UNIVERSIDAD DE MURCIA

ESCUELA INTERNACIONAL DE DOCTORADO

Four Essays on Institutions and Economics

Cuatro Ensayos sobre Instituciones y Economía

Dª Laura López Gómez

2019

UNIVERSIDAD DE MURCIA
ESCUELA INTERNACIONAL DE DOCTORADO

Four essays on institutions and economics

Cuatro ensayos sobre instituciones y economía

Dña Laura López Gómez

Supervisors:

Prof. Dra. Arielle Beyaert
Prof. Dr. José García Solanes

2019

A mis padres

.

Contents

List of Tables

List of Figures

Agradecimientos

El primer lugar de estos agradecimientos es, sin duda, para Arielle Beyaert. Desde que me matriculé en su asignatura durante mis años de licenciatura supe que algo en mi vida iba a cambiar y así fue. Todo esto no hubiera sido posible sin su motivación, ayuda, compromiso y buen hacer. Ha sido una suerte para mí que te cruzases en mi camino y un honor que seas "mi madre académica". El segundo lugar es para José García Solanes, mi "padre académico", su exquista forma de ser y su profundo conocimiento de la economía hacen que trabajar con él sea una auténtica delicia. Me siento muy orgullosa de que hayáis sido mis directores de tesis.

Quiero agradecer a los integrantes del programa DEcIDE por su esfuerzo y dedicación, especialmente a los coordinadores Arielle Beyaert y Fernando I. Sánchez. Con profesionales como vosotros la excelencia y la continuidad están garantizadas. Quiero hacer también mención al departamento de Método Cuantitativos para la Economía y la Empresa, especialmente a Máximo Camacho, Pilar Martínez, Isabel Albaladejo y Paco Martínez por su apoyo, implicación y disponibilidad para todo lo que hemos necesitado. Agradezco a todos mis compañeros de doctorado por la colaboración y ayuda mutua y especialmente a José Morales con el que he compartido los buenos y malos momentos y que me ha acompañado durante todo este proceso.

Quiero agradecer a toda mi familia y amigos. A mi prima María José por estar siempre ahí y a mi cuarteto Vero, Inma y Marien por hacer que estos años hayan sido más que un ordenador y cuatro paredes. A mis padres y mi hermano. Gracias mamá por estar siempre ahí y confiar tanto en mí. Gracias papá por aguantarme, siempre en silencio, y apoyar todas mis decisiones, todo lo que soy os lo debo a vosotros. Los dos juntos formáis un gran equipo que ha conseguido grandes logros, no lo olvidéis nunca. Sólo puedo decir que no podría haber tenido mejores padres. Gracias Juan Luis por ser mi apoyo incondicional día tras día. Os quiero a los tres. Por último, pero no menos importante, quiero agradecer a mi abuela, mi madre Salvadora, que tan orgullosa se sentía de mí y que se fue cuando se escribían las últimas páginas de esta tesis

Resumen

El objetivo de esta tesis es analizar cómo afecta la calidad institucional al desempeño económico a diferentes niveles. A nivel europeo, estudiamos el proceso de convergencia institucional en los países de la zona euro, y cómo la moneda única ha afectado a la corrupción de los países miembros de esa zona. En el plano internacional, utilizamos una muestra muy amplia de países para investigar el impacto de la calidad institucional sobre la demanda turística, y los efectos de la misma sobre el crecimiento de los países a largo plazo. Aplicamos técnicas econométricas recientes, idóneas para la naturaleza de los casos analizados.

La literatura previa, tanto empírica como teórica, coincide en el papel fundamental que tienen las instituciones en la economía. North (1990) explica el modo en que las instituciones y los cambios institucionales afectan directamente a la interacción de los agentes económicos y, por tanto, al conjunto de la economía. Desde el punto de vista empírico, Acemoglu et al. (2001) analizan cómo el pasado colonial de los diferentes países ha influido en el marco institucional de los mismos, y cómo éste ha condicionado el posterior desarrollo económico de los países.

En cuanto al desempeño institucional dentro de la eurozona, los análisis descriptivos y la observación de los escándalos de corrupción, especialmente en los países periféricos, ha fomentado la idea de que no existe un proceso de convergencia institucional entre sus miembros. El punto de arranque de esta tesis es examinar, con técnicas econométricas, hasta qué punto esta idea está fundamentada. Esta es una cuestión importante porque, si se confirma, esta brecha en la calidad institucional de la Unión Monetaria, tiene efectos nocivos para la aplicación y efectividad de la política económica y monetaria de la Unión Europea. Además, los comportamientos corruptos y la falta de control de la corrupción en algunos países de la periferia podrían estar afectando a la eficacia y eficiencia de las políticas de cohesión de la UE, ya que gran parte de esos fondos parece acabar en manos de unos cuantos en lugar de beneficiar al bienestar general de los países menos favorecidos de la eurozona.

Por otra parte, autores como Fernández-Villaverde et al. (2013) atribuyen este deterioro institucional en los países periféricos, especialmente los del sur, -Grecia, Italia, España y Portugal- a la implantación del euro. Según estos autores, la moneda común fomentó la llegada de flujos de capital desde el núcleo de la eurozona hasta la periferia, dando lugar a una

burbuja económica que alimentó comportamientos corruptos de los gobernantes de estos países. Sin embargo, toda su argumentación está basada en un análisis descriptivo de los datos, sin aportar evidencia empírica de que el euro sea el causante del evidente deterioro que muestran los indicadores de corrupción. Esta falta de soporte empírico nos ha llevado a preguntarnos y a analizar si la moneda única ha sido la causa de este hecho. Por ello, se hace necesario el estudio empírico del impacto de la implantación del euro sobre la calidad institucional, y en particular sobre el control de la corrupción.

Pero la baja calidad institucional y los hábitos corruptos no solo tienen importantes implicaciones en la eurozona, sino que otros países también se ven afectados por los efectos adversos de un marco legal y judicial débil y corrupto. Por eso, se hace necesario estudiar de manera global el impacto de las instituciones sobre el desempeño económico. En esta tesis nos centramos en dos tipos de desempeño económico, en el marco de una muestra muy amplia de países: por un lado, la llegada de turistas y, por otro el crecimiento económico de largo plazo.

La estructura de esta tesis es como sigue: en un primer capítulo analizamos las instituciones de la zona euro y su evolución a lo largo del tiempo. Nos centramos en la convergencia institucional entre los países que conforman la Unión Monetaria. Este tema es de vital importancia, dado que la efectividad de las políticas europeas depende en gran medida de la homogeneidad en la calidad institucional de los países miembros. En el segundo capítulo investigamos el impacto de la implantación del euro sobre el nivel de corrupción de los países miembros. Encontramos que el efecto no ha sido tan negativo como a primera vista sugieren los datos, pues obtenemos que los efectos han sido negativos y significativos solo para el caso de Grecia y los Países Bajos. Por otra parte, encontramos que la adopción de la moneda única ha sido positiva a la hora de reducir la corrupción en países muy concretos como Portugal, Eslovaquia y Alemania. El tercer capítulo analiza los efectos de la calidad institucional y de la corrupción, en particular, sobre el crecimiento económico. Para ello, usamos un algoritmo de Machine Learning (ML) llamado GUIDE de regresión en árbol, el cual permite identificar subgrupos de países de acuerdo con los diferentes niveles de estado de derecho y de corrupción, y ajustar un modelo tradicional de crecimiento, aumentado con la variable corrupción, en cada uno de estos subgrupos. Esto nos permite conocer el efecto directo e indirecto de la corrupción sobre el crecimiento. En cuanto a los resultados, detectamos que la corrupción es precisamente la variable que divide

la muestra, indicando que no existe homogeneidad de coeficientes en los determinantes del crecimiento; estos coeficientes varían dependiendo del nivel de corrupción del país. Por otro lado, obtenemos que la corrupción como determinante directo del crecimiento solo sería estadísticamente significativa a lo sumo en el caso de países con mucha corrupción, afectando negativamente a su crecimiento. El cuarto capítulo estudia la relación entre corrupción y calidad normativa y jurídica, por un lado, y la llegada de turistas a un país, por otro. Utilizando un modelo estándar de demanda de turismo, ampliado con efectos espaciales y con variables institucionales, obtenemos que la calidad del Estado de derecho es un determinante fundamental a la hora de elegir el destino de un viaje. Además, encontramos que la demanda turística se ve afectada por los shocks relacionados con la demanda de turismo de los países limítrofes.

Convergencia institucional en la zona euro

Existe abundante literatura sobre el modo en que las instituciones interaccionan y afectan a la economía de un país; sin embargo, no se ha estudiado mucho la convergencia institucional y las implicaciones que ésta puede tener para determinadas áreas con una integración económica elevada. Blackburn, Bose y Haque (2006) ponen de manifiesto que la divergencia institucional en grupos de países como la eurozona afecta a la convergencia económica; es más, señalan que no podrán converger de forma absoluta y, en el mejor de lo casos, lo harán de forma condicional; esto generará, por tanto, diferencias en el nivel de ingresos per cápita de los países en el largo plazo. Por tanto, las implicaciones de la convergencia institucional dentro de la Unión monetaria son claras: por un lado, aumentará el nivel de PIB per cápita y bienestar social en los países miembros, si para conseguir esa convergencia todos mejoran sus instituciones. Por otro lado, fomentará la convergencia económica dando lugar a una Europa más cohesionada, menos desigual y, por tanto, más estable.

En este sentido, en el primer capítulo de esta tesis investigamos si ha existido convergencia institucional entre los países de la zona euro y, en caso de que así haya sido, si esa convergencia ha sido hacia niveles mayores de calidad institucional. Para ello usamos dos tipos de análisis diferentes. En primer lugar, aplicamos contrates de raíz unitaria para panel (Bai y Carrion-i-Silvestre, 2009) y después realizamos un análisis de dinámica distribucional siguiendo el enfoque de Quah (1997), completado con las técnicas desarrolladas por Hyndman et al. (1996), Bashtannyk y Hyndman (2001) y Hyndman y Yao (2002). Fernández-Villaverde et al. (2013) argu-

mentan de forma teórica y descriptiva que, a raíz de la implantación de euro, se podría haber creado una divergencia institucional entre los países del centro del euro y los países del sur de la Unión Monetaria. Esta brecha estaría motivada por la llegada de capitales procedentes de los países del centro a los del sur, que habría aflojado las restricciones presupuestarias de los sectores público y privado, y alimentado una burbuja inmobiliaria en los países receptores. Todo ello habría fomentado la corrupción.

Sin embargo, son escasos los trabajos que analizan empíricamente la evolución y los efectos de las instituciones de la eurozona. En este trabajo encontramos que, mayoritariamente, no se ha detectado convergencia estocástica para ninguno de los indicadores de calidad institucional analizados para el periodo 1984-2018. Además, el análisis de la dinámica distribucional revela que tampoco se ha producido un proceso de "catching-up" entre los miembros de la periferia y del este de la eurozona con los miembros del núcleo. Asimismo, , encontramos que el euro no parece haber fomentado una posible convergencia. Sin embargo, este primer análisis no nos permite afirmar con rotundidad que el euro sea el culpable del deterioro institucional en la periferia y por tanto de la brecha entre el centro y la periferia. Volviendo al trabajo de Fernández-Villaverde et al. (2013), el deterioro detectado en corrupción debería tener entre sus causas, según estos autores, la implementación del euro. Analizar si eso ha sido así es precisamente el trabajo que se realiza en el siguiente capítulo.

Incremento de la corrupción y el euro

Como hemos mencionado con anterioridad, el origen de este capítulo se encuentra en el desarrollo teórico y en la descripción de los datos que llevan a cabo Fernández-Villaverde et al. (2013). Las conclusiones de este trabajo, unidas a los resultados obtenidos en el capítulo 1, donde detectábamos divergencia en corrupción entre los países del euro, nos lleva a preguntarnos cuál ha sido exactamente el papel que ha desempeñado la moneda única en los innegables incrementos de corrupción que se observan especialmente en países periféricos como Grecia.

Para llevar a cabo esta tarea utilizamos el Synthetic Control Method (SCM) desarrollado por Abadie et al. (2003, 2010) y ampliada por Cavallo et al. (2013). Esta metodología permite construir un indicador de corrupción sintético (contrafactual) que equivaldría al indicador real en ausencia del euro. Comparando este indicador sintético y el indicador real se obtiene el efecto que ha tenido el euro sobre la corrupción de cada país. Para

saber si ese efecto es significativo o no, utilizaremos la ampliación inferencial desarrollada por Cavallo et al. (2013) que nos permite hacer contrastes de significatividad sobre los efectos estimados.

En una primera aproximación, examinamos el efecto medio dentro de tres grupos de países que comparten características económicas e históricas: el núcleo, los países del sur y los países del Este. Para el núcleo formado por Alemania, Austria, Bélgica, Francia, Finlandia, Luxemburgo y los Países Bajos, encontramos un efecto positivo y significativo del euro. Ocurre lo mismo para los países del Este: Estonia, Eslovenia y Eslovaquia; además, en ambos casos, ese efecto medio es significativo varios años después de la puesta en circulación del euro. Para el caso de los países del sur (España, Italia, Grecia y Portugal) el efecto medio del euro no es significativo. Por tanto, el euro ha contribuido a reducir la corrupción, en media, en los países del núcleo y el este de la eurozona, pero no ha tenido un efecto medio significativo, ni positivo ni negativo, en los países del sur, en oposición a las tesis teóricas avanzadas por Fernández-Villaverde et al.(2013).

Analizando país por país, detectamos que ha existido un efecto positivo en Eslovaquia y Alemania, y un efecto negativo en Grecia o los Países Bajos. Estos resultados indican que los comportamientos corruptos y su evolución en el tiempo tienen un fuerte componente doméstico, y que el mismo acontecimiento provocará efectos muy diversos en los distintos países del euro.

En los dos primeros capítulos nos hemos centrado en el estudio de las instituciones y sus posibles efectos dentro de la zona euro; sin embargo, dado que el impacto de la calidad institucional y la corrupción es un fenómeno global, dedicamos un capítulo a estudiar los efectos sobre el crecimiento a medio y largo plazo, y otro a analizar los efectos sobre el turismo en una muestra muy amplia de países.

Crecimiento económico, calidad institucional y corrupción

La intuición y el pensamiento general nos dicen que la corrupción y la baja calidad de las instituciones tiene un efecto negativo sobre el crecimiento de un país. Sin embargo, la literatura ha encontrado evidencia tanto de efectos negativos como positivos que vendrían a indicar que el impacto de la calidad institucional y la corrupción sobre el crecimiento podría ser no lineal. Myrdal (1968), Kurer (1993), Meòn y Sekkat (2005) encuentran evidencia de que la corrupción afecta siempre negativamente

al crecimiento mientras que otros autores como Leff (1964) y Huntington (1968) sugieren que, en determinados contextos institucionales, por ejemplo, donde existe mucha burocracia, la corrupción sirve para evadir los obstáculos burocráticos facilitando el desarrollo de la actividad económica y afectando positivamente al crecimiento.

Las evidencias encontradas en un sentido y en otro muestran, a nuestro juicio, que este tema es muy complejo y que se necesita tratarlo utilizando metodologías más flexibles que las empleadas hasta ahora. Nosotros aplicamos técnicas de regresión en árbol al estilo de Tan (2010) pero para el caso y las variables que nos ocupan. Este tipo de procedimiento permite ajustar una ecuación de crecimiento tradicional a diferentes subgrupos de la muestra inicial de tal forma que podemos ver las diferencias en el modelo de crecimiento de distintos grupos de países que difieren según que estén por debajo o por encima de un cierto nivel de calidad institucional. Los subgrupos los elige el algoritmo de forma endógena tomando para la clasificación de los países una de las variables institucionales que le dejamos elegir. Usamos dos tipos de indicadores: indicadores del estado de derecho como proxy de las instituciones formales, e indicadores de corrupción, como proxy de las instituciones informales. Usamos dos bases de datos distintas para los indicadores, para aumentar la fiabilidad de nuestros resultados. La variable que resulta seleccionada es el nivel de corrupción, creando dos grupos principales: uno de alta corrupción y otro de baja corrupción. Esto nos está indicando que la corrupción tiene un efecto indirecto sobre el crecimiento, modificando los coeficientes de sus determinantes en función de si el país tiene poca o con mucha corrupción. Dicha variable, sin embargo, no resulta significativa como variable explicativa del modelo, salvo excepciones discutibles. La conclusión que obtenemos, por consiguiente, es que la corrupción no es un determinante directo del crecimiento económico, sino una variable que lo afecta indirectamente modificando la magnitud del impacto de los determinantes tradicionales del modelo de Solow según el nivel de corrupción del país.

Una vez que hemos analizado como afecta la calidad institucional y la corrupción al crecimiento de largo plazo de un país y, dado que encontramos un efecto indirecto sobre éste, cabe esperar que se encuentre un efecto directo de las mismas sobre los distintos sectores de la actividad económica. En el último capítulo analizaremos si esto es así para el caso del sector turístico.

Demanda turística e instituciones

Los determinantes básicos de la demanda de turismo han sido ampliamente analizados en la literatura; sin embargo, los efectos de las instituciones sobre la cantidad de turistas que llegan a un país han sido menos estudiados y con resultados más dispares. Autores como Tonsun y Timothy (2001), Neumayer (2004) o Das y Dirienzo (2010) encuentran evidencia empírica de un impacto negativo de la corrupción sobre el turismo mientras que otros autores como Saha y Yap (2015) demuestran que ese efecto es no lineal y niveles bajos de corrupción tienen un impacto positivo sobre la demanda de turismo.

Pero no solo las instituciones informales – como es el caso de la corrupción - tienen efectos sobre el turismo. Balli et al. (2016) o Tang (2018), por ejemplo, encuentran que la calidad normativa y judicial de un país tiene un impacto positivo en la llegada de turistas ya que estos perciben su viaje como más seguro.

En nuestro caso, utilizamos un modelo de econometría espacial, en concreto el Modelo del Error Espacial, para especificar de forma más adecuada la demanda turística y comprender cuál es el efecto de las instituciones formales e informales sobre ella. Las novedades que aporta este capítulo son principalmente tres: el estudio de cómo afectan las instituciones formales e informales al turismo, la utilización de un modelo con efectos espaciales y el uso de una muestra de 109 países que nos permite hacer un análisis con un enfoque global frente al enfoque local o regional que es el más extendido en la literatura que analiza la demanda turística.

Nuestros resultados revelan que las instituciones formales son las que tienen un efecto directo sobre la decisión de ir o no a un determinado destino turístico. La corrupción no tiene un efecto significativo y, además, la significatividad del término espacial indica que la demanda turística de un determinado país se ve afectada por los shocks que afectan al turismo de los países limítrofes. Estos resultados tienen importantes implicaciones para el diseño e implementación de políticas turísticas, la cuales deben combinar esfuerzos por mejorar las instituciones nacionales con medidas para aprovechar shocks positivos o neutralizar shocks negativos en las demandas turísticas de los países de su entorno.

Preface

The objective of this thesis is to analyze how institutional quality affects economic performance at different levels. We use various econometric techniques to study institutional convergence in the eurozone countries; we next carry out counterfactual analysis to determine to what extent the implementation of the single currency affected the level of corruption in the eurozone countries. The next step is to analyze the impact of institutions at an international level in two different aspects: we first analyze the effect of institutional quality on long-term growth; we finally evaluate the relationship between institutions and tourism demand at country level.

The empirical and theoretical existing literature coincides in the fundamental role that institutions have in the economy. North (1990) explains how institutions and institutional changes directly affect the interaction of economic agents and, therefore, affect the economy as a whole. Empirically, Acemoglu et al. (2001) demonstrate how the colonial pasts of the countries have marked their institutional frameworks and subsequent economic development.

As for institutional performance within the eurozone, descriptive analyses and observation of corruption scandals, especially in peripheral countries, have fostered the idea that there is no process of institutional convergence among its members. The starting point of this thesis is to analyse with econometric tools whether this perception is correct or not. This is an important question because, if confirmed, this gap in the institutional quality of the Monetary Union has harmful effects on the economic and monetary policy of the European Union. Thus, corrupt behavior and lack of control of corruption in some peripheral countries could be affecting the effectiveness and efficiency of EU cohesion policies, as much of the associated funds seem to end up in the hands of a few rather than benefiting the general welfare of the less favored eurozone countries. Some authors, such as Fernández-Villaverde et al. (2013), attribute this institutional dete-

rioration in the peripheral countries, especially those in the south - Greece, Italy, Spain and Portugal - to the introduction of the euro. They argue that the common currency encouraged capital flows from the core of the eurozone to the periphery, giving rise to an economic bubble and encouraging corrupt behavior among rulers in these countries. However, all their arguments are based on a descriptive analysis of the data, with no empirical evidence that the euro is the cause of the evident deterioration shown by corruption indicators. This lack of empirical support has led us to ask and analyze to what extent the single currency has been the cause. However, poor institutional quality and corrupt habits have important implications not only for the eurozone; other countries are also affected by the adverse effects of a weak and corrupt legal and judicial framework. Thus, it is necessary to study the impact of institutions on economic performance. This effect can have both a sectoral and an overall impact on the economic growth of any country. In this thesis we will deal with both impacts: first the impact on the important tourism sector and, then, from a more complex point of view, the direct and indirect impact of institutions and corruption on long-term economic growth.

The thesis is structured as follows. The first chapter analyzes the eurozone institutions and how they have evolved. More concretely, we study the institutional convergence of the countries comprising the Monetary Union, which is a highly important issue when bearing in mind that the effectiveness of European policies depends to a great extent on the homogeneity of the institutional quality of its member countries. The second chapter analyses the impact that the euro has had on the corruption of the member countries and we find that the effect has not been as negative as the data seem to describe, since we only obtain a negative and significant impact for the case of Greece and the Netherlands. On the other hand, we found that the adoption of the single currency has been positive in reducing corruption in some countries (Germany, Portugal and Slovakia). The third chapter analyzes how institutional quality and corruption affect economic growth. For that purpose, we use a Machine Learning (ML) algorithm called GUIDE to carry out tree regressions that allows us to identify subgroups of countries according to different levels of corruption and/or rule of law, and adjust an augmented growth model that includes measures of corruption as an additional explanatory variable in each of these subgroups. This allows us to ascertain the direct and indirect effects of corruption on growth. On the one hand, we detect that, among other possibilities, it is precisely corruption that divides the sample, indicating that there is no homogeneity of coefficients in the determinants of growth and

that, moreover, that these vary depending on the level of corruption in the country. In addition, the direct effect of corruption on growth would at the most be significant (and if so, with a negative impact) only in countries with high corruption. The fourth chapter looks at the relationship between corruption and regulatory and legal quality and the arrival of tourists in a country. Using a standard model of tourism demand, extended with spatial effects and institutional variables, we find that the quality of the rule of law is fundamental when choosing the destination for a trip. Additionally, we find that tourism demand is affected by shocks related to tourism demand in neighboring countries.

Institutional convergence in the eurozone

There is a wealth of literature on how institutions interact with and affect a country's economy. However, not much has been published about institutional convergence and the implications it may have for certain areas with high economic integration. Blackburn, Bose and Haque (2006) show that institutional divergence in the eurozone affects economic convergence. Moreover, they point out that they will not be able to converge absolutely and, in the best of cases, will do so conditionally. This will therefore generate differences in the level of per capita income of the countries in the long term. Therefore, the implications of institutional convergence within the Monetary Union are clear: first, the level of per capita GDP and social welfare in the member countries will increase, if in order to achieve that convergence everyone improves their institutions. Second, it will promote economic convergence leading to a more cohesive, less unequal and therefore more stable Europe. Thus, in the first chapter of this thesis we investigate whether there has been institutional convergence between the countries of the eurozone and, if so, whether that convergence has been towards higher levels of institutional quality. We use two different types of analysis. First, we apply unit-root panel contrasts (Bai and Carrion-i-Silvestre, 2009) and then perform a distributional dynamics analysis following Quah (1997) completed with the techniques developed by Hyndman et al. (1996), Bashtannyk & Hyndman (2001) and Hyndman & Yao (2002).

Fernández-Villaverde et al. (2013) argue theoretically and descriptively that the introduction of the euro may have created an institutional divergence between the countries of the centre of the euro and the countries of the south of the Monetary Union. This gap would be the consequence of the arrival of capital from the countries of the centre to those of the south,

so triggering a real estate bubble in the receiving countries and, as a consequence, an increase in corruption.

However, there is little work that empirically analyses what is happening to the institutions of the eurozone. In this thesis we find that, for the most part, no stochastic convergence has been detected for any of the institutional quality indicators analyzed for the period 1984-2018. Furthermore, the analysis of the distributional dynamics reveals that there has not been any catching-up process between the members of the periphery and the east with the members of the core. We also find that the euro does not seem to have fostered this convergence. However, this first analysis does not allow us to state unequivocally that the euro is to blame for the institutional deterioration in the periphery and therefore for the gap between the centre-periphery. Returning to the work of Fernández-Villaverde et al. (2013), the deterioration detected in corruption should have among its causes the implementation of the euro. This is precisely what the next chapter addresses.

Increased corruption and the euro

As mentioned above, the origin of this chapter lies in the theoretical development and description of the data by Fernández-Villaverde et al. (2013). The conclusions of this work, together with the results obtained in chapter 1, where we detected divergence in corruption among the euro countries, lead us to ask ourselves exactly which role the single currency has played in the undeniable increases in corruption observed in the peripheral countries especially, such as Greece.

We use the Synthetic Control Method (SCM) developed by Abadie et al. (2003, 2010) and extended by Cavallo et al. (2013). This methodology makes it possible to construct a synthetic (counterfactual) corruption indicator that would be equivalent to the real indicator in the absence of the euro. On comparing this synthetic indicator and the real indicator we obtain the effect that the euro has had on the corruption of each country. In order to know if this effect is significant or not, we will use the p-values methodology developed by Cavallo et al. (2013), which enables us to make reliable inferences on the results obtained. First, we examine the average effect within three groups of countries that share economic and historical characteristics: the core, the southern countries and the eastern countries. For the core countries - Germany, Austria, Belgium, France, Finland, Luxembourg and the Netherlands - we find a positive and significant effect

of the euro. The same occurs for the eastern countries - Estonia, Slovenia and Slovakia. Furthermore, in both cases, this average effect is significant several years after the introduction of the euro. In the case of the southern countries - Spain, Italy, Greece and Portugal - the average effect of the euro is not significant. The euro has, therefore, helped to reduce corruption or to damper its increase, on average, in the core and eastern countries, but has not had a significant average effect in the southern ones, which contradicts the theoretical thesis of Fernández-Villaverde et al. (2013).

A country-by-country analysis reveals that there has been a positive effect in Slovakia and Germany and a negative effect in Greece and the Netherlands. These results indicate that corrupt behaviors and their evolution over time have a strong domestic component and the same event will have very different effects in different euro countries.

In the first two chapters we focus on the study of institutions and their possible effects within the eurozone; however, the impact of institutional quality and corruption on the economy is widespread and affects economies around the world and also the sectors that make up these economies. Hence, the last two chapters focus on this global impact on economic activity, distinguishing between sectoral impact and long-term economic impact.

Economic growth, institutional and corruption

Intuitively we might well think that corruption and poor-quality institutions must have a negative effect on a country's growth. However, the literature has found evidence of both negative and positive effects, which might imply that the impact of institutional quality and corruption on growth is non-linear. Myrdal (1968), Kurer (1993), Meòn and Sekkat (2005) find evidence that corruption always negatively affects growth, while other authors, such as Leff (1964) and Huntington (1968), suggest that, in certain institutional contexts, for example, where there is a lot of bureaucracy, corruption serves to evade bureaucratic obstacles by facilitating the development of economic activity and so affects growth positively.

The conflicting findings show that this issue is very complex and needs to be addressed with more flexible methodologies than used to date. We apply tree regression techniques in the style of Tan (2010) since this type of procedure allows us to adjust a traditional (although, in our case, corruption augmented) growth equation to different subgroups of the initial

sample in such a way that we detect the different growth models of different groups of countries. The subgroups are chosen endogenously by the GUIDE algorithm, which we let select one or more the institutional variables to classify the countries. We use two types of institutional indicators: the rule of law as a proxy for the quality of formal institutions and a corruption indicator as a proxy for the quality of informal institutions. We use indicators from two different databases to increase reliability. The algorithm chooses one of the corruption indicators and creates two main groups: one of high corruption and the other of low corruption. This reveals that corruption has an indirect effect on growth by modifying the coefficients of its determinants depending on whether you are a country with low or high corruption. Additionally, although we incorporate corruption as an explanatory variable in the model, no direct effect on economic growth is detected. Therefore, our conclusion is that corruption does matter for growth, but only in an indirect way by varying the size of the impact of the traditional determinants of growth on the growth rate.

If institutional quality affects long-term economic growth, it will certainly also affect specific sectors of the economy. The question is how and to what extent, and that is what we analyze in the last chapter of this thesis for the case of tourism.

Tourist demand and institutions

The basic determinants of tourism demand have been widely analyzed in the literature; however, the effects of institutions on the number of tourists arriving in a country have been less studied and with dissimilar results. Authors such as Tonsun and Timothy (2001), Neumayer (2004) or Das and Dirienzo (2010) find empirical evidence of a negative impact of corruption on tourism, while others, such as Saha and Yap (2015), report that this effect is non-linear and that low levels of corruption have a positive impact on tourism demand.

But it is not only informal institutions that have effects on tourism; other authors such as Balli et al. (2016) or Tang (2018) find that the normative and judicial quality of a country also has a positive impact on the arrival of tourists, who perceive their visit as being safer.

We use the Spatial Error Model to better specify tourist demand than in the existing literature and understand the effect of formal and informal institutions on it. There are three main novelties in this chapter: the study

of how formal and informal institutions affect tourism, the use of a model with spatial effects and the use of a sample of 109 countries that allows us to make an analysis with a global approach as opposed to the local or regional approach that is the most widespread in the literature that analyzes tourism demand.

