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CHAPTER 6

DETERMINANTS OF FIRM GROWTH

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CHAPTER 6

DETERMINANTS OF FIRM GROWTH

> "*Space matters in economic growth, and also in legitimation and competition within and between industries*".
>
> Van Wissen (2004)

6.1. INTRODUCTION

Firm growth is the process due to the interaction of manager or a owner's decision about strategic financial decisions, organizational decisions. In addition to these managerial decisions, external or even random factors can change the initial conditions from a firm towards a new environment. To cope with these changes, firm need to change their size. The factorial analysis of firm growth has largely been done but there are still several gaps to be filled. In this chapter we analyse the determinants of firm growth for Spanish manufacturing and service industries between 1994 and 2002.

In the previous chapter we observed that locational variables are essential for explaining the differences between firm growth and firm size. According to the endogenous models of economic growth (Romer, 1986, 1990; Grossman and Helpman; Aghion and Howitt, 1992), firm

growth will benefit from a certain level of R&D. Firms will benefit from R&D spillovers if they locate in R&D intensive regions. Audretsch and Feldman (1996) determined the importance of location for different types of industries. Their results showed that firms concentrate in order to take advantage of knowledge spillovers. Moreover, the industrial composition of a region can produce positive or negative externalities depending on the firm's needs. Duranton and Puga (2001) showed that young firms need specialized environments in which to grow, while mature firms need more diversified regions.

In the economic literature, the geographical analysis of firm growth found greater difficulties than classical economic approaches. New approaches based on classical location theory such as `New Economic Geography´ (Krugman, 1991, 1995; Fujita et al., 1999), and in general the approaches based on economies of agglomeration (Fujita and Thisse, 2002), provide further opportunities for analysing firm demography and regional growth.

However, not only regional factors but also sectorial factors affect firm growth. Barriers to entry, capital intensity and firm size distribution will affect the propensity to grow. Therefore, we also need to include these factors as explanatory variables.

Our results show that Gibrat's Law is rejected in both the manufacturing and service sectors. Moreover, regional variables such as R&D intensity show a positive relationship between firm growth and size regardless of the type of industry. Diversified regions show a negative influence on firm growth, whereas specialised regions show a positive influence. In general, results show that barriers to entry act as barriers to growth. However, if we analyse these determinants depending on the technological or knowledge intensity in each sector, there are slight

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differences. While some factors act as barriers to growth for some sectors, they may have positive impacts on others.

This study makes several contributions to the literature on firm growth. Firstly, we analyse more territorial and sectorial variables than other studies. Secondly, we extend Spanish literature in this field. Thirdly, we differentiate between the manufacturing and the service industries (the determinants of firm growth in service industries have not been examined separately from those in manufacturing industries). Our aim is to analyse Gibrat's Law for Spanish firms between 1994 and 2002 in order to fill this gap in the literature and examine the extent and determinants of firm growth in both the manufacturing and service sectors. Incorporating the sectorial and regional dimension will enrich our analysis because we will be able to explain how barriers to entry condition firm growth.

This study is organised as follows. In section 2 we summarise the determinants of firm growth and the gaps have found in the literature. In section 3 we present the relationship between locational externalities and firm growth. In section 4 we review our methodology and empirical results. Finally, in section 5 we summarise our main findings and present our conclusions.

6.2. LITERATURE

In this section we review the literature on firm growth. We first describe several factors included in the analysis of firm growth and report the corresponding results. Finally, we analyse one of the gaps in the empirical literature: the locational effects on firm growth.

6.2.1. Factors determining firm growth

A firm's growth depends on the interaction of several circumstances, including the capabilities of its managers, its financial assets, its investment in R&D and innovation, and its sector and geographical location.

Storey (1994a) analysed the determinants of firm growth (see chapter 2). However, the stochastic theory has focused on firm size and age and has ignored the introduction of several important variables. Recent studies such as those by Calvo (2006), Niefert (2005), Audretsch and Lehman (2005), Faggio and Konings (2003) and Heshmati (2001), however, have analysed the role of other variables such as human capital, the local labour market, product and process innovation, location, legal status and capital structure.

Table 6.1 shows some of the main variables used in recent studies. To analyse how these variables affect firm growth, we have divided them into three groups: internal characteristics, sectorial characteristics and regional characteristics.

The internal characteristics of a firm are crucial to its development. Some of these variables concern people who are closely related to the firm (for example, if the entrepreneur or manager is unable to develop new products, see market opportunities or find high-quality inputs, the firm may be at serious risk). Other examples of internal characteristics are the firm's initial level of debt, ownership structure and decisions on whether to sell in foreign markets. The age of the firm is also a key determinant of its performance.

Financial constraints have been shown to be a serious barrier to growth for small and medium-sized firms suffering from asymmetric information (Evans and Jovanovic, 1989; Becchetti and Trovato, 2002; Cabral and Mata, 2003).

Access to foreign markets is also important for firm growth since it represents a learning process that improves productivity (Delgado et al., 2002). Becchetti and Trovato (2002) and Peña (2004) found a positive relationship between firm growth and the firm's external activity. Wagner (1995) noted that the most relevant economic factors positively affecting the relationship between firm size and exports are the existence of economies of scale in production, a fuller utilization of managers, the opportunity to raise finance at low cost, having a marketing and sales department and a greater capacity for taking risks due to internal diversification. Several recent scholars, such as Pfaffermayr (2004), Voulgaris et al. (2003), Wagner (2001) and Bernard and Jensen (1999), have analysed the impact of exports on firm growth. Their results show that there is a significant relationship between firm growth and import-export behaviour. Wagner (2001) found an inverse U-shaped relation between the number of employees and the export/sales ratio. However, he also found that sectorial characteristics are important for correctly determining the relationship between firm size and growth.

It is also important to take into account the characteristics of each sector. For example, the microeconomics of endogenous growth theories state that a firm belonging to an R&D intensive sector may have more opportunity to grow than a firm in a labour-intensive sector. According to Davidsson et al., 2002, firms in different sectors have different probabilities of increasing in size. This is because access to finance and specialized services etc. are obtained more easily by some sectors than by others.

R&D investment should be a key determinant of a firms' dynamics. Many researchers have emphasized the role of R&D on firm growth and found that more R&D-intensive firms tend to grow faster. Recently, Blonigen and Tomlin (2001), Niefert (2005), Oliveira and Fortunato (2005) and Yang and Huang (2005) found a positive relation between R&D intensity and growth rate.

The intensity of innovation is also a key determinant of firm growth. Jaumandreu (2003) found that product innovations enhance employment growth and that the magnitude of the effect corresponds approximately to the increase in innovative sales. Audretsch and Mahmood (1994a), Audretsch (1995a), Doms et al. (1995), Niefert (2005) and Calvo (2006) also found evidence of the positive effects of innovation on firm growth.

Firm location provides the inputs firms need to develop their activities. These inputs include aspects such as skilled labour (Heshmati, 2001; Peña, 2004), R&D support, specialized suppliers, business climate or creative atmosphere, and knowledge spillovers (Audretsch and Lehman, 2005), which allow technological or organizational improvements to move easily between firms.

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Table 6.1. Effect of variables on firm growth.

