Mechanisms of agglomeration in manufacturing: The home market effect and external economies

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MECHANISMS OF AGGLOMERATION IN MANUFACTURING: THE HOME MARKET EFFECT AND EXTERNAL ECONOMIES

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Abstract

The New Economic Geography is taken as reference in this doctoral thesis to examine in depth the concept of industrial agglomeration as a phenomenon associated with the spatial localization of economic activity. We consider two phenomena which are emphasised in that discipline: the Home Market Effect (HME) and the existence of productive externalities, which enable us to explain the pattern and mechanism of agglomeration of production and the pattern of trade in an economy. The aim of this thesis is to verify their existence and contribute to the evidence on the HME in industrial localization in Spain and on externalities in the European Union (EU).

First, the HME is analysed in the manufacturing industries of the Spanish Autonomous Communities (regions) from 1965 to 1995. We find evidence of the HME in more than half the industrial activities analysed, evidence that has grown over the period. These results were obtained with a new, more intuitive specification referring to the definition of HME as a mechanism of agglomeration of productive activity, which also presents conceptual advantages. Our research also presents novelties in the case study, referring to the Spanish regions since the 1960s.

Second, we have studied productive externalities and their use to explain processes of agglomeration or geographical concentration of activity in space through their impact on productivity growth. We verify this growth in the manufacturing industries of European Union countries from 1995 to 2002, and we make it dependent on interindustrial and intraindustrial, national and international marshallian externalities. The results show that together with national endowments and a central geographical position, productivity growth is heightened by national and international specialization and is also fed by interindustrial spillovers and the diversification of production. At the same time, in a notable outcome, we find a significant impact of international externalities on productivity, and also confirm that their omission from the analysis obscures the evidence of national externalities.

Third and last, in the context of increasing returns, monopolistic competition and transport costs, we have studied, at the theoretical level and jointly, the HME and the presence of a marshallian externality, phenomena which the literature has always tended to analyse separately. In principle, the existence of a technological shock in the production function increases productivity and reduces the price of the good it affects. If the externality coexists with a comparative advantage, it contributes to the localization of production, and strengthens the effects of the HME; but if it occurs in industries with a comparative disadvantage, these effects are modified. The externality also means income growth in the country where it occurs, triggering an effect of interindustrial transmission of localization. When the externality coincides with the comparative advantage in both countries this reinforces agglomeration, and agglomeration is moderated when the externality occurs in industries with a comparative disadvantage. The balance of trade between the countries is also affected. If the externality occurs in only one country, the total balance of trade increases, but if it occurs in both countries, the compensations of the net flows of imports and exports scarcely alter the balance of trade of each of them.

Resumen

La Nueva Geografía Económica es tomada como referente en esta tesis doctoral para profundizar en el concepto de la aglomeración industrial como fenómeno asociado a la localización de la actividad económica en el espacio. Consideramos dos fenómenos destacados en la citada disciplina: el *Home Market Effect* (HME) y la existencia de externalidades productivas, que permiten explicar el patrón y mecanismo de aglomeración de la producción y el patrón de comercio en una economía. El objetivo de esta tesis es contrastar su existencia y contribuir a la evidencia sobre el HME en la localización industrial en España y sobre las externalidades en el ámbito de la Unión Europea.

En primer lugar, se analiza el fenómeno del HME en las manufacturas de las comunidades autónomas españolas de 1965 a 1995. Encontramos evidencia de HME en más de la mitad de las actividades industriales analizadas, evidencia que ha sido creciente a lo largo de la historia. Tales resultados se han obtenido con una nueva especificación, más intuitiva en lo que se refiere a la definición de HME como mecanismo de aglomeración de la actividad productiva, y que presenta, además, ventajas de tipo conceptual. Además, nuestra investigación es novedosa por el caso de estudio, referido a las regiones españolas desde los años sesenta.

En segundo lugar, hemos estudiado las externalidades productivas y su

utilización para explicar procesos de aglomeración o concentración geográfica de la actividad en el espacio, mediante su impacto sobre el crecimiento de la productividad. Contrastamos este crecimiento en la industria manufacturera de los países de la Unión Europea de 1995 a 2002, y lo hacemos depender de las externalidades marshallianas, tanto interindustriales como intraindustriales, nacionales o internacionales. Los resultados muestran que junto con las dotaciones nacionales y una posición geográfica central, el crecimiento de la productividad se ve alentado por una especialización nacional e internacional y, además, es alimentada por los *spillovers* interindustriales y la diversificación productiva. Asimismo, y como resultado destacable, encontramos un impacto significativo de las externalidades internacionales sobre la productividad y, además, se comprueba que su omisión en el análisis oscurece la evidencia sobre las externalidades nacionales.

En tercer y último lugar, en un contexto de rendimientos crecientes, competencia monopolística y costes de transporte, hemos estudiado a nivel teórico y de forma conjunta el HME y la presencia de una externalidad marshalliana, hechos que la literatura ha tendido siempre a analizar separadamente. En un principio, la existencia de un *shock* tecnológico en la función de producción aumenta la productividad y reduce el precio del bien al que afecta. Si la externalidad coexiste con una ventaja comparativa contribuye a la localización productiva y refuerza los efectos del HME; pero si se da en sectores con desventaja comparativa, se moderan dichos efectos. La externalidad implica, además, un crecimiento de la renta del país en el que tiene lugar que desencadena un efecto de transmisión interindustrial de la localización. Cuando la externalidad tiene lugar junto a la ventaja comparativa en ambos países se refuerza la aglomeración, o se modera cuando tiene lugar en sectores con desventaja

comparativa. El saldo comercial entre los países también se ve afectado. Si la externalidad ocurre en un solo país, el saldo comercial total aumenta, pero si se da en ambos países, las compensaciones de los flujos netos de importaciones y exportaciones apenas alteran el saldo comercial de cada uno de ellos.

Introduction

Economic Geography is the discipline which studies the localization of economic activity in space. In the real world, the distribution of consumers and companies in a given geographical area is neither uniform nor random; large agglomerations form in some areas, to the detriment of others where density is lower.

This discipline is not a new field of learning, but originally sprang from the classical theory of localization and is related to Urban Economics, Regional Economics and International Trade Theory. However, it was not until the 1990s that, thanks to the work of economists such as Fujita, Venables and especially Krugman, that it was included in the mainstream of Economics. These new ideas and models led to a school of thought which was called the New Economic Geography (NEG), which emphasised the role of endogenous agglomerating forces arising from the interaction between economies of scale and transport costs.

What the NEG in fact tries to explain is why some economic activities choose to be based in certain places, thus defining a given spatial organisation of the economy. Intuitively, the spatial configuration of equilibrium can be understood as the result of a process in which two opposing forces participate, i.e., centripetal or agglomerating forces and centrifugal or dispersing forces.

The corresponding spatial equilibrium is the result of a complex interaction of forces which push and pull consumers and companies until nobody can find a better location.

Thus, geography and economy are closely related when taking into account the factors explaining spatial organisation, which is why Spatial or Regional Economics and Economic Geography are growing ever closer. Space influences how economic activity works, and in turn, the organisation of the territory is reflected in economic activity. In this context there is considerable interest in the phenomenon of industrial agglomeration, both for economists and for geographers and historians, as reality shows that the spatial distribution of economic activity is irregular.

Therefore, this doctoral thesis uses the NEG as its frame of reference. This makes it advisable to examine in more depth the main elements defining this school of thought. As set out by Head and Mayer (2004) there are basically five: i) economies of scale within companies; ii) imperfect competition; specifically, the model of product differentiation with monopolistic competition of Dixit and Stiglitz (1977); iii) the existence of transport costs, i.e., space matters; iv) companies decide on their location endogenously; and v) demand also decides its location endogenously, whether because the labour factor is mobile (Krugman, 1991), or because companies use their production as an intermediate input (Krugman and Venables, 1995). Some of these features are also shared by New Trade Theory, developed in the 1980s by authors such as Helpman, Ethier, Lancaster and Krugman.

In turn, we can cite two of the main characteristics which make the NEG different to other paradigms, which are shared by most models in this school of thought: The Home Market Effect and externalities. These are precisely the characteristics which will drive the questions we attempt to answer in this thesis, which we will divide into three chapters, each supposing a research element with a clear shared link. The first two essays are essentially empirical, and the third essay deals with the theory arising from the first two. We will now discuss our reasons for each chapter.

Regarding our first original question, the Home Market Effect (HME) or effect of higher demand sets out that a change in demand in a country or region leads to a more than proportional change in output in industries with economies of scale and transport costs. Krugman states this clearly: "In a world characterized both by increasing returns and by transportation costs, there will obviously be an incentive to concentrate production of a good near its largest market, even if there is some demand for the good elsewhere. The reason is simply that by concentrating production in one place, one can realize the scale economies, while by locating near the larger market, one minimizes transportation costs. This point –which is more often emphasized in location theory than in trade theory- is the basis for the common argument that countries will tend to export those kinds of products for which they have relatively large domestic demand" (Krugman, 1980, p.955).

The first chapter of the thesis deals with this phenomenon. We have found, throughout the literature, that the conclusions obtained regarding the existence of the HME are sensitive to the specification, disaggregation and geographical context adopted. So, a fresh approach to testing the HME will always add positive elements to the research, as there is no clear consensus as to its validity in the literature. In this work we have chosen to use regional rather than international data for the empirical application: Spain and its Autonomous Communities. Davis and Weinstein (1999) themselves put forward the main reason for choosing this option: regional data are more susceptible to detecting strong Economic Geography effects than international data, due to the lower transport costs associated with the movement of goods and the greater mobility of the factors of production at the regional level. We should also stress that our research had not been carried out for Spain nor with regional data, except for the analysis by Rosés (2003), but with a historic database from 1797 to 1910, so that updating was needed. Therefore, as one of our main contributions, our aim was to carry out a rigorous, and in some aspects, such as the specification of the proposed model, novel test of HME for data from Spain from 1965 to 1995, the most disaggregated period of information available.

Thus, the first essay in the thesis (*The Home Market Effect in Spanish Industry, 1965-1995*) deals with the empirical analysis of the existence of the Home Market Effect in Spanish manufacturing. It researches the presence and importance of these effects in determining the localization of production in Spain. For this, it uses as a base the theoretical model of Krugman (1980) and the successive empirical analyses of Davis and Weinstein (1996, 1999 and 2003). The total sample comprises information from 17 Autonomous Communities, 9 productive activities and 16 years; those available are the odd years from 1965 to 1995. The level of disaggregation used was not greater, i.e., NUTS III, Spanish provinces, as at this level there are data for only 7 branches of production, of which only one, industrial products, will be studied.

The empirical test supports the hypothesis of the existence of the HME. This evidence exists in a significant number of branches of production; specifically, the HME is found in 5 of the 9 branches analysed. These results were obtained with a new, more intuitive specification proposed here, referring to the definition of HME as a mechanism of agglomeration of productive activity, which also presents conceptual advantages.

The proposed specification, and an important methodological contribution of the analysis, is the formulation in proportions of demand and production, instead of the traditional levels. The first tests in levels were proposed by Davis and Weinstein, who closely followed the original theoretical model of Krugman (1980). These models were formulated for an absolute comparative advantage and relate individual demand with individual production. Later, the theoretical model of Weder (1995) suggests that the comparative advantage is also a reason for the existence of HME, and so uses proportions. This fact inspired specifying our model in proportions. The concept of HME itself implies working in relative terms: a change in the localization of demand leads to a more than proportional relocation of industry. Consequently, the best way to verify the effectiveness of this change in proportions is by defining the variables as proportions and not levels.

However, we also believe that proportions should be used due to the traditional tests being analyses of cross-sections, which do not take into account the possible regional variations in output due, for example, to changes in the situation, spillovers between industries or spatial correlation. Our specification is directly related with the traditional one, and is conceptually superior to it because it takes into account this variation in panel data. In other words, first, our model allows for the possible annual variations in total production of the region, which is not considered by the model in levels; second, it takes into account the composition of productive industries according to national standards; and third, it tests whether changes in the structural regional deviations from the national norm, which can be called idiosyncratic production, are more than proportional to changes in idiosyncratic demand.

In this chapter we will also refer to the comparison between the Heckscher-Ohlin (HO) model and the HME of the NEG. It is true that endowments are important elements for explaining industrial localization in the development of a region, but we complement them with the inclusion of the effects of market size, to see which of them best explains the situation. We will see how both coexist and the NEG becomes increasingly important.

Finally, in this chapter we verify the existence of the HME for a relatively long period of 30 years. It certainly makes sense to ask how the HME has evolved over time. For this reason, the chapter dedicates a section to HME dynamics, dividing the sample into two sub-periods (1965-1973 and 1985-1995) and exploring how the HME varies in each of them. As can be seen in the text, the results for the sub-periods ratify the results obtained for the whole period, while revealing a greater importance of Economic Geography in the most recent years of the analysis, without the complete disappearance of the traditional determinants of localization.

We now turn to the second of our two original questions, the so-called external economies of agglomeration. They are defined as the benefits obtained by companies when they locate in a densely occupied space, where they can find a large number of potential customers and suppliers, as well as support services and an ample labour market, with diverse professional qualifications, to which we can add a greater supply of facilities and quality infrastructure. All of these resources, which contribute to create a propitious atmosphere for business activity, are usually grouped under the generic name of economies of agglomeration. Starting with the literature on production externalities (Marshall, 1923), different types have been formulated and connections established with the New Economic Geography and Regional and Urban Economics[1].

Marshall distinguished three origins of externalities for which advantages appear in the spatial concentration of economic activity. First, the existence of agglomerations of companies favours the establishment of other complementary activities supplying specific specialized inputs, services and production equipment to each industry, generating forward and backward interindustrial linkages. Second, the emergence of a specialized labour market shared by all the companies in each industry localized in the same territory. And third, the technical information flows relating to specific know-how which spread throughout the companies of an industry, leading to a cumulative process of improvement in production: these are known as knowledge spillovers.

Later, Scitovsky (1954) distinguished between pecuniary and technological externalities. The former lead to lower input costs, which are transferred to market prices and could correspond to the first two sources described by Marshall. Technical externalities, like marshallian ones, are associated with the spread of technology and know-how between companies which improve their productivity. This distinction is similar to that used in Regional and Urban Economics, which differentiates between static externalities, which can be likened to pecuniary externalities and have to do with the size of an industry in a location, and dynamic externalities, relating to the spread of know-how and its influence on the growth of an activity, both between and within industries. The different typologies of dynamic or static external effects can be satisfactory in theory, but are highly ambiguous in practice, as the size and growth of an industry are closely linked, and are at the same time the cause

[1] For an exhaustive review, see Duranton and Puga (2004).

and effect of the same phenomenon. In short, the evidence in the literature is mixed regarding the role of externalities and geography in productivity, with a great deal of heterogeneity depending on the countries or industries analysed.

The aim of the research carried out in chapter 2 is to contribute to the scanty evidence on the role of externalities; in particular, to analyse the existence of production externalities in European Union (EU) manufacturing industries, and their effect on productivity as a mechanism of agglomeration. Although there is evidence regarding this, it is still very scanty and comes from studies of specific industries or aggregated analyses of productive activity. This work deals with a study which is disaggregated by industries for the period for which information is available, 1995-2002, and in the economic context of the EU, constituting a contribution in itself.

Thus, the second essay of the thesis (*External Economies as a Mechanism of Agglomeration in EU Manufacturing*) shows how externalities in production are significant determinants of agglomeration. To do this we analyse the impact on productivity growth of the sources of externalities found in the literature, both pecuniary and technological (with special emphasis on the latter), inter- and intraindustrial, national and international. Our starting point is the theoretical foundation which gathers in the production function, first, interindustrial externalities, analysed by Midelfart-Knarvik and Steen (2002) and by Henriksen et al. (2001); second, knowledge spillovers through external economies of specialization and diversification in each country, examined in Serrano (2000) and De Lucio et al. (2002); and last, the effect of the international dimension and geography on externalities, through the international specialization of each country in each industry and an indicator of peripherality of the country, considered in Graham (2000) and Ciccone (2002), as these can become stronger or weaker with distance.

The results show that along with national endowments and a central geographical position, production growth is encouraged by national and international specialization, and is also nourished by interindustrial spillovers and diversification of production, a more obvious result in high technology industries, while lower technology industries are more sensitive to the omission of international externalities. Because of this, it is essential to consider the effect of both externalities, national and international, at the same time, as their omission underestimates national spillovers.

In short, our empirical research focused on one hand on identifying the existence of the HME in Spanish manufacturing, and on the other, on analysing the existence of externalities in the production of manufacturing industries in EU countries. We end the work in chapter 3, analysing at the theoretical level the productivity advantages due to the existence of an externality and its effect on the HME, as the nexus joining both concepts.

Thus we create a simple theoretical model in which the presence of a marshallian externality will modify the results of the HME, produced by the existence of a comparative advantage, on the pattern of production and trade of an economy with two countries and two industries.

Thus, the third and final chapter of the thesis (*The Home Market Effect in the Presence of Marshallian Externalities*) analyses theoretically and jointly two economic phenomena which necessarily involve the concentration of production in a given location: the HME and the presence of a marshallian externality. In a context of increasing returns, monopolistic competition and transport costs, we analyse the existence of a technology shock in the production function which increases productivity, lowers the price of the good it affects, raises income for the country in which it takes place, triggering an effect of interindustrial transmission of localization. This contributes to the productive agglomeration, and increases the balance of trade between countries. The externality may affect one or both countries. It is also possible that this externality occurs in the good for which the country has a comparative advantage, or in the other. The results of all the possible taxonomy of cases can be summed up, in a very simplified form, as follows: If the shock occurs in both countries and in the industries with comparative advantage, these effects are strengthened, and they are moderated if the shock takes place in industries with a comparative disadvantage. In this situation, income growth does not generate such large income disparities as in the case of externalities in a single country. In trade, the externality in the industry with comparative advantage generates more trade through net exports of differentiated products from the industry with comparative advantage, while in the industry with comparative disadvantage, there is a drop in net imports which also increases the balance of trade.

The research concludes with a summary of the results obtained, which we present in a section of conclusions.

Introducción

La Geografía Económica es la disciplina que estudia la localización de la actividad económica en el espacio. En el mundo real, la distribución de consumidores y empresas en una determinada área geográfica de referencia no es ni uniforme ni aleatoria, sino que se forman importantes aglomeraciones en ciertas zonas, en detrimento de otras que presentan una menor densidad.

Esta disciplina no es un campo de conocimiento nuevo, sino que se basa desde sus inicios en la teoría clásica de la localización y se relaciona con la Economía Urbana, la Economía Regional o la Teoría del Comercio Internacional. Sin embargo, no es hasta la década de los noventa del pasado siglo cuando se incorpora, gracias al trabajo de economistas como Fujita, Venables y, sobre todo, Krugman, a la corriente principal de la Economía. Estas nuevas ideas y modelos dan lugar a una escuela que se denomina Nueva Geografía Económica (NGE), la cual enfatiza el papel de las fuerzas endógenas de aglomeración que surge de la interacción entre economías de escala y costes de transporte.

Lo que, en definitiva, pretende explicar la NGE es por qué algunas actividades económicas eligen establecerse en lugares concretos, definiendo de esta manera una determinada organización de la economía en el espacio. Intuitivamente, la configuración espacial de equilibrio puede ser entendida como el resultado de un proceso en el que participan dos tipos de fuerzas opuestas, esto es, fuerzas centrípetas o de aglomeración y fuerzas centrífugas o de dispersión. El correspondiente equilibrio espacial es el resultado de una compleja interacción de fuerzas que empujan y tiran de consumidores y empresas, hasta que nadie puede encontrar una localización mejor.

Así pues, geografía y economía están estrechamente relacionadas a la hora de tener en cuenta los factores explicativos de la organización del espacio; es por ello que la Economía Espacial o Regional y la Geografía Económica están cada vez más próximas. El espacio influye en el funcionamiento de la actividad económica y, a su vez, la organización territorial es reflejo de la actividad económica. Es en este contexto en el que el fenómeno de la aglomeración industrial genera un considerable interés, tanto a economistas como a geógrafos e historiadores, ya que la realidad muestra que la actividad económica está irregularmente distribuida en el espacio.

Así, esta tesis doctoral se enmarca y toma como referente la NGE. Bien estará, por tanto, profundizar en cuáles son los elementos principales que definen esta corriente de pensamiento. Siguiendo a Head y Mayer (2004) son fundamentalmente cinco: i) economías de escala internas a la empresa; ii) competencia imperfecta; en concreto, el modelo de diferenciación del producto con competencia monopolística de Dixit y Stiglitz (1977); iii) existencia de costes de transporte, es decir, el espacio importa; iv) las empresas deciden su localización endógenamente y v) la demanda también decide su ubicación de forma endógena, bien porque el factor trabajo es móvil (Krugman, 1991), bien porque las empresas utilizan su producción como un *input* intermedio (Krugman y Venables, 1995). Algunos de estos rasgos son también comunes a la Nueva Teoría del Comercio Internacional, impulsada a principios de los años ochenta del pasado siglo por autores como Helpman, Ethier, Lancaster y Krugman.

A su vez, podemos citar dos de las principales características que hacen diferente a la NGE frente a otros paradigmas, que comparten la mayor parte de modelos de la citada corriente: El *Home Market Effect* y las externalidades. Y van a ser precisamente estas características las que van a motivar los interrogantes a que se intenta dar respuesta en esta tesis, que desarrollamos en tres capítulos, y que suponen cada uno de ellos un elemento de investigación con un claro enlace común. Los dos primeros ensayos son esencialmente empíricos, y el tercero es un ensayo teórico, como culminación a los dos anteriores. Veamos a continuación, la motivación que nos ha llevado a desarrollar cada uno de ellos.

Respecto a la primera cuestión de partida, el *Home Market Effect* (HME) o efecto del incremento de la demanda, establece que un cambio en ésta en un país o región provoca un cambio más que proporcional en el *output* de aquellos sectores con economías de escala y costes de transporte. Krugman afirma esto claramente: «Un mundo caracterizado por rendimientos crecientes y costes de transporte, incentivará, obviamente, a la concentración de la producción de un bien cerca del mercado más grande, incluso si hay demanda para el bien en algún otro sitio. La razón es, simplemente, que la producción en un único lugar puede generar economías de escala, mientras que la localización cerca del mercado más grande minimiza los costes de transporte. Este punto – el cual está más a menudo enfatizado en la teoría de localización que en la teoría de comercio- es la base del conocido argumento que explica que los países tenderán a exportar esa clase de productos para los cuales tienen una demanda doméstica relativamente mayor» (Krugman, 1980, p.955).

A este fenómeno se dedica el primer capítulo de la tesis. Hemos podido constatar a lo largo de la literatura revisada que las conclusiones obtenidas sobre la existencia de HME son sensibles a la especificación, desagregación y contexto geográfico adoptados. Por ello, volver a abordar el contraste del HME siempre aporta elementos positivos a la investigación, por no existir un claro consenso en la literatura sobre su validez. En este trabajo hemos adoptado la postura de llevar a cabo la aplicación empírica con datos regionales y no internacionales: España y sus comunidades autónomas. Los propios Davis y Weinstein (1999) esgrimen el motivo principal para elegir esta opción: los datos regionales son más susceptibles de detectar fuertes efectos de Geografía Económica que los internacionales, debido a los menores costes de transporte asociados al movimiento de bienes y a la mayor movilidad de los factores productivos que se da a nivel regional. También debemos enfatizar que nuestra investigación no había sido llevada a cabo para España ni tampoco con datos regionales, exceptuando el análisis hecho por Rosés (2003), pero con una base de datos histórica de 1797 a 1910, por lo que era necesaria la correspondiente actualización. Por lo tanto, como una de nuestras principales aportaciones, pretendemos llevar a cabo un riguroso y, en ciertos aspectos, como es la especificación del modelo que se propone, novedoso contraste del HME para datos de España de 1965 a 1995, periodo de información más desagregado disponible.

Así, el primer ensayo de la tesis (*The Home Market Effect in Spanish Industry, 1965-1995*) aborda el análisis empírico de la existencia de *Home Market Effec*t en las manufacturas españolas. Se trata de investigar la presencia e importancia de estos efectos en la determinación de la localización de la producción de España. Para ello, se ha utilizado como base el modelo teórico de Krugman (1980) y los sucesivos análisis empíricos de Davis y Weinstein (1996, 1999 y 2003). La muestra total comprende la información de 17 comunidades autónomas, 9 actividades productivas y 16 años, los disponibles son los impares desde 1965 a 1995. El nivel de desagregación utilizado no ha sido mayor, es decir, NUTS III, provincias españolas, ya que a este nivel sólo hay datos para 7 ramas productivas de las cuales sólo una, los productos industriales, sería objeto de nuestro estudio.

El contraste empírico realizado apoya la hipótesis de la existencia de HME. Esta evidencia existe en un número importante de ramas productivas, en concreto, se encuentra HME en 5 de las 9 ramas analizadas. Tales resultados se han obtenido con una nueva especificación aquí propuesta, más intuitiva en lo que se refiere a la definición de HME como mecanismo de aglomeración de la actividad productiva y que presenta, además, ventajas de tipo conceptual.

La especificación que se propone, y una importante aportación metodológica del análisis, es la formulación en proporciones de demanda y producción, en lugar de la tradicional, en niveles. Los primeros contrastes en niveles fueron propuestos por Davis y Weinstein, que siguieron de cerca el modelo teórico original de Krugman (1980). Estos modelos están formulados para una ventaja comparativa absoluta y relacionan la demanda individual con la producción individual. Más tarde, el modelo teórico de Weder (1995) sugiere que la ventaja comparativa es también un motivo de existencia de HME, y utiliza, por tanto, las proporciones. Este hecho inspiró especificar nuestro modelo en proporciones. El propio concepto de HME implica trabajar en términos relativos: un cambio en la localización de la demanda conduce a una más que proporcional relocalización de la industria. Por consiguiente, el mejor camino para contrastar la efectividad de ese cambio en mayor proporción pasa por definir las variables precisamente en proporciones y no en niveles.

No obstante, también creemos que las proporciones tienen que ser utilizadas debido al hecho de que los contrastes tradicionales son análisis de corte transversal, y no toman en cuenta las posibles variaciones regionales de *output* debidas, por ejemplo, a razones coyunturales, a *spillovers* entre las industrias o a la correlación espacial. Nuestra especificación está directamente relacionada con la tradicional, y es superior conceptualmente a ella porque tiene en cuenta esta variación existente en los datos de panel. En otras palabras, nuestro modelo, en primer lugar, contempla las posibles variaciones anuales en la producción total de la región, que no es considerado por el modelo en niveles; segundo, tiene en cuenta la composición industrial de la producción de acuerdo con los estándares nacionales; y, tercero, contrasta si los cambios en las desviaciones estructurales regionales respecto al estándar nacional, lo cual podría denominarse producción idiosincrática, son más que proporcionales a los cambios en la demanda idiosincrática.

A lo largo del capítulo también haremos referencia a la comparación entre el modelo de Heckscher-Ohlin (HO) y el HME de la NGE. Es un hecho que las dotaciones son importantes elementos para explicar la localización industrial en el desarrollo de una región, pero lo complementaremos con la inclusión de los efectos de tamaño de mercado, para ver cuál de ellos explica mejor la realidad. Veremos cómo ambos coexisten y cobra cada vez más importancia la NGE.

