effects approach to analyse participants' behaviour in the labour market. For example, Hellerstein, McInerney, and Neumark (2011) and Hellerstein, Kutzbach, and Neumark (2015) have highlighted the role of networks defined by residential neighbourhoods in employment and re-employment opportunities, especially for minorities and less-skilled labourers. These studies have demonstrated empirical evidence to support the idea that social effects, or network effects in their terminology, are essential to understand local labour market functioning. Loog (2013) also shows that social effects are critical to understanding certain outcomes observed in the labour market. More precisely, this author analyses the significance of social effects in relation to working hours by using a sample of public workers in Germany between 1993 and 2005. Similarly, Collewet, de Grip, and de Koning (2017) point out that there is a small peer effect in the working time of a sample of Dutch male employees from 1994 to 2011. Similar results are in Weinberg, Reagan, and Yankow (2004).[7]

Even more closely related to the ultimate aim of the paper, we could emphasize that the connection between social effects and the labour supply from a microeconomic perspective has produced literature too. For instance, Blomquist (1993) elaborates a model where the worker's preferences regarding labour market outcomes are interdependent with other individuals' behaviour. Vendrik (1998, 2003) establishes that workers' labour supply is determined not only by his/her individual preferences but also by other individuals' labour market participation decisions. A similar approach can be found in Kapteyn and Woittiez (1987), Neumark and Postlewaite (1998), Romme (1990) or Grodner and Kniesner (2006, 2008). Finally, Woittiez and Kapteyn (1998) and Maurin and Moschion (2009), who have also demonstrated relevant social effects in the labour supply of women.

Notwithstanding, our study combines the micro and macro perspectives, and then adds a spatial dimension. Thus, there exists a critical body of research closely related to this investigation that has analysed spatial dependence among LFPR. Table 1 summarizes this strand of literature. We elaborated on this by referencing Halleck-Vega and Elhorst (2017) and other studies.

[7]Other works that have adopted a different perspective regarding social influences on individuals in the labour market are Casella and Hanaki (2008), Tassier and Menczer (2008), and Koursaros (2017).

TABLE 1 LFPR and spatial effects in the regional labor markets

Study	Regions	Population	Period	Method
Elhorst (2001)	France, Germany, United Kingdom (NUTS 2 and NUTS 1)	Total	1983–1993	Various (10 spatial panel data models)
Möller and Aldashev (2006)	Germany (NUTS 3)	Male, female	1998	SAR, SEM
Elhorst and Zeilstra (2007)	European Union (NUTS 1 and – 2)	Male, female	1983–1997 (annual)	SEM
Elhorst (2008)	European Union (NUTS 2)	Total, male, female	1983–1997 (annual)	SEM (MESS)
Cochrane and Poot (2008)	New Zealand (LMAs)	Total	1991–2006; (quinquennial)	SAR, SEM
Falk and Leoni (2010)	Austria (districts)	Female	2001	SEM
Liu and Noback (2011)	Netherlands (municipalities)	Female	2002	SEM
Fogli and Veldkamp (2011)	EEUU (counties)	Female	1940–2000; (decennial)	TSR
Halleck-Vega and Elhorst (2014)	European Union (NUTS-2)	Total	1986–2010	DSDM
Halleck-Vega and Elhorst (2017)	European Union (NUTS-2)	Total, male, female	1986–2010 (annual)	TSR
Kawabata and Abe (2018)	Tokyo metropolitan area (municipalities	Female	2010	SDM,SLX

Notes: NUTS corresponds to Nomenclature of Territorial Units for Statistics. LMAs refers to Labor Market Areas. SAR, spatial autoregressive model; SEM, spatial error model; MESS, matrix exponential spatial specification; SDM, spatial Durbin model; DSDM, dynamic spatial Durbin model; SLX, spatial lag model and TSR, time–space recursive model.
Source: Halleck-Vega and Elhorst (2017) and own elaboration.

First, a group of studies has offered, from a more general standpoint, empirical evidence on the importance of accounting for spatial effects in the labour market analysis (Cochrane & Poot, 2008; Elhorst, 2001; Halleck-Vega & Elhorst, 2014, 2017). A second group of studies has more specifically focused on the LFPR analysis from a spatial perspective. Elhorst and Zeilstra (2007) investigate the underlying factors behind the heterogeneity of LFPRs within the European regions. Similarly, Elhorst (2008) concludes that LFPRs appear to be strongly correlated in time, weakly correlated in space, and parallel their national counterparts. Möller and Aldashev (2006) explicitly link the social effects conceptual framework to spatial analysis, which we do in this paper. In particular, those authors employ spatial econometric techniques to test the existence of social effects in the LFPRs in West and East Germany.

Finally, studies have focused on female labour market participation. Falk and Leoni (2010) provide empirical evidence on a negative spatial relationship among female LFPRs in Austrian districts. In a similar context, Liu and Noback (2011) apply a spatial error model (SEM) to detect the determinants of female LFPR in the Netherlands. From a more theoretical point of view, Fogli and Veldkamp (2011) propose a conceptual framework to explain the entry of women in the labour force over the last decades in the EEUU counties. Finally, Kawabata and Abe (2018) explore the presence of spatial patterns in the LFPR of women in the metropolitan area of Tokyo.

3 | THEORETICAL MODEL

To introduce the idea of BWE, we construct a labour market participation model. We are interested in the extensive margin of the labour supply; thus, we consider a fixed working week. In this manner, labour supply choices coincide with participation decisions. Some examples of this type of model are found in Boeri and van Ours (2013), Cahuc, Carcillo, and Zylberberg (2014), and Martín-Román (2014). However, our model is extended to consider the effects of unemployment.[8] Following the distinction made by Rodrik (2015) between critical and non-critical assumptions, the structure of the model comprises of one critical assumption (i.e., the mechanism driving our results), which we call the Core Theoretical Mechanism, and a set of other non-critical assumptions (discussed in the Appendix).

> **Core theoretical mechanism** . *Labour supply decisions depend on individual determinants and on an individual's neighbours' decisions. The spatial neighbourhood affects individual choices related to the labour supply.*[9] *The PR of one specific area depends on the PRs in neighbouring areas, and all remaining areas are also mutually affected. This mechanism leads to a global spatial dependence (i.e., feedback effects are operating that are associated with the BWE).*

The goal of this theoretical framework is twofold: defining and formalizing a second-order theoretical effect, namely, the BWE, and, second, connecting such an effect with a well-established procedure in spatial analysis: global Moran's *I*. This would be an extension of the well-known BE established for the demand for goods and services (Leibenstein, 1950). In the present context, a direct means of introducing the notion of BE into the labour supply decisions is just by letting the reservation wage be a function of the PR of neighbouring areas, $PR^N(Z)$, which also depends on the business cycle.[10] In formal terms:

$$\mathrm{PR} = \phi\left(w, w_M^R\left[y(Z), p(Z), \mathrm{PR}^N(Z)\right]\right). \tag{1}$$

[8]In the Appendix, we develop the theoretical structure underlying the concept of BWE, explain the concept of reservation wage, describe the aggregation process, define the variables used, and formally derive the notions of the AWE and DWE.

[9]This behavioural supposition has been proposed, more or less explicitly, by Fogli and Veldkamp (2011), Halleck-Vega and Elhorst (2014) or Halleck-Vega and Elhorst (2017).

[10]The variable PR^N should be thought of as a sort of a weighted average of the different PRs in the neighboring areas. In a later section, we provide further details to explain how we measure this in practical terms.

According to the basic idea of BE, an individual would demand more of a good or a service if his/her social environment does so. Thus, in our context, a worker demands relatively more leisure, all the things equal, if he/she lives in a society of leisure lovers, and vice versa. Therefore, if the PR in the neighbouring areas increases, the reservation wage of the median worker should decline: $\partial w_M^R/\partial PR^N < 0$. Taking this last effect into account, we might formally state the total effect of the business cycle on labour market participation by expression 2, instead of by (A12) in the appendix:

$$\frac{\partial PR}{\partial Z} = \underbrace{\frac{\partial PR}{\partial w_M^R}}_{(-)} \left(\underbrace{\frac{\partial w_M^R}{\partial y} \cdot \frac{\partial y}{\partial Z}}_{\text{AWE}(+)} + \underbrace{\frac{\partial w_M^R}{\partial p} \cdot \frac{\partial p}{\partial Z}}_{\text{DWE}(-)} + \underbrace{\frac{\partial w_M^R}{\partial PR^N} \cdot \frac{\partial PR^N}{\partial Z}}_{\text{BWE}(?)} \right) = \beta^+ \gtreqless 0. \tag{2}$$

In expression 2, the BWE affects the cyclical behaviour of PRs in an a priori unknown form because despite the sign of $\partial w_M^R/\partial PR^N < 0$ being well-defined, $\partial PR^N/\partial Z$ could be either positive or negative, depending on whether the AWE or the DWE prevail in the neighbouring areas. Thus, we cannot affirm that β^* (the PR cyclical sensitivity without the BWE, defined in the Appendix) is either higher or lower than β^+. Notably, the BWE is relevant to understanding labour market participation because the second-order derivative calculated in expression 3 has a well-defined positive sign:

$$\frac{\partial^2 PR}{\partial Z \partial \left(\frac{\partial PR^N}{\partial Z} \right)} = \frac{\partial PR}{\partial w_M^R} \cdot \frac{\partial w_M^R}{\partial PR^N} > 0. \tag{3}$$

Expression 3 indicates that the PR cyclical pattern of a specific area is positively related to the cyclical pattern in the PRs of neighbouring areas. That is, if we measure the cyclical sensitivity of the PR in a specific region *i* (by means of an econometric procedure) and call it β_i^+, it ought to be positively related to the average PR cyclical sensitivity in the neighbouring areas (of region *i*), which is denoted here by β_i^N. Formally, this could be represented by means of expression 4:

$$\frac{\partial \beta_i^N}{\partial \beta_i^+} > 0. \tag{4}$$

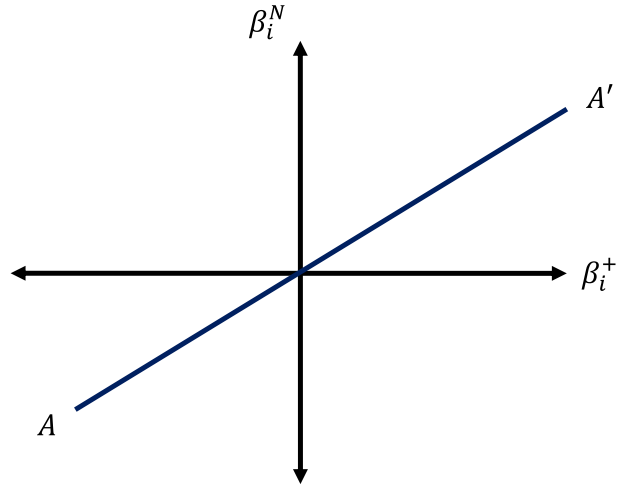

FIGURE 1 Cyclical PR sensitivity of an area as a function of the cyclical PR sensitivity of neighbouring areas

The mathematical relationship shown in (4) could be graphically depicted as line *AA'* in Figure 1. However, this apparently trivial diagram has a powerful, straightforward interpretation: It would correspond to Moran's scatterplot (with the axis being properly centered around the normalized values of β_i^+ and β_i^N), a widely used tool in spatial analysis.[11] Put differently, Figure 1 bridges the gap between the conceptual framework and the empirical strategy in this study. Thus, our theoretical setting allows us to test easily and directly the BWE, and this testing is relevant to understanding the PR cyclical patterns. This part of the study is performed in a subsequent section.

4 | METHODOLOGY

To test for the presence of the BWE, the first step is to estimate the cyclical sensitivity of the labour force. Thus, we employ a panel dataset composed of the 50 Spanish provinces for the period 1977–2015. As explained, we attempt to verify if the AWE, the DWE, or none of those effects prevail in these territories. To achieve our objective, we initially rely on equation 5:

$$CPR_{it} = \alpha + \beta_i \cdot CUR_{it} + D_{2001} + \mu_i + \varepsilon_{it}, \quad (5)$$

where CPR_{it} refers to the cyclical component of the PR of province *i* in year *t*; α is the constant of the regression; CUR_{it} is the cyclical component of the unemployment rate; D_{2001} is a dichotomous variable, which takes the value 1 after the year 2001, and 0 otherwise[12]; μ_i represents the provincial fixed effects; and ε_{it} denotes the disturbance term. In this case, α and μ_i are fixed constants, and we need additional restrictions to estimate them. One method to do that is to introduce the restriction $\sum_{i=1}^{K} \mu_i = 0$. Then, the fixed effect μ_i represents deviations from the mean intercept α (Hsaio, 2014). Using this procedure, we obtain 50 estimations of the cyclical sensitivity of the LFP (β_i), one for each Spanish province.

The main problem is obtaining the CPR_{it} and the CUR_{it} because the cyclical component of the variables cannot be observed and must be estimated. The economic literature uses several methods for obtaining these cyclical components, and one is the Hodrick–Prescott filter (Hodrick & Prescott, 1997) (HP). The first step to apply this filter is to choose a value for the λ parameter. In this case, we use λ = 400 because this value is very common in the economic literature when working with annual data (Backus & Kehoe, 1992; King & Rebelo, 1993; Maravall & Del Río, 2001).

We also refer to studies that have questioned the use of the HP filter. An influential paper in this vein is Hamilton (2018), which points out three limitations related to the application of this technique: (i) appropriateness when applied to different types of economic series; (ii) problems in obtaining future predictions; and (iii) difficulties in choosing coherent values of the λ parameter according to the data structure (e.g., monthly, quarterly, yearly). Under these circumstances, the HP filter can yield spurious dynamic relationships and erroneous estimations of the cyclical components. To solve the first limitation, the quadratic trend procedure (QT) is used as an alternative to obtain the cyclical component.[13] Regarding the second limitation, we do not make predictions but focus on the analysis of the cyclical sensitivity. Finally, and with regard to the choice of λ, the cyclical component is obtained again with the HP filter and λ = 100.[14] In addition, and as a measure of robustness, an estimate is also made with quarterly data and

[11]We acknowledge that Moran's *I* test is currently too basic in spatial econometrics. However, in this research, Moran's *I* only plays the role of linking the theoretical setting with the empirical strategy. Nevertheless, to check the sensitivity and robustness of the results, much more sophisticated spatial econometrics tests are conducted in the empirical sections of the paper.

[12]This dichotomous variable is introduced because, in 2001 a methodological change was implemented that affected how unemployment was measured. This methodological change may be seen at http://www.ine.es/epa02/meto2002.htm.

[13]This method is based on a linear regression of the data that we want to decompose, using the linear and the quadratic component of a trend as independent variables. In this manner, we extract both the trend component of the data previously mentioned and the disturbance term, which is identified by the cyclical component

[14]Econometric alternatives to these two methods are available, such as the Baxter-King filter (Baxter & King, 1999) and other more complex strategies (e.g., Phillips curve, Kalman filter).

λ = 1,600. Notably, some estimates that have applied the Hamilton filter have been conducted to obtain the cyclical component of the time series, and the outcomes are similar to those of our baseline models.[15]

We estimate equation 5. If β_i is statistically significant and greater than 0, the AWE prevails in that zone. If β_i is less than 0 and statistically significant, the DWE dominates. Finally, if the value of β_i is not significant, neither of the previous effects dominates the other. To avoid various econometric problems (e.g., spurious correlation) we must test if the cyclical components of the PR and the unemployment rate are stationary. Thus, we conduct several unit-root panel data tests (Table A1 in Appendix C).[16] Based on the results, we conclude that our cyclical components, obtained with the HP (for both λ parameter values) and the QT procedure, are stationary.

We have estimated the 50 cyclical coefficients of the PR at a provincial level. In the next step, we apply spatial analysis to test for the presence of the BWE. First, we must define a neighbourhood criterion by means of a weight spatial matrix. Further, to check the robustness of the results, we conduct the analysis by employing various alternative spatial weight matrices.[17] To detect global spatial dependence, we compute Global Moran's I, (Moran, 1948), defined as follows:[18]

$$I = \frac{n}{S_0} * \frac{\sum_{i,j}^{n} SW_{i,j}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}, \tag{6}$$

where n is the sample size, SW_{ij}refers to the components of the spatial weights' matrix, x_i represents the value of variable x in province i, x_j represents the value of variable x in province j, S_0 is equal to $\sum_i \sum_j SW_{ij}$, and $\bar{x}$ corresponds to the sample mean of variable x. Global Moran's I takes values between 1 and − 1. If the values are close to 1, there is positive spatial dependence, and there is negative spatial dependence if the values are close to −1.[19] Notably, the results of the spatial dependence analysis are used as an indicator of the BWE on the individuals' decision to participate in the labour market, namely, the AWE and the DWE are also the result of a social effect associated with the behaviour observed in the environment.

5 | RESULTS

The first part of this section shows the estimated effects of the business cycle on the LPR in the Spanish provinces. Second, we test the existence of the BWE as a positive spatial correlation in the cyclical sensitivity of the LFP among the Spanish NUTS 3 units.

5.1 | Results for the AWE and the DWE

For this research, we require information on the unemployment rate and the LFP. We used data from the Labour Force Survey (Encuesta de Población Activa, EPA) conducted by the National Statistics Institute for the 50 Spanish

[15]Results are available upon request from the authors.

[16]These panel tests are basically an extension of the ADF test (Augmented Dickey–Fuller) applied to a panel data structure. In the case of the Harris–Tzavalis test, Levin–Lin–Chu test, and Breitung test, we assume that the unit-root procedure is homogeneous. The Im–Pesaran–Shin test examines the presence of cross-section dependence in the unit-root procedure.

[17]See Moreno and Vayá (2002) for a very extensive explanation.

[18]Cliff and Ord (1981) confer this statistic with an advantage over the other spatial dependence indices.

[19]The existence of positive spatial dependence means that areas with high (low) values of the target variable are surrounded by other areas that also display high (low) values for said variable. Negative spatial dependence indicates that the areas with high (low) levels in the variables studied are located close to other territories where said variable displays low (high) values.

provinces (NUTS 3) in the period 1977–2015 (Table A2 in Appendix C provides detailed information on the variables).

Table 2 exposes the results of estimating equation 5 when the cyclical components of the variables are obtained by the application of the HP filter with $\lambda = 400$. Additionally, and because of the length of the period, we analyse what occurs in two shorter periods: 1977–1996 and 1997–2015. In this manner, we test more precisely the effect of the business cycle over the LFPRs in Spain and the robustness of the results. There are three main reasons to split the full period into these two sub-periods. First, each of these two sub-periods represents, approximately, a complete business cycle. Second, in the last years of the 1990s, Spain experienced a large wave of immigration (Carrasco, Jimeno, & Ortega, 2008) that generated notable changes in the economic dynamics of the Spanish labour market (Farré, González, & Ortega, 2011). Third, the length of these two sub-periods is approximately equal (20 and 19 years, respectively). columns (2) and (3) in Table 2 present the estimations of these sub-periods.

The results show 22 statistically significant coefficients for the period 1977–2015, and the DWE prevails over the AWE in nineteen of them. In the first sub-period (1977–1996), 27 provinces present statistically significant results, and the DWE is the most relevant effect. The AWE is present only in four territories. For the second sub-period (1997–2015), seven provinces show statistically significant results, and the DWE is the predominant effect in four of them.

To test the robustness of the results, we re-estimate the sensitivity of the LFP with the cyclical components obtained by using the QT procedure and the HP filter with $\lambda = 100$ (Table A3 in Appendix C). For the whole period, the results are similar to those obtained before, with many statistically significant results, especially when we employ the QT procedure. The principal effect is the DWE, which is present in 30 out of the 34 provinces that have statistically significant results. For the two sub-periods, the DWE also predominates in most of the provinces where the results are statistically significant. We only found the AWE in Lugo and Corunna (A) between 1977 and 1996 and in Palencia, Caceres and Huelva between 1997 and 2015. In the case of the HP filter with $\lambda = 100$, we obtain the same results. The DWE also predominates for the whole period and for the first sub-period.

Figure A2 in Appendix C includes two scatterplots that confirm the robustness of the estimations. The results obtained by the HP filter with $\lambda = 400$ and $\lambda = 100$ are positively correlated with an R^2 equal to 0.85 and a correlation coefficient (ρ) of 0.92. Additionally, the same pattern is maintained when we observe the relationship between the estimations of the HP filter with $\lambda = 400$ and the QT procedure; in this case, the R-squared is 0.79, and ρ is 0.89.

5.2 | Spatial analysis of the cyclical sensitivities

We have estimated the cyclical sensitivities. Now, we study whether there is a social influence in our results. The theoretical model suggested that the PR cyclical pattern of a specific area is positively related to the cyclical pattern shown in the PRs of neighbouring areas. This effect, named BWE, may be easily tested by means of spatial econometric techniques in line with those expressed in Equation 4. To begin the analysis, we must establish a neighbourhood criterion such as the k-nearest neighbours (Knn) or the inverse distance (ID).[20] To achieve the goal of this paper, we determine that ID and nearest neighbour are the appropriate spatial weight matrices because part of the contribution of this research is to test if the social effect is weaker when spatial proximity is less evident. The advantage of these two types of spatial matrices is that we can graduate spatial proximity in a continuous manner. In addition, the distance matrix enhances the importance of proximity with less weight to farther locations (Bertinelli & Nicolini, 2005). It is true that, by using contiguity spatial matrices, we can define the first-order neighbourhood, second neighbourhood, and so forth; however, we conclude that this is insufficiently continuous. Moreover, we have islands in our database, causing the well-known drawbacks of the contiguity spatial matrices. Notably, we did not

[20]See O'Sullivan and Unwin (2010) for more detailed information about the Knn and ID matrixes.