	Variyam and Kraybill (1992)	Audretsch and Mahmood (1994a)	Audretsch (1995a)	Doms et al.. (1995)	Blonigen and Tomlin (2001)	Heshmati (2001)	Becchetti and Trovato (2002)	Peña (2004)	Audretsch and Lehman (2005)	Niefert (2005)	Oliveira and Fortunato (2005)	Yang and Huang (2005)	Calvo (2006)
INTERNAL													
Independent establishment	-	-											
Foreign activity							+	+					
Rents							+						
SECTORIAL													
Sales	-												
R&D intensity					+					+	+	+	
Innovation		+	+	+						+			+
Capital intensity		-	+	+	-	+						+	
Industrial growth		+	+										
Labour productivity				+		-						+	
REGIONAL													
Human Capital						+		+					
University productivity									+				
Public Subsidies							+, not signif.						

Source: author's own.

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Here we assume that external economies depend on regional characteristics such as R&D intensity, industrial diversity and industrial specialisation. The region is the element that allows us to group territories in which external economies are similar. We consider that the boundaries of cities are not limited and their effect may spread over the territory. Therefore, our territorial dimension will be the region. The role of policy makers is also important since government subsidies are another important determinant of firm performance. Becchetti and Trovato (2002), however, found that this is not a concluding variable of firm growth.

6.2.2. Locational dimension

In this section we highlight a gap in the analysis of firm growth. This is the impact of a firm's geographical location on its growth. Clearly, the location of the firm affects its performance through positive and negative externalities. The concentration of firms in a small geographical area will have a positive impact on their levels of efficiency.

As most studies in this field tend to focus on growth, they do not consider the role of spatial externalities. However, to explain the spatial patterns of firm growth, we need to know which mechanisms are necessary for firms to grow. These mechanisms depend on entrepreneurial characteristics, firm characteristics and environment (Storey, 1994a). Few studies have studied the effect of a firm's location on its future growth.

To explain the locational effect on firm growth, we need to understand the role of space in this process both through networks and in product markets. The roles of location in firm growth involve:

- Market opportunities i.e. firms tend to locate near the region in which consumers are willing to buy their product.
- Suppliers who are able to satisfy the organizational needs of the firm.

Firm performance therefore depends not only on its internal factors but also on the environment in which it operates. These spatial factors should ideally be incorporated into empirical analysis. This is a mutually reinforcing process in which firms are affected by the region but in which the region develops at the same speed as the firms within it.

There has been much interest in the impact of location-specific variables on firm dynamics in Spain because of regional economic differences (Callejón and Segarra, 1999; Arauzo and Manjón, 2004; Arauzo and Teruel, 2005)[1]. However, such variables are lacking in firm growth theory. International studies such as those by Audretsch and Dohse (2004), Resende (2004), Hoogstra and Dijk (2004) and Reichstein and Dahl (2004)[2] examined how the growth of a firm depends on its location. In general, their results show that location matters. There is also a lack of contributions analysing the impact of location on firm growth in the service sector. Hoogstra and Dijk (2004) and Reichstein and Dahl (2004) included firms from both the manufacturing and service industries but did not investigate the differences between the two sectors.

[1] Callejón and Segarra (1999) found that firm entries and exits increase the total factor productivity in industries and regions. Arauzo and Manjón (2004) found that the analysis of firm entry in Catalonia can be misleading if regional effects are ignored. Arauzo and Teruel (2005) found that Spanish firm entries depend on the size of the municipality.

[2] Daly and Webber (1973) presented a theory of firm growth related to urban amenities. Their approach is related to the classic conception of the existence of an optimal firm size.

The aim of our study is to fill these gaps in the literature by focusing on Gibrat's Law in order to estimate firm growth in the manufacturing and service sectors, paying special attention to the impact of location.

6.3. LOCATIONAL EXTERNALITIES

Since location plays a key role, we are interested in analysing the relationship between locational externalities and firm growth[3]. Many contributions have analysed the relationship between a firm's geographical location and its economic performance. In this section we will define the concepts of "externalities" and "locational externalities".

6.3.1. Externalities

External economies can be regarded as increases in efficiency experienced by agents in an area due to the concentration of people or activities in the region. Krugman (1991, 1995) popularised the inclusion of space in economic models, though Alfred Marshall (1892) had introduced the economic concepts a century before. According to Marshall (1892), there are three types of external economies: a) specialised local suppliers, b) specialised labour markets, and c) knowledge spillovers. Krugman (1995) presented different models in which economies of scale, the size of the home market, and transportation costs generate positive returns to scale.

Since the initial contributions on externalities, there have been many attempts in the literature to classify and define which factors cause

[3] In this chapter, we analyse the effect of locational variables on firm growth and, though we do not present a detailed analysis of locational externalities, we briefly analyse the concept and review the literature.

economic externalities. Recently, externalities were developed by Glaeser et al. (1992) and Henderson et al. (1995). Glaeser et al. (1992), for example, defined three kinds of dynamic externalities:

- MAR (Marshall-Arrow-Romer) externalities: these appear when there is industrial specialisation (local monopoly). MAR externalities imply that knowledge comes from firms in the same industry. Therefore, an increase in an industry's concentration will increase spillovers.
- Jacobs externalities (Jacobs, 1970): these appear when there is industrial diversity. Jacobs externalities imply that spillovers come from firms in different industries.
- Porter externalities (Porter, 1990): these appear in the presence of industrial specialisation in an industry (local competence). Porter highlighted the input-output relationships between different industries in order to increase efficiency.

Glaeser et al.'s (1992) study analysed whether technological externalities affect firms in the same sector (intrasectorial externalities) or whether they affect firms from different sectors (intersectorial externalities). Their results show that metropolitan areas in the United States have intersectorial externalities on employment growth.

Henderson et al. (1995) continued the typology of Glaeser et al.'s (1992) externalities but ignored those of Porter:

- MAR Externalities: these locational externalities are due to knowledge spillovers between firms in the same industry.
- Jacobs Externalities: these urbanization externalities are due to knowledge spillovers between firms in different industries.

Conversely, Henderson et al. (1995) found evidence of knowledge transmission and generation between firms in the same industry. Therefore, with regard to technological information they observed the existence of intrasectorial externalities.

Understanding to what extent externalities affect the local economy is crucial for policy makers. On the one hand, if externalities are intrasectorial, firms located in specialised environments from their own activity will benefit from the generation of external effects. On the other hand, if externalities are intersectorial, firms located in diversified areas will enjoy more external benefits.

Empirical evidence on Spanish manufacturing industries is rather diverse. Lucio et al. (2002) showed recent evidence of U-shaped effects due to specialization (MAR externalities) on Spanish manufacturers, but did not find any evidence of diversity (Jacobs externalities) or competition (Porter externalities). Costa et al. (2004) also analysed the effect of agglomeration economies on Spanish manufacturers and found that diversity and specialisation externalities can simultaneously affect firms in the same urban environment. More recently, Viladecans (2004) analysed agglomeration economies—urbanization (diversity) and localization (specialization)—in Spanish manufacturing industries. Her results show that diversity accounts for most of the influence on the location of manufacturing activity.

Finally, it is highly probable that the size of externalities depends on the size of the firm: the smaller the firm, the greater the effect. This is mainly because a small firm may benefit more from facilities provided by the territory in which it is located than a large firm. In this sense, policy makers should take care of policies affecting firms and territory.

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6.3.2. Locational externalities

In this section we will analyse the different factors that affect the location of the firm.

- Proximity to demand market and production factors

Krugman (1991) defined the best location for a firm as the place where there is access to cheap production factors and the largest market for the firm's final goods at the lowest transportation costs. In this way, firms will concentrate near metropolitan areas close to the final demand.