Por último, en el capítulo se contrasta la existencia de HME para un periodo relativamente largo de 30 años. Ciertamente, tiene sentido plantearse cómo ha evolucionado en el tiempo el HME. Por ello, el capítulo dedica un epígrafe a la dinámica del HME, en el que se divide la muestra en dos subperiodos (1965-1973 y 1985-1995) y se explora cómo varía HME en cada uno de ellos. Como se puede comprobar en el texto, los resultados por subperiodos ratifican los obtenidos para el periodo completo, a la vez que revelan una mayor importancia de la Geografía Económica en los años más recientes del análisis, sin que desaparezcan por completo los determinantes tradicionales de localización.

Continuemos con la segunda cuestión de partida planteada, las denominadas economías externas de aglomeración. Se definen como aquellos beneficios que obtienen las empresas por el hecho de localizarse en un espacio densamente ocupado, donde pueden encontrarse una gran cantidad de clientes y proveedores potenciales, además de servicios de apoyo y un mercado de trabajo amplio, con cualificaciones profesionales diversas, a lo que se suma una mayor dotación de equipamientos e infraestructuras de calidad. Todos esos recursos, que contribuyen a crear una atmósfera propicia para la actividad empresarial, suelen englobarse bajo la denominación genérica de economías de aglomeración. Desde el origen de la literatura sobre externalidades en la producción (Marshall, 1923), se han formulado diferentes tipologías y establecido conexiones con la Nueva Geografía Económica y la Economía Regional y Urbana[2].

Marshall distinguía tres orígenes de las externalidades por las que aparecen ventajas en la concentración espacial de la actividad económica. En primer lugar, la existencia de aglomeraciones de empresas favorece el establecimiento de otras actividades complementarias proveedoras de *inputs* especializados, servicios y bienes de equipo específicos a cada sector, generando los vínculos (*linkages*) interindustriales *forward* y *backward*. En segundo lugar, la forma-

[2]Para una revisión exhaustiva véase Duranton y Puga (2004).

ción de un mercado de trabajo especializado compartido por todas las empresas de cada sector localizadas en un mismo territorio. Y, en tercer lugar, los flujos de información tecnológicos relacionados con los conocimientos específicos que se difunden entre las empresas de sector, dando lugar a un proceso acumulativo de mejora en la producción (*know-how*): son los conocidos *knowledge spillovers* o desbordamientos tecnológicos.

Posteriormente, Scitovsky (1954) distinguió entre externalidades pecuniarias y tecnológicas. Las primeras dan lugar a una reducción en los costes de los *inputs* que se transmite a los precios de mercado y podrían corresponder a las dos primeras fuentes descritas por Marshall. Las externalidades tecnológicas, al igual que las marshallianas, se asocian a la difusión de la tecnología y conocimientos entre empresas que mejoran su productividad. Esta distinción se asemeja a la utilizada por la Economía Regional y Urbana, que diferencia entre externalidades estáticas, asimilables a pecuniarias y que tienen que ver con el tamaño de una industria en una localización, y externalidades dinámicas, relativas a la difusión de conocimientos y su influencia en el crecimiento de una actividad, tanto intra como interindustrial. Las distintas tipologías de efectos externos dinámicos o estáticos pueden resultar satisfactorias teóricamente, pero son de gran ambigüedad cuando se llevan a la práctica, ya que el tamaño y el crecimiento de un sector están estrechamente relacionados, y son a la vez causa y efecto de un mismo fenómeno. En definitiva, en la literatura existe una evidencia mixta sobre el papel de las externalidades y de la geografía en la productividad, con gran heterogeneidad según los países o sectores analizados.

El objetivo de la investigación llevada a cabo en el capítulo 2, es contribuir a la escasa evidencia sobre el papel de las externalidades; en particular, analizar la existencia de externalidades productivas en la industria manufacturera de la Unión Europea (UE), y su efecto en la productividad como mecanismo de aglomeración. Aunque existe evidencia al respecto, es todavía muy escasa y procede de estudios de industrias concretas o de análisis agregados de la actividad productiva. En este trabajo se aborda un estudio desagregado por actividades industriales para el periodo de información disponible, años 1995-2002, y en el contexto económico de la UE, lo que constituye una aportación en sí misma.

Así, en el segundo ensayo de la tesis (*External Economies as a Mechanism of Agglomeration in EU Manufacturing*) mostramos cómo las externalidades productivas son determinantes significativos de la aglomeración. Para ello, analizamos el impacto sobre el crecimiento de la productividad de las fuentes de externalidades reunidas en la literatura, pecuniarias y tecnológicas (haciendo especial hincapié en estas últimas), tanto inter como intraindustriales, nacionales e internacionales. Partimos de la fundamentación teórica que recoge en la función de producción, en primer lugar, las externalidades interindustriales, analizada por Midelfart-Knarvik y Steen (2002) o por Henriksen et al. (2001); en segundo lugar, los *knowledge spillovers* mediante las economías externas de especialización y de diversidad dentro de cada país, examinado en Serrano (2000) y De Lucio et al. (2002); y por último, el efecto de la dimensión internacional y la geografía sobre las externalidades, a través de la especialización internacional de cada país en cada actividad industrial y de un indicador de perificidad del país, consideradas en Graham (2000) o Ciccone (2002), puesto que éstas pueden potenciarse o debilitarse con la distancia.

Los resultados muestran que junto con las dotaciones nacionales y una posición geográfica central, el crecimiento de la productividad se ve alentado por una especialización nacional e internacional y, además, es alimentada por los *spillovers* interindustriales y la diversificación productiva, un resultado más evidente para las industrias de alta tecnología, mientras que las industrias de menor tecnología son más sensibles a la omisión de las externalidades internacionales. Por ello, es fundamental considerar simultáneamente el efecto de ambas externalidades, nacionales e internacionales, ya que su omisión subestima los *spillovers* nacionales.

En definitiva, nuestra investigación empírica se ha centrado, por un lado, en identificar la existencia de HME en las manufacturas españolas y, por otro, en analizar la existencia de externalidades productivas en la industria manufacturera en los países de la UE. Cerramos el trabajo en el capítulo 3 analizando, a nivel teórico, las ventajas en productividad debidas a la existencia de una externalidad y su efecto en el HME, como nexo de unión entre ambos conceptos.

Así, elaboramos un modelo teórico sencillo en el que la presencia de una externalidad marshalliana modificará los resultados del HME, producido por la existencia de ventaja comparativa, sobre el patrón de producción y comercio en una economía con dos países y dos industrias.

De este modo, en el tercero y último capítulo de la tesis (*The Home Market Effect in the Presence of Marshallian Externalities*) se analiza teóricamente y de forma conjunta dos fenómenos económicos que tienen como implicación fundamental la concentración de la producción en una localización determinada; a saber, el HME y la presencia de una externalidad marshalliana. En un contexto de rendimientos crecientes, competencia monopolística y costes de transporte, analizamos la existencia de un *shock* tecnológico en la función de producción que aumenta la productividad, reduce el precio del bien al que afecta, incrementa la renta del país en el que tiene lugar. Esto desencadena un efecto de transmisión interindustrial de la localización, contribuye a la aglomeración productiva y aumenta el saldo comercial entre los países. Es posible que la externalidad afecte a un país o a los dos. También es posible que dicha externalidad se produzca en el bien en el que un país tiene ventaja comparativa, o en el otro. Los resultados de toda la posible taxonomía de casos podrían resumirse, de forma muy simplificada, como sigue. Si el *shock* ocurre en los dos países y en los sectores con ventaja comparativa, estos efectos se refuerzan; y se moderan si el *shock* tiene lugar en los sectores con desventaja comparativa. En esta situación, el crecimiento de la renta no genera diferencias de renta tan grandes como en el caso de externalidades en un solo país. En lo que se refiere al comercio, la externalidad en el sector de ventaja comparativa genera un aumento del comercio por exportaciones netas de variedades de la industria con ventaja comparativa, mientras que si se produce en el sector de desventaja comparativa tiene lugar un recorte en las importaciones netas que también aumenta el saldo comercial.

La investigación concluye con una síntesis de los resultados obtenidos, que presentamos en un apartado de conclusiones.

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Chapter 1

The Home Market Effect in Spanish Industry, 1965-1995

1.1 Introduction

The works of Fujita, Krugman or Venables, among others, have given rise, since the early 1990s, to a new strain in the literature on localization known as the New Economic Geography (NEG). One of the theoretical inferences deduced from this is the so-called Home Market Effect (HME) or effect of increased demand, according to which a change in demand in a country or region provokes more than a proportional change in the output of those industries with increasing returns and transportation costs.

In this chapter we intend to carry out a rigorous and in some ways, novel test of HME with Spanish data from 1965 to 1995. The analysis can also be seen as a comparison test of trade theories (Head and Ries, 2001; Trionfetti, 2001): Increasing versus constant returns models. In fact, HME was originally introduced within the framework of the New International Trade Theory, later being adopted as an element of the NEG models.

We can defend the value of this exercise with four arguments. First, the specification of the model proposed in this chapter is not only the traditional one. As we will explain in the specification of the empirical model, we have opted to analyse percentage changes in demand and production in a panel of regions. The advantages of this approach are twofold. On one hand, the specification is in much greater agreement with the real concept of HME (an increase of X per cent in the demand for a good produces an increase greater than X per cent in its production) and thus both more intuitive and more rigorous. On the other hand, estimations based on the panel of regions, in which some variables are defined with reference to the national average, mean the introduction of an additional geographical element, where the location of demand and production in some regions goes hand-in-hand with their delocation in others.

Second, the Spanish case has been studied by Rosés (2003), but using a historical database from 1797 to 1910 and a corresponding updating is needed if one thinks, as we ourselves believe, that the mechanisms of NEG could have been active during the industrial revolution as well as in modern times. Third, undertaking an empirical test of HME, far from being redundant, will always shed new light on the phenomenon, and so there is no clear consensus in the literature about its validity. In other words, testing of HME is still a useful task.

Finally, the empirical application is carried out with regional rather than international data. Davis and Weinstein (1999) themselves put forward the principal motives for choosing this option. Briefly, their main thesis is that it is easier to detect strong effects of Economic Geography in regional data than in international data due to lower transportation costs in the movement of goods and the greater mobility of factors found at the regional level.

The rest of the paper is set out as follows. In the second section a conceptual explanation of HME and its theoretical foundations is presented, along with a summary of the most relevant empirical applications. The third section concerns the specification of the empirical model for Spanish manufacturing industry. The fourth section describes the database used in the empirical application. The fifth section offers an estimation of the model and the results of the econometric analysis. The sixth section, titled Heckscher-Ohlin (HO) versus HME, is a joint analysis of the pattern of production from both the neoclassical and the NEG perspective; and HME dynamics are analysed in section 7. The most significant results indicate evidence of the existence of HME in four of the nine industries analysed, while in other four endowment factors are predominant in any explanation of location. In any case, HO and NEG coexist, in different intensities according to industry, as determinants of the industrial geography of Spain. Finally, the conclusions close the study.

1.2 HME: theory and evidence

The HME concept is one of the cornerstones of the New International Trade Theory and of the NEG, and with different nuances is generally accepted as one of the typical outcomes of the models which present increasing returns to scale (IRS) and transport costs. However, on the theoretical level, there is a strain of literature which specifies under which circumstances this is produced or not produced, depending on the different initial hypotheses.

The theoretical foundations of HME are found in Krugman (1980) and

Weder (1995) which in turn have inspired both theoretical discussion and diverse empirical tests.

1.2.1 Concept and theoretical discussion

The principal, groundbreaking innovation of Krugman is to show how the introduction of transportation costs alongside the presence of increasing returns imply that an increased demand for a certain product within a country will drive a more-than-proportional increase in production of that product in that country, a phenomenon known as HME. More recently, Weder (1995) introduces different sizes of countries, seeking thus to distinguish between absolute and relative differences in the dimensions of domestic demand of nations. He considers two countries as completely identical except for the absolute and relative size of their domestic demand for each type of differentiated product. Market size does not affect the scale of production, only the number of varieties of the product such that, when international transportation costs are reduced, competition between national and foreign companies increases, which implies that small differences in market sizes can have a great effect on the relative number of varieties produced in the two countries. In a nutshell, one country may be smaller than another and yet be a net exporter when its relative demand is greater. To sum up, the principal contribution of Weder (1995) is the introduction of the idea of a greater relative demand and the study of its consequences on production.

Taking the microfoundations referred to above as a basis, the main research on the HME phenomenom has tried to understand the conditions needed for the HME to appear. The first contribution is from Davis (1998), who shows, in a model based on Krugman (1980), that the HME vanishes when both industrial and agricultural goods have the same trade costs. More recently, Behrens et al. (2009) establish that the validity of the HME when it passes from a universe of two geographical units, as in the original propositions, to another with a greater number of regions or countries, is not immediate. Essentially, in defining a setting with multiple non-equidistant countries, they deduce that the appearance of HME should always be produced as long as it is possible to define an index of effective local demand which takes into account, besides local demand, the demands of other countries weighted by distance. Besides, they derive an alternative prediction that holds whatever the number of countries considered. This new prediction takes into account important features of the real world such as comparative advantage due to cross-country technological differences and lack of factor price equalization.

The problems arising from dealing with more than two regions were also anticipated in Ottaviano and Thisse (2004).

Hanson and Xiang (2004) note that if the hypothesis present in Davis and Weinstein of intercorrelation between the impact of demand and the impact of supply in the industry is not fulfilled, the results may be inconsistent. Elsewhere, Head and Mayer (2004) reason that the HME result depends crucially on the fulfilment of the hypothesis that the increasing returns industry has a perfectly elastic supply of labour. If this is not the case, a reverse HME effect can even be deduced. The interesting possibility of a non-linear HME, that is, HME being more important for very large and very small countries, is presented in Crozet and Trionfetti (2008). This result is produced when traditional goods are eliminated from the analysis.

Finally, the theoretical literature on the HME has recently produced several works, among which we may cite Melitz (2003), Baldwin and Okubo

(2004), Behrens and Thisse (2005), Baldwin and Robert-Nicoud (2005) and Okubo and Rebeyrol (2006); most of them explore the consequences of the introduction of heterogenous companies for the HME.

Definitively, from different perspectives, the literature demonstrates that the existence of the HME depends on the initial suppositions; therefore, it is necessary and indispensable to refer to the data in order to assess the empirical relevance of a phenomenon which, as we have just seen, has been extensively discussed at the theoretical level.

1.2.2 The evidence

The seminal papers trying to find evidence of HME are the ones by Davis and Weinstein, who have developed an empirical methodology to answer the following question: are idiosyncratic changes in demand associated with more-than-proportional changes in output? If the answer is affirmative the existence of HME is possible.

In their initial contribution, Davis and Weinstein (1996) carried out this analysis for OECD countries. Its objective is to explore the part played by idiosyncratic elements of demand in the determination of patterns of production via models of Economic Geography and comparative advantage. It is the first empirical test to nest trade models of Economic Geography with others of the Heckscher-Ohlin-Vanek type. To sum up, they find that factor endowments are a crucial element in understanding the manufacturing structure of the countries in the sample, given that they constitute 90 percent of explanatory power, whereas Economic Geography, via the Home Market Effect, constitutes only 10 percent.

In the construction of variables they follow closely the theoretical model of Krugman (1980). This means that the variable which reflects HME (called $IDIODEM$) initially lacks geographical input, as it supposes that the relative location of countries does not matter, and this implies that links of demand between neighbouring countries are not a priori stronger than links with countries on the other side of the world, which is not very realistic and which has an effect on the results. Therefore, two strategies were employed to improve these results. The first strategy is used in Davis and Weinstein (1999). The fundamental difference is that $IDIODEM$ is now applied to regions within a single country, in this case, Japan. The $IDIODEM$ coefficient is greater than one in the aggregate level estimates, therefore there is evidence of Home Market Effect[1]. Davis and Weinstein interpret this result as "clearly in the range of economic geography", in contrast to the result obtained in Davis and Weinstein (1996) with international data, which revealed the nonexistence of the Economic Geography effect. They explain this divergence of results with two reasons: the different trade costs between regions and between countries; and the greater mobility of factors between regions compared to this mobility between countries. Nevertheless, when factor endowments are included there is no evidence of Home Market Effect; but breaking down the data to the level of goods helps the HME emerge in eight of nineteen goods.

In the second strategy, in Davis and Weinstein (2003), the OECD countries are also analysed but $IDIODEM$ is measured differently. The authors conclude that the key to identifying Home Market Effects is to introduce more realism in their models of production and trade. Specifically, the main difference to Davis and Weinstein (1996) is the construction of a new $IDIODEM$

[1] In the third section we explain how HME happens when the coefficient of $IDIODEM$ is greater than one.

variable which weighs demand against the distance between countries, such that the size of the economy, bilateral distance and the characteristics of a particular industry are brought together in a gravity equation, which determines how demand is dissipated by distance.

However, this is only one of the ways of contrasting the explanatory power of these theoretical models from an empirical perspective. Other articles tackle the problem directly by considering an estimation strategy that uses the spatial variation in earnings to identify the structural parameters of a geography model. Thus, Redding and Venables (2004) and Hanson (2005) estimate a wage equation that relates nominal wages in each zone (cross-country data for Redding and Venables, US cross-county data for Hanson) to its distance from economic centres. In general, they found a spatial correlation of wages and demand. Along the same lines, Crozet (2004) analyses the influence of access to markets (market potential) in the localization choices of the agents using inter-regional migration data for five European countries. The Spanish case has also been studied using this approach in the works of García-Pires (2006) and Paluzie et al. (2007), where the existence of a spatial wage gradient is detected: a greater access to markets in the core regions ensures higher profits for local firms, and thus higher wages. The articles described above form an established strain in the contemporary literature on the NEG which is complementary to the approach adopted in this work.

The interest for the study of the Spanish case arises from the evidence that, during the industrial development of the 19th century, important regional differences emerged, with Spanish manufacturing becoming concentrated in a few regions due to reduced transport costs and internal trade barriers. The only known research specifically devoted to the analysis of HME in Spain is that of Rosés (2003), who combines the Hecksher-Ohlin and Economic Geography models à la Davis and Weinstein. He concludes that the comparative advantage and the effects of increasing returns were economically very significant and explain practically all the differences in industrialisation levels in Spanish provinces; and, more importantly for our purposes, the deficits of some regions in terms of industrialisation seem to be attributable to their factor endowments, combined with an apparent absence of Home Market Effects (no HME).

Also, the Spanish case could be a good testing ground for analysing this phenomenon, as it has shown an irregular regional distribution of economic activity since the beginning of its industrial development. Among the determinants of localization, the effects of the reduction in transport costs and internal barriers seem to be eclipsed by a specialization due fundamentally to factor endowments. However, our hypothesis in this paper is that from the late 19th century to today, factor endowments have gradually given way to the forces of Economic Geography in the production of the Spanish regions and many industries now show clear evidence of the HME phenomenon.

1.3 Specification of the empirical model of HME for Spanish manufacturing

As mentioned above, this paper attempts to verify the empirical validity of one of the theoretical prescriptions of the NEG, specifically the HME, starting from the methodology proposed by Davis and Weinstein.

Adopting the habitual notation of empirical literature, we start with the following relationship:

$$X_g^{nc} = f(SHARE_g^{nc}, IDIODEM_g^{nc}) \tag{1.1}$$

where X_g^{nc} is the output of the activity g included in total manufacture n and region c. $SHARE_g^{nc}$ attempts to capture the tendency, in the absence of idiosyncratic demand, for each region to produce activity g in total manufacture n in the same proportion as the national average of regions. It is therefore expressed as:

$$SHARE_g^{nc} = \frac{X_g^{nS}}{X^{nS}} X^{nc} \tag{1.2}$$

where S represents the totality of Spain and the term X^{nc} is a scalar reflecting the total production of industry in the region, i.e., an indicator of its size. $IDIODEM_g^{nc}$ collates idiosyncratic demand. Based on this we can detect the existence or otherwise of the Home Market Effect and it is by definition the crucial variable in the test of HME:

$$IDIODEM_g^{nc} = \left(\frac{D_g^{nc}}{D^{nc}} - \frac{D_g^{nS}}{D^{nS}} \right) X^{nc} \tag{1.3}$$

where D is internal absorption, proxied in the empirical application by gross value added to factor cost.

The coefficient associated with this variable captures the impact of idiosyncratic demand on production, and so the key point is its interpretation. Three possible scenarios are identified: first, in a context of comparative advantage without transportation costs, the geographical structure of demand should have no effect on production behaviours, and so the coefficient of $IDIODEM$ would be equal to zero. Second, in a world of comparative advantage with transportation costs and without increasing returns, demand deviation affects production location, but in a lesser proportion, so that the coefficient of $IDIODEM$ would be between zero and one. Thus a comparatively high demand for a product in a country will generally lead to net imports of this good. And third, if the typical characteristics of Economic Geography prevail, the coefficient of $IDIODEM$ will be greater than one, so an increase in demand for good g in industry n in region c leads to a more-than-proportional increase in output X_g^{nc}. Therefore a comparatively high demand for a product in a country will generally lead to net exports of this good. Thus we conclude that the associated Home Market Effect plays some part in production location.

Consequently, the empirical model for estimation would be given by

$$logX_g^{nc} = \alpha_0 + \alpha_1 logSHARE_g^{nc} + \alpha_2 logIDIODEM_g^{nc} + \alpha_g^{nc} \tag{1.4}$$

where α_0 is the independent term and α_g^{nc} represents random perturbation. For simplicity we omit the time dimension in the notation. Before presenting the results of the estimation we should take into account the following considerations. The $IDIODEM$ variable may take negative values given that it is a deviation from the national average with the subsequent problem of losing information when logs are taken. To avoid this, $IDIODEM$ is normalised (the most negative value is given a value of almost zero and the rest of the values are rescaled), so it is always positive, and an increase of the variable is unequivocally associated with an increase in the idiosyncratic demand of the region in the subindustry in question. Moreover, the use of logarithms allows us to interpret the estimated coefficients as elasticities.

On the other hand, equation (1.4) measures the volume of production in levels, which is equivalent to the original specification of Davis and Weinstein. We feel an alternative presentation of the model in percentage variations is relevant and useful, given that the same determinants express not only that a region increases production as an effect of increased demand, but also that it includes the element of specialization or lack of it, because it indicates the position or relative weight of each productive sector in the set of industries. The specification in proportions permits us to analyse if the change in the production of a industry is more or less than proportional to the change in demand, independently of the change in total production level; thus, it allows us to avoid false evidence of HME where the production of an industry can increase because of increases across all industries and not only because of the existence of HME. In other words, working in proportions allows us to control for the variations in the total production level.

There are also theory-based reasons for working with shares rather than levels. Krugman's (1980) original model, which introduces the HME in the literature, is in fact expressed in shares. The HME concept itself and the later contribution of Weder (1995) imply working with relative terms: a change in the location of demand leads to a more than proportional relocation of industry. This is the HME. The best way to test the effectiveness of the change in larger proportions is by defining the variables in shares and not in levels.

Definitively, our proposed specification of proportions which, in our opinion, finds support in recent theory and represents a more intuitive and direct approach to the concept of HME, is:

$$log\left(\frac{X_g^{nc}}{X^{nc}}\right) = \delta_0 + \delta_1 log\left(\frac{SHARE}{X^{nc}}\right) + \delta_2 log\left(\frac{IDIODEM}{X^{nc}}\right) + \delta_g^{nc} =$$

$$= \delta_0 + \delta_1 log\frac{X_g^{nS}}{X^{nS}} + \delta_2 log\left(\frac{D_g^{nc}}{D^{nc}} - \frac{D_g^{nS}}{D^{nS}}\right) + \delta_g^{nc} \qquad (1.5)$$

We would like to examine further the effects of a formula like (1.5). The specification given in (1.4), in levels, derives from the supposition adopted by Davis and Weinstein that demand deviation is transmitted to production proportional to the size of the region through the scale variable X^{nc} which is also imbedded in term δ_0. However, in the model in proportions suggested in (1.5) this hypothesis of proportionality according to size or scale of the region is completely unnecessary due to the specification itself, already relativised by size and by considering regional-and-time variations can be controlled assuming individual and time effects[2].

Also, and this is very important, this relationship between demand deviation and size does not always hold, and in fact it does not hold in our data: we find that it is precisely the smallest regions that have the greatest demand deviation. In this sense estimation in proportions is conceptually superior to estimation in levels, and therefore, having discounted the effect of size there is no need to impose a hypothesis which is not necessarily demonstrable. Because of this also, we consider these results more reliable and also intuitive. Once

[2]This region-time variation is controlled statistically by the existence of individual effects in the estimation, contrasted statistically by Hausman's test. We also would like mention that this variation is not very big, with quite stable scale in regions along time which can be caught by the individual effects.

we control region-and-year total production and the industry composition of production according to the national standards, our model tests if changes in the structural regional deviations from the national standard, which might be called idiosyncratic production, are more than proportional than changes in idiosyncratic demand.

Moreover, the RHS of (1.5) has a range of variation from $-\infty$ to $+\infty$, while the LHS is limited and takes only negative values, generating possible inconsistencies. In order for both sides of the equation to have the same range of variation, and following Conniffe (1993), a logistical transformation was carried out on the endogenous variable, as is usual if this is a proportion[3].

An important aspect which we would like to comment on before passing to empirical application in the next section, is the introduction of more geography in the estimation, that is, the consideration of trade costs between regions (transportation costs, which may depend on distance, besides other elements). On one hand, any magnitude which does not change with time is controlled by fixed effects. On the other, the estimation of trade costs can be done in two ways (see Crozet and Trionfetti, 2005, p. 19-20), but both need data on bilateral trade flows between regions, which does not exist in the Spanish case[4].

Consequently, like Davis and Weinstein (1999), we do not introduce trade costs in the estimation, believing that our results can be understood, perhaps,

[3] There are other reasons, apart from mathematical consistency, to justify the use of the logistical transformation. From a statistical point of view, the random perturbation in (6) has a distribution closer to normal than that of (5) with a truncated variable. From an empirical point of view, we have found that the results in terms of HME are transformation-robust, corroborating the statement by Greene (2003) that the difference is negligible and would be relevant only for very extreme values of $IDIODEM$.

[4] The estimation made by Josep Oliver on bilateral trade flows between Spanish regions only covers the final part of our sample period.

as a conservative estimation of the existence of HME, given that Davis and Weinstein (2003) appear to confirm that a more explicit consideration of geographic factors such as trade costs tends to increase the probability of detecting HME.

Definitively, the model to estimate is expressed in equation (1.6), where our interest centers on the part played by demand deviation, i.e., the sign and magnitude of β_2.

$$log\left(\frac{\frac{X_g^{nc}}{X^{nc}}}{1-\frac{X_g^{nc}}{X^{nc}}}\right)=\delta_0+\delta_1 log\left(\frac{SHARE}{X^{nc}}\right)+\delta_2 log\left(\frac{IDIODEM}{X^{nc}}\right)+\delta_g^{nc} \quad (1.6)$$

1.4 Database

Regions were taken as the geographical units of reference, as the regional scope is better suited than the international for quantitative testing of HME, as seen in the better results obtained by Davis and Weinstein in a reduced ambit (the regions of Japan as opposed to OECD countries). Also, this could be more convenient in the case of internal trade barriers as the previous test for Spain HME suggests.

The main source of statistics was the publication Renta Nacional de España y su Distribución Provincial, years 1999 and 2000, by the Fundación BBVA. The data provided on Spanish manufacturing industry are the following: production of regions by industries (value of total production and gross value added to factor cost) and total employment in the regions by industries.