TABLE 2 Cyclical sensitivity of the LFP (HP λ = 400)

	1977–2015	1977–1996	1997–2015
Alava	−0.140*	−0.320***	−0.006
Albacete	0.030	−0.031	0.040
Alicante	−0.087	−0.223**	−0.007
Almeria	−0.112**	−0.557***	−0.039
Asturias	−0.006	0.001	0.009
Avila	0.046	0.185**	0.076
Badajoz	0.003	−0.207***	0.106
Balearic Islands	−0.043	−0.245**	0.038
Barcelona	−0.055	−0.052	−0.062
Burgos	−0.134*	−0.152	−0.109
Caceres	0.102**	−0.040	0.159***
Cadiz	0.047	0.012	0.050
Cantabria	−0.170**	−0.179	−0.187**
Castellon de la Plana	−0.139**	−0.275**	−0.090
Ciudad Real	−0.068	−0.105	−0.033
Cordoba	0.000	−0.173**	0.076
Corunna (A)	0.080	0.633***	−0.105
Cuenca	−0.041	−0.155	0.010
Girona	−0.259***	−0.512***	−0.142
Granada	−0.010	−0.218***	0.057
Guadalajara	−0.190***	−0.265***	−0.085
Guipuzcoa	−0.169**	−0.105	−0.293**
Huelva	0.075*	−0.112*	0.189***
Huesca	−0.080	0.002	−0.140
Jaen	0.029	−0.176**	0.130**
Leon	0.007	−0.342*	0.055
Lleida	−0.138	0.335**	−0.170
Lugo	0.164*	0.508**	0.109
Madrid	−0.142**	−0.063	−0.196**
Malaga	0.034	0.020	0.043
Murcia	−0.095*	−0.418***	−0.032
Navarre	−0.178**	−0.141	−0.194
Orense	−0.076	−0.707***	0.033
Palencia	0.034	−0.113	0.121
Palmas (Las)	−0.094*	−0.208**	−0.013
Pontevedra	−0.090	0.007	−0.115
Rioja (La)	−0.158**	−0.185**	−0.134
Salamanca	0.072	0.053	0.111
S C Tenerife	0.031	0.010	0.010
Segovia	−0.077	0.053	−0.140
Seville	−0.077*	−0.051	−0.074

(Continues)

TABLE 2 (Continued)

	1977–2015	1977–1996	1997–2015
Soria	−0.135	−0.526***	0.066
Tarragona	−0.245***	−0.378***	−0.116
Teruel	−0.126	−0.268*	−0.151
Toledo	−0.080	−0.131	0.005
Valencia	−0.095**	−0.115*	−0.116
Valladolid	−0.231***	−0.400***	−0.117
Vizcaya	−0.119*	−0.081	−0.177
Zamora	−0.170**	−0.163	−0.213**
Saragossa	−0.063	−0.139*	−0.038

Note:
*, **, and ***shows statistical significance at 10%, 5%, and 1% levels, respectively.

use socioeconomic weight matrices because our phenomenon has a clear spatial rationale. In this paper, we use ten different Knn matrices (K = 1…10) where the specification of the spatial weights is:

$$SW_{i,j} = \begin{cases} 1, & \text{if centroid of j is one of the k nearest centroids to that of i} \\ 0, & \text{otherwise} \end{cases}.$$

We also apply ten ID matrices for different values of α (α = 3,2.75,…0.75) and the following spatial weights:

$$SW_{ij} = \begin{cases} d_{ij}^{-\alpha}, & \text{if } i \neq j \\ 0, & \text{otherwise} \end{cases},$$

where α is any positive parameter, and $d_{i,j}$ is the distance between regions i and j.

Table 3 presents the results of Global Moran's I for the cyclical sensitivity of the LFP obtained with the HP method with λ = 400.[21] For the period 1977–2015, the results show a positive spatial dependence with both sets of matrices. The analysis of the sub-periods indicates that between 1977 and 1996, a positive spatial dependence is observed either when we consider less than three neighbours or when the distance is more penalized. From 1997 to 2015, a positive spatial dependence is again observed for all the matrices, but it is weaker than in the case of the whole period. Additionally, a test to detect local spatial dependence is implemented. The local Moran's I statistic and two neighbouring matrices are used: five nearest neighbours and ID with α = 1. The results show a higher concentration of DWE in the northeast of Spain, whereas the AWE is more common in the east and south (figure A3 in Appendix C).

To test the robustness of our results, we perform the spatial analysis using the values obtained by the QT procedure and the HP filter with λ =100 (Table A4 in Appendix C). In the case of the QT procedure, the results show positive spatial dependence both for the whole period and for the two sub-periods. This effect is stronger than before and occurs for the two sets of spatial matrices. If we use the HP filter with λ = 100, the results are similar to those obtained with λ = 400. The spatial dependence is present both for the entire period and for the two groups of matrices. The analysis by sub-periods only shows spatial dependence between 1997 and 2015 and for some spatial

[21]We also perform the same analysis by putting a value equal to 0 in those provinces where we have obtained results of the cyclical sensitivities that are not statistically significant (no prevalence of either the AWE or the DWE over the other in these territories). The results are very similar to what we present in Table 3. Detailed results are available from the authors upon request

TABLE 3 Global spatial dependence analysis (HP λ = 400)

	1977–2015	1977–1996	1997–2015
Knn = 1	0.517***	0.385**	0.398**
Knn = 2	0.376***	0.196*	0.306***
Knn = 3	0.336***	0.112	0.297***
Knn = 4	0.344***	0.059	0.287***
Knn = 5	0.303***	0.002	0.255***
Knn = 6	0.277***	–0.015	0.259***
Knn = 7	0.249***	0.003	0.218***
Knn = 8	0.242***	0.003	0.228***
Knn = 9	0.220***	–0.028	0.214***
Knn = 10	0.203***	–0.048	0.193***
ID (α = 3)	0.299***	0.166**	0.238***
ID (α = 2.75)	0.283***	0.144**	0.229***
ID (α = 2.50)	0.265***	0.121**	0.219***
ID (α = 2.25)	0.244***	0.098**	0.206***
ID (α = 2)	0.220***	0.075*	0.190***
ID (α = 1.75)	0.193***	0.053*	0.170***
ID (α = 1.50)	0.163***	0.033	0.147***
ID (α = 1.25)	0.130***	0.016	0.121***
ID (α = 1)	0.098***	0.003	0.093***
ID (α = 0.75)	0.065***	–0.007	0.064***

Notes: The values in the table refer to the Global Moran's I. The null hypothesis refers to the absence of spatial dependence. *, **, and *** show statistical significance at 10%, 5%, and 1% levels, respectively.

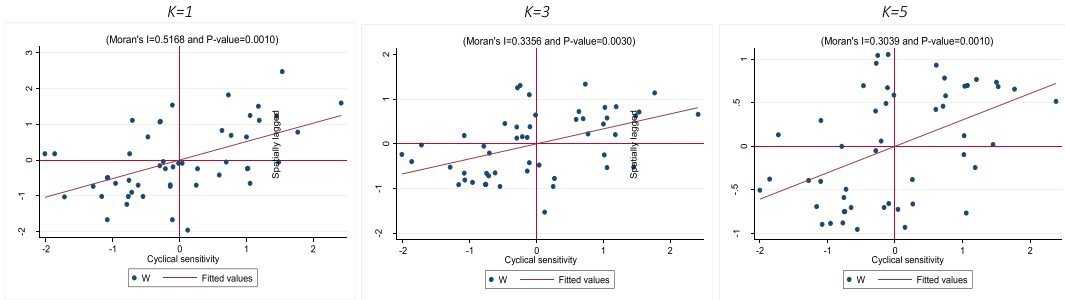

FIGURE 2 Global scatterplot diagrams of Moran's I (HP λ = 400) (1977–2015)

matrices. Figures 2 and 3 present the scatter plots of Global Moran's I for the HP filter (λ = 400) when three Knn matrices (K = 1, 3 and 5) and three ID matrices (α = 1, 2 and 3) are used. The spatial correlation that is present in figures 2 and 3 is consistent with the interaction presented in figure 1 and allows us to confirm the presence of the BWE. This corroborates the existence of a social effect, which causes the cyclical sensitivity of the LFP in one territory to be influenced by what occurs in its neighbouring regions.[22]

[22]Detailed results for the other spatial matrices and the other two methods (QT procedure and HP (λ = 100)) are available from the authors upon request.

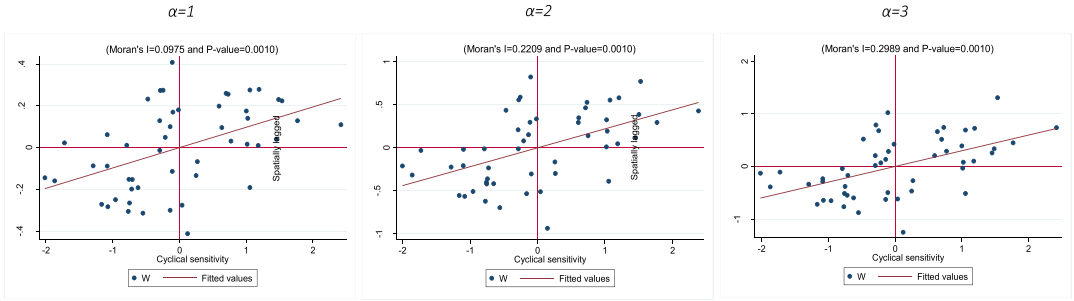

FIGURE 3 Global scatterplot diagrams of Moran's I (HP λ = 400) (1977–2015)

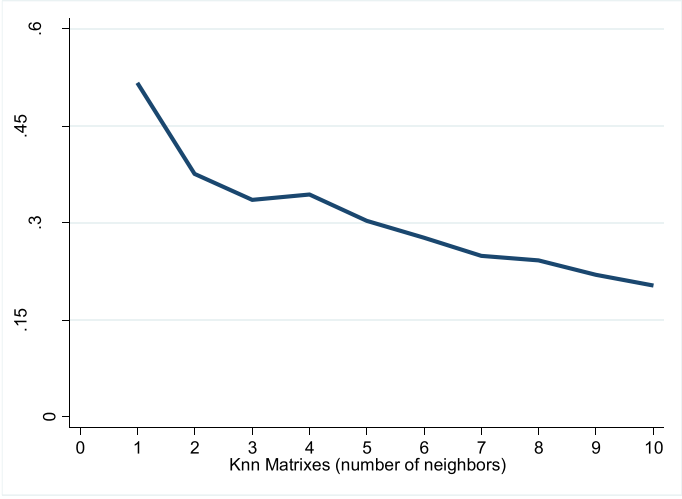

FIGURE 4 Evolution of the global spatial dependence of the Knn matrixes (1977–2015) (HP λ = 400)

The next step in the spatial analysis is to study the evolution of the spatial dependence before changes in neighbourhood parameters. As explained, each neighbourhood criterion includes ten different levels. Depending on the spatial correlation at each level, we can understand how the social effect works. The results in Table 3 show that as we increase the number of neighbours (or we reduce the α parameter), the spatial correlation coefficient decreases. To explain this point in more detail, Figures 4 and 5 depict the evolution of the spatial correlation as the matrix parameters of the two sets change. The decreasing slope in both figures indicates that the BWE is caused by what occurs in the nearest territories. As we increase the number of provinces that we consider neighbours, the social effect tends to disappear.[23]

6 | EXTENSIONS

The results presented in Section 5 have demonstrated the existence of a BWE; thus, we must broaden the analysis to discard other possible explanations. To this end, two spatial models are presented that allow us to confirmation of the influence of the closest environment and global spillovers, from a geographical point of view, over the cyclical

[23]Detailed results for the other two methods (QT procedure and HP with λ = 100) are available from the authors upon request.

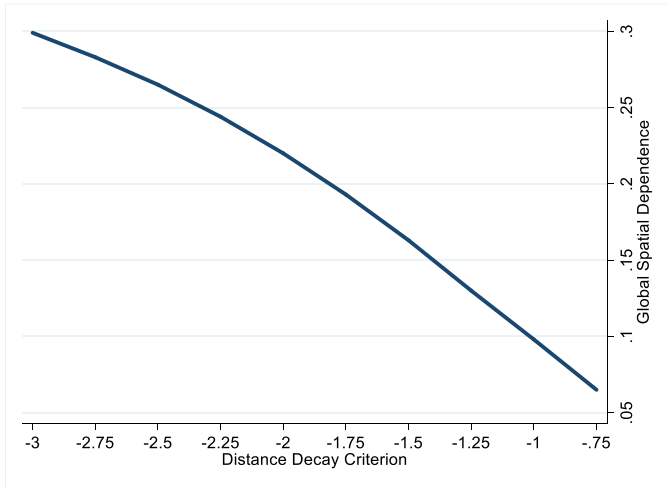

FIGURE 5 Evolution of the global spatial dependence of the Inverse Distance matrixes (1977–2015) (HP λ = 400)

Notes: Distance decay criterion is equal to the $-\alpha$ parameter of the equation that determines the spatial weights of the inverse distance matrix ($d_{ij}^{-\alpha}$).

sensitivity of the PR. Appendix B also includes a sensitivity analysis with specifications that control for population composition, methodological changes, labour reforms, or data structure.

Regarding cross-sectional dependence, a logical assumption is that the correlation should be related to the variables not included in the model and would be detected by estimating an SEM such as that presented in Equation 7:

$$CPR_{it} = \alpha + \beta_{i1} \cdot CUR_{it} + \beta_2 D_{2001} + \mu_i + \varepsilon_{it}, \tag{7}$$

$$\varepsilon_{it} = \lambda W \varepsilon_{it} + \eta_{i,t} \text{ with } \eta_{i,t} \tilde{N}\left[0.\sigma_\eta^2 I_n\right].$$

From the results obtained in this new estimation, the spatial correlation of the cyclical sensitivity is tested again with the two previous weight matrices (ID and five nearest neighbours). The results presented in Figure 6 show that the spatial correlation decreases slowly. However, a statistically significant BWE is maintained even when spatial dependence in the errors is also detected (Table A5 in Appendix C includes the cyclical sensitivity coefficients and the lambda parameter related to the SEM).

The second spatial approach is the spatial lag model or spatial autoregressive model (SAR). This model is a global spillover specification that includes an additional term obtained as the product of the spatial weight matrix and the cyclical component of the PR, in Equation 8:

$$CPR_{it} = \alpha + \rho W CPR_{it} + \beta_{i1} \cdot CUR_{it} + \beta_2 D_{2001} + \mu_i + \varepsilon_{it}. \tag{8}$$

In this case, because of the presence of the spatial lag of the dependent variable, a change in a single observation (region) associated with any given explanatory variable affects the region (direct impact) and potentially affects all other regions indirectly (indirect impact). The total effect is the sum of both the direct and the indirect or global effect and is obtained as $\beta_{i1}(1 - \rho W)^{-1}$. When the global spatial correlation test over that total effect is performed, the Moran I is not significantly different from 0 (Figure 7). This result makes sense because the SAR model captures the global spillovers and the spatial lag coefficient of the dependent variable is positive and significant (Table A5 in Appendix C includes the total effects of changes in CUR variables and the rho parameter).[24]

[24]As an additional measure of robustness, we have estimated a spatial Durbin model that includes the spatial lag in the cyclical component of the unemployment rate; once again, the rho parameter was positive and significant (results are available upon request of the authors).

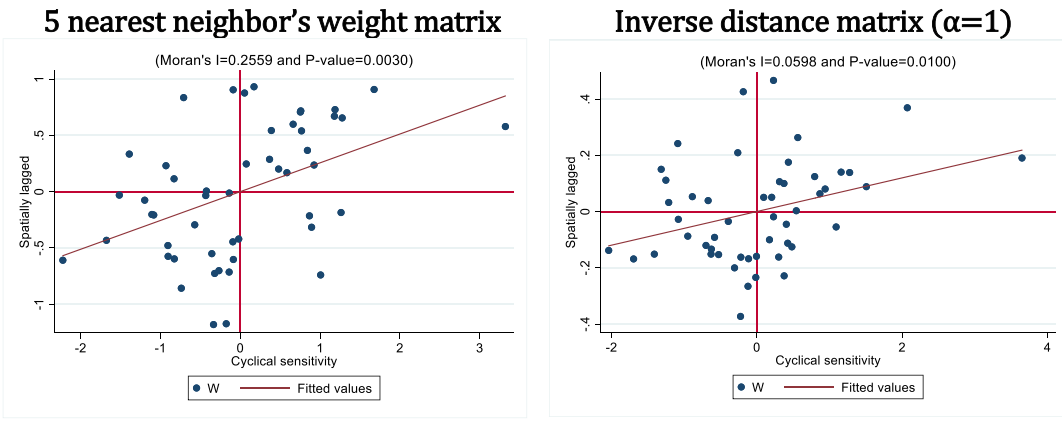

FIGURE 6 Global scatterplot diagrams of Moran's *I*: SEM (1977–2015) (HP λ = 400)

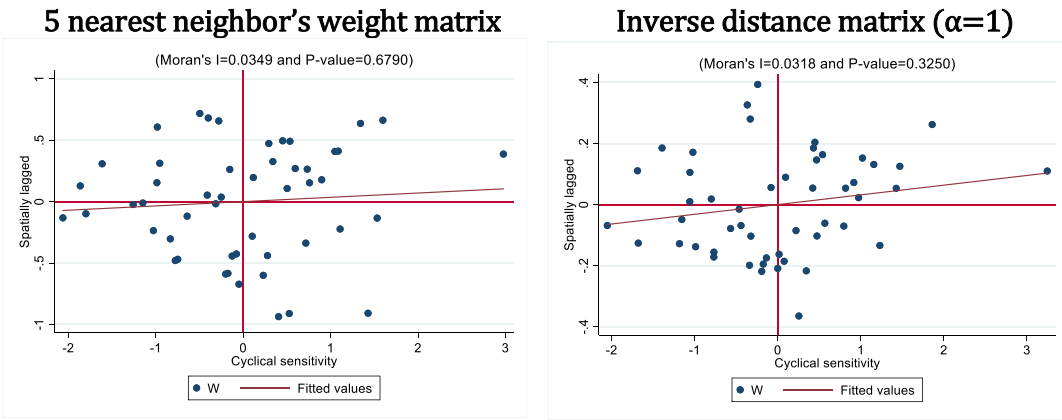

FIGURE 7 Global scatterplot diagrams of Moran's *I*: SAR (1977–2015) (HP λ = 400)

The similarity in magnitude and significance of ρ and λ seems to indicate that the spatial correlation was included in the disturbance of the SEM (LeSage, 2014). If we add to this that the spatial dependence on the cyclical sensitivity is still present when estimating the SEM and disappears with the SAR model, we consider that the latter is the true data-generating process. These results, and especially the value of the ρ parameter in the SAR model, confirm the presence of global spatial dependence (LeSage & Pace, 2009; García-López, Nicolini, & Roig, 2020; López-Torres, Nicolini, & Prior, 2017) and therefore also the BWE hypothesis.

7 | DISCUSSION AND POLICY IMPLICATIONS

We have offered empirical evidence of the existence of the BWE; thus, in the following paragraphs, we propose economic policy implications. We organize the economic policy implications and recommendations into three categories: proposals related to the heterogeneity in the cyclical response of the LFP in different spatial units; economic policy consequences related to the spatial dependence in the LFP cyclical patterns (i.e., the significance of the BWE); and policy suggestions resulting from the particular administrative hierarchy among NUTS 2 and NUTS 3 units in Spain.

First, our results show that local labour markets react differently to cyclical fluctuations. More precisely, we find that in some Spanish NUTS 3 units, the DWE dominates the AWE; in other units, the AWE is stronger than the DWE; and there are spatial units where both effects offset each other. In general, the economic measures should be conducted while considering the territorial context; thus, policy-makers should not design economic policies that have the same intensity of effect in all regions. In other words, different territories require policies tailored to the labour market dynamics of each territory. More specifically, this spatial heterogeneity has implications for the implementation of both aggregate demand policies and policies on the supply side.

As aforementioned, during a downturn, if the DWE dominates the AWE, the unemployment rate is understated, whereas if the AWE prevails over the DWE, the unemployment rate is overstated. Evidently, the opposite is true during an economic upturn. Hence, an obvious economic policy implication of our results is that in those geographical areas in which we have estimated a prevailing DWE, economic authorities ought to implement a more expansionary fiscal policy (e.g., government spending increases or tax cuts) than indicated by the official unemployment rate during a recession. Following the same line of reasoning, but from an aggregate supply perspective, additional active labour market policies (e.g., training schemes, public employment services) should be applied in those spatial units with a predominant DWE during downturns, and vice versa. In addition, our estimates of the Spanish spatial units with a prevailing DWE or AWE serve as a guideline for policy-makers to better distribute a limited fiscal budget in different business cycle phases. Policy-makers should devote less (more) budgetary resources to spatial units with a predominant AWE during recessions (expansions) than suggested by the measured unemployment rate and more (less) to those with a prevailing DWE. This economic policy rule would enhance efficiency as long as the fiscal budget remained unchanged at the aggregate level.

Second, our evidence shows a significant spatial dependence in the cyclical sensitivity of LFP, that is, what we name the BWE. Thus, cyclical patterns that the labour force follows in a given territory are guided and conditioned by the behaviour of its neighbouring territories. For this reason, it is necessary to consider this social effect when analysing the policy implications of the labour market policies. For instance, the implementation of macroeconomic policies by the regional governments could cause spillover effects beyond those initially expected. The obvious economic policy implication regarding this topic is that regions cannot be studied in isolation from each other but interact with their neighbours. However, this statement is too general.

