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Abstract. Although there is growing evidence on the role of agglomeration economies in the formation and growth of firms, both the concepts of agglomeration economies and entrepreneurship tend to be ambiguously defined and measured in the literature. In this study, we aim to improve the conceptualisations and measures of agglomeration economies and entrepreneurship. Indicators of agglomeration economies are analysed in clearly defined urban regimes on three spatial scales in the Netherlands – national zoning, labour market connectedness, and urban size. This is done in order to uncover their effect on two entrepreneurial phases in the firm life cycle - new firm formation and the growth of incumbent firms in the relatively new ICT industry in the Netherlands.
In comparison with new firm formation, the growth of incumbent firms is not so much related to spatial clustering of the ICT industry and other localized sources of knowledge economies associated with urban density. Instead, knowledge as an input for growth of incumbent firms is associated with more endogenous (firm internal) learning aspects, reflected by a significant correlate with R&D-investments. Also the effect of local ICT firm competition differs between the two types of firms: a positive effect on new firm formation, but a negative effect on incumbent firm growth. In general, agglomeration economies have stronger effects on the formation of ICT firms than on the growth of ICT firms.

JEL: D21, L25; L63, L86, M13, O18, R12, R30
Keywords: agglomeration economies, spatial externalities, entrepreneurship, location, urban regimes, ICT industry

1 Introduction[*]

The role accorded to agglomeration economies in determining growth has long been a central theme in urban and regional economics. In theoretical terms, the topic has acquired greater importance in years following seminal contributions by Romer (1986) and Lucas (1988) where economic growth was modelled in an endogenous framework. In these types of models, knowledge spillovers between economic agents, an important source of agglomeration economies, play a crucial role in the growth and innovation process leading to external economies of scale in production. At the core of the new economic growth theory lies the concept of technological change as a non-rival and partially excludable good (as opposed to the neoclassical view of knowledge as an entirely public good). On this basis, new technological knowledge is usually tacit, meaning that its accessibility, as well as its growth spillovers, are bounded by geographic proximity of high-tech firms or knowledge institutions, and by the nature and extent of the interactions among these actors in an innovation system (Acs, 2002). A large and growing empirical literature has grown around testing this idea using data from cities (Glaeser et al, 1992; Henderson et al, 1995; Dumais et al, 2002; Van Oort, 2004). The assumption here is that if knowledge spillovers are important to new firm formation and firm growth, they should be more easily identified in cities where many people are concentrated in a relatively small and confined space and where knowledge is transmitted more easily.

Most studies along these lines tend to focus on overall employment growth and as a consequence they do not consider the role of spatial externalities in different phases of the firm life-cycle: localised growth caused by new firm formation as opposed to growth of incumbent firms potentially is an important source for explaining differences in spatial economic dynamics. This paper examines how agglomeration economies, actually indicators of knowledge spillovers, affect new firm formation and growth of incumbent firms, drawing upon a unique data set for the

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Netherlands. The analysis focuses on the information and communication technology (ICT) industry, an important growth industry that is characterized by relatively many new firms and innovations (Beardsell and Henderson, 1999; Norton, 2001). Two questions are central in our paper. First we want to determine which measurable agglomeration factors are connected to new firm formation and firm growth in the ICT industry in the Netherlands. Second, our analysis focuses on the conceptual spatial configurations that best describe patterns of new firm formation and growth of incumbent firms. We ask ourselves what additional role spatial regimes (such as urban hierarchy, labour market areas, national core-periphery distinctions) play compared to the localised proximity-thesis stressed in the literature. In the end we focus on the question whether entrepreneurship as measured by the *growth* of firms in the dynamic ICT industry is differently related to the spatial externalities debate than new firm formation rates in this industry.

The spatial, longitudinal and sectoral detail of the data allows for more sophisticated testing of these questions than previous studies. The data provide counts (relative to the population) of new and incumbent firms and their employment levels by industry for 580 municipalities over a five-year period extending from 1996-2000. The approach taken is quite similar to that in Rosenthal and Strange (2002) who analysed determinants of establishment births in United States zip codes using Dun & Bradstreet Marketplace data. While the US data have the advantage that more is known about each establishment, the Dutch data provide information about all establishment births and growth. For example, in the Henderson et al (1995) study, the strategy of analysing all cities in a given industry presented many problems. As a result of disclosure rules, employment data for as many as 30% of cities were censored. The Dutch data set concerns a longitudinal survey on employment in all ICT establishments in the Netherlands; it is therefore expected to provide a clearer picture of the types of areas and the local and regional characteristics that affect new firm formation and firm growth.

The remainder of the paper consists of four sections. Section 2 provides the background for the agglomeration and entrepreneurship hypotheses tested in the analysis. We argue that the entrepreneurship debate recently focuses more on external factors, determining entrepreneurship in new as well as in incumbent firms. We therefore focus on testable indicators of (industry-specific) localisation economies and urbanisation economies, also called spatial externalities. The indicators are important means for answering the research questions of the paper. Section 3 on the research design describes in detail the dataset, the spatial regimes, and the agglomeration indicators. Section 4 presents econometric analyses concerning the relation between agglomeration indicators and growth in all and only in incumbent ICT firms. In section 5 the overall conclusion will be presented and discussed.