The productive capital factor data also came from the Fundación BBVA (2002), specifically their publication El Stock de Capital en España y su Distribución Territorial (1964-2000). Data on land productive factors were obtained from the statistical service of the Ministry of Agriculture (Anuario de Estadística del Ministerio de Medio Ambiente y Medio Rural y Marino, 1965-1995) and correspond to productive land area.

The productive manufacturing industries in the sample are the following: Food, Beverages and Tobacco (1), Transport Equipment (2), Basic Metals (3), Paper, Publishing and Printing (4), Plastics, Rubber, Wood, Cork and Furniture (5), Non-Metallic Mineral products (6), Metal Products and Machinery (7), Chemical Products (8) and Textile, Leather and Footwear (9).

The total sample comprises a panel of 2448 observations, as there is information on 17 autonomous regions, 9 productive manufacturing activities and 16 years (odd years from 1965 to 1995). The description of our data summarised in figure 1.1 suggests to us that an amplified average in output might be found in the industries Food, beverages and tobacco (1), Transport equipment (2), Plastics, robber, wood, cork and furniture (5), non-metallic mineral products (6) or metal products and machinery (7), on average and for the whole period.

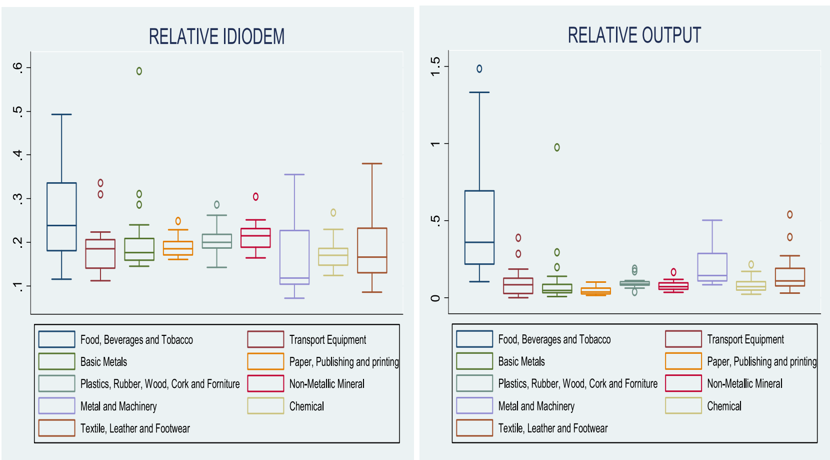

Figure 1.1: Data description

1.5 Empirical estimation and results on the existence of HME

Empirical estimation of (1.6) presents a problem of simultaneity, which was confirmed by the specification test of Hausman (1976). In this case the set of instruments which allow us to correct endogeneity considers factor endowments: the contemporary K/L (capital-labour) and K/T (capital-land) ratios[5]. Also, as we consider data with a geographical component, the possible presence of spatial autocorrelation has been tested. The pertinent contrasts, I by Moran (1950) and C by Geary (1954), at a 5% significance level, inequivocally show the absence of spatial autocorrelation in the variables used in this work.

In the first phase the equation (1.6) was estimated industry by industry, giving an initial approximation of the importance of the HME. However, estimations industry by industry do not take into account the interdependence which can exist between the different equations, given that, although in logarithms and with logistical transformation, the dependent variables are expressed as proportions of one total production. Therefore, it makes sense to consider the joint estimation of the system of equations, combining the panel data technique with instrumental variables and SURE (3SLS-PANEL). This allows us to obtain a more efficient estimation and an additional contrast of the existence of HME. The same instruments have been chosen as in the individual equations. The results, by industry or jointly, are identical and robust, so we present only the latter. Table 1.1 shows the results with the whole sample

[5]Both contemporaneous and one year lagged endowments have been considered, with similar results omitted here for shortness.

(first three numerical columns) and without outliers (last three columns). In both cases, as usual, time specific effects have been taken into account. As can be seen, the HME is present, with and without outliers, in the following industries: Transport Equipment (2), Plastics, Rubber, Wood, Cork and Furniture (5), Non-Metallic Mineral Products (6) and Metal Products and Machinery (7).

Table 1.1: EXISTENCE OF HME. 3SLS-PANEL

	PROPORTIONS			PROPORTIONS NO OUTLIERS		
	SHARE	IDIODEM		SHARE	IDIODEM	
1: Food. Beverages and Tobacco	0.07 (0.85)	0.28* (2.39)	R2 Adj= 0.91 Nobs= 272	0.19* (2.58)	0.06 (0.56)	R2 Adj= 0.99 Nobs= 257
2: Transport Equipment	-1.20 (-0.45)	3.75* (11.87)	R2 Adj= 0.24 Nobs= 272	0.71 (0.28)	4.23* (13.12)	R2 Adj= 0.29 Nobs= 272
3: Basic Metals	1.31* (19.95)	0.39* (4.01)	R2 Adj= 0.92 Nobs= 272	1.13* (17.16)	0.63* (6.60)	R2 Adj= 0.99 Nobs= 227
4: Paper. Publishing and Printing	0.87* (12.54)	0.39* (3.18)	R2 Adj= 0.90 Nobs= 272	0.94* (17.34)	0.26* (2.64)	R2 Adj= 0.90 Nobs= 272
5: Plastics. Rubber. Wood. Cork and Furniture	0.29 (0.69)	2.22* (35.60)	R2 Adj= 0.84 Nobs= 272	-7.52 (-0.67)	8.59* (3.07)	R2 Adj= 0.14 Nobs= 242
6: Non-Metallic Mineral products	1.19* (13.02)	2.62* (39.03)	R2 Adj= 0.91 Nobs= 272	1.27* (13.43)	2.65* (36.94)	R2 Adj= 0.91 Nobs= 272
7: Metal Products and Machinery	-6.47 (-0.73)	1.13* (10.84)	R2 Adj= 0.33 Nobs= 272	-5.58 (-0.70)	1.14* (12.01)	R2 Adj= 0.40 Nobs= 272
8: Chemical Products	13.01* (2.58)	0.08* (2.79)	R2 Adj= 0.05 Nobs= 272	27.87* (2.54)	0.75* (6.32)	R2 Adj= 0.57 Nobs= 257
9: Textile. Leather and Footwear	1.09* (25.22)	-0.52* (-7.63)	R2 Adj= 0.91 Nobs= 272	1.09* (24.88)	-0.53* (-7.44)	R2 Adj= 0.90 Nobs= 272

Note. The t-statistics are in parentheses. *Indicates significance level of 5%. All estimations include individual and time specific effects and contemporaneous endowments as instruments. The results are robust using lagged instruments.

The application of the specified model to Spanish manufacturing takes the period 1965-1995 (odd years only) as reference. The conclusions obtained reflect the changes and impulses which arose starting with the 1960s, with the opening up of the Spanish economy to the outside world, the stabilisation plan of 1959 and greater flexibility in its internal markets. These were the boom years of the '60s, and later, integration into and catching up with Europe.

In the decade of the 1960s there was a very marked specialization of Spanish manufacturing industries in traditional activities with internal demand and relatively low technological content, corresponding to industries 1, 3, 4, 6 and 9. This period marked the beginning of certain changes in interindustrial specialization, reducing the weight of the more labour intensive activities (industries 5 and 9) and producing an increase in capital-intensive industries, i.e., the more advanced or with higher demand and technological content (industries 7 and 8, which include office equipment and other machinery, electric materials and accessories and chemical products). Traditional activities still have greater weight, but less markedly, as the advanced industries have grown at a faster rate.

We have seen that HME exists in industries 2, 5, 6 and 7. Industry 7 has a higher percentage of gross added value than the others; moreover, it has become more important in production due to an increase in productivity levels, as is also the case with 6, despite being a traditional activity. Industry 5 produces intermediate and final products with intensive processes and strong increasing returns, these last being the most important determinants of location of economic activity in Spain between 1979 and 1992, according to Paluzie et al. (2001). Finally, industry 2 features economies of scale, making its size a relevant variable and making Spain one of the world's leading producers of motor vehicles.

This abundant evidence of HME since the 1960s contrasts with the scanty evidence obtained by Rosés (2003) for the period before 1910. His conclusions attribute the process of industrialisation exclusively to factor endowments (HO) and remark on the minor influence of HME in Spanish industry. Because of this, it appears that over time the mechanisms of agglomeration propounded by the NEG have acquired a certain relative importance. However, factor endowments have not necessarily lost their importance in industry location in Spain, but rather can coexist as determinants along with the importance of the internal market. The explicit analysis of the joint effect of factor endowments and demand elements is examined in the following section.

Finally, we should refer to the limitations of the results obtained so far. Principally, absorption of demand through gross value added to factor cost is approximate, due to the absence of data on intermediate consumption, imports and exports for our sample. Not allowing for intermediate demand, which represents a fundamental mechanism of agglomeration through backward and forward linkages, could be the reason that, for example, in industries such as textiles HME is never found, skewing the results, essentially because this industry is fed by intermediate consumption of other industrial activities.

1.6 Heckscher-Ohlin (HO) versus Home Market Effect (HME)

The fact that factor endowments are an essential determinant of output assures a potentially relevant role for neoclassical trade theory. Depending on the degree to which regions specialize in the more intensive factor-abundant industries, endowments are important elements when explaining industrial specialization.

Rosés (2003), investigating the impact of the HO model on production location in Spanish provinces of the 19th century, concludes that endowments account for nearly 85% of the variation in manufacturing output. At the same time, he emphasises that his estimations of the HO model do not necessarily reject an interpretation of differences in regional levels of industrialisation based on forces of Economic Geography. The development of a region does not depend solely on its own factor endowments, but also on the effects of market size, i.e., endowments alone may not be enough to explain the whole story. In this context, our specification is as follows, where the SHARE variable is replaced by regional factor endowments, combining directly the HO theory with the NEG in the determination of location patterns in Spanish manufactures:

$$log\left(\frac{\frac{X_g^{nc}}{X^{nc}}}{1-\frac{X_g^{nc}}{X^{nc}}}\right) = \beta_0^* + \beta_1^* log\left(\frac{IDIODEM}{X^{nc}}\right) + \beta_2^* log\left(\frac{K}{L}\right)_g^{nc}$$

$$+\beta_3^* log\left(\frac{K}{T}\right)_g^{nc} + \beta_g^{*nc} \tag{1.7}$$

The results of the estimation are very similar to those of equation (1.6) and corroborate the presence of HME in the same industries, and so in order to avoid repetitiveness they are not presented.

Consequently, the emphasis in this section is placed on very different aspects than in the last section. In the previous study we have tried to determine statistically if the mechanism reflected in the $IDIODEM$ variable has a qualitative impact on the pattern of production. Our objective now is to quantify the importance of HME as opposed to factor endowments (see Schumacher and Siliverstovs, 2006). To this end, we use the appropriate technique, that of β-coefficients, as proposed by Leamer (1984). For this, we use a statistic which permits investigation of which independent variables are more important in explaining movements in the dependent variable. In order to calculate this statistic we take Z as the matrix of observations for the independent variables and Z^M the same matrix with the entries of the variable(s) M equal to its sample average[6]. β^M is defined as follows:

$$\beta^M = \sqrt{\frac{\frac{1}{1-n}(\beta Z - \beta Z^M)'(\beta Z - \beta Z^M)}{\sigma_X^2}} \tag{1.8}$$

where n is the number of observations and σ_X^2 the variance of the dependent variable.

In other words, β^M explains how the standard deviation of the dependent variable can be explained by a movement of the standard deviation in the variable(s) M. The results of this calculation for the 9 productive industries appear in table 1.2.

The β-coefficients^{IDIODEM} indicate how a movement in the standard deviation of idiosyncratic demand modifies the standard deviation in production by a certain percentage. The β $^{\text{FACTOR ENDOWMENTS}}$ indicate how a movement in the standard deviation of factor endowments (measured by the K/L ratio) modifies the standard deviation in production by a certain percentage.

[6] M is the $IDIODEM$ variable or the factor endowments variables, grouped by the K/L ratio.

Table 1.2: β- LEAMER'S COEFFICIENTS		
	3SLS-PANEL	
	β^{IDIODEM}	$\beta^{\text{FACTOR ENDOWMENTS}}$
1: Food. Beverages and Tobacco	0.15	0.01
2: Transport Equipment	0.08	0.04
3: Basic Metals	0.04	0.30
4: Paper. Publishing and Printing	0.03	0.29
5: Plastics. Rubber. Wood. Cork and Furniture	0.91	0.07
6: Non-Metallic Mineral products	0.86	0.52
7: Metal Products and Machinery	0.94	0.27
8: Chemical Products	0.11	0.60
9: Textile. Leather and Footwear	0.26	0.27

See note table 1.

The results are again coincident. In four of the industries (industries 2, 5, 6 and 7), Economic Geography is more important for these industries at a regional level for two reasons: first, because HME appears in them and second, because it is proven that in these industries $\beta^{IDIODEM} > \beta^{\text{ FACTOR ENDOWMENTS}}$.

Regarding the weight of factor endowments (K/L ratio), we observe that in industries 3, 4, 8 and 9 this is the element with the most power of explanation, although in the last the differences are minimal. In industry 1, variation in production is more sensitive to internal demand than factor endowments, but not enough (see the section above) to present the HME. Definitively, the internal market mechanism plays a greater part than endowments in industries such as Transport Equipment (2), Plastics, Rubber, Wood, Cork and Furniture (5), Non-Metallic Mineral products (6) and Metal Products and Machinery (7), which also present evidence of HME, which is perfectly consistent. In other words, the results obtained in sections 5 and 6 can be seen to be systematic.

To conclude this analysis, we can affirm that there is evidence that both mechanisms, HO and HME, coexist and complement each other as explaining factors in production location.

1.7 HME dynamics

An additional relevant point for a better understanding of the HME phenomenon in Spanish regions is the analysis of its temporal dynamic during the period analysed. In this paper the existence of HME is contrasted for a relatively long period of 30 years. It indeed would make sense to consider how it has evolved over time. In this section we will attempt to contrast if there is a change in behaviour over time relating to HME. In order to do this we have repeated the analysis for two sub-periods: one at the beginning of the sample and the other at the end, eliminating the intermediate years, characterised by the instability of the periods of the two oil crises (1974-1984). The first sub-period (1965-1973) was a time of rapid increase in the per capita GDP and of convergence with the rest of Europe; years of accelerated industrial growth, an important opening up to external trade and foreign investment, great improvements in productivity and fast growing demand. The second period (1985-1995) is a time of integration in Europe after Spain joined the EU. Here there is a significant change in the rate of economic growth with a very similar evolution to that of the EU countries: greater capacity for generating employment, although with small improvements in productivity which did not help to correct the imbalances related to inflation and external debt. The intermediate years witnessed political transition, economic crisis, industrial reconversion and divergence from Europe in terms of per capita income.

Thus, the analysis has been repeated for each sub-period and the possible existence of of a significant change in the coefficient of the $IDIODEM$ variable, indicative of the existence of HME, has been contrasted. The estimation was carried out for the branches which present HME in the total period and as with this case with contemporary and retarded instruments.

Table 1.3 presents the $IDIODEM$ coefficient for the first and second subperiods and the t-statistics which contrast the significance of their difference, with contemporary instruments and 3SLS estimation with time specific effects.

Table 1.3: HME DYNAMICS. 3SLS-PANEL

	COEFFICIENTS OF IDIODEM (t-TEST)		
	INITIAL-COEFF (1965-73)	FINAL-COEFF (1985-95)	FINAL COEFF AGAINST INITIAL COEFF
1: Food. Beverages and Tobacco	2.02*	1.51*	11.89
2: Transport equipment	6.11*	3.19**	3.19
3: Basic Metals	2.88*	3.61*	-5.25
4: Paper. Publishing and Printing	-0.004	3.54*	-1.82
5: Plastics. Rubber. Wood. Cork and Furniture	2.17*	2.32*	-1.97
6: Non-Metallic Mineral products	2.68*	2.56*	0.98
7: Metal Products and Machinery	1.19*	1.16*	0.96
8: Chemical Products	2.61*	3.21*	-3.38
9: Textile. Leather and Footwear	-0.12**	2.42*	-41.76

See note table 1.

In our opinion, the conclusions which can be drawn from the table 1.3 are extremely interesting. First, eliminating the years of the energy crises makes the HME mechanism much more relevant. In fact, it not only appears in industries 2, 5, 6 and 7, which we already knew; it also appears for the first time in industries 1, 3, and 8, and in the second subperiod of industries 4 and 9. Here one might explore whether the HME is, to some extent, procyclical, given that it has greater importance in the positive phases of economic cycles. In other words, intense crises can make the weight of internal demand tend to diminish in a context of increasing scale returns and transport costs. What is obvious is that the perturbations of the crisis interfere with the HME mechanisms.

Second, the HME shows different intensities in both subperiods. It is stable over time in industries 6 and 7, diminishes in 1 and 2 and increases in the other five industries. This sectorial analysis demonstrates that the relevance of the HME tends to grow over time, although we believe this result needs further empirical evidence to corroborate it.

1.8 Conclusions

The purpose of the study was to identify empirically the existence of the Home Market Effect (HME) in Spanish manufactures, i.e., we have tried to analyse the presence and importance of these effects in the determination of production location in Spain. For this, we have used as a basis the theoretical models of Krugman (1980) and Weder (1995) and the successive empirical analyses of Davis and Weinstein (1996, 1999 and 2003).

The empirical test carried out for 17 regions and 9 industrial sectors from 1965 to 1995 lends support to the hypothesis of the existence of the Home Market Effect. This evidence exists in an important number of productive industries; specifically, HME is found in 4 of the 9: Transport Equipment (2), Plastics, Rubber, Wood, Cork and Furniture (5), Non-Metallic Mineral products (6), Metal Products and Machinery (7). We want to highlight that these results were obtained with a new specification proposed here, a more intuitive definition of HME as a mechanism of agglomeration of productive activity, which also presents conceptual advantages.

At the same time there is remarkable, wider evidence if the years of economic crisis are left out the analysis, together with the increasing HME over time. The widespread existence of HME in recent Spanish industry contrasts with earlier periods, such as the first industrial revolution, when Heckscher-Ohlin mechanisms predominated over the HME in our manufactures (Rosés 2003)[7]. This demonstrates that the cumulative factors proposed by the New Economic Geography have now become more relevant. This conclusion has been confirmed in the works of García-Pires (2006) and Paluzie et al. (2007), which also analyse the incidence of the NEG on the Spanish economic landscape.

Furthermore, we have found that factor endowments are still relevant in industrial location in Spain, being especially predominant in Basic Metals (3), Paper, Publishing and Printing (4), Chemical Products (8) and Textile, Leather and Footwear (9).

In any case, HO and the NEG coexist, in different intensities according to industry, as determinants of the industrial geography of Spain. This key result confirms all the empirical evidence accumulated to date on the HME. In the words of Head and Mayer (2004, p. 2641) "results are again mixed for the HME".

[7]Rosés (2003) does not deny the presence of Economic Geography effects in the period corresponding to the first industrial revolution in Spain, although he argues that elements of specialization as described in the H-0 theory had greater explanatory capacity in this phase of Spanish economic development.

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Chapter 2

External Economies as a Mechanism of Agglomeration in EU Manufacturing

2.1 Introduction

An essential reason for the geographic concentration of an industry is the existence of increasing returns in the individual production function, besides which, the Marshallian tradition of economic analysis has emphasised the positive effects of externalities on the productivity of companies. One type of externalities are known as economies of agglomeration, which mainly occur with expensive transport costs, and begin a trend towards grouping new companies in the nearest geographical area, leading to a self-reinforcing process of industrial localization (Hoover 1937; Weber 1929). Agglomeration is fuelled by geographical proximity and the flow of knowledge, so important spillovers should be expected between neighbouring regions. Definitively, externalities give rise to agglomeration processes whose mechanisms have obvious effects on industry productivity.

The purpose of this research is, indeed, to analyse the existence of productive externalities in industry and their effect on productivity as an agglomeration mechanism. The existing evidence is scarce and comes from studies at the regional level or focused on individual countries or industries. This work approaches an analysis desegregated by industrial activity and in the economic context of the EU, a contribution in itself. Indeed we hypothesize that, for a supranational region, both national and international externalities should be analysed simultaneously, because both have a role on productivity growth and omitting the international dimension of spillovers can skew the effect of the national one. Starting from the theoretical foundation which gathers pecuniary externalities in the production function, we also consider knowledge spillovers by means of what have been called external economies of specialization and of diversity within each country. And the main contribution in our analysis is to add the international dimension to the technological externalities between countries, which are introduced in two ways. On one hand, the international specialization of each country in each activity is a source of additional externalities, besides the commonly used national specialization. On the other, the peripherality of the country is considered, given that the effects of international externalities may be weaker on the activity of a distant country. Thus, this paper estimates a production function for each industry, using an international data panel, segregating countries, years and sectors, in order to determine the impact of national and international externalities and of geography on productivity growth in every industry in the EU.

Perhaps a central country, which supports low transport costs and enjoys a diversified international economic environment, can become specialized in some industry; but a country more or less isolated on the periphery needs to have a dynamic and diversified industry to get a higher productivity growth. And we might not see its relevance unless we consider this country in a wider economic context.

The paper is structured as follows: first, the basic theoretical foundations of externalities in production are reviewed, as are recent studies which have investigated the relationship between externalities, economies of agglomeration and productivity. Second, we propose an empirical model of productivity growth with national and international externalities which will be tested for the EU countries and industries. Third, the results obtained are discussed and are followed by a discussion about the appropriate nature of supranational regions for this analysis; finally, we sum up the conclusions derived from the analysis.

2.2 External economies in production: theoretical foundations and empirical evidence

From the origins of the literature on externalities in production, in the contribution of Marshall (1923), different typologies have been formulated and connections established with the New Economic Geography and Regional and Urban Economics[1]. Essentially, spatial concentration of economic activity can create advantages in production through two main channels. First, the existence of agglomerations of companies favours the establishment of other com-

[1]For an exhaustive review, see Rosenthal and Strange (2004) or Duranton and Puga (2004).

plementary activities supplying specialized inputs, goods and services for each sector, generating forward and backward interindustry linkages. And second, the flow of technological information related to specific knowledge which is shared by the companies within a sector and enables a cumulative process of improvement in production, called intraindustry knowledge spillovers. Later, Scitovsky (1954) described the former type as pecuniary and the latter as technological; and Regional and Urban Economics stresses the static nature of the pecuniary ones, and the dynamic externalities related to the diffusion of knowledge and its influence on the growth of an activity.

The different typologies of dynamic and external effects may be theoretically satisfactory but turn out to be highly ambiguous in practice, as the size and growth of an activity are closely related, and are at once cause and effect of a single phenomenon. Their endogenous nature is highlighted in the concept of economies of agglomeration in the New Economic Geography, according to which there is a trade-off between two opposing forces – externalities against transaction costs such as transport cost or economic peripherality - which act on economic productivity and begin a cumulative process between productivity and agglomeration.

There is mixed evidence in the literature on the part played by externalities and by geography in productivity, with pronounced heterogeneity in the analysed countries or sectors. Most studies related to Regional and Urban Economics highlight how productivity increases with the size of the industry itself (economies of localization, outside the company but within the industry) or with the size of the region (economies of urbanisation, outside the company and the industry, but within the region). Nakamura (1985) proves how the larger industries in Japan receive more productive advantages from economies of localization, while small industry benefits especially from economies of urbanisation. We can also mention Moomaw (1998) for the USA and Dogan (2001) for Turkey, remarking on the importance of economies of urbanisation. Finally, in other works like Lall et al. (2004), even including infrastructures facilitating access to markets in India, market size of the region does not appear to play a significant part.

Some authors go further and attempt to identify the relationship that exists between economies of agglomeration, the type of industries that become localized and the characteristics of the regions where they do so. Thus, Feser (2001) and Henderson (1986) identify high technology industries as those that present the most intense economies of localization in the USA. Henderson (1986, 1997 and 2003) underlines the strong correlation between these economies of localization and specialization instead of diversity in the regions where they localize.

The same result is emphasised by De Lucio et al. (2002) in their analysis of productivity growth by sector and Spanish province, following Martin and Ottaviano (1996), obtaining evidence of technological spillovers when there is a high degree of specialization. Also, Partridge and Rickman (1999) find that, in the industrial sector for the US states, specialization more than diversification yields a higher labour productivity growth. Serrano (2000) gives an interpretation when analyses the impact of external technological externalities in the Spanish regions for agriculture, energy, industry and services: diversity increases the differential in regional productivity growth and a maturing period is required to make the externalities evident, while specialization economies have a notably positive contemporaneous impact. Only Glaeser et al. (1992) finds that the impact of diversification is much larger, and he associates larger industries to larger regions; but in all papers there is general evidence of the effect of interindustry externalities on productivity growth.

To sum up, the evidence in existing literature reveals the significant importance of the size of the industry itself on economic productivity, as well as the specialization or diversification of a region, aspects linked in turn with technological spillovers, and which we consider to be of central relevance in our own analysis. A main hypothesis in our paper is that these externalities, usually restricted to the regional level within a country, can be found as a mechanism of agglomeration also at the international level, and this is more evident when the international dimension of externalities is also considered.

In an international context, considering countries as regions, mainly interindustry pecuniary spillovers have been studied. In this line, Caballero and Lyons (1990, 1992) obtain significant evidence of national and international pecuniary externalities on productivity in four EU countries, both sectoral and aggregated. Henriksen et al. (2001) carry out a similar analysis to that of Caballero and Lyons also in four EU countries, but they add externalities between clusters, interindustry national and international intraindustry externalities; the high technology cluster shows more national externalities and the international ones are evident in transport. Following Henriksen et al. (2001), Midelfart-Knarvik and Steen (2002) analyse the Norwegian maritime sector using a production function with the size and growth of the supply sectors as a proxy of externalities towards the maritime cluster, obtaining evidence that vertical links reinforce agglomeration. In the same way, we also include theses interindustry externalities in our international analysis. In Puga (2009) we can see a review about the evidence, magnitude and causes of agglomeration economies where externalities play a major role.

Finally, the geographical dimension of technological externalities is introduced in a group of studies, mainly Smith (1999), Graham (2000), Ciccone (2002), Feser (2002), Davis and Weinstein (2003), Cohen and Paul (2005) and Amiti and Cameron (2007). This literature emphasises that proximity is important for the flow of know-how, so that we should expect knowledge spillovers are particularly important for countries in a central geographical position.

Graham (2000) identifies spatial externalities by employment density between regions in UK but the results do not show a significant influence on variation in productivity. Evidence from spatial externalities is found by Ciccone (2002) for the European regions (NUTS 3) using production density, but there is no evidence for countries. For the US economy, Smith (1999) confirms the interindustry and inter-state spillovers. Moreover, Cohen and Paul (2005), for the US and food processing industry, find costs economies from production density in own and neighbour regions; again these economies are lower at the State wider level.

Feser (2002) obtains evidence of the importance of the geographical component via the inclusion of distance which considers three possible sources of externalities: the possible supply of intermediate inputs, approximating the distance to supply regions; the availability of specialized labour, which measures access to a specialized labour market; and the total spending on research carried out by the universities, which approximates knowledge externalities.

Amiti and Cameron (2007) use information on the location of input suppliers in Indonesia to show that the benefits of proximity to suppliers and their relationship with distance. They measure the effect of technology spillovers by proximity to other firms in the same industry in every district, distance adjusted. The more firms in close proximity with related technology, the more likely is that firms can learn from each other.