Our results reveal that it is formal institutions that have a direct effect on the decision of whether or not to go to a particular tourist destination. Corruption does not have a significant effect and, furthermore, the significance of the spatial term indicates that the tourism demand of a given country is affected by shocks affecting tourism in neighboring countries. These results have important implications for the designers and implementers of tourism policies, who should combine efforts to improve national institutions with measures to take advantage of or neutralize transitory increases or decreases in the tourism demands of the surrounding countries.

Chapter 1

Do institutions of the euro area converge?

1.1. Introduction

**This chapter is accepted for publication in Economic Systems (https://www.journals.elsevier.
systems). Date: 14 January 2019. DOI not available at dissertation submission time**.

There exists abundant theoretical and empirical literature showing that the quality of institutions matters as much or more than factor endowments and technology in explaining the differences in both productivity and long-term growth of countries (North,1990, Knack and Keefer, 1995, Hall and Jones, 1999, Acemoglu et al. 2001, 2005, Acemoglu and Robinson 2012, Besley and Persson 2010, Iversen and Soskice, 2018, and Neyapti, 2013, among others). In the same vein, Blackburn, Bose, and Haque (2006) stress that if a process of institutional divergence really takes place in a group of countries, for instance the Eurozone, the individual members could reach, at best, only conditional economic convergence, which would imply very different levels of national per-capita income in the long-run. In the context of the Eurozone it is therefore important that a) the member states improve the quality of their institutions as a way of increasing economic welfare in the long run, and that b) institutional convergence take place to contribute to the existence of a common long-run economic path among the Eurozone members, which in turn guarantees the survival of the euro and an adequate level of economic cohesion among them.

In this chapter we investigate whether national institutions of the Eurozone have converged towards higher quality levels in recent decades.

For that purpose, we use a wide range of institutional variables on which we perform two types of analysis: stochastic convergence with a third-generation panel unit root test (Bai and Carrion-i-Silvestre, 2009) and distribution dynamics analysis, in the line of Quah (1997), using the tools developed by Hyndman et al. (1996), Bashtannyk and Hyndman (2001) and Hyndman and Yao (2002).

In principle, we should expect that economic integration that took place among the eurozone countries would erode the institutional gaps between them. The rationale stressed by La Porta, López de Silanes, and Shleifer (2008) is that economic integration accelerates the exchange of ideas and pushes countries to compete in attracting foreign direct investments, which then translates into the transfer of knowledge as well as into the adoption of similar (good) cultural characteristics and legal frameworks.

Recent contributions that analyses the situation after the implementation of the euro, (Fernandez-Villaverde et al., 2013, Jaccard and Smets, 2017), point out that the national institutional quality and capacities of the eurozone countries differ in a non-negligible way, and that the implementation of the euro has widened the institutional gap between the core and the peripheral countries of this currency area. The theoretical reason provided by Fernandez-Villaverde et al. (2013) is that the inception of the euro, by easing credit conditions, loosened the government budget constraints of these countries, and reduced transparency and accountability of politicians. As a result, many institutional reforms were postponed or avoided.

From an empirical point of view, Schönfelder and Wagner (2016) analyze the determinants of institutional development with the use of a dynamic panel data model, and find that prospective EU membership had a positive impact on institutional development in European countries with relatively poor institutions but they could not detect a positive influence of the euro area membership on this development.

In a recent and parallel study to ours, Schönfelder (2017) investigates institutional catching-up processes (with σ-convergence and β-convergence approaches) within several groups of EU members. She does not detect catching-up among eurozone countries in the area of Governance and detects divergence in Rule of Law within the initial twelve members of the euro area.

Savoia and Sen (2016) analyze β-convergence in legal, bureaucratic, and administrative institutional quality, but on a large worldwide sam-

ple of countries from the 1970s to 2010. They find that although institutional quality has grown faster in countries with initially poor institutions (developing economies) following the end of the Cold War, the resulting catching-up convergence was only a temporary process.

This paper addresses the convergence process in institutions within the euro area with a dual approach that is innovative in several ways. First, instead of analyzing institutional convergence as a catching-up process as in β- and σ-convergence, it analyses whether stochastic convergence has taken place or not. Both β- and σ-convergence concepts are aimed at checking whether the countries in the worst positions are in transition towards the long-run path of the better positioned countries, that they do not have reached yet[1] . By contrast, stochastic convergence tests check whether the countries have already transited towards, and share, the same long-run path (or at the worst, parallel long-run paths). They are usually based on unit-root tests. In the case of institutional convergence in the eurozone, analyzing stochastic convergence consists of studying whether euro countries already share the same institutional long-run evolution paths (or in the worst case of stochastic convergence, parallel long-run paths). This is the first question we address in this paper. To that end, we apply the third-generation panel unit root test developed by Bai and Carrion-i-Silvestre (2009) that resolves significant drawbacks of simpler techniques applied so far to the study of stochastic convergence, namely cross-section dependence and multiple structural change. The use of this test is an innovation in the field of institutional convergence analysis.

As an additional innovation, we complete the stochastic convergence analysis with the distribution dynamics approach, advocated especially by Quah (1997) for economic convergence and adapted here to our institutional study. This approach consists of analyzing the evolution over time of the whole cross-country distribution of the institutional variable of interest. We assess it by using kernel and stochastic kernel estimators

[1]Under the β-convergence approach, the analyst investigates –typically with a cross-section regression- whether the countries initially in worse initial situations catch up over time with the countries in better situations. If detected, β-convergence means that the worst countries are progressively reducing the gap that separates them from countries in better positions, but it does not detect whether the countries share the same long-run path. As far as σ-convergence is referred, it focuses on the reduction over time of the dispersion of the variable under study across countries, by centering the analysis on the variances across countries of that variable. Although frequently applied, these two approaches are not free from criticism because there does not exist a one-to-one correspondence between them and convergence (see for instance Quah, 1995)

of the density and conditional density functions of the institutional indicators across countries. This help to complete and refine our analysis and obtain more accurate conclusions.

We apply our panel unit root tests and kernel density estimations to a wide range of monthly institutional indicators that extends from January 1984 or 1999 (depending of the group of countries) to July 2018. Our results indicate that no convergence exists among the members of the whole eurozone, or among the components of several sub-groups of countries considered in the analysis, for each of the six institutional variables used in the empirical tests. Moreover, our distribution dynamics analysis reveals that, since the inception of the euro, neither the periphery (Italy, Spain, Greece, Ireland, Portugal, Malta and Cyprus) nor the Eastern countries (Estonia, Latvia, Lithuania, Slovakia and Slovenia) have followed a catching-up process towards the three eurozone countries that exhibit the best institutional levels. These results provide support for the view that the euro did not boost institutional reforms across these members of the eurozone capable of enhancing institutional convergence. These results suggest important policy implications, developed in the conclusions, that are relevant for the eurozone welfare and sustainability.

The rest of the chapter is organized as follows: Section 2 describes the relevant aspects of the econometric methodologies that we use and the data to which they are applied. Section 3 presents and discusses the empirical results. Finally, Section 4 summarizes our findings and offers conclusions and policy prescriptions.

1.2. Econometric methodology and data

1.2.1. Econometric methodology

A very large part of the prolific empirical literature on *economic* convergence is derived from the econometric concepts of integrated (unit roots) and cointegrated series. The basic idea of the convergence tests of this type, that need not be limited to economic convergence analysis, can be described as follows: If several time series converge with each other, the difference of each of them from their common mean should exhibit mean reversion. In other words, for two or more series to converge with each other in the long run, their individual deviations from the common mean

may not be permanent and this common mean should represent a reference path that adequately describes the long-run common tendency of these series. This approach of convergence is based on the evaluation of the persistence or transience of the differences of the series from their common mean. Technically speaking, this means that the deviations from that mean do not exhibit unit roots; they are not $I(1)$ or integrated series but instead all are $I(0)$ series. In the literature, this type of convergence is often known as stochastic convergence or time-series convergence.

Bernard and Durlauf (1995) applied this type of test on long period GDP per capita time series of different countries. Evans and Karras (1996) developed one of the most well-known tools of stochastic convergence analysis based on unit root tests in a panel data framework. Within this panel unit root framework many unit root tests have been developed that are useful for the analysis of convergence, which allows for the improvement of the original Evans-Karras methodology.

After very important improvements emerged from Pesaran (2007) who included contemporaneous interdependence (cross-section dependence) among the panel units in panel unit root tests, the test developed by Bai and Carrion-i-Silvestre (2009) is empirically even more relevant and useful for convergence analysis: besides accounting for cross-section dependence using common factors models, it also allows for the presence of up to five structural changes in the deterministic component of the series at unknown dates, with the additional advantage that the structural changes need not be homogeneous, i.e. they need not take place at the same dates in all units. Considering the possibility of structural changes, that can even be heterogenous, in unit root tests (and therefore in convergence tests based on unit root techniques) is especially important to avoid spurious divergence conclusions when in fact convergence is in place (about the importance of taking into account structural changes in unit root tests, see Perron, 1989, and the subsequent abundant literature).

As emphasized in this literature, the risk of spurious conclusions is especially present if the series cover long periods of time and/or time periods that include relevant changes in societal structure, as is the case with our datasets. The sample period of our study starts, indeed, before the year 2000 and ends in 2018 for countries of the euro area. This period includes at least two important events that might have altered the structure of the society: the implementation of the euro as a common currency in the first part of the sample, and the deep economic crisis in the middle part of it. This sample therefore requires the use of tests that address the possibility of structural breaks in the series. Additionally, it also re-

quires to deal with the existence of cross-section dependence among the panel units, since the countries of our sample are extremely interrelated through financial and trade channels. As far as we know, the use of Bai and Carrion-i-Silvestre (2009) technique to analyze institutional convergence is an important novelty; as such, our study sheds additional light on the question of institutional convergence in an innovative and reliable way, to the extent that it reduces more than other tests the risk of spurious unit roots, i.e. in our case, the risk of an erroneous conclusion of divergence[2] . To avoid confusion, it is worthwhile stressing at this point that the ultimate objective of our analysis is not to detect whether structural breaks have taken place, but rather to test whether the institutional indicators of the eurozone countries converge or not, while considering possible structural breaks -if any- to avoid spurious divergence results.

Bearing in mind all of the above, the null and alternative hypothesis of Bai and Carrion (2009), in our study are:

$$H_0 : \textit{the deviations from common mean are } I(1) \textit{ for all countries}$$
$$H_1 : \textit{the deviations from common mean are } I(0) \textit{ at least for some countries}$$

Under the null hypothesis all countries deviations exhibit unit root, and divergence therefore is taking place, whereas under the alternative the deviations follow an $I(0)$ process (strictly speaking, at least for part of the countries). The authors propose six different test statistics, to be used according to the sample characteristics. P_m and P_m^* have to be excluded because they have good properties only when the number N of countries in the panel is very large, which is not our case. As far as Z and P are concerned, their distributions under the null are not invariant to the number and location of structural breaks, whereas Z^* and P^* are. These are therefore the test statistics we report here. The asymptotic distribution of Z^* under the null is a $N(0,1)$ and the test is left-tailed, whereas the asymptotic distribution of P^* is a χ^2_{2N}[3].

As indicated, the preceding approach to the analysis of institutional convergence is aimed at detecting whether the countries have already transited towards, and share, the same long-run path in institutional quality

[2]In fact, our previous applications of other panel unit root tests, such as Im, Pesaran and Shin (2002) among others, on the same data did not offer more evidence of convergence than Bai and Carrion-i-Silvestre (2009).

[3]For more details about the testing strategy of Bai and Carrion (2009), see Appendix A. To apply it, we use the GAUSS codes developed by the authors.

(or at the worst parallel long-run paths). In case the test concludes that they do not share yet a common long run path, the approach based on the *distribution dynamics* of the institutional indicators -in the line of Quah (1997) proposal for the analysis of economic convergence- may shed additional and interesting light on the absolute and relative evolution over time of the institutional quality in the countries of the eurozone, and could therefore give rise to policy prescriptions.

This second approach which is a non-parametric methodology based on kernel density estimates focuses, indeed, on the evolution over the whole sample period of the entire cross-country distribution of the institutional indicators. It therefore provides much more information than the other two more popular alternatives to examine whether a catching-up process is taking place, namely β- and σ-convergence approaches, since it does not limit the analysis to the study of the first two moments of the distributions (β-convergence centers only on the mean whereas σ-convergence focuses on the standard deviation of the distributions; they both can be shown to contain limited and confusing information about the real process of convergence; see Quah, 1995, among others). Moreover, this approach can also provide interesting information on the intradistributional mobility of the countries over time; this is possible thanks to the estimation of *conditional* distributions of the indicators, where the conditioning variable is the past value of the indicator itself. Additionally, it can also shed light on how the shape and location of the indicator distributions could be conditioned by other variables of interest, such as the amount of European structural funds, for instance; or on how the distribution of, say, real per capita GDP might be conditioned by the level of institutional indicators and therefore by institutional quality.

The distribution dynamics approach requires density estimations. A frequent and basic tool for that purpose is the kernel density estimator. Let $f(y)$ be the value of the density function of the stochastic variable Y at point y and let $y_1, y_2, ..., y_M$ be a sample of M observations of that variable. Then the kernel estimator of $f(y)$ is

$$\hat{f}(y) = \frac{1}{Mh} \sum_{i=1}^{M} K(\frac{y - y_i}{h})$$

where h is the bandwidth of the interval around y and K is the kernel function that associates a weight to each observation of Y around point y. The kernel function has to satisfy conditions that coincide with the properties of univariate and unimodal probability density functions, so that

such functions are traditionally used in kernel estimation. In our case, we use Epanechnikov function and the bandwidth is data-driven. This kernel density estimator can be seen as a more sophisticated smoothed-curve alternative to a simple histogram and therefore provides insightful graphical information on the shape, position and dispersion of the distribution of the variable of interest; it therefore allows to evaluate the basic characteristics of this distribution.

The graphical representation of the estimated distributions for a given year in a two-dimensional space provides a point-in-time cross-country distribution of the institutional indicator under study. In the literature, such graphs are often referred to as "snapshots" since they give the distributional characteristics of the indicator at a given moment of time. The comparison of snapshots at different points in time helps to study how the (marginal) distributions evolve over time. By contrast, if we want to study how the distribution evolves as a function of past values of the same variable (which provides information about the intradistributional movements) or as a function of another variable (which informs about the dependencies of the whole distribution on the values of that other variable), what we need to estimate are the *conditional* distributions. This can be done using the kernel estimator techniques for conditional densities developed by Hyndman and coauthors (Hyndman et al., 1996, Bashtannyk and Hyndman, 2001 and Hyndman and Rao, 2002).

As explained by Hyndman et al. (1996), let us assume we wish to estimate the density of Y conditional on $X = x$, and we have a sample of size M on both variables denoted by $\{(y_1, x_1), (y_2, x_2), ..., (y_M, x_M)\}$; let $g(x, y)$ be the joint density of (X, Y), let $h(x)$ be the marginal density of X and let $f(y|x) = g(y, x)/h(x)$ be the conditional density of $Y|(X = x)$. The natural kernel estimator of $f(y|x)$ is

$$\hat{f}(y|x) = \frac{\hat{g}(y, x)}{\hat{h}(x)}$$

where

$$\hat{g}(y, x) = \frac{1}{Mh_y h_x} \sum_{i=1}^{M} K\left(\frac{\|x - x_i\|}{h_x}\right) K\left(\frac{\|y - y_i\|}{h_y}\right)$$

and

$$\hat{h}(x) = \frac{1}{Mh_x} \sum_{i=1}^{M} K\left(\frac{\|x - x_i\|}{h_x}\right)$$

where $\|\cdot\|$ stands for some distance metrics. The authors opt for the Euclidean distance. They also use the Epachnenikov function for the kernel function K.

This estimator is the starting point for estimating the conditional densities analyzed in the present paper. We complete it with the improvements aimed at tackling the bias problem in the estimation of the conditional mean (Hyndman et al. 1996, section 5) to correctly locate the conditional distribution graph on the y-axis. We also combine it with the bandwidth automatic selection rules described in Bashtannyk and Hyndman (2001) and Hyndman and Rao (2002)[4].

1.3. Data: first characterization

The database we use is the International Country Risk Guide (ICRG)[5] developed by PRS Group[6]. This poll-based database provides information on twelve variables related to distinct aspects of institutional quality. Although it offers data for some countries from 1984 onwards, data for all the countries that conform the eurozone is available on a monthly basis only since December 1998. Therefore, our study will cover the period December 1998 to July 2018 unless otherwise said when we analyze subgroups of countries for which data are available earlier. Our analysis focuses on the variables of this database that are more explicitly related with the quality of institutions:

- *Government stability:* measures the government's ability to accomplish its program and to stay in office.
- *Investment profile:* assesses three important factors affecting it, namely expropriation, profits repatriation, and payment delays.

[4]For our estimations, we use the "cde" and associated R functions, included in the "hdrcde" package, which has been written and is maintained by R. Hyndman and is available in CRAN repository.

[5]We also initially used the annual database developed by Kuncic (2014), who calculated different indices of institutional quality for 126 countries for the period between 1990 and 2010. However, given the annual periodicity of this dataset, the fact that it stops in 2010, and that the qualitative conclusions do not differ from those presented here, we do not present the results here. We did not use other well-known databases such as the Worldwide Governance Indicators of the World Bank, or QoG data set from University of Gotheburg because the time span is also too short for the type of convergence analysis that we carry out in this paper. Moreover, the latter indicators are largely built on the information provided by ICRG.

[6]https://www.prsgroup.com/about-us/our-two-methodologies/icrg

- *Corruption:* assesses corruption within the political system, taking into account both corruption in the form of bribes, special payments and similar forms of corruption affecting investment, and corruption in the form of nepotism, job reservations, or secret party funding.
- *Law and order:* evaluates the legal and judicial systems and crime rates.
- *Democratic accountability:* measures the quality of democracy. This includes the existence of a free and fair election system, the active presence of more than one political party, and evidence of the protection of personal freedom.
- *Bureaucracy quality:* this variable gives a better score to those countries with a bureaucracy free from political pressures.

We treat the six variables as measuring distinct institutional concepts even though they might be cross-correlated. In this sense we depart from the proposal of Langbein and Knack (2010) of averaging together the six indexes into a single broader index, and agree more with Kaufmann, Kraay and Mastruzzi (2010) in that correlation does not imply that variables are invalid empirical measures of different aspects of institutional quality.

These institutional indices can be classified into two broad categories depending on whether they better reflect either "formal" or "informal" institutions since, as stressed by Neyapti (2013), they impact differently on the economy. Formal institutions refer to legal and judicial frameworks and to the implementation of policies. Formal institutions change as a result of a political decision, usually following a discontinuous and punctuated pattern. On the other hand, informal institutions are those linked with the culture, behaviors, and habits of social agents, and tend to change continuously but at a slow pace. In accordance with these definitions, Government Stability, Investment Profile, Law and Order are more related with the quality of formal institutions. The quality of informal institutions is better reflected in Corruption, Democratic Accountability and Bureaucracy Quality.

The challenges involved in measuring institutional quality are well-known. Whether it is based on surveys or on expert views, in all cases measuring institutional quality necessarily includes some subjectivity. The database used in this study is not free of this common drawback: it is based on or derived from expert's reviews, formed by collecting information and then assigning risk points according to a consistent pattern of evaluation of this type of measurement. However, given the nature and characteristics of what is measured, there is no easy solution to this com-

mon drawback. In any case, this database offers, as far as we know, the greater data availability for our purpose. As far as the interpretation of the indicators is concerned, it is important to bear in mind that, in this paper, a higher score of the indicator reflects a higher institutional quality.

Figure 1.1 presents the eurozone real GDP per capita distributions as a function of two representative institutional indicators: the corruption indicator, as an example of informal indicator, and the law and order indicator in its quality of formal indicator. The density estimator is obtained from the data on the full period 1999-2018. Both graphs lead to a very clear conclusion: the higher the institutional quality level, the higher the GDP per capita. Similar conditional densities graphs are obtained for the rest of indicators and are not presented here for brevity. These graphs let no doubt about the link between institutional quality and economic performance and welfare in the eurozone. They fully motivate that we analyze whether there is or not institutional convergence, or at least institutional improvements, in the eurozone countries.

Figure 1.1: Kernel estimates of the distribution of the eurozone real GDP per capita conditional on the Corruption and Law and Order indicators (in deviations from the cross-sectional mean), 1999-2018

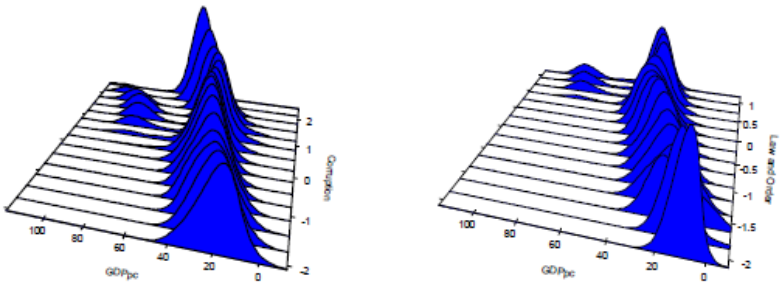
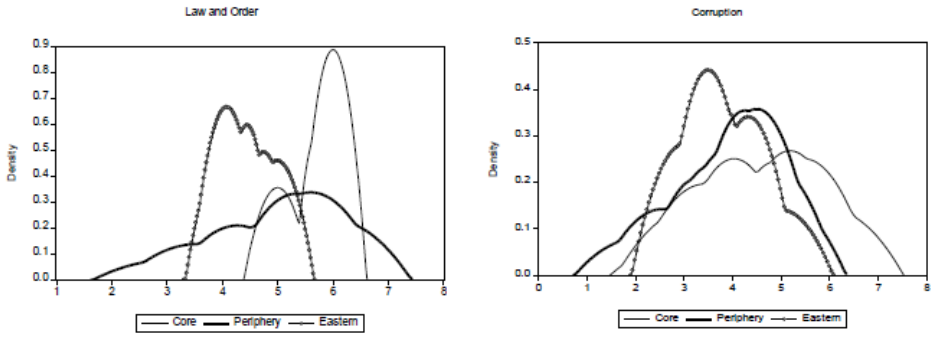


Figure 1.2 represents the kernel distribution in 1999, i.e. at the launching year of the euro, for the same two representative indicators -Law and Order and Corruption-, for the three main groups of countries of the eurozone: the core (Austria, Belgium, Germany, Finland, France, the Netherlands and Luxembourg), the periphery (Italy, Spain, Greece, Ireland, Portugal, Malta and Cyprus) and the Eastern euro countries that acceded the eurozone from 2004 onwards (Estonia, Latvia, Lithuania, Slovakia and Slovenia). Considering the Eastern countries in a separate group is done in order to detect possible differentiating features of having belonged to the Communist bloc.

As far as the Law and Order indicator is concerned, three very distinct distributions emerge for each subgroup; the superiority of the distribution in the core is clear given its smaller variance around a higher mean, although it exhibits some symptoms of polarization (bimodal distribution). As regards control of corruption, the best distribution corresponds again to the core. It is followed by the periphery and by the Eastern group in the last position. Similar conclusions can be drawn from the distributions of the remaining four indicators (see Figures and comments in Appendix B for more details).

The descriptive results that can be inferred from Figure 1.2 and Appendix B justify that, in addition to studying whether the institutional variables converge around a common average, we also analyze the extent to which the subgroups with overall lower quality (periphery and East) have approached the institutions of countries with the best institutional practices over the last two decades.

Figure 1.2: Kernel distributions for Law and Order and Corruption indicators in 1999



1.4. Empirical Results

In this section we perform two types of empirical analysis. The first one consists of applying the third-generation panel unit root test developed by Bai and Carrion-i-Silvestre (2009) on the dataset described in the previous section, to investigate institutional stochastic convergence across the members of the eurozone and of three subgroups of this currency area. The second approach performs distributional dynamics analysis based on snapshots of kernel density estimates and stochastic kernels to investigate how the periphery and the East have evolved with respect to the three core countries with the best institutional level and to examine the link between institutional quality and European structural and cohesion funds.

1.4.1. Panel unit root test

Table 1.1 collects the institutional convergence tests applied to the ICRG data for the 19 countries that currently make up the common currency area. We performed the analysis for the period from December 1998 to July 2018.

Table 1.1: Institutional Convergence tests. Complete eurozone. Period: December 1998 - July 2018 - ICRG database

Formal Institutional variables	Z^*	P^*
Government Stability	-0.353	37.697
Investment Profile	-0.260	31.798
Law and Order	-0.965	46.485
Informal Institutional variables	Z^*	P^*
Corruption	-0.363	35.524
Democratic Accountability	-0.699	28.462
Bureaucracy Quality	-0.077	27.532
** convergence at 5 per cent, * at 10 per cent.		
Z^* test Critical values: at 5 per cent -1.645, at 10 per cent -1.28		
P^* test Critical values: at 5 per cent 53.383 at 10 per cent 49.512		
Unless otherwise said in footnote, no structural breaks have been detected (maximum number allowed in tests:5)		

Divergence is detected in all indicators. We can conclude that the eurozone has not been able to bring their national institutions into convergence around a common long- run path.
Since this divergence conclusion could be due to the presence of non-converging subgroups while others are converging to each other, we apply the same convergence tests for several subgroups of countries. We start with the core countries, for which Table 1.2 presents the convergence tests.

Table 1.2: Institutional Convergence: Core countries. Period: December 1998 - July 2018 -ICRG database

Formal Institutional variables	Z^*	P^*
Government Stability	0.515	5.330
Investment Profile	1.641	5.489
Law and Order	-0.877	13.578
Informal Institutional variables	Z^*	P^*
Corruption	-1.541*	19.333
Democratic Accountability[7]	-0.610	16.757
Bureaucracy Quality	-0.638	9.646
** convergence at 5 per cent, * at 10 per cent.		
Z^* test Critical values: at 5 per cent -1.645, at 10 per cent -1.28		
P^* test Critical values: at 5 per cent 23.685 at 10 per cent 21.064		
Unless otherwise said in footnote, no structural breaks have been detected (maximum number allowed in tests:5)		

No convergence is detected in this subgroup, except at 10% for Corruption with Z^* but not with P^*. Although P^* is preferred in this case (because no structural changes have been detected for this indicator and Z^* is then less reliable, see Bai and Carrion, 2009, p.484), we analyze the evolution of the cross-sectional mean of the Corruption index of these countries over time – as a proxy of their long-run path towards which they would be converging- by fitting a trend on it and examining its characteristics; this allows us to know if there are signs of convergence in the right direction (convergence towards less corruption, and not towards more).

The results presented in Figure 1.3 show that, if convergence took place, this would be a case of "good" convergence in the sense that this common mean, i.e. the long-run path proxy variable, tends to improve over time: the core members get closer to each other around a lower level of corruption (towards a higher level of the corruption indicator) in almost all period, although since 2010 this common mean tends to slightly worsen.

Figure 1.3: Common mean of Corruption as long-run path proxy in Core countries. Period: December 1999-July 2018 -ICRG database

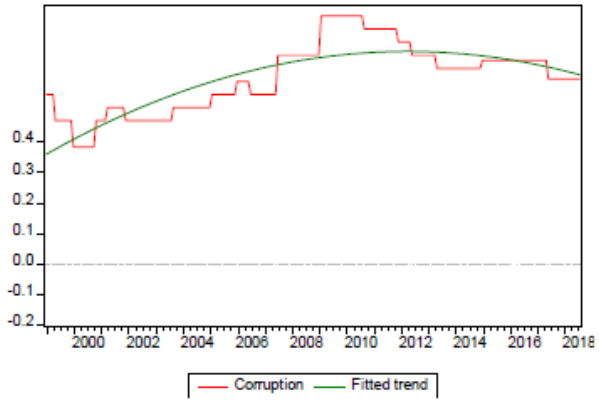


Table 1.3 presents the convergence tests for the peripheral countries (Italy, Spain, Greece, Ireland, Portugal, Malta and Cyprus). The results show that countries of this subgroup have nothing in common since we do not find evidence of convergence in any indicator with P^*, although some symptoms of convergence in Corruption (at 10%) and in Government Stability (at 5%) appear with Z^*. In both cases, the result from P^* is more reliable for the reasons explained before.

However, there is some interest in analyzing the trend of the cross-sectional mean of the Corruption index. Some authors, such as Fernández-Villaverde et al (2013a) argue that corruption exhibits a deterioration in

[7]Structural breaks detected: In Belgium 2012/03 and 2015/04, in Finland 2012/04 and 2015/04, in Germany 2005/05 and 2014/04

southern euro members, after the implementation of the euro. These authors explain that, after adopting the euro, peripheral countries abandoned institutional reforms, and this precipitated an institutional deterioration and a delayed response to the speculative boom, making the crisis deeper than in the richer countries. Challe, Lopez and Mengus (2016) document a similar phenomenon.

Table 1.3: Institutional Convergence: Periphery. Period: December 1998 - July 2018 -ICRG database

Formal Institutional variables	Z^*	P^*
Government Stability	-1.627**	19.488
Investment Profile	-0.687	10.329
Law and Order	-0.990	12.620
Informal Institutional variables	Z^*	P^*
Corruption	-1.306*	17.157
Democratic Accountability	-0.067	8.930
Bureaucracy Quality[8]	-0.963	11.589
** convergence at 5 per cent, * at 10 per cent.		
Z^* test Critical values: at 5 per cent -1.645, at 10 per cent -1.28		
P^* test Critical values: at 5 per cent 23.685 at 10 per cent 21.064		
Unless otherwise said in footnote, no structural breaks have been detected (maximum number allowed in tests:5)		

Figure 1.4 shows that peripheral euro countries tend to a worse long-run path from 1999 onwards. The average value of the Corruption index exhibits a huge decline between 2001 and 2004; after a slight improvement between 2004 and 2006 the common mean is rather stable around a lower level than in the early 2000s. In general, this seems to reinforce the idea that the euro did not help to improve corruption control in the peripheral countries.