2 Entrepreneurship and agglomeration economies: hypotheses and indicators

2.1 Spatial perspectives on entrepreneurship

This section addresses the broad definitions of entrepreneurship generally used in the literature, and links these to agglomeration economies. Although entrepreneurship has been traditionally defined as new firm formation, some entrepreneurship scholars argue that entrepreneurship should not be thought of as confined to start-up activities: entrepreneurship also manifests itself as firm growth (Merz et al, 1994; Davidsson et al, 2002). Our paper focuses exactly on this question, by comparing new firm formation and employment growth in all and only incumbent firms in the young and dynamic ICT industry.

The role of the entrepreneur became rather neglected in mainstream economics in the second half of the twentieth century, but acquired central importance in the recently emerging multidisciplinary field of 'entrepreneurship studies'. Entrepreneurship studies contribute to the understanding of the uniqueness of entrepreneurship that cannot be understood within the framework of existing scientific disciplines (Sexton and Landström, 2000). Entrepreneurship studies used to be focused on studying the traits and characteristics of autonomous entrepreneurial actors (Gartner, 1989), sometimes called the 'omnipotent, lonely wolf' view on entrepreneurship. Until recently, this supply-side perspective, which focused on the assumed specific traits of entrepreneurs and the availability of suitable individuals to occupy entrepreneurial roles was the dominant school of research. During the 1980s research on entrepreneurship gradually moved away from the 'lonely wolf' view towards a 'relationship manager' view of the successful entrepreneur (Davidsson, 2002; Nijkamp, 2003). Several studies in entrepreneurship research have redirected the focus of research from the individual to the entrepreneurial process or event, i.e. the creation of a new firm (Gartner, 1989). There is an emerging consensus within entrepreneurship studies on what distinctive entrepreneurial processes are: opportunity recognition, resource acquisition, resource generation, and coordination of resources (Garnsey, 1998). The current scientific object studied in entrepreneurship studies is "the dialogic between individual [the entrepreneur] and new value creation within an ongoing process and within an environment that has specific characteristics" (Bruyat and Julien, 2000, page 165). In short, entrepreneurship studies show a marked shift towards an interactive perspective focusing on the interaction between the entrepreneur and his context. Studies within the interactive perspective focus on the context in which entrepreneurship occurs. We argue that entrepreneurship also has to be analysed in a spatial context, as it is influenced by regional characteristics and it has an effect on regional economies. Entrepreneurship can be defined as the process in which entrepreneurial opportunities – opportunities to bring into existence new goods, services, markets, supply sources, and organizing methods – are recognized, and realized in a profitable way. This definition is based on both Schumpeterian innovations and an Austrian economics' view on opportunity recognition. The early growth of new firms is largely a reflection of entrepreneurship. However, there is a difference between entrepreneurship as new firm formation and entrepreneurship as firm growth. The first phenomenon can largely be explained by environmental and personal factors, while entrepreneurship as firm growth is better explained with (other) environmental and firm-specific factors like Research and Development (Plummer and Taylor, 2003; Stam, 2003; Van Oort, 2004). In order to explain the (spatial) patterns of firm growth, we need to understand which mechanisms are necessary for the growth of firms. These mechanisms may be affected by spatial proximity or ecological characteristics of spatial units (localities, regions, and countries). Several mechanisms are necessary for the growth of young firms in relatively new industries, like the ICT industry (Stam, 2003). The recognition of an opportunity is the primary mechanism for the start of a new business. However, the entrepreneur(s) recognizing this opportunity need to have access to some resources in order to realize this opportunity. Most probable, other resources have to be acquired externally and/or created internally for the new venture. To reach economic viability a business has to generate resources in a specific product-market. The subsequent growth of the firm can be realized if the demand in this initial product-market increases (without increasing competition) or if new opportunities are recognized and realized in new product-markets. This growth also requires managerial competence to deploy the necessary resources in an effective and efficient way. These processes do not take place in a vacuum. The characteristics of the markets and networks in which the firm operates have to be taken into account to explain the creation and growth of firms.

In order to explain the spatial pattern of firm growth, the role that space plays in these processes, be it in networks (of resource providers or co-producers) or in product-markets needs to be uncovered. Several propositions can be formulated for firm growth in the ICT industry. Opportunities are a determinant of where in space new businesses are started. However, the recognition of an opportunity is the product of both the experience and imagination of the firm members and the nature of the firm environment. Individuals working and living in (ICT) industry centres are more likely to have the (industry) experience needed to recognize new opportunities. Information rich (urban) environments potentially affect the probability of new opportunities to be recognized positively, be it directly by the entrepreneur or via his personal networks. The access to resources is probably affected by the spatial distribution of resources. Areas that are relatively resource munificent may offer better chances for firms to acquire these resources directly (on markets) or indirectly (via network connections to resource holders). However, two ‘intervening’ effects must also be taken into account. First, these resources may be acquired rather easily in other areas if proximity effects have dissipated and internal learning trajectories (e.g. via R&D) become more important over the years. Second, competition in these resource munificent areas may in the end mean that these resources are perhaps harder to acquire in these areas than in 'resource-scarce' environments with less severe competition. The resource generation process may be stimulated by concentrations of consumers of ICT products, again controlling for competition in those areas and taking into account the importance of proximity. Finally, a factor that is specific for firm growth is the presence of managerial talent and skilled labour in the region of the firm, again taking into account the level of competition, but assuming that this type of labour is region bound to a large extent.