Davis and Weinstein (2003) analyse the potential market impact on Japanese regions, together with cost and demand linkages and the existence of intraindustry and international externalities, although distance is not a determinant in this case. Thus, given a definition of region or country, distance considered by some indicator of economic activity is considered a good instrument for analysing the impact of geography in the relationship between externalities and productivity, and so we will use the same focus in our analysis.

In conclusion, De Groot, Henri L. F; Poot, Jacques; Smit, Martijn J. (2009) collect a theoretical perspectives on agglomeration externalities and growth and a short review of recent empirical literature on agglomeration and growth. The chapter evaluates the statistical robustness of evidence for externalities presented in 31 scientific articles, all building on the seminal work of Glaeser et al. (1992).

2.3 An empirical model on productivity growth with national and international externalities

The base of our analysis takes as its starting point the production function, in line with the work of Midelfart-Knarvik and Steen (2002), Serrano (2000) or De Lucio et al. (2002). Together with factor endowments, we include the sources of externalities indicated in the previous section, with special emphasis on technological externalities, besides introducing the effect of economic geography. Starting with the premise that agglomeration affects the total productivity of the factors and that this in its turn affects output, we will analyse the existence of externalities on the growth rate of labour productivity by sectors. Among the externalities which we consider in the production function, we first take into account the national ones, where we distinguish between those coming from other industries – interindustry – and those within the industry itself; then we add to the analysis the effect of international externalities.

If we consider a production function of the Cobb Douglas type:

$$Q_{i,c} = A_{i,c} K_{i,c}^{\alpha} L_{i,c}^{1-\alpha} \tag{2.1}$$

where $Q_{i,c}$ is the gross value added at market prices, K is the gross capital stock, L is employment, α measures the degree of scale returns, c is the country and i the productive sector.

We use the same equation in relative terms, and thus obtain an expression of the productivity of labour,

$$\left(\frac{Q}{L}\right)_{i,c} = A_{i,c} \left(\frac{K}{L}\right)_{i,c}^{\alpha} \tag{2.2}$$

Taking differences in logarithms,

$$log\left(\frac{Q}{L}\right)_{i,c} = logA_{i,c} + \alpha log\left(\frac{K}{L}\right)_{i,c} \tag{2.3}$$

Given that we are interested in looking for the effects of dynamic externalities in the productivity growth rate, we take equation (3) in growth rates,

$$\Delta log\left(\frac{Q}{L}\right)_{i,c} = \Delta logA_{i,c} + \alpha \Delta log\left(\frac{K}{L}\right)_{i,c} \tag{2.4}$$

which is equivalent to

$$g_{PvLi,c} = g_{TFPi,c} + \alpha g_{\left(\frac{K}{L}\right)_{i,c}} \tag{2.5}$$

Thus we have the labour productivity growth rate ($g_{PvLi,c}$) on the left of the equation, measured as gross value added (VA) per worker, and on the right the total factor productivity growth rate and the growth rate of their use, respectively. So, $g_{\left(\frac{K}{L}\right)_{i,c}}$ is the relative factor endowment growth rate measured by the capital/labour ratio. The urban and regional areas of greatest economic size have a greater ratio which in turn is associated with higher levels of technology and human resources. Thus, there is both a spatial and a sectoral association between factor endowments and productivity. Therefore, we expect the coefficient associated with this variable to have a positive value.

Externalities have an effect on the use of productive factors, which means an impact on the total productivity of the factors and thus on output and labour productivity. For this reason we suppose that this productivity depends on technological externalities, both interindustry and intraindustry, national or international.

$$TFP_{i,c} = f(\tilde{q}_{j,c}, S_{i,c}, D_{i,c}, E_{i,c}) \tag{2.6}$$

where $\tilde{q}_{j,c}$ approximates national interindustry externalities;

$S_{i,c}$ approximates the national intraindustry externalities derived from specialization of activity in sector i;

$D_{i,c}$ approximates the national interindustry externalities, in this case due to the productive diversification of the country;

$E_{i,c}$ approximates the international intraindustry externalities;

We go on to explain how each of these variables is measured, and according to theory, the hypothesis on its behaviour.

$\tilde{q}_{j,c}$ is the output variation of country c in all sectors j different to i within the country, and we expect a positive impact on productivity. This behaviour is due to the economies that can be obtained in large scale production. Increases in the size of markets permit greater specialization which is reflected in productivity increases, while a growth of the supply market reduces production costs.

$$\tilde{q}_{j,c} = \sum_{j \neq i} q_{j,c}$$

Another two dimensions of national externalities are economies of specialization of intraindustry activity ($S_{i,c}$), and interindustry economies of diversification ($D_{i,c}$). The concentration of the country in activity i can be measured via the Herfindhal index of the proportions of each activity in the country as a whole; we opt to use the VA as a measurement of activity and proxy of innovation processes, given that we cannot distinguish which is the activity which concentrates the VA of a country, and we are interested in approximating the effects of specialization on this activity with an interaction of this coefficient with the production level itself. Thus a high value of this interaction approximates the specialization of VA in activity i and will be an indicator of national intraindustry externalities, which is reflected in productivity increases.

$$S_{i,c} = q_{i,c} \sum_{i} (VA_{i,c}/VA_c)^2$$

We also considered distinguishing impact from other sectors using an interaction of the coefficient with production in other industries. However this has been excluded from the analysis because we could not identify the sector

where the externality comes from, and in the case of a sector-by-sector interaction the degrees of freedom are enormously reduced.
A practicable alternative is to include the influence of the rest of the sectors by the diversification of industries in the country. The index of diversity $D_{i,c}$ in the country c excludes activity i from the above concentration coefficient, so we can know if the variety of other production in the country has an influence on activity i.

$$D_{i,c} = \sum_{j \neq i} (VA_{j,c}/VA_c)^2$$

A lower value of this index is the result of the variety of activities and a more homogenous distribution of the country's production; a greater value indicates production concentration in one of the remaining activities and perhaps less diversification. The literature supposes that greater diversification generates more productivity, as suppliers and clients are plentiful in the region, empowering interindustry linkages; thus, we expect the coefficient assigned to this variable to be negative.

The international intraindustry externalities are measured by the index of specialization of country c in activity i:

$$E_{i,c} = \frac{\left(\frac{VA_{i,c}}{VA_c}\right)}{\left(\frac{VA_{i,EU}}{VA_{EU}}\right)}$$

calculated in terms of VA in country c in the ith sector. With this variable we measure the relative size of the sector in the country compared to the average of all the EU countries, or, along similar lines, the international localization of a given sector. It is supposed that a bigger sector in the country, or in other words a more specialized country, can attract new resources while increasing productivity in the existing ones. This is an additional agglomeration mechanism which feeds back to specialization and productivity growth. As such, we expect this variable to be positive.

Once the variables which approximate the externalities are defined, assuming that the total productivity growth of the factors is a multiplying function of them, we consider, as an additional international element, that geography will colour this effect, so that more distant regions will receive a smaller effect from the same externality than more central regions. A common way to monitor the effect of geography is to include an index of peripherality (G_c) of the country receiving the externality, which weighs the distance to each country against its economic importance, and which we expect a negative value for,

$$G_c = \frac{\sum_{k \neq c} d_{c,k} * DP_k}{N - 1}$$

where $d_{c,k}$ is the bilateral distance between two countries c and k, DP_k is the gross interior product and N is the total of countries in the sample.

Taking into account that each variable defined takes a different value each year t and that there is an error term for each observation $u_{i,c,t}$, we suggest an empirical model of labour productivity growth as follows,

$$g_{PvLi,c,t} = \alpha g_{\left(\frac{K}{L}\right)i,c,t} + \beta_{\tilde{q}} g_{\tilde{q}_{j,c,t}} + \beta_S g_{S_{i,c,t}} + \beta_D g_{D_{i,c,t}} + \beta_E g_{E_{i,c,t}} + \beta_G G_{i,c,t} + u_{i,c,t} \tag{2.7}$$

The next sections estimate this model for the EU countries and explain the results, first stressing the effect on productivity growth of national and international externalities by industry, and then discussing the significant evidence of technological spillovers, in particular for supranational regions.

The statistics have come from EUROSTAT for the principal aggregates of National Annual Accounts in millions of Euros, such as Gross Value Added to basic prices, Gross Interior Product at market prices, Intermediate Consumption and Employment. The Gross Capital Stock has been obtained from the OECD STAN Structural Analysis Database 2005 Edition and the distance to large circles came from Jon Haveman's website[2] . All these data are available in the EU[3] annually from 1995 to 2002 and for 13 industries, forming a total sample of 1248 observations. According to the Statistical Classification of Economic Activities (NACE) in Rev.1.1., our industries are: (1) Food products, beverages and tobacco; (2) textiles and textile products; (3) leather and leather products; (4) wood and wood products; (5) pulp, paper and paper products; publishing and printing; (6) coke, refined petroleum products and nuclear fuel; (7) chemicals, chemical products and man-made fibres; (8) rubber and plastic products; (9) other non-metallic mineral products; (10) basic metals and fabricated metal products; (11) machinery and equipment (12); electrical and optical equipment; and (13) transport equipment.

Figure 2.1 shows the descriptive boxplots of productivity growth and externalities variations along time, in average and by industry. National interindustry externalities (other sectors' output) have a similar dispersion pattern across countries, lightly skewed towards medium-low values; the exceptions are coke, refined petroleum, nuclear fuel (6), with lower dynamism in other national sectors, and electrical and optical equipment (12), with less dispersion and tending towards more dynamism. The speed of national intrain-

[2] See http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/Data/Gravity/dist.txt

[3] The widest sample available is that of Austria, Belgium, Germany, Denmark, Spain, Finland, France, Greece, Italy, the Netherlands, Portugal and Sweden.

dustry externalities (specialization) is the most heterogeneous externality and dispersed across countries, with always some outliers with low specialization; specialization is higher in coke, refined petroleum, nuclear fuel (6) and lower in textiles and its products (2), and the more sophisticated industries seem to experience a faster specialization. National interindustry externalities (diversification) present moderate variation rates, although some sectors enjoy an increasing diversification, while others are characterized by the opposite, and there are always countries at the extremes[4]; electrical and optical equipment (12) stands out because of the associated dispersion in industrial diversification. Finally, international intraindustry externalities (specialization) show the slowest changes and less dispersion. Most industries share similar and moderate rates of agglomeration, with some tendency towards faster variations; in particular, the fastest agglomeration occurs in electrical and optical equipment (12), transport equipment (13) and especially in coke, refined petroleum, nuclear fuel (6), where national specialization leads to international agglomeration. Finally, productivity growth is more dispersed in leather products (3), refined petroleum (6), electrical and optical equipment (12) and transport equipment (13), where a small number of countries show faster growth; its profile is striking, similar to that of national and international specialization.

[4]Sweden and Finland experience faster concentration in other industries and Greece a faster diversification. Greece also shows a slower – even negative – national intraindustry externality.

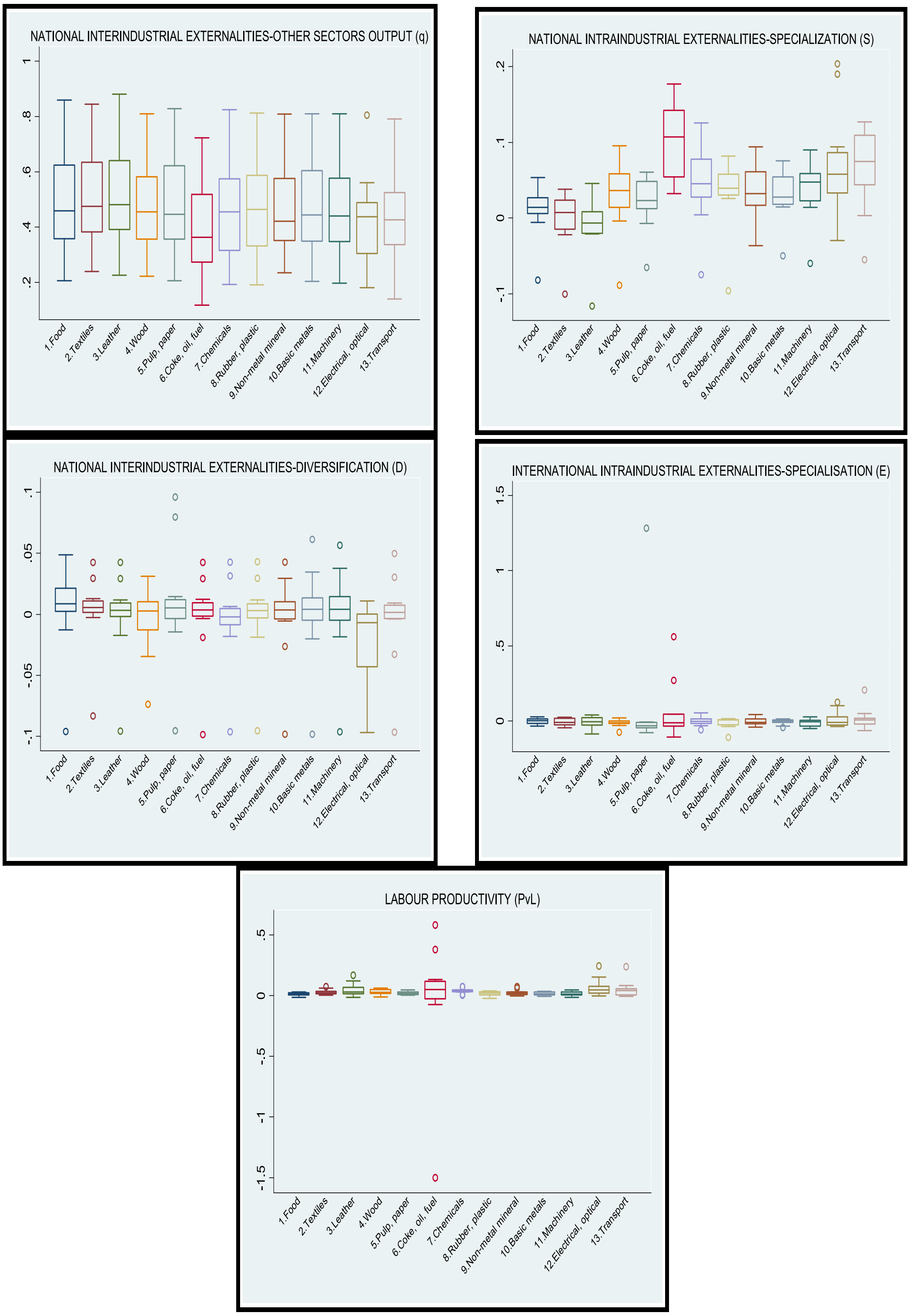

Figure 2.1: Externalities and labour productivity by industry. Growth rates

2.4 Empirical estimation and results for the EU countries

The estimation of our model has been carried out sequentially, considering first variables of national character such as factor endowments and national externalities, both inter and intraindustry, and then introducing international externalities and the effect of geography. In each stage of the sequence, panel data estimation by industry tests the absence of correlation between the explicative variables and the error term; in most sectors the rejection of this hypothesis allows us to assume the existence of fixed effects and mainly, in a small sample such as ours, obtaining some unbiased estimators and the control of any possible omitted and time invariant variables. However, the estimation of the equation (2.7) can present a problem of endogeneity because of using the VA both in the endogenous variable and in some explicatives, and the growth of the VA by employee can determine the agglomeration of the activity reflected in concentration, diversification and specialization indices. Moreover, agglomeration is an endogenous phenomenon itself, so that endogeneity by industry has been contrasted by Hausman's test (1976). Arellano and Bond (1991) recommend the use of their Generalized Method of Moments (GMM) when the model includes endogenous or predetermined variables; this method works in differences to prevent the fixed effects and other regressors to be correlated with the residuals. But with finite samples, as it is our case, there is a problem of identification and difference-GMM yields downwards biased standard errors and inefficient estimators. To solve this, Blundell and Bond's (1998) GMM system and the Windmeijer (2005) correction for small samples are recommended; this method is used in those industries where we find evidence of endogeneity.

In the next paragraphs, we first explain the sequence of estimations and the effects on productivity growth of national externalities, then the changes when the international externalities are introduced jointly with the national ones, and we finish this section with a discussion of the differences we might expect from an international sample which is not economically integrated in a supranational region.

2.4.1 National externalities and productivity growth

The relevant equation is now:

$$g_{PvLi,c,t} = \alpha g_{\left(\frac{K}{L}\right)i,c,t} + \beta_{\tilde{q}} g_{\tilde{q}_{j,c,t}} + \beta_S g_{S_{i,c,t}} + \beta_D g_{D_{i,c,t}} + \epsilon_{i,c,t} \tag{2.8}$$

The summary table (table 2.1) synthesises the variables which turn out to be significant in each case and the value of the coefficients obtained. The details of the complete estimation and the relevant statistics are in the Appendix (tables 2.A1 and 2.A2).

Table 2.1. Summary of significant variables and coefficients.
Dependent variable: labour productivity growth rate (1995-2002)

Variables[a] / **Industries**	Endowments and National Externalities				Endowments, National Externalities, International Externalities and Geography					
	$g_{(K/L)_{i,c}}$	$g_{\tilde{q}_{j,c}}$	$g_{S_{i,c}}$	$g_{D_{i,c}}$	$g_{(K/L)_{i,c}}$	$g_{\tilde{q}_{j,c}}$	$g_{S_{i,c}}$	$g_{D_{i,c}}$	$g_{E_{i,c}}$	G_c
1 Food products; beverages and tobacco	0.42		0.46	-0.77	0.40	-0.02			0.79	0.53^{-10}
2 Textiles and textile products	1.14		1.16	-1.20	0.71		0.34		1.04	-0.44^{-09}
3 Leather and leather products	1.01		0.65	-0.97	1.05	0.01	0.28		0.74	-0.35^{-09}
4 Wood and wood products	0.52	-0.03	0.69		0.84	0.03	0.34	-0.22	0.93	-0.33^{-09}
5 Pulp, paper; publishing, printing	0.64		0.63	-0.30	0.76		0.60			-0.29^{-09}
6 Coke, refined petroleum, nuclear fuel					0.59	0.31			0.98	
7 Chemicals, and man-made fibres	0.47	-0.03	0.68	-0.99	0.67	-0.03	0.35		0.83	-0.20^{-09}
8 Rubber and plastic products	0.93		0.61	-0.51	0.89		0.26			
9 Other non-metallic mineral products	0.58		0.56		0.78			0.53	0.86	
10 Basic metals and metal products	1.14	-0.02	0.67	-0.83	1.14	-0.02	0.58	-0.52	0.35	
11 Machinery and equipment	1.15			-0.65	1.10	0.02	0.58	-0.62	0.56	0.32^{-09}
12 Electrical and optical equipment	1.01		0.47	-1.19	1.36		0.31	-0.76		-0.78^{-09}
13 Transport equipment			0.40	-1.26			0.31	-1.01	0.46	

[a] $S_{i,c} = q_{i,c} \sum_i \left(VA_{i,c} / VA_c \right)^2$; $D_{i,c} = \sum_{j \neq i} \left(VA_{j,c} / VA_c \right)^2$; $E_{i,c} = \dfrac{VA_{i,c} / VA_c}{VA_{i,EU} / VA_{EU}}$; $G_c = \dfrac{\sum_{k \neq c} d_{c,k} \; DP_k}{N-1}$

The results confirm the relevance of factor endowments in practically all sectors and of national externalities of specialization and diversification, which highlights the importance of growth of national localization of industrial activity. In all cases the signs obtained are as expected, and we can affirm that a greater endowment of capital per worker has a positive influence on productivity growth; the same effect is deduced from the growth of concentration of activity within the country and the growth of its diversification in the supply and client sectors. Only in the transport equipment industry (13) do we find that endowment factors are not relevant, but externalities are; this may indicate that the mechanisms of agglomeration and interindustry linkages propounded by the New Economic Geography play a very important part in this sector. At the same time it is noticeable that neither endowment factors nor national externalities are relevant in coke, refined petroleum products and nuclear fuel (6), logically enough if we think of our dependence on the exterior regarding these products, which leads us to think that international externalities will have more influence.

The growth of concentration or national specialization contributes to the growth of productivity in all sectors – except, as mentioned, petrol refinery (6), and also machinery and equipment (11) – and is usually accompanied by a significant diversification of suppliers and clients within the country ($D_{i,c}$). Diversification in other industries contributes to productivity growth in all activities but wood and its products (4), coke and petroleum products and nuclear fuel (6) and other non-metallic mineral products (9). And interindustry linkages are only relevant for wood and its products (4), chemicals (7) and basic metals and fabricated metal products (10); the striking thing is that this effect is negative, against the hypothesis, indicating perhaps the sensitivity of these sectors to imbalances in their interindustry relationships.

2.4.2 Joint effect on productivity growth of national and international externalities

The second column in table 2.1 and table 2.A2 of the Appendix shows the effect of factor endowments and externalities, adding the international dimension of externalities ($E_{i,c}$) as well as the effect of the peripherality of the country (G_c) on the growth of productivity of each sector, shown in equation (1.7). Again, the evidence of the relevance of the abundance of capital is robust and agrees with the literature (Feser, 2002, for example), with a positive and significant effect in all sectors except transport equipment (13).

International specialization ($E_{i,c}$), is highly significant in almost all industries, and it is usually accompanied by national sectoral specialization ($S_{i,c}$); this would mean that, when countries are taken as regions in a supranational context, the fact that an industry concentrates activity in one country may give place also to international location or agglomeration. The exceptions are the paper and printing sector (5), rubber and plastic (8) and electrical and optical equipment (12), where national specialization is significant but international location is not, so that national specialization does not imply the same at the supranational level. Also, international agglomeration is significant for food products, beverages and tobacco (1), other non-metal and mineral products (9) or coke, refined petroleum products and nuclear fuel (6), but these industries do not need a simultaneous national specialization; and, interestingly, in machinery and other equipment (11), where sectoral concentration tends to be significant when international location is taken into account.

Peripherality is significant in all industries but coke, refined petroleum products and nuclear fuel (6), rubber and plastic (8), non-metallic minerals (9), metals (10) and transport (13). Regarding the sectors of coke, refined petroleum products and nuclear fuel (6), mineral products (9) and metals (10), the result is logical if we think that these sectors are tied to the existence of natural resources, so international specialization is tied to factor endowments. The transport sector (13) is so important in many countries that governments treat it as a barometer of the economy. For this reason, governments will pull out all the stops to attract new investment or give grants to vulnerable companies. Many developing countries have tried to provide themselves with, for example, a car manufacturing industry (motor vehicles have a higher exportation coefficient than the transport equipment manufacturing sector), with mixed results. Most of the world's car production is concentrated in only six countries: Japan, the USA, Germany, France, Spain and South Korea, followed by five more, the UK, Canada, Italy, Belgium and Brazil. Within those that correspond to our study sample, Spain and Italy are regarded as peripheral. Also, the rubber and plastics sector (8) depends largely on the car manufacturing sector and is closely tied to its progress. Generally, in all these activities the importance of national and/or international specialization is seen both in peripheral and in central countries, and thus geography is not an influence.

In the sectors of food products, beverages and tobacco (1) and machinery and equipment (11) the indication of geography is the opposite of what is expected. The former is a sector with interindustry diseconomies, is negatively influenced by the dynamism of other sectors, and benefits from international but not from national specialization, even before controlling its geographical position, i.e., it is important not at a national level but when compared with other countries. A descriptive analysis of this sector shows us its importance in countries such as Greece, Spain and Italy, countries where culturally the sector related to food may carry enormous weight despite being peripheral, which indicates that they could reasonably be benefited by their geographical position. The second is now remarkable for its externalities of national and international specialization and diversification. It is characterised by a highly qualified workforce and highly technological content where the diffusion of know-how plays a very important part. Competition is also very relevant, which in this case is not diminished by distance, as the sector has high activity in peripheral countries as well as in central ones. Perhaps de-localization, frequent in the internationalisation process of many large companies and most of all in specific high technology sectors, is playing an important part here.

But there is a very relevant result which, in our opinion, is a major contribution of this analysis: some of the national spillovers have weak evidence when the international dimension was not controlled (see column 1 in table 2.1); they do not show evidence or yield an unexpected result, such as finding that interindustry or diversity externalities might interrupt productivity growth. Indeed, when we dimension both the sample and externalities at the same time, by focusing on an international sample and also introducing international externalities in the estimation, the unexpected results at the national level tend to be consistent with the theory, at the same time that international spillovers have a robust effect on productivity growth. Two changes are worth highlighting: in an international context, national interindustry externalities become more significant and national diversification becomes less relevant.

Indeed, column 2 in table 2.1 shows that national interindustry externalities (other sectors output growth) are reinforced when international externalities are introduced in the analysis. Now, the dynamism of interindustry links presents robust evidence in activities like refined petroleum and nuclear fuel (6), leather and its products (3), wood and wood products (4), or machinery and other equipment (11), together with national specialization and international location in the last three ones. Apparently, the countries where these industries locate and agglomerate internationally take advantage also from a national specialization and do not need a dynamic and diversified economic structure in order to enjoy interindustry advantages[5]. But, when international agglomeration and peripherality are considered, the productivity growth increases if the industry is concentrated within countries and enjoys interindustry linkages with other dynamic activities, generating a higher value added. Only in food products, beverages and tobacco (1) the growth of other industries seems to be a break to its productivity growth; this evidence is also found in chemicals, chemical products and man-made fibres (7) and basic metals and fabricated metal products (10), but their linkages are not changed by the consideration of international externalities.

The other relevant change is that in a wider supranational context, national diversification loses its significance in low technology industries. It could happen that, for a country which agglomerates one activity and is in a central geographical location, the availability of a diversified economic structure and a wide supply of inputs is not important any more; perhaps this country can benefit from the proximity of other international suppliers.

To sum up, we may distinguish three groups of industries according to the effect of externalities on the growth of productivity, and stressing how the

[5] We have found a negative correlation between international specialization (E) and dynamism in other industries' growth ($\tilde{q}_{j,c}$).

effect can change when international spillovers – international specialization and geography - are taken into account for an international sample[6]. The first group is that with no effect of international externalities; here we find only rubber and plastic products (8), an industry where only national specialization is significant.

The second group is the biggest one, with mixed results, but where the common and very important feature is that the effect from national externalities is sensitive to the consideration of international spillovers, and these are usually significant. In such a way as to draw attention, national diversification loses significance to a great extent when jointly considered with international spillovers. Moreover, only for three industries, national specialization is no longer significant, but instead, international specialization is – these are food, beverages and tobacco (1), coke, refined petroleum and fuel (6) and other non-metal and mineral products (9). For the rest, national specialization maintains its relevance, together with international specialization, in both sides of table 1.1, with the exception of pulp, paper, printing and publishing (5), where international specialization is not significant.

Two industries can be highlighted in this second group because all determinants are significant, and these are wood and its products (4) and machinery and other equipment (11); in both of them the dynamism of other activities reveals significant when international externalities are introduced.

And finally, in the third group, three industries receive a positive effect of international externalities and of national specialization and diversification and, what specifically characterises this group, the effect from national

[6]In all industries but the transport sector (13) capital endowments per worker are important determinants of productivity growth.

spillovers does not change if we omit the international dimension; here we find basic metals and metal products (10), electrical and optical equipment (12) and transport equipment (13). These sectors have on average a higher technology level compared to the second group; so, apparently, the low technological industries seem to yield a more evident estimation bias from omitting the international externalities.