A more specific economic policy implication regarding the influence of the BWE is that the policies implemented should pay more attention to the existence of spatial areas rather than single spatial units to better understand the relationship between the labour market participation and the state of the business cycle. If the BWE is a relevant socioeconomic phenomenon, we might expect the DWE and the AWE to spread across neighbouring spatial units during economic upturns and downturns. In this manner, the overstatement or understatement of true unemployment across spatial units would be contagious, and consequently, the correct economic policy; even more importantly, the correct intensity of such a policy should be determined by adopting a supra-provincial perspective.

The last group of economic policy implications is related to the particular administrative division of the Spanish territory NUTS 3 units in Spain (provinces), which are grouped into NUTS 2 units (autonomous communities) in some cases but not in others. Thus, in a limited number of cases (Madrid, Balearic Islands, Asturias, Cantabria, Rioja (La), Murcia, and Navarre), a coincidence is observed between the NUTS 2 and NUTS 3 levels, but this does not occur in the remaining 43 Spanish provinces. Furthermore, our findings imply that the actions of the regional governments at the NUTS 2 level could affect either other NUTS 2 territories or NUTS 3 units that do not belong to that region. More importantly, Spanish NUTS 2 units manage a significant portion of the government's budget, whereas NUTS 3 units run much less of it.[25] This entails the autonomous communities playing a key role from an economic and political point of view, and the Spanish provinces have a limited capacity to act. As our results point to a strong

[25]Spanish NUTS 2 (autonomous communities) represented approximately 30% of public expenditure in Spain during 2015 and 2016. NUTS 3 units (provinces) was approximately 11% of public spending in Spain during those same years (OECD, 2017).

interdependence at the NUTS 3 level, co-ordination of economic policies among neighbouring NUTS 2 regional governments is required because there are critical spillover effects beyond the NUTS 2 level administrative division.

The aforementioned issue could be addressed from two points of view. First, political leaders governing neighbouring autonomous communities might spontaneously seek higher co-ordination in their policies against unemployment. In this vein, supra-regional committees managing labour market policies could be created to co-ordinate political efforts to minimize the true unemployment problem, by devising strategies that account for the spillover effects. Second, if regional (NUTS-2) governments do not reach an agreement by themselves, the Spanish central government might act to promote such an agreement. Here, again, there are two options: (i) the Spanish central government might create by itself an inter-regional committee where the representatives in charge of labour issues in each autonomous community could hold discussions with other regional representatives to make agreements that seek the co-ordination; and (ii) the Spanish central government might directly act to solve this question. More precisely, it could create a political institution that depends on the Ministry of Labour (e.g., a Secretary of State or a General Directorate), devoted exclusively to co-ordinating different regional labour market policies.[26]

8 | CONCLUSIONS

The main purpose of this paper is to test whether the relationship between the business cycle and LFP in any given area is affected by the behaviour of its neighbours. To achieve this objective, we first elaborate a microeconomic decision model to conceptualize the AWE and the DWE. In a second stage, using an aggregation process, we incorporate the BWE as a social effect. Finally, we use spatial econometrics techniques to test for the existence of the BWE in Spanish local labour markets.

The first part of this work studies the cyclical sensitiveness of the LFP by employing a panel dataset composed of the 50 Spanish provinces during the period 1977–2015. Additionally, because of the length of the period of study, we extend our analysis to two sub-periods (1977–1996 and 1997–2015). Regardless of the method used to obtain the cyclical components of the variables (HP with λ =400, HP with λ =100, or QT), we conclude that the DWE dominates in most of the territories and in periods where the coefficients are significant.

Our theoretical model demonstrates that the cyclical sensitivity of the LFP in one area is influenced by the behaviour of its neighbours. To study that finding, after conducting a macroeconomic aggregation process, we coined the BWE and tested it with standard spatial econometric techniques we derived directly from our theoretical discussion. Using different neighbourhood criteria, the results reveal the presence of a positive global spatial dependence in the cyclical sensitivity of the LFP in the Spanish local labour markets. This is consistent with what we illustrate in our theoretical framework and verifies the existence of the BWE. Finally, the empirical analysis shows that the intensity of the BWE is not linear, that is, as we fix a laxer neighbourhood criterion, the strength of the BWE decreases.

Based on our work, we propose economic policy implications that affect the outcome of the regional labour markets. First, policy-makers should consider that the regions may react differently to the economic shocks of the business cycle. Thus, the policies should be applied while considering the economic dynamics of each zone because the application of economic policy with the same intensity for all the regions could lead to heterogeneous results. Another notable factor is that the territories interact with their neighbours; thus, they are not fully independent of each other. In this manner, policy-makers should focus on spatial areas instead of spatial units because of the existence of social effects among the territories that might condition the outcome of the economic policies. Our work corroborates that social effects play a key role in implementing labour market policies. This implies that these phenomena could generate types of effects that are not initially planned and that affect the economic dynamics of

[26]Coordination among different actors is proposed, but in practice this could be quite challenging. A main consideration is thus how feasible this would be (e.g., coordination failure, transaction costs, and so on and so forth). These issues might be included within the scope of the political economy and constitute an appealing avenue for future research.

neighbouring areas, even when the neighbours belong to a different territorial administration. That interdependence at the NUTS 3 level requires co-ordination of the economic policies among neighbouring NUTS 2 regional governments.

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APPENDIX A: THEORETICAL MODEL

In this appendix, we develop the theoretical framework to define the BWE. Non-critical Assumptions 1–6 of the model are as follows:

Assumption A1 *Labor is homogenous. This implies that the wage is the same for all workers.*[27]

Assumption A2 *Labor contracts last one period. To sign a new contract, it is always necessary to spend a fixed amount of time in job-search activities, as specified in Assumption A3.*

Assumption A3 *A certain amount of time is associated with labor participation. Before signing a new contract, the worker must devote s units of time to job searches. Here, s is considered a fixed and exogenous sum of time.*[28]

Assumption A4 *A positive unemployment rate exists. Such a rate determines the likelihood p of finding a job, which is the same for all individuals.*[29]

Assumption A5 *The size of the working week, which we denote by $\bar{l}$, is fixed and exogenously determined.*[30]

[27]This assumption is adopted because of the macroeconomic orientation of the paper.
[28]It is beyond the scope of the paper to consider *s* an endogenous variable. That is the field of job-search theory. This theory was pioneered by Mortensen (1970) and McCall (1970). See Lippman and McCall (1976a), Lippman and McCall (1976b), Mortensen (1986), and Mortensen and Pissarides (1999) for some classical surveys on the topic. Recent examples of this type of literature are Tatsiramos and van Ours (2012) and Tatsiramos and van Ours (2014).
[29]In other words: unemployment is primarily involuntary. Obviously, the higher the unemployment rate, the lower the *p*.
[30]We are interested in the extensive margin of the labour supply, and this assumption allows us to focus on the participation decision.

Assumption A6 *The utility function is additive. That is, if we denote C as the consumption (or the total income because there is no saving) and H as the leisure time (i.e., total time minus hours of work), this assumption establishes that* $U(C,H) = \Lambda(C)+\Omega(H)$. *As usual, marginal utilities are supposed to be positive and decreasing.*[31]

The set of alternatives for the worker is shown in Figure A1 (Appendix C). Inside the utility function, the levels of consumption and leisure have been replaced by the corresponding values associated with each decision. In this manner, we are already considering the budget constraints within the choice framework. In Figure A1, *w* is the real wage per unit of time, $\bar{l}$ stands for the duration of the fixed working week, *y* is the real non-labor income, and *s* stands for the job-search duration linked to the participation decision. Total time has been normalized to 1.

According to Figure A1, an individual has two options. Each of these options is associated with a level of utility, either certain or expected: (A1) not to participate and (A2) to participate, which can be formalized, respectively, as:

$$U(y,1), \tag{A1}$$

$$pU\left(w\bar{l}+y,1-\bar{l}-s\right)+(1-p)U(y,1-s). \tag{A2}$$

The reservation wage for an individual (w^R) might be defined, as per usual, as the value of *w* that equates both options. We easily prove from expression A3 that w^R is always positive ($w^R > 0$):[32]

$$pU\left(w^R\bar{l}+y,1-\bar{l}-s\right)+(1-p)U(y,1-s)=U(y,1). \tag{A3}$$

If workers have different preferences regarding consumption–income and leisure–work and different non-labor incomes, their reservation wages will also differ. This diversity of reservation wages $w^R \in [0,+\infty)$ might be represented by a cumulative distribution function $\phi(\cdot)$. If the remainder of the PR determinants do not change (i.e., non-labor income and likelihood of finding a job in our theoretical setting), the aggregate labor supply could be expressed in formal terms accordingly:

$$L = N\cdot\phi(\cdot), \tag{A4}$$

where *L* denotes the labor force, and *N* denotes the total working-age population. Therefore, the PR is simply $\phi(\cdot)$, as expressed in equation A5:

$$PR=\frac{L}{N}=\phi(\cdot). \tag{A5}$$

Inasmuch as $\phi(\cdot)$ is a cumulative distribution function, by definition, that proportion is increasing in its argument, $\phi_w > 0$. Nevertheless, as we show next, non-labour income and the likelihood of finding a job play a critical role in determining PR because both change. To incorporate this idea, we call w_M^R the reservation wage for the median individual within the cumulative distribution. In this manner, a stylized PR function is described by means of expression A6:

$$PR=\phi\left(w,w_M^R\right). \tag{A6}$$

[31]This assumption is less restricting than it initially seems. First, this sort of utility function generates indifference curves that typically decrease and are convex to the origin. Second, within the ordinal utility theory, a logarithmic transformation of the very well-known Cobb–Douglas utility function is additive, representing an identical set of preferences.

[32]Focusing first on leisure time, we have $1 > (1-s) > (1-\bar{l}-s)$. This would entail that $w^R\bar{l} > y$ in order to attain an equality in (A3), which implies that $w^R > 0$.

As aforementioned, ($\partial PR/\partial w$) > 0, by definition; furthermore, it is consistent with the concept of a reservation wage $\left(\partial PR/\partial w_M^R\right) < 0$. Finally, w_M^R is thus a function of some additional arguments. In the model developed here, w_M^R depends on *y* and *p*. In addition, *y*(*Z*) and *p*(*Z*) are regarded as functions of the business cycle (*Z*). We consider that if our measure of the business cycle increases, the state of the economy improves, whereas when Z decreases, the economy worsens. Thus, we may rewrite expression A6 as follows:[33]

$$PR = \phi\left(w, w_M^R[y(Z), p(Z)]\right). \tag{A7}$$

Equation A7 reveals that PR depends on the business cycle through a double channel: cyclical variations in the median worker's non-labour income that result in the AWE, and cyclical changes in the likelihood of finding a job that results in the DWE.

As aforementioned, the driver of the AWE is one spouse's non-labour income variations as a result of the other spouse's changes in his/her labour market status. We easily demonstrate that this result fits well in our theoretical framework. We first create an implicit function $R(\cdot) = R\left(w_M^R, y, p, \bar{l}, s\right)$ from Equation A3, which is defined by the following expression:

$$R(\cdot) = pU\left(w_M^R\bar{l} + y, 1 - \bar{l} - s\right) + (1-p)U(y, 1-s) - U(y,1) = 0,$$

and then, we use the implicit function theorem:

$$\frac{\partial w_M^R}{\partial y} = -\frac{\partial R/\partial y}{\partial R/\partial w_M^R} = -\frac{pU_C\left(w_M^R\bar{l} + y\right) + (1-p)U_C(y) - U_C(y)}{p\bar{l}U_C\left(w_M^R\bar{l} + y\right)} > 0. \tag{A8}$$

It is evident that a reduction in the non-labor income (as a consequence of a downturn) would decrease the reservation wage of the median worker, and this would encourage labor participation. In more formal terms (maintaining *p* constant), we may characterize the AWE by means of (A9):

$$\left.\frac{\partial PR}{\partial Z}\right|_{\bar{p}} = \frac{\partial PR}{\partial w_M^R} \cdot \frac{\partial w_M^R}{\partial y} \cdot \frac{\partial y}{\partial Z} < 0, \tag{A9}$$

because we know that $\partial y/\partial Z > 0$ (by hypothesis), that $\partial w_M^R/\partial y > 0$ (from the discussion in this section), and that $\partial PR/\partial w_M^R < 0$ (from the concept of reservation wage).

As explained, the DWE operates through changes in expectations of finding a job. Hence, the method to formalize the DWE within the model is by means of *p*. Taking Equation A3 and making use again of the implicit function $R(\cdot) = R\left(w_M^R, y, p, \bar{l}, s\right)$, we straightforwardly compute the effects of changes in *p* on w^R:

$$\frac{\partial w_M^R}{\partial p} = -\frac{\partial R/\partial p}{\partial R/\partial w_M^R} = -\frac{U\left(w_M^R\bar{l} + y, 1 - \bar{l} - s\right) - U(y, 1-s)}{p\bar{l}U_C\left(w_M^R\bar{l} + y\right)} < 0 \tag{A10}$$

The negative sign of (A10) is the result of the definition given in (A3). First, obviously, $U(y,1) > U(y,1-s)$. Second, to achieve equality in (A3), $U\left(w_M^R\bar{l} + y, 1 - \bar{l} - s\right) > U(y,1) > U(y, 1-s)$ must be fulfilled. In other words, when *p* rises (drops),

[33]The basic exposition of this aggregation process may be found in some labour economics' textbooks (e.g., Boeri & van Ours, 2013; Cahuc et al., 2014; Cahuc & Zylberberg, 2004). The idea of the cumulative distribution function $\phi(\cdot)$ is from Cahuc and Zylberberg (2004). The idea of the PR function depending on the reservation wage of the median individual, which depends on the business cycle, is ours.

w_M^R decreases (increases). We can obtain a stylized mathematical version of the DWE (maintaining non-labor income constant) through expression A11 :

$$\left.\frac{\partial PR}{\partial Z}\right|_{\bar{y}} = \frac{\partial PR}{\partial w_M^R} \cdot \frac{\partial w_M^R}{\partial p} \cdot \frac{\partial p}{\partial Z} > 0. \tag{A11}$$

As before, we can affirm that $\partial p/\partial Z > 0$ (by hypothesis), that $\partial w_M^R/\partial p < 0$ (from the discussion in this section), and that $\partial PR/\partial w_M^R < 0$ (from the concept of reservation wage).

We have described the two theoretical effects separately; now, we analyse their effects jointly. When, for instance, the economy enters a recession, the PR decreases as a consequence of the DWE and increases because of the AWE. What may be observed directly through the data is the net effect, namely, the sign of (A12):

$$\frac{\partial PR}{\partial Z} = \underbrace{\frac{\partial PR}{\partial w_M^R}}_{(-)} \left(\underbrace{\frac{\partial w_M^R}{\partial y} \cdot \frac{\partial y}{\partial Z}}_{\text{AWE}(+)} + \underbrace{\frac{\partial w_M^R}{\partial p} \cdot \frac{\partial p}{\partial Z}}_{\text{DWE}(-)} \right) = \beta^* \gtreqless 0. \tag{A12}$$

APPENDIX B: SENSITIVITY ANALYSIS

Population composition effect

The first point to consider when explaining the observed spatial dependence is the possible influence of the population characteristics in each territory. To analyse this effect, four additional variables are included in Equation 5 to indicate the composition by gender and age in each territorial unit. The new model is expressed as follows:

$$CPR_{it} = \alpha + \beta_{i1} \cdot CUR_{it} + \beta_2 D_{2001} + \beta_3 F + \beta_4 A1 + \beta_5 A2 + \beta_6 A3 + \mu_i + \varepsilon_{it}, \tag{A13}$$

where the *F* variable is the weight of females and variables *A*1,*A*2 and *A*3 show the percentage of individuals aged from 15 to 24 years, from 25 to 54 years, and from 55 to 64 years, respectively, over the total population. Once the estimation is complete, the presence of spatial correlation is also tested using, as spatial weight matrices, the 5nn and the ID with α = 1.

The results presented in Figure A4 show that the spatial dependence in the cyclical sensitivity is maintained, although with somewhat lower values of the Moran's I. This finding seems to indicate that the BWE is not a consequence of similar population structures in bordering territories (the cyclical sensitivity coefficients are included in Table A5).

To deepen the demographic aspects, the cyclical sensitivity of the activity rate is also estimated separately for males and females (Table A5). In this case, the spatial correlation is only present for women and with values of the Moran's *I* higher than those obtained previously (Figure A5 and A6). This result is coherent with the social effects found in the labor supply of women by Woittiez and Kapteyn (1998) or Maurin and Moschion (2009).

Methodological changes and labour reforms

Other important aspect when analysing a long series of data is the possibility of methodological changes or reforms that may cause breaks in series. Regarding methodological changes, the EPA presents three important modifications that may affect our sample and that occurred in 1999, 2001 and 2005 (the 2001 change was considered in previous

specifications because of its special relevance). As for labour reforms, Spain is characterized as having frequent legislative changes that affect the labour market. However, the most ambitious reforms since the approval of the Workers' Statute (1980) were implemented in 1984, 1994, 2010 and 2012. To consider all these possible effects, we include eight dummy variables in the model (Equation A14):

$$CPR_{it} = \alpha + \beta_{i1} \cdot CUR_{it} + \beta_2^1 D_{1980} + \beta_2^2 D_{1984} + \beta_2^3 D_{1994} + \beta_2^4 D_{1999} + \beta_2^5 D_{2001} + \beta_2^6 D_{2005} + \beta_2^7 D_{2010} + \beta_2^8 D_{2012} + \mu_i + \varepsilon_{it}, \quad (A14)$$

where each D_i represents the methodological change or labour reform made in year *i*. We have estimated Equation A14; now, the global spatial correlation test on the $\beta_{i1}$is repeated using the ID and the five nearest neighbours matrix. The results of this analysis are presented in Figure A7 and once again reaffirm the robustness of our conclusions with a statistically significant BWE (the estimated values for the cyclical sensitivity are shown in Table A5 of Appendix C). The methodological changes and labor reforms have a significant effect on the PR but do not explain the spatial correlation of the cyclical sensitivity.

Quarterly data

Finally, we analyse if spatial dependence is determined by data structure. Thus, we re-estimate Equation 5 by using quarterly data. Using this type of data has additional consequences. On the one hand, it is necessary to deseasonalize the time series, and to do that, we use the x-12 ARIMA method. On the other hand, to obtain the cyclical component of the series, we must modify the smoothing parameter of the HP filter. The empirical literature on this issue is unanimous and advises using λ = 1,600 (Ravn & Uhlig, 2002). The model also includes a three lags structure for the dependent variable and the independent variables. In this manner, two objectives are achieved: the results are comparable with the yearly structure used in the rest of the work, and adjustments that need more than one quarter to take effect are considered. The correct specification in this case is as follows:

$$CPR_{it} = \alpha + \sum_{j=1}^{3} \psi_i^j CPR_{it-j} + \beta_{i1} \cdot CUR_{it} + \sum_{j=1}^{3} \beta_{i1}^j CUR_{it-j} + \beta_2 D_{2001} + \mu_i + \varepsilon_{it.} \quad (A15)$$

Including a lag structure in the dependent variable and in the explanatory variables provides two types of cyclical sensitivity: short term (β_i^S) and long term (β_i^L). They are defined as follows:

$$\beta_i^S = \beta_{i1} + \sum_{j=1}^{3} \beta_{i1}^j \text{ and } \beta_i^L = \frac{\beta_i^S}{1 - \sum_{j=1}^{3} \psi_i^j}. \quad (A16)$$

In this point, the spatial correlation of β_i^S and β_i^L is tested again to analyse if the data structure modifies the results. As in the previous cases, the spatial dependence is maintained with both matrices (five nearest neighbours and ID), which confirms that the yearly data structure does not determine the presence of the BWE. We can also check that the value and the significance of the Moran's *I* are similar in the sensitivity of the short term and long term (Figures A8 and A9)[34].

[34]Table A5 in Appendix C presents the short- and long-term elasticities obtained from the quarterly data estimation.

APPENDIX C: TABLES AND FIGURES

TABLE A1 Unit-Root tests

	HP (λ = 400)		QT		HP (λ = 100)	
	CPR	*CUR*	*CPR*	*CUR*	*CPR*	*CUR*
IPS	−11.930***	−6.254***	−6.330***	−1.817**	−15.745***	−9.008***
LLC	−9.812***	−12.947***	−1.694**	−5.787***	−16.330***	−16.402***
HT	0.551***	0.756***	0.705***	0.872***	0.647***	−14.723***
B	−10.121***	−9.917***	−5.945***	−2.891***	−14.391***	−4.387***

Notes: IPS is the W-t-bar statistic for Im–Pesaran–Shin unit-root test (panel-specific AR parameter, panel means included and without time trend); LLC refers to the bias-adjusted t statistic for Levin–Lin–Chu unit-root test (1 lag in the ADF); HT is the rho statistic for the Harris–Tzavalis test (common AR parameter, panel means included and without time trend) and finally, B refers to lambda statistic for the Breitung unit-root test (common AR parameter, panel means included, and without time trend).
***, **, and *show statistical significance at 1%, 5%, and 10% levels, respectively.