Since the Government Stability indicator also shows some evidence of convergence with Z^*, Figure 1.5 adds some information about its type. The graphical information is very clear: if convergence took place, it was convergence towards a worse state.

So, to conclude, the general result for the periphery is absence of stochastic convergence or, at the most, maybe some convergence towards a worse situation in two indicators.

[8]Two structural breaks are detected for this variable, one for Italy on January 2013 and one for Malta on December 2002

Figure 1.4: Common mean of Corruption as long-run path proxy in the periphery. Period: December 1998 - July 2018 - ICRG database

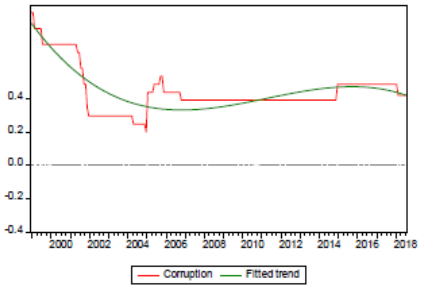


Figure 1.5: Common mean of Government Stability as long-run path proxy in the periphery. Period: December 1998 - July 2018 - ICRG database

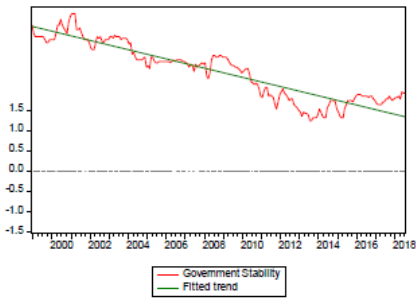


Table 1.4 shows the results for the Eastern euro countries. Although we might a priori expect that these countries have more in common than other euro members, since they share the historical characteristic of being former members of the communist bloc, the results indicate that they do not converge among them.

Savoia and Sen (2016) might provide some clue to explain this: their results support the idea that the adoption of market institutions by developing countries after the Cold War helped them to experiment some initial convergence to countries with "higher" institutional quality, but this effect disappeared quickly and the institutional differences persisted. The behavior of Estonia, Latvia and Lithuania after the adoption of the market economy shows some similarities with Savoia and Sen (2016) descriptions.

Table 1.4: Institutional Convergence: Eastern euro countries (Estonia, Latvia, Lithuania, Slovakia and Slovenia). Period: December 1998 - July 2018 -ICRG database

Formal Institutional variables	Z^*	P^*
Government Stability	-0.651	11.304
Investment Profile	0.577	3.586
Law and Order	-0.638	9.354
Informal Institutional variables	Z^*	P^*
Corruption[9]	-0.724	16.316
Democratic Accountability	1.755	3.866
Bureaucracy Quality	-0.634	13.430
** convergence at 5 per cent, * at 10 per cent.		
Z^* test Critical values: at 5 per cent -1.645, at 10 per cent -1.28		
P^* test Critical values: at 5 per cent 23.685 at 10 per cent 21.064		
Unless otherwise said in footnote, no structural breaks have been detected (maximum number allowed in tests:5)		

[9]Structural breaks detected: Slovenia 2009/04

Additionally, we examine separately euro countries who adopted the euro since its implementation and those who adopted the common currency years after. Table 1.5 presents the results for the original members of the eurozone (in this case the sample starts in December 1984).

Here again, we do not find evidence of convergence in any indicator. This suggests that not even the founder members of the eurozone have carried out the necessary reforms to achieve a harmonized institutional framework.

If there is no convergence among original euro countries, we can expect that countries who joined later do not exhibit common institutional features either. Table 1.6 confirms this suspicion.

Table 1.5: Institutional Convergence: Original members of Eurozone (Austria, Belgium, Germany, Finland, France, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain). Period: December 1984 - July 2018 -ICRG database

Formal Institutional variables	Z^*	P^*
Government Stability	-1.128	26.662
Investment Profile	-0.742	25.156
Law and Order	1.323	13.082
Informal Institutional variables	Z^*	P^*
Corruption	-1.035	24.448
Democratic Accountability	0.175	14.567
Bureaucracy Quality	-0.520	28.834
** convergence at 5 per cent, * at 10 per cent.		
Z^* test Critical values: at 5 per cent -1.645, at 10 per cent -1.28		
P^* test Critical values: at 5 per cent 33.924 at 10 per cent 30.813		
Unless otherwise said in footnote, no structural breaks have been detected (maximum number allowed in tests:5)		

Table 1.6: Institutional Convergence: New members of Eurozone (Cyprus, Estonia, Greece, Latvia, Lithuania, Malta, Slovakia and Slovenia). Period: December 1998 - July 2018 -ICRG database

Formal Institutional variables	Z^*	P^*
Government Stability	-0.582	20.944
Investment Profile[10]	-0.686	15.188
Law and Order	-1.163	23.654
Informal Institutional variables	Z^*	P^*
Corruption	-0.582	22.422
Democratic Accountability	0.227	14.414
Bureaucracy Quality	0.574	7.123
** convergence at 5 per cent, * at 10 per cent.		
Z^* test Critical values: at 5 per cent -1.645, at 10 per cent -1.28		
P^* test Critical values: at 5 per cent 26.296 at 10 per cent 23.541		
Unless otherwise said in footnote, no structural breaks have been detected (maximum number allowed in tests:5)		

The general conclusion is thus that there are practically no signs of stochastic convergence in institutions, neither for the whole eurozone, nor for specific subgroups. It is therefore interesting to perform distribution dynamics analysis in order to detect evolution patterns of the institutional levels that might shed light on what should be done to improve the institutional situation of the eurozone members.

1.4.2. Distributional dynamics based on successive snapshots

We carry out the distribution dynamics analysis for two subgroups: the periphery and the Eastern countries. We examine the distributions of their institutional position and their evolution with respect to the three overall best positioned countries of the eurozone, that will serve as a benchmark: Germany, Luxemburg and Finland (these countries correspond to the upper left pole of the GDPpc distribution in Figure 1.1). The objective is to investigate whether and how these two groups have been catching up or not with the three best countries over the last twenty years.

Figure 1.6 plots the kernel distributions of the deviations of the indicators of the periphery from the average institutional indicators of the three best, for three years of the sample -1999, 2009 and 2018- that are representative of the start of the euro era, the first year after the financial crisis shock and the last available year. As regards Government Stability, a backward movement took place between 1999 and 2009, and this was partially reversed in the last ten years. In Investment Profile and control of corruption, a clear worsening took place during the whole period. We also observe a slight backward movement in law and order accompanied by higher concentration and stratification. In Democratic Accountability the most striking feature is stratification together with a marked backward shift of the distribution with respect to 1999. Finally, in Bureaucracy Quality there is no significant changes in the mean since 1999, no changes since 2009, but a strong polarization since the beginning.

All in all, the periphery has moved away from the best core countries in virtually all the institutional indicators. All this implies that the countries of the periphery have not taken advantage of their euro membership to approach the countries with better institutions, which reinforces the results of the econometric tests.

The corresponding snapshots of the Eastern subgroup are represented in Figure 1.7. Since the Eastern countries acceded the eurozone form 2004

[10]Structural breaks detected: Malta 2002/02

onwards, we add the 2004 snapshots in the figure. For Government Stability, after an initial worsening to the left, in 2018 the distribution is better located with a smaller dispersion, reflecting an overall improvement of this institutional indicator since 2004. For Investment Profile, the distribution gets much more concentrated around a slightly improved mean from 1999 to 2009, but it moves strongly backwards in the last ten years. In Law and Order the indicator is much worse than the benchmark countries (the whole distributions are located over negative values); the distributions reveal stratification with less dispersion since 2004 than in 1999, and the situation has not changed since then.

As far as the control of corruption is concerned, the net effect is ambiguous because although the worsening movement experienced between 1999 and 2009 is partially reversed in the last ten years, the final distribution is more concentrated on negative values. For Democratic Accountability, the initial polarization of the distribution evolves towards stratification since 2009 with a lower mean, so that the net result is deterioration in the quality of this institutional aspect.

Finally, for Bureaucracy Quality, the most striking features are: a generalized worse situation than the benchmark countries, characterized by stratification, hardly no change in the mean location, together with an increased concentration around that mean.

To sum up, no significant improvements are detected with respect to the benchmark, except for Government Stability. Moreover, some backsliding is revealed for Investment Profile as well as a general increase in stratification.

Figure 1.6: Kernel distributions for institutional indicators. Periphery relative to Germany, Finland and Luxembourg

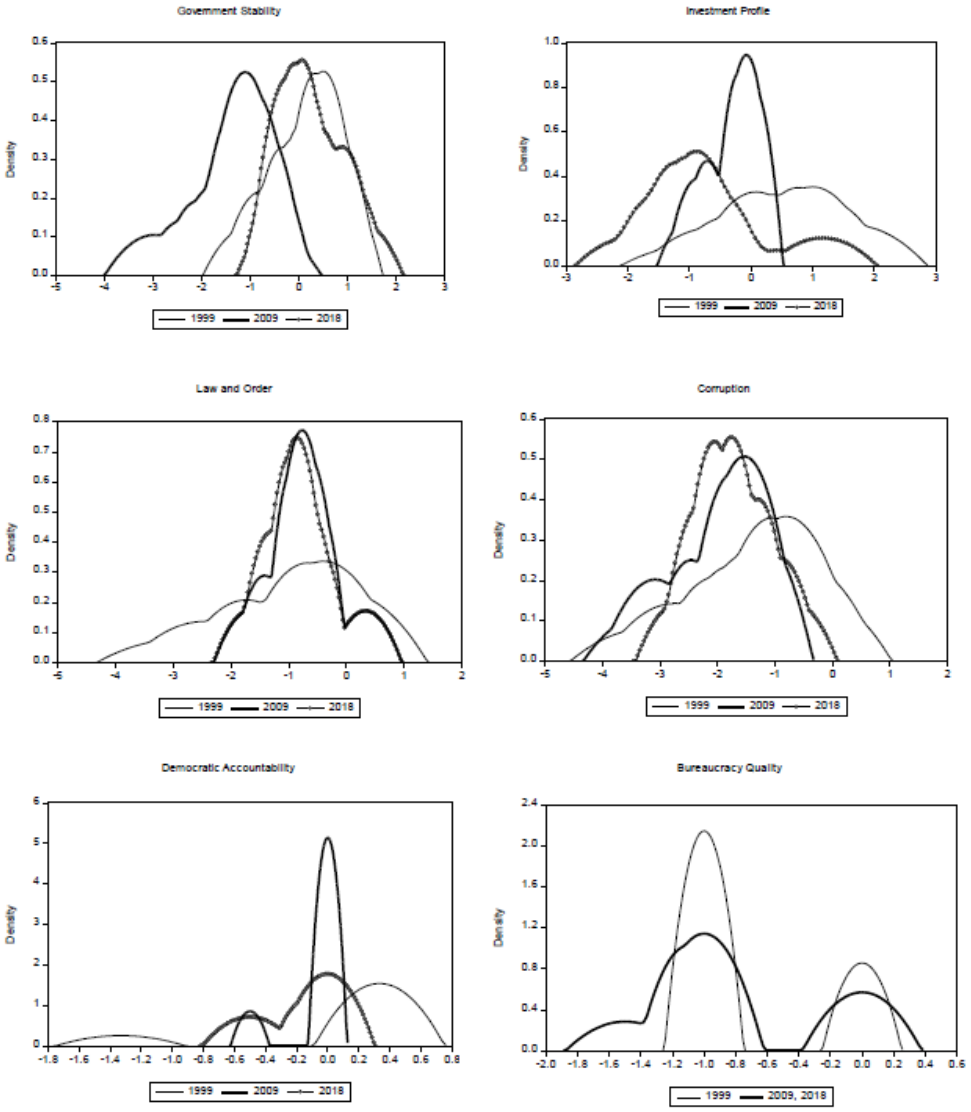
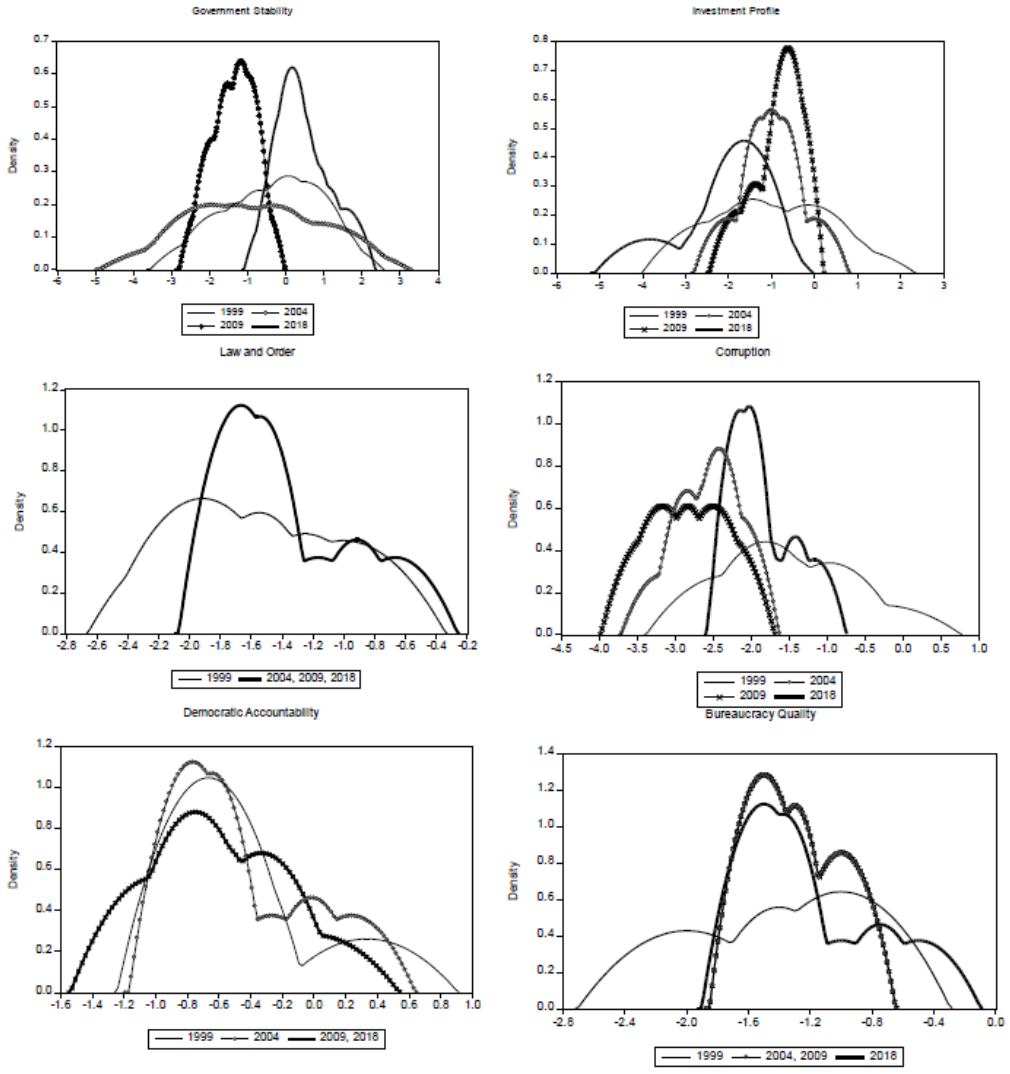


Figure 1.7: Kernel distributions for institutional indicators. Eastern countries relative to Germany, Finland and Luxembourg



1.4.3. Distributional dynamics based on stochastic kernels

The three-dimensional graphical representations of stochastic kernels for the period 1999-2018, presented in Figure 1.8, show the dynamics of institutional distribution in the whole eurozone with respect to their common mean. The conditional distributions are represented vertically. The straight line that crosses obliquely the $(t, t+5)$ horizontal space of each graph is the locus of distributional immobility; peaks of distributions located on this locus indicate high persistence in the level of institutional quality and a lack of intra-distribution mobility from one year, in t, to five years ahead in $t+5$. Distributions located to the right of this locus indicate a worsening of the distributional quality of the corresponding indicator over a 5-year period, and the reverse is true when the distributions are located below and to the left of that straight line.

The graphs of Figure 1.8 show very different intragroup dynamics. For the Government Stability, the probability mass reflects more movements to the right than to the left of the immobility locus; the latter occurs for those that initially were in a very bad situation. So, some symptoms of catching-up are detected for those in worse positions, although a general worsening of the institutional quality can be inferred for this indicator over a 5-year transition period. For the Investment Profile, the movements are similar but the worsening trend is even more evident. Similar conclusions of degradation can be drawn for the control of corruption and for Bureaucracy Quality where all members evolve into a worse situation. In Law and Order and in Democratic Accountability the results are mixed, but with a predominant tendency towards deterioration. In Law and Order, it appears that only a small proportion of the countries that were in a very bad initial position move towards better positions. To sum up, this graphical analysis shows a predominant evolution towards worst positions in all institutional indicators, although a timid movement towards some convergence in Government Stability and Investment Profile is detected and some improvement takes place for the countries in the worst initial positions, although, as detected in our panel unit root tests, convergence is not reached yet.

Figure 1.9 presents the dynamics of institutional distribution in the periphery with respect to the institutional level of the three best countries of the eurozone, over one year (from t to $t+1$)[11] for the period 1999-2018. For Government Stability, the distributions are widely spread to the right of the persistence locus, with special intensity in the distributions with ini-

[11] We consider in this case the pair (t, t+1) instead of (t, t+5) due to data availability, since the number of countries in the periphery is much lower than in the complete eurozone.

tially better institutions. The stochastic kernel reveals that the persistence decreases as the initial value of the indicator increases, so the situation with respect to the benchmark countries is worsening. For Investment Profile, the situation deteriorates at the upper end of the indicator but it is bimodal at the lower end: some countries with worse initial position improve but most of them worsen.

As for the remaining four indicators, the general tendency is towards degradation also. This is especially true for Law and Order and Democratic Accountability. In Law and Order, however, a small group of the initially badly positioned countries tend to improve. In Democratic Accountability, polarization takes place at both extremes of the indicator with some improvement occurring only at the upper extreme. Corruption is the indicator for which the deterioration process from one year to the other is the mildest.

Joining these results with those of the unit root test, periphery countries diverge from each other and their overall positions tend to deteriorate with respect to the benchmark countries.

Figure 1.10 presents the one-year transition dynamics of institutional distribution in the Eastern group with respect to the institutional level of the three benchmark countries of the eurozone between 1999 and 2018[12] . The dynamics of Government stability is very similar to that of the peripheral countries, thus pointing out divergence away from the benchmark. The distributions of Investment Profile and Democratic Accountability move to the right of the immobility locus, except for some polarized cases that shift to the left of that locus. The net result is divergence towards lower institutional quality with respect to the benchmark in both cases. For Law and Order, we detect low persistence with an important mass of probability moving upwards and to the right in some distributions of the middle and the upper side of the sample. Since the cases where improvements -registered at the upper end of the indicator- are less than the cases of degradation, the net effect is a deterioration with respect the benchmark countries in this indicator. For Corruption, the distributions shift rather uniformly to the right of the immobility locus. This reveals a deteriorating situation that depends less then in other indicators on the initial level. Finally, in Bureaucratic Quality, we also infer an overall divergence away from the benchmark.

Based on all these results, the conclusion is that no catching up towards the better-positioned eurozone countries is detected in the former communist bloc countries.

[12]See the preceding note.

In conclusion, just like in the periphery, these countries neither converge to each other nor catch up with the benchmark.

Figure 1.8: Stochastic kernel of the whole eurozone indicators in deviation from their common-mean; 1999-2018. The conditional density functions (of the indicators at t+5 given the indicator at t) are plotted on the vertically.

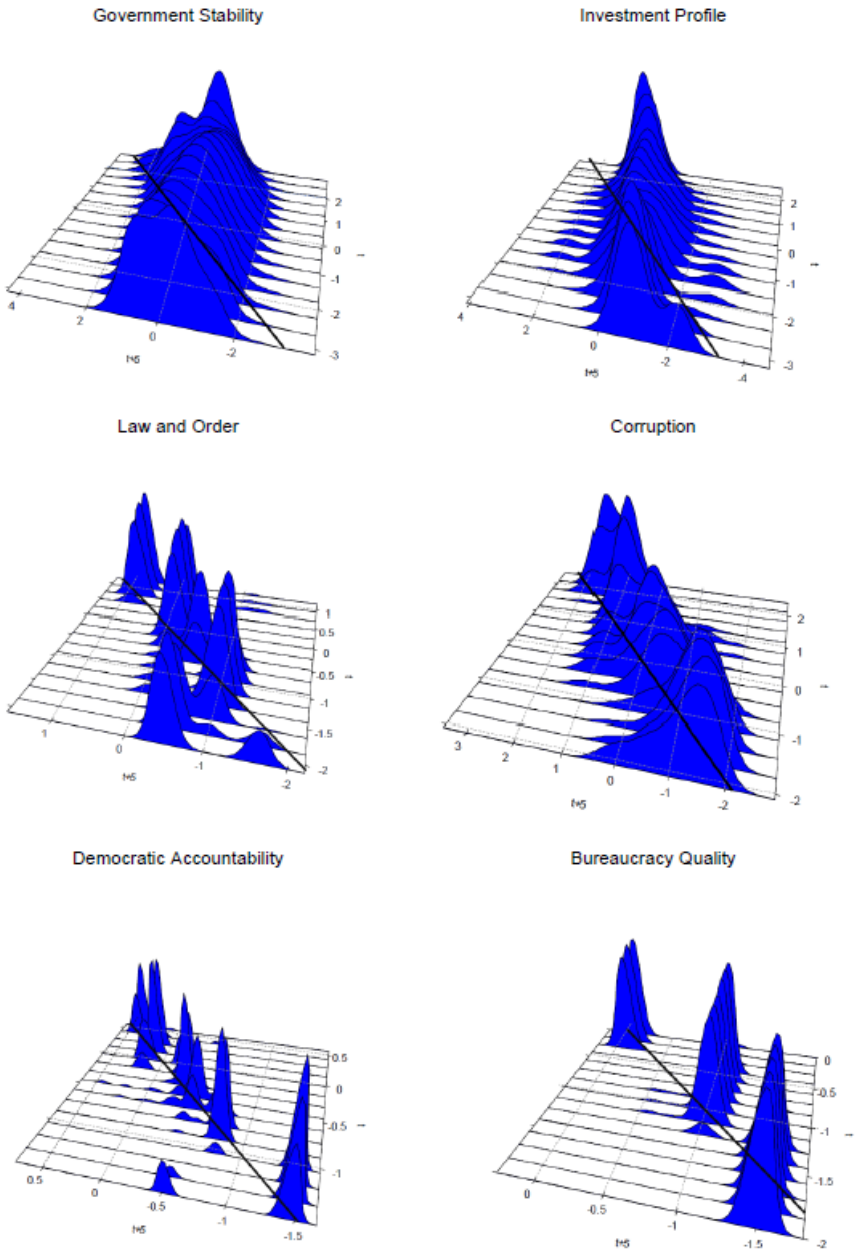


Figure 1.9: Stochastic kernel of the periphery indicators in deviation from the indicators of the three benchmark countries of the eurozone; 1999-2018. The conditional density functions (of the indicators at t+1 given the indicator at t) are plotted on the vertically.

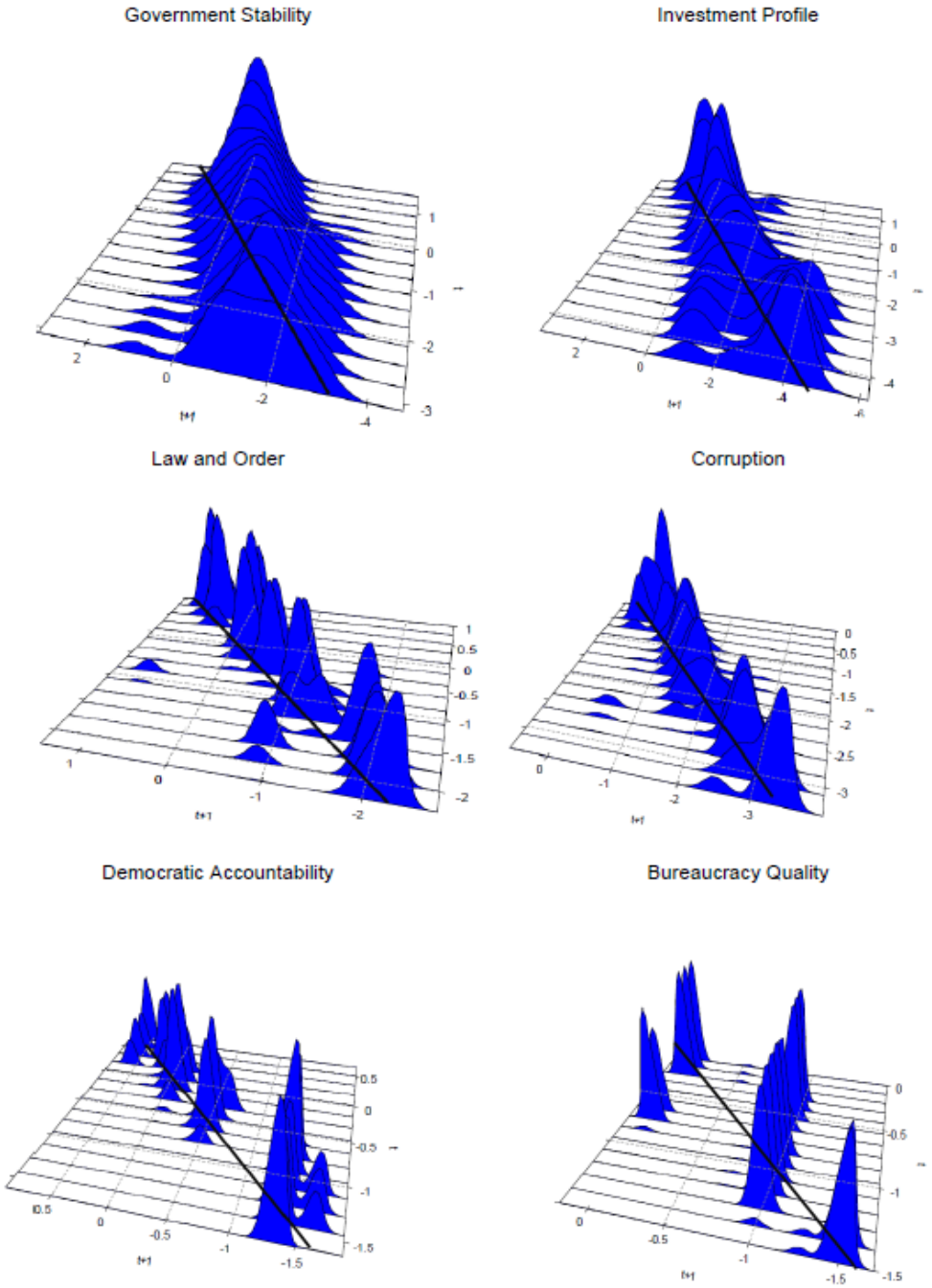
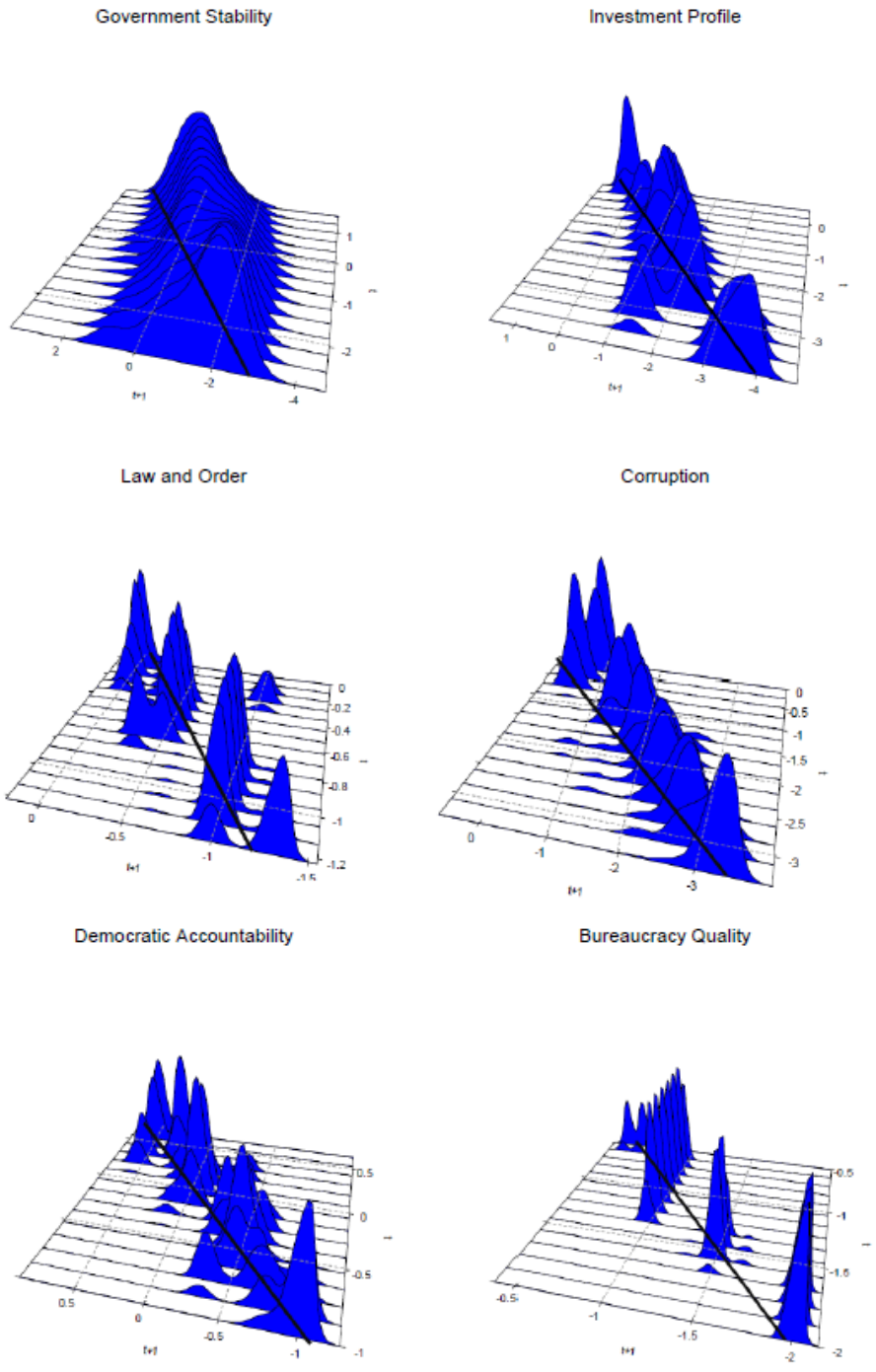


Figure 1.10: Stochastic kernel of the Eastern countries indicators in deviation from the indicators of the three best countries of the eurozone; 1999-2018. The conditional density functions (of the indicators at t+1 given the indicator at t) are plotted on the vertically.