Definitively, technological externalities play a role also in the international context, and their omission can skew the effect on productivity growth of national spillovers. Our analysis finds robust and important evidence of specialization, more than diversification, which is in line with most of the literature, for example with De Lucio et al. (2002) and Henderson (2003). Some of these papers maintain that this is evident only in the regional context, where activity finds less friction to localization; but in this paper we find evidence for the national and international level. We would like to underline again the relevance of considering a geographical dimension of externalities which is accurate to the sample, and so, in an international context both national and international effects should be studied jointly.

Moreover, we also find evidence of interindustry externalities, in line with Midelfart-Knarvik and Steen (2002) and Caballero and Lyons (1990, 1992). But we would like to stress that this evidence is sensitive to their joint analysis with international intraindustry externalities when countries are considered as regions and, in some industries, their effect is underestimated when international spillovers are omitted. Also, our results are in line with those obtained by Henriksen et al. (2001), who find interindustry national externalities; mainly in high technology activities. We find this robust evidence also in the more sophisticated industries, such as basic metals and products (10), electrical and optical equipment (12) and transport equipment (13); in less technological industries they are also significant, but only when international agglomeration and peripherality are considered.

2.4.3 Economic integration and externalities as a mechanism of agglomeration

In our analysis we found evidence about the positive effect on productivity growth of interindustry externalities, technological spillovers like national specialization and diversification in an international context, and the relevance of international externalities and the advisability of considering them jointly with the national ones. For this experiment we took the widest homogeneous sample with available information, and this is the majority of EU countries in the studied period. This is a contribution to knowledge of the European case, but we also are conscious that our evidence might have benefited from the fact that the countries in our sample are all developed and geographically close. They also benefit from economic integration that maximizes the mobility of goods and factors and minimizes transaction and transport costs, so that they work as regions in a supranational area, and this is an ideal sample. In this section we ask what would happen with an international but more heterogeneous sample or, alternatively, how economic integration for developed countries can help externalities to work as a mechanism of agglomeration.

There is some literature that relates agglomeration patterns and growth differentials to economic development and geographical position[7]. For instance,

[7] For a survey of the theoretical and empirical literature about the relationship between knowledge spillovers and differentials in growth see Döring and Schnellenbach (2006).

Glaeser et al. (1992) and Fujita and Thisse (2002) explain that knowledge spillovers in agglomerations can be a source of sustained regional growth, and different agglomeration patterns imply different growth rates. Also Baldwin and Martin (2003) maintain that concentration exerts a different effect on central or peripheral regions. So there will be developed and central regions which agglomerate knowledge and technology intensive industries, and other peripheral less developed regions with production processes intensive in low tech and low skill labour and, because of the endogenous nature of agglomeration, this pattern fuels growth differentials and vice versa.

Unfortunately, we have information for estimating the effects of externalities only for another small international sample, which lacks endowment information and is a very heterogeneous sample of less developed countries[8]. We re-estimated our empirical model without endowments again for the EU countries and also for the non-EU sample, and sum up the results in table 2.2 (complete estimations are in the Appendix tables 2.A3 and 2.A4).

[8] Argentina, China, Costa Rica, Ecuador, Israel, Morocco, Russian Federation, Singapore and Tunisia.

Table 2.2 Summary of significant variables and coefficients.
Dependent variable: labour productivity growth rate (1995-2002)

Endowments, National Externalities, International Externalities and Geography

	EU					Non-EU[b]				
Variables[a] / Industries	$g_{\tilde{q}_{j,c}}$	$g_{S_{i,c}}$	$g_{D_{i,c}}$	$g_{E_{i,c}}$	G_c	$g_{\tilde{q}_{j,c}}$	$g_{S_{i,c}}$	$g_{D_{i,c}}$	$g_{E_{i,c}}$	G_c
1 Food products; beverages, tobacco		0.64	-0.67		3.29^{-11}	0.04	0.41	-0.25		
2 Textiles and textile products			-0.54	0.60	-0.32^{-09}					-8.80^{-17}
3 Leather and leather products		-0.59		0.59			1.27	-0.99	0.03	
4 Wood and wood products	0.04		-0.15	0.52	3.18^{-11}	0.17				
5 Pulp, paper; publishing, printing		0.48	-0.56				0.61	-0.78		
6 Coke, refined petroleum, nuclear fuel		-0.22	-0.73	1.17			0.82			
7 Chemicals, and man-made fibres	-0.02	0.49	-0.59	0.35	0.30^{-10}		1.57	-2.56		
8 Rubber and plastic products		0.44	-0.94	0.47		0.05	0.24			
9 Other non-metallic mineral products			-0.40	0.31		0.04	0.32	-0.51		
10 Basic metals and metal products		0.52	-0.60	0.19			0.91	-0.45		
11 Machinery and equipment		0.53	-0.80	0.30		0.03			0.32	
12 Electrical and optical equipment		0.41	-0.61	0.56			0.76			
13 Transport equipment	-0.03	0.38	-1.04	0.59						

[a] $S_{i,c} = q_{i,c} \sum_{i} \left(VA_{i,c} / VA_c \right)^2$; $D_{i,c} = \sum_{j \neq i} \left(VA_{j,c} / VA_c \right)^2$; $E_{i,c} = \dfrac{VA_{i,c} / VA_c}{VA_{i,EU} / VA_{EU}}$; $G_c = \dfrac{\sum_{k \neq c} d_{c,k} \; DP_k}{N-1}$

[b] Non-EU sample: Argentina, China, Costa Rica, Ecuador, Israel, Morocco, Russian Federation, Singapore and Tunisia.

At first glance, both table 2.2 show evidence that externalities are in general less significant for the less developed and non-integrated sample. In this case, most industries benefit from national specialization and, in some cases, together with diversification, such as food products (1), leather and its products (3), pulp, paper, printing and publishing (5), chemicals (7), other non-metal mineral products (9) and basic metals and products (10). In general, for the non-EU countries, only national externalities are significant, which is the main difference with the EU sample, where international specialization and a central geographical location are relevant[9].

But in this experiment we omit capital per worker because it is not available for non-EU countries, a determinant which was very significant for the EU sample, and is usually more important for less developed countries' specialization. Its omission for the EU sample tends to show a robust pattern for national specialization, a much more significant role of industry diversification, more significance with a habitual underestimation of interindustry linkages, only a little more significance of international agglomeration and much less significance of geographical position. So, assuming that changes follow a similar direction for non-EU countries, by controlling endowments we can expect that national specialization would be the same, geography would be more significant and we would lose evidence about the rest of externalities; perhaps, we might find more evidence about interindustry mechanisms for growth, because geography usually reinforces linkages in the EU sample for less sophisticated

[9] For the non-EU countries, international specialization is significant only for leather and its products (3) and machinery and other equipment (11), and geography is significant for textiles and their products (2). But this behaviour for these sectors is common for both EU and non-EU subsamples.

activities. The geographic dispersion of the non-European sample may have contributed to this result. Moreover, in the EU sample endowments were positively correlated with diversity, and negatively with international agglomeration and distance. So that, for the non-EU sample, with lower development levels and where capitalization is more important for productivity growth, we can expect a larger bias from endowments omission which means a bigger correction on the effects of externalities when capital per worker is controlled in the analysis: a much lower effect on productivity growth from diversity and a peripheral location besides a much higher benefit from international specialization and which is, in principle from our estimation, very weak. Because of all of this, in our opinion, significance in table 2.2 for the non-EU sample could be overestimated.

To sum up, for non-integrated and less developed countries, it is likely that endowments and national specialization have a leading role in productivity growth and, in the best of cases, interindustry linkages and distance. International agglomeration might increase its effect, but if this is overestimated for the non-EU sample and the two industries which benefits from it – leather (3) and machinery (11) – we do not think that international agglomeration is a relevant mechanism for less developed and non integrated countries. This evidence is in line with Glaeser et al. (1992) and Fujita and Thisse (2002), and we find different patterns of externalities as agglomeration forces for developed and non developed countries, and technological externalities work as agglomeration mechanisms in the national and international context mainly for developed and integrated countries. We would like to raise this hypothesis carefully, because the lack of endowments data and externalities for a wider sample of countries does not allow us to present a more robust test, which will have to wait for our future research.

2.5 Conclusions

The aim of this study was to analyse the existence of productive externalities in the manufacturing activity of European countries, desegregated by industry and for the period 1995-2002.

The evidence of our analysis suggest the advisability of dimensioning the externalities according to the sample, which means that with an international context and a sample of countries, both national and international externalities should be tested jointly. Moreover, we find evidence of significance not only for national interindustry linkages, but also for national specialization and diversification, something usually tested only for regions within a country; and the evidence also stresses the significance of international specialization and geographical location. Economic integration seems to be relevant so that the externalities act as mechanisms of agglomeration, with countries acting as regions in a supranational area where the mobility of goods and factors is maximized and transaction frictions minimized.

In our sample of EU countries, our analysis shows that, even with similar factor endowments and geographical proximity, productivity growth is encouraged in those industries with a higher capitalization and, with regard to externalities, national and international specialization are the most significant; also interindustry linkages and, in some cases, national diversification. Omitting international externalities causes a bias in the effect of national ones, because international externalities reinforce the significance of interindustry linkages and weaken the relevance of diversity within a country, at the same time that they reveal that international specialization and central location in a supranational integrated area are significant determinants of productivity growth and growth differentials between country members. Furthermore, lower technological industries are more sensitive to the omission of these international externalities. Thus, it would be beneficial to implement development policies which support sectors whose productivity is liable to benefit from the positive effects of national and international spillovers, which will result in greater economic growth.

In a nutshell, the leitmotiv of the chapter is that we provide evidence for the underestimation of national externalities if we omit international ones, which makes it necessary to consider an international sample. This underestimation is more intense in low technology industries and in groups of countries which could be classified as integrated.

2.6 Appendix: Detailed estimations

This Appendix shows the details of the complete estimation and the relevant statistics of table 2.1 (tables 2.A1 and 2.A2) and table 2.2 (tables 2.A3 and 2.A4).

Table 2.A1: Endowments and National Externalities

	$g(K/L)_{i,c}$	$g_{\tilde{q}_{j,c}}$	$g_{S_{i,c}}$	$g_{D_{i,c}}$	
1 Food products; beverages and tobacco	0.42* (1.88)	-0.0013 (-0.13)	0.46* (3.13)	-0.77* (-3.43)	R^2Aj= 0.28 F(6,32) = 1.66 Nobs= 43 CHISQ(2) = 3.05
2 Textiles and textile products	1.14* (4.41)	-0.03 (-1.59)	1.16* (4.22)	-1.20* (-3.28)	R^2Aj= 0.52 F(4,23) = 3.85 Nobs= 32 CHISQ(3) = 6.67
3 Leather and leather products	1.01* (16.11)	-0.01 (-0.84)	0.65* (4.49)	-0.97* (-2.40)	R^2Aj= 0.81 F(4,23) = 6.57 Nobs= 32 CHISQ(1) = 0.0022
4 Wood and wood products	0.52* (2.11)	-0.03** (-1.95)	0.69* (5.07)	0.13 (0.66)	R^2Aj= 0.32 F(5,29) = 0.48 Nobs= 39 CHISQ(3) = 0.74
5 Pulp, paper and paper products; publishing and printing	0.64* (4.78)	-0.02 (-1.52)	0.63* (5.33)	-0.30* (-2.25)	R^2Aj= 0.44 F(6,32) = 2.01 Nobs= 43 CHISQ(2) = 31.28
6 Coke, refined petroleum products and nuclear fuel	0.45 (0.40)	0.01 (0.05)	0.06 (0.14)	-5.14 (-0.97)	R^2Aj= -0.08 F(6,32) = 0.80 Nobs= 43 CHISQ(1) = 0.75
7 Chemicals, chemical products and man-made fibres	0.47* (2.59)	-0.03* (-3.30)	0.68* (7.58)	-0.99* (-4.43)	R^2Aj= 0.66 F(5,29) = 2.48 Nobs= 39 CHISQ(2) = 1.59
8 Rubber and plastic products	0.93* (5.08)	-0.01 (-0.97)	0.61* (4.99)	-0.51** (-1.71)	R^2Aj= 0.39 F(5,29) = 0.84 Nobs= 43 CHISQ(2) = 0.021
9 Other non-metallic mineral products	0.58* (4.54)	-0.01 (-1.39)	0.56* (4.29)	-0.41 (-1.36)	R^2Aj= 0.32 F(6,32) = 0.72 Nobs= 43 CHISQ(2) = 0.60
10 Basic metals and fabricated metal products	1.14* (7.53)	-0.02* (-3.20)	0.67* (8.15)	-0.83* (-5.14)	R^2Aj= 0.81 F(4,23) = 14.28 Nobs= 32 CHISQ(1) = 7.78
11 Machinery and equipment	1.15* (1.92)	0.01 (0.14)	0.74 (1.17)	-0.65* (-4.42)	Prob>CHISQ=0.26 F(4,7) = 62.94 Nobs= 43 p-H:CHISQ(1)=1.29
12 Electrical and optical equipment	1.01* (4.24)	0.001 (0.04)	0.47* (3.66)	-1.19* (-3.08)	R^2Aj= 0.77 F(6,32) = 3.41 Nobs= 28 CHISQ(3) = 7.98
13 Transport equipment	0.14 (0.58)	-0.003 (-0.19)	0.40* (2.50)	-1.26* (-3.40)	R^2Aj= 0.25 F(6,32) = 1.56 Nobs= 43 CHISQ(3) = 3.21

Note. t-statistics in parentheses. *5% significance level except **at 10%. CHISQ(n) Hausman test statistic. F () Statistic for homogeneity of individual effects hypothesis. p-H Hansen test of overidentifying restrictions, for those sectors which have presented endogeneity. Prob>CHISQ Hausman endogeneity statistic.

Table 2.A2: Endowments, National Externalities, International Externalities and Geography

	$g\left(K/L\right)_{i,c}$	$g_{\tilde{q}_{j,c}}$	$g_{S_{i,c}}$	$g_{D_{i,c}}$	$g_{E_{i,c}}$	G_c	
1 Food products; beverages and tobacco	0.40* (2.35)	-0.02* (-2.12)	0.05 (0.40)	0.32 (1.13)	0.79* (5.05)	0.53^{-10}* (2.50)	R^2Aj= 0.58 F(6,30) = 1.64 Nobs= 43 CHISQ(2) = 4.20
2 Textiles and textile products	0.71* (5.81)	-0.001 (-0.13)	0.34* (2.21)	0.26 (0.91)	1.04* (8.94)	-0.44^{-09}* (-3.67)	R^2Aj= 0.87 F(4,21) = 15.10 Nobs= 32 CHISQ(1) = 2.74
3 Leather and leather products	1.05* (32.89)	0.01** (1.78)	0.28* (4.83)	-0.07 (-0.37)	0.74* (10.18)	-0.35^{-09}* (-3.11)	R^2Aj= 0.97 F(4,21) = 15.65 Nobs= 32 CHISQ(1) = 15.28
4 Wood and wood products	0.84* (4.28)	0.03* (2.84)	0.34* (2.59)	-0.22* (-2.14)	0.93* (5.35)	-0.33^{-09}* (-2.20)	R^2Aj= 0.75 F(5,27) = 3.81 Nobs= 39 CHISQ(3) = 6.23
5 Pulp, paper; publishing, printing	0.76* (7.80)	-0.001 (-0.03)	0.60* (3.93)	-0.11 (-0.98)	0.21 (1.26)	-0.29^{-09}** (-1.85)	R^2Aj= 0.57 F(6,30) = 2.77 Nobs= 43 CHISQ(2) = 23.04
6 Coke, refined petroleum, nuclear fuel	0.59* (2.37)	0.31* (5.81)	-0.15 (-1.09)	-3.49 (-1.37)	0.98* (11.02)	-0.57^{-5} (-0.81)	Prob>CHISQ=0.8 F(6,7)=137.9 Nobs= 43 p-H:CHISQ(2)=0.41
7 Chemical products and man-made fibres	0.67* (4.47)	-0.03* (-2.95)	0.35* (3.60)	0.02 (0.08)	0.83* (6.14)	-0.20^{-09}** (-1.66)	R^2Aj= 0.87 F(5,27) = 4.74 Nobs= 39 CHISQ(3) = 6.81
8 Rubber and plastic products	0.89* (3.69)	-0.01 (-0.28)	0.26** (1.65)	0.30 (0.62)	0.69 (0.54)	-0.11^{-5} (-0.40)	Prob>CHISQ=1.00 F(6,6)=232 Nobs= 39 CHISQ(2) = 0.00
9 Other non-metal mineral products	0.78* (6.74)	0.01 (1.45)	0.18 (1.36)	0.53** (1.73)	0.86* (5.41)	0.14^{-10} (0.56)	R^2Aj= 0.57 F(6,30) = 1.81 Nobs= 43 p-H:CHISQ(2)=0.84
10 Basic metals and metal products	1.14* (7.05)	-0.02* (-3.03)	0.58* (5.23)	-0.52** (-1.88)	0.35** (1.68)	-0.48^{-10} (-0.58)	R^2Aj= 0.82 F(4,21) = 12.91 Nobs= 32 CHISQ(2) = 5.64
11 Machinery and equipment	1.10* (4.10)	0.02** (1.69)	0.58* (5.12)	-0.62* (-2.59)	0.56* (3.70)	0.32^{-09}* (2.10)	R^2Aj= 0.71 F(6,30) = 3.60 Nobs= 39 CHISQ(2) = 45.19
12 Electrical and optical equipment	1.36* (4.86)	0.03 (1.61)	0.31* (2.56)	-0.76* (-2.03)	0.38 (1.63)	-0.78^{-09}* (-2.62)	R^2Aj= 0.82 F(6,30) = 2.94 Nobs= 43 CHISQ(3) = 27.69
13 Transport equipment	0.29 (1.28)	-0.02 (-1.22)	0.31* (2.08)	-1.01* (-2.88)	0.46* (3.27)	0.45^{-10} (1.06)	R^2Aj= 0.39 F(6,30) = 1.56 Nobs= 43 CHISQ(3) = 1.25

Note. To see Table 2.A1.

Table 2.A3: EU: National Externalities, International Externalities and Geography

	$g_{\tilde{q}_{j,c}}$	$g_{S_{i,c}}$	$g_{D_{i,c}}$	$g_{E_{i,c}}$	G_c	
1 Food products; beverage and tobacco	-0.01 (-1.22)	0.64** (1.65)	-0.67* (-2.38)	0.12 (0.45)	3.29^{-11}* (3.61)	Prob>CHISQ=0.08 F(5,12)=3.97 Nobs= 76 p-H:CHISQ(2)=5.06
2 Textiles and textile products	0.005 (0.55)	0.12 (0.82)	-0.54* (-4.16)	0.60* (4.02)	-0.32^{-09}* (-2.46)	R^2Aj= 0.48 F(11,59) = 2.58 Nobs= 76 CHISQ(3) = 6.28
3 Leather and leather products	-0.01 (-0.49)	-0.59* (-2.26)	0.20 (0.55)	0.59* (2.65)	-0.24^{-10} (-0.26)	R^2Aj= 0.06 F(11,59) = 0.51 Nobs= 76 CHISQ(2) = 0.8^{-01}
4 Wood and wood products	0.04* (4.24)	-0.08 (-0.47)	-0.15** (-1.82)	0.52** (1.88)	3.18^{-11}* (3.98)	Prob>CHISQ=0.19 F(5,12)=11.1 Nobs= 74 p-H:CHISQ(4)=6.14
5 Pulp, paper; publishing, printing	0.14^{-02} (0.09)	0.48* (3.99)	-0.56* (-5.41)	0.09 (0.96)	0.28^{-10} (1.18)	R^2Aj= 0.27 F(11,59) = 2.13 Nobs= 76 CHISQ(3) = 4.41
6 Coke, refined petrol, nuclear fuel	0.33* (3.84)	-0.22* (-3.27)	-0.73* (-2.40)	1.17* (29.63)	-8.33^{-11} (-1.48)	Prob>CHISQ=0.5 F(5,11)=424.1 Nobs= 72 p-H:CHISQ(4)=3.35
7 Chemical products and man-made fibres	-0.02* (-2.39)	0.49* (5.00)	-0.59* (-5.97)	0.35* (3.14)	0.30^{-10}** (1.65)	R^2Aj= 0.53 F(11,59) = 1.17 Nobs=76 CHISQ(3) = 1.20
8 Rubber and plastic products	-0.02 (-1.20)	0.44** (1.92)	-0.94* (-2.45)	0.47* (3.06)	3.05^{-12} (0.14)	Prob>CHISQ=0.5 F(5,12)=13.39 Nobs= 76 p-H:CHISQ(4)=3.40
9 Other non-metal mineral products	-0.41 (-0.04)	0.25 (1.56)	-0.40* (-2.46)	0.31* (2.79)	0.17^{-10} (0.63)	R^2Aj= 0.18 F(11,59) = 0.96 Nobs= 76 CHISQ(2) = 0.66
10 Basic metals and metal products	-0.01 (-1.20)	0.52* (5.36)	-0.60* (-6.50)	0.19* (2.07)	-0.80^{-11} (-0.43)	R^2Aj= 0.49 F(11,59) = 1.83 Nobs= 76 CHISQ(3) = 8.19
11 Machinery and equipment	0.02 (1.51)	0.53* (5.09)	-0.80* (-8.07)	0.30* (3.59)	-0.99^{-11} (-0.35)	R^2Aj= 0.49 F(11,59) = 3.35 Nobs= 76 CHISQ(2) = 5.51
12 Electrical and optical equipment	-0.01 (-0.76)	0.41* (4.24)	-0.61* (-5.68)	0.56* (4.51)	-0.31^{-10} (-0.87)	R^2Aj= 0.71 F(11,59) = 0.87 Nobs= 76 CHISQ(3) = 0.64^{-01}
13 Transport equipment	-0.03* (-2.55)	0.38* (3.23)	-1.04* (-8.39)	0.59* (8.20)	-0.31^{-09} (-1.48)	R^2Aj= 0.82 F(11,59) = 2.04 Nobs= 76 CHISQ(3) = 14.04

Note. To see Table 2.A1.

Table 2.A4: Non-EU: National Externalities, International Externalities and Geography

	$g_{\tilde{q}_{j,c}}$	$g_{S_{i,c}}$	$g_{D_{i,c}}$	$g_{E_{i,c}}$	G_c	
1 Food products; beverage and tobacco	0.04* (3.41)	0.41* (4.47)	-0.25* (-3.91)	0.06 (0.51)	0.22^{-16} (0.45)	R^2Aj= 0.54 F(7,32) = 0.47 Nobs= 45 CHISQ(1) = 2.59
2 Textiles and textile products	0.17 (1.01)	-1.49 (-0.71)	0.61 (0.51)	-0.13 (-1.43)	-8.80^{-17}* (-2.11)	Prob>CHISQ=0.4 F(5,8)=5.24 Nobs= 45 p-H:CHISQ(4)=4.06
3 Leather and leather products	-0.04 (-1.45)	1.27* (3.35)	-0.99* (-4.35)	0.03** (1.70)	-4.63^{-18} (-0.22)	Prob>CHISQ=0.5 F(5,8)=153.6 Nobs= 45 p-H:CHISQ(4)=3.19
4 Wood and wood products	0.17* (2.38)	-0.93 (-0.81)	0.5 (1.49)	0.06 (0.33)	-2.56^{-18} (-0.16)	Prob>CHISQ=0.5 F(5,8)=67.71 Nobs= 45 p-H:CHISQ(4)=3.21
5 Pulp, paper; publishing, printing	0.02 (0.92)	0.61* (2.48)	-0.78* (-3.82)	0.19^{-02} (0.02)	0.45^{-17} (-0.11)	R^2Aj= 0.55 F(7,32) = 1.42 Nobs= 45 CHISQ(1) = 0.37
6 Coke, refined petrol, nuclear fuel	0.004 (0.12)	0.82* (10.94)	-0.16 (-1.16)	-0.12^{-03} (-0.66)	-7.44^{-17} (-0.73)	Prob>CHISQ=0.4 F(5,8)=4818.1 Nobs= 45 p-H:CHISQ(4)=4.18
7 Chemical products and man-made fibres	-0.09 (-1.60)	1.57* (2.57)	-2.56* (-3.71)	-0.04 (-0.12)	-0.89^{-16} (-0.6)	R^2Aj= 0.07 F(7,32) = 1.40 Nobs= 45 CHISQ(2) = 0.41
8 Rubber and plastic products	0.05* (2.95)	0.24** (1.73)	-0.13 (-0.67)	0.48 (0.10)	0.20^{-16} (-0.96)	R^2Aj= 0.53 F(7,32) = 1.33 Nobs= 45 CHISQ(1) = 0.23^{-01}
9 Other non-metal mineral products	0.04* (2.46)	0.32** (1.73)	-0.51* (-2.34)	0.13 (1.21)	0.44^{-17} (0.11)	R^2Aj= 0.55 F(7,32) = 0.6 Nobs= 45 CHISQ(3) = 7.74
10 Basic metals and metal products	-0.01 (-0.99)	0.91* (8.42)	-0.45* (-4.41)	0.02 (0.61)	0.29^{-16} (0.93)	R^2Aj= 0.74 F(7,32) = 0.99 Nobs= 45 CHISQ(4) = 0.2
11 Machinery and equipment	0.03* (2.35)	-0.45 (-0.06)	-0.21 (-1.11)	0.32* (4.74)	-0.38^{-16} (-0.71)	R^2Aj= 0.29 F(7,32) = 0.61 Nobs= 45 CHISQ(1) = 0.23^{-01}
12 Electrical and optical equipment	0.41^{-03} (0.01)	0.76* (4.41)	-0.40 (-0.63)	0.004 (0.12)	3.78^{-18} (0.18)	Prob>CHISQ=0.4 F(5,8)=16.30 Nobs= 45 p-H:CHISQ(2)=1.97
13 Transport equipment	0.08 (1.27)	0.35 (0.46)	0.77 (0.77)	0.08 (1.49)	-8.81^{-18} (-0.63)	Prob>CHISQ=0.7 F(5,8)=2806.7 Nobs= 45 p-H:CHISQ(2)=0.7

Note. To see Table 2.A1. Non-EU sample: Argentina, China, Costa Rica, Ecuador, Israel, Morocco, Russian Federation, Singapore and Tunisia

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Chapter 3

The Home Market Effect in the Presence of Marshallian Externalities

3.1 Introduction

The literature has tended to analyse separately the existence of two economic phenomena which fundamentally involve the concentration of production in a determined location. One of these is the Home Market Effect (HME), or the amplified effect of demand on the production of varieties of a country; the other is the existence of marshallian technological externalities. The HME, or the effect of market size (Krugman, 1980, Helpman and Krugman, 1985) is the tendency of industries with increasing returns, in the presence of transport costs, to concentrate production near larger markets and export to smaller markets. As occurs with the theory of comparative advantage compared to absolute advantage, Weder (1995) shows that what demand advantage can offer for the concentration of production of varieties, and thus for net exports, is the relative size of the demand facing an industry. Regarding technological externalities, there is ample evidence that the presence of profits derived from production and innovation in neighbouring firms leads to the agglomeration of production and the forming of industrial clusters (Rosenthal and Strange, 2004). There has been a tendency to differentiate between knowledge spillovers of the home market hypothesis type, which determine that a country concentrates production and exports a type of product, and those linked to a certain industry, which tend to associate the most intense externalities with high technology industries, and which have been called "knowledge stickiness" (Laursen and Meliciani 2000).