TABLE A2 Descriptive statistics

	Variables	Periods	Mean	Std. Dev.	Min	Max
HP (λ = 400)	*CPR*	1977–2015	4.98e-10	1.277	−5.539	3.967
		1977–1996	−4.98e-10	1.170	−3.960	3.774
		1997–2015	4.57e-10	1.258	−5.561	3.610
	CUR	1977–2015	2.07e-09	3.451	−11.377	9.376
		1977–1996	1.31e-09	2.576	−7.987	10.234
		1997–2015	1.17e-09	3.851	−10.698	10.000
QT	*CPR*	1977–2015	−5.93e-09	1.590	−6.263	5.500
		1977–1996	−0.120	1.380	−3.972	4.806
		1997–2015	0.126	1.776	−6.263	5.500
	CUR	1977–2015	−9.39e-09	5.426	−16.482	13.693
		1977–1996	1.528	4.283	−12.300	12.359
		1997–2015	−1.608	6.008	−16.482	13.693
HP (λ = 100)	*CPR*	1977–2015	1.56e-08	1.080	−5.374	3.348
		1977–1996	0.009	1.068	−3.831	3.348
		1997–2015	−0.010	1.093	−5.374	3.227
	CUR	1977–2015	−1.01e-07	2.693	−9.784	8.980
		1977–1996	0.239	2.447	−8.003	8.980
		1997–2015	−0.251	2.909	−9.784	7.708

Note: CPR is the cyclical component of the PR. CUR is the cyclical component of the unemployment rate.

TABLE A3 Cyclical sensitivity of the LFP (QT procedure and HP λ = 100)

	QT			HP λ = 100)		
	1977–2015	1977–1996	1997–2015	1977–2015	1977–1996	1997–2015
Alava	−0.286***	−0.342***	−0.257***	−0.013	−0.186	0.175
Albacete	0.003	−0.001	−0.002	0.025	−0.012	0.048
Alicante	−0.045	−0.071	−0.041	−0.108*	−0.292***	0.020
Almeria	−0.177***	−0.263***	−0.153***	−0.067	−0.427***	0.042
Asturias	−0.011	0.096	−0.055	0.055	0.015	0.083
Avila	0.015	0.055	0.003	0.062	0.064	0.070
Badajoz	−0.063*	−0.152***	−0.020	0.020	−0.110	0.150*
Balearic Islands	−0.159***	−0.232***	−0.129*	0.011	−0.135	0.101
Barcelona	−0.125***	−0.082*	−0.182***	−0.009	−0.033	0.030
Burgos	−0.220***	−0.179**	−0.245***	−0.084	−0.119	−0.035
Caceres	0.087**	0.036	0.105**	0.138***	−0.094	0.200***
Cadiz	−0.013	−0.024	−0.006	0.068	0.089	0.060
Cantabria	−0.196***	−0.138*	−0.231***	−0.113	−0.111	−0.109
Castellon de la Plana	−0.179***	−0.188**	−0.189***	−0.119**	−0.277***	−0.046
Ciudad Real	−0.101**	−0.086	−0.109*	−0.027	−0.064	0.021
Cordoba	−0.017	−0.068	0.001	0.033	−0.167**	0.142**
Corunna (A)	−0.005	0.289***	−0.149*	0.239***	0.439***	0.039
Cuenca	−0.038	−0.043	−0.040	−0.032	−0.205	0.030
Girona	−0.334***	−0.442***	−0.285***	−0.220***	−0.415***	−0.075
Granada	−0.025	−0.085	−0.004	0.006	−0.154*	0.087
Guadalajara	−0.204***	−0.167***	−0.239***	−0.130*	−0.250***	0.009
Guipuzcoa	−0.251***	−0.193***	−0.311***	−0.089	−0.037	−0.216
Huelva	0.050	−0.014	0.078*	0.100**	−0.129*	0.260*
Huesca	−0.215***	−0.083	−0.305***	−0.001	0.076	−0.057
Jaen	0.012	−0.068	0.051	0.020	−0.080	0.142**
Leon	0.001	0.037	−0.016	0.034	−0.173	0.126
Lleida	−0.326***	−0.118	−0.405***	−0.053	0.040	−0.100
Lugo	0.143**	0.326**	0.106	0.154	0.523***	0.024
Madrid	−0.242***	−0.132**	−0.321***	−0.071	−0.058	−0.082
Malaga	0.047	0.063	0.033	0.026	0.003	0.043
Murcia	−0.146***	−0.194***	−0.138***	−0.056	−0.219**	0.055
Navarre	−0.286***	−0.193***	−0.388***	−0.110	−0.142	−0.060
Orense	−0.074	−0.403***	−0.013	−0.088	−0.671***	0.050
Palencia	0.094**	0.048	0.107*	0.049	−0.035	0.207*
Palmas (Las)	−0.098***	−0.085*	−0.112**	−0.099**	−0.438***	0.035
Pontevedra	−0.191***	−0.121	−0.215***	−0.001	0.105	−0.047
Rioja (La)	−0.272***	−0.218***	−0.325***	−0.092	−0.129	−0.043
Salamanca	−0.032	−0.052	−0.015	0.118*	0.095	0.144
S C Tenerife	−0.025	−0.019	−0.039	0.064	0.098	0.044

(Continues)

TABLE A3 (Continued)

	QT			HP λ = 100)		
	1977–2015	1977–1996	1997–2015	1977–2015	1977–1996	1997–2015
Segovia	−0.121*	0.022	−0.233**	−0.050	0.007	−0.107
Seville	−0.093***	−0.065	−0.107**	−0.043	−0.029	−0.046
Soria	−0.275***	−0.441***	−0.187*	−0.050	−0.458**	0.153
Tarragona	−0.253***	−0.307***	−0.224***	−0.229***	−0.397***	−0.049
Teruel	−0.102*	−0.059	−0.140*	−0.157*	−0.122	−0.202
Toledo	−0.169***	−0.227***	−0.142**	−0.022	−0.194*	0.079
Valencia	−0.172***	−0.147***	−0.197***	−0.049	−0.042	−0.060
Valladolid	−0.212***	−0.283***	−0.183***	−0.236***	−0.428***	−0.061
Vizcaya	−0.145***	−0.088	−0.194***	−0.072	−0.058	−0.095
Zamora	−0.115***	0.019	−0.183***	−0.183**	−0.093	−0.218**
Saragossa	−0.110**	−0.109	−0.129**	−0.023	−0.053	0.015

Note:
*, **, and ***show s statistical significance at 10%, 5%, and 1% levels, respectively.

TABLE A4 Global spatial dependence analysis (QT procedure and HP λ = 100)

	QT			HP (λ = 100)		
	1977–2015	1977–1996	1997–2015	1977–2015	1977–1996	1997–2015
Knn = 1	0.379**	0.346**	0.401**	0.511***	0.194	0.246
Knn = 2	0.453***	0.235**	0.488***	0.290**	0.091	0.125
Knn = 3	0.445***	0.164*	0.502***	0.223**	0.030	0.119
Knn = 4	0.425***	0.126*	0.476***	0.268***	−0.006	0.123
Knn = 5	0.408***	0.115*	0.446***	0.214***	−0.050	0.087
Knn = 6	0.405***	0.105*	0.449***	0.155**	−0.054	0.100*
Knn = 7	0.349***	0.110**	0.381***	0.154***	−0.025	0.084
Knn = 8	0.355***	0.122**	0.386***	0.140***	−0.014	0.111**
Knn = 9	0.332***	0.099**	0.364***	0.108**	−0.049	0.094**
Knn = 10	0.315***	0.099**	0.342***	0.093**	−0.050	0.082**
ID (α = 3)	0.342***	0.195***	0.372***	0.241***	0.074	0.100
ID (α = 2.75)	0.330***	0.178***	0.360***	0.223***	0.065	0.093
ID (α = 2.50)	0.314***	0.161***	0.345***	0.203***	0.055	0.087
ID (α = 2.25)	0.295***	0.142***	0.324***	0.181***	0.044	0.080*
ID (α = 2)	0.270***	0.121***	0.299***	0.158***	0.033	0.072*
ID (α = 1.75)	0.240***	0.100***	0.268***	0.133***	0.021	0.063*
ID (α = 1.50)	0.206***	0.078***	0.232***	0.107***	0.011	0.053**
ID (α = 1.25)	0.168***	0.056***	0.191***	0.081***	0.001	0.043**
ID (α = 1)	0.128***	0.037**	0.147***	0.057***	−0.006	0.031**
ID (α = 0.75)	0.087***	0.019***	0.103***	0.034***	−0.012	0.018***

Notes: The values in the table refer to the Global Moran's I. The null hypothesis refers to the absence of spatial dependence.
*, **, and ***show statistical significance at 10%, 5%, and 1% levels, respectively.

TABLE A5 Cyclical sensitivity of the LFP. Extensions to the baseline model

		Gender		SEM		SAR			Quarterly data	
	Demographic variables	Female	Male	5-nn	Distance	5-nn	Distance	Breaks in series	Short term	Long term
Alava	0.016	−0.038	−0.249***	−0.011	0.069	−0.072	−0.131	−0.016	−0.039	−0.093
Albacete	0.069*	0.072	−0.061	0.077*	0.108***	0.102	0.276	0.087**	0.032	0.086
Alicante	0.010	−0.089	−0.035	−0.029	0.030	−0.098	−0.177	−0.017	−0.037	−0.094
Almeria	−0.028	0.049	−0.124***	−0.080*	−0.028	−0.218**	−0.453**	−0.062	0.050	0.127
Asturias	0.089	0.051	−0.041	0.057	0.146***	0.015	0.214	0.106*	0.071	0.191
Avila	0.041	0.117*	0.026	0.106**	0.176***	0.168*	0.458**	0.113**	−0.028	−0.070
Badajoz	0.007	0.097	0.015	0.095**	0.133***	0.045	0.222	0.082*	0.012	0.028
Balearic Islands	0.042	−0.022	−0.111*	−0.018	0.061	0.059	0.029	0.020	0.046	0.131
Barcelona	0.010	0.016	−0.106**	−0.002	0.069*	0.036	0.136	0.020	0.042	0.125
Burgos	−0.038	−0.040	−0.096	−0.043	0.052	−0.159	−0.233	−0.007	−0.053	−0.122
Caceres	0.087*	0.184***	0.069	0.139***	0.216***	0.211**	0.681***	0.198***	0.106	0.299
Cadiz	0.110***	0.152***	−0.067	0.149***	0.183***	0.164**	0.540***	0.140***	0.021	0.055
Cantabria	−0.056	−0.080	−0.181**	−0.096	0.004	−0.254**	−0.454*	−0.042	0.018	0.045
Castellon de la Plana	−0.076	−0.044	−0.159***	−0.099*	−0.048	−0.232**	−0.509**	−0.089*	−0.044	−0.089
Ciudad Real	−0.023	−0.094	−0.039	0.191***	0.294***	0.259*	0.856	0.031	0.046	0.083
Cordoba	0.026	0.137**	−0.076*	0.085**	0.128***	0.024	0.231	0.082*	0.066	0.138
Corunna (A)	0.200***	0.055	0.014	0.191***	0.111**	−0.018	0.064	0.243***	0.040	0.161
Cuenca	−0.068	0.006	−0.090	0.109*	0.138**	0.094	0.233	0.081	0.023	0.048
Girona	−0.137**	−0.211**	−0.233***	−0.215***	−0.109*	−0.425***	−0.899***	−0.164**	0.000	0.000
Granada	0.022	0.082	−0.098**	0.066*	0.113***	0.054	0.210	0.067*	0.030	0.095

(Continues)

TABLE A5 (Continued)

		Gender		SEM		SAR			Quarterly data	
	Demographic variables	Female	Male	5-nn	Distance	5-nn	Distance	Breaks in series	Short term	Long term
Guadalajara	−0.080	−0.122*	−0.100	−0.108*	−0.015	−0.275**	−0.497**	−0.082	0.046	0.118
Guipuzcoa	−0.023	−0.108	−0.111	−0.078	0.022	−0.180	−0.323	−0.058	0.031	0.082
Huelva	0.132***	0.192***	0.044	0.140***	0.169***	0.157*	0.479***	0.137***	0.084	0.170
Huesca	0.010	0.004	−0.069	0.002	0.128*	0.012	0.176	0.030	−0.011	−0.021
Jaen	0.022	0.231***	−0.024	0.112***	0.144***	0.128	0.388**	0.102***	−0.002	−0.005
Leon	0.012	0.063	−0.044	0.104	0.205***	0.072	0.432	0.136**	0.057	0.142
Lleida	0.031	−0.087	−0.227**	−0.060	0.079	−0.077	−0.065	−0.003	−0.088	−0.201
Lugo	0.243***	0.234**	0.007	0.362***	0.449***	0.517***	1.477***	0.369***	0.043	0.139
Madrid	−0.018	−0.109	−0.171***	−0.070	0.025	−0.224**	−0.338	−0.058	−0.016	−0.028
Malaga	0.088**	0.188***	−0.054	0.095**	0.121***	0.061	0.263	0.087**	0.011	0.028
Murcia	0.007	−0.016	−0.135***	−0.028	0.034	−0.116	−0.187	−0.018	0.021	0.049
Navarre	−0.064	−0.139	−0.117	−0.078	0.029	−0.196	−0.324	−0.066	−0.029	−0.055
Orense	−0.027	0.000	−0.163**	0.022	0.073	−0.092	−0.143	0.029	0.000	−0.001
Palencia	0.043	−0.033	0.033	0.121**	0.198***	0.228**	0.573**	0.126**	0.076	0.224
Palmas (Las)	−0.016	0.01	−0.172***	−0.057	−0.032	−0.223**	−0.437**	−0.068	0.011	0.027
Pontevedra	0.046	−0.002	−0.102	0.007	0.113**	−0.114	−0.087	0.054	0.056	0.185
Rioja (La)	−0.072	−0.080	−0.107	−0.070	−0.002	−0.185	−0.422	−0.080	0.003	0.007
Salamanca	0.073	0.085	0.008	0.148**	0.239***	0.247**	0.661**	0.191***	0.108	0.208
Segovia	−0.036	0.087	−0.052	0.007	0.131**	0.003	0.120	0.041	0.009	0.019
Seville	0.011	0.027	−0.101	0.034	0.065*	−0.132	−0.127	0.010	0.028	0.078
Soria	−0.141	0.070	−0.128***	−0.021	0.120	−0.063	−0.040	0.013	−0.026	−0.067

TABLE A5 (Continued)

		Gender		SEM		SAR			Quarterly data	
	Demographic variables	Female	Male	5-nn	Distance	5-nn	Distance	Breaks in series	Short term	Long term
Tarragona	−0.105*	0.072	−0.224**	−0.158***	−0.076	−0.376***	−0.732***	−0.143**	−0.097	−0.169
S C Tenerife	0.127**	−0.200**	−0.194***	0.096*	0.133***	0.098	0.378*	0.095*	0.009	0.023
Teruel	−0.067	−0.084	−0.159*	0.014	0.089	−0.054	−0.057	0.003	−0.081	−0.179
Toledo	−0.002	0.052	−0.153***	0.024	0.100**	−0.068	−0.015	0.036	−0.014	−0.038
Valencia	−0.013	−0.010	−0.192***	0.002	0.039	−0.087	−0.124	−0.024	−0.008	−0.021
Valladolid	−0.108*	−0.156**	−0.169**	−0.141**	−0.038	−0.388***	−0.736***	−0.109*	−0.056	−0.162
Vizcaya	−0.007	−0.082	−0.080	−0.017	0.090	−0.049	0.021	0.012	−0.031	−0.078
Zamora	−0.194***	0.021	−0.280***	−0.128**	−0.016	−0.341***	−0.603**	−0.053	0.038	0.087
Saragossa	0.017	−0.026	−0.101*	0.007	0.080	−0.020	0.056	0.013	0.023	0.062
λ				0.559***	0.826***					
ρ						0.518***	0.795***			

Notes:
*, **, and ***show s statistical significance at 10%, 5%, and 1% levels, respectively.
The cyclical sensitivity in the SAR model is the sum of the direct and the indirect effect.
In the last two columns the level of significance is not included because the results are obtained by using expressions (24) and (25)

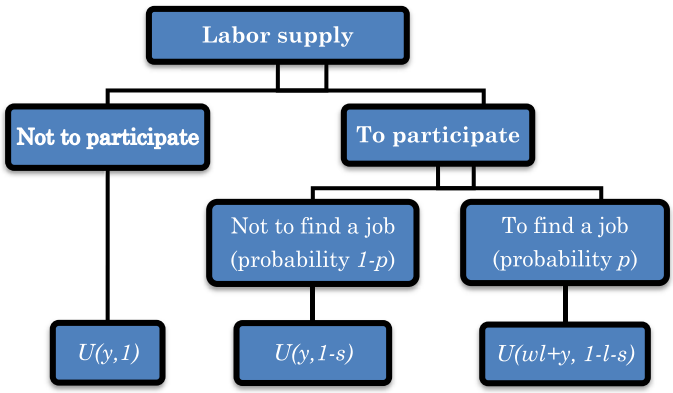

FIGURE A1 Set of alternatives for the worker

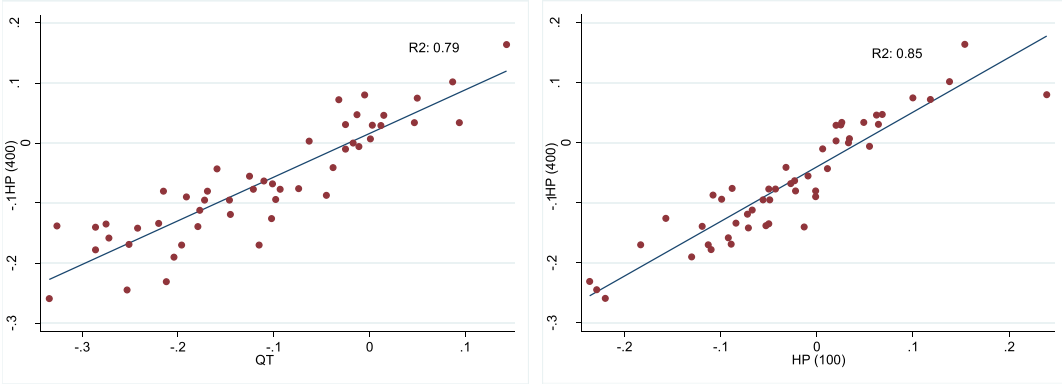

FIGURE A2 Scatterplot diagrams of the relationship between the cyclical sensitivities obtained by the HP method (λ = 400), HP method (λ = 100) and the QT procedure

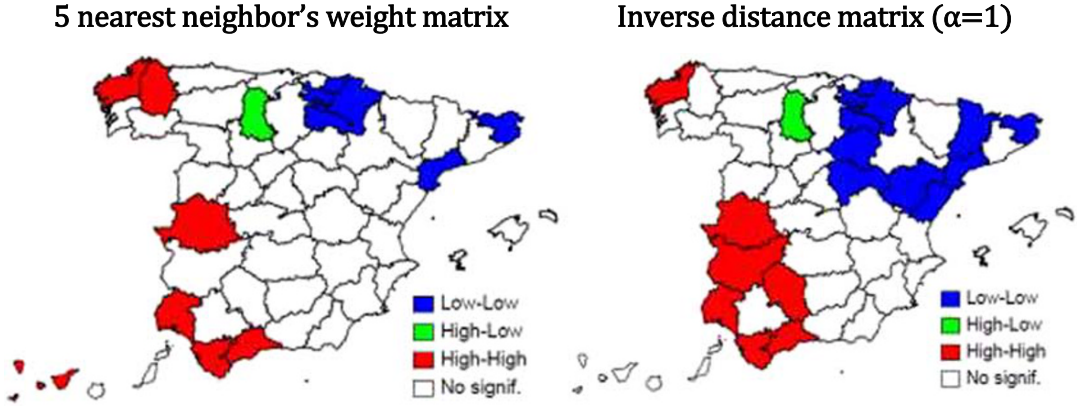

FIGURE A3 Local spatial dependence test (1977–2015) (HP λ = 400)

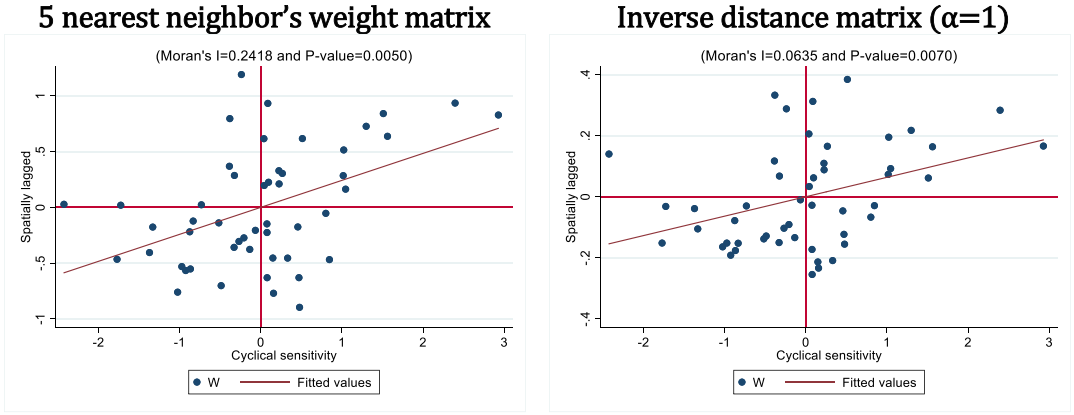

FIGURE A4 Global scatterplot diagrams of Moran's *I*: Population variables (1977–2015) (HP λ = 400)