- External economies for specialization

Porter (1990) pointed out that other factors also determine firm growth e.g. proximity to local institutions provides a firm with tacit knowledge that cannot be acquired in the market. Consequently, firm location depends on the location of regional institutions, which can affect firm performance.

- Knowledge spillovers

The geographical proximity of firms in the same industry can lead to greater firm growth. Maskell (2001) pointed out that a more specialised environment in a less dense area may enhance contact between firms and thus increase knowledge spillovers.

This is one of the main reasons behind the attraction of rural areas. Today there is a process of migration of inhabitants from large metropolitan areas towards less densely populated areas.

Krugman (1991) pointed out that the concentration of specialised firms will create a specialised labour market, thus improving the performance of firms located in the area. In addition to specialised labour market niches, there will also appear institutions which will enhance the social and economic activity and which will increase the entrepreneurship.

We have discussed the theoretical effects of firm location on firm performance, but what evidence is there? Yoon-Suk Baik (2000) examined the evolution of firms in the American biotechnological industries and observed that firms located in highly competitive and specialised environments (*clusters*) present higher growth rates. Also, Staber (2001) showed evidence of firms located in highly specialised environments that present higher survival rates than firms located in a more diversified area.

The models of firm growth have ignored the presence of these locational externalities. Recently, however, Audretsch and Dohse (2004) with a regional approach, and Resende (2004) and Hoogstra and Dijk (2004) introduced the locational dimension into their analyses of firm growth. Hoogstra and Dijk (2004) also analysed the effect of regional factors on firm growth and introduce an index of regional specialisation on the labour market.

6.4. METHODOLOGY AND EMPIRICAL ESTIMATION

In this section we analyse which factors have an impact on firm growth and determine the extent of their influence. Our aim is to measure differences in the growth of Spanish firms between the two sectors.

Our starting point is the assumption that firm growth patterns depend on the industrial sector, i.e. the process of firm growth in the service sector is different from that in the manufacturing sector. Manufacturing activities have certain requirements that affect growth. Also, an entrepreneur's individual decisions can affect the behaviour of the firm.

6.4.1. Econometric methodology

The above empirical literature shows that internal, locational and sectorial variables can play an important role in firm growth. For a more complete view, we now incorporate several explanatory variables into the equation for Gibrat's Law.

The explanatory variables are divided into four groups (Table 6.2). The first group comprises individual characteristics such as the firm's lagged size, age, external activity, whether it belongs to a holding, and its legal status. The coefficients on the firm's lagged size variables (*Size*) will determine whether Gibrat's Law is accepted. As we have seen in previous chapters, the age variable (*Age*) represents how the firm evolves over time. This variable is closely related to the Theory of Learning (Jovanovic, 1982), which states that the youngest surviving firms will have the highest growth rates.

Exp identifies firms that export, *Imp* identifies firms that import, and *Expimp* identifies firms that export and import. These variables should have a positive impact on firm growth.

Holding measures whether the firm has consolidated and unconsolidated accounts relative to firms with unconsolidated accounts. We expect firms belonging to a holding to have a positive impact. *Legal* therefore

compares the performance of joint stock companies to the performance of firms with different legal statuses.

The second group comprises the variable *GDPgrowth*, which is the rate of growth of GDP in the economy for the period studied. Since firm growth behaves procyclically, firms are expected to benefit from increases in economic growth. We therefore expect a positive sign for this parameter.

Table 6.2. Description of variables

Variable	Description
	Individual variables
Size	Logarithm of the size from the previous period
Age	Logarithm of age
Exp	Dummy identifying whether the firm exports
Imp	Dummy identifying whether the firm imports
Expimp	Dummy identifying whether the firm exports and imports simultaneously
Holding	Dummy identifying whether the firms belongs to a holding of firms
Legal	Dummy identifying whether the firm is a joint stock company
	Cyclical variables
GDPgrowth	Annual growth of GDP
	Regional variables
RDregional	Regional R&D divided by regional GDP in year 2002.
DIV	Inverse of the concentration index of Hirshman-Herfindahl
SPE	Share of added value of industry k in region j with respect to total manufacturing added value of region j, divided by the share of added value of industry k in all regions in each year.
AR1…AR19	Dummies identifying location in one of the Spanish autonomous regions
	Sectorial variables
RDsector	R&D divided by sales in a sector.
INNOV	Expenditure on innovation divided by sales in each sector.
MES	Minimum efficient size measured by the percentage of sales divided by firms in each sector.
Micro	Firms with less than 10 employees in each sector.
KL	Capital divided by employees in each sector.
GrowthSector	Growth of the added value in each sector.
ENT	Firms entering with respect to the active firms in the market every year in each sector.

Source: author's own.

The third group comprises the regional effects on firm growth. *RDregional* identifies regional intensity in R&D in the year 2002, measured as R&D expenditure divided by regional GDP. We also include dummies identifying the location of the firm in one of the 19 Spanish autonomous regions (*AR1…AR19*) in order to ascertain the advantages and disadvantages of locating in a particular region. There are 19 regions and we compare all of these regions with the Autonomous Region of Madrid.

DIV_{jt} indicates how diversified the industrial structure of a region is and captures the effect on firm growth of a specific type of economies of agglomeration. According to some geographic models, regions with a greater diversity of industries are more likely to be preferred by new firms in innovative industries because of the effect of interindustrial knowledge spillovers, also known as Jacobs externalities (Glaeser et al., 1992). A diversified industrial structure is a normal characteristic of large cities. Other factors linked to diversity that favour innovative growth are the availability of specialized and advanced suppliers and business services, and a greater probability of finding niche markets. This indicator is defined as the inverse of the concentration index of Hirshman-Herfindahl,

$$DIV_{jt} = \Big/ \sum_i \left(\frac{V_{kjt}}{V_{jt}} \right)^2$$

where V is the added value in industry *k* and region *j* in the current year. The level of diversification of a region's industrial structure grows as the value of the indicator increases. The sign of the parameter is ambiguous. We may expect a diversified industry structure to foster firm growth in high-tech industries but not to affect it in traditional ones.

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SPE_{ij} indicates how specialised the industrial structure of a region is. In some industries, firms may benefit from locating in a specialized area. This happens because proximity allows them to benefit from industry-specific knowledge spillovers (Henderson et al. 1995) or other types of Marshallian externalities, such as the availability of skilled labour or specialized suppliers. This indicator is defined as the share of added value of industry *k* in region *j* with respect to total manufacturing added value of region *j*, divided by the share of added value of industry *k* in all regions in each year between 1994 and 2002.

$$SPE_{kjt} = \left[\frac{\frac{V_{kjt}}{V_{jt}}}{\frac{V_{kt}}{V_t}} \right]$$

The fourth group comprises sectorial variables. *RDsector* is the amount of expenditure in R&D as a percentage of sales in industry in each year. The intensity of innovation in an industry captures the technological opportunities open to new firms but also the greater risk associated with a dynamic market. Highly innovative markets attract new ventures, but survival is difficult and new firms present high rates of turbulence. The expected effect is undetermined.

MES estimates the minimum efficient size and measures barriers to entry. Empirical evidence shows that firms smaller than the minimum efficient size will grow faster than larger ones. We therefore expect a positive relationship between firm growth and *MES*: the larger the MES in the industry, the more firms will have to grow in order to survive.