The general view, and the evidence, is that marshallian externalities in advanced or technology intensive industries are more likely and stronger. Taking more advantage of these effects has led to defending the generation of externalities in high technology industries, regardless of whether there is any comparative advantage in these industries. However, authors such as Rodríguez Clare (2007) indicate that the relevant approach s to encourage externalities in industries which have demonstrated a comparative advantage, whether or not they are high technology industries; this gives less advanced countries with comparative advantages in medium or low technology industries the opportunity to take advantage of the externality, rather than replacing imports in high technology industries.

In this chapter we analyse both phenomena together, using a simple theoretical model of two countries and two industries, in which there are no technological differences between two productive activities, and where a technological externality will alter the consequences of the Home Market Effect on the accumulation of production and the pattern of trade. Even without supposing different technological intensities between the industries, which would imply a different impact of externalities, we show that there is a different effect if the externality takes place in the industry in which a country has a comparative advantage or disadvantage; also, the effect will be different if the externality is produced in one country or in both In fact, in line with Rodríguez Clare (2007), both agglomerating forces are strengthened when an innovation or a technological shock takes place in the industry with a larger relative market with comparative advantage according to the HME literature, giving rise to the formation of clusters and increasing net exports from the larger country. If, however, it takes place in the industry with the smaller market and there is a comparative disadvantage, both agglomerating forces cancel each other out. Even without supposing intraindustry spillovers, the externality in both cases sets off an income effect leading to increased production of all varieties, an increment in balance of trade and growth for the country where it happens. In the case of the externality taking place in both countries the effect is strengthened if it happens in the industries with a comparative advantage, and is lessened if it takes place in industries with a comparative disadvantage; in any case, growth does not generate such large differences in income as in the case of externalities in only one country. In trade, an externality in the industry with comparative advantage generates increased trade in the form of net exports of varieties in the industry with comparative advantage, while if it appears in the industry with comparative disadvantage, net imports fall, which also increases the balance of trade.

In our model we emphasize the role of technical innovation and marshallian externalities in the smaller-sized countries and industries, helping to localize production and increase the range of varieties exported in conditions which in principle would be disadvantageous. This approach is similar to the model of Flam and Helpman (1987) although in this case they consider differentiated products according to quality; they highlight the role of technical change in less developed countries for replacing the production of some varieties with others of higher quality, which can make them net exporters to the advanced countries. At the same time, our model, like all those à la Krugman, analyses the changes taking place in the growth of new varieties, which the literature calls the extensive margin, of imports and exports (Krugman, 1989). The importance of the extensive margin, mainly that of exports, was demonstrated in recent works such as that of Hummels and Klenow (2005). Its direct implications for trade imbalances have been analysed by Corsetti et al (2007, 2008); concretely, a larger volume of exports can be achieved in the extensive margin, i.e., exporting new varieties without there necessarily being a worse exchange relationship, and with lower impact on international price levels. Our model can be of interest for countries with small markets where a marshallian externality can enable an improvement in trade imbalance, basically reducing its extensive margin for imports, replacing imported varieties with national varieties, while still expanding the extensive margin of its exports.

The schema of the chapter is as follows. Next, we discuss the HME model and technological externalities. This is a conventional model with two economies, Home and Foreign, two industries, A and B, with identical technology, in which the companies use as much labour as capital, and operate in a context of monopolistic competition producing n and m varieties, respectively. Each economy has greater relative demand in a given good; we will suppose that Home has greater relative demand in A and Foreign has it in B. This supposition leads to the Home Market Effect, so that A specializes in the production and trade of varieties of A and Foreign in those of B. We suppose a technology shock to occur, so that the productivity of one or both industries is increased, in either of the two countries or in both at once. This technological externality implies the existence in the aggregate of increasing returns, with an effect on the number of companies and varieties produced and a potential alteration of the comparative advantages provided by relative demand. We work with every possible case, beginning with the externality takes place in the industry where there is a comparative advantage and in only one country, Home. Here we develop the basic model completely and in the rest of the possibilities we summarise the results. Finally we make an overall assessment of all the effects found.

3.2 The Model

The model is a generalisation with two factors of production from the HME model of Krugman (1991) and Weder (1995), who consider only labour as input. As in the seminal works, a context of monopolistic competition is considered à la Dixit-Stiglitz, but in this case the companies produce according to a Cobb-Douglas function with labour and capital factors, to obtain varieties from industry A and industry B, differentiated horizontally. Both industries have the same technology and are only distinguished by the existence of a technology shock in one of them and in one country. We limit the analysis to two countries, Home and Foreign, where the consumers demand both types of varieties, but in Home they demand a larger proportion of class A differentiated products. If we give the name h to the proportion of consumers buying class

A products in Home and f the same proportion in Foreign, our supposition specifies that $h > f$ and $(1-h) < (1-f)$. This demand structure permits us to identify the existence of a comparative advantage for Home in A (or disadvantage in B) and for Foreign in B (or disadvantage in A). Thus the countries are identical except for their different demand structure and the existence of one or another technological externality.

The technology shock which will alter the technology of one or both goods is exogenous, and leads to increased productivity and the appearance in the aggregate of increasing returns in the corresponding good.

The consideration of an exogenous shock can be justified from various points of view. First, it fits in directly with the neoclassical model of exogenous growth in Solow (1956) or, more recently, Basu et al. (2006) or Das (2008). Second, the priority of this chapter is to analyse the effects of an externality on the patterns of production and trade of countries; rather than to study internally the causes and motives leading to the appearance of that externality, which would give us essentially a different work in both approach and objectives. Finally, without contradicting the above, we have explored the consequences of the shock being endogenous, depending, for example, on the relative strength of labour (L/L^*) or the relative number of varieties (n/n^*); in this case an accumulative process of circular causality is produced, which ends by concentrating the production of both goods in a single country, which in fact nullifies the explicative power of the model.

Examples of important externalities might be the appearance of a technological innovation; better public or private institutions leading to improvements in education, healthcare, justice, or public order; better negotiations between unions and business owners; a large influx of skilled labour on the labour market; more capital and investments in these industries, in the form of major infrastructure, etc.; in short, any event which increases the possibilities of production of a country.

We will consider all the possible cases depending on if the externality takes place in the industry with comparative advantage in a single country or in both, and if it takes place in the industry with comparative disadvantage, in one country or in both. This gives us four cases with different effects on production and consumption. We will begin with the case where the technology shock happens in Home and in the industry with comparative advantage, A. In this scenario, which will serve as a reference for the rest of the chapter, we present the pattern of production and trade exhaustively, its analytical development being similar in the remaining cases, but with the pertinent variations as to the good and the country in which the technology shock happens, leading to important conceptual differences.

3.2.1 Technology shock in the good with comparative advantage in a single country

As a starting point we will consider the case in which a country experiences a technology shock in the production of the good in which it has a comparative advantage, and this will be the only difference in production between both countries and industries. The other difference is the demand structure. Specifically, Home has a comparative advantage in good A, given by a larger proportion of demand for this good.

The characteristic company in each industry combines labour and capital à la Cobb-Douglas, with constant returns. The production functions of goods

A and B for both countries is defined as follows[1]:

$$q_{Ai} = HK_{Ai}^{\alpha}L_{Ai}^{\beta}T_{Ai}^{\gamma}Z; \quad q_{Ai}^{*} = HK_{Ai}^{*\alpha}L_{Ai}^{*\beta}T_{Ai}^{*\gamma} \tag{3.1}$$

$$q_{Bi} = HK_{Bi}^{\alpha}L_{Bi}^{\beta}T_{Bi}^{\gamma}; \quad q_{Bi}^{*} = HK_{Bi}^{*\alpha}L_{Bi}^{*\beta}T_{Bi}^{*\gamma} \tag{3.2}$$

where Ai is the ith good in the group differentiated class A product and Bi is the ith good in group differentiated class B product, q is the production quantity, H is the parameter of technology, K is capital, L is labour, T is the fixed factor, $*$ indicates the foreign country and Z is the externality $(Z > 1)$. Constant returns in the use of the primary factors of labour, capital and their fixed component are given by the condition $\alpha + \beta + \gamma = 1$. The effect of the externality in Home and good A is higher total productivity of factors, implying the existence of increasing returns in the country and good with the externality. Transport costs allow both countries to produce both classes of differentiated products (A and B); larger relative demand provides a comparative advantage which leads to accumulation of production and net exports. Next, we will show that the externality relaxes the need for the country benefiting from it to have a larger relative demand in order to produce the Home Market Effect and net exports.

The typical company in industry A, and similarly for industry B, decides the optimum combination of factors of production which minimises production costs $C_{Ai}(q_{Ai}) = wL_{Ai} + rK_{Ai} + dT_{Ai}$, subject to the production function (1). w, w^{*} are salaries in Home and Foreign, respectively, r , r^{*} the income of the

[1] See Lucas (1988) for a similar analysis of the introduction of spillovers in the production function.

capital factor, d and d^* is the price of the fixed factor. The optimum demand for factors is given by:

$$L_{Ai} = \left[\frac{q_{Ai}}{HT_{Ai}^{\gamma}Z}\left(\frac{r\beta}{w\alpha}\right)^{\alpha}\right]^{\frac{1}{\alpha+\beta}}; \quad L_{Ai}^{*} = \left[\frac{q_{Ai}^{*}}{HT_{Ai}^{*\gamma}}\left(\frac{r^{*}\beta}{w^{*}\alpha}\right)^{\alpha}\right]^{\frac{1}{\alpha+\beta}} \quad (3.3)$$

$$K_{Ai} = \left[\frac{q_{Ai}}{HT_{Ai}^{\gamma}Z}\left(\frac{w\alpha}{r\beta}\right)^{\beta}\right]^{\frac{1}{\alpha+\beta}}; K_{Ai}^{*} = \left[\frac{q_{Ai}^{*}}{HT_{Ai}^{*\gamma}}\left(\frac{w^{*}\alpha}{r^{*}\beta}\right)^{\beta}\right]^{\frac{1}{\alpha+\beta}} \quad (3.4)$$

The production costs of the optimal demand for factors are:

$$C_{Ai}(q_{Ai}) = \left(\frac{q_{Ai}}{HT^{\gamma}Z}\right)^{\frac{1}{\alpha+\beta}}\left[\left(\frac{r}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{w}{\beta}\right)^{\frac{\beta}{\alpha+\beta}}(\alpha+\beta)\right] + dT_{Ai} \quad (3.5)$$

$$C_{Ai}^{*}(q_{Ai}^{*}) = \left(\frac{q_{Ai}^{*}}{HT^{*\gamma}}\right)^{\frac{1}{\alpha+\beta}}\left[\left(\frac{r^{*}}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{w^{*}}{\beta}\right)^{\frac{\beta}{\alpha+\beta}}(\alpha+\beta)\right] + d^{*}T_{Ai}^{*} \quad (3.6)$$

We obtain the profit maximizing price for each differentiated class A product in the Home and Foreign countries by replacing the above cost functions with their benefit functions, respectively:

$$\pi_{Ai} = P_{Ai}q_{Ai} - \left(\frac{q_{Ai}}{HT_{Ai}^{\gamma}Z}\right)^{\frac{1}{\alpha+\beta}}\left[\left(\frac{r}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{w}{\beta}\right)^{\frac{\beta}{\alpha+\beta}}(\alpha+\beta)\right] - dT_{Ai} \quad (3.7)$$

$$\pi_{Ai}^{*} = P_{Ai}^{*}q_{Ai}^{*} - \left(\frac{q_{Ai}^{*}}{HT_{Ai}^{*\gamma}}\right)^{\frac{1}{\alpha+\beta}}\left[\left(\frac{r^{*}}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{w^{*}}{\beta}\right)^{\frac{\beta}{\alpha+\beta}}(\alpha+\beta)\right] - d^{*}T_{Ai}^{*} \quad (3.8)$$

The first order condition, marginal revenue equals marginal cost, $MR_{Ai} = MC_{Ai}$, yields the producer prices of each variety in class A, P_{Ai} and P_{Ai}^{*}, in the Home and the Foreign country respectively.

$$MR_{Ai} = P_{Ai}\left(1-\frac{1}{\sigma}\right) = P_{Ai}\theta; \quad MR^*_{Ai} = P^*_{Ai}\theta \tag{3.9}$$

$$MC_{Ai}(q_{Ai}) = q_{Ai}^{\frac{1-\alpha-\beta}{\alpha+\beta}}\left(\frac{1}{HT^{\gamma}_{Ai}Z}\right)^{\frac{1}{\alpha+\beta}}\left(\frac{r}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{w}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} \tag{3.10}$$

$$MC_{Ai}(q^*_{Ai}) = q_{Ai}^{*\frac{1-\alpha-\beta}{\alpha+\beta}}\left(\frac{1}{HT^{*\gamma}_{Ai}}\right)^{\frac{1}{\alpha+\beta}}\left(\frac{r^*}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{w^*}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} \tag{3.11}$$

$$P_{Ai} = \theta^{-1}q_{Ai}^{\frac{1-\alpha-\beta}{\alpha+\beta}}\left(\frac{1}{HT^{\gamma}_{Ai}Z}\right)^{\frac{1}{\alpha+\beta}}\left(\frac{r}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{w}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} \tag{3.12}$$

$$P^*_{Ai} = \theta^{-1}q_{Ai}^{*\frac{1-\alpha-\beta}{\alpha+\beta}}\left(\frac{1}{HT^{*\gamma}_{Ai}}\right)^{\frac{1}{\alpha+\beta}}\left(\frac{r^*}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{w^*}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} \tag{3.13}$$

Where the parameter $\theta = \left(1-\frac{1}{\sigma}\right)$ represents the love-of-variety effect of consumers, where σ is price elasticity of demand and elasticity of substitution between pairs of varieties. $0 < \theta < 1$ and $\sigma > 1$ are needed to ensure that the individual class A differentiated products are substitutes (and not complements) for each other, which enables price setting behaviour based on monopolistic competition power. See the utility functions in (3.18) and (3.19).

Thus the prices depend mainly on wages, capital rents, elasticity of substitution and, at Home and for good A, the externality. Prices are lower when wages and rents are lower, and the elasticity of substitution is higher, meaning greater competition. The existence of an externality Z yields higher productivity and prices fall; the greater this external effect, the cheaper is good A compared to the rest of the world, and the price difference increases.

Assuming free entry, profits per firm are driven to zero in equilibrium. The zero profit conditions in equations (3.7) and (3.8) for the profit maximizing prices (3.12) and (3.13) yield:

$$q_{Ai} = \left[\frac{dT}{\left[\left(\frac{1}{HT_{Ai}^{\gamma} Z} \right)^{\frac{1}{\alpha+\beta}} \left(\frac{r}{\alpha} \right)^{\frac{\alpha}{\alpha+\beta}} \left(\frac{w}{\beta} \right)^{\frac{\beta}{\alpha+\beta}} \right] \left[\theta^{-1} - (\alpha+\beta) \right]} \right]^{\alpha+\beta} \tag{3.14}$$

$$q_{Ai}^{*} = \left[\frac{d^{*}T^{*}}{\left[\left(\frac{1}{HT_{Ai}^{*\gamma}} \right)^{\frac{1}{\alpha+\beta}} \left(\frac{r^{*}}{\alpha} \right)^{\frac{\alpha}{\alpha+\beta}} \left(\frac{w^{*}}{\beta} \right)^{\frac{\beta}{\alpha+\beta}} \right] \left[\theta^{-1} - (\alpha+\beta) \right]} \right]^{\alpha+\beta} \tag{3.15}$$

Where q_{Ai} and q_{Ai}^{*} are the producer output of each variety in class A, produced in the Home and Foreign country, respectively. Quantities depend on the same variables as prices, although in the opposite direction. Higher wages and rents make production expensive and yield lower quantities; a higher elasticity of substitution means greater competition and so a lower quantity. Higher productivity due to the externality Z in Home and good A yields a larger quantity than without this externality.

It is worth assessing the changes in prices, quantities and incomes, due to the externality and the corresponding increase in productivity. It can be shown that the variation of price and quantity, although inversely, is proportional to the change in the externality. That is, $E_{ZP_{Ai}} = -1$ and $E_{Zq_{Ai}} = 1$, where $E_{ZP_{Ai}}$ is the elasticity of the price in relation to externality Z and $E_{Zq_{Ai}}$ is the elasticity of the quantity in relation to externality Z. The remunerations of the variable factors are given by the value of marginal revenue, in imperfect competition, measured by the product of marginal revenue by marginal productivity.

$$w = MR_{Ai} * MP_{L_{Ai}} = P_{Ai}\left[1 - (1/\sigma)\right] * MP_{L_{Ai}} \quad (3.16)$$

$$r = MR_{Ai} * MP_{K_{Ai}} = P_{Ai}\left[1 - (1/\sigma)\right] * MP_{K_{Ai}} \quad (3.17)$$

It can also be demonstrated that the positive effect on productivity caused by the externality is more than proportional to the reduction of marginal revenue with the same externality. That is, $E_{ZMR_{Ai}} = -1$ and $E_{ZMP_{K_{Ai}}} > 1$, $E_{ZMP_{L_{Ai}}} > 1$, where $E_{ZMR_{Ai}}$ is the elasticity of marginal revenue (MR_{Ai}) in relation to externality Z, $E_{ZMP_{L_{Ai}}}$ and $E_{ZMP_{K_{Ai}}}$ are the elasticities of the marginal productivity of labour and capital in relation to the externality, respectively. In fact, the productive incomes of Home rise thanks to the technology shock, with the expected consequences for the pattern of production and trade of the economy.

Externality and the pattern of production (Home Market Effect)

In this section we try to determine the number of differentiated varieties of goods A and B produced by the two countries in the open economy equilibrium. We show that, in the absence of international transaction costs, the country with larger relative demand for varieties of a good will produce a larger number of varieties of it, and that a technology shock in this industry strengthens the Home Market Effect. However, the pattern of production and trade is undetermined, as it is not possible to specify which varieties will be produced by each country. In other words, the externality allows relaxation of the condition of greater relative demand for the good in order to accumulate the production of class A differentiated products and to be a net exporter of them.

Next we determine the demand for varieties of each good, A and B, in both countries and the condition of equilibrium provided by the proportion of varieties produced. There are two groups of consumers who buy class A differentiated products or type B. The utility function of each representative consumer is given by a function of the "taste-for-variety" type:

$$U_A = U_A^* = \sum_{i=1}^{n} d_{Ai}^{\theta} + \sum_{i=1}^{n^*} d_{Ai}^{*\theta} \tag{3.18}$$

$$U_B = U_B^* = \sum_{i=1}^{m} d_{Bj}^{\theta} + \sum_{i=1}^{m^*} d_{Bj}^{*\theta}, \text{ where } 0 < \theta < 1 \tag{3.19}$$

Where $d_{Ai}\,(d_{Bj})$ and $d_{Ai}^*\left(d_{Bj}^*\right)$ are the amounts of consumption demanded of $ith(jth)$ good in the group $A(B)$ produced in the two countries, respectively. The constant elasticity of product substitution $\sigma = (1-\theta)^{-1}$ is assumed to be identical in both groups of goods and countries. n and n^* (m and m^*) are the number of varieties in Home and Foreign of the type of goods $A(B)$.

The maximisation of this utility function leads to the marshallian demand function of the representative consumer (see Helpman and Krugman, 1985) to obtain the aggregate demand (D_{Ai} and D_{Ai}^*) for each variety in Home. We assume "iceberg" transport costs: only a fraction, $1/t$, of the units dispatched reach their destination ($t > 1$). Also, the price per unit is t times higher in the destination country.

We give the name h to the proportion of consumers buying class A differentiated products in Home and f to the proportion of consumers consuming class A differentiated products in Foreign, $0 < h < 1, 0 < f < 1$. Respectively, $(1-h)$ and $(1-f)$ are the proportions of consumers who consume class B differentiated products. The marshallian demand functions are as follows, where I (I^*) is the income of Home (Foreign):

$$D_{Ai} = \frac{P_{Ai}^{-\sigma}}{nP_{Ai}^{1-\sigma} + n^*(P_{Ai}^* t)^{1-\sigma}} hI \quad (3.20)$$

$$D_{Ai}^* = \frac{(P_{Ai}^* t)^{-\sigma}}{n{P_{Ai}}^{1-\sigma} + n^*\left(P_{Ai}^* t\right)^{1-\sigma}} thI^*, \text{ where } \sigma = 1/(1-\theta) > 1. \quad (3.21)$$

We define the term c as the demand ratio for a typical imported variety in relation to another of the same class produced locally. This ratio is $\frac{P_{Ai}^* D_{Ai}^*}{P_{Ai} D_{Ai}}$, and is similar for c^*, that is, from (3.20) and (3.21) the result is:

$$c = \left(\frac{P_{Ai}}{P_{Ai}^*}\right)^{\sigma-1} t^{1-\sigma}; \quad c^* = \left(\frac{P_{Ai}}{P_{Ai}^*}\right)^{1-\sigma} t^{1-\sigma} \quad (3.22)$$

By the usual supposition of symmetry $P_{Ai} = P_A$ and $P_{Ai}^* = P_A^*$, we can determine aggregate demand for the varieties of A produced in Home (nD_A), and in Foreign $(n^* D_A^*)$ (Weder, 1995, Helpman and Krugman, 1985):

$$nD_A = \frac{nP_A^{-\sigma}}{nP_A^{1-\sigma} + n^*(P_A^* t)^{1-\sigma}} hI + \frac{n\left(P_A t\right)^{-\sigma}}{n^* {P_A^*}^{1-\sigma} + n\left(P_A t\right)^{1-\sigma}} tfI^* \quad (3.23)$$

$$n^* D_A^* = \frac{n^* P_A^{*-\sigma}}{n^* {P_A^*}^{1-\sigma} + n\left(P_A t\right)^{1-\sigma}} fI^* + \frac{n^*\left(P_A^* t\right)^{-\sigma}}{n{P_A}^{1-\sigma} + n^*\left(P_A^* t\right)^{1-\sigma}} thI \quad (3.24)$$

Based on the proportions of income spent on domestic products and foreign produced class A products, we can establish the condition of equilibrium of the market for which the supply of varieties equals expenditure on such varieties, as a sum of domestic residents' and foreigners' expenditures.

$$P_A n q_A = \frac{n}{n+n^*c} hI + \frac{nc^*}{n^*+nc^*} fI^*; \tag{3.25}$$

$$P_A^* n^* q_A^* = \frac{n^*}{n^*+nc} fI^* + \frac{n^*c}{n+n^*c} hI \tag{3.26}$$

Replacing in (3.25) and (3.26), P_A, P_A^*, q_A and q_A^* in equations (3.12) to (3.15) above, we obtain the following two conditions for equilibrium of the open economy:

$$\frac{\theta^{-1} dT}{\left[\theta^{-1} - (\alpha+\beta)\right]} = \frac{1}{n+n^*c} hI + \frac{c^*}{n^*+nc^*} fI^*; \tag{3.27}$$

$$\frac{\theta^{-1} d^*T^*}{\left[\theta^{-1} - (\alpha+\beta)\right]} = \frac{1}{n^*+nc^*} fI^* + \frac{c}{n+n^*c} hI \tag{3.28}$$

From this we can determine the relative number of varieties produced in each economy, solving this equation system for n/n^*. To simplify, given that there are no technology differences, we consider that the fixed costs are identical in both countries ($dT = d^*T^*$). Thus,

$$\frac{n}{n^*} = \frac{\frac{h}{f} - c\varphi}{\varphi - c^*\frac{h}{f}}, \text{ where } \varphi = \left(\frac{I^*}{I}\right)\left(\frac{1-c^*}{1-c}\right) \tag{3.29}$$

For class B differentiated products the expression would be similar, with the corresponding varieties m, m^*, and the proportions of demand $(1-h)$ and $(1-f)$:

$$\frac{m}{m^*} = \frac{\frac{1-h}{1-f} - c\varphi}{\varphi - c^*\frac{1-h}{1-f}}, \text{where } \varphi = \left(\frac{I^*}{I}\right)\left(\frac{1-c^*}{1-c}\right) \tag{3.30}$$

Equation (3.29) indicates the pattern of production for class A goods

(n/n^*) as a function of relative demand (h/f) of the externality (Z included in the demand ratios c and c^* through prices) and the productive incomes of both countries (I and I^*).

The Home Market Effect sustain that the greater relative demand for class A differentiated products in Home $(h/f > 1)$ leads to a greater production of these varieties $(n/n^* > 1)$, and the accumulation of production will be greater as relative demand increases. In class B differentiated products relative demand is lower, and this leads to a lower concentration of production of these varieties; i.e., a decrease of m/m^* (Weder, 1995).

If here we consider the effect of the externality Z in A and Home, the HME is strengthened and the increase in n/n* is still greater. This intensification of the HME is caused by two reasons, which can be derived from the equation (3.29). First, the externality reduces the prices of class A differentiated products in Home, so that the demand ratios c and c^* vary; thus, this effect is seen in lower c, higher c^*, and by these variations, a reduction of φ. Second, as we have shown, the income of Home increases due to the rise in productivity, so that there is a divergence with the income of Foreign which leads to a further reduction of φ. Thus, the externality reinforces the accumulation of production of class A differentiated products due to the reduction of their prices and the higher income of Home.

This rise in income in Home, which we could call income effect, becomes a channel of interindustrial transmission of growth, as the divergence of incomes leads to moderation of the fall in production of class B differentiated products, through the equation (3.30). In this way, two opposing forces are at play in the production of class B differentiated products: lower relative demand and increasing demand via income growth. Therefore, as long as the accumulation of production of good A is always reinforced, the final effect on the production of class B differentiated products will depend on the net result of both forces. In the case of the result of the technology shock being weaker, as can happen in less technologically intense industries, HME will be strengthened in industry A and delocalization will be more moderate in industry B.

Figure 3.1 represents the ratio of production of class A differentiated products in Home and Foreign (n/n^*) according to relative demand (h/f). HME is represented by the solid line, the effect of the externality is represented by the dashed line and the dotted line represents the income effect. These three types of line of the function, with their respective ranges represented by the x-axis, also correspond to the three effects mentioned for all subsequent figures. In the absence of externality complete specialization of Home in these varieties can be obtained if $h/f \geq \varphi/c^*$ given that n^* tends to zero; in contrast, if $h/f \leq \varphi c$ it is Foreign which localizes all production, as n tend to zero. If $\varphi c < h/f < \varphi/c^*$ there is an incomplete specialization and the production of varieties in Home is larger as relative demand increases. The effect of the externality is a shrinking of the range of demands which make Foreign specialize in these varieties, and a widening of the range for which there is total specialization in Home, as well as a greater slope for the function n/n^*; given a relative demand h/f and incomplete specialization, the externality implies a greater proportion of varieties produced in Home, strengthening HME; or in other words, the externality implies localization of production without there being enough condition of larger relative demand, or permits a relaxation of it.