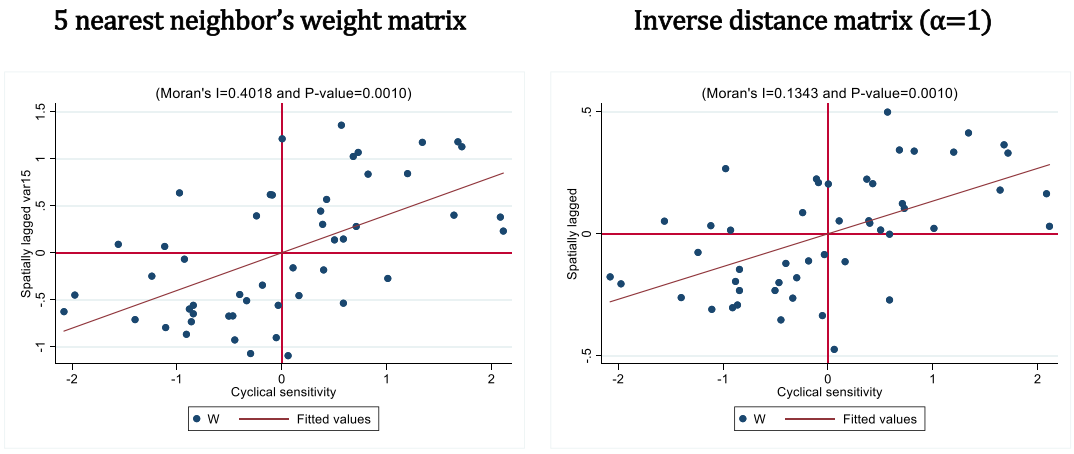

FIGURE A5 Global s diagrams of Moran's *I*: females (1977–2015) (HP λ = 400)

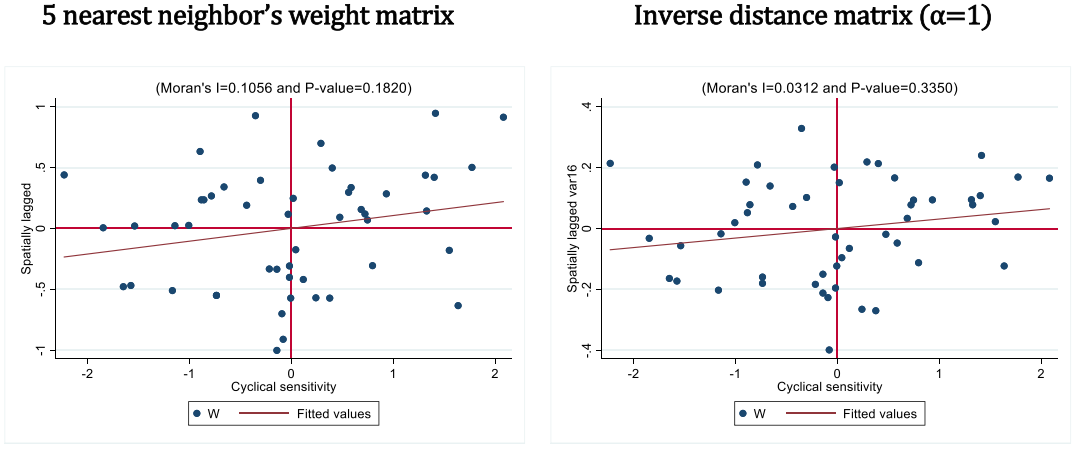

FIGURE A6 Global scatterplot diagrams of Moran's *I*: males (1977–2015) (HP λ = 400)

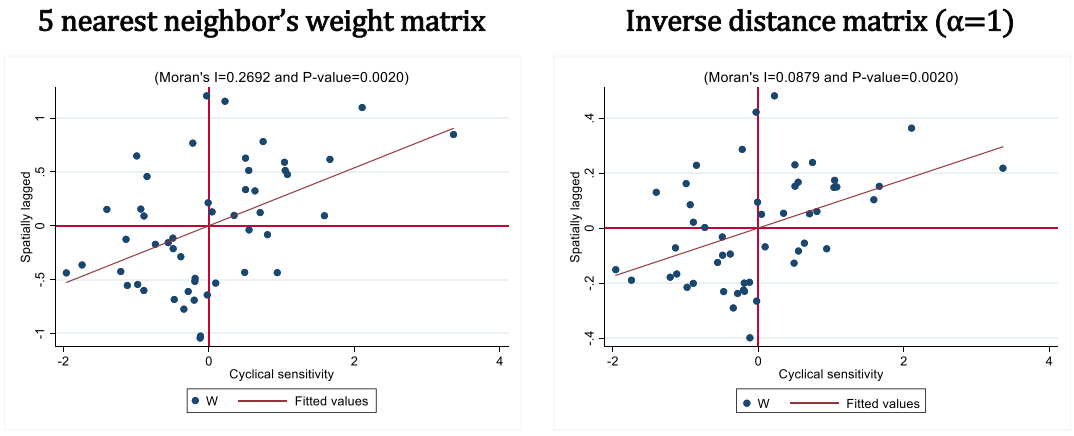

FIGURE A7 Global scatterplot diagrams of Moran's *I*: labour reforms and breaks in series (1977–2015) (HP λ = 400)

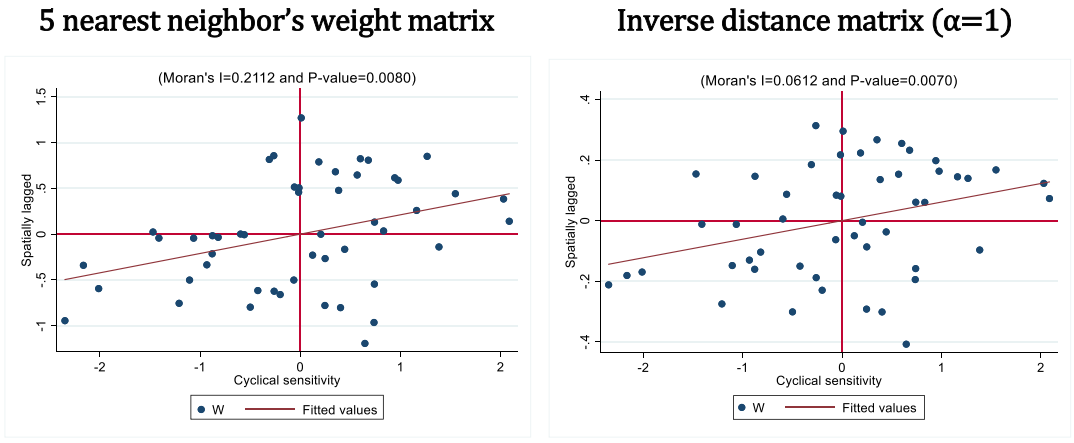

FIGURE A8 Global sScatterplot diagrams of Moran's *I*: short term elasticity (1977–2015 quarterly) (HP λ = 400)

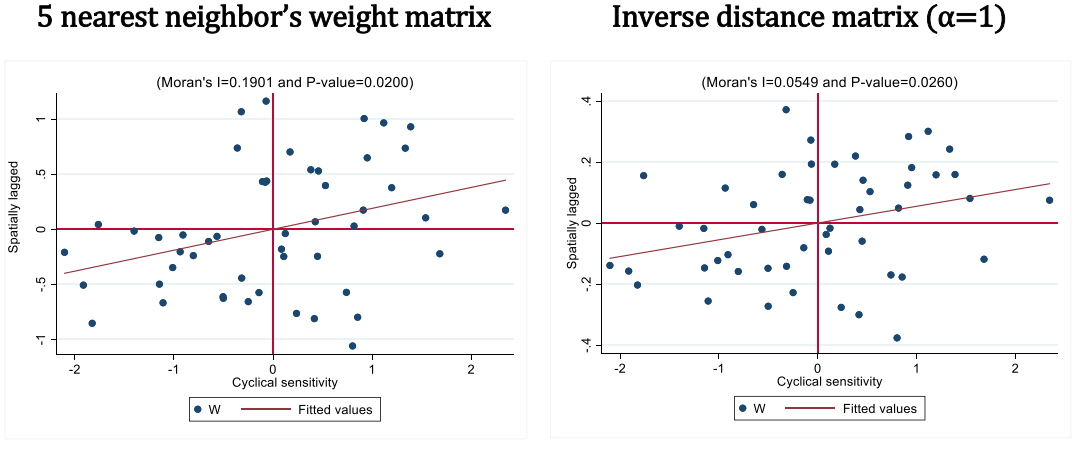

FIGURE A9 Global scatterplot diagrams of Moran's *I*: long term elasticity (1977–2015 quarterly) (HP λ = 400)

CAPÍTULO 4

Una evaluación de impacto del segundo Plan Regional de Empleo de Castilla y León

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Una evaluación de impacto del segundo Plan Regional de Empleo de Castilla y León

An impact evaluation of the second Regional Employment Plan of Castile and Leon

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KEYWORDS: Regional analysis, Impact evaluation, Local labour markets

Clasificación JEL: R23, J68, C21.

RESUMEN

En este trabajo se lleva a cabo una evaluación del Segundo Plan Regional de Empleo de Castilla y León (SPRECyL). Para ello se utiliza la metodología expuesta en Meyer (1995), basada en el enfoque "cuasi-experimental". Concretamente se estudian los efectos del SPRECyL sobre la tasa de ocupación y desempleo de Castilla y León durante su periodo de vigencia. Esta investigación puede ser de gran utilidad a los responsables de política económica debido a la escasa evaluación de este tipo de políticas y a que aporta una importante información que permite utilizar de forma más eficiente los recursos públicos.

ABSTRACT

Introduction

Active labor market policies are a tool used by Public Administrations aimed at increasing the level of employment and, at the same time, at reducing the unemployment rate of an economy. For this purpose, regional governments have implemented employment plans to support national actions. In the case of Castile and Leon, the first Regional Employment Plan of Castile and Leon (PRECyL) was carried out in 1998 with a duration of three years. This one was followed by the Second Regional Employment Plan of Castile and Leon (SPRECyL), for the period 2001-2003, and by several subsequent plans to the present.

However, as far as the evaluation of these programs is concerned, we have only found a first attempt for the PRECyL (Martín Román, 2007). All other plans have remained unassessed. From

our point of view, it is necessary to continue analyzing the effects of the second plan in order to evaluate its effectiveness adequately. On the one hand, this evaluation will allow us to make an interesting comparison regarding the effects associated with the implementation of the PRECyL. On the other hand, it will reveal to us if the variations in the main indicators of the labor market that we observe in the provinces of Castile and Leon are due to the implementation of the SPRECyL or, on the contrary, can be attributed to the economic situation (which produces effects, in general, for all the Spanish provinces). The key point is that the outcomes obtained in such studies can be very useful for the policy makers. These results let us know their effects on the economic activity at the regional level and, moreover, they make it possible to assess the efficiency of using public funds.

Methodology

From an applied perspective, the evaluation corresponding to this SPRECyL is implemented through the methodology presented in Meyer (1995), which is based on a "quasi-experimental" approach. Then, the objective is to evaluate the impact of a treatment on a specific population where the "quasi-experiment" is determined exogenously (through a natural phenomenon, a law...), that is, the researcher does not intervene in determining which group has been affected by the treatment and which does not (the latter is what we can call as the control group or the comparison group). In this work in particular, the interest lies in evaluating the effectiveness of a Regional Employment Plan on the labor market of Castile and Leon.

Consequently, the group of treatment here consists of all the provinces of this region that are beneficiaries of the program and the group of control is represented by the rest of provinces of the national territory that will not be affected by the treatment previously defined.

In order to perform the estimates, we have chosen the econometric technique of "differences in differences", which has been widely used in different fields of economic research (Card and Krueger 1994; Crépon and Kramarz 2002; Sánchez-Mangas and Sánchez-Marcos, 2008; Delgado and Florax, 2015). By using this methodology, we can easily evaluate the results achieved from the public program or policy developed. We only have to compare the results of the group of treatment (all the provinces of Castile and Leon) with those of the group of control (the provinces of the rest of Spain). Thus, the ultimate goal of the study is to measure the impact of the program considered, isolating the effect that other factors can cause.

The period considered in this analysis is the one covering 1998-2003. In the first three years (1998, 1999, 2000) the PRECyL was in force, while the last three (2001, 2002, 2003) refer to SPRECyL. In this way, it is possible to examine whether the second plan produces any differential effect on the level of employment or unemployment, beyond those observed with the former one. In addition, it must be taken into account that this is a relative comparison. In Castile and Leon there was already a plan in the first period of analysis and the regions used as control can also have been affected by other actions or policies. Hence, what we want to find out is if the SPRECyL has caused significant results to those observed in the rest of the Spanish provinces during the period contemplated.

Main Results

Initially, our results point to an increase in the employment rate and a reduction in the unemployment rate, during the years when the SPRECyL was implemented (2.6 and -1.7 percentage points, respectively). Nevertheless, we cannot establish a direct causal relationship between these rates and the SPRECyL. Thus, it is possible that this effect is a consequence of a global trend, common to all the provinces in Spain, not only for the provinces of Castile and Leon (where the SPRECyL acts). Once we introduce other regressors, capturing whether the previous rate variations have occurred in a gradual way, we observe that the effect of the SPRECyL ceases to be significant, which is a signal of their lack of effectiveness.

Later, with the application of the "differences in differences" analysis, we observe how the different evolution of Castile and Leon provinces, in comparison with others provinces of Spain, is negative for the case of the employment rate (more precisely 0.6 percentage points). To prove the robustness of our results we have performed different econometric specifications, obtaining

similar results. In this case, we can state that the employment rate grew less in Castile and Leon provinces than in the rest of Spain provinces in those years when the SPRECyL was implemented. On the other hand, the results for the unemployment rate point to a similar evolution to the rest of Spanish provinces during the same years. In this case, the diff-in-diff estimates establish that despite maintaining a negative sign, the coefficients are generally not significant.

Conclusions

The results found from the exploration of the employment and unemployment rates let us draw some interesting conclusions. First of all, the increase observed in the employment rates of the provinces of Castile and Leon during the years of the SPRECyL is lower than the one detected in other provinces not influenced by this plan. Besides, the evolution of the unemployment rate in the provinces of Castile and Leon is very similar to that perceived in the rest of provinces of Spain. As a consequence, the first conclusion that can be depicted, being the most immediate, is the absence of a remarkable impact of the SPRECyL.

In other words, it can be said that the increase in the employment rate, as well as the reduction in the unemployment rate, observed in the provinces of Castile and Leon during the three years of the SPRECyL is equally generalizable to the rest of Spanish provinces. As a result, it seems logical to assume that the evolution noted in the labor market of this region may have been due to a favorable trend of the economic situation during the period of interest rather than the implementation of a program or a policy in particular (in our case, the SPRECyL). Finally, it should be indicated that the result achieved here is not new, since it coincides with that found for the first plan, the PRECyL.

1. INTRODUCCIÓN

Las políticas activas del mercado de trabajo son una herramienta utilizada por las Administraciones Públicas orientadas a incrementar el nivel de empleo y, a su vez, a reducir el desempleo de una economía. Con este objetivo, los gobiernos regionales han implementado planes de empleo que apoyen las actuaciones realizadas a nivel nacional. Para el caso de Castilla y León, en 1998 la Junta puso en marcha el primer Plan Regional de Empleo de Castilla y León (PRECyL) con una duración de tres años. A este le siguió el Segundo Plan Regional de Empleo de Castilla y León (SPRECyL) para el periodo 2001-2003. De acuerdo con los datos reflejados en la memoria anual del Consejo Económico y Social de Castilla y León (CESCyL, 2004, p. 281), los destinatarios del SPRECyL ascendieron a 285.377 personas. El presupuesto de dicho plan en materia de apoyo al empleo alcanzó los 188,5 millones de euros para el conjunto del periodo (en 2001 fue de 43,8 millones de euros, en 2002[1] ascendió a 65,5 millones de euros y en 2003 fue de 79,2 millones de euros). Por lo que respecta a la formación, se destinaron más de 141 millones de euros y estuvo dirigida a un total de 117.371 alumnos. Los puestos de trabajo subvencio-

1 *La cifra de la dotación del presupuesto para el SPRECyL de 2002 no resulta comparable con la ofrecida para el año 2001. La relativa a 2002 incorpora partidas previamente incluidas en las Políticas Activas del INEM (CESCyL, 2002, p. 293).*

nados mediante el SPRECyL se situaron en 55.040 y el número de personas que recibieron orientación laboral fue de 79.774.

La magnitud de las cifras presentadas por este Segundo Plan Regional de Empleo pone de manifiesto la necesidad de llevar a cabo una investigación sobre su eficacia que puede resultar muy reveladora. De un lado, permitirá realizar un análisis comparativo en relación a los resultados obtenidos por el PRECyL (Martín Román, 2007). También podremos obtener conclusiones más precisas acerca de la eficacia que un programa de gasto público como éste ha tenido en función de los objetivos planteados y de la evolución del empleo y el desempleo regional durante esos años.

Este trabajo continúa la evaluación realizada por (Martín Román (2007) para el PRECyL. Aunque con posterioridad se han seguido implementando más planes no ha ocurrido lo mismo con su proceso de evaluación. Es por ello que consideramos necesario continuar con el análisis de los efectos del segundo de estos planes con el fin de valorar adecuadamente su eficacia. Por este motivo, cabe volverse a preguntar si los resultados logrados por el SPRECyL, en términos de empleo en las provincias de Castilla y León, son consecuencia de la implementación del programa o, por el contrario, se deben a una determinada coyuntura económica a nivel nacional que pueda apreciarse también en el comportamiento del resto de provincias españolas.

En este punto conviene aclarar que la evaluación que aquí se plantea es en términos relativos. Por un lado, y como ya se ha comentado, en Castilla y León ya existía un plan en los primeros años del periodo. Por otro, en todas las provincias utilizadas como control también pueden haber existido actuaciones similares. Por lo tanto, lo que nos planteamos es si el SPRECyL ha sido diferencialmente mejor del resto de planes que pueden haber estado actuando en ese periodo en cualquiera de las provincias empleadas en el análisis.

Adicionalmente a la política que aquí se evalúa, en Castilla y León se han seguido implementando planes de empleo. Entre 2004 y 2006 se aplicó el III Plan Regional de Empleo, y después se aprobaron el IV (entre 2007 y 2010) y el V que transitoriamente se desarrolló solo para el año 2011. Desde este momento los planes de empleo se han incluido en estrategias integradas de empleo, formación profesional, prevención de riesgos laborales e igualdad y conciliación en el empleo. La primera se desarrolló entre 2012 y 2015, y actualmente se está inmerso en la segunda de ellas, que abarca el periodo comprendido entre 2016 y 2020.

El trabajo se estructura del siguiente modo: en la segunda sección se analizan algunas de las implicaciones de las políticas activas de empleo en diversos trabajos académicos a nivel de España y desde una perspectiva internacional. La tercera sección detalla las características principales del SPRECyL, tanto en términos de apoyo al empleo como en políticas de formación. En el apartado cuarto se estudia brevemente la base de datos utilizada. La sección quinta, describe la estrategia empírica utilizada y las especificaciones econométricas propuestas. El apartado

sexto analiza los resultados obtenidos y, finalmente, se presentan las principales conclusiones del trabajo.

2. ALGUNAS CONSIDERACIONES ACERCA DE LAS POLÍTICAS ACTIVAS

Las *políticas activas* del mercado de trabajo abarcan todas aquellas medidas destinadas a incidir directamente en el funcionamiento del mercado de trabajo con la finalidad de incrementar el nivel de empleo o reducir el paro. Dentro de las *políticas activas* podemos realizar una triple clasificación: (1) medidas destinadas a aumentar la demanda de trabajo, (2) medidas que buscan mejorar los procesos de ajuste a corto plazo entre oferta y demanda de trabajo (por ejemplo, mediante la formación de los trabajadores en paro) y (3) medidas destinadas a la disminución de la oferta de trabajo o a la redistribución del empleo existente (sirvan de ejemplo las jubilaciones anticipadas o la reducción de la jornada de trabajo) [2].

Un primer trabajo centrado en el caso de España, que trata de evaluar la efectividad de las políticas de empleo es el de Alujas Ruiz (2002). En él se sugiere que las políticas activas se orienten a aquellos colectivos de personas con menor probabilidad de recibir ofertas de empleo, puesto que influyen tanto en la probabilidad de abandonar el desempleo como en su duración. Asimismo, afectan a la eficacia del sistema de formación profesional con el objetivo de evitar los desajustes en la cualificación. En un segundo trabajo, Herrarte *et al.* (2006) agrupan estas políticas en las siguientes áreas: políticas de prevención y de activación que mejoren la inserción profesional de desempleados, políticas específicas de formación, políticas de reducción de desigualdades en materia de empleo y políticas de fomento del empleo. La mayor o menor trascendencia de las políticas activas se ha venido asociando a tres particularidades: las circunstancias de la economía, la situación financiera del sector público y, especialmente, al nivel de paro presente en cada momento. Respecto a este último, las *políticas activas* se pueden concebir como políticas complementarias en el sentido de que tienen un alcance limitado. En otras palabras, nunca bastan para solucionar problemas graves (circunstancia que se ha de tener siempre presente).

Por su parte, (Martín Román (2007) en una evaluación de los efectos del PRECyL, concluye que a lo largo del periodo de vigencia del PRECyL se observó un aumento de la ocupación y una reducción de las tasas de desempleo en las provincias castellanoleonesas, pero esta circunstancia estuvo motivada, funda-

2 *Véase García-Serrano (2007) para una explicación más detallada de estas y Alujas Ruiz (2006) para su desarrollo en el contexto de la Unión Europea durante las últimas décadas.*

mentalmente, por la coyuntura favorable de la economía española y no tanto por el programa en concreto. De hecho, las provincias castellanoleonesas experimentaron una peor evolución relativa del empleo y el desempleo, durante el mismo periodo, en comparación con otras provincias españolas.