MICRO determines the barriers to entry in an industry for microfirms with less than 10 employees. A high percentage of microfirms indicates that barriers to entry in an industry are small, so firms will have no

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incentive to grow in order to survive. The relationship is expected to be negative.

KL also identifies the barriers to surviving in an industry. We expect capital intensive industries to encourage firms to grow if they want to survive.

GrowthSector represents sectorial dynamics and is measured as the average annual growth of the industrial added value for each sector between 1994 and 2002. We expect a positive impact because industries that enjoy a higher growth in demand will encourage firms to grow.

INNOV measures the intensity of innovation. Unlike *RDsector*, it measures the intensity of innovation in a sector. Several factors are needed for innovation, but it is observed that small or radical modifications in the process lead to innovative products. Therefore, it is not necessary to incorporate R&D activities in order to innovate. Every firm has a different capacity to innovate depending on a set of factors that can affect the innovation process positively or negatively. These factors are:

a) There must be positive conditions affecting external factors such as product demand, market dimension, product life cycle and evolution of the scientific and technical tools required.
b) There must be internal factors on the engineering, design, research and merchandise of the product.
c) Firms should have a strategic organization and management.
d) Firm should wish to differentiate their products or processes from those of their competitors.

For successful innovators, greater innovation can have a positive effect. Firms that do not innovate as much as their competitors, however, may see a negative effect. We expect an undetermined effect.

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ENT represents the percentage of new firms entering a sector every year with respect to the number of active firms. It is known that new firms are smaller than active firms. New entrants can have two effects on the market. On the one hand, they may provide an incentive to active firms to be more efficient and increase in size. On the other hand, active firms may ignore new firms because they think they are not powerful enough. Therefore, we do not expect any sign.

The introduction of regional, sectorial and cyclical variables meant that we had to analyse different databases. The *Encuesta sobre Innovación Tecnológica* provides information about sectorial innovation and R&D expenditure. The *Encuesta Industrial* and *Encuesta Annual de Servicios* provide information about the amount of sales and number of employees. The *Directorio Central de Empresas* classifies establishments by size. The *Spanish National Accounts* provides information about regional GDP, sectorial added value and capital.

To analyse the effect of these groups on firm growth, we introduced them separately. The final model to be estimated has the following specification:

$$\begin{aligned}\Delta \log S_{i,t} = {} & \alpha_i + \beta_1 \log S_{i,t-1} + \beta_2 \log Age_{i,t} + \beta_3 \log Exp_i + \beta_3 HOLDING_i + \beta_4 LEGAL_i + \\ & + \beta_5 GDPgrowth_t + \beta_6 RDregional_{it} + \beta_7 DIV_{it} + \beta_8 DIV_{it} AR_i + \beta_9 RD\sec tor_t + \\ & + \beta_{10} INNOV_i + \beta_{11} MES_t + \beta_{12} MICRO_{it} + \beta_{13} KL_{it} + \beta_{14} GrowthSector_i + \\ & + \beta_{15} ENT + \varepsilon_{i,t}\end{aligned}$$

Note that, because of data restrictions in public databases (e.g. variables such as *HOLDING, LEGAL, GrowthSector*), some of our variables are static over time.

To estimate the previous equation, we apply panel data with random effects in order to capture the coefficients of variables with no time dimension. Dummy variables are also needed to analyse certain regional behaviours. We therefore estimated our equations with random effects panel data.

6.4.2. Results

This subsection shows the econometric results. Our aim was to analyse the effect of different variables on firm growth. In all the regressions estimated, the dependent variable is the difference in log firm size between two different periods. Our results appear to be meaningful and most of the parameters presented the expected sign. First we present the results classified by manufacturing and service industries and then classify the industries according to their level of technology.

We introduced the explanatory variables into four different estimations. The first one incorporated the internal variables, the second one incorporated the cyclical variables, the third one incorporated the regional variables and the last one incorporated the sectorial variables. The results of these four estimations are shown in the Annex V because we think it is interesting to compare the estimations of all variables for the whole database (both manufacturing and service industries).

6.4.2.1. Determinants of firm growth

Table 6.3 presents the four estimations of the determinants of firm growth for Spanish manufacturing and service industries between 1994 and 2002[4]. With regard to the internal characteristics, we significantly reject Gibrat's Law since there is a negative relationship between firm

[4] Annex V shows estimations incorporating the different groups.

growth and firm size. That means that small firms will grow more than large firms. However, there are differences between the manufacturing and the service industries. The effect on manufacturing firms is higher than on service firms. As is shown in the literature, the minimum efficient size of service firms is smaller than that of manufacturing firms (Audretsch et al., 2004). Therefore, the process of adjustment in the service sector is smaller than it is in the manufacturing sector. This is in line both with our results in previous chapters and with those of other scholars (Calvo, 2006; Peña, 2004; Fotopoulos and Louri, 2004).

According to Jovanovic's (1982) model, a firm's age or experience has a positive impact on firm growth since firms have the opportunity to know their own level of efficiency over time. Despite the positive and significant impact on the whole sample, the results differ between industries. Specifically, the impact of age on service industries is negative and much smaller than in manufacturing, though the estimated coefficient is not significant.

Age has obtained conflicting results in the empirical literature. Peña (2004), Audretsch and Lehman (2005) found a positive relationship between firm age and firm growth but Calvo (2006) and Oliveira and Fortunato (2004a, 2004b) found a negative relationship. It is likely that some service firms are created without a commitment to growth, i.e. they are run by entrepreneurs who have no intention of achieving a higher firm size. The fact that the minimum efficient size in service industries is smaller than in manufacturing industries reinforces the entrepreneur's decision to maintain the firm's size[5].

Firms that belong to a *Holding* group grow more than those that do not because these firms may be positively affected by the know-how of the

[5] Bird (1988) pointed out that an entrepreneur's motivation to grow is a crucial factor in firm growth.

other companies. They might also take more risks because other companies in the group may be able to make good any financial loss. Audretsch and Mahmood (1994a) also obtained a positive relationship between holdings and firm growth. Variyam and Kraybill (1992) found that independent firms grow less than those in holdings.

In agreement with Becchetti and Trovato (2002), Voulgaris et al. (2003) and Peña (2004), we found that firms with external activity have a higher and significant firm growth regardless of whether they belong to a manufacturing or service industry. This is because exporting firms need to be more efficient in order to compete internally, increase production and therefore increase in size. Finally, we should highlight several points. First, import behaviour has a higher impact for firms in the manufacturing sector than for firms in the service sector. Second, firms with simultaneous import-export behaviour have a higher positive impact than firms that only import or export.

The last internal characteristic was legal status. Our results show that, regardless of the type of industry, joint stock companies will have a significantly higher growth than firms with other legal statuses. These results are consistent with those of Niefert (2005), which showed that limited liability and joint-stock companies enjoy greater firm growth than others.

We also found that the cyclical variable (growth in Spanish GDP) had a significant and positive impact on firm growth. As expected, firm growth behaves procyclically. Therefore, economic growth will push the growth of existing firms. Few studies have introduced the evolution of GDP into their analyses of firm growth. One exception is Kangasharju (1999), who found that small Finnish firms are highly affected by macroeconomic fluctuations.