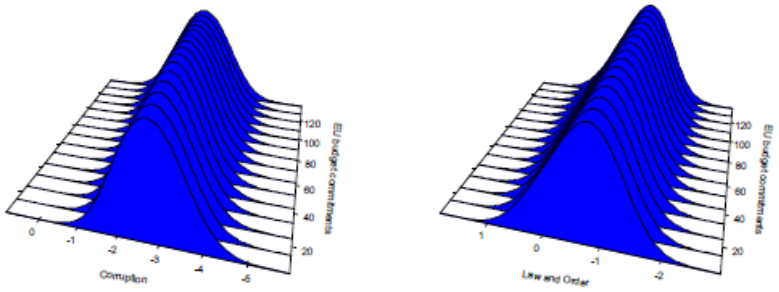
1.4.4. Institutional quality and Structural and Cohesion Funds in the Eurozone

The preceding sections revealed both the absence of a common long-run path in the evolution of the institutional indicators among the countries of the eurozone, and an overall lack of catching-up process towards the best positioned eurozone countries in the two subgroups made of the peripheral and Eastern countries. The question is which supranational European measures could be adopted to improve the situation of the worst positioned.

The first solidarity tool that comes to mind is directly related to the assignments of European structural and cohesion funds, given that the countries of these two subgroups have been net receivers of this type of budgetary aids. It is well known (Selih, Bond and Dolan (2017)) that these funds have not produced the expected economic results, mainly due to institutional shortcomings of the recipients (especially in corruption control and Bureaucracy Quality)[13]. Moreover, and up till now, in spite of being the improvement of institutional and legal framework one of the objectives of the Structural and Cohesion funds, their assignments have been either totally useless in fostering or not at all paralleled with institutional improvement reforms. This can be immediately concluded from the graphs of Figure 1.11: both in control of corruption and in Law and Order, the indicator distribution is practically invariant in shape, location and dispersion when conditioned on the real amount of structural funds, over the period 1999-2018.

[13]Börzel (1999) highlights that the same supranational policy in a currency area has different results on each member, due to differences in institutional structures and cultures. On the other hand, Bongardt and Torres (2013) explain that the Sovereign debt crisis has impacted very differently on the members of the eurozone due to the lack of institutional convergence among them.

Figure 1.11: Kernel distributions of the eurozone Corruption and Law and Order indicators conditional on the real amount of budgeted European Structural and Cohesion funds; 1999-2013.



Consequently, the European authorities should give priority to a new model of European funds assignment, aimed at fostering significant improvements in institutional quality in the recipient countries and at guaranteeing an efficient management of Structural funds. Acting in this way the European Cohesion Policy would foster institutional convergence, which is a prerequisite for improving both economic outcomes and social welfare as stressed by Rodríguez-Pose and Tselios (2013).

1.5. Concluding remarks

The main goal of this chapter has been to detect whether institutional convergence in the euro area takes place or not. More concretely, we examine whether or not the member states share a long-run evolution path in institutional development. For this purpose, we use Bai and Carrion-i-Silvestre (2009) panel unit root test for stochastic convergence of six institutional indicators. We have been unable to detect stochastic convergence in the eurozone as a whole, nor in any of the four sub-groups of this area considered in the analysis: the core, the periphery, Eastern countries, and the original members of the eurozone. We complete the analysis with the distribution dynamics approach based on kernel and stochastic kernel estimations of several types of density functions of the institutional indicators across countries. This analysis also reveals that, after the inception of the euro, the periphery and the Eastern countries have not followed a catching-up process towards the three eurozone countries that exhibit the highest institutional levels.

These findings put in evidence that these countries, which are characterized by institutions of lower quality, have not taken advantage of form-

ing part of the eurozone to reform their institutions and bring them closer to those of the core countries. The issue is of paramount importance for several reasons: first, institutional quality influences the productivity of national economies, and determines the level of per capita income in the long run. Second, increased institutional homogeneity at high levels in the eurozone is a prerequisite for ensuring that the stabilization policies adopted at the European level, particularly the monetary policy, affect all eurozone countries in the same way. Last but not least, it is highly unlikely that countries with weak institutions will be able to use the structural funds efficiently from both economic and social standpoints[14].

As far as the Eastern countries is concerned, our distributional dynamics based on successive snapshots reveals that they suffered backsliding in Investment Profile, but not in the other five institutional indicators, for which only reform slowdown is detected, compared to the three-euro countries with best institutional practices. This finding is consistent with the results of Levitz and Pop-Eleches (2010) showing a lack of backsliding in political reforms among the new post-communist EU members.

The survival of the euro in the coming years depends crucially on the success with which the countries of the peripheral and Eastern countries of the eurozone can improve their institutions and close the gap that separates them from the institutions prevailing in the core of this area. For this reason, the reform and institutional convergence across the member states of the eurozone should be a top priority task on the agenda of national authorities and policymakers. We have shown in this paper that the distribution of European funds has not helped so far to make the quality of the institutions of the euro countries more convergent.

Therefore, one way to stimulate the convergence of national institutions of the peripheral and Eastern countries towards the best institutional practices could be to condition the allocation of such funds to well-defined reforms in the peripheral and Eastern countries of the eurozone. This program could be implemented and monitorized, under a yearly and a multiannual perspective, by a European Semester particularly devoted to institutional convergence across the eurozone members, in the line of what has been done for other important European issues[15]. In our opinion, our

[14]See Selih, Bond and Dolan (2017) for a useful discussion about the relevance of the rule of law for an efficient utilization of the European structural funds.

[15]See the Thematic Factsheets of the European Semester, published by the European

results provide strong empirical support to the recommendations of Papaioannou (2016, p. 8-9) for specific European actions that can be summarized as follows. In addition to linking the European funds to institutional reforms, this author proposes: a) to implement a European program to reduce institutional differences between member states; b) to settle a European Institute to monitor institutional behavior and the capacity of national governments to enforce the new rules and institutions; c) to link any debt forgiveness and aid from the European Stabilization Fund to countries meeting well-defined targets; d) to block UE transfers to countries whose governments do not respect the basic European values and liberties; e) to provide EU technical and financial assistance to countries that reform their public administration and expedite their courts. Finally, f) to give a more active role to the European Parliament, and increase its coordination with the National Parliaments on these issues.

1.6. Bibliography

1. Acemoglu, D., Johnson, S., & Robinson, J. A. (2005). 'Institutions as a fundamental cause of long-run growth'. *Handbook of economic growth*, 1, 385-472.

2. Acemoglu, D., Johnson, S. & Robinson, J.A. (2001). 'The colonial origins of comparative development: An empirical investigation'. *The American Economic Review,* 91, 1369-1401.

3. Acemoglu, D., & Robinson J.A, (2012). "Why Nations Fail: The Origins of Power, Prosperity and Poverty (1st). 1st ed. New York: Crown, 529.

4. Bai, J., & Carrion-I-Silvestre, J. L. (2009). 'Structural changes, common stochastic trends, and unit roots in panel data'. *The Review of Economic Studies*, 76(2), 471-501.

5. Bai, J. & Perron, P., (1998), Estimating and Testing Linear Models with Multiple Structural Changes, *Econometrica*, 66, issue 1, p. 47-78.

6. Bashtannyk, D.M., & Hyndman, R.J. (2001) "Bandwidth selection for kernel conditional density estimation". *Computational statistics and data analysis*, 36(3), 279-298.

Commission. European Commission (https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/european-semester/thematic-factsheets_en)

7. Bernard, A. B., & Durlauf, S. N. (1995). 'Convergence in international output', *Journal of applied econometrics*, 10(2), 97-108.

8. Besley, T & T Persson (2010) Pillars of prosperity. Princeton Universrity Press, Princeton, NJ. USA.

9. Blackburn, K., Bose, N. & Haque, M. E., (2006), "The incidence and persistence of corruption in economic development", *Journal of Economic Dynamics and Contro*l, 30, issue 12, p. 2447-2467.

10. Bongardt, A., Torres, F., Hefeker, C., Wunsch, P., & Hermann, C. (2013). 'Convergence in the EU'. *Intereconomics*, 48(2), 72-92.

11. Börzel, T. A. (1999). 'Towards convergence in Europe? Institutional adaptation to Europeanization in Germany and Spain'. *Journal of Common Market Studies*, 37(4), 573-596.

12. Challe, E., Lopez, J. I. & Mengus, E. (2016): Southern Europe's institutional decline (HAL, hal-01331723), https://hal.archives-ouvertes.fr/hal-01331723.

13. Evans, P., & Karras, G. (1996). 'Convergence revisited'. *Journal of monetary economics*, 37(2), 249-265.

14. Fernandez-Villaverde, J., Garicano, L. & Santos, T. (2013). 'Political Credit Cycles: The Case of the Eurozone', *Journal of Economic Perspectives*, American Economic Association, vol. 27(3), pages 145-66.

15. Hall, R.E. & Jones, C.I. (1999). 'Why Do some Countries Produce So Much More Output Per Worker than Others?', *The Quarterly Journal of Economic*s, 114(1), 83-116.

16. Hyndman, R.J., Bashtannyk, D.M., & Grunwald, G.K., (1996). 'Estimating and Visualizing Conditional Densities', *Journal of Computational and Graphical Statistics*, vol.5, 315-336.

17. Hyndman, R.J. & Yao, Q. (2002) "Nonparametric estimation and symmetry tests for conditional density functions". *Journal of Nonparametric Statistics*, 14(3), 259-278.

18. Im, K. S., Pesaran, M. H., & Shin, Y. (2003). 'Testing for unit roots in heterogeneous panels'. *Journal of econometric*s, 115(1), 53-74.

19. Iversen, T., & D. Soskice. 2018. 'A structural-institutional explanation of the eurozone crisis.' Unpublished manuscript. In Philip Manow, Hanna Schwander, Bruno Palier (eds.). Welfare Democracies and Party Politics. Oxford: Oxford University Press.

20. Jaccard, I. & Smets, F. (2017). 'Structural asymmetries and financial imbalances in the eurozone', ECB Working paper N^{o} 2076, june.

21. Kaufmann, D., Kraay, A. & Mastruzzi, M., (2010). "The worldwide governance indicators: methodology and analytical issues", Policy Research Working Paper Series 5430, The World Bank.

22. Knack, S. & Keefer, P. (1995). 'Institutions and economic performance: Cross-country tests using alternative institutional measures', *Economics and Politics*, 7(3), 207-228.

23. Kuncic, A. (2014) 'Institutional quality dataset', *Journal of Institutional Economics*, 10(1), pp. 135–161.

24. Langbein, L. & Knack, S., (2010), "The Worldwide Governance Indicators: Six, One, or None?", *Journal of Development Studies*, 46, issue 2, p. 350-370.

25. La Porta, R., López de Silanes, F. & Schleifer, A. (2008). 'The economic consequences of legal origins', *Journal of Economic Literature*, 46(2), 285-332.

26. Levitz, P & Pop-Eleches, G. (2010). "Why no backsliding? The european union's impact on democracy and governance before and after accession". *Comparative Political Studies*, 43(4):457–485, April 2010.

27. Neyapti, B. (2013). "Modeling institutional evolution". *Economic Systems*, 37(1), 1-16.

28. North, D. C. (1990). 'Institutions, institutional change and economic performance'. Cambridge university press.

29. Papaioannou, E. (2016). 'Needed: A European institutional union'. VOX, CEPR's Policy Portal, 12 February, pp. 1-11.

30. Perron, P., (1989),'"The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis". *Econometrica*, 57, issue 6, p. 1361-1401.

31. Pesaran, M. H. (2007). 'A simple panel unit root test in the presence of cross-section dependence'. *Journal of Applied Econometrics* , 22(2), 265-312.

32. Quah D. (1993), "Galton's Fallacy and Tests of the Convergence Hypothesis", *Scandinavian Journal of Economics*, 95(4), 427-443.

33. Quah D. (1997), "Empirics for Growth and Distribution: Stratification, Polarization and Convergence Clubs", *Journal of Economic Growth*, 2:27-59.

34. Rodríguez-Pose, A. & Tselios, V. (2009), 'Education and income inequality in the regions of the European Union'. *Journal of Regional Science*, 49: 411–437. doi:10.1111/j.1467-9787.2008.00602.x

35. Savoia, A., & Sen, K. (2016). 'Do we see convergence in institutions? A cross-country analysis'. The Journal of Development Studies, 52(2), 166-185.

36. Schönfelder, Nina: Institutional Convergence in Europe. Impact of European Integration. Hagen 2017. Fern Universität in Hagen, https://ub-deposit.fernuni-hagen.de/receive/mir_mods_00001046.

37. Schönfelder, N., & Wagner, H. (2016). 'Impact of European Integration on Institutional Development'. *Journal of Economic Integration*, 472-530.

38. Selih, J., Bond I. & Dolan, C. (2017). "Can EU funds promote the Rule of Law in Europe)", Center for European Reform. Policy brief.

1.7. Appendix A

1.7.1. Bai and Carrion-i-Silvestre test (2009)

Bai and Carrion-i-Silvestre (2009) developed a testing strategy based on constructing modified Sargan-Bhargava statistics (MSB statistic) for each panel unit and then pooling them with correction terms. This allowed them to obtain a unique statistical measure that facilitates testing the null hypothesis of the existence of unit roots for all the units of the panel (which implies divergence), against the alternative hypothesis of no unit root in at least a substantial fraction $(i > 1)$ of the panel units (which implies convergence among them).

Following Bai and Carrion-i-Silvestre 's notation, the model is written as[16]:

$$\Delta\tilde{y}_{i,t} = \delta_i + \sum_{k=1}^{m_i} \gamma_{i,k} DU_{i,k,t} + \Delta F_t' \pi_i + \Delta e_{i,t}^* \tag{1.1}$$

where the subscript $i = 1, ..., N$ refers to country i and the subscript $t = 1, ..., T$ refers to the time period. $\tilde{y}_{i,t}$ is defined as $\tilde{y}_{i,t} = y_{i,t} - \bar{y}_t$ where

[16]This corresponds to Model 2 in Bai and Carrion-i-Silvestre (2009)

$y_{i,t}$ is the value taken by a specific institutional variable or index in country i at time t and $\bar{y}_t = \frac{1}{N}\sum_{i=1}^{N} y_{i,t}$ is the cross-country mean of this institutional variable at time t. $\Delta\tilde{y}_{i,t}$ are the first-differences of the institutional variable in deviation from its cross-mean. $DU_{i,k,t}$ are step dummies where $DU_{i,k,t} = 1$ from time t onwards when a trend break is detected at that time, and $DU_{i,k,t} = 0$ elsewhere. $\Delta F_t'$ is a matrix of differenced common factors for all the panel units. π_i is the $(r \times 1)$ vector of loading parameters for each i. $\Delta e^*_{i,t} = \Delta e_{i,t} + \sum_{j=1}^{l_i} \theta_{i,j} D(T^i_{b,k})_t$ where $D(T^i_{b,k})_t = 1$ immediately after a structural change in mean is detected and 0 elsewhere. m_i is the number of breaks in trend in country i and l_i is the number of changes in mean in country i. Multiple structural breaks and one or more common factors, reflecting cross-section interdependence, are allowed. Break dates can be known or unknown; in our case, the break points are treated as unknown and are estimated unit by unit following the sequential procedure developed by Bai and Perron (1998) as explained in Bai and Carrion (2009). Common factors are estimated following Bai and Ng (2004). Once the changes are detected, model (1) is estimated and the estimated residuals $(\hat{e}_{i,t})$ are obtained in order to compute the MSB[17] statistic for each country i. The univariate MSB statistic is given here by:

$$MSB^*(i,\lambda_i) = \frac{\sum_{k=1}^{\hat{m}+1}((\hat{T}_{i,b,k} - \hat{T}_{i,b,k-1})^{-2} \sum_{t=\hat{T}_{i,b,k-1}}^{\hat{T}_{i,b,k}} \hat{e}^2_{i,t-1})}{\hat{\sigma}^2} \tag{1.2}$$

Once the individual MSB statistics are obtained, they are pooled to obtain the Z^* statistic:

$$Z^* = \sqrt{N}\frac{\overline{MSB}^* - \bar{\xi}^*}{\bar{\zeta}^*} \rightarrow N(0,1) \tag{1.3}$$

$$\overline{MSB}^* = \frac{1}{N}\sum_{i=1}^{N} MSB^*(i,\lambda_i) \tag{1.4}$$

where $\bar{\xi}^*$ is the average of the mean of each individual $MSB^*(i,\lambda_i)$, while $\bar{\zeta}^*$ is the average of the variance of each individual $MSB^*(i,\lambda_i)$.

The Z^* statistic, to be used in a left-tailed test, follows an asymptotic normal distribution under the null hypothesis of $I(1)$ series. Therefore, institutional convergence is detected (in the specific institutional quality

[17]The MSB statistic can be assimilated to the Durbin-Watson statistic.

aspect reflected by the variable) if the Z^* test statistic takes a value smaller than the left-hand critical value at standard probability levels.

On the other hand, the P^* test has the following expression:

$$P^* = -2\sum_{i=1}^{N} \ln p_i \rightarrow \chi^2_{2N} \tag{1.5}$$

where p_i are the p-values associated with the individual MSB^* statistics. If the test takes a value smaller than the critical value then divergence takes places.

1.8. Appendix B

1.8.1. Kernel distributions at the launching year of the euro (1999) for three main groups of countries

Institutional indicators: Government Stability, Investment Profile, Democratic Accountability and Bureaucracy Quality.

Figure 1.12: Kernel distribution of Government Stability in 1999

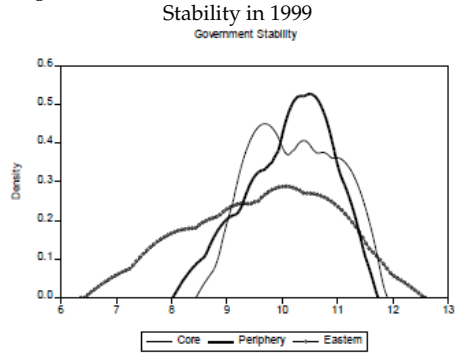


Figure 1.13: Kernel distribution of Investment Profile in 1999

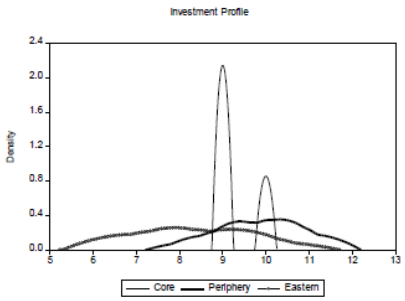


Figure 1.14: Kernel distribution of Democratic Accountability in 1999

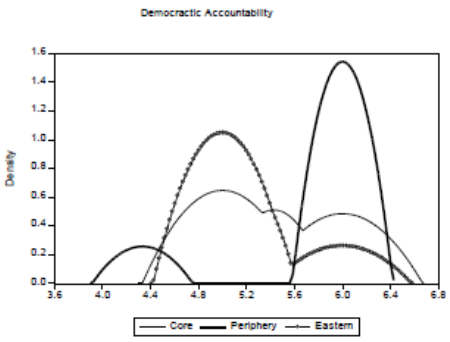
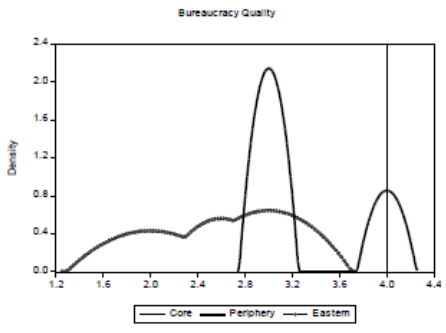


Figure 1.15: Kernel distribution of Bureaucracy Quality in 1999



Regarding Government Stability (Fig. 1.12), the group in the worst overall position is the Eastern group since its distribution exhibits greater dispersion and contains the most extreme values of the indicator. The core and the periphery groups have similar mean and variance, but the distribution of the core seems slightly better located. The investment profile indicator (Fig. 1.13) has a bimodal distribution in the core. The superiority of the distribution in this group of countries is based on a much lower variance (high concentration) of the indicator. The periphery and the Eastern countries have a similar distribution shape, although the periphery is better positioned. The distribution of Democratic Accountability (Fig. 1.14) shows polarization in the East sub-group and the periphery, and stratification (multimodal) in the core, which makes more difficult in this case to establish an order in the quality of this indicator. Finally, regarding Bureaucracy Quality (Fig. 1.15), we infer from the graph a very clear superiority of the core's distribution based on both the high value of the mean and the strong concentration of the observed values; in fact, all core countries share the same high value of this indicator in 1999. The distribution of the periphery exhibits an important polarization. The worst position corresponds to the Eastern group.

Chapter 2

Did the euro increase corruption? A counterfactual analysis

2.1. Introduction

In this paper, we apply the Synthetic Control Method to analyze the impact of the inception of the euro on corruption in the member states of the Eurozone. The motivation underlying our study is that, as far as we know, the scarce contributions on this issue did not empirically address the causal relationship that may exist between the two phenomena differentiated by country (or almost subgroups of countries).

Fernández-Villaverde et al. (2013), for instance, provide only untested theoretical explanations to sustain that the arrival of the euro fed the abandonment of economic reforms and deterioration of institutions - including control of corruption - in the peripheral countries of the Eurozone. The argued channels for these effects rely on the fact that the large capital inflows and financial bubble, triggered by the euro, relaxed the budget constraints of both governments and private agents, and reduced transparency and accountability of politicians.

Gokcekus and Suzuki (2011) analyze the extent to which corruption is affected by the different phases of the business cycle. With the help of panel models, these authors show that corrupted practices expand in good times and shrink in bad times, confirming Galbraith's proposition (Galbraith, 1997). Schönfelder and Wagner (2016) apply a dynamic panel data model to show that institutions, namely control of corruption, deteriorated in the peripheral countries of the Eurozone immediately after the

adoption of the euro.

Papaiannou (2016) explains, in a descriptive way, that the introduction of the euro did not preclude the gap between the institutional quality of two groups of countries of the Eurozone, the periphery and the core, from increasing over the last few decades. This author stresses the particular divergent trend observed in the control of corruption.

Beyaert et al. (2019) focus on institutional convergence within the eurozone. Applying third generation panel unit root tests and distribution dynamics analysis, these authors discover that, after the inception of the euro, the periphery and the Eastern member countries have not followed a catching-up process towards the institutions of the best positioned countries of the eurozone.

In spite of the interest of the preceding contributions, they fail to assess the possible effect of the adoption of the common currency on the level of corruption in individual Euro countries, since they either use a panel model approach or carry out institutional convergence analysis. This paper aims at discovering the likely effects of the euro on the corruption level of the euro-countries (considered one by one) by comparing the actual trajectory of their corruption indicator with the trajectory that would have taken place in absence of the euro.

For this purpose, we perform a counterfactual analysis applying the Synthetic Control Method (SCM), following the methodology of Abadie and Gardeazabal (2003) and Abadie, Diamond and Hainmueller (2010). The method that we apply here provides an appropriate way to select the comparison units to construct the counterfactual. The selection of the control unit is a fundamental step to avoid erroneous conclusions, and SCM does it following a data-driven strategy to obtain the optimal selection of units. Once this synthetic control is built, the counterfactual can be inferred and compared with the actual experience of the analyzed euro country after the introduction of the euro. From this comparison, we can infer whether the inception of the euro has contributed, or not, to modify the evolution of the corruption indicator.

To the extent of our knowledge, our paper is the first in applying SCM to unravel the effects of the euro adoption on corruption. This methodology has been fruitfully applied in other fields. Authors have investigated the economic impact of the terrorist conflict in the Basque country (Abadie

and Gardeazábal 2003), the effects of Proposition 99 (a scale tobacco control program implemented in California in 1988) on tobacco consumption (Abadie et al. 2010), the economic impact of the 1990 German reunification on West Germany (Abadie et al. 2015), how the Stability and Growth Pact has influenced the development of government debt making in the Eurozone after the introduction of the common currency (Koehler and Köenig 2015), and the long-run effect of fiscal consolidation on economic growth in six case studies of OECD countries (Kleis and Moessinger, 2016).

Our empirical analysis is grouped under the headlines of three sets of countries: the periphery, the ex-communist bloc, and the core of the eurozone. As far as the peripheral group is concerned, the adoption of the euro turns out to affect negatively in Greece and positively in Portugal. Regarding the Eastern group of countries, we note a positive impact of the euro on corruption in the averaged corruption of the group and in the case of Slovakia. Therefore, we do not detect any backsliding effects of the euro in Eastern countries of the eurozone. As regards the group of core countries, our analysis reveals that adhering to the euro impacted positively on corruption in Germany, and had a negative and significant effect in the Netherlands.

As can be seen, our country-by-country analysis delivers more nuanced results than those of the empirical literature to date. It is worth stressing that a positive result of the euro on corruption in a given country, such as Portugal or Germany, obtained with our approach, should be interpreted as evidence that the euro has helped to improve the situation of corruption compared with what would have happened if the country had not adopted the common European currency.

The rest of the paper is structured as follows: section 2 explains the specific features of the Synthetic Control Method applied in this study. Section 3 presents the data and discusses the empirical results, including the graphs testifying the quality of the estimated relationships and the placebo tests. Finally, section 4 summarizes our findings and derives policy prescriptions.

2.2. Methodology: The Synthetic Control Method approach

The objective of the Synthetic Control Method (SCM) is to build a valid counterfactual with which to compare the actual evolution of the outcome of interest; in our case, this outcome is the corruption indicator of a specific euro country or group of countries. For that purpose, it uses a data-driven procedure to identify and construct a valid comparison group: from a panel of countries not belonging to the euro area, the procedure identifies the group of countries that are most able to mimic -via a convex combination of the characteristics of all of them- the evolution of the corruption indicator of the euro country of interest before the implementation of the euro. From this optimal combination, the counterfactual is extracted: it reflects what the evolution of the corruption indicator would have been in the euro country (or group of countries) in the absence of the implementation of the euro. The comparison between the counterfactual evolution and the actual evolution of the corruption indicator of the euro country provides the estimated effect of the implementation of the euro on corruption in this euro country. Once the effect is obtained a significance test is carried out on it.

In what follows we provide a brief technical summary of the SCM procedure. It is widely inspired by the pioneering paper of Abadie and Gardeazabal (2003) as well as by Abadie et al. (2010, 2015), and completed by results of Cavallo et al. (2013)

Let us assume we have data on $(J+1)$ units at time t, for $t = 1, ..., T_0, T_{0+1}, ..., T$ where $T_0 + 1$ is the date of the event the effects of which will be studied. In our case the units are countries and $T_0 + 1$ is the year of implementation of the euro (or the date of the entrance of the country under study in the euro area, if posterior to the implementation). Without loss of generality, country 1 is the affected unit (a specific euro country) whereas the J remaining countries do not belong to the euro area and constitute the potential control units; these J countries are often called the "donor pool". Let Y_{jt} be the outome variable of interest (the corruption indicator) for $j =, 2, ..., J+1$ and $t = 1, ..., T$. Let X_1 be a $(K \times 1)$ vector of pre-euro values of K predictors for the corruption indicator of country 1. By the same token, let X_0 be the $(K \times J)$ matrix of pre-euro values of the same characteristics or predictors for the J countries of the donor pool. Let $W = (w_2, ..., w_{J+1})'$ a $(J \times 1)$ vector of nonnegative weights such that $\sum_{j=2}^{J+1} w_j = 1$. These weights will define the combination of control units

(of non-euro countries) that will be used to build the synthetic control in the pre-event period from which the counterfactual of country 1 corruption indicator will be extracted for the post-event period. Each value of W defines a different weighted average of the control countries and therefore a different synthetic control. Given the restrictions imposed on these weights, the resulting combination is convex. Finally let V be a $K \times K$ diagonal matrix with non-negative components that will reflect the relative importance of the different predictors in the construction of the synthetic control.

The vector of optimal weights W^* will be selected so as to minimize the discrepancy between X_1 and X_0W:

$$W^* = \arg\min_W (X_1 - X_0W)V(X_1 - X_0W)'$$

subject to $w_j \geqslant 0 \; \forall j = 2, ..., J+1$ and $\sum_{j=2}^{J+1} w_j = 1$

So, W^* defines the convex combination of non-Euro countries that best mimics the Euro country in corruption predictors before its belonging to the euro area.

However, W^* depends on V, the diagonal matrix of relative importance of the different predictors. The value of V will also be evaluated by a data-driven procedure: it will be determined so as to minimize the distance between the pre-euro actual trajectory of the corruption indicator of the Euro country and its synthetic control estimator. Let Y_1 be the $(T_0 \times 1)$ vector containing the data on corruption for the euro country before belonging to the Euro area. Similarly, let Y_0 be the $(T_0 \times J)$ matrix containing the data on corruption for the non-Euro countries of the donor pool before $T_0 + 1$. Then

$$V^* = \arg\min_V (Y_1 - Y_0W^*(V))(Y_1 - Y_0W^*(V))'$$

So, at the end, we obtain an optimal pair of W and V that provides the estimator of the synthetic control over the pre-euro period, $Y_0W^*(V^*)$ that mimics as well as possible Y_1, in the sense of minimizing the Root Mean Squared Prediction Error (RMSPE) of Y_1. The better the fit (the smaller RMSPE), the more reliable the counterfactual for the post-event period is considered to be.