From this section, several important spatial agglomeration factors can be distinguished that we want to hypothesise and test empirically. What are the sources of information opportunities: are these intra-sectoral (reflected in R&D-spillovers of more mature firms or localized specializations), inter-sectoral (reflect by sectoral diversity)? What is the role of competition between ICT firms? Is entrepreneurship directly linked to new firms (as was researched in Van Oort and Atzema, 2004), or can growth in incumbent firms in the (young and dynamic) ICT industry be described by similar agglomeration circumstances? And finally, which spatial scales are important for new and incumbent ICT firms to profit from agglomeration benefits?[1]

2.2 Agglomeration hypotheses

In this section we suggest the agglomeration indicators that will be used in order to test for the relation between agglomeration and entrepreneurship that leads to new firm formation and firm growth in the ICT industry. The concepts of economic diversity, specialisation and local competition are translated into indicators for agglomeration economies related to urban density. These statistical indicators are broader than commonly used 'pure' innovation indicators, like patent-citation (Van Oort, 2002; Capello, 2002). For example, knowledge spills over between

[1] This careful analysis of mechanisms at different spatial scales is indeed one of the key strengths of 'economic geography proper' (Overman, 2004, page 513).

firms via informal contacts between employees, or because employees switch jobs and take their knowledge with them. Indeed, the most important type of knowledge that plays a role in growth and innovation processes is not necessarily related to path-breaking innovations, but may be everyday learning opportunities for people (Glaeser, 1999). Empirical tests of this theory have often looked at cities to identify settings in which these external factors most effectively foster (endogenous) economic firm dynamics. The much used 'simple agglomeration hypothesis' therefore only states that more densely populated urban regions breed more entrepreneurship and hence more growth in firms' employment (Brakman et al, 2001; Fujita and Thisse, 2002). Previous results of recent research aiming at disentangling agglomeration factors in urbanisation and localisation economies, however, have been divided. On the one hand, Glaeser et al (1992) and Feldman and Audretsch (1999) find that employment growth and firm dynamics is enhanced by diversity of activity across a broad range of industries. Henderson et al (1995), Black and Henderson (1999), and Beardsell and Henderson (1999), on the other hand, find faster growth when more activity is concentrated in a single industry (specialisation). While endogenous (technological) growth theory is among the most powerful advances in economics in the last decades, the fact that no clear view has emerged regarding situations to which it best applies represents a barrier to its further development and application. The lack of agreement on the relative importance of industrial concentration, diversity and their spatial composition sends an ambiguous message regarding policy choices to promote or manage growth, entrepreneurship or innovation in urban areas (Parr, 2002; Rosenthal and Strange, 2001).

As indicated, the determinants of technological change became subject of further theorizing in endogenous development theory, which led to the advent of new growth models. These models also include education, research & development (R&D) or learning-by-doing as additional inputs affecting growth[2]. Firm-internal (and not so much urban bounded, firm-

[2] Additional to learning opportunities related to intra- and intersectoral localized specialization, diversity and competition structures in dense urban areas.

external) knowledge became regarded as an endogenous core input for economic growth as well, and, associated economies of scale or scope also became to be considered as 'knowledge economies'. Since, debates in economic growth theory have shifted from material to immaterial inputs, and, in particular, to the positive externalities arising from knowledge spillovers (Jaffe 1986; Griliches 1992). And, as spillovers imply the possibility of under-investment in knowledge (as firms recognize the danger of knowledge leaking towards competitors), government policy increasingly focused on providing subsidies for R&D and stimulating university-firm cooperation. These additional spillover hypotheses can only partly be applied to the Dutch ICT industry, as especially SMEs in the Dutch ICT industry do hardly interact with universities (Wever and Stam, 1999). But, based on R&D-indicators in Van Oort (2002) on the same spatial level of analysis as applied in this paper, we will additionally test for the correlation of localized R&D-expenditures on localized growth of ICT firms.