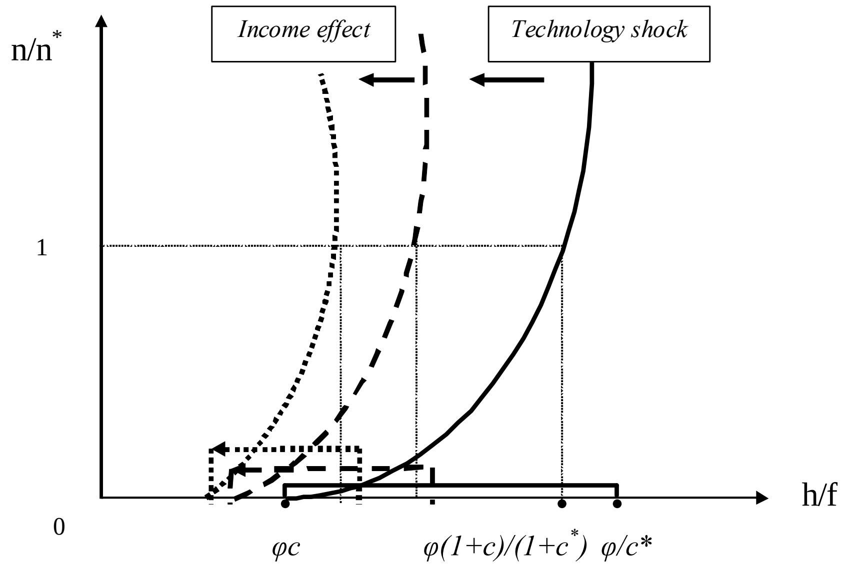

Figure 3.1. Technology shock in the good with comparative advantage in a single country (A)

The effect on the relative production of class B differentiated products (m/m^*), figure 3.2, is symmetrical in the absence of externality, with lower production of class B differentiated products in Home. The effect of the externality is a similar displacement of the function m/m^*, which means a larger production of class B differentiated products in Home given a relative demand $(1-h)/(1-f)$; this also means a smaller range of total specialization in Foreign and a wider range of specialization in Home. The difference of effects on both productions is that the technology shock in A and Home strengthens HME, and prices are lowered for these class A differentiated products and an increase of income rises for A; the increased varieties of B in Home are due solely to increased income.

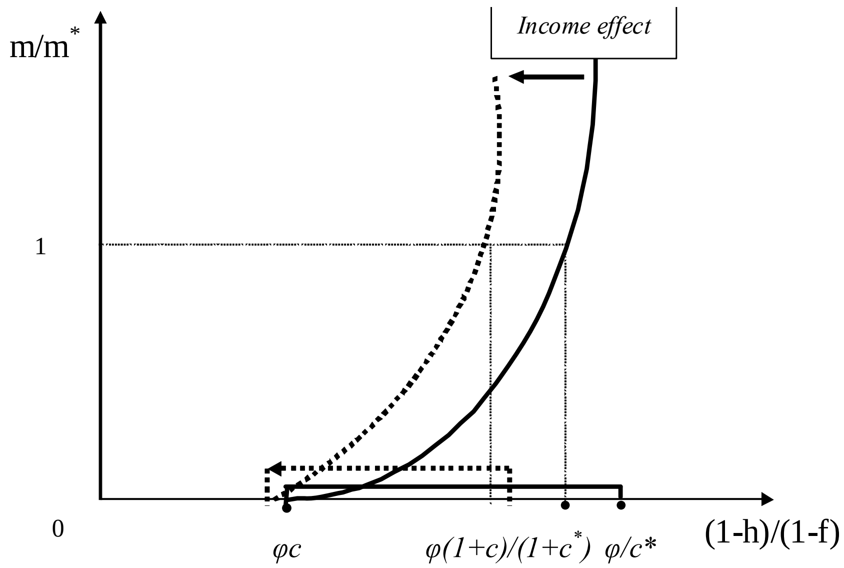

Figure 3.2. Technology shock in the good with comparative advantage in a single country (B)

Externality and the pattern of trade (net exports and comparative advantage)

We have shown that the externality permits relaxation of the necessary condition of comparative advantage, given by the relative demand for a good, when determining specialization in production. The combined effect of comparative advantage and the externality also has a result on the pattern and balance of trade, an aspect which we analyse in this section. We will see that the externality increases the balance of trade, both through greater net exports of class A differentiated products and through a reduction of net imports of class B differentiated products.

The balance of trade of Home for class A and B differentiated products is T_A and T_B, respectively, given the conditions of market equilibrium for both countries obtained in equations (3.25) and (3.26):

$$T_A = X_A - M_A = \frac{nc^*}{n^* + nc^*} f I^* - \frac{n^* c}{n + n^* c} hI; \tag{3.31}$$

$$T_B = X_B - M_B = \frac{mc^*}{m^* + mc^*}(1-f) I^* - \frac{m^* c}{m + m^* c}(1-h) I \tag{3.32}$$

Considering the production of varieties in equilibrium between both countries, n/n^* and m/m^*, from equations (29) and (30) and regrouping terms, we obtain:

$$T_A = \frac{hIc^*}{1-c^*} - \frac{fI^*c}{1-c} \tag{3.33}$$

$$T_B = \frac{(1-h)\,Ic^*}{1-c^*} - \frac{(1-f)\,I^*c}{1-c} \tag{3.34}$$

The effect on total balance of trade T is given by adding both together.

$$T = T_A + T_B = \frac{Ic^*}{1-c^*} - \frac{I^*c}{1-c} \tag{3.35}$$

The fact of having a larger relative demand for good A in Home ($h/f > 1$) is a necessary and sufficient condition for having net exports of A and net imports of B. The effect of the externality, both by reducing the price of A -and thus the demand ratio c and increasing ratio c^*- and by increasing the income of Home, means higher net exports of A; but only higher income has an effect on the trade of B, meaning a fall in net imports of B. The combined effect is an increase in the total balance of trade in favour of Home. Thus, the externality reinforced the effect of the comparative advantage in the trade of class A differentiated products and moderated the effect of the comparative disadvantage in good B.

That the existence of an externality relaxes the condition of greater relative demand to show HME is also reflected in the pattern of trade. This gives two interesting results: First, the externality lets Home be a net exporter with a lower relative demand for good A; second, the divergence of incomes in itself also permits a positive total balance of trade. This can be shown by observing the condition of trade equilibrium, imposing $T_A = 0$ and $T_B = 0$ on equations (3.33) and (3.34). The relative demand of trade equilibrium is:

$$\frac{h}{f} = \frac{I^*}{I} \frac{(1 - c^*) c}{(1 - c) c^*} \tag{3.36}$$

In absence of the externality, the equality of relative demands would imply trade equilibrium. If there is a technology shock in A in Home, and given that the price of A is reduced - this reduces demand ratio c and increases ratio c^* - and the income of Home rises, the relative demand of trade equilibrium in Home can be lower. In other words, the externality means relative demand does not have to be so different in order to achieve a positive total balance of trade.

Additionally, the ratio of incomes of Home and Foreign with trade equilibrium is given by:

$$\frac{I}{I^*} = \frac{(1 - c^*) c}{(1 - c) c^*} \tag{3.37}$$

The existence of an externality in A means that the ratio of incomes with trade equilibrium is lower, but, given that there is an increase in income in A, the total balance will be positive.

In fact, the presence of an externality in the good with greater relative strengthens the localization of production of that good and moderates the delocalization of the other one; it also increases the balance of trade of the country, by enhancing net exports of the good with greater relative demand and moderating net imports of the good with lower relative demand.

3.2.2 Technology shock in the good with comparative advantage in both countries

In this section we consider a technological externality in the production of A in Home and B in Foreign. With a similar analysis to that of the externality in A only in Home, we show that this externality strengthens the patterns of production and trade by reducing prices; however, the income effect becomes more moderate in relative terms. To simplify, let us suppose that the same technology shock takes place in both industries, with the same effects, as we are supposing the same technology.

The production of a typical company is given by the Cobb-Douglas production functions:

$$q_{Ai} = HK_{Ai}^{\alpha}L_{Ai}^{\beta}T_{Ai}^{\gamma}Z; \qquad q_{Ai}^{*} = HK_{Ai}^{*\alpha}L_{Ai}^{*\beta}T_{Ai}^{*\gamma} \tag{3.38}$$

$$q_{Bi} = HK_{Bi}^{\alpha}L_{Bi}^{\beta}T_{Bi}^{\gamma}; \qquad q_{Bi}^{*} = HK_{Bi}^{*\alpha}L_{Bi}^{*\beta}T_{Bi}^{*\gamma}Z \tag{3.39}$$

The optimisation of profits and the condition of market equilibrium lead to the following functions of relative production of class A and B differentiated products:

$$\frac{n}{n^*} = \frac{\frac{h}{f} - c\varphi}{\varphi - c^*\frac{h}{f}}, \text{ where } \varphi = \left(\frac{I^*}{I}\right)\left(\frac{1-c^*}{1-c}\right) \tag{3.40}$$

$$\frac{m^*}{m} = \frac{\frac{1-f}{1-h} - c^*\varphi^*}{\varphi^* - c\frac{1-f}{1-h}}, \text{where } \varphi^* = \left(\frac{I}{I^*}\right)\left(\frac{1-c}{1-c^*}\right) \tag{3.41}$$

Where φ^* is the parameter φ but considered from the point of view of Foreign.

The relative production of class A differentiated products is identical to that obtained in the above case, in which the externality is found in A and in Home. For class B differentiated products the effect is symmetrical, with a reduction in its price in Foreign, where income I^* also rises . Thus, the reduction of prices in A and Home means higher relative production of A in this country (n/n^*); and the reduction of prices in B in Foreign means higher relative production of B in Foreign (m^*/m). Given that the increase in productivity leads to income growth in both countries, the relationship of incomes I/I^* does not present as much variation as in the case in which the externality happens in only one country, and we can suppose that the income effect will be lower, or even be cancelled out if there is no variation in the relationship I/I^*. In any case, the externality strengthens the effect of relative demand in both countries and, therefore, HME, with a greater agglomeration of production[2].

We have supposed the same technology shock in both industries. If we try

[2]It can be stated that if the final effect is an increase in the relative income of Home, this will add to the strengthening of production localisation of A in Home and will moderate the delocalisation of B, given that the greater income will increase demand and production of B in Home. If the relative income of Home is lowered, the final effect on B is undetermined, as well as weakening the localisation of A.

to generalise more and we assume that they act with different intensity in the production functions, the consequence will be as corresponds to a net effect of both shocks. If, for example, the externality were greater in Home and good A, this case would be the same as the one where the shock takes place only in this country and good.

If we represent these effects in a figure, the case of class A differentiated products would be identical to figure 3.1, except that the income effect would be lower or nonexistent. In the case of good B, the graph could be as follows (figure 3.3), showing how, for the same comparative disadvantage of Home, the externality agglomerates more production of B in Foreign.

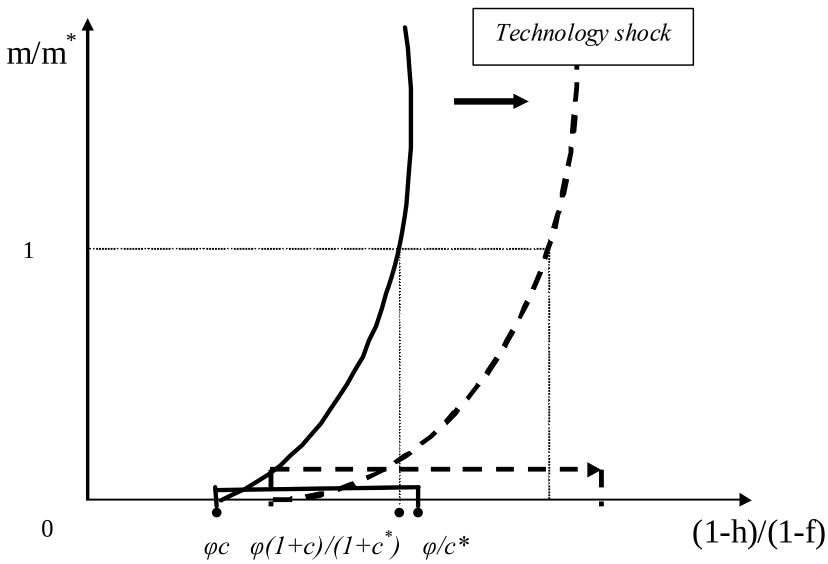

Figure 3.3 Technology shock in the good with comparative advantage in both countries (B)

Regarding the pattern of trade, the trade balance of class A and B differentiated products (T_A and T_B, respectively) is given by the same expressions as for the case of the externality in Home and good A (equations (3.33), (3.34) and (3.35), this last for the total balance). Here, the externality strengthens the comparative advantages through reducing the price of A in Home and the price of B in Foreign, with a lower or null income effect. Therefore, in Home net exports of A increase, and so do net imports of B. The total balance $T = T_A + T_B$ varies less as both industries are aggregated.

In turn, the externality again relaxes the condition of greater relative demand for a country to become a net exporter of the type of varieties indicated by this demand. Nevertheless, and given that the income effect is lower, its contribution to the balance of trade will also be lower, and the balance of trade will also be affected depending on whether growth in Home or in Foreign predominates. We can consider, for example, that there is a predominant increase in the income of Home; in this case, the increase in the ratio I/I^* will mean growth of total trade, as this income effect reinforces the comparative advantage and adds to the increase in net exports of A, while it makes net imports of B, the good with comparative disadvantage, more moderate. If, in contrast, the ratio I/I^* is reduced, the income effect moderates the effect of the comparative advantage and slows down net exports of A, while it adds to the comparative disadvantage in B, and enhances its net imports, with the result of reducing the total balance of trade.

3.2.3 Technology shock in the good with comparative disadvantage in a single country

In the above graphs, technology shocks appeared in the good with greater relative demand, so that the combined effect strengthens HME, both in the localization of production and in the net balance of exports and imports. Next, we will consider what happens if the technology shock is in the good with lower relative demand, so that there will be opposing forces. Specifically, we will suppose that the externality appears in industry B in Home. The typical companies of each industry and country produce according to the following production functions:

$$q_{Ai} = HK_{Ai}^{\alpha}L_{Ai}^{\beta}T_{Ai}^{\gamma}; \qquad q_{Ai}^{*} = HK_{Ai}^{*\alpha}L_{Ai}^{*\beta}T_{Ai}^{*\gamma} \tag{3.42}$$

$$q_{Bi} = HK_{Bi}^{\alpha}L_{Bi}^{\beta}T_{Bi}^{\gamma}Z; \qquad q_{Bi}^{*} = HK_{Bi}^{*\alpha}L_{Bi}^{*\beta}T_{Bi}^{*\gamma} \tag{3.43}$$

The equilibrium of production and the market leads to equation (3.44) representing the pattern of production of class A differentiated products and equation (3.45) for class B differentiated products:

$$\frac{n}{n^{*}} = \frac{\frac{h}{f} - c\varphi}{\varphi - c^{*}\frac{h}{f}}, \text{ where } \varphi = \left(\frac{I^{*}}{I}\right)\left(\frac{1-c^{*}}{1-c}\right) \tag{3.44}$$

$$\frac{m}{m^{*}} = \frac{\frac{1-h}{1-f} - c\varphi}{\varphi - c^{*}\frac{1-h}{1-f}}, \text{where } \varphi = \left(\frac{I^{*}}{I}\right)\left(\frac{1-c^{*}}{1-c}\right) \tag{3.45}$$

And figure 3.4 represents the effect of the externality on the production of good B according to its relative demand.

The externality reduces the price of good B in Home, modifying the demand ratios - c decreases and c^{*} grows. Given a relative demand for B in Home $(1-h)/(1-f)$, demand which we suppose to be lower for this good in this country, the externality will increase this type of production; as a consequence, there will be a decrease in the range of relative demands for which Foreign specializes totally in B, and an increase in the range of demands for which Home

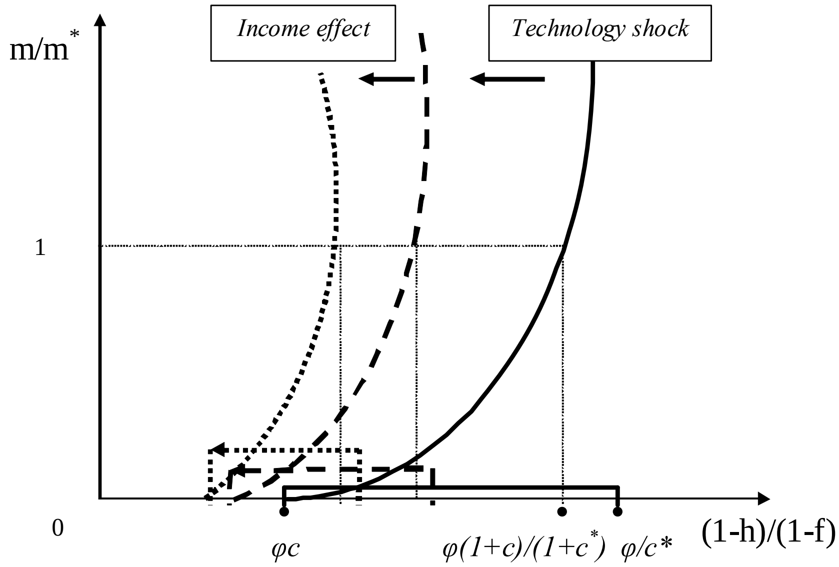

Figure 3.4. Technology shock in the good with comparative disadvantage in a single country (B)

specializes totally. Given that the slope of this function increases, the range of incomplete specialization is reduced. Also, the increase in productivity leads to an increased income in Home which adds to the effect of the externality in B. An interindustrial transfer of this income effect takes place, so that there is also an increase in the proportion of varieties of A produced in Home for each relative demand, and an increase in the range of complete specialization of Home in A.

In terms of the pattern of trade, equations (3.33), (3.34) and (3.35), the externality moderates the comparative disadvantage of Home in B, and both its effect of reducing prices of B and the increase in income lead to the reduction of its net imports (T_B). The increased income of Home has the additional effect of strengthening its comparative advantage in A, with the increase of net exports (T_A). The final combined result is an increment of the total balance of trade. Equation (3.37) shows the relationship between the incomes ratio and the total balance of trade; also in this case, the increase in the income of Home due to the externality leads to an increment in the total balance of trade; or, in other words, the incomes ratio of trade equilibrium I/I^* is lower. However, the change in each type of good A and B differs from case 3.2.1 – externality in Home and in A – in that higher net exports of A are now due only to the increase in income, while in case 3.2.1 they were due both to higher income and to an improved comparative advantage. And the reduction of net imports of B are now due both to increased income and to the reduction of the comparative disadvantage, while in case 3.2.1 they are due only to increased income.

3.2.4 Technology shock in the good with comparative disadvantage in both countries

Finally, we consider the case in which a technology shock takes place in the good for which relative demand is lower, i.e., in B for Home and in A for Foreign. We can confirm that the externality means, on one hand, the moderation of the comparative disadvantage in each country and, on the other, growth of income in both which will add to the moderation of the comparative disadvantage and also be reflected in a strengthening of the comparative advantage, with the corresponding good in each country. The pattern of trade will be modified so that the net imports and net exports of each country will be reduced.

To demonstrate the changes in the production of each type of varieties, we now consider what the typical company produces according to the following production functions:

$$q_{Ai} = HK_{Ai}^{\alpha}L_{Ai}^{\beta}T_{Ai}^{\gamma}; \quad q_{Ai}^{*} = HK_{Ai}^{*\alpha}L_{Ai}^{*\beta}T_{Ai}^{*\gamma}Z \tag{3.46}$$

$$q_{Bi} = HK_{Bi}^{\alpha}L_{Bi}^{\beta}T_{Bi}^{\gamma}Z; \quad q_{Bi}^{*} = HK_{Bi}^{*\alpha}L_{Bi}^{*\beta}T_{Bi}^{*\gamma} \tag{3.47}$$

The equations of relative production of good A and B can be derived from the equilibriums of production and of the market, which are the following:

$$\frac{n^{*}}{n} = \frac{\frac{f}{h} - c^{*}\varphi^{*}}{\varphi^{*} - c\frac{f}{h}}, \text{where } \varphi^{*} = \left(\frac{I}{I^{*}}\right)\left(\frac{1-c}{1-c^{*}}\right) \tag{3.48}$$

$$\frac{m}{m^{*}} = \frac{\frac{1-h}{1-f} - c\varphi}{\varphi - c^{*}\frac{1-h}{1-f}}, \text{where } \varphi = \left(\frac{I^{*}}{I}\right)\left(\frac{1-c^{*}}{1-c}\right) \tag{3.49}$$

In the relative production of A, equation (3.48) shows the changes of the technology shock in Home, and those produced in Foreign are reflected in the relative production function of B, equation (3.49). The externality in Home leads to a reduction of the price of B and of the demand ratios so that c decreases and c^{*} increases, and growth of income in Home; this reduces the comparative disadvantage of Home in good B, and the income growth strengthens the demand and production of goods A and B in Home. At the same time, the technology shock in Foreign makes A cheaper and modifies the demand ratios – in this case, c increases and c^{*} decreases in equation (3.48) – stimulating the production and demand of good A in Foreign. The increase in productivity also leads to rising income in Foreign, stimulating the demand and production of good B. Income growth in both countries means less variation of ratio I/I^{*} in relation to the case in which it grows in only one country, or if the impact is the same, they will tend to compensate for each other. In fact, given determined relative demands for good A in Home and Foreign (h/f) and for B $((1-h)/(1-f))$, and supposing that Home has greater relative demand for A and thus produces a greater proportion of these varieties, this moderates this specialization in the production of A in Home, and also moderates the specialization of Foreign in class B differentiated products. The effect of income growth will favour the production of the good with comparative advantage in the country which grows more due to the technology shock. If we consider that the ratio of both incomes does not vary because the growth rates compensate for each other, we can show in a graph the effect of externalities on the relative production of both goods in Figures 3.5 and 3.6.

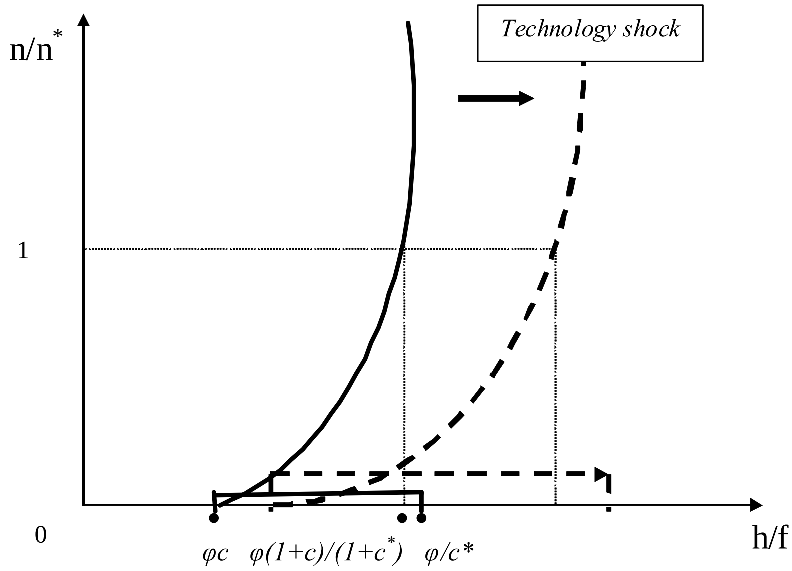

Figure 3.5. Technology shock in the good with comparative disadvantage in both countries (A)

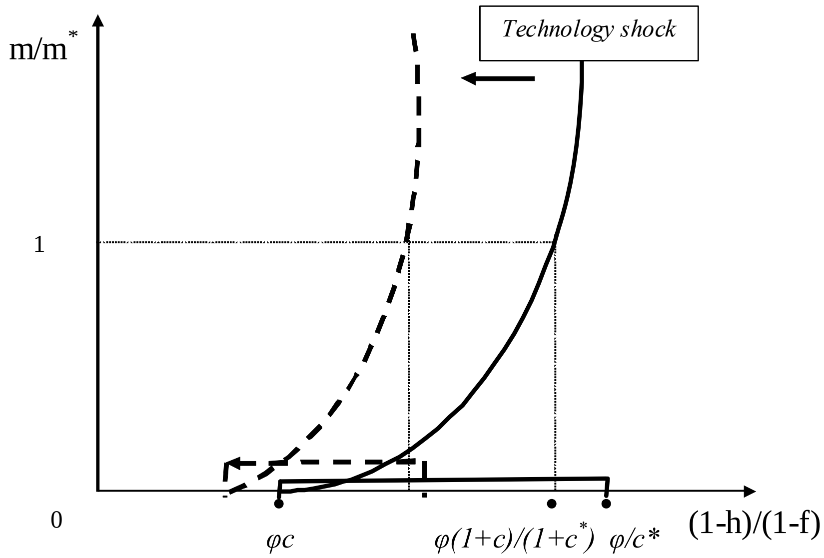

Figure 3.6. Technology shock in the good with comparative disadvantage in both countries (B)

As for the pattern of trade, the reduction of comparative disadvantages means a reduction of the net imports in Home of class B differentiated products, and of the net imports in Foreign of class A. If we suppose that all the effects have the same impact in Home as in Foreign, given that the only difference is the relative demand and the externality is the same in both goods, the net effect of income growth is null – the ratio I/I^* does not vary – equal reductions of the net balances of A and B will mean a null variation in total trade. If there should be greater income growth in Home, net imports of B by Home would be reduced even more and the total trade balance would increase; if there is greater income growth in Foreign, net imports in Foreign of good A would be reduced even more, and there could be a reduction of the total trade balance of Home.

3.3 Conclusions

This chapter has analysed the effect of a technological externality, which improves productivity, on the production and trade of two countries whose comparative advantage is based on the greater relative demand for a good, producing the phenomenon known as the Home Market Effect.

We have considered the cases in which a technology shock happens in the good with comparative advantage in one country and in both countries, and the cases where the shock takes place in the good with comparative disadvantage, in one or both countries. Any other option could be reduced to one of those analysed, considering the net effect of the technology shock on the production of the good or country in which it is more intense.

We have shown that the effect of the technology shock is a reduction of the price of the good it affects and an increase in the income of the country where it takes place, triggering an effect of interindustrial transmission of localization. The change in the price strengthens the comparative advantages or moderates the disadvantages, strengthening or weakening the initial effects caused by relative demands, respectively, enhancing the localization of the production of varieties of the good with the advantage, in the first case, or moderating it for the good with disadvantage, in the second. If the shock occurs in both countries these effects are added together. If the shock takes place in a single country it strengthens the comparative advantage or weakens the comparative disadvantage, and in both cases, increases the total balance of trade.

Also, the improvement in productivity leads to growth of income in the country where the technology shock happens. When this happens in a single country and good, an interindustrial effect takes place, enhancing the demand and production of both goods; as a result, the net exports of the good with comparative advantage increase, and net imports of the good with disadvantage decrease. If the technology shock occurs in both countries, the income effect may be cancelled out if the relationship between the incomes of both does not vary, but the reduction of prices strengthens the comparative advantages or makes the disadvantages more moderate. In both cases the total balance of trade does not vary.

These results suggest that the effects on the localization of production of each good, on the balance of trade and the pattern of trade depend on the technology shock taking place in the good with advantage or comparative disadvantage, and in one or both countries. Thus, the country which introduces a technological improvement favours localization of the activity and increases its balance of trade, either because it enhances its exporting capacity, if it improves the productivity of the good with comparative advantage, or because it reduces dependence on imports, if the improvement occurs in the good with disadvantage.

There still remains a great deal of scope for further research. An aspect which needs more analysis is the consideration of shocks of different intensity or the effect of different technologies. We could also consider the endogenous nature of some determinants of the model, such as the technological change or relative demand itself given the existence of non-homothetic preferences.