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Table 6.3. Determinants of firm growth for the whole database (GLS random effects model)

	WHOLE DATABASE	MANUFACTURING	SERVICES
Size	-0.2113	-0.2722	-0.1533
	(0.0009)*	(0.0013)*	(0.0013)*
Age	0.0022	0.0041	-0.0001
	(0.0001)*	(0.0002)*	(0.0002)
Exp	0.0117	0.0177	0.0595
	(0.0045)*	(0.0052)*	(0.0104)*
Imp	0.0313	0.0443	0.0427
	(0.0050)*	(0.0065)*	(0.0081)*
ExpImp	0.1534	0.2123	0.0587
	(0.0038)*	(0.0047)*	(0.0074)*
Holding	0.2600	0.3046	0.2025
	(0.0056)*	(0.0073)*	(0.0085)*
Legal	0.1716	0.2247	0.1166
	(0.0026)*	(0.0038)*	(0.0036)*
GDPgrowth	0.0246	0.0254	0.0269
	(0.0008)*	(0.0010)*	(0.0013)*
RDregional	0.0350	0.0350	0.0443
	(0.0052)*	(0.0070)*	(0.0078)*
DIV	-0.0149	-0.0020	-0.0195
	(0.0028)*	(0.0044)	(0.0036)*
SPE	0.0033	0.0049	-0.0095
	(0.0009)*	(0.0010)*	(0.0036)*
RDsector	0.0091	-0.0005	0.0042
	(0.0007)*	(0.0032)	(0.0009)*
INNOV	0.0056	0.0225	0.0025
	(0.0005)*	(0.0038)*	(0.0006)*
MES	-0.0021	-0.0011	-0.0023
	(0.0002)*	(0.0010)	(0.0002)*
Micro	-0.0025	-0.0024	0.0008
	(0.0001)*	(0.0002)*	(0.0004)**
KL	-0.0006	-0.0063	-0.0002
	(0.00004)*	(0.0007)*	(0.00005)*
GrowthSector	0.0001	0.0038	-0.0013
	(0.0001)	(0.0003)*	(0.0002)*
ENT	0.0079	-0.0086	0.0121
	(0.0005)*	(0.0017)*	(0.0006)*
Constant	0.3295	0.3261	0.0338
	(0.0399)*	(0.0666)*	(0.0600)
Chi2	58918.63	47327.02	17006.21
	(0.000)	(0.000)	(0.000)
R^2	0.4171	0.4657	0.3432
Hausman test	180349.94	130493.38	60551.04
	(0.000)	(0.000)	(0.000)
N	414123	235056	179067
Firms	139922	68281	71641
Hausman Test			

[a] This equation includes territorial variables (see Table 6.4).
Standard deviation in brackets.
** significant at 1%, ** significant at 5% and *** significant at 10%.*

The third group of variables are regional. In agreement with endogenous growth models, regional R&D intensity has a significant and positive impact on firm growth regardless of the industry. Firms located in regions with higher R&D intensity enjoy higher growth thanks to external spillovers. Audretsch and Lehman (2005) found a positive relationship between university spillovers and firm growth. Moreover, the closer the distance between the university and the firm, the greater the impact.

The fourth group of variables are sectorial. We found that intersectorial externalities (*MAR* externalities) have a significantly negative impact on firm growth i.e. regional diversification influence negatively. However, as this impact is not significant for manufacturing firms, there must be some manufacturing firms that benefit from diversified spillovers. Intrasectorial externalities (*Jacobs* externalities), on the other hand, have a significantly positive impact. Therefore, firms located in industrially specialised regions will benefit from positive externalities. However, we should point out that, for service industries, intrasectorial externalities had a significantly negative impact on firm growth.

The first analyses of regional externalities in Spain were conducted by Callejón and Costa (1995), Moreno (1996) and de Lucio et al. (1996). Much empirical evidence has recently appeared from the regional, provincial and city perspectives regarding the impact of external economies on concentration, productivity and competitiveness in Spanish manufacturing industries (Costa and Viladecans, 1999; Viladecans, 1999). Using a different approach, Segarra and Arcarons (1999) also estimated the impact of intrasectorial and intersectorial externalities on manufacturing industries in Spanish regions. Their results were not homogenous but, in general, intrasectorial (specialised) externalities

prevailed over intersectorial (diversified) externalities. These heterogeneous results were probably due to the area of reference: in large regions, diversity/specialisation may have a low impact because the area analysed is too large but in smaller regions they may have a greater impact.

Sectorial R&D intensity appears to have a positive and significant impact on firm growth, so firms operating in R&D intense sectors will benefit from sectorial externalities. However, we observed differences between manufacturing and service industries: service industries present a positive impact but manufacturing industries present a negative, though not significant, impact on firm growth. Some manufacturing firms observe sectorial R&D as a barrier to growth rather than an advantage. Blonigen and Tomlin (2001), Niefert (2005), Oliveira and Fortunato (2005) and Yang and Huang (2005) reported a generally positive relation between R&D intensity and firm growth. Clearly, however, firm size is an important variable in R&D activity: service firms are usually smaller, so they find it more difficult to do research[6].

Sectorial innovative intensity (*INNOV*), however, has a significantly positive impact regardless of the type of industry. Thus, innovative sectors will encourage a firm's growth. This is in agreement with Calvo (2006), who found that product and process innovation have a positive impact on the firm growth of Spanish manufacturing industries. Jaumandreu (2003) also observed a positive relationship between product innovation and employment growth. Audretch and Mahmood (1994a), Audretsch (1995a), Doms et al. (1995) and Niefert (2005) found international evidence for a positive relationship.

[6] Here we measure the private rate of return in terms of firm growth. However, some authors, e.g. Los and Verspagen (2000), have concluded that the social rate of return to R&D is larger than the private rate of return.

In general we observed a significant and negative relationship between firm growth and a high percentage of microfirms. This means that firms operating in sectors characterised by microfirms will be discouraged from growing. For service firms, however, the impact on firm growth was significant and positive, although the coefficient was close to zero.

Sectorial capital intensity (*KL*) had a significant and negative impact, which means that it acts as a barrier to growth. These results are in agreement with those of Audretsch and Mahmood (1994a), who also found a negative relationship between capital intensity and firm growth, but in disagreement with Doms et al. (1995), who found a positive relationship. Thus, the literature does not show conclusive results for this variable.

Industrial dynamics showed a positive but non-significant relationship, which means that a firm will grow if the sector in which it operates increases its added value. Audretsch and Mahmood (1994a) also found a positive impact for industrial dynamics. However, service industries showed a significant and negative relationship, perhaps because the increase in sectorial dynamics attracts the entrance of new firms, which may increase competitiveness and lead to a negative impact on firm growth.

Finally, entry rate has a significant and positive impact on firm growth. However, an analysis by industry shows that high entry rates discourage firms in the manufacturing sector. New entrants can therefore have a positive or a negative impact depending on the reaction of active firms. As we will see later, there will also be differences depending on the sectorial technological intensity.

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Table 6.4 shows the evolution of regional dummies compared to the region of Madrid. With the exception of Asturies, regional dummies for manufacturing industries generally have a positive impact on firm growth. Few regional dummies (the Balearic Islands, Cantabria, Castile la Mancha, Galicia, Navarre and Rioja) show a significant coefficient, however.