Knowledge-based theories of endogenous development are tested at the city (municipal) level in this paper. The density of economic activity in cities facilitates face-to-face contact as well as other forms of communication (Lucas, 1993). Several hypotheses have been proposed concerning conditions under which knowledge spillovers affect growth. One hypothesis, originally developed by Marshall (1890) and later formalised by Arrow (1962) and Romer (1986) (collectively called 'MAR'), contends that knowledge is predominantly industry-specific and hence that local or regional specialisation will foster entrepreneurship that leads to new firm formation and firm growth in the ICT industry. The theory of Marshallian externalities states that intra-regional spillover effects occur alongside agglomeration effects due to labour market pooling and input sharing (see for recent elaborations Feser (2002) and Rosenthal and Strange (2001), and for an application to computing services Fingleton et al (2004)). Furthermore, (local) market power is also thought to stimulate firm growth as it allows the innovating firm to internalise a substantial part of the rents. A possible conjecture in this regard is that a local competition variable (at the municipal level) is an indicator of both product market and labour market competition for non-manufacturing establishments (e.g. ICT services) that sell goods and services only locally, but an indicator of just labour market competition for manufacturing establishments (e.g. ICT manufacturers) that are more likely to sell in national or even worldwide markets (Feldman and Audretsch, 1999; Van Soest et al, 2002). These differences in relevant spatial scales should ideally be incorporated in empirical analysis. The second hypothesis, proposed by Porter (1990), also states that knowledge is predominantly industry-specific, but argues that its effect on growth is enhanced by local competition rather than market power as firms need to be innovative in order to survive. The third hypothesis, proposed by Jacobs (1969), agrees with Porter that competition fosters growth, but contends that regional diversity in economic activity will result in higher growth rates as many ideas developed by one industry can also be fruitfully applied in other industries. Table 1 summarises the spatial externality circumstances related to urban density distinguished in these respective hypotheses. This paper will empirically relate these hypotheses (controlling for sectoral and spatial heterogeneity) to spatial patterns of ICT firm growth in populations of (a) all firms present in any year in the period 1996-2000 and (b) the isolated population of incumbent firms (present in 1996 and eventually later years) in the Netherlands. Focusing on populations with and without correction for establishment births is an important element of urban employment dynamics (see for example Ashcroft and Love, 1996). It facilitates analysis in the sense that initial economic conditions prevailing in an area at the beginning of the sample period (1996-2000) can arguably be treated as exogenous determinants for all firms identically, independent of life-cycle phase. As argued in the previous section, both new and incumbent firms need entrepreneurship and learning opportunities for survival. New and young firms can be viewed as taking initial conditions as given and then deciding where to locate, being less affected by large 'sunk costs', that is to say, irrevocably committed costs or investments which are not recoverable in the case of exit or relocation (Clark and Wrigley, 1995). Incumbent firms are much more characterised by these latter characteristics. This may cause the two research populations distinguished in this study (all firms and just incumbent firms) to be differently related to agglomeration indicators reflecting urbanisation (diversity), localisation (specialisation) and competition. Incumbent firms might also be more vulnerable to firm-or sector-internal learning strategies like R&D. We will test for this in the empirical part of the paper.

Table 1. Stylised and hypothesised relations of agglomeration circumstances with economic growth

	MAR	Porter	Jacobs
Concentration	+	+	–
Diversity	–	–	+
Competition	–	+	+

3 Research design: data, urban regimes and agglomeration indicators

3.1 Data: ICT establishments in the Netherlands 1996-2000

Although ICT as a current 'general purpose enabling technology' (Carlaw and Lipsey, 2002; Bresnahan and Greenstein, 2001) is used in almost all sectors of the Dutch economy, we have limited our research to ICT providing firms, which also includes services industries. These high-tech firms are relatively footloose (little sunk-costs in terms of capital) and dependent on (urban) learning opportunities with customers, suppliers and competitors. We focus on 22 ICT industries (see table 2).

Table 2. Employment in the ICT industries in the Netherlands (average 1996-2000)

Industry	No. of jobs	% of jobs
Production:		
Production of hardware	9,154	4,7
Production of software	46,196	24,1
Trade:		
Wholesale trade of ICT products	27,603	14,4
Retail trade of ICT products	4,443	2,3
Services:		
Internet/(multi)media, telecom	35,722	18,7
Data- and computer centres	10,701	5,6
ICT Consultancy	54,498	28,5
Other kinds of (ICT) producer services	3,149	1,6
Total	191.466	100

Earlier research showed that high-tech production in the Netherlands is dominated by a few large corporations (Van Oort, 2004). Trade and services, which make up some 70% of the research population, is not affected by this firm size determinism. These preliminary remarks are important, since this affects research outcomes, both theoretically and technically (through the spatial competition indicator that also captures relative firm size, see section 3.3). As will be explained in section 4, formal testing will be undertaken at the aggregated sectoral scale as a result of insufficient spatial dependency in growth rates over individual industries or the three broad sectors ‘production’, ‘trade’ and ‘services’ presented in table 2. Firm growth in all and incumbent establishments in the ICT industry are therefore measured by employment dynamics aggregated over all ICT industries.