This counterfactual will be computed using the data of the control countries - optimally selected and weighted via W^* - for the post-euro

period (i.e. from $T_0 + 1$ onwards). Let Y_1^N be this counterfactual. It is a $(T - T_0 \times 1)$ vector computed as $Y_1^N = Y_0^N W^*(V^*)$, where Y_0^N is the $(T - T_0 \times J)$ matrix of data of the outcome data of the donor pool for the post-intervention period. Similarly, let Y_1^I be the observed outcome variable for country 1 for the same period, with the same dimension as Y_1^N. Then the effect for country 1 of belonging to the euro area, for each t from the euro area entrance date onwards, will be estimated by the difference between these two vectors:

$$\alpha_1 = Y_1^I - Y_1^N$$

Alternatively:

$$\alpha_{1t} = Y_{1,t}^I - Y_{1,t}^N$$

$t = T_0 + 1, ..., T$.

To evaluate the significance of this difference, a "placebo test" is applied, following Abadie et al. (2010, section 3.4) and Cavallo et al.(2013). It consists of repeating the whole process for each of the J countries in turn in order to obtain the placebo trajectories $\alpha_{jt} = Y_{j,t}^I - Y_{j,t}^N \quad t = T_0 + 1, ..., T$; $j = 2, .., J + 1$. This generates a distribution of trajectories which serves to compare the trajectory of α_{1t} from $T_0 + 1$ onwards. According to Abadie et al. (2010) approach, the latter has to differ sufficiently from the other ones (it has to stand sufficiently "outside" the distribution of the trajectories obtained for the other J countries) to be able to conclude that the event really affected country 1 outcome variable. However in this paper, this placebo test is carried out using an extension of this approach, developed by Cavallo et al. (2013). They first get the aforementioned trajectories α_{jt}, they then develop a procedure to calculate a p-value for a one-sided test of non-zero effect for each t-period after the inception of the euro $(t = T_0 + 1, ..., T)$. Following the notation of Cavallo et al (2013) these p-values are computed as follows:

for positive effects $(\alpha_{1t} > 0)$:

$$p - value_t = \frac{\sum_{j \neq 1} I(\alpha_{jt} > \alpha_{1t})}{J} \tag{2.1}$$

for $t = T_0 + 1, ...T$ where $I(x) = 1$ if x is true and 0 otherwise.

For negative effects $(\alpha_{1t} < 0)$:

$$p - value_t = \frac{\sum_{j \neq 1} I(\alpha_{jt} < \alpha_{1t})}{J}$$

for $t = T_0 + 1, ..., T$.

Additionally, we use the methodology developed by Cavallo et al. (2013) to build a counterfactual for the averaged corruption level of specific subgroups of countries. These countries have implemented the common currency at different times, which means that $T_0 + 1$ may be different for each country. Let E be the number of events in the group, i.e. the number of inceptions of the euro on each group. In our cases each country in the group implement the euro only once. So, E coincides with the number of countries which form each group. Let now assume that we can compute the $T - T_0$ impacts of the E events. The estimated average effect for the implementation of the euro on each group is:

$$\overline{\alpha} = \frac{1}{E} \sum_{e=1}^{E} (\alpha_{e,T_0+1}, ..., \alpha_{e,T})$$

with

$$\bar{\alpha}_t = \frac{1}{E} \sum_{e=1}^{E} \alpha_{e,t}$$

for $t = T_{0+1}, ..., T$ where $\alpha_{e,t}$ is the estimated effect after the event for country e and for the period t. (T_{0+1} is now the date of the latest entrance in the eurozone within the group)

Then we calculate an "averaged placebo effect" of the E countries composed by a placebo effect of each donor country. And all possible combinations of averages are made, calculating $N = J^E$ placebo averages. All these placebo averages are indexed by $np = 1, .., N$. Then we rank the $\bar{\alpha}_t$ in the distribution of N average placebo effects, which implies N comparisons . Finally, we calculate the p-values as follows:

if $\bar{\alpha}_t > 0$

$$p - value_t = \frac{\sum_{np=1}^{N} I(\bar{\alpha}_t^{(np)} > \bar{\alpha}_t)}{N}$$

and if $\bar{\alpha}_t < 0$

$$p - value_t = \frac{\sum_{np=1}^{N} I(\bar{\alpha}_t^{(np)} < \bar{\alpha}_t)}{N}$$

2.3. Data and results

Before showing the results some considerations about the data must be done. The outcome variable in our analysis is the Corruption indicator, and the data are derived from the International Country Risk Guide (ICRG). The indicator evaluates corruption within the political system (bribes, job reservations, secret fund party, etc.). The scores vary between 0 and 6, with an increase indicating an improvement in the quality of this institutional aspect.

The period examined is 1984-2017, and the event is the implementation of the euro which takes place in 1999. However, for Greece, Estonia, Slovakia and Slovenia the event occurred in 2001, 2011, 2009 and 2007 respectively, which are the years where those countries adopted the common currency. We use annual country-level data for the main countries in the euro area, leaving Latvia and Lithuania out because their recent accession does not allow enough data for a reliable empirical analysis.

To evaluate the effect of the common currency on this variable we need a counterfactual that reflects how Corruption would have evolved in the absence of the implementation of the euro. As explained above, we apply the Synthetic Control Method to create the "synthetic indicator". The methodology uses a convex combination of countries in the donor pool that most resemble the country analysed in the pre-euro years (see Section 2). Our donor pool is composed of all countries belonging to the European Union but outside the euro area: Bulgaria, Czech Republic, Denmark, Hungary, Poland, Romania, Sweden and United Kingdom[1]

For these eight donor pool countries and the euro country under study, eleven predictors are used. We select them by taking as a guide the variables that in the literature are most related to corruption. Following Seldadyo and de Haan (2006), we include variables covering institutional factors, as well as economic, demographic and gender equality aspects. The variables related to our institutional predictors come from the International Country Risk Guide (IGRG) and are defined as follows:

1. Government stability: measures the government's ability to accomplish its program and to stay in office.

[1]We also have used the OCDE countries as donor pool but the obtained results do not improve those obtained with the EU non-euro countries.

2. Investment profile: assesses three important factors, namely, expropriation, profits repatriation, and payment delays.

3. Democratic accountability: measures the quality of democracy.

4. Bureaucracy quality: assesses if the bureaucracy on each country is free from political pressures.

5. Law and Order: assesses the legal and judicial framework and the crime rates.

As far as the variables of economic nature are concerned, we include the sum of exports and imports as a share of GDP (trade), to capture the association between foreign trade and corruption and GDP per capita in constant 2010 US dollar as a proxy of the level of wealth in the country. As regards demographic factors, we use total population of the country to account for the relationship between demography and corruption. Finally, we include the female labour force as percentage of the total labour force as a gender equality proxy. All these variables are derived from the World Bank.

It is important to bear in mind that the Synthetic Control Method is a data-driven methodology, which means that we use as predictors some variables which are related to corruption level and the methodology will select the importance given to each predictor using optimal weights (W^*) in the construction of the counterfactual. Notice that some of these weights could be zero, in which case, some of these predictors would not enter in the construction of the synthetic variable.

Since our institutional variables are final assessment based on expert opinions, the resulting scores are a subjective and discrete reflection of a subjacent continuous process. For this reason, we opt to fit polynomial trends (of degree up to 4) to extract this subjacent continuous phenomenon[2].Table 2.1 presents a short summary of what has been described so far.

[2]The data corresponding to these trends are available on request

Table 2.1: Summary data

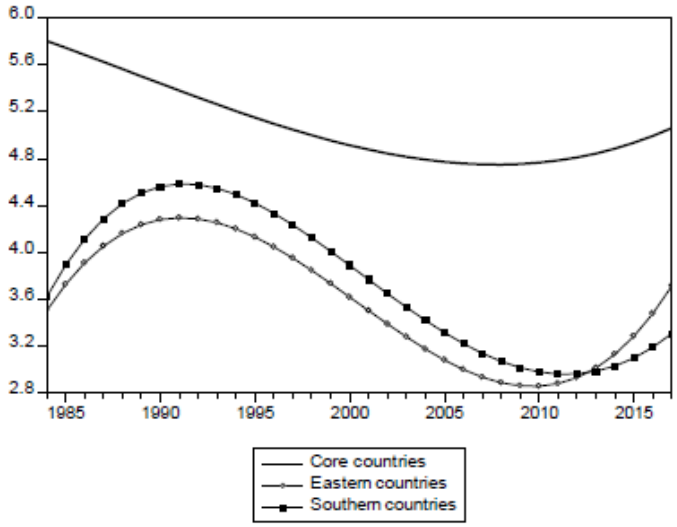
Treated countries	Outcome variable	Predictors	Event years	Donor Pool
Spain, Italy, Greece, Portugal, Estonia, Slovakia, Slovenia, Germany, Luxembourg, the Netherlands, Austria, Belgium, France, Finland.	Corruption	Government Stability Investment Profile Democratic accountability Law and Order Bureaucracy quality Female labour force Population Trade GDPpc	The implementation of the euro 1999 for Spain, Portugal, Austria, Belgium, France, Finland, Germany, Luxembourg and the Netherlands 2001 for Greece 2007 for Slovenia 2009 for Slovakia 2011 for Estonia	Bulgaria Czech Republic Denmark Hungary Poland Romania Sweden United Kingdom

2.3.1. Group analysis

In what follows, we present our results grouped in three set of economies: the core countries, the south periphery and the Eastern ex-communist bloc. This division is well-established in the literature and is based on general economic and institutional aspects. In addition, these three groups do have different levels of corruption over the period under study, as can be seen in Figure 2.1. In this figure, the averaged trend-fitted level of corruption[3] is presented and can be compared. It is obvious that the core countries performed much better than the other two groups; the Eastern bloc stands in the worst position almost all period and southern countries are in a middle position.

[3]This is computed as the mean of the country corruption trends fitted on the scores of the corruption indicator

Figure 2.1: Mean of trend-fitted corruption indicator by groups



First, we analyse the southern countries: Italy, Spain, Greece and Portugal. Second the eastern countries group formed by Estonia, Slovakia and Slovenia. And third, the core countries (Austria, Belgium, France, Finland, Germany, Luxembourg and the Netherlands) are considered.

For all countries and groups two figures are presented. The first figure shows the actual corruption level and the counterfactual obtained. In this first figure, the vertical line in the center of the graph locates the date of the inception of the euro $(T_0 + 1)$. The second figure represents the effect of the euro on corruption (right scale continuous curve, continuous horizontal line at zero as a reference), jointly with the one-sided p-values (left scale, dots, dashed horizontal line at 10% as a reference) that allow us to confirm or not the statistical significance of this effect.

Figure 2.2 and 2.3 are referred to the average of Italy, Spain, Greece and Portugal and give us a first sight about the impact of the common currency on corruption in these countries.

Figure 2.2: Corruption in southern countries: southern countries vs Synthetic southern countries

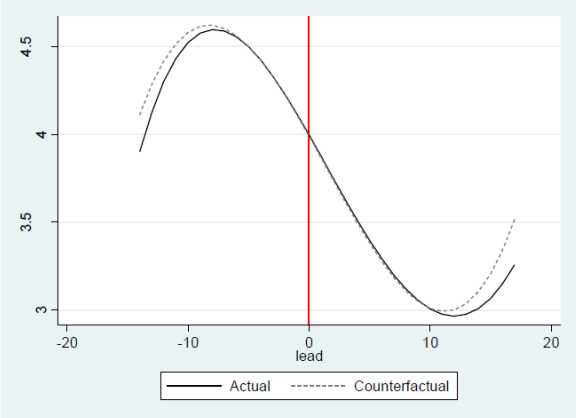
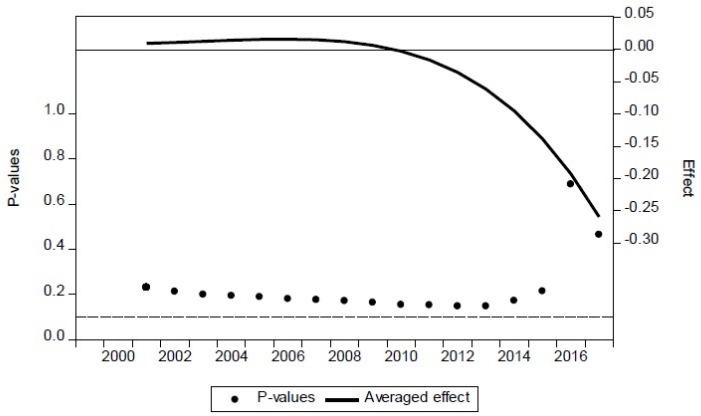


Figure 2.3: Effect and adjusted one-sided p-values for averaged southern countries



As illustrated in figure 2.2, the actual variable (continuous curve) exhibits a large decrease and is satisfactorily fitted by the synthetic one (dotted line). These results are in line with the observation of a deterioration of corruption in southern countries after the implementation of the euro. However, this does not mean that the euro is the cause of this worsening. The gap between the actual indicator and its counterfactual is small, which means, that this average does not differ much from its evolution in the absence of the euro. In addition, as can be seen in figure 2.3, this deterioration after the inception of the euro in the averaged corruption level of southern countries is not significant (since all p-values stand above the 10% threshold), which means that the detected gap and the observed downturn are not due to the inception of the euro.

The evolution of corruption and its linkage with the euro in eastern countries is interesting too. These countries belonged to the soviet bloc

and, since the dissolution of the Soviet Union in the nineties, they experimented a profound institutional transformation that should be fostered with their accessions to the monetary union.

Figure 2.4 and 2.5 present the evolution of the averaged corruption of Estonia, Slovenia and Slovakia and its counterfactual, i.e. the evolution if they would not have implemented the euro.

Figure 2.4: Corruption in eastern countries: eastern countries vs Synthetic eastern countries

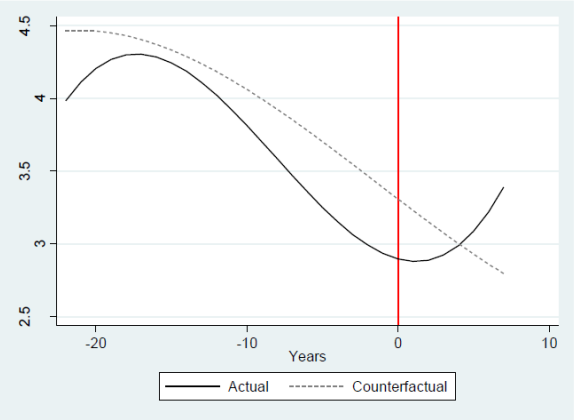
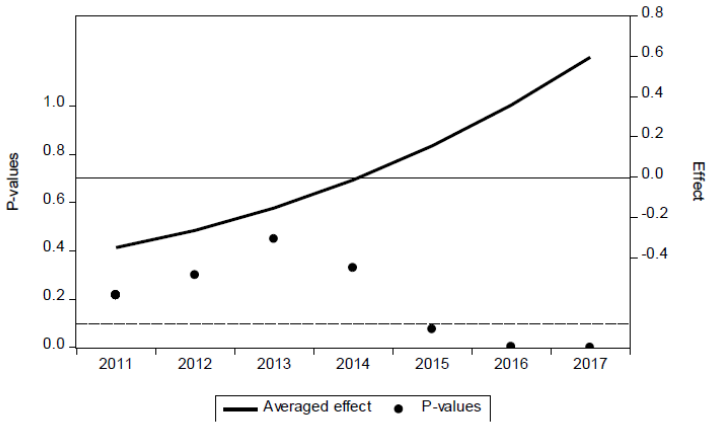


Figure 2.5: Effect and adjusted one-sided p-values for averaged eastern countries



The counterfactual presented in figure 2.4 reveals that without the euro, the averaged evolution of corruption in these three eastern countries would have tended to be worse and, on the opposite, the actual variable exhibits an improvement after the inception of the euro. The estimated effect of the euro is presented in figure 2.5. The results in this figure indicate that, the average effect of the euro on corruption in Eastern countries is positive

and significant from 2015 onwards.

The implementation of the euro in eastern countries took place between 2007 and 2011. Estonia adopts the euro in 2011, Slovakia in 2009 and Slovenia 2007. According to Levitz and Pop-Eleches (2010), although a descriptive analysis of the data detects a backsliding effect in institutional issues in these countries after the accession to the EU, a deeper empirical analysis demonstrates that there was no backsliding but only a slowdown in institutional reforms. Our study allows to conclude that, on average, there was no backsliding in corruption due to the euro, but rather a positive impact on their corrupt behaviours, at least in recent years.

The last set of grouped euro countries are the core countries. This group is composed of Austria, Belgium, Germany, Finland, France, Luxembourg and the Netherlands. Figure 2.6 shows the actual averaged corruption level of the group and its synthetic version.

Figure 2.6: Corruption in core countries: core countries vs Synthetic core countries

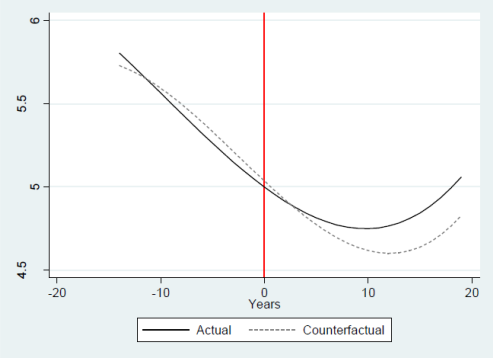


Figure 2.7: Effect and adjusted one-sided p-values for averaged core countries

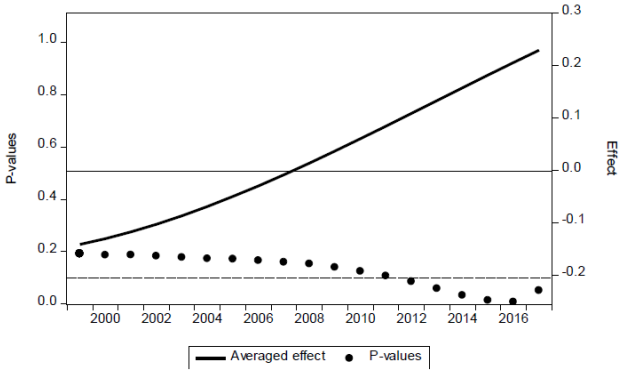


Figure 2.6 shows that on average, the core countries might have bene-

fited from a positive impact of the euro on corruption, since the counterfactual stands below the actual corruption level after the implementation of the euro. Figure 2.7 shows that this improvement is at least partially attributable to the euro since it ends up significant at the end of the period of analysis.

To sum up, there is no effect of the euro on the averaged corruption of southern countries, but the common currency has had a positive impact on corruption in eastern and core countries, where, after some years, the changes introduced by the euro have meant a significant relative improvement on their averaged level of corruption.

Since these findings are averaged ones, the impact of the euro could differ from one country to another. In what follows we analyse each individual country within these three different subgroups.

It is important to remember, that the counterfactual has to fit well the actual variable in the period before the implementation of the euro. If not, we will not achieve reliable counterfactual results. For this reason, we only present here the results for individual countries for which we get a good counterfactual, i.e. a good pre-event fit.

2.3.2. Individual country analysis

Southern countries

In the group formed by Italy, Greece, Spain and Portugal we only find a reliable counterfactual for Greece and Portugal. Figures 2.8 to 2.11 present the results for these countries.

For the case of Greece, the extended idea is that it has suffered a deterioration in its institutional quality, especially in corruption, after the arrival of the euro in 2001. However, there is no empirical literature that demonstrates a causal effect of the euro so far. Figure 2.8 represents the corruption indicator in Greece, together with its counterfactual obtained with our approach.

Figure 2.8: Corruption in Greece: Greece vs Synthetic Greece

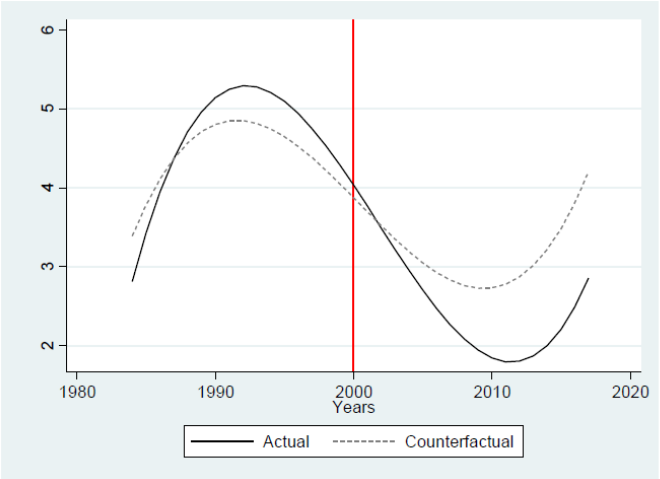
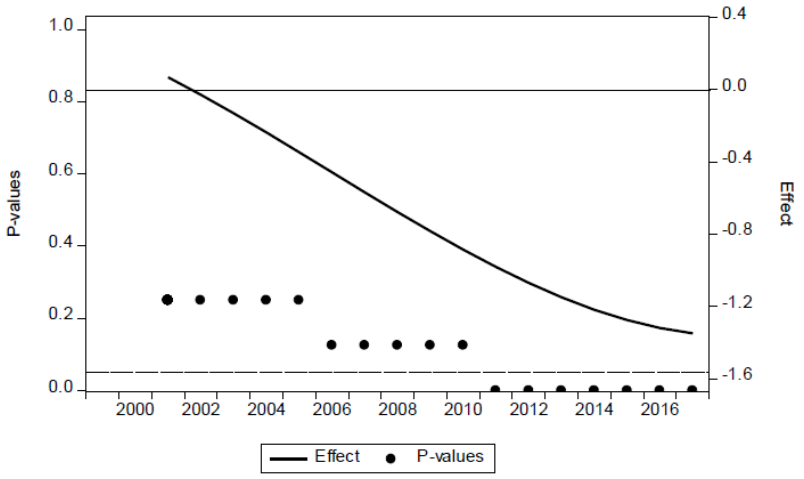


Figure 2.9: Effect and adjusted one-sided p-values for Greece



Our results reveal a deeper decrease of the actual corruption indicator than in the absence of euro. Figure 2.9 shows that this negative effect is significant (even though the first period of deterioration might not be attributed to the euro): after approximately a decade, the deterioration becomes more intense and highly significant.

Figure 2.10: Corruption in Portugal: Portugal vs Synthetic Portugal

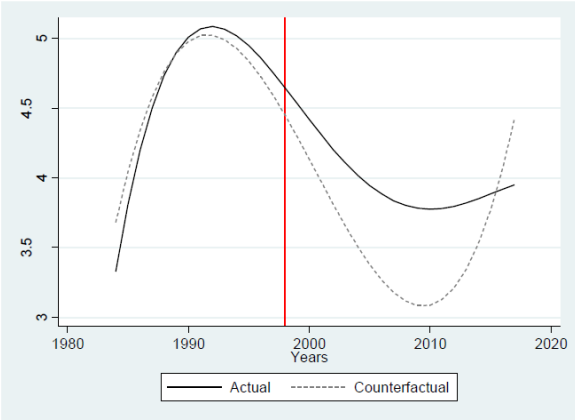
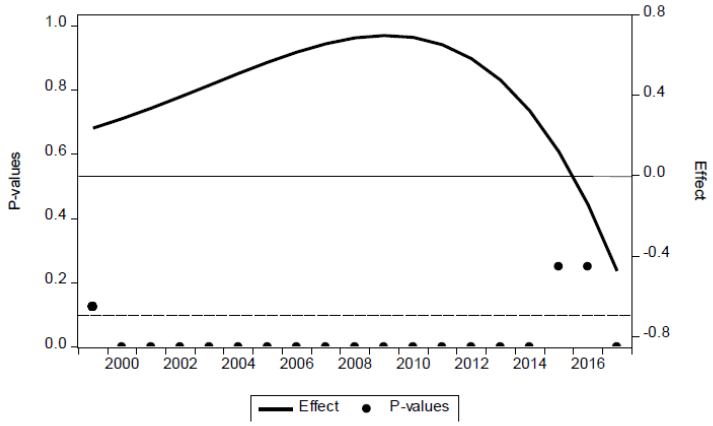


Figure 2.11: Effect and adjusted one-sided p-values for Portugal



As far as Portugal is concerned, a comparison of the actual corruption indicator and its counterfactual in figure 2.10 shows a positive effect of the euro on the corruption level. As a southern European country, it is often suspected of increasing the corrupt behaviours with the adoption of the euro but our results show that the reverse took place in this country; even though corruption worsened, it would have deteriorated more in the absence of the euro and this positive effect of the common currency is highly significant as can be seen in figure 2.11.

We do not achieve a good fit for the synthetic indicators of Spain and Italy with the predictors used in this study in spite of being guided by what are considered in the literature as the main determinants of corruption. This could be explained by the special features of corruption in these countries.

To sum up, the euro has had different types of effects in southern countries. In Greece it has fostered the increase of corruption and in Portugal we detect a positive impact of the euro on corruption. Let us also remember that in this group taken as a whole we do not detect a significant causal impact of the euro as the deterioration fo corrupt behaviors so, our results do not confirm the general thought according to which the common currency has had a negative impact on southern euro country. On the opposite, they allow us to conclude that, in general, the euro is not the villain in the perceived deterioration of corruption in southern countries of the eurozone except for the case of Greece.

Eastern countries

The country by country analysis in this group provides a reliable counterfactual only for the case of Slovakia. Figures 2.12 and 2.13 show what happens with corruption in this euro member.

According to Figure 2.12, Slovakia seems to benefit from the euro, and this effect, although small, is highly significant according to the results exhibited in Figure 2.13. In this country we therefore do not find any evidence of backsliding effect due to the common currency. On the opposite, we detect that the euro has prevented corruption from being greater.

Figure 2.12: Corruption in Slovakial: Slovakia vs Synthetic Slovakia

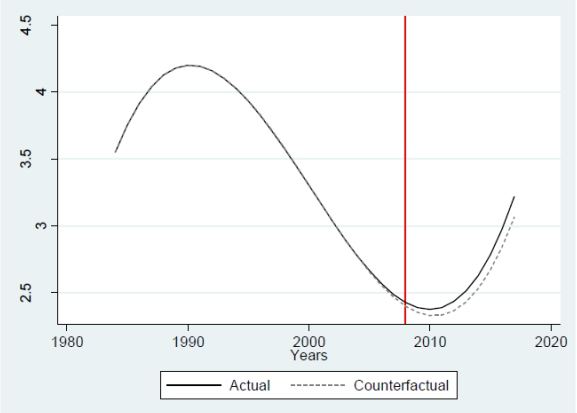
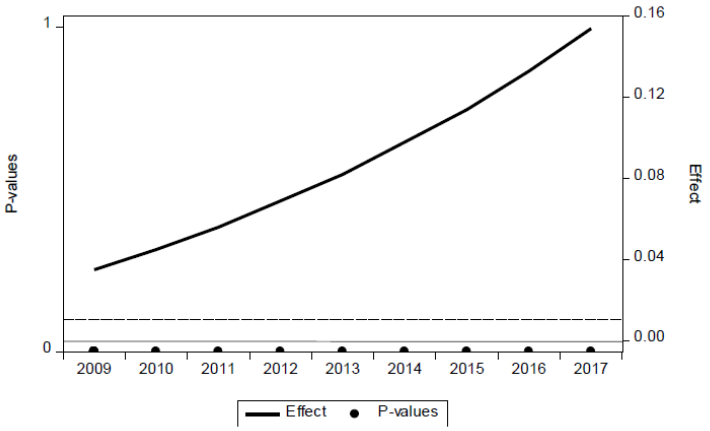


Figure 2.13: Effect and adjusted one-sided p-values for Slovakia



So, the whole set of results that we have obtained for the Eastern euro countries are in line with the findings obtained by Levitz and Pop-Eleches (2010) and Beyaert et al (2019): neither the accession to the European Union nor the adoption of the euro have provoked an institutional backsliding in Eastern euro countries.

Core countries

Core countries present the greatest performance on corruption across the eurozone. It is usually thought that they have not changed their institutions and, therefore, no event has been able to modify their corruption path. However, our country-by-country analysis reveals some interesting features that complete these of the core group as a whole, for which we detected a positive impact of the euro (see section 2. 3.1).

Figure 2.14: Corruption in Germany: Germany vs Synthetic Germany

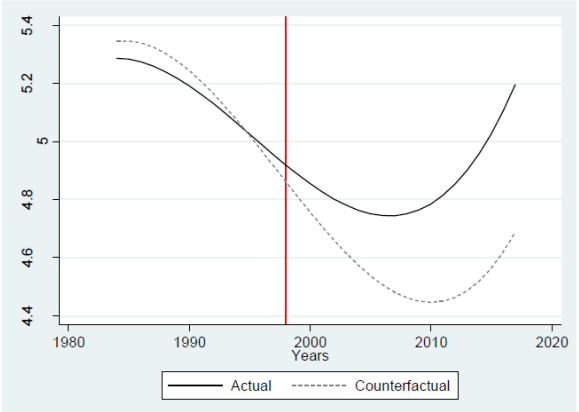
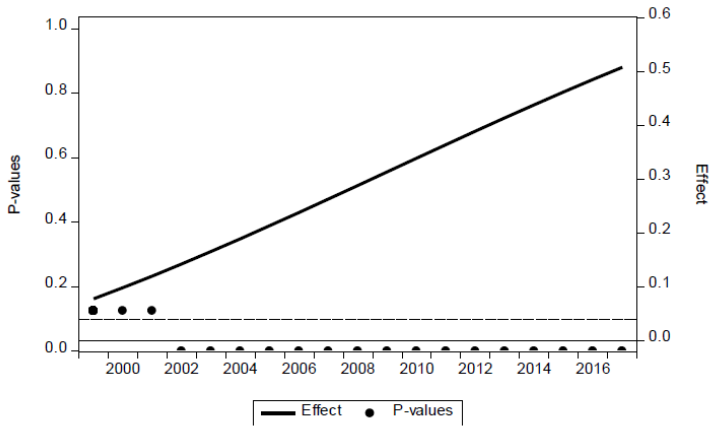


Figure 2.15: Effect and adjusted one-sided p-values for Germany



As far as Germany is concerned, it does not exhibit the highest performance in corruption along the period probably due to the effect of the reunification. Our analysis reveals that in Germany the euro has had a positive effect (figure 2.14 and 2.15). Figure 2.15 shows the persistently positive impact of the euro on its corruption level and this effect is highly significant almost inmediatly after its implementation. Furthermore, the euro has fostered this reduction allowing Germany to experience great results in terms of absolute reduction of corruption.