Table 6.4. Regional dummies

	WHOLE DATA BASE	MANUFACTURING INDUSTRIES	SERVICE INDUSTRIES
AR1-ANDALUSIA	0.0416	0.0235	0.0676
	(0.0136)*	(0.0218)	(0.0174)*
AR2–ARAGON	0.1000	0.0221	0.1398
	(0.0177)*	(0.0267)	(0.0236)*
AR3–ASTURIAS	0.0281	-0.0173	0.0545
	(0.0198)	(0.0290)	(0.0271)**
AR4–BALEARIC ISLANDS	-0.0054	0.0692	-0.0115
	(0.0246)	(0.0394)*	(0.0317)
AR5– CANARY ISLANDS	-0.0390	0.0100	-0.0333
	(0.0206)***	(0.0337)	(0.0260)
AR6–CANTABRIA	0.1962	0.1643	0.1893
	(0.0186)*	(0.0315)*	(0.0232)*
AR7–CASTILE LA MANCHA	0.1204	0.0933	0.1288
	(0.0164)*	(0.0246)*	(0.0220)*
AR8– CASTILE LEON	0.0867	0.0311	0.1175
	(0.0150)*	(0.0228)	(0.0198)*
AR9–CATALONIA	0.1146	0.0250	0.1457
	(0.0193)*	(0.0293)	(0.0255)*
AR10–CEUTA	-0.1158	0.0304	-0.1680
	(0.0380)*	(0.0621)	(0.0483*
AR11-VALENCIA	0.0877	0.0389	0.1121
	(0.0167)*	(0.0251)	(0.0223)*
AR12–EXTREMADURA	0.0239	0.0211	0.0392
	(0.0165)	(0.0260)	(0.0211)***
AR13–GALICIA	0.0924	0.0455	0.1120
	(0.0152)*	(0.0230)**	(0.0202)*
AR15–MELILLA	-0.1139	0.0386	-0.1442
	(0.0696)	(0.1544)	(0.0776)***
AR16–MURCIA	0.0898	0.0357	0.1211
	(0.0165)*	(0.0260)	(0.0213)*
AR17–NAVARRE	0.1337	0.0640	0.1578
	(0.0186)*	(0.0277)**	(0.0250)*
AR18–BASQUE COUNTRY	0.0651	0.0061	0.0875
	(0.0166)*	(0.0254)	(0.0217)*
AR19–RIOJA	0.0720	0.0019	0.1083
	(0.018)*	(0.0275*	(0.0240)*
R^2	0.4171	0.4657	0.3411

Standard deviation in brackets.
** significant at 1%, ** significant at 5% and *** significant at 10%.*

The service industries show a positive relationship between regional dummies and firm growth. The only exceptions are the Balearic Islands, the Canary Islands, Ceuta and Melilla).

Therefore, it would appear that, if we keep all parameters constant, a manufacturing firm located in any other region than Madrid would grow more. However, as firm growth does not depend only on these regional dummies but also on a set of factors, which we have analysed previously, we cannot state that manufacturing firms located in regions other than Madrid grow more than in Madrid.

Finally, the positive sign for regional dummies has another interpretation. It reflects the existence of regional positive externalities in the territory that are not described by regional R&D intensity, diversification externalities or specialised externalities. Territories may therefore attract firms and encourage growth through other factors such as natural resources, strategic location, public subsidies, etc.

6.4.2.2. The technological intensive sectors

In general, the results in Table 6.3 suggest that firm growth behaviour is negatively and strongly related to lagged firm size and positively related to R&D intensity and differences between manufacturing and service industries. One of the main reasons behind the heterogeneous behaviour of the two industries is the different technological intensity. Variables that represent a barrier to grow for some firms may encourage other firms to grow. Therefore, we will analyse the difference between belonging to a technology-intensive sector and belonging to a knowledge-intensive sector.

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Table 6.5. OECD classification of sectors depending on technological intensity according to the CNAE-93 Spanish classification

HIGH TECH

High-tech manufactures

30	Office machinery and computers
32	Radio, television and communication equipment and apparatus
33	Medical, precision and optical instruments, watches and clocks

High-tech services

64	Post and telecommunications
65 - 67	Financial intermediation, except insurance and pension funding, Insurance and pension funding, except compulsory social security, activities auxiliary to financial intermediation.
71 - 73	Renting of machinery and equipment without operator, computer and related activities and R&D activities.

Medium-high-tech manufactures

24	Chemicals and chemical products
29	Machinery and equipment n.e.c.
31	Electrical machinery and apparatus n.e.c.
34	Motor vehicles, trailers and semi-trailers
35	Other transport equipment

LOW TECH

Medium-low-tech manufactures

25	Rubber and plastic
26	Other non-metallic mineral products
27	Basic metals
28	Fabricated metal products, except machinery and equipment

Low tech services

50 - 51	Sale, maintenance and repair of motor vehicles and motorcycles, wholesale trade and commission trade, except of motor vehicles and motorcycles
55	Hotels and restaurants
60 - 63	Land, water and air transport and supporting and auxiliary transport activities

Low-tech manufactures

15	Food products and beverages
17 - 19	Textiles, leather clothes, tanning and dressing of leather.
20	Manufacture of wood and products of wood and cork, except furniture
21	Pulp, paper and paper products
22	Publishing, printing and reproduction of recorded media
36	Furniture

Source: author's own from OECD (2002)

To classify the sectors according to their technological and knowledge intensity, we followed OECD's (2002) classification. Table 6.5 shows the

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classification of sectors according to R&D intensity. The OECD currently classifies sectors in four groups depending on the ratio of R&D to GDP. These four classifications are as follows:

a) High tech industries in which the R&D/GDP ratio is above 5%.
b) Medium-high-tech industries in which the R&D/GDP ratio is between 3% and 5%.
c) Medium-low-tech industries in which the R&D/GDP ratio is between 1% and 3%..
d) Low-tech industries in which the R&D/GDP ratio is below 1%.

The sectorial characteristics and regional variables in these groups present some homogeneity. Table 6.6 shows that the number of workers is on average strongly linked to the technological intensity of the industry, since the number of employees grows as the technological intensiveness increases (from 21.35 employees in low-tech service firms to 54.28 employees in high-tech manufacturing firms). This situation also occurs in relation to other variables. For example, as expected, firms with sectorial R&D intensity and innovation intensity presented a higher level of R&D than firms with low technological intensity.

Table 6.6. Average and Standard deviation

	Manufacturing Industries				*Service Industries*			
	High-Tech		Low-Tech		**High-Tech**		Low-Tech	
workers	54.28	(318.52)	25.07	(193.70)	40.31	(63.89)	21.35	(301.99)
DIV	13.17	(3.75)	13.40	(3.23)	13.30	(2.94)	1.36	(3.17)
SPE	0.80	(1.35)	1.13	(1.40)	0.95	(0.20)	1.044	(0.48)
RDsector	1.22	(0.83)	0.29	(0.44)	2.70	(8.49)	0.08	(0.33)
INNOV	2.42	(0.90)	0.79	(0.25)	4.58	(15.37)	0.42	(0.17)
MES	6.24	(3.69)	1.79	(0.91)	7.54	(12.84)	0.58	(0.41)
micro	65.04	(5.67)	74.35	(5.75)	84.50	(6.19)	90.32	(22.97)
KL	8.55	(3.81)	7.21	(2.59)	123.61	(261.93)	10.43	(6.23)
GrowthSector	7.08	(3.04)	8.04	(5.87)	22.91	(14.79)	2.56	(6.76)
ENT	5.48	(0.55)	6.09	(1.17)	12.14	(3.95)	6.76	(2.08)
Obs.	50060		255232		45268		234023	

Source: author's own.