The population of ICT firms has been collected in a two-step procedure. In the first step the Yellow Pages for all regions in the Netherlands were screened for the selection of firms from the following business categories: software, automation, internet, tele- and data communication. This selection consists of 12,878 ICT firms in the Netherlands. This method has two disadvantages: the Yellow Pages does not contain information on every company and has no information on existing employment levels. We therefore completed the dataset in a second step, in which the file obtained through the Yellow Pages was linked to the nationally covered LISA file. This LISA file registers on an annual basis the employment of over 750,000 companies and institutions in the Netherlands. Both files have been compared with one another and the Yellow Pages file has been extended with other companies from the LISA file. This results in a file of 18,985 ICT firms on average for the period 1996-2000. The number of jobs in ICT firms contributes nearly 4% of the total employment: the ICT providing industry is still a relatively small industry in the Netherlands. Furthermore, it becomes clear that employment in the Dutch ICT industry is dominated by service activities like consultancy, internet providing and wholesale trade. Within the field of production activities, the production of software dominates (Weterings and Van Oort, 2004).

Several additional alterations to the data were carried out for this paper. Concentration and specialisation indicators are calculated as average over the years 1996-2000. Growth indicators compare the average stock of firms over 1996 and 1997 with the average stock of firms over 1999-2000 in order to minimise (spatial or temporal) outlier dependency. Growth rates are calculated in populations with (all firms) and without (only incumbents) new firm formation, since earlier research indicated that employment growth patterns are to a large extent associated with new firm formation (Ashcroft and Love, 1996). We explicitly want to test for this life-cycle aspect in the (overall relatively young and dynamic) ICT industry. Furthermore, the firm level data are aggregated into 580 locations that represent municipalities. The four largest municipalities (Amsterdam, Rotterdam, The Hague and Utrecht) are split into 3-digit zip code areas in order to make distinctions in harbour, central location and edge-city locations within municipalities (still referred to as municipalities). The longitudinal, firm level database allows a distinction to be made between new and incumbent firms.

3.2 Spatial regimes in the Netherlands

Spatial proximity (clustering) is considered important by many observers for 'explaining' localised growth and new firm formation in high-tech sectors, the ICT industry in particular (Audretsch and Feldman, 1999). The marginal cost of transmitting tacit knowledge rises with distance. As tacit knowledge and human interaction become more valuable in the innovation process, geographical proximity becomes crucial to the innovation and growth process. The exchange of tacit knowledge may require a high degree of mutual trust and understanding. Most of the relevant empirical literature focuses on American states as the spatial unit of analysis. Some research, however, focuses on lower scales of analysis. Anselin et al (2000) and Wallsten (2001), for instance, use metropolitan statistical areas to analyse the spatial extent of R&D and growth externalities and find that local spatial externalities are present and important. Proximity matters in the transmission of innovation- and growth-based knowledge of dynamic (incumbent and new) firms, while distance decays tend to be rather steep (Jaffe et al, 1993).

The (geographic) literature also provides clues for non-contiguous (regime) types of spatial dependence. Quality of life aspects, regional labour markets, specialised networks and city size appear as significant locational considerations, both to professional workers and to growing ICT firms (Van Oort et al, 2003; Atzema, 2001). The spatial structures of proximity (contiguous nearness at the municipal level) and heterogeneity (urban hierarchical and regional, not necessarily contiguous, spatial dependence) have been tested for in this study (and when appropriate been controlled for) by spatial dependence (spatial lag and spatial error) tests and spatial regimes respectively. When appropriate, the spatial coefficient in spatial lag estimation shows whether the dependent variable in a model (in our case localised firm growth) is dependent on neighbouring values of this dependent variable. If so, conclusions can be reached on the significance and magnitude of this spatial dependence (Anselin, 1988). Spatial heterogeneity on the other hand is modelled by spatial regimes, involving change-of-slope regression estimation over various types of locations that theoretically 'perform' differently. Three sets of spatial regimes are distinguished, each indicating aspects of urban structures at different spatial scales:

(1) On the macro-level, three national zoning regimes have been distinguished: the Randstad core region, the so-called Intermediate zone and the National periphery (figure 1) Distinguishing between macro-economic zones in the Netherlands is based on a gravity model of total employment concerning data from 1997. The Randstad region in the Netherlands historically comprises the economic core provinces of Noord-Holland, Zuid-Holland and Utrecht, the intermediate zone mainly comprises the growth regions of Gelderland and Noord-Brabant, while the national periphery is built up by the northern and southern regions of the country. This zoning distinction is hypothesised as important in many studies on endogenous growth in the Netherlands, in the sense that the Randstad region traditionally has better economic potential for development (cf. Manshanden, 1996; Van Oort, 2004).

(2) On the meso-level we distinguish a labour market induced connectedness regime from a non-connectedness regime (figure 2). This spatial regime concerns commuting based labour market relations. In the figure, core and suburban municipalities together comprise the connected regime, as opposed to the other types of locations that are characterised as non-connected. The four types of locations have been distinguished, initially based on municipal data for 1990-1999. The classification is based on the dependency of a municipality's population upon employment and services proximity and accessibility. Urban core areas have an important employment function. More than 15,000 persons commute into these municipalities (while living somewhere else) on a daily basis. Municipalities

where more than 20 per cent of residents commute to central core locations are labelled suburban. The literature finds in general that urban areas in the connected regime show higher economic growth and innovation rates than areas in the non-connected regime (e.g. Anselin et al, 2000). As becomes clear from figure 2, locations in the connected regime are not necessarily adjacent to each other.