Figure 2.16: Corruption in the Netherlands: The Netherlands vs Synthetic the Netherlands

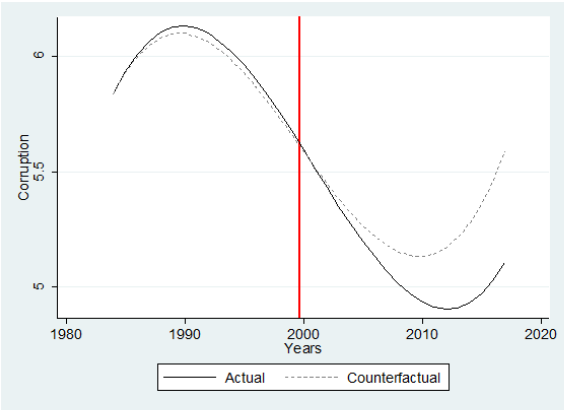
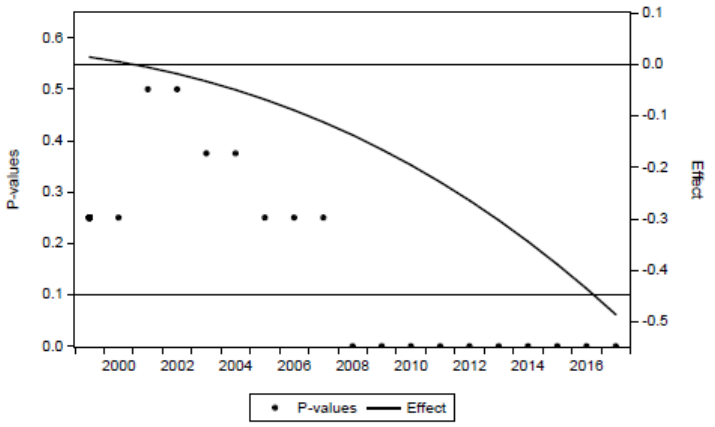


Figure 2.17: Effect and adjusted one-sided p-values for the Netherlands



In the case of the Netherlands, corruption exhibits a great deterioration after the euro and it seems that the inception of the currency has amplified this decrease (Figure 2.16). The p-values represented in figure 2.17, indicate that the effect is not significant until 2008 after which it turns highly significant. This establishes a causal effect from the euro adoption to the deterioration of corruption in this country.

So, in euro core countries, the country-by-country analysis exhibits different impacts of the euro. For Germany, the euro has resulted beneficial for reducing corruption, while in the case of The Netherlands the common currency has increased the deterioration of its level of corruption.

To sum up, despite the general idea of a negative impact of the euro on corruption, especially in peripheral countries, our findings demonstrate that the common currency has been less negative than expected. We do not detect a significant effect on the averaged corruption in southern countries while the euro fostered a significant improvement in averaged corruption in core and Eastern countries.

In the country- by- country analysis, we detect an improvement in Portugal, Germany and Slovakia. On the opposite the euro has been negative for the case of Greece and the Netherlands. In conclusion, we detect a different impact of the euro in corruption level across the eurozone. Furthermore, we do not find a differentiated pattern between core and non-core countries impacts and the sign of the effects detected seems to respond more to domestic features of each individual country.

2.4. Concluding remarks

There is a general conviction that the adoption of the euro has aggravated corruption in the eurozone, particularly in the peripheral economies of this area. However, to the best of our knowledge no study has been carried out so far to prove econometrically that presumed result in the individual members of that common-currency union. In this paper we have investigated the extent to which the adoption of the euro has affected the level of corruption in three groups of countries of the Eurozone by comparing the actual trajectory of the corruption indicator with the trajectory that would have taken place in absence of the euro. Our counterfactual analysis has been performed applying the Synthetic Control Method (SCM).

As far as the core is concerned, our results indicate that, on average, the euro has had a positive impact on corruption. In the country-by-country analysis we find that the common currency significantly and negatively affected corruption in the Netherlands, and that it has had a positive effect on the corruption indicator of Germany. The analysis carried out on the group as a whole reveals an overall significant and positive effect (although it takes place several years after the implementation of the common- currency).

Regarding the peripheral countries, we do not detect any significant impact of the euro, neither positive nor negative, on corruption in the Southern countries taken as a whole. We do however find a significantly negative impact in Greece and, by the contrary, a significantly positive effect in Portugal. These results show that the general thought about a widely spread and more intense corrupted behavior in Southern countries as a result of the implementation of the euro does not correspond with the facts and only fits well in the case of Greece.

Finally, regarding Eastern countries of the eurozone, we detect an overall positive effect of the euro on corruption in this group, with a special mention for Slovakia, for which we show that the adoption of the euro has significantly reduced the level of corruption compared with the case where the country would had not adopted the euro. These results point out that the inception of the common-currency has not caused backsliding in corruption in ex-communist countries of the euro area, which agrees

with the empirical findings of Levitz and Pop-Eleches (2010) and Beyaert et al. (2019).

From these results, some policy prescriptions can be derived. Since the governments of the periphery of EMU cannot blame the euro for the rebound of the corruption observed in their countries in recent decades, except in Greece, they have no excuse to fight strongly against the deterioration of this institutional variable with domestic measures. Obviously, efforts to reduce or eradicate corruption must be intense in Greece if the Government of that country wishes to remain within EMU.

2.5. References

1. Abadie, A., & Gardeazabal, J. (2003). "The Economic Costs of Conflict: A Case Study of the Basque Country ". *American Economic Review*, 93 (1): 113-132. DOI: 10.1257/000282803321455188.

2. Abadie, A., Diamond, A., & Hainmueller, J. (2010). "Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program ", *Journal of the American Statistical Association*, 105:490, 493-505, DOI: 10.1198/jasa.2009.ap08746.

3. Abadie, A., Diamond, A. & Hainmueller, J. (2015), "Comparative Politics and the Synthetic Control Method ". *American Journal of Political Science*, 59: 495-510. doi:10.1111/ajps.12116.

4. Beyaert, A., Garcia-Solanes, J., & Lopez-Gomez, L. (2019), "Do institutions of the euro area converge? ". *Economic Systems*, forthcoming.

5. Cavallo, E., Galiani, S., Noy, I. % Pantano, J., (2013), "Catastrophic Natural Disasters and Economic Growth ", *The Review of Economics and Statistics*, 95, issue 5, p. 1549-1561,

6. Fernandez-Villaverde, J., Garicano, L. & Santos, T. (2013)."Political Credit Cycles: The Case of the Eurozone ", *Journal of Economic Perspectives*, American Economic Association, vol. 27(3), pages 145-66.

7. Galbraith, J.K., (1997). *The Great Crash 1929*. Mariner Books, Houghton Mifflin Company, New York, USA.

8. Gokcekus, O., & Suzuki, Y., (2011). "Business cycle and corruption " *Economics Letters*, 111, 138-140.

9. Kleis, M. & Moessinger, MD. (2016), "The Long-Run Effect of Fiscal Consolidation on Economic Growth: Evidence from Quantitative Case Studies ". ZEW - Centre for European Economic Research Discussion Paper No. 16-047. Available at SSRN: https://ssrn.com/abstract=2801590 or http://dx.doi.org/10.2139/ssrn.2801590.

10. Koehler, S., & Köenig, T. (2015). "Fiscal Governance in the Eurozone: How Effectively Does the Stability and Growth Pact Limit Governmental Debt in the Euro Countries? ", *Political Science Research and Methods*, 3(2), 329-351. doi:10.1017/psrm.2014.26.

11. Levitz, P. & Pop-Eleches, G. (2010). "Why no backsliding? The European union's impact on democracy and governance before and after accession ". *Comparative Political Studies*, 43(4):457- 485, April 2010.

12. Papaioannou, E. (2016). "Needed: A European institutional union ". VOX, CEPR's Policy Portal, 12 February, pp. 1-11.

13. Seldayo H., & de Haan J. (2006), "The Determinants of Corruption: A Literature Survey and New Evidence ", paper presented at the 2006 EPCS Conference, Turku, Finland, 20-23 April.

14. Schönfelder, N., & Wagner, H. (2016). "Impact of European Integration on Institutional Development ". *Journal of Economic Integration*, 472-530.

Chapter 3

Quality of institutions, corruption and growth

3.1. Introduction

There is an extensive literature unambiguously showing that the quality of institutions positively influences economic growth. See, for example, North (1990) and Acemoglu, Johnson and Robienson (2005). However, results referred to the effects of a particular institutional indicator, the level of corruption, are diverse and even opposite. Contributions in this field can be grouped around two major hypotheses. On the one hand, the "sand-in-the-wheels" hypothesis, which considers that corruption hampers economic growth mainly because it contributes to a misallocation of resources (Myrdal 1968, Kurer 1993). On the other hand, the "grease-in-the-wheels" hypothesis, supporting the idea that corruption may have a beneficial effect on economic growth in countries where a heavy bureaucracy obstructs and slows down the normal functioning of the institutions. Leff (1964) and Huntington (1968), for instance, emphasize that, by avoiding uncertainty in public contracts and enabling civil servants to streamline the machinery, corruption can enhance growth in very bureaucratized economies.

In this work, we aim to investigate the impact of corruption on economic growth, and therefore the relative validity of each of the scenarios outlined above, taking into account not only the direct effects of corruption, but also the impact of this indicator on the economy through the overall institutional quality of the countries. Meòn and Sekkat (2005) performed an investigation with the same scope and found that corruption

has a negative impact on economic growth, even in countries where bad governance could be circumvented by corruption. They estimated a linear model (applying Generalized Least Squares) including a two-way impact of corruption on the economy: directly as an independent variable, and indirectly through a multiplicative variable deemed to capture the combined effects of corruption with government effectiveness. We believe, however, that the results obtained by these authors crucially depend on the linear specification of their testing model; and that this limitation is not adequately addressed by including a multiplicative interaction variable. Indeed, their model assumes that corruption and the institutional framework affect all countries in the same way, and that all countries share exactly the same growth model. We consider that these assumptions may bias the results and blur the actual effects of institutional operation and corruption on growth.

To overcome these drawbacks, we use regression tree analysis, a methodology that is relatively new and still infrequently used in economics, though it has been previously applied in the computer science area of machine learning. We depart from the strict linearity framework by allowing the modeling process to take into account the possible effects of variables that do not appear explicitly as explanatory variables in the model. Our approach also avoids the assumption that all countries in the dataset share the same model. It offers an additional important advantage: the methodology endogenously determines the grouping of countries which share an identical model. Thus, the discretionary (and possibly biasing) influence of the analyst on the final results is minimized. To the best of our knowledge, the first use of this methodology to quantify the role of institutions in economic growth is by Tan (2010). He concludes that institutional quality has a positive impact on economic performance, and suggests that the high quality of institutions can help to mitigate the negative impact of other factors, such as ethnic fractionalization. However, among other differences and in contrast with our paper, he does not take corruption into account.

The application of the regression tree methodology to our sample detects the existence of two diverse groups of countries according to the level of corruption, fitting the same growth model to both subgroups. Our results indicate that, either in countries with the highest levels of corruption or in those with low level, corruption does not directly affect growth. However, corruption has an indirect effect by splitting the sample in two groups of countries in which the determinants of the Solow model ex-

plain satisfactorily economic growth but with a different impact in each group. Thus, using this methodology, we demonstrate that the net impact of corruption depends on the way this variable affects the coefficients of important determinants of economic growth. In addition, we observe that countries with lower levels of corruption are those with a higher institutional quality and better economic performance which indicates that institutional quality improves economic performance.

The paper is structured as follows: Section 2 reviews the literature that relates institutions and economic growth and provides a theoretical framework to analyze these relationships properly. Section 3 describes the methodology used in our study. Section 4 presents the results, and Section 5 concludes.

3.2. Literature review

Seminal papers on the empirics of economic growth, such as Barro and Sala-i-Martin (1991), Barro (1991) or Mankiw, Romer and Weil (1992) among others, have fruitfully estimated growth equations derived from the Solow Model, in which the production function is approximated by a Cobb-Douglas function. Estimations have routinely used cross-country datasets, on the conviction that estimations based on panel data tend to bias the results upwards by the fact that they are influenced by the business cycle. Several estimates in the more conventional line show that economic growth is driven fundamentally by initial per capita income, stock of investment on human and physical capital, international trade and population growth.

More recent contributions highlight the relevance of institutional factors in explaining economic growth. Dollar and Kraay (2002, 2003) find that trade openness and good institutions positively affect economic growth, but without significantly influencing on income levels in poorer countries. Rigobon and Rodrik (2004) investigate the effects of trade, institutions and geography on income levels, and derive positive effects from the quality of institutions in the sense that when it is taken into account, the rest of determinants become less relevant. Alcalá and Ciccone (2004) found that institutional quality improves both the capital output ratio and the average level of human capital. Rodrik et al (2004) and Rodriguez-Pose (2013) argue that the neoclassical model does not work in countries with a low institutional quality. Rodrik et al. (2004) and Glaeser et al. (2004) suggest

that societies can thrive with weak institutions if they accumulate physical capital; this might be the case, for instance, of Russia and China. These authors support the Lipset-Przeworski-Barro view, according to which poor countries grow by accumulating human and physical capital, even under dictatorships, and that a certain level of development is necessary for these countries to improve their institutions.

The econometrics techniques most frequently used to detect the relationships between institutions and economic growth in a panel of countries are linear, which implies assuming that institutional quality produce the same effects in all countries. According to Rodriguez-Pose (2013), to analyze the effects of institutions on the economy, it is useful to distinguish between formal and informal institutions. Formal institutions refer to legal and judicial frameworks and to the implementation of policies; they change as a result of political decisions following a discrete and punctuated pattern. Informal institutions are linked to culture and to the behavior and habits of social agents, and tend to change gradually over time. However, the intuition that the two types of institutions affect differently the economy has not been tested in the literature. In this work, we assess the different effects of these two types of institutions by incorporating in the analysis an indicator representative of each group of institutions: Rule of Law on the part of formal institutions, and Corruption on the part of informal institutions. The Rule of Law is a measure of the legal and judicial framework, and Corruption is a set of bad behaviors sustained by contacts, relationships and informal networks.

How corruption affects income is a relevant and relatively new issue within institutional and growth literature. One of the first and more important papers of this literature is Mauro (1995). This author estimates, by OLS and 2SLS, the effect of corruption on investment and average economic growth from 1960 to 1985 for a total of 67 countries, finding a direct negative effect of corruption on growth, and an indirect one through investment in the context of an endogenous growth model.

In the sixties, some works discussed the idea that corruption can affect positively economic growth, giving rise to the "grease-in-the-wheels" hypothesis. Thus, Leff (1964) argues that in underdeveloped and over-bureaucratized nations, corruption can improve growth by stimulating investment. The reason is that corruption guaranties the viability and success of many investment projects. Leys (1965) argued that corruption can amend a bureaucracy through the officials. They argue that when

wages in government service are low, more capable civil servants can be attracted by the opportunity of earning additional money by accepting bribes. Huntington (1968) explains that corruption helps circumvent bureaucratic regulations and increase growth. According to him, this result was observed in the railroad and industrial corporations in the United States with the consequence of a faster growth. Beck and Maher (1986) and Lien (1986) maintain that this allocative efficiency can exist even in public offerings. Acemoglu and Verdier (1998) find that, under some contexts, corruption can introduce efficiency in the economy and can affect economic growth positively.

The opposite view, known as the "sand-in-the-wheels" hypothesis, has received larger support in the empirical literature. Myrdal (1968) and Kurer (1993), among others, suggest that, even with high levels of bureaucracy, corruption affects negatively economic growth. They explain that civil servants can cause delays to force citizens to bribe them, and that these can create other type of economic distortions. Kurer (1993) also argues that older corrupt officials can prevent the access of new and more efficient workers in the public sector. Empirical evidences provided by Tanzi and Davoodi (1998) and Mauro (1998) show that, in countries with high level of corruption, big amounts of public investment are diverted to the less productive sectors. In addition, corruption generates uncertainty for investment decisions and, for this reason, it does not "greases" the economy, but adds instead more political risk in economies with a weak institutional framework (Lambsdorff [2003]).

3.3. Econometric model and methodology

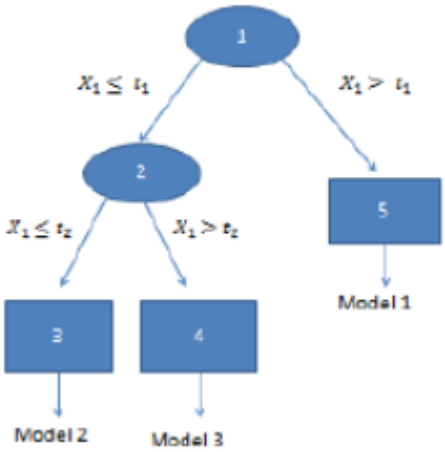
Our main objective is to analyze the impact of institutional quality and corruption on growth. We assess the relevance of institutions in the traditional growth model employed in some of the seminal studies (such as Barro and Sala-i-Martin ,1992, Mankiw et al., 1992). We complete the traditional model with corruption variables in order to test its possible direct influence on growth. As far as estimation is concerned, the main novelty with respect to the classical growth model is that we do not estimate one single model for all countries. Instead, we use the regression trees approach which consists of fitting the same growth model specification to different subgroups of countries of our sample, obtaining different coefficient estimations for each subgroup. This methodology splits the sample

in different groups of countries according to endogenously determined threshold values of specific variables called split variables.

So, after applying this technique we obtain different estimations of the same growth model for different groups of countries.

We propose a classical growth equation for each country i belonging to a given subgroup. These subgroups are mutually exclusive and are defined according to the combinations of values of the split variables. To simplify, let us imagine there are two split variables: X_1 and X_2 and two thresholds: t_1 and t_2. Figure 3.1 illustrates a possible splitting: the whole sample is split into two groups depending on whether the value of X_1 is under or above the threshold t_1.In addition, the group of countries with $X_1 \leq t_1$ is split again, but in this case the split variable is X_2 and the threshold value is t_2. Note that this second splitting could have taken place according to a new thershold value, $t_3 \ll t_1$ of X_1. In this example we use X_2 to illustrate that the methodology allows for the existence of interactions between split variables. This example ends up with three subgroups called in Figure 1 as Model 1, Model 2 and Model 3.

Figure 3.1: Tree schematic



It is also important to note that the groups of countries with $X_1 > t_1$ could in turn be further split into new groups according to new thresholds for X_1 and/or X_2. The criterion to stop splitting is to achieve a preset minimum sample size for the final subgroups.

Using the notation of Tan (2010) the growth equation is as follows:

$$g_i = \alpha_j + \beta_i^0 \ln(y_i^0) + \beta_j^k \ln(I_i^k) + \beta_j^n \ln(n_i + \delta + \zeta) + \beta_j^y \ln(C_i^c) + \varepsilon_i \quad (3.1)$$

for $j = 1, ...m$.

where g_i is the average annual growth rate of country i measured as the difference in log per capita real GDP between the initial and final year of the sample; y_i^0 is the initial real GDP value of country i; I_i^k corresponds to the average ratio of investment to GDP over the period of the study in country i; $n_i + \delta + \zeta$ is the sum of the population growth rate of country i over the period, the depreciation rate for physical and human capital (0.05), and the rate of exogenous technological growth; finally, C_i^c is a variable measuring the corruption indicator in country i[1].

In this equation, i is the individual country index (with a total of N countries in the sample) and j is the country group index (with a total of m groups of countries detected in the analysis).This notation reflects that m different models will be estimated: as many as the number of subgroups of countries the methodology detects; it also indicates that all the countries of a given group share the same model.

In our particular case, we have selected four variables as appropriate candidates to distinguish between different growth models for distinct groups of countries (i.e., to identify and build the $m \ll N$ groups of countries which might share a common model): two corruption indicators and two indicators of the Rule of Law. With this a priori selection we intend to test whether the overall institutional quality of a country does, in fact, have an impact on the general growth process. Our estimation procedure determines endogenously whether these variables define different growth models for different groups of countries; it also classifies each country i in one of the m groups, depending on whether the values taken by these variables in each country are above or below a threshold value which is also endogenously determined.

We estimate a cross-section regression for an averaged sample period from 1996 to 2017. The data used to estimate the equation are derived from two different datasets. Corruption and Rule of Law are obtained from the International Country Risk Guide (ICRG) developed by PSR Group, while

[1]We include natural resources as an explanatory and split variable but we do not detect any effect

Control of Corruption and other index of Rule of Law are extracted from Worldwide Governance Indicators developed by the World Bank. The ICRG Corruption variable (Cor_i^c) assesses corruption within the political system, both in form of bribes, special payments, in the form of nepotism, job reservations, or secret party funding. It varies between 0 to 6 where 0 means the greatest degree of corruption. We also use the variable Control of Corruption (CC_i^c) provided by the World Bank. This variable catches the perceptions of the citizens about how the public agents use public resources to obtain private gains. It varies between -2.5 to 2.5 where -2.5 is the worst case in which there is no control of corruption. Since corruption is a negative measure of what are known as informal institutions, both indicators measure and consider the effect of informal institutions on economic growth.

The Rule of Law variable derived from ICRG evaluates the quality of the legal and judicial systems and crime rates in each country. It varies from 0 to 6 where 0 means the worst performance. Rule of Law from the World Bank assesses the quality of contract enforcement, property rights, the quality of judicial system and crime and violence. It varies from -2.5 to 2.5 where 2.5 is the best possible performance. Rule of Law is a positive measure of what are known as formal institutions. These indicators are expected to enhance growth, according to the existent literature.

3.4. Regression tree analysis

As mentioned, the regression tree analysis splits the sample into various subsamples. As depicted in Figure 3.1 this splitting generates a structure similar to that of a tree, so that the subgroups can be associated with the nodes of the tree structure. and are composed of countries with similar characteristics with respect to the selected threshold variables: the application of this method generates a tree of successive nodes. The starting point consists of estimating of the model on the whole sample; the sample is then progressively split into subsamples according to the values of one or more threshold variables, until no additional splitting is possible or required. At the final splitting stage, the corresponding subsamples are called final nodes. A model is estimated for each node; thus, for each group of countries, a different model is estimated. Furthermore, the methodology allows us to deal with outliers and, in some cases, with heteroskedasticity, since it splits the sample into homogeneous subgroups of countries. Breiman et al (1984) show that this methodology is consistent, i.e. regression trees

replicate the true splits when the number of observations gets large.

The first implementation of the regression tree methodology made use of the AID algorithm [Morgan and Sonquist (1963) and Fielding (1977)]. The CART algorithm was later developed by Breiman, Friedman, Olshen, and Stone (1984) in order to address some of the weaknesses of the original algorithm. The main advantage of CART, which is also its main difference from AID, is the use of cross-validation (CV) to estimate the total Sum of Squared Errors (SSE) in order to prune the tree[2]. This reduces complexity and facilitates the interpretation of the results. However, an important drawback of CART derives from the selection bias caused by the use of a greedy algorithm. Despite this bias selection, the CART approach is still widely used in machine learning and is applied in many other areas, from economics to health sciences. In our case, to minimize this bias, we instead make use of the GUIDE methodology (Generalized Unbiased Interaction Detection and Estimation; Loh, 2002). GUIDE addresses this problem by substituting the greedy algorithm used in CART for selecting the split variable by an LM test of linear fit. The algorithm applies this LM test for each possible threshold variable selecting the candidate with the lowest p-value.

GUIDE consists of several steps:

- It runs an Ordinary Least Square (OLS) regression on the whole sample and obtains the residuals.
- It creates a contingency table for each candidate for a split variable by divid-ing the residuals into quartiles between positive and negative values.
- Finally, for each split variable candidate, it applies a chi-square test for linear fit. The split candidate with the lowest p-value (i.e., for which the rejection of linearity is strongest) is selected to split the data into two new nodes.

The threshold value of the split variable is the one which minimizes the joint residual sum of squared errors. This procedure is applied iteratively

[2]The pruning process avoids overfitting problems. This pruning process could be using CV or imposing a minimum number of observations in the final nodes. In our cases, we impose a minimum of thirty-five observation in each final group to obtain good final estimations.

and the splitting process stops when the number of observations in one of the two newly created nodes reaches a preset reasonable minimum value (the objective is to eliminate the risk of creating nodes within which the number of observations is too low to generate reliable estimations).

To sum up, we estimate equation (3.1) in disjoint subsets of countries which share similar levels of one or more split variables and obtain final estimations for each differing subset. This allows us to analyze how the determinants of economic growth differ from one group of countries to another and to what extent the overall quality of institutions, as represented by the degree of respect of the Rule of Law and the intensity of Corruption, can affect the growth process.

3.5. Empirical results

Before we present and discuss the results, the way in which we have selected and utilized the data requires some comments. We use several institutional indicators extracted from two different databases: ICRG and The Worldwide Governance indicators. The first one is provided by PSR group and the second one by the World Bank. The selected indicators are: Rule of Law and Corruption from ICRG and Rule of Law and Control of Corruption from the World Bank.

We employ institutional data as follows: The Rule of Law indicators are used only as threshold variables, while Corruption and Control of Corruption are used as both threshold and explanatory variables, so we have four possible split variables, allowing the algorithm to determine endogenously which of them is or are the most suitable to split the sample.

With these specifications we are able to test the way in which representatively formal and informal institutions enhance economic growth. By entering Rule of Law only as a split variable and corruption both as a split and an explanatory variable, we assume that Rule of Law could affect economic growth only indirectly while corruption could affect it directly and/or indirectly. Using Rule of Law and Corruption in this way allows us to analyze which of the two hypotheses "sand-in-the-wheels" or "grease-in-the-wheels" is more realistic. Berkowitz et al (2003) argue that the impact of the legal framework on economic development is indirect supporting the use of Rule of Law only as a split variable. Moreover,

as stressed by Neyapti (2013), the Rule of Law is a formal institution that changes in a punctuated or even abrupt form, in contrast with corruption which evolves gradually. This also justifies its use as a split variable only. Additionally, the grease-in-the-wheels hypothesis supports the idea that the impacts of corruption on growth may differ according to the quality of formal institutions. That is to say, different levels of corruption combined with different levels of Rule of Law can affect economic performance in different ways.

In what follows we offer a summary table of the different model specifications that we are going to estimate.

Figure 3.2: Model specifications

Model	ICRG Rule of Law		ICRG Corruption		World Bank Rule of Law		World Bank Control of Corruption	
	Split variable	Explanatory variable	Split variable	Explanatory variable	Split variable	Explanatory variable	Split variable	Explanatory variable
General 1	X	-	X	-	X	-	X	X
General 2	x	-	X	X	X	-	X	-
Model 1	X	-	X	X	-	-	-	-
Model 2	-	-	X	X	X	-	-	-
Model 3	X	-	-	-	-	-	X	X
Model 4	-	-	-	-	X	-	X	X

We first consider first two general models. These are those with more flexibility, i.e. they are models for which the algorithm can select any of our institutional variables as split variable. We have to consider two general models, and only one nesting both of them, because it is not possible to use both corruption indicators at the same time as explanatory variables, given their definition. We may consider them as benchmark models, because we are going to compare their results with simpler , -though reasonable – alternatives, in search of robustness for our conclusions. In Table 1, Benchmark 1 is the model where the explanatory variable is the Control of Corruption and Benchmark 2 where the variable is Corruption

itself. In both models our two indicators of Rule of Law and corruption could be chosen to split the sample.

For robustness, in the line of Tan (2010), we estimate four additional models that are all nested in their "benchmark" counterpart . The underlying idea is as follows: if we find a repetitive pattern in the whole set of different models with different combinations of split variables, we can conclude that our results are robust.

It is true that the explanatory variables are potentially endogenous. However, we have to bear in mind that this methodology aims more at detecting patterns than accurately measuring causal relationships. Moreover, as Tan (2010) explains, we cannot use - at this stage- an instrumental variable method due to sample restrictions. Finally, dealing with endogeneity is not an easy task and there is not yet a satisfactory solution to this problem in this methodology. What we do at this stage is to obtain a broad vision of which variable or interaction of variables are affecting growth, without pretending a precise quantification of the effect of corruption, but rather trying to detect its direct or indirect impact on growth. The issue of endogeneity is tackled in a second step to be explained below.

Figure 3.3 presents the regression trees for growth regimes. We can observe that whenever the ICRG corruption indicator is allowed to split the sample, this indicator is endogenously chosen as the relevant split variable and two groups are detected. The only cases where this does not occur correspond to Model 3 and 4 which the ICRG corruption indicator is a priori excluded. Even when we allow the algorithm to choose between ICRG and World Bank corruption indicator (Benchmark 1 and 2), the first one is always preferred.