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One aspect that deserves special analysis is the localization of firms according to diversity or specialised externalities, because the existence of a more diversified environment (firms operating in different sectors) is considered to be an environmental characteristic that enhances a firm's efficiency if it can take advantage of this environment. Only low-tech service firms locate in low specialised regions. Moreover, both low-tech manufacturing firms and low-tech service firms prefer specialised regions.

Minimum efficient size is also a key issue for firm entry. It is highly likely that firms will enter and exit in sectors with low MES. This may negatively affect those sectors with a high MES since firms will have to make a greater effort than in other sectors. Our evidence shows that low-tech industries have a lower MES. Moreover, the percentage of microfirms is higher in sectors with a low MES, which is in agreement with our expectations: the lower the MES, the higher the firm entry.

Additionally, firms in low-technological sectors have a lower capital-intensity than firms in other sectors. Moreover, service industries have a higher percentage of new firms entering and providing competition every year. Finally, high-tech sectors present a higher growth than low-tech sectors, so it is quite probable that the correlation between growth and firm entry will be positive.

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Table 6.7 shows the correlation between different variables. Variables such as sectorial innovation and sectorial R&D are positively correlated with capital intensity. Moreover, innovation and R&D sectorial intensity are also positively correlated. These relationships show that R&D, innovation and capital are closely related: highly innovative sectors are also R&D and capital intensive.

Table 6.7. Correlation between different variables.

	workers	*micro*	*KL*	*GrowthSector*	*INNOV*	*ENT*	*DIV*	*SPE*	*MES*	*RDsector*
workers	1.000									
micro	-0.024	1.000								
KL	0.005	0.030	1.000							
GrowthSector	-0.002	-0.113	0.127	1.000						
INNOV	0.012	-0.100	0.909	0.063	1.000					
ENT	0.009	0.201	0.230	0.561	0.123	1.000				
DIV	-0.006	0.032	-0.007	-0.016	-0.011	-0.012	1.000			
SPE	0.005	-0.032	-0.010	-0.094	-0.008	-0.093	0.194	1.000		
MES	0.018	-0.177	0.088	-0.097	0.013	-0.142	-0.017	-0.020	1.000	
RDsector	0.010	-0.089	0.889	0.133	0.774	0.198	-0.010	-0.005	0.006	1.000

Source: author's own.

Finally, we should highlight the relationship between growth in the sector and the percentage of entrants. Our evidence shows that sectors with a greater increase in added value will also see an increase in the percentage of entrants (with a positive correlation of 0.561).

Table 6.8 analyses the effect of the high-tech sectors on firm growth. In general, the signs and coefficients of individual, cyclical, regional and sectorial variables are identical to those of our previous results, except for sectorial innovative intensity and sectorial dynamics, which have a significant and negative impact on firm growth. These changes may be caused by the absence of regional dummies[7] and by the introduction of three new dummies to identify whether firms belong to high-tech

[7] We have excluded regional dummies because of matrix size limitations in Stata software.

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manufacturing, low-tech manufacturing or low-tech services in order to compare them with low-tech services.

Table 6.8. Determinants of firm growth (GLS random effects model)

	WHOLE DATABASE	
Size	-0.2116	(0.0009)*
Age	0.0022	(0.0001)*
Exp	0.0150	(0.0045)*
Imp	0.0386	(0.0050)*
ExpImp	0.1576	(0.0038)*
Holding	0.2602	(0.0056)*
Legal	0.1710	(0.0026)*
GDPgrowth	0.0271	(0.0008)*
RDregional	0.0203	(0.0042)*
DIV	0.00001	(0.0004)
SPE	0.0024	(0.0009)*
RDsector	0.0060	(0.0005)*
INNOV	-0.0052	(0.0008)*
MES	-0.0072	(0.0003)*
Micro	-0.0009	(0.0002)*
KL	-0.0001	(0.00003)*
GrowthSector	-0.0032	(0.0002)*
ENT	0.0088	(0.0005)*
High-tech Manufactures	0.0150	(0.0110)
Low-tech Manufactures	-0.0823	(0.0039)*
Low-tech services	-0.1013	(0.0061)*
Constant	0.1546	(0.0153)*
Chi2	58796.55	
	(0.000)	
R^2	0.4211	
Hausman test	180024.36	
	(0.000)	
N	414123	
Firms	139922	

Standard deviation in brackets.
** significant at 1%, ** significant at 5% and *** significant at 10%.*

Our results show, on the one hand, that firms in high-tech manufacturers have a more positive impact than firms in high-tech services. On the other hand, firms in low-tech intensive sectors have a more negative impact than firms in high-tech services. Those results are in agreement with those of Calvo (2006), who found that high and medium technologically intensive sectors of Spanish manufacturing industries obtain higher growth rates.

To sum up, technology and knowledge intensity in the sector in which a firm operates affects its future growth. However, we should expect crucial variables such as industrial diversity to have a different impact on the firm growth process. To identify these differences, Table 6.7 shows the previous estimation (which includes regional dummies).

The results shown in Table 6.9 generally support the main conclusions of Tables 6.3 and 6.8 concerning the individual and cyclical variables. The exception was the variable age, which has a significant and negative impact on firm growth for service firms in high-tech sectors. It may be that, in the first few years after entering the market, these sectors benefit from the novelty of their products.

It therefore appears that firm growth is not independent of regional externalities or sectorial variables. In particular, the impact of territorial R&D intensity on firm growth is still positive and significant, and our results are therefore still consistent with Tables 6.3. and 6.8. Differences appear when analysing the MAR and Jacobs externalities. MAR externalities broadly agree with those from previous results. Note, however, that the impact of this variable on low-tech manufacturers is positive, which means that low-tech manufacturers located in a diversified environment will grow more than low-tech-intensive manufacturers in other areas. With regard to the Jacobs externalities, i.e. specialised externalities, as we expected from Table 6.3, there are differences between the manufacturing and service industries. Specifically, specialised environments present positive externalities for manufacturing firms but negative externalities for service firms regardless of technological intensity. One by-product of this result is that different firms may prefer different environment.

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Table 6.9. Determinants of firm growth depending on technological intensity (GLS random effects model)