(3) The third set of spatial regimes is constructed using the degree of urbanisation of municipalities (figure 3). Following Dutch standards of urbanisation, cut-off population thresholds of 200,000 and 45,000 inhabitants distinguish large and medium-sized cities in the Netherlands from small cities and rural municipalities. For comparison with the international literature, we also make an aggregation into urban municipalities (being the large and medium sized cities) and non-urban ones (being the small cities and rural municipalities) respectively.

In sum, these three aspects of spatial heterogeneity constitute three spatial levels of urban constellation: the meso-level ‘agglomerative fields’ of the Randstad core region compared to its adjacent Intermediate zone and the National periphery, the functional (commuting) region, and the urban level itself.

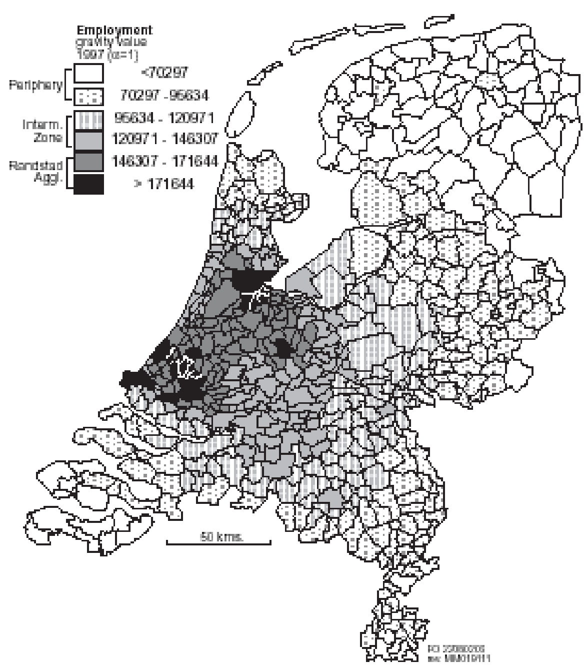

Figure 1. National zoning spatial regimes

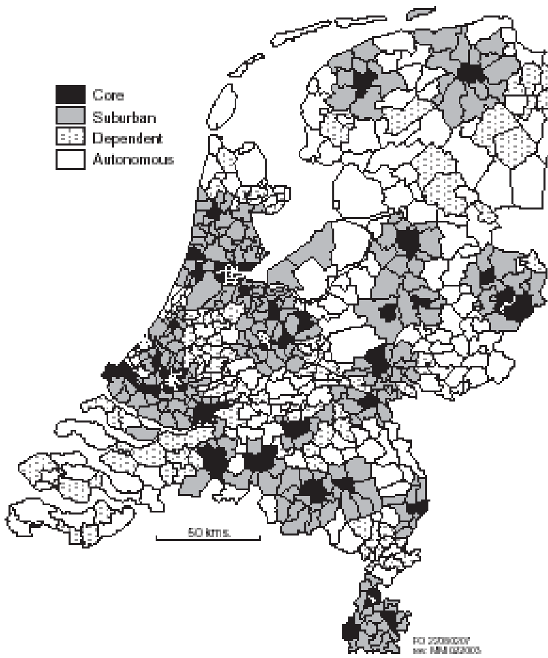

Figure 2. The (labour market) connectedness spatial regimes

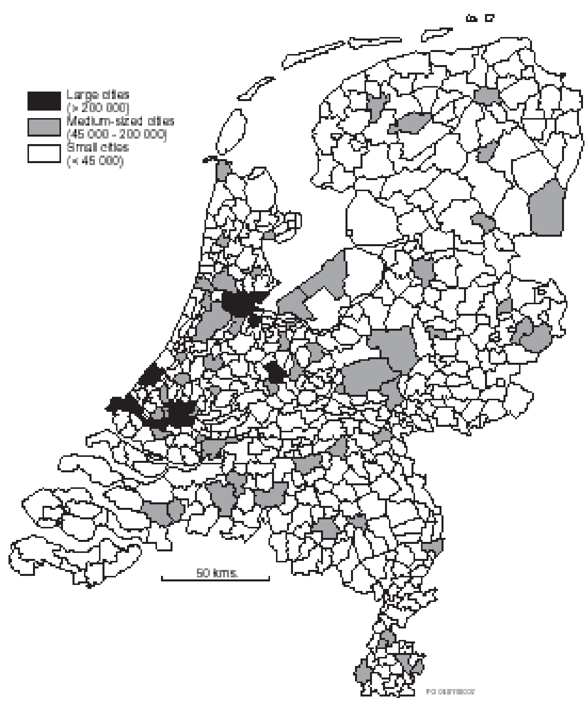

Figure 3. Urban size (municipal) spatial regimes

3.3 Agglomeration indicators

The relatively small size of the Netherlands provides a natural control for much location-specific heterogeneity. In fact, several variables enumerated in related studies (Henderson et al, 1995; Cortright and Mayer, 2001; Glaeser, 1999) – that are potentially important location-specific factors affecting either employment growth or establishment birth rates – are either roughly constant between locations in the Netherlands, or else can be at least partially controlled. Cultural differences, variations in taxes, environmental amenities (such as climate), and environmental regulations between locations are small. Differences in prices of non-land inputs exhibit little variation across the country. Prices charged for energy inputs vary by industry, but within an industry, they are the same throughout the Netherlands. Wages also vary by industry, but not much within industries. Thus, wage rates within an industry would be uniform and there is little need to control for labour force characteristics such as level of education, proportion of workers with particular skills, or percentage of workers with union membership (see Van Oort, 2004 for actual testing of these elements).

A Dutch municipal data set on sectoral employment structures is used to construct indicators of various types of agglomeration economies (as hypothesised earlier in this section) that are as reminiscent as possible to those used in prior studies (see especially Glaeser et al, 1992 and Henderson et al, 1995). The agglomeration indicators are not constructed relative to the ICT database itself but relative to a national, all-inclusive sectoral data set, both for technical reasons (multicollinearity) and for theoretical reasons (agglomeration economies are commonly defined in a national, aggregated setting). As we want to test whether initial spatial circumstances are connected to firm growth (a 'sources of growth' analysis, see Glaeser et al, 1992) explanatory variables are constructed using data from the base year (1996) to reduce problems of simultaneity. *CONCENTRATION* is defined as a location quotient showing the percentage of employment accounted for by an industry in a municipality relative to the percentage of employment accounted for by that industry in the Netherlands. This indicator in particular comprises (industry-specific) localisation or specialisation economies[3]. *COMPETITION* is measured as establishments per worker in a municipality and industry divided by establishments per worker in that industry in the Netherlands. This measure indicates whether establishments in industries tend to be larger or smaller in a municipality compared to the country as a whole. This spatial indicator of relative firm size fits in a tradition of identifying common labour market competition and market structure indicators. Glaeser et al (1992) interpret this variable as a measure of local