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Final Conclusions

Throughout the three chapters of this doctoral thesis using the New Economic Geography (NEG) as a reference, we have examined in depth the concept of industrial agglomeration as a phenomenon associated with the spatial localization of economic activity. To do this, we began with two questions which are of relevance to the NEG: the role of the Home Market Effect (HME) and of externalities in production to explain the pattern and mechanism of agglomeration of production and the pattern of trade in an economy. With this approach, the aim of this thesis was to analyse these two concepts in depth using an eminently empirical approach and then to bring them together at the theoretical level. Below, we underline the fundamental results which we obtained.

In the first essay, *The Home Market Effect in Spanish Industry, 1965-1995*, our aim was to try to empirically identify the existence of the HME in the manufacturing industries of the Spanish autonomous communities, i.e., with regional rather than international data, in order to detect greater Economic Geography effects due to the lower transport costs and greater mobility of the factors of production found at the regional level. The available period of information was the odd-numbered years from 1965 to 1995. Neither the geographical area chosen nor the period had been previously analysed in the literature, except for the work of Rosés (2003), who used a historical database, from 1797 to 1910. We reviewed the main theoretical contributions which enable us to study the HME, understood as the tendency of large countries to be net exporters of goods with high transport costs and strong scale economies. We used as reference theoretical models of Krugman (1980) and Weder (1995), and the successive empirical analyses of Davis and Weinstein (1996, 1999 and 2003).

Our main contribution to this research was the specification of the model presented, as we opted to analyse percentage changes in demand and production in the panel of autonomous communities mentioned above, rather than changes in levels, which is the traditional specification used in the literature, and which corresponds to the original specification of Davis and Weinstein. This version of the model owes its existence to the concept of the HME itself, which implies working in relative terms. And it has a very important empirical justification, as it permits monitoring the possible regional variations in production which can arise in a panel of data. This need does not exist in the cross-section analyses used for the traditional tests. Thus, we have tested the effectiveness of the more than proportional increase in the production of a good which has led to a rise of a certain percentage in demand for this good in an industry, defining the variables in proportions rather than levels.

As a result of our econometric estimation, we have found evidence in favour of the presence of HME in many branches of production. Specifically, 5 of the 9 branches analysed: food, drink and tobacco; paper and printed goods; plastic, rubber, wood, cork and furniture; non-metallic mineral products; and metal products and machinery. The important evidence of HME could be a reflection of the growing openness of Spain's economy in the 1960s and the later economic integration Europe.

The potential endogeneity present in the equations at the industrial level, but not in all, seems to arise from the construction of the variables within each branch, and not from their expression in proportions. Given the possible sensitivity of the results to the chosen instruments, we have opted to correct the endogeneity one equation at a time (PANEL by industry), for better control of its effect on the residuals, without mixing them with the effects of the relationship between the equations. Nevertheless, we also considered the possibility of jointly estimating the system using a SURE (3SLS-PANEL), which would take into account the possible relationships existing between equations, which arise from the fact that proportional changes in the production or demand of an activity affect the proportion of the other branches. Greater efficiency can be expected from an estimation using SURE, but not significant changes in the coefficients, which initially are already consistent. In fact, the results in terms of HME, where the main aim of the chapter lies, are robust to the estimation technique used (PANEL by industry or 3SLS-PANEL).

Next we analysed the joint effect on the pattern of production of the specialization deriving from factor endowments (Heckscher-Ohlin model, HO) and of the evidence obtained in our work in favour of the market size (NEG), to explain the determinants of the localization of industry in Spain since the 1960s. It can be seen how, of the industries where HME systematically exists, i.e., food, drink and tobacco, plastic, rubber, wood, cork and furniture, non-metallic mineral products, metal products and machinery, and paper and printing, in the first four Economic Geography is more important at the regional level. In the rest of the industries factor endowments have greater relevance. There is only one branch of activity, paper and printing, where there is evidence that HO and HME coexist and complement each other when explaining the localization of production. In short, Rosés (2003) concluded that in the 19th century factor endowments explained nearly 85% of the variation in manufacturer output; we conclude that we have provided evidence enabling us to affirm that since the 1960s, the accumulative factors put forward by the NEG have acquired greater relevance, together with factor endowments, as determinants of the industrial geography of Spain.

In the second essay of the thesis, titled *External Economies as a Mechanism of Agglomeration in EU Manufacturing*, we studied externalities of production and their use in explaining processes of agglomeration or geographical concentration of activity in space. More specifically, the sources of marshallian externalities explain the geographic concentration of economic activity thanks to the presence of three key factors: a combined market of skilled labour, supply and demand links arising from input-output relationships (also called pecuniary or static externalities) and finally, the existence of technology spillovers as a consequence of the exchange of information between companies close together spatially (known as technological or dynamic externalities).

Therefore, in this essay we have analysed the impact of these externalities on the growth of productivity as a mechanism of agglomeration. In this way, we show how productivity growth depends on pecuniary and technological externalities, both interindustrial and intraindustrial, national and international. We have tested all of this in the manufacturing industry, disaggregated by activities, of the countries in the European Unión and for the period for which information is available, 1995-2002. This approach to the analysis constitutes a contribution in itself, as although there is evidence regarding this in the literature, it is still very scanty, and comes from studies of specific industries or aggregated analyses of productive activity.

Another important contribution in our work is that these externalities at the international level also play an important role as a mechanism of agglomeration. This analysis is normally restricted to the regional level within a country, but we have found a greater effect of these externalities when we consider their international dimension. We have also tested how geography emphasises their effect on productivity, as the more distant regions experience less effect of the same externality than those in a central location.

Going on to the concrete results obtained, these can be divided into two lines. First, if we consider only national externalities, we can confirm the positive incidence on labour productivity growth of the endowment factors in practically all the industries analysed, even to the appearance of economies of scale in some of them. As exceptions, in the transport industry, endowment factors are not relevant but externalities are, and neither factor endowments nor national externalities are important in refined petroleum products, which makes sense, as this is an industry which depends heavily on imports.

The existence of intraindustrial economies of specialization is also evident in most manufacturing industries, except the above mentioned refined petroleum and machinery and equipment industries. Those of interindustrial diversification are also relevant, except in wood products, refining petroleum and oil by-products, and in other non-metallic mineral products. At the same time, interindustrial links are only important for wood products, chemical products and basic metals and metal products, perhaps indicating the sensitivity of these industries to imbalances in their interindustrial relationships.

Second, if we consider the national and international externalities jointly, we see how once again the abundance of capital is significant and positive in all industries except for transport. This may mean that the agglomeration mechanisms put forward by the NEG play a very important role in this industry.

International specialization is highly significant in almost all industries and nearly always accompanied by national specialization. Exceptions are, first, paper, advertising and printing, rubber and plastic, and optical and electric equipment, industries where national specialization is important, but international specialization is not. Second, food, drink and tobacco, refined petroleum and oil by-products, and other non-metallic mineral products, industries which show only international significance. It is remarkable to see how, in an international context, national interindustrial externalities acquire relevance, while national diversification loses it. This occurs in industries such as refining petroleum and oil by-products, leather and its by-products, wood products, and machinery and equipment. Special mention should be given to these last two branches of activity, because in them all the determinants of agglomeration are significant when the international effects of an externality are considered.

Peripherality is significant in all industries except those which are depend on the existence of natural resources and thus on factor endowments: refined petroleum and oil by-products, rubber and plastic, other non-metallic mineral products and transport material.

In short, we have found substantial evidence of specialization, more than diversification, in line with most of the existing literature (De Lucio et al. 2002 and Henderson 2003). And at the national and the international level, a fact which the literature only finds in a regional context, which is a difference to be taken into account as a contribution. Also, in line with Henriksen et al. (2001) national interindustrial externalities are robust in more sophisticated industries, such as basic metals and metal products, optical and electric equipment, and transport material, and also in less technological ones when the international context and peripherality are considered. For this reason, it is important to take this environment into account, as if not the national externalities are underestimated, especially in low-technology industries.

Our results are a contribution to the European case, that is, developed, geographically close countries which benefit from economic integration which maximises the mobility of goods and factors and minimises transaction and transport costs. Comparing these results with a more heterogeneous international sample, we conclude that economic integration seems to be relevant for externalities to act as agglomeration mechanisms. In any case, we should be cautious about this affirmation because of the absence of data for a wider sample of countries, a fact which is an incentive for future lines of research.

Finally, in the third essay, *The Home Market Effect in the Presence of Marshallian Externalities*, we have studied jointly at the theoretical level the two classic phenomena of agglomeration of production in a physical space, examined separately in the literature: the HME and the presence of a marshallian externality. Through these processes of agglomeration, augmented production of differentiated goods and the increment of the balance of trade, externalities could be compensating the tendency to decreasing returns in the accumulation of factors and with this, making long-term growth possible.

Thus, we developed a simple model in a context of increasing returns, monopolistic competition and transport costs, so that in countries where production is agglomerated and demand is concentrated in certain goods, the well-known HME is produced. There are two countries, Home and Foreign, and two industries, with no technological differences between them. This is precisely when the introduction of a technological externality alters the consequences of the HME on the accumulation of production and the pattern of trade.

The existence of this technological shock raises the productivity of one or both industries, in one country or both at the same time. It also reduces the price of the good it affects and increases the income of the country where it happens. To this fact we must add that there is a larger relative market or comparative advantage (origin of the HME) in this industry, or the opposite, a smaller market or comparative disadvantage. As might be expected, the results are different depending on which situation we find ourselves in.

First, if the shock occurs in the good with comparative advantage in just one country, it strengthens the localization of the production of this good. That is, the externality reinforces the comparative advantage. Also, an income effect is produced which acts as an interindustrial channel of growth towards the industry with a comparative disadvantage, and also increases its production; the final effect on it will depend on the net result of both forces. Regarding trade, the total balance of the country increases, mainly due to improving net exports of the good with a comparative advantage.

Second, if the externality appears in the good with comparative advantage in both countries, the effects of each advantage on localization will be reinforced, and the income effect will be practically zero, given that both countries grow. The total balance of trade scarcely varies, as the increased net exports of the good with comparative advantage are compensated by the increased net imports of the good with lower relative demand.

Third, if the shock takes place in the good with comparative disadvantage in just one country the forces are opposing: the externality increases production of the good with comparative advantage, and the income effect produces an interindustrial transfer towards the good with comparative advantage, whose production also increases. The total balance of trade also grows, as net exports of the good with comparative advantage grow due to the income effect, and the net imports of the good with comparative disadvantage decreases due to higher income and lessened comparative disadvantage.

Fourth, if the externality occurs in the good with comparative disadvantage in both countries this means, on one hand, the moderation of the comparative disadvantage in each country, and on the other, income growth in both, so that the income effect scarcely exists in net terms. The moderation of comparative disadvantages means a brake on agglomeration of production in both countries responding to relative demand. The patter of trade will be modified so that net imports and exports are decreased in both countries, and as both decreases compensate each other, the balance will not change.

In short, the effects on localization of production and balance of trade if an externality occurs can be very different, depending on whether it takes place in an industry with comparative advantage or comparative disadvantage. In general, in line with Rodríguez Clare (2007), the externality together with the comparative advantage reinforces the effects of the HME, but if it occurs in industries with comparative disadvantage it moderates agglomeration. The externality also means income growth in the country where it occurs, triggering an effect of interindustrial transmission of localization. If this occurs in a single country, the total balance of trade will increase. If the externality takes place in more than one country and in the industries with comparative advantage, the agglomeration of production is reinforced, and moderated when industries have a comparative disadvantage; also, the compensations of net flows of imports and exports hardly alter the balance of trade of each of the countries.

Conclusiones Finales

A lo largo de los tres capítulos de esta tesis doctoral que utiliza como referente la Nueva Geografía Económica (NGE), profundizamos en el concepto de la aglomeración industrial como fenómeno asociado a la localización de la actividad económica en el espacio. Para ello, nos hemos situado en dos cuestiones de partida relevantes en la NGE: el papel del *Home Market Effect* (HME) y de las externalidades productivas para explicar el patrón y mecanismo de aglomeración de la producción y el patrón de comercio en una economía. Con este planteamiento, el objetivo de esta tesis ha sido ahondar en el análisis de estos dos conceptos desde un enfoque eminentemente empírico para, posteriormente, unirlos desde un punto de vista teórico. A continuación subrayamos los resultados fundamentales que hemos obtenido.

En el primer ensayo titulado, *The Home Market Effect in Spanish Industry, 1965-1995*, nuestro objetivo ha consistido en tratar de identificar empíricamente la existencia de HME en las manufacturas de las comunidades autónomas españolas, es decir, con datos regionales y no internacionales, con el propósito de detectar mayores efectos de Geografía Económica debido a los menores costes de transporte y mayor movilidad de los factores productivos que se dan a nivel regional. El periodo de información disponible ha sido los años impares de 1965 a 1995. Ni el ámbito geográfico elegido, ni el temporal, habían sido analizados anteriormente en la literatura, a excepción del trabajo de Rosés (2003), quien utiliza una base de datos histórica de 1797 a 1910. Hemos revisado las principales aportaciones teóricas que permiten estudiar el HME, entendido como la tendencia de los grandes países a ser exportadores netos de bienes con altos costes de transporte y fuertes economías de escala. A su vez, hemos empleado como referencia los modelos teóricos de Krugman (1980) y Weder (1995), y los sucesivos análisis empíricos de Davis y Weinstein (1996, 1999 y 2003).

Nuestra principal aportación en esta investigación ha sido la especificación del modelo presentado, ya que hemos optado por analizar cambios porcentuales de demanda y producción, en el citado panel de comunidades autónomas, en vez de cambios en niveles como sería la especificación tradicional en la literatura, y que corresponde a la especificación original de Davis y Weinstein. Esta versión del modelo se ha debido al propio concepto del HME, que implica trabajar en términos relativos. Y tiene una justificación empírica muy importante puesto que permite controlar las posibles variaciones regionales en la producción que se pueden producir en un panel de datos. Esta necesidad no existe en los análisis de corte transversal con los que se realizan los contrastes tradicionales. Así, hemos contrastado la efectividad del incremento más que proporcional en la producción de un bien que provoca el aumento en un determinado porcentaje en la demanda de ese bien en una industria, definiendo las variables en proporciones y no en niveles.

Así, como resultado de la estimación econométrica realizada hemos encontrado evidencia a favor de la presencia de HME en un número importante de ramas productivas. En concreto en 5 de las 9 ramas analizadas: alimentos, bebidas y tabaco; papel y artes gráficas; plástico, caucho, madera, corcho y mobiliario; productos de minerales no metálicos; y productos metálicos y maquinaria. La importante evidencia de HME podría ser reflejo de la creciente apertura económica exterior española durante los años 60 y la posterior integración económica europea.

La potencial endogeneidad presente en las ecuaciones a nivel industrial, que no en todas, parece derivarse de la construcción de las variables dentro de cada rama, y no de su expresión en proporciones. Dada la posible sensibilidad de los resultados a los instrumentos escogidos, hemos optado por corregir la endogeneidad ecuación a ecuación (PANEL por industria), para un mejor control de su efecto sobre los residuos, sin mezclar sobre éstos los efectos de la relación entre las ecuaciones. No obstante lo anterior, también nos hemos planteado la posibilidad de estimar conjuntamente el sistema mediante un SURE (3SLS-PANEL), de forma que se tengan en cuenta las posibles relaciones existentes entre ecuaciones, que se derivan del hecho de que los cambios proporcionales en la producción o demanda de una actividad afectan a la proporción de las demás ramas. De la estimación mediante SURE cabe esperar una mayor eficiencia, pero no cambios significativos en los coeficientes, que inicialmente ya son consistentes. De hecho, los resultados en términos de HME, en los que reside el objetivo principal del capítulo, son robustos a la técnica de estimación empleada (PANEL por industria o 3SLS-PANEL).

A continuación, hemos analizado el efecto conjunto sobre el patrón de producción de la especialización derivada de las dotaciones de factores (modelo Heckscher-Ohlin, HO) y de la evidencia obtenida en nuestro trabajo a favor del tamaño de mercado (NGE), para explicar los determinantes de la localización de la industria en España desde la década de los sesenta. Se puede apreciar cómo de los sectores dónde existe sistemáticamente HME, es decir, en alimentos, bebidas y tabaco, plástico, caucho, madera, corcho y mobiliario, productos de minerales no metálicos, productos metálicos y maquinaria, y papel y artes gráficas, en los cuatro primeros la Geografía Económica tiene mayor importancia a nivel regional. En el resto de sectores la mayor relevancia la tienen las dotaciones de factores. Sólo hay una rama de actividad, papel y artes gráficas, en la que hay evidencia de que HO y HME coexisten y se complementan a la hora de explicar la localización de su producción. En definitiva, Rosés (2003) concluyó que en el siglo XIX las dotaciones de factores explicaban cerca del 85% de la variación del *output* manufacturero; nosotros concluimos que hemos aportado evidencia que permite afirmar que, desde la década de los sesenta, han cobrado relevancia los factores acumulativos propugnados por la NGE, en convivencia con las dotaciones de factores, como determinantes de la geografía industrial en España.

En el segundo ensayo de la tesis, titulado *External Economies as a Mechanism of Agglomeration in EU Manufacturing*, hemos estudiado las externalidades productivas y su utilización para explicar procesos de aglomeración o concentración geográfica de la actividad en el espacio. Más concretamente, las fuentes de externalidades marshallianas explican la concentración geográfica de la actividad económica gracias a la presencia de tres factores clave: un mercado conjunto de mano de obra cualificada, vínculos de oferta y demanda fruto de relaciones *input-output* (también llamadas externalidades pecuniarias o estáticas) y, por último, la existencia de desbordamiento tecnológico consecuencia del intercambio de información entre empresas próximas en el espacio (conocidas como externalidades tecnológicas o dinámicas).

Pues bien, en este ensayo se ha analizado el impacto de estas externalidades sobre el crecimiento de la productividad como mecanismo de aglomeración.

De este modo, mostramos cómo el crecimiento de la productividad depende de las externalidades pecuniarias y tecnológicas, tanto interindustriales como intraindustriales, nacionales o internacionales. Todo ello lo hemos contrastado en la industria manufacturera, desagregado por actividades, en los países de la Unión Europea y para el periodo de información disponible, 1995-2002. Esta manera de abordar el análisis constituye una aportación en sí misma, ya que aunque en la literatura existe evidencia al respecto, es todavía muy escasa y procede de estudios de industrias concretas o análisis agregados de la actividad productiva.

Otra importante aportación de nuestro trabajo es que estas externalidades a nivel internacional también juegan un papel importante como mecanismo de aglomeración. Habitualmente este análisis se ha restringido a nivel regional dentro de un país, pero nosotros hemos encontrado mayor efecto de estas externalidades cuando consideramos su dimensión internacional. Asimismo, también hemos contrastado cómo la geografía pone de relieve su efecto sobre la productividad, puesto que las regiones más alejadas recibirán un efecto menor de una misma externalidad que aquéllas con una posición central.

Pasando ya a resultados concretos obtenidos, éstos pueden dividirse en dos líneas. En primer lugar, si sólo consideramos las externalidades nacionales, se confirma la incidencia positiva en el crecimiento de la productividad del trabajo de las dotaciones factoriales en prácticamente todos los sectores analizados, con aparición incluso de economías de escala en varios de ellos. Como salvedades, en la industria de material de transporte no son relevantes las dotaciones de factores pero sí las externalidades, y ni las dotaciones factoriales ni las externalidades nacionales son importantes en productos refinados del petróleo, lo que parece lógico al ser un sector del que se depende mucho del exterior.

También es evidente la existencia de economías intraindustriales de especialización en la mayoría de las manufacturas, excepto en el mencionado refinado del petróleo y en maquinaria y equipo. Las del tipo interindustrial de diversificación son, a su vez, relevantes, excepto en los productos de la madera, en el refino de petróleo y aceites derivados y en otros productos de minerales no metálicos. Asimismo, los vínculos interindustriales son sólo importantes para los productos de la madera, productos químicos y en metálicas básicas y productos metálicos, indicando quizás la sensibilidad de estos sectores al desequilibrio en sus relaciones interindustriales.

En segundo lugar, si consideramos las externalidades nacionales e internacionales conjuntamente, comprobamos cómo, nuevamente, la abundancia de capital es significativa y positiva en todos los sectores excepto en material de transporte. Esto puede implicar que los mecanismos de aglomeración propugnados por la NGE juegan un papel muy importante en este sector.

Respecto a la especialización internacional, ésta es altamente significativa en casi todas las industrias y casi siempre acompañada por especialización nacional. Como salvedades, en primer lugar, papel, publicidad e imprenta, caucho y plástico, y equipo óptico y eléctrico, sectores en los que la especialización nacional es importante pero no la internacional. En segundo lugar, alimentos, bebidas y tabaco, refino de petróleo y aceites derivados, y otros productos de minerales no metálicos, sectores que sólo muestran significatividad internacional. Es destacable comprobar cómo en un contexto internacional las externalidades interindustriales nacionales cobran relevancia frente a la diversificación nacional, que la pierde. Esto ocurre en sectores como refino de petróleo y aceites derivados, piel y sus derivados, productos de la madera, y maquinaria y equipo. Especial mención merecen estas dos últimas ramas de actividad porque en ellas todos los determinantes de aglomeración son significativos cuando los efectos internacionales de una externalidad son considerados.

La perificidad es significativa en todos los sectores excepto en aquellos que están sujetos a existencia de recursos naturales y, por tanto, a la dotación de factores: refino de petróleo y aceites derivados, caucho y plástico, otros productos de minerales no metálicos y material de transporte.

En definitiva, hemos encontrado evidencia importante de especialización, más que de diversificación, en línea con la mayoría de la literatura existente (De Lucio et al. 2002 y Henderson 2003). Y, a nivel tanto nacional como internacional, hecho que la literatura sólo encuentra en un contexto regional, lo cual supone una diferencia a tener en cuenta como aportación. Además, en línea con Henriksen et al. (2001) las externalidades interindustriales nacionales son robustas en industrias más sofisticadas, tales como metálicas básicas y productos metálicos, equipo óptico y eléctrico, y material de transporte y, también, en las menos tecnológicas cuando se considera el contexto internacional y la perificidad. Por ello, es importante tener en cuenta este entorno ya que si no se subestiman las externalidades nacionales, sobre todo en industrias de baja tecnología.

Nuestros resultados son una contribución al caso europeo, es decir, países desarrollados y geográficamente próximos que se benefician de la integración económica que maximiza la movilidad de bienes y factores y minimiza los costes de transacción y transporte. Pues bien, comparando estos resultados con una muestra internacional más heterogénea, llegamos a la conclusión de que la integración económica parece ser relevante para que las externalidades actúen como mecanismo de aglomeración. De todas formas, debemos ser cautelosos con esta afirmación por la ausencia de datos para una muestra más amplia de países, hecho que incentiva una futura línea de investigación.

Por último, en el tercer ensayo titulado *The Home Market Effect in the Presence of Marshallian Externalities*, hemos estudiado a nivel teórico y de forma conjunta los dos fenómenos económicos clásicos de aglomeración de la producción en un espacio físico, examinados separadamente por la literatura: el HME y la presencia de una externalidad marshalliana. A través de estos procesos de aglomeración, del incremento de la producción en las variedades y del aumento del saldo comercial, las externalidades podrían estar compensando la tendencia a rendimientos decrecientes en la acumulación de factores y con ello posibilitando crecimiento a largo plazo.

Así, hemos desarrollado un modelo sencillo en un contexto de rendimientos crecientes, competencia monopolística y costes de transporte, de tal manera que en aquéllos países que aglomeran la producción y concentran su demanda en unos determinados bienes se produce el conocido HME. Hay dos países, Home y Foreign, y dos industrias, sin diferencias de tecnología entre ellas. Es precisamente entonces cuando la introducción de una externalidad tecnológica altera las consecuencias del HME sobre la acumulación de la producción y sobre el patrón de comercio.

La existencia de este *shock* tecnológico aumenta la productividad de alguna industria o de ambas, en uno de los dos países o en ambos a la vez. También reduce el precio del bien al que afecta e incrementa la renta del país en el que tiene lugar. A este hecho hay que añadir el que exista mayor mercado relativo o ventaja comparativa (origen del HME) en esa industria o lo contrario, mercado menor o desventaja comparativa. Como es esperable, los resultados son diferentes dependiendo en qué situación nos encontremos.

En primer lugar, si el *shock* ocurre en el bien con ventaja comparativa en un sólo país, se da un fortalecimiento de la localización de la producción de dicho bien. Es decir, la externalidad refuerza la ventaja comparativa. Además, se produce un efecto renta que actúa como canal de transmisión interindustrial de crecimiento hacia el sector con desventaja comparativa y también aumenta su producción; el efecto final en el mismo dependerá del resultado neto de ambas fuerzas. Respecto al comercio, aumenta el saldo comercial total del país, principalmente por mejorar las exportaciones netas del bien con ventaja comparativa.

En segundo lugar, si la externalidad se da en el bien con ventaja comparativa en los dos países, se van a ver reforzados los efectos de cada ventaja sobre la localización, y el efecto renta va a ser prácticamente nulo, puesto que ambos países crecen. El saldo comercial total apenas varía, por cuanto el aumento de las exportaciones netas del bien con ventaja comparativa queda compensado con el aumento de las importaciones netas del bien con menor demanda relativa.

En tercer lugar, si el *shock* tiene lugar en el bien con desventaja comparativa en un solo país las fuerzas son opuestas: por la externalidad se incrementa la producción del bien con desventaja comparativa y, por el efecto renta, se produce una transmisión intersectorial hacia el bien con ventaja comparativa, cuya producción también aumenta. El saldo comercial total crece asimismo, ya que aumentan las exportaciones netas del bien con ventaja comparativa por el efecto renta y, disminuyen las importaciones netas del bien con desventaja comparativa por el incremento de la renta y por la disminución de la desventaja comparativa.

En cuarto lugar, si la externalidad ocurre en el bien con desventaja comparativa en los dos países implica, por un lado, la moderación de la desventaja comparativa en cada país y, por otro, un crecimiento de la renta en ambos, por lo que apenas existe un efecto renta en términos netos. La moderación de las desventajas comparativas supone un freno a la aglomeración de la producción en ambos países atendiendo a la demanda relativa. El patrón de comercio se verá modificado de modo que disminuyen tanto las importaciones como las exportaciones netas de cada país y, en tanto en cuanto ambas disminuciones se compensen, el saldo no variará.

En definitiva, los efectos sobre la localización de la producción y sobre el saldo comercial si se produce una externalidad pueden ser muy diferentes, según tenga lugar en una industria con ventaja comparativa o con desventaja comparativa. En general, en línea con Rodríguez Clare (2007), la externalidad unida a la ventaja comparativa refuerza los efectos del HME, pero si se da en sectores con desventaja comparativa se modera la aglomeración. La externalidad implica, además, un crecimiento de la renta del país que tiene lugar que desencadena un efecto de transmisión interindustrial de la localización. Si esto ocurre en un solo país, el saldo comercial total aumenta. Si la externalidad tiene lugar en más de un país y en los sectores con ventaja comparativa, se refuerza la aglomeración de la producción, y se modera cuando las industrias tienen desventaja comparativa; además, las compensaciones de los flujos netos de importaciones y exportaciones apenas alteran el saldo comercial de cada uno de los países.

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