Existe otro grupo de trabajos que se centra en los efectos adversos de las políticas activas de empleo. Toharia *et al.* (2008), distinguen tres efectos adversos que pueden causar aquellas políticas ligadas a la concesión de subvenciones para creación de nuevos puestos de trabajo. Son los siguientes: (1) *"efecto ganga"* o *"efecto peso muerto" (deadweight)*, que consiste en que un empresario habría contratado igualmente a un trabajador en ausencia de incentivos. El único efecto aquí es el despilfarro de recursos por el sector público; (2) *"efecto sustitución"*, es decir, cuando lo máximo que se consigue es contratar a un empleado para remplazar a otro; (3) *"efecto desplazamiento"*, es aquel que surge cuando las ventajas que se consiguen con la subvención "expulsan" a otros competidores del mercado, esto es, puede ocurrir que se destruya empleo en otras empresas (se da principalmente en actividades muy competitivas). Estos tres son los primordiales, tal y como identifican Malo *et al.* (1999), pero también pueden darse otros efectos añadidos, como la disminución de incentivos al desarrollo tecnológico, que reducirían en gran medida el impacto de dichas políticas en las variables agregadas a las que vayan orientadas. Por tanto, la tendencia a creer que al financiar un puesto de trabajo se incrementa la ocupación, y por tanto, se consigue reducir el desempleo resulta engañosa. Es preciso analizar el efecto neto concreto que tienen las políticas activas sobre el nivel de empleo y desempleo para poder obtener conclusiones claras sobre su utilidad y eficacia.

En este contexto, el trabajo de Ramos *et al.* (2010) hace especial hincapié en la necesidad de evaluar de forma continua los efectos desencadenados por las políticas activas de empleo. Los autores destacan que en el caso de España, pese a llevar a cabo un gasto en políticas activas de empleo similar al de otros países europeos, los resultados resultan ser muy pobres. Finalmente, también se incide en la necesidad de reforzar y reordenar el papel del sector público como elemento clave para dinamizar el mercado laboral y la reasignación de recursos procedentes de políticas activas de empleo.

Un buen resumen de los trabajos sobre evaluación de políticas realizados en España se puede encontrar en el Cuadro 1. En este cuadro se muestran los autores de los trabajos, el enfoque del estudio, las políticas evaluadas, la población objetivo, el periodo analizado, el método de evaluación y el resultado obtenido. En general, son tres los tipos de programas evaluados, los de formación, los incentivos a la contratación y las políticas de intermediación laboral. Con respecto al primero de ellos, en la mayoría de los trabajos se aprecian efectos positivos de los programas de formación en el acceso al mercado de trabajo (Mato y Cueto, 2008; Cueto y

CUADRO 1
EVALUACIÓN DE POLÍTICAS ACTIVAS DE EMPLEO EN ESPAÑA

Estudios	Enfoque de estudio	Tipo de política activa de empleo	Grupo objetivo	Periodo temporal	Método de evaluación	Efecto del programa
Mato et al.(2004)	Microeconómico	Incentivos al autoempleo	Autoempleados sin trabajadores	1995-1999	Regresión logística (Logit)	Positivo
Cueto (2006)	Macroeconómico	Incentivos al empleo/contratación	Varios	Mediados de los años 90 y principios de los 2000.	Análisis descriptivo	Positivo (Ayudas a la contratación indefinida) Adverso (Reforma 1997, programa nacional de fomento de la contratación indefinida, medidas de carácter autonómico)
Malo y Muñoz-Bullón (2006)	Microeconómico	Intermediación laboral Promoción del empleo	Personas con discapacidad	1999	Diseño cuasi-experimental	Nulo (No mejoran la calidad del emparejamiento con el puesto)
Mato y Cueto (2008)	Microeconómico	Cursos de formación	Desempleados	1995	Diseño cuasi-experimental	Positivo (Tiempo trabajado y acceso al empleo)
Cueto y Mato (2009)	Microeconómico	Cursos de formación	Desempleados	1999	Diseño cuasi-experimental	Positivo
García Pérez y Rebollo (2009)	Microeconómico	Subsidios salariales (Incentivos a contratación y transformación de temporales en indefinidos)	Transiciones desempleo-empleo indefinido y empleo temporal-empleo indefinido.	Mediados de los años 90 hasta mediados de los 2000.	Diseño cuasi-experimental	Positivos (aunque con un efecto muy reducido)
Ramos et al. (2009)	Microeconómico	Cursos de formación Orientación e intermediación laboral	Desempleados	2005	Diseño cuasi-experimental	Positivo
Arellano (2010)	Microeconómico	Cursos de formación	Desempleados	2000-2001	Diseño cuasi-experimental	Positivo

continúa...

CUADRO 1
EVALUACIÓN DE POLÍTICAS ACTIVAS DE EMPLEO EN ESPAÑA (CONCLUSIÓN)

Estudios	Enfoque de estudio	Tipo de política activa de empleo	Grupo objetivo	Periodo temporal	Método de evaluación	Efecto del programa
Malo y Cueto (2015)	Microeconómico y macroeconómico	Intermediación laboral Creación directa de empleo Cursos de formación Incentivos a la contratación	Varios	Primera parte de la década de los años 2000	Diseño cuasi-experimental	Positivo
Castelló (2012)	Microeconómico	Incentivos a la contratación	Personas con discapacidad	1996-2007	Diseño cuasi-experimental	Positivo
Clemente et al. (2012)	Microeconómico	Incentivos a la contratación Formación para el empleo Creación directa de empleo público	Demandante de individuos desempleados (beneficiarios directos) Desempleados (beneficiarios indirectos)	2005-2010	Diseño cuasi-experimental	Positivo
Borra et al. (2012)	Microeconómico	Cursos de formación e intermediación laboral	Desempleados	2004-2006	Diseño cuasi-experimental	Positivo (corto plazo) Nulo (largo plazo)
Blázquez et al. (2012)	Microeconómico	Cursos de formación	Desempleados	2006-2009	Probit bivariado con selección muestral	Positivo
Arranz et al. (2013)	Macroeconómico	Incentivos a la contratación, autoempleo y creación empleo Cursos de formación	Transiciones desempleo-empleo. Transiciones empleo temporal-empleo indefinido.	1987-2010	Panel de datos dinámico	Positivo (aunque reducido): Incentivos a la contratación/autoempleo/creación de empleo Nulo o escaso: Resto de programas
Clemente et al. (2014)	Microeconómico	Cursos de formación	Desempleados	2005-2009	Diseño cuasi-experimental	Positivo
De la Rica (2015)	Microeconómico y macroeconómico	Cursos de formación. Incentivos a la contratación/Empleo	Varios	Décadas de los años 90 y 2000.	Varios	Positivo (aunque reducido) en la mayoría de los casos.
Jiménez-Martín et al. (2017)	Microeconómico	Incentivos a la contratación	Personas con discapacidad	1990-2014	Diseño cuasi-experimental	Inefectivos o nulos en la mayoría de los casos.

Fuente: Elaboración propia.

Mato, 2009; Arellano, 2010; Cueto et al, 2010; Cansino y Sánchez 2011; Blázquez et al, 2012 y Clemente et al, 2012 y 2014), aunque también hay estudios donde este efecto es menos claro o reducido (Arranz et al, 2013; Borra et al, 2012 y De la Rica, 2015). En el caso de incentivos a la contratación no se encuentran efectos positivos claros (Cueto, 2006; García Pérez y Rebollo, 2009; Arranz et al, 2013; De la Rica, 2015 y Jiménez-Martín et al, 2017) salvo en los trabajos de Castelló (2012) y Clemente et al. (2012) donde estos programas afectan positivamente sobre el mercado de trabajo. Finalmente, Ramos et al. (2009) y Malo y Cueto (2015) también encuentran efectos positivos de las políticas de intermediación laboral (en un análisis para discapacitados, Malo y Muñoz Bullón (2006) no encuentran efectos en este programa).

Desde una perspectiva internacional son varias las líneas de análisis que se pueden destacar por lo que a evaluación de políticas se refiere. Por un lado, existen varios trabajos dedicados a analizar los efectos de las políticas activas de empleo, tanto a corto como a largo plazo. Para el caso alemán, Hujer et al. (2009) utilizan técnicas espaciales sobre una estructura de datos de panel y evalúan el efecto de las políticas activas de empleo sobre una muestra de individuos registrados en un total de 141 oficinas de empleo locales. Los autores estudian cuatro tipos de políticas activas: Perfeccionamiento profesional y readiestramiento; Medidas de formación en el corto plazo; Planes de creación de empleo y subsidios salariales. Los resultados indican que no se incrementan los flujos de desempleo hacia el empleo a corto plazo. También para Alemania, Lechner y Wunsch (2009) se centran en el efecto de los cursos de formación sobre una base de datos compuesta por demandantes de empleo, durante el periodo 1986-1995. Empleando diferentes estimadores de emparejamiento (matching) aportan evidencia empírica de que estas políticas tienen efectos negativos (positivos) sobre el empleo y los salarios en el corto (largo) plazo. También dichos efectos son diferentes en función de si existe una situación de bajo o alto desempleo, obteniéndose efectos negativos (positivos) mayores en el primer (segundo) caso.

Dentro de esta misma línea Sianesi (2008) analiza seis programas de políticas activas de empleo para Suecia en el año 1994. Como en el caso anterior, los resultados indican una reducción de la probabilidad de empleo de los participantes en el corto plazo. Sin embargo, en el largo plazo, el empleo subsidiado (incentivos al empleo) así como los programas centrados en otorgar experiencias laborales a los desempleados, resultan ser los más efectivos. Finalmente, Brown y Koettl (2015) realizan un trabajo exhaustivo de detección y clasificación de los programas centrados en las políticas activas del mercado laboral. Los autores establecen que aquellas políticas destinadas a "retener el empleo" sólo deberían utilizarse en el corto plazo y en recesiones severas. Por otra parte, se deberían potenciar aquellas políticas centradas en la creación de empleo, tratando de lograr la incorporación de

individuos inactivos reforzando su vinculación con el mercado de trabajo. Los autores también apuntan que tanto el empleo público como los subsidios, no suelen generar grandes incrementos del empleo a diferencia de las políticas relacionadas con la activación de los individuos dentro del mercado laboral. Además se señala que los réditos de estos programas suelen ser mayores en el largo plazo en comparación con los ofrecidos en el corto plazo.

Otra línea de trabajos especialmente interesante es la que incluye análisis recopilatorios basados en técnicas de meta-análisis. Una buena referencia en esta literatura es el trabajo de Card et al. (2010) donde se estudian 97 investigaciones realizadas entre 1995 y 2007 y que engloban a un total de 199 programas. La primera conclusión está en la línea de los trabajos anteriores y muestra que las evaluaciones a largo plazo suelen ofrecer unos resultados más favorables que las de corto plazo. En segundo lugar se apunta que las fuentes de datos resultan ser un elemento muy determinante a la hora de evaluar el impacto de la política en cuestión. Para terminar, se concluye que las políticas basadas en programas de subsidios públicos tienen peores resultados y que el género no ejerce influencia sobre la efectividad de las políticas activas de empleo. Otro trabajo muy similar es el de Kluve (2010). En este caso la investigación abarca a un total de 96 trabajos académicos que engloban a 137 evaluaciones programáticas de políticas activas de empleo, dirigidas a un total de 19 países europeos. El autor concluye que las condiciones macroeconómicas ejercen un papel muy reducido a la hora de determinar la eficacia de los programas de políticas activas. Por el contrario lo que parece influir en mayor medida es el tipo de programa que se va a implementar y sus características concretas. También se establece que las políticas centradas en subsidios salariales así como los programas de "*Services and Sanctions*", parecen incrementar las probabilidades de obtener un empleo por los individuos participantes.

Un tercer grupo de trabajos es el de aquellos más centrados en el tipo de programa implementado. En esta línea encontramos el trabajo de Boone y van Ours (2004), donde se analizan diferentes tipos de políticas activas de empleo para un total de veinte países pertenecientes a la OCDE durante el periodo temporal 1985-1999. Los autores ponen de manifiesto que son las políticas centradas en la formación en el mercado de trabajo (*labor market training*) aquellas que poseen un mayor impacto en la reducción del desempleo y en la mejora de los niveles de empleo. También se constata el importante papel del sector público a la hora de reducir el desempleo. Sin embargo, los incentivos al empleo (empleos subsidiados) no ejercen ningún tipo de efecto en el mercado laboral. En Blundell et al (2004) se evalúa el efecto de las políticas activas de empleo, intermediación laboral e incentivos al empleo (subsidios a la contratación), entre los desempleados más jóvenes en el Reino Unido durante los últimos años de la década de los noventa. Esta investigación ofrece evidencia a favor de estas políticas a la hora de aumentar las incorporaciones al empleo con un efecto mayor en el corto plazo.

Por su parte, Jespersen et al. (2008) analizan el efecto de cuatro programas relacionados con las políticas activas de empleo (formación desde el sector privado, formación desde el sector público, formación en el aula y los denominados como "programas residuales") en Dinamarca durante el periodo 1995-2005. Sus resultados indican a que la formación desde el sector privado, en primer lugar y posteriormente, la formación desde el sector público son los programas que mejores resultados arrojan en términos de empleo e ingresos futuros para los participantes. Finalmente, Lalive et al. (2008) estudian el caso de Suiza empleando dos estimadores diferentes. Las conclusiones apuntan a que, utilizando el primer estimador, las políticas centradas en subsidios laborales de carácter temporal son las más efectivas. Por su parte, el segundo estimador establece que ninguna de las políticas activas reduce la duración del periodo de desempleo de los individuos.

Por último, y ahora desde una perspectiva regional, Dauth *et al.* (2016) estudian la efectividad de las políticas activas de empleo desde una perspectiva regional para el caso de Austria. Los autores apuntan a un efecto positivo de estas políticas activas a la hora de lograr emparejamientos en el mercado laboral. También se pone de manifiesto el importante papel de este tipo de programas a la hora de reducir los "costes psicológicos" que conlleva estar en una situación de desempleo, así como el efecto que estas ejercen a la hora de reducir la depreciación del capital humano de los individuos en situación de desempleo[3].

3. EL SEGUNDO PLAN REGIONAL DE EMPLEO DE CASTILLA Y LEÓN

Este epígrafe se divide en dos bloques, por un lado se analizan las características generales del SPRECyL .Por otro se detallan las políticas destinadas al empleo y a la formación.

3.1 Aspectos y características generales del SPRECyL

Una vez finalizado el primer Plan Regional de Empleo de Castilla y León, (PRECyL) que comprendía el periodo 1998-2000, en 2001 se suscribió el nuevo plan para el periodo 2001-2003: el SPRECyL. Al igual que sucedía con su antecesor, el SPRECyL se ajusta a las Directrices de la Cumbre de Luxemburgo[4], teniendo

3 Para una explicación más extensa de la evaluación de las políticas activas de empleo y de los métodos que se emplean en este tipo de literatura, consúltese el clásico trabajo de Heckman et al. (1999).

4 La Cumbre de Luxemburgo sobre el empleo se produjo en noviembre de 1997 y fue el preludio a la entrada en vigor del Tratado de Amsterdam. Igualmente, supuso el impulso definitivo a la Estrategia Europea de Empleo (EEE), cuyo objetivo primordial era reducir el desempleo de manera notable en cinco años.

como referencia el contenido del Plan del Gobierno Central y contribuyendo con medidas suplementarias. Sus objetivos se pueden sintetizar en cuatro: (1) mejorar la capacidad de inserción, (2) desarrollar el espíritu de empresa, (3) fomentar la capacidad de adaptación de los trabajadores y de las empresas y (4) reforzar la política de igualdad de oportunidades.

Teniendo en cuenta las pautas sugeridas por la Consejería de Economía y Empleo de la Junta de Castilla y León, las principales actuaciones en materia de políticas activas de empleo se disponen en torno a cuatro grandes ejes. Un primer pilar se dirige a los jóvenes, quienes se consideran objetivo prioritario en la lucha contra el desempleo. Se sugieren medidas preventivas que posibiliten una mayor capacidad de inserción y de adaptación al mercado de trabajo. En segundo término, se acomete la subrepresentación de la mujer en determinados sectores y actividades. En tercer lugar, se establecen diversas medidas pioneras con la finalidad de que toda posibilidad de contratación se haga efectiva. De esta forma, por ejemplo, se acuerdan acciones dirigidas a la sustitución de horas extraordinarias mediante la formalización de nuevos contratos, la reordenación de la jornada, etc. En cuarto y último lugar, se incentiva el empleo ampliando y promoviendo una cultura empresarial.

En el Cuadro 2 se detallan los principales resultados referentes al SPRECyL. En él figura una comparativa entre diferentes partidas (PIB, presupuesto, gasto en formación…) para cada uno de los años en que el mencionado plan estuvo vigente. En primer lugar, se observa que el PIB de Castilla y León se incrementa sucesivamente durante estos años. Del mismo modo, también se aprecian aumentos tanto en el presupuesto como en la población activa de la Comunidad Autónoma. En términos de ocupación, se pasa de 902.000 ocupados en 2001 a 937.000 en 2003. No obstante, el número de parados también se incrementa, pasando de 100.000 en 2001 hasta 116.000 personas en 2003.

Las partidas de apoyo al empleo y formación también se incrementan y, al final del periodo, llegan a alcanzar el 0,30% del PIB de la región. Esto supone una proporción superior a la que se destina en promedio en Europa (Cueto, 2006). En términos presupuestarios, en 2001 se destinaron en Castilla y León casi 89 millones de euros a estos objetivos, lo que representa un 1,8% del presupuesto castellanoleonés. En 2002, esta cifra se incrementó considerablemente y llegó a representar un 2,2%, mientras que en 2003, pese a que continúa incrementándose, perdió significación en términos relativos (1,7% del presupuesto). Cabe reseñar, asimismo, el incremento de la partida de apoyo al empleo en términos de € por persona, que alcanzó en promedio los 3.464 euros en 2003, mientras que la de formación a desempleados supuso 447 euros en 2001 y 422 euros en 2003. En este punto, el objetivo no es otro que averiguar si las medidas adoptadas en el SPRECyL constituyeron el principal motivo de los resultados positivos obtenidos o si, por el contrario, tuvieron su origen en la situación coyuntural de la economía del país.

CUADRO 2
PRINCIPALES CIFRAS RELATIVAS AL SEGUNDO PLAN REGIONAL DE EMPLEO DE CASTILLA Y LEÓN

	2001	2002	2003
PIB CyL (€)	37.166.328.000	39.756.283.000	42.570.763.000
Presupuesto CyL (€)	4.891.743.963	5.148.688.135	7.442.067.513
Apoyo al Empleo (€)	43.800.000	65.500.000	79.200.000
Formación (€)	45.156.677	46.928.741	49.260.176
Apoyo + Formación (€)	88.956.677	112.428.741	128.460.176
% PIB CyL	0,24%	0,28%	0,30%
% Presupuesto CyL	1,8%	2,2%	1,7%
Ocupados (miles)	902,850	921,675	937,125
Parados (miles)	100,975	107,925	116,650
Puestos	13.452	20.536	22.861
Puestos / Ocupados (%)	1,5%	2,2%	2,4%
Apoyo al empleo / Puestos (€/persona)	3.256	3.190	3.464
Formación / Parados (€/persona)	447	435	422

Fuente: Elaboración propia a partir de los datos de CESCyL (2002, 2003 y 2004), Encuesta de Población Activa y Contabilidad Regional de España.

3.2 El empleo y la formación en el SPRECyL

Existen dos líneas principales en las que el SPRECyL incide con mayor énfasis: el empleo y la formación. En términos de empleo, se potencian políticas activas de ocupación que gravitaran en torno al fomento del espíritu empresarial, la igualdad de la mujer en el acceso al mercado de trabajo, la lucha contra la exclusión laboral de determinados colectivos de trabajadores y medidas para dinamizar el empleo local. En esta línea, se señalaron ocho objetivos a cumplir-(CESCyL, 2002, p.247): (1) reforzar la estabilidad en el empleo y el mantenimiento de puestos de trabajo, (2) promover y favorecer la incorporación a la vida activa laboral de los colectivos más desfavorecidos, (3) incentivar la incorporación de mujeres en profesiones y oficios en los que está infrarrepresentada, (4) promover y fomentar el empleo de los desempleados de los núcleos rurales, (5) fomentar la contratación en los sectores definidos como *"nuevos yacimientos de empleo"*, (6) fomentar la reordenación y adaptación de puestos de trabajo, (7) apoyar a trabajadores autónomos para lo-

grar el objetivo de que puedan contratar al primer trabajador por cuenta ajena y (8) fomentar la contratación indefinida de técnicos de prevención de riesgos laborales.

En lo que atañe a la formación, todo proceso de reinserción en el mercado laboral tras un largo periodo de inactividad es excesivamente costoso. A fin de abordar este asunto, se diseñaron diversas políticas de formación. Partiendo de la clasificación utilizada por el Sistema de Información Mutua sobre Políticas de Empleo de la Comisión Europea, nos ceñiremos a los tres tipos de formación más destacados: la formación ocupacional, la formación continua y la formación reglada (aunque esta última no se considera dentro del plan de empleo). La política de formación ocupacional habitualmente plantea dos cuestiones a resolver: la carencia de una formación práctica adecuada al puesto de trabajo a ocupar (especialmente, en el caso de los jóvenes) y la obsolescencia en las cualificaciones adquiridas por los desempleados de larga duración (más acentuada a mayor edad). Y para ello se desarrollaron tres líneas de subvenciones: (1) programas de titularidad autonómica incluidos en el Plan Regional de Empleo, (2) programas de titularidad estatal con gestión transferida a la Comunidad de Castilla y León e incluidos en el Plan Regional de Empleo y (3) el programa de iniciativas comunitarias.