Figure 3.3: Regression trees for growth models

Model	Regression tree	Observations	Final nodes
Benchmark 1	ICRG Corruption indicator ≤ 0.916 ICRG Corruption indicator > 0.916	105	2
Benchmark 2	ICRG Corruption indicator ≤ 0.916 ICRG Corruption indicator > 0.916	105	2
Model 1	ICRG Corruption indicator ≤ 0.916 ICRG Corruption indicator > 0.916	105	2
Model 2	ICRG Corruption indicator ≤ 0.916 ICRG Corruption indicator > 0.916	105	2
Model 3	ICRG Rule of Law < 1.150 ICRG Rule of Law > 1.150 World Bank Control of Corruption ≤ 0.378 ICRG Rule of Law > 1.150 World Bank Control of Corruption > 0.378	105	3
Model 4	World Bank Control of Corruption ≤ 0.269 World Bank Rule of Law ≤-0.484 World Bank Control of Corruption ≤ 0.269 World Bank Rule of Law > -0.484 World Bank Control of Corruption > 0.269	105	3

Rule of Law is not detected as a split variable in any benchmark model, and appears as a relevant splitter only in Model 3, which a priori excludes the ICRG corruption indicator. According to this, we may conclude that corruption does affect economic growth in an indirect way.

As far as the direct influences on growth are concerned, Tables 3.1 to 3.6 show the results of the regressions for the six different models. Each table includes in the second column the estimated coefficients using the whole sample, i.e. the estimation without subgroups and, in the following columns, the estimations for each detected subgroup. In parenthesis below the coefficients, we include the p-values. It is important to note that

Model 1 and Model 2 are exactly the same model with the same estimated coefficients because the difference between them refers only to the option to select either the Rule of Law of the World Bank or ICRG Rule of Law as split variables. Since in both cases ICRG corruption is the selected variable, the same model is fitted and coincides with Benchmark 2.

Our results first show that the coefficients of the traditional determinants of growth in all models and all groups are in line with the literature. In particular, their signs are the expected ones: investment, population growth enlarged with depreciation and tecnological change, and initial GDP per capita are positive, negative and negative respectively, which means that capital accumulation fosters growth, the growth of population and the depreciation of capital erodes it and, finally, the negative sign of the initial GDP per capita confirms that countries of the sample or subsample have experienced a catching-up process in terms of income per capita.

Table 3.1: Regression tree estimations for the Benchmark model 1

Determinants	**Estimation without subgroups**	**High Corruption group**	**Low Corruption group**
Constant	-0.344 (0.360)	0.351 (0.509)	-0.662 (0.269)
$Ln(Inv_i)$	0.751*** (0.000)	0.743*** (0.000)	0.649*** (0.000)
$Ln(Y_i^0)$	-0.154*** (0.000)	-0.209*** (0.000)	-0.092** (0.021)
$Ln(n_i + \delta + \zeta)$	-0.583*** (0.000)	-0.873*** (0.000)	-0.422*** (0.002)
CC_i	0.044 (0.136)	0.162 (0.127)	0.021 (0.588)
R^2	0.603	0.727	0.486
N	105	45	60

Table 3.2: Regression tree estimations for the Benchmark model 2

Determinants	**Estimation without subgroups**	**High Corruption group**	**Low Corruption group**
Constant	-0.539 (0.116)	0.683 (0.884)	-0.837 (0.119)
$Ln(Inv_i)$	0.748*** (0.000)	0.736*** (0.000)	0.651*** (0.000)
$Ln(Y_i^0)$	-0.139*** (0.000)	-0.200*** (0.000)	-0.064** (0.021)
$Ln(n_i + \delta + \zeta)$	-0.587*** (0.000)	-0.900*** (0.000)	-0.432*** (0.000)
$Ln(Cor_i)$	-0.075 (0.324)	0.037** (0.035)	-0.067 (0.560)
R^2	0.598	0.741	0.487
N	105	45	60

Table 3.3: Regression tree estimations for Model 1

Determinants	Estimation without subgroups	High Corruption group	Low Corruption group
$Constant$	-0.539 (0.116)	0.683 (0.884)	-0.837 (0.119)
$Ln(Inv_i)$	0.748*** (0.000)	0.736*** (0.000)	0.651*** (0.000)
$Ln(Y_i^0)$	-0.139*** (0.000)	-0.200*** (0.000)	-0.064** (0.021)
$Ln(n_i + \delta + \zeta)$	-0.587*** (0.000)	-0.900*** (0.000)	-0.432*** (0.000)
$Ln(Cor_i)$	-0.075 (0.324)	0.037** (0.035)	-0.067 (0.560)
R^2	0.598	0.741	0.487
N	105	45	60

Table 3.4: Regression tree estimations for Model 2

Determinants	Estimation without subgroups	High Corruption group	Low Corruption group
$Constant$	-0.539 (0.116)	0.683 (0.884)	-0.837 (0.119)
$Ln(Inv_i)$	0.748*** (0.000)	0.736*** (0.000)	0.651*** (0.000)
$Ln(Y_i^0)$	-0.139*** (0.000)	-0.200*** (0.000)	-0.064** (0.021)
$Ln(n_i + \delta + \zeta)$	-0.587*** (0.000)	-0.900*** (0.000)	-0.432*** (0.000)
$Ln(Cor_i)$	-0.075 (0.324)	0.037** (0.035)	-0.067 (0.560)
R^2	0.598	0.741	0.487
N	105	45	60

Table 3.5: Regression tree estimations for Model 3

Determinants	Estimation without subgroups	Low institutional quality group	Medium institutional quality group	High institutional quality group
$Constant$	-0.344 (0.360)	0.378 (0.504)	-1.292* (0.069)	1.447 (0.209)
$Ln(Inv_i)$	0.751*** (0.000)	0.718*** (0.000)	0.911*** (0.000)	0.399* (0.077)
$Ln(Y_i^0)$	-0.155*** (0.000)	-0.210*** (0.000)	-0.108** (0.020)	-0.228** (0.013)
$Ln(n_i + \delta + \zeta)$	-0.583*** (0.000)	-1.081*** (0.000)	-0.470*** (0.000)	-0.113 (0.611)
$Ln(Cor_i)$	0.044 (0.137)	0.066 (0.137)	-0.114 (0.369)	0.006 (0.928)
R^2	0.603	0.655	0.760	0.414
N	105	40	30	35

Table 3.6: Regression tree for Model 4

Determinants	Estimation without subgroups	Low institutional quality group	Medium institutional quality group	High institutional quality group
$Constant$	-0.344 (0.360)	0.366 (0.493)	-0.891 (0.299)	-1.785* (0.069)
$Ln(Inv_i)$	0.751*** (0.000)	0.619*** (0.000)	0.968*** (0.000)	0.471** (0.017)
$Ln(Y_i^0)$	-0.155*** (0.000)	-0.177*** (0.000)	-0.166** (0.016)	-0.295*** (0.000)
$Ln(n_i + \delta + \zeta)$	-0.583*** (0.000)	-0.896*** (0.000)	-0.783*** (0.000)	-0.016 (0.906)
CC_i	0.044 (0.137)	0.084 (0.493)	-0.168 (0.407)	0.009** (0.049)
R^2	0.603	0.680	0.722	0.551
N	105	35	30	40

Turning now to the coefficients of the corruption indicators, let us first remember that the World Bank indicator refers to the intensity of the control of corruption and that ICRG corruption indicator is defined in such a way that a higher score reflects less corruption in the country. So, the higher these indicators the better the corrup-tion situation of the country . With this in mind, Table 3.7 shows a summary of the sign and significance results for the coefficients of the corruption in our estimations.

Table 3.7: Significance and signs of estimated coefficients for corruption indicators by groups of countries

	Groups with high corruption	**Groups with middle corruption**	**Groups with low corruption**
Benchmark 1	Non-significant	-	Non-significant
Benchmark 2	Significant	-	Non-significant
Model 1	Significant	-	Non-significant
Model 2	Significant	-	Non-significant
Model 3	Non-significant	Non-significant	Non-significant
Model 4	Significant	Non-significant	Non-significant

First of all, it is clear that the corruption indicator has no significant effect for countries with low or middle level of corruption. For the high-corruption countries, at first sight, we find evidence of a significant effect in four models out of six. However, three of these four models are exactly the same, as explained above. So, in fact, we have two different models where the corruption indicator is significant and other two models with non-significant effect of this indicator. According to these results we cannot conclude whether corruption is or not significant for economic growth in these countries. Since the results could be affected by endogeneity problems, we elucidate this uncertain result by estimating both Benchmark models with Instrumental Variables. The idea is to use a pre-sample data for the corruption indicator as an instrument. However, in the case of the World Bank Control of Corruption indicator, all the available data have been used in our analysis. So, there is no pre-sample value available. For this reason, we use the value of the ICRG corruption indicator in 1995 as the instrumental variable, both for Benchmark 1 and Benchmark 2 models. That is to say, the ICRG corruption indicator in 1995 is the instrument both for the ICRG corruption indicator in Benchmark model 2 and for the World Bank corruption indi-cator in Benchmark model 1. Tables 3.8 and 3.9 presents the results using this estimation method.

Table 3.8: Instrumental Variables Estimation of Benchmark model 1

Determinants	High Corruption group	Low Corruption group
$Constant$	0.162 (0.360)	-0.800 (0.548)
$Ln(Inv_i)$	0.777*** (0.000)	0.658*** (0.000)
$Ln(Y_i^0)$	-0.218*** (0.000)	-0.074*** (0.000)
$Ln(n_i + \delta + \epsilon)$	-0.954*** (0.000)	-0.424*** (0.000)
$Ln(Cor_i)$	0.080 (0.882)	-0.015 (0.932)
R^2	0.706	0.483
N	45	60

Table 3.9: Instrumental Variables Estimation of Benchmark model 2

Determinants	High Corruption group	Low Corruption group
$Constant$	0.364 (0.691)	-0.863 (0.274)
$Ln(Inv_i)$	0.758*** (0.000)	0.652*** (0.000)
$Ln(Y_i^0)$	-0.220*** (0.000)	-0.069 (0.264)
$Ln(n_i + \delta + \epsilon)$	-0.939*** (0.000)	-0.426*** (0.000)
$CC_i)$	0.097 (0.810)	-0.009 (0.892)
R^2	0.704	0.479
N	45	60

The IV results are unambiguous: there is no significant direct effect of corruption on economic growth. So, the general conclusion is that we find only an indirect effect through the splitting the sample according to the corruption situation of the countries, which influences, in this way, the value of the estimated coefficients. In other words, the growth model has a standard specification for all countries but the influence of the traditional determinants of growth differ according to the corruption situation of the country. Obviously, that means that using a unique model for all countries, as done in several well-known studies presents a high risk of serious specification problems, since their approach does not allow to capture different behaviors of corruption and indirect effects.

In short, our results do not support neither the sand-in-the-wheels hypothesis nor the grease-in-the-wheels hypothesis. Morover, we find evidence that neither of two hypothesis could be fulfilled because the effect of corruption in growth is just indirect.

Our results are in line with those of Durlauf et al (2001) who argue that there is parameter heterogeneity in Solow model, and that the empirical literature has not been able to incorporate these differences in parameters. We consider that the methodology we have adopted deals with this issue and our results solve the mentioned limitation and provide robust evidence that parameter hetero-geneity is indeed attributable to differences in the levels of corruption that are not taken into account in the traditional empirical approach of economic growth.

The composition of each institutional group deserves some comments. Table 3.10 shows the country composition of each group of institutional quality for Benchmark Model 1 and 2.

Table 3.10: Groups of countries for Benchmark models 1 and 2

High corruption group	**Low corruption group**
Algeria, Angola, Argentina, Albania, Armenia, Belarus, Bangladesh, Bolivia, Burkina Faso, Cameroon, China, Rep. Congo , Cote d'Ivoire, Dominican Republic, Egypt, Gabon, Ghana, Guatemala, Guinea-Bissau, Honduras, Indonesia, India, Jamaica, Kenya, Latvia, Mali, Malawi, Mexico, Mozambique, Niger, Nigeria, Pakistan, Papua New Guinea, Panama, Paraguay, Philippines, Russia, Sierra Leone, Togo, Thailand , Turkey, Uganda, Ukrania, Zimbabwe.	Australia, Austria, Bahrain, Belgium, Botswana, Brazil, Bulgaria, Canada, Chile, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Ecuador, El Salvador, Finland, France, Gambia, Germany, Greece, Hong Kong, Hungary, Iceland, Ireland, Israel, Italy, Japan, Jordan, Korea, Rep., Kuwait, Lithuania, Luxembourg, Malaysia, Madagascar Malta, Morocco, Namibia, Netherlands, Nicaragua, New Zealand, Norway, Oman, Peru, Poland, Portugal, Romania, Singapore, Senegal, Slovak Republic, Slovenia, Spain, Sri Lanka,Sweden, Switzerland, , Tunisia, , United Kingdom, United States, Uruguay, Zambia, Saudi Arabia

In general, we can detect three big geographical areas: Europe and North America with good institutions, Africa and Latin America with the lowest institutional performance, linked to their colonial past (Acemoglu et al. (2001), La Porta et al .(2008)), and Asia with a great heter-ogeneity of corruption levels.

It is important to highlight that China and Russia take part of the group with higher corruption. For the case of Russia Levin and Satarov (2000) argue that corruption has been a burden reducing growth and slowing its transition to a market economy. However, China grows quickly and seems to take advantage of its level of corruption; Larsson (2006) explains that this difference is explained by their different comparative advantages and because corruption is more "organized" in China than in Russia. Our analysis does not detect a direct impact of corruption on growth so these

differ-ences seems not to be significant in terms of economic growth, although maybe a detailed analysis at the country level might shed some additional light on this aspect. This is however beyond the scope of this chapter.

3.6. Concluding remarks

The main goal of this paper is to test which of the "grease-in-the-wheels" or "sand-in-the-wheels" hypotheses better explains the impact of corruption on economic growth. To achieve our objective, we apply a machine learning technique, not frequently used in economics, known as regression tree analysis. We apply this algorithm to a Solow model equation augmented with corruption. The application of the algorithm splits the sample into different groups of countries according to their level of corruption, and generates different estimations of the Solow model for each group. Following this procedure, we are able to unravel how institutional quality and corruption affect economic growth.

The existing empirical literature on the effects of institutional quality on growth show different and even contradictory results, due to the fact that they use methodologies with two main weaknesses: first, authors assume that all countries in the sample fit the same growth model and, second, they ignore the direct or indirect effect of other variables. The methodology that we apply in this paper addresses and solves both drawbacks allowing for indirect effects of corruption on economic growth. We obtain three main key empirical contributions. First, corruption have no direct impact on economic growth. Second, in presence of corruption, formal institutions such as Rule of Law have no effect neither directly on economic growth, nor indirectly affecting the determinants of growth, which means that corruption affects economic performance more intensively than the legal and judicial framework. Third, we find evidences that neither the sand-in-the-wheels nor grease-in-the-wheels hypothesis are fulfilled because the actual effect of corruption on growth is indirect. In our opinion, this is probably the most plausible explanation for why the literature fails to achieve a general result on this respect.

The composition of the subgroups reinforces the well-established pattern North-South. There is a gap between a richer North and a poorer South. Our results suggest that this gap could be explained by their dif-

ferences in terms of institutional quality and corruption. While North exhibits, in general, a good institutional quality and lower levels of corruption, the South shows the opposite. According to these results, it is important that Southern countries reduces their levels of corruption and improve their legal and judicial systems as a crucial way to foster economic growth and achieve greater welfare.

3.7. References

1. Acemoglu, D., Johnson, S., & Robinson, J. A. (2001).“The colonial origins of comparative development: An empirical investigation”. *American economic review*, 91(5), 1369-1401.

2. Acemoglu, D., Johnson, S., & Robinson, J. A. (2005). “Institutions as a fundamental cause of long-run growth”. *Handbook of economic growth*, 1, 385-472.

3. Acemoglu, D., & Verdier, T. (1998). “Property rights, corruption and the allocation of talent: a general equilibrium approach”. *The economic journal*, 108(450), 1381-1403.

4. Alcalá, F., & Ciccone, A. (2004). Trade and productivity ”. *The Quarterly journal of economics*, 119(2), 613-646.

5. Barro, R. J., & Sala-i-Martin, X. (1992). “Convergence”. *Journal of political Economy*, 100(2), 223-251.

6. Beck, P. J., & Maher, M. W. (1986).“A comparison of bribery and bidding in thin markets. Economics letters, 20, 1-5.

7. Breiman, L., Friedman, J. H., Olshen, R. A.,& Stone, C. J. (1984). “Classification and Regression Trees”. Monterey, CA: Wadsworth and Brooks.

8. Dollar, D., & Kraay, A. (2002).“Growth is Good for the Poor”. *Journal of eco-nomic growth*, 7(3), 195-225.

9. Dollar, D., & Kraay, A. (2003). “Institutions, trade, and growth”. *Journal of monetary economics*, 50(1), 133-162.

10. Glaeser, E. L., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2004). “Do institutions cause growth?”. *Journal of economic Growth*, 9(3), 271-303.

11. Huntington, S.P. (1968). "Political order in changing societies". New Haven: Yale University Press.

12. Kurer, O. (1993). "Clientelism, corruption, and the allocation of resources". *Public Choice*, 77(2), 259-273.

13. Lambsdorff, J.G. (2003). "How corruption affects persistent capital flows". *Economics of Governance*, 4: 229-243.

14. Larsson, T. (2006). "Reform, corruption, and growth: Why corruption is more devastating in Russia than in China". *Communist and Post-Communist Studies*, 39(2), 265-281.

15. Leff, N.H. (1964)."Economic development through bureaucratic corruption". *American Behavioral Scientist*, 8: 8-14. Reprint in A.J. Heidenheimer, M. Johnston and V.T. LeVine (Eds.), Political corruption: A handbook, 389-403, 1989. Oxford, Transac-tion books.

16. Levin, M., & Satarov, G. (2000)."Corruption and institutions in Russia". *European journal of political economy*, 16(1), 113-132.

17. Leys, C. (1965). "What is the problem about corruption?". *Journal of Modern African Studies*, 3: 215-230. Reprint in A.J. Heidenheimer, M. Johnston and V.T. LeVine (Eds.), Political corruption: A handbook, 51-66, 1989. Oxford: Transaction books.

18. LaPorta, R., Lopez-de-Silanes F., & Shleifer A. (2008). "The Economic Consequences of Legal Origins". *Journal of Economic Literature*, 46 (2): 285-332.

19. Lien, D. H. D. (1986). "A note on competitive bribery games". *Economics Letters*, 22(4), 337-341.

20. Loh, W. Y. (2002). "Regression tress with unbiased variable selection and interaction detection". *Statistica Sinica*, 361-386.

21. Mankiw, N. G., Romer, D., & Weil, D. N. (1992)."A contribution to the empirics of economic growth". *The quarterly journal of economics*, 107(2), 407-437.

22. Mauro, P. (1998). "Corruption and the composition of government expenditure". *Journal of Public economics*, 69(2), 263-279.

23. Mauro, P. (1995). Corruption and growth. Quarterly Journal of Economics.

24. Méon, P. G., & Sekkat, K. (2005).“Does corruption grease or sand the wheels of growth?”. *Public choice*, 122(1-2), 69-97.

25. Myrdal, G. (1968).“Asian drama, an inquiry into the poverty of nations”.

26. North (1990), D.C,. Institutions, “Institutional Change and Economic Performance”. Cambridge Univ. Press, 1990.

27. Durlauf, S. N., Kourtellos, A., & Minkin, A. (2001). The local Solow growth model . *European Economic Review*, 45(4-6), 928-940.

28. Rigobon, R., & Rodrik, D. (2005). “Rule of law, democracy, openness, and income”. *Economics of transition*, 13(3), 533-564.

29. Rodríguez-Pose, A. (2013).“Do institutions matter for regional development?”*Regional Studies*, 47(7), 1034-1047.

30. Rodrik, D., Subramanian, A., & Trebbi, F. (2004).“Institutions rule: the primacy of institutions over geography and integration in economic development”. *Journal of economic growth*, 9(2), 131-165.

31. Tan, C. M. (2010). “No one true path: uncovering the interplay between geography, institutions, and fractionalization in economic development”. *Journal of Applied Econometrics*, 25(7), 1100-1127.

32. Tanzi, V., & Davoodi, H. (1998).“Corruption, public investment, and growth”. In The welfare state, public investment, and growth (pp. 41-60). Springer, Tokyo.

Chapter 4

Tourist arrivals, spatial effects and institutions

4.1. Introduction

The literature on international tourism from the past two decades highlights the quality of institutions as a relevant determinant of tourist demand. See, for instance, Vail and Heldt (2010), Assaf and Josiassen (2012), Balli et al. (2016) and Chor Foon Tang (2018). On the other hand, recent studies show that the geographic-spatial dimension plays an important role in regional tourism growth. For instance, de la Mata and Llano Verduras (2012) find evidence of significant spatial and network dependence in the bilateral tourism flows between Spanish regions; Yang and Fik (2014) analyze two types of spatial effects in regional tourism growth (spatial spill-over and spatial heterogeneity) across 342 prefactural-level cities in China from 2002 to 2010; and Yang and Zhang (2019) conduct spatial-temporal forecasting to predict inbound tourism demand in 29 Chinese provincial regions. Long, Liu and Song (2018) show, in fact, that adding spatial effects to the panel data models also increases forecasting accuracy. However, to the best of our knowledge, no work has investigated the incidence of spatial effects on tourism flows between countries, and even less when combining these effects with institutional determinants.

To fill this gap, in this paper, we estimate a standard tourism demand model, in which both elements are explicitly and simultaneously considered. On the one hand, we incorporate two indicators of institutional quality – corruption and Rule of Law and, on the other, we apply econometric

techniques particularly designed to address the spatial phenomenon using a panel dataset of 109 countries for the period 1995-2017.

Corruption is an institutional variable within the group of informal institutions, which are linked to culture and to habits and behavior of social agents. These types of institutions tend to change very gradually. The empirical literature on the impact of corruption on international tourism is not conclusive, although there is a predominance of results showing a negative sign, or values that are statistically not significant.[1] . Tonsun and Timothy (2001) obtain that corruption deteriorates the tourist demand in Turkey on the basis of political instability, which discourages investment in the tourist sector. Neumayer (2004) also derives a negative impact due to the insecurity that corruption creates in the country of destination. In the same line, Das and Dirienzo (2010) find that a reduction in corruption levels impacts positively on the level of tourism competitiveness because corruption deteriorates the country's image. They also obtain that the marginal gains in tourism competitiveness, from a reduction in corruption are greater for developing countries than for developed ones. According to Propawe (2015), countries with lower corruption are more attractive for international tourists since corruption requires paying bribes that, like a tax, increase the travel costs for the tourists.

Saha and Yap (2015) find a nonlinear relationship between corruption and tourist demand, in the sense that at low levels corruption impacts positively on tourist arrivals, but the effects become negative once it exceeds a threshold. Lv and Xu (2017) also derive a nonlinear relationship between corruption and tourism demand, which is significant only at the 50^{th} and 75^{th} quantiles. Using a sample of 100 countries over 16 years, Santana-Gallego et al. (2017) obtain a negative sign between corruption and tourism demand, but the effect is not statistically significant. Moreover, when they disaggregate the country-sample according to the level of development, they find that an increase in the perceived level of corruption increases the total tourist arrivals to less developed countries.

The second institutional variable we consider in this study is the rule of law, which belongs to the group of formal institutional indicators. These types of variables refer to judicial and legal frameworks and to the im-

[1]Poprawe (2015) and Ekine (2018) present instructive summaries of the theoretical arguments that support the positive and the negative effects of corruption on tourism demand.

plementation of social and economic policies. They change as a result of political decisions, following discontinuous or punctuated patterns[2]. We should expect that a good rating in this indicator would generate a positive perception of the country, and a feeling of safety, which attracts the tourists. After examining six institutional variables of a set of 158 countries over eight years, Steyn and van Vuuren (2016) find, indeed, that the rule of law in the destination countries plays a relevant and positive role in the international demand for tourism services of those economies; and Balli et al. (2016) find that the quality of formal institutions, along with civil liberty indices, are relevant in selecting tourism destinations in OECD countries. Chor Foon Tang (2018) obtain similar results in the case of Malasia, and Vail and Heldt (2000) stress the crucial role of a good legislation building a long-run sustainable tourist structure.

As stressed above, in this paper we take a step further in the analysis of the influence of institutional factors on the international tourist demand by incorporating effects of spatial dependence. We consider that this is a fundamental aspect that so far has only been tackled at regional level. Consequently, the main contribution of this paper is to analyze the joint effects of the two phenomena by means of spatial econometric models that estimate the extent to which tourism shocks in some economies are transmitted to the neighboring countries ("spatial spillovers"). Both intuition and the economic theory indicate that the geographic component must play an important role in the tourism industry and in the overall economy; and that for this reason it must be explicitly and appropriately included in the analysis.

Our results indicate that: a) the level of corruption of the destination country does not affect the number of tourist arrivals significantly; b) the legal security and the normative quality (synthesized in the "Rule of law") positively influence the demand for tourism towards the receiving country, and c) the shocks hitting international tourism in the neighboring countries significantly affect the tourist flows towards the analyzed country with the same sign.

The rest of the paper is organized as follows: section 2 explains the econometric methodology, and section 3 presents and analyzes the empir-

[2]As argued by Neyapti (2013), the distinction between formal and informal institutions is justified in the sense that they impact differently on the economy, and particularly on tourist flows and tourism competitiveness.

ical results. Finally, in section 4 we offer the main conclusions and derive some prescriptions for tourism policy.

4.2. Methodology

Spatial econometrics provides suitable frameworks to deal with variables influenced by the geopraphical location of the phenomenon at hand, as in the case of tourism. They are particularly useful in an international context with multidirectional relationships among the variables of interest.

We start with a basic tourism demand model (for example Santana-Gallego et al. 2017) as follows:

$$LnT_i = \alpha + \beta_1 LnGDPpc_i + \beta_2 LnPOP_i + \beta_3 LnPRICE_i + \varepsilon_i \tag{4.1}$$

where LnT_i is the logarithm of the averaged tourist arrivals in a country i $(i = 1, 2, ..., N)$, during a specific period, in our case between 1995 to 2017. $LnGDPpc_i$ is the logarithm of the averaged GDP per capita over the period in country i, as a proxy of the income level in this country. $LnPOP_i$ is the logarithm of the averaged population in country i, used as a proxy of the country size. $LnPRICE_i$ is the logarithm of the average of consumer price indices of each country i. Finally, ε_i is the error term.

For our purposes, we include two additional explanatory variables: corruption, measuring the quality of informal institutions, and an indicator of the legal and judicial framework, usually called Rule of Law, deeemed to measure the quality of formal institutions. So, (4.1) is augmented as follows:

$$\begin{aligned} LnT_i = \alpha + \beta_1 LnGDPpc_i + \beta_2 LnPOP_i + \beta_3 LnPRICE_i + \beta_4 LnC_i \\ + \beta_5 LnRL_i + \varepsilon_i \end{aligned} \tag{4.2}$$

where LnC_i and $LnRL_i$ are the logs of the averaged corruption indicatior and the averaged indicator of Rule of Law of country i, respectively.

As an important novelty, we propose estimating model 4.2 by applying two of the most widely used models in spatial econometrics models: the

Spatial Autorregresive Model (SAR) and the Spatial Error Model (SEM).

The SAR model equation is

$$LnT_i = \alpha + \rho W_i^{'} LnT + \beta_1 LnGDPpc_i + \beta_2 LnPOP_i + \beta_3 LnPRICE_i + \beta_4 LnC_i + \beta_5 LnRL_i + \varepsilon_i \quad (4.3)$$

where $LnT = (LnT_i, ..., LnT_N)'$ y W_i' is the i^{th} row of the spatial contiguity matrix W. The difference between model (4.3) and model (4.2) is that the latter includes the spatial matrix W, which captures the degree of neighbourhood or contiguity among the spatial units. In our case, these units are countries located on a geographical map.

The matrix W is composed of zeros in its main diagonal, reflecting that a country cannot be neighbor of itself. There are three types of spatial matrices commonly used in the literature: Rook, Queen and Bishop, respectively. Queen type assigns value 1 to the non-diagonal elements in the matrix if the spatial units share a common border. Rook type uses 1 if these units share a border or a common corner and, finally Bishop takes 1 when the spatial units share only one point or a common corner. Since we are dealing with countries, we use a Queen matrix of order 1: the element (i, j) in W takes value 1 if the countries i and j share a common border. Regardless of the type of W, a spatial model such as (4.3) indicates that the tourism demand i is affected by the tourism demand of its neighbouring countries, in addition to other internal variables.

The SEM model is specified as follows:

$$LnT_i = \alpha + \beta_1 LnGDPpc_i + \beta_2 LnPOP_i + \beta_3 LnPRICE_i + \beta_4 LnC_i + \beta_5 LnRL_i + \epsilon_i \quad (4.4)$$

where $\epsilon_i = \gamma W_i^{'} \varepsilon + \vartheta_i$. In this case, the matrix W is part of the error term, where ϑ is the column vector which includes the error term of all countries of the sample ree of spatial dependece. The spatial term in this model reflects the fact that shocks in the tourism demand in neighboring countries may generate spillover effects, in the sense that a shock in any country j affects the number of tourist arrivals in country i.

As the spatial specification complicates the modeling, we only include the spatial effects if the data so require. To select correctly a spatial model we use first the spatial autocorrelation test based on Moran's I, which measures the global spatial autocorrelation, and is defined as

$$I = \frac{N}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij}(Y_i - \bar{Y})(Y_j - \bar{Y})}{\sum_i (Y_i - \bar{Y})^2} \tag{4.5}$$

where w_{ij} is the element (i, j) in W; N is the total number of countries in the sample; Y_i is the variable of interest of country i; in our case, it is the log of the tourism demand. By the same token, Y_j is the tourism demand in country j, and $\bar{Y}$ is the average of the tourism demand for all countries of the sample. The null hypothesis in this test is the absence of spatial dependence. Consequently, if the null hypothesis is rejected, we infer that there is spatial dependence and that we have to select between the SAR and the SEM models. For large samples, the Moran's I is distributed under the null as a $N(0, 1)$.