competition on the assumption that competition is more intense among a larger number of smaller establishments than among a smaller number of larger establishments. This interpretation, however, has been called into question by Combes (2000), who contends that it may measure internal diseconomies of scale, and by Rosenthal and Strange (2003), who view it as a broader measure of local industrial organisation. For consistency reasons, i.e. optimal comparison with the Glaeser et al (1992) and Henderson et al (1995) influential earlier studies on localized firm growth, we apply the relative firm size definition of localised competition. Several variables were tried as a measure of industrial diversity to indicate how evenly employment in a municipality is spread across economic sectors. *DIVERSITY,* the Gini-coefficient for the distribution of employment by industry in a municipality, measures the absence of diversity. The locational Gini-coefficient has a value of zero if employment shares among industries are distributed identically to that of total employment in the reference region (across 49 sectors in the Netherlands, of which the ICT industry is only a minor part). A value of 0.5 results if employment is concentrated in only one industry. Lower values of *GINI* thus indicate higher degrees of diversity. The diversity indicator is treated as indicator of urbanisation (not industry specific) economies. Results presented in the next section can be used to

[3] Although Fingleton et al (2004) argue that the location quotient as an indicator averages over size effects, the measure they propose (the absolute deviation of employment from a location quotient equal to 1) correlates highly with the measure of location quotients (r=0.76), indicating that the two approaches are not divergent in their application in our analyses.

make at least a suggestive test of the three sets of agglomeration hypotheses (see table 1)[4]. Regarding employment growth of small computing services firms in Great-Britain, Fingleton et al (2004) conclude that competition and diversity do not significantly affect employment growth in this ICT industry, while concentration and university presence are important factors for employment growth. This latter factor was also central in the studies of Acs (2002). He found that university R&D spillovers significantly affected employment growth (in narrowly defined high-technology industries) in Metropolitan Statistical Areas (MSA) in the US. In his analyses, university and industrial R&D are positive and statistically significant determinants of high technology employment in the same MSA and three-digit industry. This seems to support the MAR thesis discussed earlier. However, in contrast to our data, this research was based on cross-sectional data that cannot directly address some of the key issues of growth performance. These outcomes cannot be compared to the Dutch ICT industry, as especially SMEs in the Dutch ICT industry do hardly interact with universities (Wever and Stam, 1999). Based on R&D-indicators in Van Oort (2002) on the same spatial level of analysis as applied in this paper, we will test for the influence of (local scores of) R&D-intensity of firms (*R&D INTENSITY*) on growth of ICT firms.

Several control variables were introduced in the models. *EMPLOYMENT1996* measures absolute employment values per municipality, and controls for localised start-of-period development bases. Spatial variations in wage structures (and development in wage structures) were not found significant in any analysis (in contrast to Glaeser et al, 1992). The same applies to a variable indicating whether a more than average number of business sites were opened up in a municipality in the research period (that institutionally might lead to employment growth) and to the distance to highway ramps (as an indicator of physical connectedness that potentially influences firm performance). For reasons of parsimonious presentation, the non-significant control variables are left out of the final analyses and presentations.