Los programas de titularidad autonómica son cuatro. El primero de ellos es el de *Formación profesional ocupacional* (programa I). Este abarca, además de a desempleados, a trabajadores amenazados de exclusión del mercado laboral y a trabajadores de PYMES. El segundo programa, *Formación en alternancia* (programa II), trató esencialmente de interconectar Universidad y empresa. Este objetivo se llevó a cabo mediante una formación práctica con el objetivo de enseñar al alumno una serie de destrezas y habilidades que completaran los conocimientos teóricos adquiridos durante la carrera. El tercero se denominó *Prácticas para titulados universitarios* (programa III) y ambicionaba reparar la situación de los titulados universitarios (posteriores a 1998) en situación de desempleo. En último lugar, dentro de los programas de titularidad autonómica incluidos en el Plan Regional de Empleo, están las *Medidas complementarias, de acompañamiento y mejora de la FPO* (programa IV). Emergieron con un doble objetivo: corregir la capacidad de inserción de los demandantes de empleo y optimizar la adaptabilidad de los trabajadores a variaciones en el mercado de trabajo.

Los programas de titularidad estatal con gestión transferida a la Comunidad de Castilla y León e incluidos en el Plan Regional de Empleo incluían el Plan Nacional de Formación e Inserción Profesional (FIP) destinado a los trabajadores desempleados. Su propósito consistía en prepararles para facilitar su acceso al mundo laboral partiendo, principalmente, de dos supuestos concretos: cuando careciesen de formación profesional específica o cuando su cualificación resultara insuficiente o inadecuada. El último programa dentro de esta unidad de formación ocupacional fue el denominado programa de iniciativas comunitarias, el cual se

implementó, esencialmente, a través de un doble procedimiento. En primer lugar, mediante la Iniciativa Comunitaria EQUAL, centrada en promocionar nuevos métodos para combatir discriminaciones y desigualdades en el mercado de trabajo. En segundo lugar, a partir del Programa Plurirregional de Lucha contra la Discriminación, reservado a los colectivos peor situados y con mayores limitaciones para encontrar un empleo.

En cuanto a la formación continua, cabe referirse a tres *iniciativas* puestas en marcha durante los años de vigencia del SPRECyL. Una primera, referente a *Planes de Formación*, se centró en la cualificación, el desarrollo personal y profesional de los trabajadores y la mejora de la competitividad de las empresas. Se subdividió en dos grupos: planes de formación de oferta y planes de formación de demanda. Los primeros, se dedicaron a suministrar a los trabajadores cualificaciones transferibles hacia otras empresas y sectores productivos. Los segundos, se manifestaron bajo la idea de compensar las necesidades de formación solicitadas por las empresas. Además de estos *Planes de Formació*n, se impulsaron las *Acciones Complementarias y de Acompañamiento a la Formación* que sirvieron como puerta de enlace al desarrollo de medidas relacionadas con los estudios de necesidades formativas, la elaboración de herramientas, etc. Finalmente, los *Permisos Individuales de Formación* compatibilizaron la promoción de acciones formativas con la de puestos de trabajo.

4. BASE DE DATOS

Los datos utilizados en este trabajo proceden de la Encuesta de Población Activa (EPA) y de la Contabilidad Regional de España (CRE) que elabora el Instituto Nacional de Estadística (INE). En concreto, se utiliza información de las 50 provincias españolas[5] para el periodo comprendido entre 1998 a 2003. Los tres primeros corresponden al PRECyL (1998, 1999 y 2000), mientras que los tres siguientes corresponden al SPRECyL (2001, 2002 y 2003)[6].

En este punto es preciso dejar constancia de que en 2001 se produjo una significativa reforma de la EPA que trajo consigo una nueva definición de paro. Debido a ello, se ha redefinido la tasa de desempleo para configurar una nueva variable con la que poder trabajar. Utilizando el citado año como enlace de referencia, y una

5 Por la escasa representatividad de algunos de sus datos se han suprimido las ciudades autónomas de Ceuta y Melilla.

6 La razón de seleccionar un periodo de seis años reside en la duración del mencionado plan: de carácter trienal. Así, podemos establecer un análisis comparativo entre ambos planes, a diferencia de lo que ocurría en (Martín Román (2007)).

vez recopilados los datos relativos a la serie de parados que aparece en el INE[7], hemos reconstruido y completado dicha serie ajustándola proporcionalmente a los años anteriores.

De este modo, la tasa de paro utilizada es el resultado de dividir el número de parados (obtenidos siguiendo este procedimiento) entre la población potencialmente activa. Se ha empleado la población potencialmente activa en lugar de la población activa porque el indicador de nueva construcción se considera más objetivo de la potencial oferta de trabajo[8]. La otra variable dependiente utilizada es la tasa de ocupación, entendida como el ratio entre la población ocupada y la población mayor de 16 años.

El Cuadro 3 brinda una primera aproximación al análisis empírico al recoger los principales estadísticos descriptivos de las variables objeto de examen. Además, contrasta los valores obtenidos durante el primer PRECyL frente a los conseguidos durante el SPRECyL.

CUADRO 3
ESTADÍSTICOS DESCRIPTIVOS
I PLAN REGIONAL DE EMPLEO DE CASTILLA Y LEÓN (1998-2000)

España	**Media**	**Máximo**	**Mínimo**	**Desviación estándar**
TASA_OCUP	41,34	56,87	30,16	5,45
TASA_PARO	9,02	22,02	2,89	3,56
TV_PIB	3,65	12,09	-3,19	2,48
C y L	**Media**	**Máximo**	**Mínimo**	**Desviación estándar**
TASA_OCUP	39,54	48,08	30,22	4,52
TASA_PARO	7,82	12,81	3,13	2,36
TV_PIB	3,13	10,77	-2,59	2,72

Fuente: Martín Román (2007).

7 Encuesta de Población Activa. Principales resultados año 2001 (resultados provinciales).
8 Véase: Martín Román (2007).

CUADRO 3
ESTADÍSTICOS DESCRIPTIVOS
II PLAN REGIONAL DE EMPLEO DE CASTILLA Y LEÓN (2001-2003)

España	**Media**	**Máximo**	**Mínimo**	**Desviación estándar**
TASA_OCUP	44,81	59,63	31,09	5,70
TASA_PARO	11,59	34,65	3,71	5,30
TV_PIB	4,36	11,88	-4,97	2,35
C y L	**Media**	**Máximo**	**Mínimo**	**Desviación estándar**
TASA_OCUP	42,46	51,57	31,09	5,07
TASA_PARO	10,53	20,74	4,55	3,40
TV_PIB	3,59	11,39	-1,82	2,74

Fuente: Elaboración propia a partir de los datos de la EPA y de la CRE.

Podemos observar que, durante la vigencia del SPRECyL, la situación económica en Castilla y León en comparación con la situación del país en su conjunto es muy similar a lo observado durante el PRECyL. La tasa de ocupación y la tasa de paro en la región son ligeramente inferiores a las nacionales en ambos casos. Asimismo, conviene destacar que durante el periodo 2001-2003 la tasa de ocupación y la tasa de variación del PIB son superiores a la del periodo anterior, tanto en España como en Castilla y León, a pesar de que también la tasa de paro sea mayor en el segundo periodo tanto a nivel regional como nacional. Esto permite afirmar que la coyuntura económica es sensiblemente más favorable durante la vigencia del SPRECyL. No obstante, la diferencia entre el crecimiento del PIB en Castilla y León con respecto al crecimiento a escala nacional se incrementa ligeramente durante el periodo 2001-2003. Esto quiere decir que, durante el segundo periodo, dicho crecimiento, pese a ser positivo en todo momento, se incrementa en media más a nivel nacional que a nivel regional.

5. METODOLOGÍA

La estrategia empírica utilizada en este trabajo gravita, como ya sucediera en (Martín Román (2007), en torno a la metodología de los experimentos naturales. El objetivo es evaluar el efecto de un tratamiento sobre una población determinada, donde el *"cuasi-experimento"* (Meyer, 1995) viene determinado de forma exógena (a través de un fenómeno natural, ley…). Por lo tanto, el investigador no interviene a la hora de determinar qué grupo ha sufrido el tratamiento y cual puede considerarse

grupo de control. En este trabajo nuestro interés radica en evaluar la efectividad del SPRECyL sobre el mercado laboral de Castilla y León. Por lo tanto, el grupo de tratamiento lo constituyen todas las provincias de Castilla y León que son las beneficiarias del plan. Mientras que el grupo de control estará integrado por el resto de provincias que conforman el territorio español.

Desde un punto de vista metodológico, el análisis se realiza utilizando la técnica de diferencias en diferencias, como en los trabajos de (Martín Román (2007) y Meyer (1995). Está técnica ha sido aplicada en diversos contextos de la investigación en economía. Card y Krueger (1994) la utilizan para evaluar el efecto de una subida del salario mínimo sobre el empleo en Nueva Jersey y Pennsylvania. En otros trabajos del ámbito de la economía laboral se utiliza en Crépon y Kramarz (2002) y en Sánchez-Mangas y Sánchez-Marcos (2008). Finalmente, aplicaciones más recientes de esta técnica se encuentran en Delgado y Florax (2015), Lee y Lee (2016) y en Palali y van Ours (2017).

El análisis de diferencias en diferencias permite valorar los resultados en grupos intervenidos (Castilla y León) y compararlos con grupos no expuestos al tratamiento (resto de España). Por lo tanto, lo deseable es que las diferencias en los resultados vengan explicadas, en su mayor parte, por la exposición a la intervención exógena en el grupo de tratamiento, la cual no tiene lugar en el grupo de control. En definitiva, la finalidad del trabajo consiste en averiguar si existen efectos sobre las variables laborales en Castilla y León imputables al SPRECyL y, siempre que se pueda, aislarlos del resto[9]. En el trabajo se utilizan cinco especificaciones econométricas distintas. Las tres primeras se aplican exclusivamente a las provincias de Castilla y León con 54 observaciones (9 provincias durante 6 años). Para las especificaciones 4 y 5 se emplean la totalidad de las provincias españolas, y por lo tanto se dispone de 300 observaciones (50 provincias por 6 años). Las provincias que no pertenecen a Castilla y León se toman como referencia, esto es, no pueden imputarse los efectos de la implementación del SPRECyL.

Con el objetivo bien definido, la primera especificación a estimar es la siguiente:

$$TASA(i,t) = \beta_0(i) + \beta_1 X_{01\text{-}03}(t) + \varepsilon\ (i,t) \qquad (1)$$

9 Existen otras técnicas que también han sido utilizadas en la literatura para estudiar la evolución del empleo y otras variables laborales en un contexto regional. Bande y Fernández (2003) utilizan una ecuación de determinación salarial para evaluar el desempeño de la economía gallega respecto al comportamiento de la economía a nivel nacional. En este caso los autores apuntan a que las debilidades de algunos sectores junto con unos mecanismos de negociación salarial muy rígidos, generan una importante barrera a la creación de empleo por parte de la economía gallega. En un contexto un tanto diferente, De Toledo Saavedra et al. (2013) plantean, para el caso de Andalucía durante el periodo 2007-2010, una nueva herramienta de clasificación de los individuos a través de la formación de grupos o "clusters" para mejorar el emparejamiento en el mercado de trabajo.

En esta ecuación la variable TASA se refiere, bien a la tasa de ocupación (TASA_OCUP), bien a la tasa de paro o desempleo (TASA_PARO) dependerá del análisis concreto que se realice en cada momento. Los términos (i,t), por su parte, se refieren a la dimensión espacial y temporal de la variable, respectivamente. β_0 representa el término constante y recoge la variabilidad espacial puesto que estamos estimando un modelo de efectos fijos provinciales. Mientras, $X_{01\text{-}03}$ es una variable dummy que toma el valor 1 para los años 2001, 2002 y 2003 (esto es, los años en que se implementa el SPRECyL) y el valor 0 para el resto de años (1998, 1999 y 2000, es decir, el trienio en que se llevó a cabo el primer PRECyL). El objetivo en este caso parece evidente: determinar si existe un término constante diferencial durante el periodo en que el SPRECyL ha permanecido vigente. Finalmente, ε (i,t) representa la perturbación aleatoria que recoge el componente de error en la regresión.

Ahora bien, en aquellos casos en que la estimación del parámetro β_1 resulte estadísticamente significativa, hemos de ser prudentes en la interpretación de los resultados. Imputar íntegramente el eventual cambio en las variables analizadas al SPRECyL no sería del todo correcto. El razonamiento es sencillo, puesto que puede que el origen de estos cambios se deba a otros factores. Así por ejemplo, la fase del ciclo económico en que nos hallemos inmersos se convierte en un factor determinante. En este sentido, puede ocurrir que coincida la implementación del plan con una época de bonanza económica. Con el fin de evitar extraer conclusiones erróneas, introducimos una nueva variable en la ecuación anterior que nos permita controlar este hecho: la tasa de variación del PIB real provincial (TV_PIB).

$$TASA(i,t) = \beta_0(i) + \beta_1 X_{01\text{-}03}(t) + \beta_2 TV\_PIB\ (i,\ t) + \varepsilon\ (i,t) \qquad (2)$$

En este caso, una estimación estadísticamente significativa del parámetro en la ecuación [2] nos impediría aún valorar con rigor la eficacia del plan. Puede ocurrir que durante los años de vigencia del plan se aprueben determinadas normas o se modifiquen las características del mercado de trabajo español. Las variables objeto de análisis se verían nuevamente afectadas, siendo preciso controlar este efecto. Para ello se proponen dos alternativas. En una primera, optamos por incluir una tendencia temporal lineal:

$$TASA(i,t) = \beta_0(i) + \beta_1 X_{01\text{-}03}(t) + \beta_2 TV\_PIB\ (i,\ t) + \beta_3 TIEMPO\ (t)\ + \varepsilon\ (i,t) \qquad (3)$$

Si, por ejemplo, es significativo en [1] y [2] pero no en [3], estaríamos asistiendo a un cambio progresivo en las variables laborales estudiadas. No cabría hablar entonces de éxito del plan implementado ya que no se apreciaría una mejora concreta en los años en que el mismo se lleva a cabo. Una segunda vía para superar este obstáculo consiste en adaptar la metodología de Meyer (1995) al problema que se

nos plantea. De este modo, se seleccionan las provincias de Castilla y León como grupo de tratamiento y el resto de provincias españolas como grupo de control. Por lo tanto, al añadir un grupo no tratado para la comparación, se obtiene el resultado de una estimación de diferencias en diferencias que permite evaluar mejor los efectos del SPRECyL. Esta consideración requiere elaborar un panel con datos de las 50 provincias españolas de cara a valorar si, efectivamente, las medidas asumidas en el SPRECyL tienen efectos única y exclusivamente en las provincias para las que fue concebido. La estimación de la ecuación [4] nos permitirá dilucidar esta cuestión:

$$TASA(i,t) = \beta_0(i) + \beta_1 X_{01\text{-}03}(t) + \beta_2 TV\_PIB\ (i,\ t) + \beta_3 X_{01\text{-}03} \cdot Y_{CyL}(i,t)\ + \varepsilon\ (i,t) \quad (4)$$

En esta nueva ecuación, es preciso poner de manifiesto la relevancia que adquiere la dimensión i. Hasta ahora, tomaba valores desde 1 hasta 9 (las provincias de Castilla y León). No obstante, aquí oscilará de 1 a 50 (la totalidad de provincias que componen España). Por otra parte, en [4] aparece un nuevo término ($\beta_3 X_{01\text{-}03} \cdot Y_{CyL}$), cuya justificación en la especificación se ha mencionado con anterioridad. Este término supone el producto de dos variables categóricas: las variables dummy $X_{01\text{-}03}$ y Y_{CyL} y, respectivamente. Esta última, con valor 1 para cada una de las nueve provincias de Castilla y León y valor cero en otro caso. Un β_3 significativo vendría a reflejar un comportamiento *propio* de las variables a nivel regional. En caso contrario, es decir, si el parámetro no es significativo, no cabría asignar al SPRECyL la explicación del cambio de tendencia en Castilla y León.

La siguiente ecuación introduce nuevamente una tendencia temporal lineal, sólo que ahora lo hace en [4]:

$$TASA(i,t) = \beta_0(i) + \beta_1 X_{01\text{-}03}(t) + \beta_2 TV\_PIB\ (i,\ t) + \beta_3 X_{01\text{-}03} \cdot Y_{CyL}(i,t)\ + \beta_4 TIEMPO\ (t)\ + \varepsilon\ (i,t) \quad (5)$$

Finalmente, hay que indicar que en la tabla de resultados (cuadro 4) aparecen otras tres estimaciones más. Todas ellas presentan una especificación idéntica a [5], si bien varían las provincias (o Comunidades Autónomas) que se utilizan como control. Tanto en [6] como en [7] se han seleccionado para el análisis, además de las provincias de Castilla y León, aquellas que, tomando como referencia los valores registrados por éstas, no rebasaron los límites máximo y mínimo de las tasas de ocupación y de paro, respectivamente. A pesar de que el número de observaciones en ambas ecuaciones coincide (234), las provincias escogidas en una y otra regresión difieren. Por lo que respecta a [6], quedan excluidas del análisis: Baleares, Las Palmas, Barcelona, Girona, Lleida, Tarragona, Castellón, Madrid, Navarra, Álava y Guipúzcoa. En cuanto a [7], se prescinde de las siguientes: Cádiz, Córdoba, Granada, Huelva, Jaén, Málaga, Sevilla, Huesca, Teruel, Castellón y Badajoz. Por

CUADRO 4
RESULTADOS DE LAS ESTIMACIONES

TASA_OCUP	*Especificación* **(1)**	*Especificación* **(2)**	*Especificación* **(3)**	*Especificación* **(4)**	*Especificación* **(5)**	*Especificación* **(6)**	*Especificación* **(7)**	*Especificación* **(8)**
$X_{01\text{-}03}$	2,644***	2,711***	-0,271	3,250***	-0,169	-0,219	-0,135	-0,203
	(3,840)	(4,540)	(-0,400)	(4,283)	(-0,341)	(-0,485)	(-0,302)	(-0,497)
TV_PIB	-	0,219***	0,123**	0,064***	0,020	0,005	0,019	0,034
		(9,994)	(2,841)	(3,334)	(1,100)	(0,367)	(1,062)	(1,189)
TIEMPO	-	-	0,959**	-	1,226***	1,210***	1,199***	1,089***
			(4,635)		(8,660)	(9,993)	(9,103)	(10,208)
$X_{01\text{-}03} \cdot Y_{CyL}$	-	-	-	-0,612***	-0,817**	-0,721***	-0,777***	-0,406**
				(-2,900)	(-5,947)	(-4,770)	(-5,551)	(-2,579)
R^2	0,937	0,932	0,951	0,952	0,987	0,981	0,988	0,977
D-W	1,955	2,102	1,962	1,858	1,492	1,502	1,528	1,719
N	54	54	54	300	300	234	234	180

Fuente: Elaboración propia.

Notas: Estimaciones mediante MCG (Mínimos Cuadrados Generalizados). Estadísticos *t* entre paréntesis. (*) significativa al 10% o menos, (**) significativa al 5% o menos, (***) significativa al 1% o menos.

CUADRO 4
RESULTADOS DE LAS ESTIMACIONES
(CONCLUSIÓN)

TASA_PARO	*Especificación* **(1)**	*Especificación* **(2)**	*Especificación* **(3)**	*Especificación* **(4)**	*Especificación* **(5)**	*Especificación* **(6)**	*Especificación* **(7)**	*Especificación* **(8)**
$X_{01\text{-}03}$	-1,682**	-1,686**	0,290	-1,445**	0,313	0,139	0,369	0,259
	(-2,131)	(-2,118)	(0,213)	(-2,208)	(0,264)	(0,114)	(0,089)	(0,210)
TV_PIB	-	0,040	0,100***	-0,031**	-0,044***	-0,030	-0,019	-0,006
		(1,349)	(2,831)	(-2,245)	(-3,087)	(-1,514)	(-0,855)	(-0,257)
TIEMPO	-	-	-0,666	-	-0,608*	-0,595	-0,514	-0,509
			(-1,464)		(-1,698)	(-1,645)	(-1,108)	(-1,373)
$X_{01\text{-}03} \cdot Y_{CyL}$	-	-	-	-0,252	-0,277	-0,126	-0,349**	-0,461
				(-1,114)	(-0,994)	(-0,425)	(-2,124)	(-1,618)
R^2	0,885	0,886	0,917	0,912	0,940	0,945	0,848	0,924
D-W	1,500	1,517	1,510	1,448	1,395	1,429	1,379	1,374
N	54	54	54	300	300	234	234	180

Fuente: Elaboración propia.

Notas: Estimaciones mediante MCG (Mínimos Cuadrados Generalizados). Estadísticos *t* entre paréntesis. (*) significativa al 10% o menos, (**) significativa al 5% o menos, (***) significativa al 1% o menos.

último, [8] no se apoya en un criterio predefinido a la hora de seleccionar provincias (dado que en este caso no se efectúa un estudio de carácter provincial). Omite las que se caracterizan por un mayor dinamismo respecto de Castilla y León, es decir aquellas provincias pertenecientes a las comunidades autónomas que presentan un mayor crecimiento medio del PIB real y de la tasa de ocupación durante los años del periodo objeto de estudio (Cataluña, Andalucía, Comunidad Autónoma de Madrid, Comunidad Valenciana, Región de Murcia, Baleares y Canarias).