If the presence of a spatial component is statistically is confirmed, the next step is to choose between SAR and SEM. For that purpose, we use four LM tests: the LM-error (Burridge, 1980) to detect a SEM model, the LM-lag (Anselin, 1988) to detect a SAR model, and the two robust versions of these tests (Anselin et al, 1996). For all these tests, under the null hypothesis the best choice is the model without spatial effects, and under the alternative hypothesis the best model is the one that includes spatial effects.

Following Burridge (1980), we define the LM-error test as follows:

$$LM - error = \frac{d^2_{error}}{T} \sim \chi^2_1 \tag{4.6}$$

where $d^2_{error} = \frac{e' We}{\hat{\sigma}^2}$ and $T = tr(WW + W'W)$ and e is the column vector with the residuals of the model estimated under the null hypothesis. W is the spatial matrix, and $\hat{\sigma}^2$ is the estimated variance. Under the null hypothesis, this test follows a χ^2_1 distribution.

The LM-lag test (Anselin, 1988) has the following expression:

$$LM - lag = \frac{d_{lag}^2}{D} \sim \chi_1^2 \tag{4.7}$$

where $d_{lag}^2 = \frac{e'Wy}{\hat{\sigma}^2}$ y $D = (WX\hat{\beta})' \frac{\left[I - X(X'X)^{-1}X'\right](WX\hat{\beta})}{\hat{\sigma}^2} + T$

where y is the dependent variable in the model under the null hypothesis, X is a matrix with the explanatory variables of the model also under the null hypothesis, and $\hat{\beta}$ is the vector of OLS estimated coefficients.

These tests have the problem of not being able to correctly discriminate between SAR and SEM models. In some cases, both of them reject the null hypothesis, when in reality the alternative model is the true one. To overcome this difficulty Anselin et al. (1996) created the robust version of these tests to correct this problem:

$$robust\ LM - lag = \frac{\left(d_{lag} - d_{error}\right)^2}{(D - T)} \sim \chi_1^2 \tag{4.8}$$

$$robust\ LM - error = \frac{(d_{error} - TD^{-1}d_{lag})^2}{[T(1 - TD)]} \sim \chi_1^2 \tag{4.9}$$

The robust LM tests are only used when both LM-lag and LM-error are significant.

When both robust LM are statistically significant, we consider the p-value as a criterion of selection. If the lowest p-value is associated with the robust LM-lag, we choose a SAR model. If, on the contrary, the robust LM-error has the lower p-value, we select a SEM model.

To sum up, and following Florax et al. (2003), the steps needed to select the right model are:

1. Use Moran's I to detect whether there is spatial autocorrelation. If there is, we go to step two.

2. To choose between a SAR and a SEM model, we use LM-lag and LM-error tests. If the LM-lag test rejects the null and the LM-error does not reject it, we choose a SAR model. In contrast, if the LM-error test

rejects the null and the LM-lag does not reject it, we select a SEM model. Finally, if both tests reject the null hypothesis, we go to the robust version of both statistics.

3. If the robust LM-lag rejects the null and the robust LM-error does not, we select a SAR model. If the robust LM-error rejects the null hypothesis and the robust LM-lag does not, we specify a SEM model. If both robust LM-error and robust LM-lag reject the null, we choose the model associated with the LM test that has the lowest p-value.

4. Finally, we apply the Breusch-Pagan test to detect for heterocedasticity. If it exists, we must estimate the model with methods that correct the variances. In order to ensure the reliability of the results.

4.2.1. Data

We use the following variables for a sample composed of 109 countries:

1. The average tourist arrivals in country *i* between 1995 to 2017. Source: World Bank.

2. The average real GDP per capita for the period 1995-2017. The data are measured in Purchasing Power Parity (PPP). Source: World Bank.

3. The average population over the period. Source: World Bank.

4. Consumer Price Index as a proxy of the price of tourist services. Source: World Bank.

5. The averaged corruption indicator is derived from the International Country Risk Guide (ICRG) developed by the PSR Group. It is based on expert opinions. This indicator ranges from 0 to 6, where 0 is the highest level of corruption and 6 the lowest. With this interpretation, we should expect a positive sign for the coefficient associated to the level of corruption. A positive sign would indicate that corrupt behaviours negatively affect tourist arrivals and a negative sign would denote a positive effect of corruption on tourism demand in country *i*. However, in order to facilite the interpretation of the results, we have transformed the data by multipliying the indicator by -1. Now a negative sign in corruption indicates a decrease in tourists arrivals.

6. The averaged Rule of Law indicator comes from the International Country Risk Guide (ICRG) by PSR Group. The score varies between 0 and 6 for each country, where 0 the worst institutional quality and 6 the best possible legal and judicial framework.

As a first step in modelling spatial effects and institutional quality in tourism demand, it is useful to explore the data using cluster analysis. We present below three types of cluster maps; The first reflects the spatial correlation between the tourist arrivals in country i and corruption. The second reflects the same as in the previous case but with the Rule of Law indicator instead of corruption indicator and, finally, the third shows the spatial correlation between tourist arrivals in country i and the tourist arrivals in its neighboring country j.

To construct these maps we use two indicators of spatial correlation: LISA (Local Indicators of Spatial Analysis) and BiLISA (Bivariate Local Indicators of Spatial Analyisis), both based on the Moran's I.

The LISA indicator is defined as follows:

$$I_i = y_i \sum_{j=1}^{N} w_{ij} y_j \tag{4.10}$$

where y_i is the objective variable, in this case the logarithm of the standarized number of tourist arrivals in country i. w_{ij} is the (i, j) element of the spatial matrix W (Queen order 1), and y_j is the logarithm of the number of tourist arrivals in country j.

The BiLISA indicator is similarly defined:

$$I_i = y_i \sum_{j=1}^{N} w_{ij} x_i \tag{4.11}$$

where x_i represents the considered institutional indicator: corruption or Rule of Law in country i.

The indicators explained above reflect the correlation between tourist arrivals in country i and tourist arrivals in the neighboring countries (LISA), or between tourist arrivals in country i and corruption or Rule of Law (BiLISA).

Figures 4.1 and 4.2 show the cluster maps elaborated according to the BiLISA indicator. The maps represent geographic areas in which there is a high correlation between our institutional variables and the tourist arrivals. In Figure 4.1 the institutional variable is the level of corruption, while in Figure 4.2 it is the Rule of Law.

Figure 4.1: Cluster map (BiLISA) for levels of corruption and tourism demand (both in logarithm)

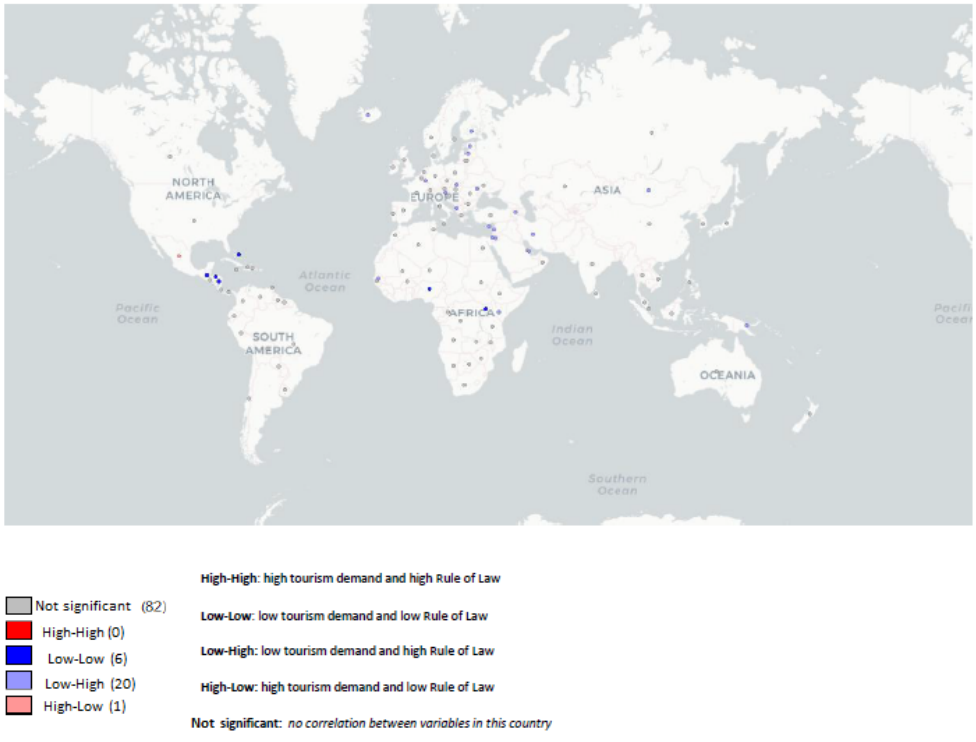
In Figure 4.1, we detect five groups of countries according to the relationship between the level of corruption and tourist arrivals. In the first group, high influx of tourists goes with a high performance on corruption, i.e., lower level of corrupt behaviours (indicated in the legend as High-High); the group is mainly made up of central European countries. The second group exhibits low tourism demand coupled with bad performance in corruption (Low-Low) and is composed of African countries. In the third group, a low tourism demand is associated with good levels of quality in corruption (Low-High). This group includes Panama and some Adriatic countries. The fourth group comprises countries that have high level of tourist arrivals and a very bad corruption performance; it is mostly made up of Asian countries including China and India. Finally, the fifth group is composed of seventy-eight countries of very diverse locations; it is the group with the highest number of countries.

An analysis of the groups does not detect, at first sight, countries with high correlation between the tourism demand and the quality of their legal

and judicial framework. The second group, composed of countries with low tourism demand and low institutional quality, is mainly located in Central America and Africa. In this group of countries the low number of tourist arrivals is high correlated with their poor institutional quality.

The largest group of countries is that showing low tourist arrivals and high institutional quality and is located in Eastern Europe, the Persian Gulf and the Middle East. This result could be explained by the fact that potential tourists perceive these countries less safe for several reasons. First, since some of them come from the former Eastern bloc, their institutional quality still generates doubts. Second, the permanent conflicts in the Middle East and the Persian Gulf generate a feeling of insecurity making this area less attractive to potential tourist.

Figure 4.2: Cluster map (BiLISA) for Rule of Law and tourism demand (both in logarithm)



The fourth group includes only Mexico. This country is very attractive for tourists, despite exhibiting low institutional quality. In fact, Mexico has a flourishing tourist industry, even though its institutions inspire little confidence. This result reveals that, although tourists care a lot about instituional quality, they give priority to other aspects such as historical and cultural heritage when choosing a destination.

Finally, there is a group where no correlation between Rule of Law and tourist arrivals is detected. As in the case of the corruption map, this is the most numerous group of countries in the analysis.

Figure 4.3: Cluster map (LISA) for tourism demand and tourism demand in neighboring countries (both in logarithm)

As far as the LISA indicator is concerned, the results show strong correlation between tourist arrivals in a specific country and the tourist inflow in its neighboring countries. Figure 4.3 shows two major groups in which the tourism demand is highly correlated with the tourism demand in nearby countries.

The first group is mainly composed of European countries and shows that high tourism demand is strongly correlated with the flow of tourist to the surrounding countries. The African countries show the opposite situation; i.e, a geographically group of economies close to each other with a low tourism demand.

There are six countries with low tourist arrivals that are surrounded by countries with high tourist demand (Low-High), and all of them are located in the Adriatic, which is an area with a wide tourist offer. Some countries, such as Croatia are close to other countries with a lower tourism demand such as Albania or Slovenia.

The fourth cluster is made up of very touristic countries surrounded by

neighbors with low toursim demand. The group has two members: The Dominican Republic and Brazil. Again, this feature indicates that some countries are very attractive to tourist independently of their geographical characteristics and location. Finally, the most numerous group is made up of countries in which there is no strong correlation between the own tourism demand and that of their neighboring countries.

This bidimensional analysis, which is a first view of the data, reveals, that in general there is no strong correlation between tourism demand and our variables of interest, since the most numerous clusters are those showing no correlation among variables. However, caution is needed in this assessment since the computation of these indicators does not take into account other factors that may simultaneously affect tourist arrivals in a country. Therefore, for a more reliable and robust analysis, we need to perform an econometric analysis that accounts for these additional factors.

4.3. Empirical results

Table 4.1 shows the results of the LM test and Moran's I, providing information about the convenience of using a spatial model and , if so, which type of spatial model we should specify. The table also includes the Breusch-Pagan test for heteroscedasticity

The significance of Moran's I indicates that there is spatial dependence, and that a spatial model is, consequently, the appropiate approach to model the tourism demand[3]. To ascertain which of the two spatial model we should specify, After verifying that both non-robust versions are statistically significant, we use the robust versions to ascertain, which spatial model to specify. The robust LM-error statistic indicates that the most appropiate model is a Spatial Error Model (SEM).

[3]As a preliminary task to the application of LM tests and heteroscedasticity, we have made - as is required in these cases - an estimation of the model by Ordinary Least Squares. The results appear in the appendix, because they are not relevant because they do not take into account the significant spatial effects.

Table 4.1: Hypothesis testing

	Statistics	*P-values*
Moran's I	4.494***	0.000
LM-lag	5.580**	0.001
LM-error	15.670***	0.000
robust *LM-lag*	0.063	0.800
robust *LM-error*	10.154**	0.001
Breusch-Pagan	6.234	0.284
*** significance at 1%, ** at 5%, * at 10%		

The Breusch-Pagan test does not reject the null hypothesis, which means that it is not neccesary to estimate the variance of the coefficients in a robust way.

Table 4.2 offers the results of the estimation of the SEM model, estimated by applying the Maximum Likelihood method.

Before analyzing the results is convinient to clarify that the LR statistic presented in the table confirms the validity of the model with spatial effects. This statistic tests, under the null hypothesis, if the model without spatial terms is better than a spatial model. Since the p-value associated with this LR statistic is 0.000, the null hypothesis of a non-spatial model is strongly rejected.

Table 4.2: Spatial Error Model (SEM) estimation by Maximum Likelihood. Period: 1995-2017

	Coefficients	*P-values*
constant	-1.632	0.332
$LnGDPpc_i$	0.908***	0.000
$LnPOP_i$	0.627***	0.000
$Ln\,\mathrm{Pr}\,ice_i$	-0.778**	0.018
LnC_i	-0.360	0.197
$LnRL_i$	1.059***	0.000
γ	0.509***	0.000
R-squared	0.815	
Likelihood ratio test p-value	0.000	
Breusch-Pagan test p-value	0.486	
*** significance at 1%, ** at 5%, * at 10%		

The most novel results presented in Table 4.2 refer to the institutional variables and the spatial term.

First, it appears that corruption is not significant, while the Rule of Law indicator is confirmed as a significant factor which positively affect

the number of tourist arrivals. The value of the estimated coefficient for the Rule of Law is 1.059, indicating that an increase of one percent in the quality index of the legal and judicial framework in a country increases the number of tourist arrivals by the same percentage. This result is in line with what is usually obtained in the literature for this specific indicator. So, it turns out that the security provided by a high quality institutional framework is very important for potential tourists when they decide their destination country, since judicial security guarantees that everything will go well during their stay.

In the case of corruption, the literature does not clarify the role that it has in tourist arrivals. Many authors, such as Poprawe (2015) or Neumayer (2004), argue that corruption deteriorates the tourism demand directly. Additionally, authors such as Saha and Yap (2015) find evidence that low levels of corruption can bring benefits. In our case, when we also introduce the indicator of formal institutions Rule of Law, and taking into account spatial effects, we do not find evidence of a direct effect on tourism demand. This informal institutional variable does not affect visitors (although a negative effect on the inhabitants of the country is expected).

With regard to traditional variables (GDPpc, prices and population), the results are in line with those usually obtained in the literature: the GDPpc and the size of country positively affect tourist arrivals and the price level negatively influences the tourists inflow.

The results of our analysis also highlight the relevance of the spatial effects on tourist arrivals. The spatial coefficient (γ) is significant at 1%, and has a positive sign, indicating that shocks on tourist arrivals in neighbouring countries affect the arrivals of tourist in the own country with the same sign. This finding confirms the intuition that what happens to my neighbor affects me. In this case, although the tourism demand in nearby countries does not directly affect the tourism demand of the own country, there are indirect spatial effects associated with positive or negative shocks that are transmitted from neighboring countries. For instance, the shocks that reduce the arrival of tourists to surrounding countries also negatively affect the arrival of tourists to the own country, and the opposite happens when positive shocks hit the neighbouring countries.

These results have important implications for the design of tourism policies. First, since measures to boost national tourism are affected by

the situation in neighboring areas, it is recommended that countries adopt coordinated tourism policies. The second implication emerges when we combine our findings with the results of Pike et al. (2006), who argue that public policy gains in efficiency when it is implemented at the regional level, because closeness gives the authorities easier, quicker and deeper knowledge of the problems and opportunities presented in their regions or municipalities. In the case of tourism demand, the benefits that derive from actions at the regional level are very obvious: advantage can be taken of the dynamism of neighboring towns or regions, in addition of detecting the problems that harm the nearby municipalities or regions more easily. Taking into account both types of results, we draw the conclusion that national governments should adopt coordinated tourism policies for their cross-border regions. This prescription could be applied, for example, to the multinational regions of the Mediterranean Basins, or to the Franco-Spanish regions on both sides of the Pyrenees. We confirm one of the proposals of Fanfani et al. (2000) for the multi-national regions of the Western Mediterranean Sea.

4.4. Concluding remarks

In this paper, we have applied spatial econometric techniques to analyze the determinants of international tourism demand using a sample of 109 countries over the period 1995-2017. Our study innovates by investigating the joint influence of two types of phenomena on the international tourism demand: the quality of two institutional indicators, corruption and the rule of law (representative of the informal and formal nature of institutions, respectively) and the geographical or spatial dimension of the issue in hand. We have obtained two types of results that improve the findings reported in the empirical literature in this domain.

First, we find that the spatial effects are important determinants of tourist arrivals, which indicates that what happens in the neighboring countries that affects the arrival of tourists to them, in particular external shocks, is transmitted to the country under study with the same impact sign. We derive from this finding that tourism policies designed to enhance tourism development should be flexible enough to absorb the positive effects coming from the environment, and to minimize the likely harmful effects triggered by negative shocks on international tourism in neighboring countries. Our results also suggest that national governments

should cooperate in the tourism promotion of their cross-border regions.

The second group of results relates to the incidence of institutions on the tourist's arrival. Our empirical analysis reveals that the normative and judiciary framework – i.e. the rule of law, representative of the formal institutions - positively affects the arrival of tourists in a non-ambiguous way, while corruption -representative of Informal institutions - does not have a significant effect. Consequently, in order to promote tourism, governments should implement laws that people perceive as fairer, and take steps to ensure judicial independence. These actions would generate security for potential tourists, favoring their decision to visit the country, and therefore benefiting not only the tourist industry, but also the whole economy of a particular country or region.

4.5. References

1. Assaf, A.G., & Josiassen, A. (2012): "Identifying and Ranking the Determinants of Tourism Performance: Global Investigation", Journal of Travel Research, 51(4), 388-399.

2. Balli, F., Balli, H. O. & Rosmy, J. L. (2016): "The impacts of immigrants and institutions on bilateral tourism flows", Tourism Management, 52, 221–229.

3. Chor Foon Tang (2018): "The impacts of governance and institutions on inbound tourism demand: evidence from a dynamic panel data study", Asia Pacific Journal of Tourism Research, 23:10, 1000-1007.

4. Das, J., & Dirienzo, C. (2010): "Tourism competitiveness and corruption: A cross-country analysis", Tourism Economics, 16(3), 477–492.

5. De la Mata, T., & Llano-Verduras, C. (2012). "Spatial pattern and domestic tourism: An econometric analysis using inter-regional monetary flows by type of journey ". Papers in regional science, 91(2), 437-470.

6. Ekine, S. (2018): "Corruption and Tourism: Evidence from democracies and non-democracies", Issues in Political Economy, Vol 27(1), 2018, 47-59

7. Fanfani, R., García Solanes, J., Leonardi, R. & Titecat, M. (2000): "Étude stratégique de coopération intérregionale en Méditerranée Occiden-

tale", Informe de la Comisión Europea. Conferencia de las Regiones Periféricas Marítimas de Europa.

8. Florax, R., Folmer, H. & Rey, S. (2003): "Specification searches in spatial econometrics: the relevance of Hendry's methodology", Regional Science and Urban Economics, 33, issue 5, p. 557-579.

9. Long, W., Liu, C., & Song, H. (2018)."Pooling in tourism demand forecasting. Journal of Travel Research, 0047287518800390.

10. Lv, Z., & Xu, T. (2017). "A panel data quantile regression analysis of the impact of corruption on tourism". Current Issues in Tourism, 20(6), 603-616.

11. Neumayer, E. (2004): "The impact of political violence on tourism: Dynamic cross-national estimation", Journal of Conflict Resolution, 48 (2), 259–81.

12. Neyapti, B. (2013): "Modeling institutional evolution", Economic Systems, 37(1), 1-16.

13. Pike, A., Rodríguez-Pose, A. & Tomaney, J. (2006): Local and Regional Development. Routledge, London.

14. Poprawe, M. (2015): "A panel data analysis of the effect of corruption on tourism", Applied Economics, Vol. 47(3), 2399-2412.

15. Saha, S., & Yap, G. (2015): "Corruption and tourism: An empirical investigation in a non-linear framework", International Journal of Tourism Research, 17(3), 272-281.

16. Santana-Gallego, M., Roselló, J., & Fourie, J. (2016): "The effects of terrorism, crime and corruption on tourism", ERSA Working paper 595. Cape Town: Economic Research Southern Africa (ERSA).

17. Steyn, R., & Jansen van Vuuren, O. (2016): "The relationship between quality of governance and foreign tourist numbers".

18. Tosun, C. & Timothy, D. (2001): "Shortcomings in planning approaches to tourism development in developing countries: The case of Turkey", International Journal of Contemporary Hospitality Management, 13(7), 352– 359.

19. Vail, D., & Heldt, T. (2000): "Institutional factors influencing the size and structure of tourism: Comparing Dalarna (Sweden) and Maine (USA)", Current Issues in Tourism, 3(4), 283-324.

20. Yang, Y., & Fik, T. (2014)."Spatial effects in regional tourism growth. Annals of Tourism Research, 46, 144-162.

21. Yang, Y., & Zhang, H. (2019). "Spatial-temporal forecasting of tourism demand". Annals of Tourism Research, 75, 106-119.

4.6. Appendix

Table 4.3: List of countries in the sample

Angola, Albania, Germany, Armenia, Algeria, Austria, Australia, Bahamas, Belgium, Burkina Faso, Bulgaria, Barhain,Bolivia, Brazil, Botswana, Canada, Qatar, South Korea, Switzerland, Chile, China, Congo, Democratic Republic of Congo, Colombia, Costa Rica, Cyprus,Czech Republic, Denmark, Dominican Rep., Ecuador,Egypt , Spain, Ethiopia, Slovenia, Slovakia, United States, Estonia, Philippines, Finland, France, United Kingdom, Gambia, Greece, Guatemala, Guyana, Croatia, Haiti, Honduras, Hungary, India, Indonesia, Ireland, Iran, Iceland, Israel, Italy, Jamaica, Jordan, Japan, Kazakhstan, Kenya, Lebanon, Sri Lanka, Lithuania, Latvia, Luxembourg, Madagascar, Malasya, Malawi, Mali, Malta, Morroco, Mexico, Mongolia, Namibia, Niger, Nigeria, Nicaragua, the Netherlands, Norway, New Zealand, Oman, Panama, Paraguay, Peru, Papua New Guinea, Poland, Portugal, Romania, Russia, Sudan, Senegal, Singapore, El Salvador, Surinam, South Africa, Sweden, Thailand, Tanzania, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, Uruguay, Venezuela, Vietnam, Zambia, Zimbabwe.

Table 4.4: International tourism demand model estimation by OLS. Period: 1995-2017

	Coefficients	*P-values*
constant	-1.535	0.415
$LnGDPpc_i$	0.931***	0.000
$LnPOP_i$	0.607***	0.000
$Ln\,\mathrm{Pr}\,ice_i$	-0.787**	0.042
LnC_i	-0.168	0.583
$LnRL_i$	0.949***	0.002
*** significance at 1%, ** at 5%, * at 10%		

Conclusions

The main goal of this thesis is to analyze how institutions, and specifically, corruption affect economic performance. We start focusing on the eurozone examining the institutional convergence among its members and how the common currency has impacted on corruption levels. In the following chapters we move our attention to an international level delving into the effects of corruption in long-run economic growth. Finally, we study the effects of formal and informal institutions on the tourism demand.

As far as institutional convergence is concerned, we have been unable to detect stochastic convergence in the eurozone as a whole, nor in any of the four sub-groups of this area considered in the analysis: the core, the periphery, Eastern countries, and the original members of the eurozone. We complete the analysis with the distribution dynamics approach based on kernel and stochastic kernel estimations of several types of density functions of the institutional indicators across countries. As a result, our analysis also reveals that, after the inception of the euro, the periphery and the Eastern countries have not followed a catching-up process towards the three eurozone countries that exhibit the highest institutional quality levels.

This issue is very important if we take into account that the survival of the euro in the coming years depends crucially on the success with which the countries of the peripheral and Eastern countries of the eurozone can improve their institutions and close the gap that separates them from the institutions prevailing in the core of this area. For this reason, the reform and institutional convergence across the member states of the eurozone should be a top priority task on the agenda of national authorities and policymakers. We have shown that the distribution of European funds has not helped to make the quality of the institutions of the euro countries more convergent.

There is a general conviction that this lack of convergence is strongly related with an aggravation of corruption in the eurozone, particularly in the peripheral economies of this area. However, to the best of our knowledge no study has been carried out so far to prove econometrically that presumed result in the individual members of that common-currency union. In this paper we have investigated the extent to which the adoption of the euro has affected the level of corruption in these countries by comparing in each individual country the actual trajectory of the corruption indicator with the trajectory that would have taken place in absence of the euro. Our counterfactual analysis has been performed applying the Synthetic Control Method (SCM). As far as core countries is concerned, our results indicate that, on average, the euro has had a positive impact on corruption. In the country-by-country analysis we find that the common currency affected negatively in the Netherlands, and that it has had a positive effect on the corruption indicator (reduction of corruption) of Germany.

In Southern countries we do not detect a significant averaged impact but in the country-by-country analysis we find a negative impact in Greece, and a positive effect in Portugal. These results show that the general thought about a widespread deterioration of corruption after the euro in these countries has not been caused by its implementation: this idea is not confirmed by a counterfactual analysis, except for the case of Greece.

Regarding the ex-communist countries of the eurozone, we detect positive averaged effect of the euro and also a positive impact on corruption levels in Slovakia, where the adoption of the euro has reduced the level corruption compared with the case where the country would had not adopted the euro. Our results point out that the inception of the euro has not caused backsliding in corruption in the three mentioned Eastern countries of the eurozone, in line with the findings of Levitz and Pop-Eleches (2010) and in line with our results or Chapter 1.

Corruption and quality of institutions influence the economy in a more global context. In the literature, the determinants of economic growth have been analyzed assuming that their impact is direct, without considering the possibility that there might also exist an indirect influence. In these circumstances, we test which of the "grease-in-the-wheels" or "sand-in-the-wheels" hypotheses better explains the impact of corruption on economic growth and to detect if this effect is direct or indirect. To achieve

our objective, we use a machine learning technique not widely used in economics aimed at detecting multiple-variables multiple-thresholds relations and called regression tree analysis. We apply this algorithm to a corruption-augmented Solow model equation. The application of the algorithm splits the sample into different groups of countries according to their level of corruption and generates different estimations of the Solow model for each group. With this methodology we use a non-linear framework that allows for indirect effect of institutional quality on the corruption-augmented Solow model. We obtain three main key empirical contributions. First, corruption have no direct on economic growth neither on countries with high levels of corruption nor on countries with better levels of corruption. Second, it appears that, in presence of corruption, formal institutions such as Rule of Law have no effect neither directly on economic growth, nor indirectly through the impacts of the determinants of growth, which means that corruption itself is affecting more economic performance than the legal and judicial framework. Third, for those countries with high corruption, mainly poor countries, it is absolutely necessary to implement policies which reduce corruption in order to achieve a better economic performance.

Our global approach of the influence of institutional quality on economics ends with a sectoral analysis. Our empirical analysis of the tourism demand reveals that, in a non-ambiguous way, the normative and judiciary framework - i.e. the rule of law, representative of the formal institutions - positively affects the arrival of tourists, while corruption -representative of Informal institutions - does not have a significant effect. Consequently, in order to promote the tourism industry, governments should implement laws that people perceive as fairer, and take steps to ensure judicial independence. These actions would generate security for potential tourists, favoring their decision to visit the country, and therefore benefiting not only the tourist industry, but also the whole economy of a particular country or region.

Taking into account all our results we may conclude that our empirical approach contributes to better understand how institutions and, specifically, corruption may be a key determinant of economic performance. However, there are still some aspects which could be addressed. According to the literature, institutional convergence affects income convergence. However, as far as we know, there is no empirical contributions that evaluate and quantify this effect. In future papers we want to analyze how these two types of convergence are related each other and how this af-

fects euro members. As far as corruption and the euro is concerned, the corruption indicator of some counties exhibits a great deterioration that, according to our results, is not caused by the common currency. Our objective is to extend this analysis to deepen into the reasons of this deterioration. Regarding economic growth and institutions, the main problem when we deal with the regression tree analysis is that the algorithms use Ordinary Least Squares as the main estimation method. We propose to improve the methodology allowing GUIDE algorithm to use other estimation methods such as Instrumental Variables. We are also interested in some additional country-by-country analysis of the relationship between institutional quality and growth. Finally, we want to study the relationship between tourism demand and institutions applying more complex and flexible methodologies that analyze non-linear effects of institutional quality on tourism.