	MANUFACTURING		SERVICES	
	High-tech	**Low-tech**	**High-tech**	**Low-tech**
Size	-0.1927	-0.2895	-0.1775	-0.1485
	(0.0027)*	(0.0014)*	(0.0031)*	(0.0013)*
Age	0.0002	0.0050	-0.0041	00005
	(0.0003)	(0.0003)*	(0.0006)*	(0.0002)*
Exp	0.0731	0.0104	0.0998	0.0565
	(0.0108)*	(0.0058)***	(0.0289)*	(0.0110)*
Imp	0.0142	0.0557	0.1154	0.0387
	(0.0150)	(0.0072)*	(0.0241)*	(0.0085)*
ExpImp	0.1726	0.2231	0.0812	0.0622
	(0.0095)*	(0.0054)*	(0.0213)*	(0.0078)*
Holding	0.1883	0.3435	0.2503	0.1809
	(0.0116)*	(0.0090)*	(0.0150)*	(0.0110)*
Legal	0.0254	0.2377	0.1801	0.0974
	(0.0026)*	(0.0042)*	(0.0099)*	(0.0039)*
GDPgrowth	0.1385	0.0267	0.0338	0.0181
	(0.0081)*	(0.0011)*	(0.0034)*	(0.0015)*
RDregional	0.0445	0.0302	0.0399	0.0285
	(0.0151)*	(0.0078)*	(0.0217)***	(0.0087)*
DIV	-0.0039	0.0050	-0.0125	-0.0125
	(0.0123)	(0.0050)	(0.0116)	(0.0039)*
SPE	0.0043	0.0030	-0.0025	-0.0025
	(0.0024)***	(0.0011)*	(0.0241)	(0.0036)
RDsector	-0.0037	-0.0055	0.0003	-0.0095
	(0.0063)	(0.0047)	(0.0012)	(0.0045)**
INNOV	0.0494	-0.0195	-0.0005	1.9780
	(0.0112)*	(0.0093)**	(0.0009)	(0.2983)*
MES	-0.0057	0.0168	-0.0030	0.2493
	(0.0067)	(0.0033)*	(0.0015)**	(0.0487)*
Micro	0.0028	-0.0028	-0.0107	-0.0210
	(0.0027)	(0.0003)*	(0.0035)*	(0.0035)*
KL	-8.98e-06	-0.0109	0.00002	-0.0026
	(0.0027)	(0.0012)*	(0.0001)	(0.0004)*
GrowthSector	-0.0019	0.0059	0.0006	0.00228
	(0.0067)	(0.0003)*	(0.0015)	(0.0040)*
ENT	-0.0173	-0.0116	-0.0080	0.1540
	(0.0385)	(0.0021)*	(0.0043)***	(0.0230)*
Constant	-	0.2903	1.0873	-
		(0.0792)*	(0.3546)*	
Chi2	6355.43	42331.08	3913.95	14522.83
	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.3688	0.4792	0.3332	0.3498
Hausman test	14878.74	107534.28	10590.98	50689.57
N	39594	195462	32761	146306
Firms	10459	57822	12504	59137

[a] This equation includes territorial variables.
Standard deviation in brackets.
* significant at 1%, ** significant at 5% and *** significant at 10%.

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Sectorial R&D intensity has somewhat ambiguous results since it has a non-significant negative impact on manufacturing firms but a positive impact on high-tech service industries. This suggests that sectorial R&D enhances the performance of firms in high-tech service industries but acts as a barrier to growth for the other groups. In fact, those results are in concordance with Arauzo and Segarra (2005). Those authors pointed out that the expected sign of R&D intensity is undetermined. This is because in sectors with low R&D intensity, the technological barriers are important for the larger newcomers, and in sectors with high R&D intensity, technological spillovers encourage the birth of new firms, especially smaller ones.

The result for innovative intensity is also ambiguous: it has a positive impact on firm growth for high-tech manufacturing industries and low-tech service industries, but a negative impact for low-tech manufacturers and high-tech service industries. However, the impacts of sectorial R&D and innovative intensity should be interpreted jointly. On the one hand, high-tech manufacturing industries benefit from innovative sectors and high-tech service industries benefit from R&D intensive sectors. On the other hand, low-tech manufactures do not benefit from innovative or R&D intensive sectors and low-tech service industries benefit from innovative sectors. We measure innovation as the ratio of business expenditure on innovation to sales. However, authors such as Fritsch (2003) pointed out that, while such expenditure on innovation is necessary, firm cooperation also helps to spread information about innovation. Innovation may therefore be a good proxy for knowledge spillovers, but further investigation in this area is needed.

In fact, there is international evidence of the positive effect of innovation on firm growth. For the United Kingdom, Van Reenen (1997) and Machin and Wadhani (1991) found positive empirical evidence for manufacturing

firms. For Germany, Smolny (1998) also found a positive relationship but found no effect for process innovations. However, Brouwer et al. (1993) found a negative relation between innovation and firm growth for Dutch manufacturing industries.

For Spain, Harrison et al. (2005) showed that process innovation displaces employment but that there are compensation effects in manufacturing industries. These authors also found that product innovation implies an increase in employment in manufacturing industries. An increase in innovation therefore implies an increase in manufacturing employment. On the other hand, results for service industries are not so conclusive and the only significant result is that new products are associated with larger increases in productivity.

Minimum efficient size shows a negative impact on firm growth for knowledge and technologically intensive sectors. This means that when the sales to be achieved by firms are high, firms in these sectors will face more difficulties. Conversely, minimum efficient size has a significant and positive impact in knowledge non-intensive and technologically non-intensive sectors. This may mean that firms in technologically or R&D intensive sectors have more difficulties to grow because they have to invest in innovation or R&D. In low intensive sectors, however, firms may grow and be able to increase easily their market share in comparison with competitors .

As expected, a high) percentage of microfirms and capital intensity in a sector had a negative effect. However, microfirms show a non-significant positive impact for technologically intensive manufacturers, and capital intensity shows a non-significant positive impact for knowledge intensive sectors.

As expected, sectorial dynamics also presented the positive sign. This is probably due to the positive effect of the coordinated evolution between sectors and firms. However, sectorial dynamics showed a negative impact on firm growth for technologically intensive manufacturing sectors. Alternatively, there might be some kind of time mismatch between firms and sectorial evolution. Except for those in knowledge non-intensive sectors, new entrants generally had a negative impact on firm growth, though this was not significant.

6.5. SUMMARY AND CONCLUDING REMARKS

The aim of this chapter was to examine the factors that affect the firm growth of Spanish firms. Gibrat's Law states that firm growth is independent of its initial size, but most of the evidence rejects it. In previous chapters, we found that Gibrat's Law was rejected. In this chapter, therefore, we have studied the determinants of firm growth in greater detail, thus contributing to international and Spanish literature.

Our findings suggest that firm growth in manufacturing industries is different in some respects from that of firms in service industries. This may be because service firms generally have a lower minimum efficient size and do not need to grow as much as manufacturing firms. Also, firms can at least partially compensate for their inherent size disadvantages by acquiring certain individual characteristics, localising in regions with certain characteristics and operating in sectors which enhance their performance. Briefly, our main results are:

a) Internal variables have the same impact on firms in manufacturing industries as on firms in service industries. Belonging to a holding, importing and exporting, and being a joint stock company implies a positive externality on firm growth.

b) Firm growth shows a procyclical pattern with respect to the evolution of the economy, i.e. positive economic growth causes firm growth. In other words, increases in demand have a positive effect on firm growth.
c) Regional R&D intensity positively affects all sectors, but regional externalities do not affect all sectors uniformly. This suggests that location is crucial in future firm growth. Accumulative variables such as R&D may be eroded or strengthened depending on the agents involved in the R&D process.
d) Sectorial variables, especially sectorial R&D intensity and innovation, have heterogeneous effects that depend on the sector in which they operate.

Consequently, territories may attract firms thanks to natural resources such as rivers, the sea or mining goods. Policy makers cannot modify the distribution of these resources but they can increase or decrease the distribution of resources such as R&D. As we have seen, R&D is a key to attracting fast-growing firms but is not sufficient for successful regional development.

To maximise the efficiency of a firm's investments, information between active agents must be transparent and fluent in order to optimize decisions about where to locate. If this is achieved, firms may attain higher growth rates with a positive regional economic impact.

Due to database limitations, we were unable to explore in greater detail other factors that affect firm growth, such as access to finance or entrepreneur's characteristics. The economic literature has analysed the firm entry process. However, post-entry evolution is also important for increasing market competition. For this reason, we believe firm growth to be a promising line of research.