6. RESULTADOS

En el Cuadro 4 se disponen los resultados de las estimaciones que acabamos de detallar previamente. El método utilizado ha sido el de Mínimos Cuadrados Generalizados (MCG). No obstante, dado que las variables dependientes en nuestras regresiones son tasas y, por consiguiente, están acotadas entre 0 y 100, también se ha procedido a llevar a cabo una transformación log-odds de dicha variable dependiente, como medida de robustez[10]. Los resultados se muestran en el apéndice (cuadro A1), y el principal resultado es que los signos de las variables, así como su significación, tienden a coincidir con los de la regresión lineal. Hay que advertir, sin embargo, que los coeficientes de la regresión log-odds no pueden interpretarse como efectos marginales y su magnitud no es estrictamente comparable con los de la regresión lineal. Dado que es más fácil y directo interpretar estos últimos coeficientes, nos centraremos en comentar los resultados obtenidos con las variables sin transformación del Cuadro 4.

A tenor de los resultados de la primera especificación, parece que el SPRECyL supuso un éxito rotundo. Los datos arrojan un aumento de 2,6 puntos porcentuales en la tasa de ocupación y una reducción de 1,7 puntos porcentuales en la tasa de paro en las provincias de Castilla y León. Los resultados son además muy significativos. Si incorporamos al modelo la tasa de variación del PIB provincial, sigue resultando muy significativa la dummy . Esto sucede además, tanto en la ecuación donde la tasa de ocupación ejerce el papel de variable dependiente, como cuando lo es la tasa de paro.

Examinadas las dos primeras estimaciones, se puede afirmar que durante los años en que el SPRECyL estuvo vigente se registró un considerable crecimiento en la tasa de ocupación y una reducción en la tasa de desempleo no menos reseñable, aunque sería aventurado establecer una relación causal. En cuanto al comportamiento del ciclo económico, computado a través de la tasa de variación

10 Formalmente: log(TASA/(100-TASA).

del PIB real, es muy significativo en la ecuación de la ocupación pero muy poco en la del desempleo.

La tercera especificación incluye una tendencia temporal lineal para capturar factores que hayan podido ir cambiando gradualmente en los años en los que se produce el análisis. La dummy $X_{01\text{-}03}$, a diferencia de lo ocurrido en las dos primeras estimaciones, deja de ser significativa ahora. Por el contrario, la tendencia temporal sí lo es, y en gran medida. Esto significaría que los cambios en la tasa de ocupación y en la tasa de desempleo se han ido produciendo de forma paulatina y que no se detecta un cambio significativo en los tres años de implementación del plan, por lo que se obtiene una primera evidencia de su falta de impacto.

Para profundizar en esta cuestión, en la cuarta de las estimaciones del Cuadro 4 se incluyen el resto de provincias españolas y, de este modo, se dispone de un grupo de control. En la especificación 4, no se incluye la tendencia temporal y la variable $X_{01\text{-}03}$ nuevamente cobra significación, con signo positivo en la ecuación de ocupación y signo negativo en la ecuación de desempleo. Sin embargo, ahora la interpretación de dicha variable es distinta, pues se refiere a todas las provincias de España. De hecho, el efecto diferencial para las provincias de Castilla y León se recoge con la variable compuesta $X_{01\text{-}03} \cdot Y_{CyL}$. Dicha variable registra una significación muy elevada. Además, presenta signo negativo en la ecuación de ocupación, lo que debe interpretarse como que la tasa de ocupación en Castilla y León creció menos que en España (0,61 puntos, en concreto) justamente durante los años en que se implementaba el SPRECyL.

Respecto de la ecuación donde la tasa de paro ejerce de variable explicada, ésta se redujo 0,25 puntos porcentuales más que en el resto de España, si bien la variable no resulta significativa. La tasa de variación del PIB, por su parte, se muestra igualmente significativa. En conjunto, la conclusión que se obtiene de la regresión 4 es que durante los tres años de vigencia del SPRECyL, la tasa de ocupación se incrementó menos en las provincias de Castilla y León que en las del resto de España, mientras que la tasa de desempleo experimentó una evolución similar. Esta sería una segunda evidencia de la falta de impacto del citado plan de empleo.

La especificación de la columna 5 vuelve a mostrar que el componente de la tendencia temporal lineal se muestra muy significativo para explicar aumentos progresivos de la tasa de ocupación. También se detecta una reducción anual de 0,61 puntos porcentuales de la tasa de paro significativa al 10%. Aunque, para los objetivos de este trabajo, la variable más importante sigue siendo $X_{01\text{-}03} \cdot Y_{CyL}$.

Cualitativamente, los resultados obtenidos son muy similares a los comentados en el párrafo anterior: peor comportamiento de la tasa de ocupación en Castilla y León y similar comportamiento de la tasa de paro. La idea general que se extrae de todo el análisis previo es que el incremento de la tasa de ocupación y la reducción de la tasa de desempleo registrada en las provincias de Castilla y León durante los

tres años de vigencia del SPRECyL parece que no pueden atribuirse de forma muy evidente a la implementación de dicho plan. De hecho, el análisis econométrico precedente sugiere que el incremento registrado en la ocupación y la disminución del desempleo son muy progresivos y compartidos (e incluso superado, en el caso de la tasa de ocupación) por el resto de provincias españolas.

La elevada significación de la tendencia temporal lineal es el resultado más sobresaliente en la quinta especificación, ratificando las impresiones obtenidas con la tercera especificación. Se vuelve a poner de manifiesto la tesis de que las variables laborales han evolucionado de forma más bien progresiva, gradual. En consecuencia, no se aprecian signos de variaciones repentinas, los cuales hubiesen constituido el mejor indicio para valorar positivamente la eficacia y el influjo del SPRECyL. En las tres últimas estimaciones, los resultados obtenidos anteriormente se mantienen estables, tanto para la especificación de la tasa de ocupación (6) como para la que tiene en cuenta la tasa de paro (7), así como para la que excluye a las regiones de mayor dinamismo (8) con una y otra variable dependiente. La tendencia temporal sigue siendo una variable significativa, especialmente en las estimaciones de la tasa de ocupación. El coeficiente estimado de la variable presenta signo negativo en la sexta especificación, lo que nos permite deducir que en las provincias castellanoleonesas la tasa de ocupación, tal y como ocurría en la especificación (4), crece menos que en las provincias españolas seleccionadas en los años de implementación del plan (en concreto 0,72 puntos menos). Por tanto, la tasa de ocupación creció menos que en las provincias que se comportan de forma más similar en sus niveles de ocupación. De igual modo, en la especificación (7) el coeficiente de esta variable presenta signo negativo, aunque con menor significación. Esto quiere decir que, cuando las comparamos con las provincias que tienen una tasa de paro similar, ésta aumenta 0,35 puntos menos en las provincias de Castilla y León durante los años de vigencia del SPRECyL.

En la especificación de la tasa de paro de la octava especificación, los coeficientes estimados no resultan significativos. De este modo, cabe deducir que las provincias castellanoleonesas no presentan un comportamiento muy diferenciado al del resto de provincias seleccionadas. En cambio, en la especificación de la tasa de ocupación para esta misma regresión, la variable es significativa y presenta un coeficiente negativo. Por tanto, sí podemos afirmar que en las provincias de Castilla y León la tasa de ocupación crece menos (en torno a 0,4 puntos) que en aquellas con las que las comparamos. Además, la tendencia temporal continúa siendo muy significativa.

7. CONCLUSIONES

El propósito de este trabajo es continuar con el proceso de evaluación de los planes de empleo regional de Castilla y León, y más concretamente, analizar los efectos de la aplicación del Segundo Plan Regional de Empleo de Castilla y León, que tuvo lugar durante los años 2001-2003. Con esta finalidad se estudia el comportamiento de las tasa de ocupación y de paro de las provincias susceptibles de aplicación, y se compara con lo ocurrido en el resto de provincias españolas. Esto nos permite discernir si la existencia de dicho plan ha tenido un efecto positivo claro sobre el comportamiento del empleo, o si ha tenido más que ver con la coyuntura económica favorable de ese periodo.

Inicialmente, nuestros resultados apuntan hacia un importante aumento de la tasa de ocupación junto con una reducción de la tasa de paro, en las provincias de Castilla y León durante la aplicación del SPRECyL, en comparación con lo ocurrido en los tres años anteriores. Sin embargo, en una segunda etapa, cuando comparamos el desempeño de las provincias castellanoleonesas con lo ocurrido en el resto de provincias del país, obtenemos unos resultados muy distintos. En este caso, la tasa de ocupación de las provincias de esta región experimenta un incremento menor que lo observado en aquellas provincias españolas con las que se lleva a cabo la comparación. Lo anterior pone de manifiesto los escasos resultados obtenidos por parte del SPRECyL en las provincias de Castilla y León durante el periodo 2001-2003 para el caso de la tasa de ocupación. Por lo que se refiere a los resultados obtenidos para la tasa de paro se puede afirmar que las medidas destinadas a luchar contra el desempleo sí tuvieron cierto éxito relativo. De esta manera, en general, la tasa de paro evolucionó de una forma similar a la experimentada por el resto de provincias españolas durante tal periodo objeto de estudio.

A la luz de los resultados anteriores se puede señalar que las variaciones en el empleo y en el paro en las provincias castellanoleonesas ha podido deberse más bien a una tendencia favorable de la economía durante este periodo, que a un comportamiento diferencial de estas por la acción del SPRECyL durante su aplicación.

Los resultados observados tanto en éste como en otros trabajos de evaluación permiten proponer líneas de actuación de las futuras políticas económicas en el mercado de trabajo. En general, los trabajos de evaluación realizados para España muestran unos efectos más claros en los programas de formación que en otras medidas como incentivos a la contratación o la intermediación laboral. Por lo tanto son las actuaciones dirigidas a actividades formativas las que más se deben fomentar dentro de las políticas de empleo y dirigir los incentivos a la contratación solo a aquellos colectivos con más peligro de exclusión del mercado laboral. También se observa que los efectos de las políticas activas se manifiestan más a largo que a corto plazo, por lo tanto es conveniente planificar las actuaciones con periodos

amplios de tiempo y realizar las evaluaciones con una cierta perspectiva para que hayan podido manifestarse todos los efectos pretendidos.

Finalmente, como colofón, también se pueden hacer algunas recomendaciones de líneas de investigación futuras. Aunque es cierto que la evaluación macroeconométrica que aquí se plantea tiene algunas ventajas sobre la microeconométrica (como considerar los efectos peso muerto, sustitución y desplazamiento), no es menos cierto que también presenta algunas desventajas, por ejemplo, a la hora de determinar el mecanismo causal que hace que unas políticas sean más efectivas que otras en la lucha contra los problemas del mercado laboral. A partir de lo observado dentro de la literatura de análisis de impacto, parece necesario promover la evaluación microeconométrica de las políticas de empleo en España. Este tipo de análisis permite ahondar en los mecanismos y los canales a través de los cuales las políticas generan los efectos observados.

APÉNDICE

CUADRO A1
RESULTADOS DE LAS REGRESIONES LOG-ODDS

TASA_OCUP	*Especificación* **(1)**	*Especificación* **(2)**	*Especificación* **(3)**	*Especificación* **(4)**	*Especificación* **(5)**	*Especificación* **(6)**	*Especificación* **(7)**	*Especificación* **(8)**
$X_{01\text{-}03}$	0,110***	0,112***	-0,012	0,133***	-0,007	-0,010	-0,006	-0,009
	(3,792)	(4,494)	(-0,416)	(4,286)	(-0,331)	(-0,494)	(-0,312)	(-0,529)
TV_PIB	-	0,009***	0,005***	0,003***	0,001	0,000	0,001	0,001
		(10,293)	(2,887)	(3,307)	(1,301)	(0,230)	(1,223)	(1,169)
TIEMPO	-	-	0,040***	-	0,051***	0,050***	0,049***	0,044***
			(4,616)		(8,056)	(9,079)	(8,157)	(9,478)
$X_{01\text{-}03} \cdot Y_{OyL}$	-	-	-	-0,023***	-0,034***	-0,030***	-0,031***	-0,014**
				(-2,929)	(-6,072)	(-4,739)	(-5,658)	(-2,134)
R^2	0,935	0,932	0,951	0,951	0,987	0,979	0,985	0,975
D-W	1,968	2,102	1,971	1,857	1,486	1,483	1,518	1,714
N	54	54	54	300	300	234	234	180

Fuente: Elaboración propia.

Notas: Estimaciones mediante MCG (Mínimos Cuadrados Generalizados). Estadísticos t entre paréntesis. (*) significativa al 10% o menos, (**) significativa al 5% o menos, (***) significativa al 1% o menos.

CUADRO A1

RESULTADOS DE LAS REGRESIONES LOG-ODDS

TASA_PARO	*Especificación* **(1)**	*Especificación* **(2)**	*Especificación* **(3)**	*Especificación* **(4)**	*Especificación* **(5)**	*Especificación* **(6)**	*Especificación* **(7)**	*Especificación* **(8)**
$X_{01\text{-}03}$	-0,194**	-0,194**	-0,010	-0,157**	0,003	-0,009	0,000	-0,007
	(-2,327)	(-2,299)	(-0,064)	(-2,325)	(0,017)	(-0,061)	(-0,002)	(-0,041)
TV_PIB	-	0,002	0,005	-0,002	-0,003	-0,001	-0,003	-0,001
		(0,766)	(1,453)	(-0,861)	(-1,031)	(-0,476)	(-1,162)	(-0,403)
TIEMPO	-	-	-0,062	-	-0,057	-0,054	-0,053	-0,050
			(-1,204)		(-1,219)	(-1,221)	(-1,043)	(-1,059)
$X_{01\text{-}03} \cdot Y_{CyL}$	-	-	-	-0,036	-0,031*	-0,024	-0,040***	-0,042*
				(-1,603)	(-1,876)	(-1,184)	(-3,307)	(-1,807)
R^2	0,890	0,890	0,912	0,927	0,940	0,944	0,848	0,906
D-W	1,558	1,558	1,510	1,488	1,440	1,472	1,420	1,392
N	54	54	54	300	300	234	234	180

Fuente: Elaboración propia.

Notas: Estimaciones mediante MCG (Mínimos Cuadrados Generalizados). Estadísticos t entre paréntesis. (*) significativa al 10% o menos, (**) significativa al 5% o menos, (***) significativa al 1% o menos.

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CONCLUSIONES

Una vez se han presentado los cuatro capítulos principales de la tesis doctoral, pasamos a exponer las conclusiones generales que hemos alcanzado con la realización de esta investigación.

1. Esta tesis doctoral ha contribuido a profundizar en el conocimiento de los mecanismos y componentes que dictaminan el funcionamiento del mercado de trabajo español desde una perspectiva regional. Los cuatro artículos que componen el documento constituyen análisis diferenciados de algunos de los aspectos más relevantes del mercado laboral: a) Las dinámicas que subyacen en la formación del desempleo efectivo; b) El análisis del territorio como elemento determinante del mercado laboral; c) La importancia macroeconómica de los efectos sociales en el mercado de trabajo y d) La evaluación cuantitativa de las políticas activas del mercado laboral a nivel regional.

2. Han sido analizados distintos espacios geográficos españoles, comunidades autónomas (NUTS-2) y provincias (NUTS-3), destacando la relevancia de los fenómenos económicos originados en estas clasificaciones territoriales para analizar el entorno económico y social de la totalidad del país. En este caso, nuestro trabajo contribuye al desarrollo de la literatura científica encuadrada dentro de la economía laboral, prestando atención a las dinámicas territoriales que se generan entre las diferentes unidades administrativas que conforman al conjunto del país.

3. Una de nuestras principales aportaciones radica en la aplicación de la técnica de las fronteras estocásticas para analizar el mercado de trabajo a nivel territorial en España, concretamente, para profundizar en el análisis de los componentes del desempleo efectivo. Adoptando el enfoque de la compartimentalización del desempleo, dividimos al desempleo efectivo de las unidades NUTS-3 y NUTS-2 españolas en dos componentes diferenciados: Desempleo natural, vinculado a factores de oferta agregada y el desempleo cíclico, el cual se encuentra explicado mediante la acción de factores de demanda agregada. La utilización de las fronteras estocásticas nos permite emplear información económica relevante para poder obtener una estimación de ambos componentes inobservables, profundizando en el conocimiento acerca de las dinámicas que explican a la tasa de desempleo efectiva. De forma adicional, aportamos evidencia empírica que demuestra que es el componente natural el principal elemento encargado de explicar tanto la persistencia como la evolución temporal de la magnitud del desempleo efectivo, destacando su importante papel durante la "Gran Recesión".

4. Nuestro trabajo amplia y completa el abanico de estimaciones del componente cíclico del desempleo efectivo. Ofrecemos una propuesta de estimación, mediante las fronteras estocásticas, que otorga un mayor margen de actuación para los responsables de política económica en comparación con las estimaciones obtenidas por parte de algunos filtros univariantes ampliamente utilizados en la literatura científica (HP, BK y QT). Las implicaciones de dicho resultado pueden ser importantes a la hora de determinar el tipo y la intensidad de las políticas de demanda agregada a aplicar en función de la situación de los mercados laborales a nivel territorial.

5. Por otro lado, esta tesis emplea la econometría espacial para destacar al conjunto de los territorios del país como elementos relacionados entre sí, en contraposición a su consideración como elementos independientes unos de otros, lo que conlleva a la formación de áreas económicas integradas. Nuestro análisis, mediante la utilización de estadísticos descriptivos espaciales y técnicas de panel, contribuye a destacar estas sinergias económicas territoriales, cuantificando el grado de dependencia de las diferentes unidades territoriales entre sí.

6. Los resultados obtenidos revelan los motivos por los cuales las tasas de desempleo efectivo a nivel provincial en España (NUTS-3) exhiben una alta persistencia tanto a nivel temporal como desde el punto de vista espacial. En este caso, la existencia de una fuerte dependencia espacial entre los componentes naturales de las tasas de desempleo efectivo, en comparación con la observada para los componentes cíclicos, se erige como el factor determinante a la hora de justificar dicha persistencia. De acuerdo con lo anterior, es posible afirmar que las tasas de desempleo provincial en España no se distribuyen de forma aleatoria, sino que los territorios en los cuales el desempleo, en términos relativos, es reducido (noreste del país) y los territorios de alto desempleo (sur del país) se encuentran rodeados por territorios con dinámicas laborales similares. La existencia de unos fuertes peer effect, commuting effect y migration effect explicarían la persistencia existente en el componente friccional del desempleo natural, mientras que el spillover effect (a través de su efecto estándar) justificaría la persistencia del componente natural a través del desempleo estructural.

7. Esta tesis doctoral destaca la importancia macroeconómica que generan los efectos sociales en los comportamientos de los agentes laborales dentro del mercado de trabajo. Nuestro análisis revela que las decisiones de participación cíclica en el mercado de trabajo no se deben únicamente a comportamientos y preferencias individuales, sino que se encuentran influenciadas por las decisiones que toman aquellos individuos en territorios vecinos. Para poder explicar esta interrelación, partiendo de los efectos del trabajador añadido y trabajador desanimado, acuñamos un efecto relativamente novedoso, el Bandwagon Worker Effect, que ayuda a comprender el importante papel de los efectos sociales a la hora de generar dependencia espacial en los mercados de trabajo en general y entre las decisiones de participación laboral de los individuos en particular.

8. Nuestro análisis detecta la existencia de dependencia espacial positiva en la sensibilidad cíclica de la participación laboral de las tasas provinciales de actividad en España, validando la operatividad en el mercado de trabajo español del Bandwagon Worker Effect. Por otro lado, nuestros resultados muestran que el grado de influencia entre los individuos no resulta ser lineal, sino que depende de la distancia geográfica de las áreas en las cuales estos se ubiquen. Dicho con otras palabras, las interrelaciones entre estos dependerán de la mayor o menor laxitud del criterio de vecindad empleado, detectando una mayor intensidad del efecto social conforme las áreas se encuentren más próximas entre sí y una menor intensidad en el caso contrario.

9. Este trabajo contribuye a ampliar la evidencia empírica existente en torno a la evaluación de políticas del mercado laboral desde el punto de vista regional. Nuestro análisis, centrado en la región española de Castilla y León, ayuda a cuantificar los efectos concretos de una de las políticas laborales más importes aplicadas en la región: El Segundo Plan Regional de Empleo de Castilla y León (SPRECyL) (2001-2003). Empleando un enfoque cuasi-experimental, desarrollado a través de la metodología econométrica del análisis de diferencias en diferencias, realizamos un análisis relativo de la efectividad de dicha actuación pública. Los resultados iniciales parecen indicar que, dicha política, generó un importante aumento de la tasa de ocupación laboral en las provincias castellanoleonesas donde se aplicó además de un notable descenso de las tasas de desempleo provinciales.

Sin embargo, al comparar el desempeño, durante dicho periodo, con el de las otras provincias españolas (que no formaban parte del ámbito de aplicación del SPRECyL), detectamos un incremento menor del nivel de ocupación mientras que el desempleo experimentó una evolución similar, lo que pone en cuestión la efectividad relativa de dicha política activa del mercado laboral.

10. El análisis de las políticas activas del mercado laboral elaborado en esta tesis doctoral, permite proponer líneas de actuación futuras para los responsables de política económica en

base al estudio concreto y riguroso de los efectos de la actuación analizada en cuestión. De esta manera, nuestra tesis doctoral aporta evidencia científica relevante a nivel regional para una política activa del mercado de trabajo que no contaba con ninguna evaluación de este tipo, profundizando en las herramientas disponibles para aumentar la efectividad y acondicionar las políticas futuras a las características de los territorios concretos en las que se apliquen.

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