[4] Due to restrictions of space, correlation diagnostics of all explanatory variables used in this paper are not presented. No correlation higher tan 0.5 in absolute terms was permitted in the analyses.

4 Agglomeration economies in spatial regimes and ICT firm growth

Van Oort and Atzema (2004, page 277-281) presented localised Moran scatterplot maps for location quotients of (aggregated) employment in ICT firms over the period 1996–2000, for new firm formation rates (average 1996–2000), employment growth in incumbent firms (present in all years of the period 1996-2000) and employment growth in all ICT-firms (new and incumbent) for the period 1996–2000. Their analyses revealed the spatial dependence of the formation of new ICT firms, but not the spatial dependence of employment growth of incumbent ICT firms. They argued that the ('simple') incubation hypothesis, stating that only larger cities are breeding places for entrepreneurship, needs to be adjusted to the appropriate spatial level: that of the agglomerated region. In this way, central core locations, suburban locations, large and medium sized cities in the Randstad and Intermediate zone of the Netherlands together make up a complex and detailed polycentric urban field having more than average propensities for employment growth. In this section we will focus on the effect of agglomeration economies on incumbent firm growth in comparison with new firm formation, in different spatial regimes.

In tables 3 and 4, econometric models that we tested for are summarised. Only parsimonious research results are presented. Below the tables technical explanation on the models is provided. The degree of localised concentration, diversity and competition are introduced according to the definitions given in sections 2.2 and 3.3. Besides concentration indices of ICT firms, concentration indices for manufacturing and business service activities are introduced in the model. Likewise, localised competition, in line with the influential Glaeser et al (1992) approach, is measured by relative firm size both for ICT firms and for all firms in localities in an aggregated sense.

The Ordinary Least Squares model for employment growth in all ICT firms (column (1) in table 3) shows the significance of both concentration indicators (of the 'own' ICT industry, as well as in general for business services in a positive sense, and for manufacturing specialisation in a negative sense) and the diversity indicator. The third agglomeration indicator, measuring localised (labour market or service market) competition circumstances in the ICT industry, shows a positive relationship with employment growth when measured for the 'own' ICT industry. But this indicator shows a negative relationship when measured in general terms, taking all firms within a municipality into account independent of sectoral composition. Interestingly, these results do not provide unambiguous support for any of the three endogenous development theories discussed in section 2. The variable on R&D-intensity of economic activities (R&D INTENSITY) shows no significant relation with total employment growth in ICT-firms. This indicates that spatial externalities related to urban density are more a source of growth for ICT-firms in general than innovative behaviour of firms.

Results for own (ICT) sectoral specialisation support the MAR and Porter hypotheses, but results for industrial diversity do not. Results for industrial diversity support the Jacobs hypothesis. Results for (own, ICT) levels of localised competition support Porter and Jacob's hypotheses of growth, but not the MAR hypothesis. The general indicators of concentration stress the importance of business service specialisation as important correlate to employment growth, and the negative influence of manufacturing specialisation in general. The general competition indicator is clearly negatively related to employment growth, concluding on the MAR hypothesis of economic dynamics. These outcomes for *all* ICT firm growth rates partly resemble the general OLS model for new firm formation (see Van Oort and Atzema, 2004): the same positive effects of ICT concentration and ICT firm competition (albeit both not so strong as for new firm formation), business services concentration, diversity, ICT firm competition, and the same negative effect of competition in general. However, the negative effect of manufacturing concentration on firm growth could not be found for new firm formation.

The results presented are very much of interest from the broader perspective of those concerned with the location tendencies of new establishments and firm growth in the ICT industry connected to agglomeration circumstances. ICT firms tend to cluster in municipalities that already are ICT employment centres, and rich in industrial diversity. The test statistics of

LM(ρ) and LM(λ) in Column (1) reveal the lack of spatial autocorrelation dependency of the model. In columns (2)-(5) of table 3, therefore, the models are estimated without spatial -lag or -error specification, but with spatial regime estimation. Heteroscedasticity does emerge as a problem in some of the models estimated (see the LM(BP) statistics in the tables), the spatial regime estimates do often solve this technical problem (the spatial regimes adequately capture the causes of residual-divergence or heteroscedasticity). Columns (2a-c), (3a-b), (4a-b) and (5a-c) present OLS-estimations, but with the allowance of structural change of coefficient estimates between spatial regimes. Certain spatial regimes on urban character capture significant spatial dependence in the growth-data of ICT firms. Table 3 shows in columns (3), (4) and (5) that the concentration indicators work out more favourably for firm growth in urban municipalities as opposed to non-urban ones, especially in medium-sized cities, and in (commuting) connected locations rather than unconnected locations. The spatial Chow-Wald tests for these models confirm the significance of the spatial regimes at the 10% significance level (for the urban regime at the 5% level). The model fit improves considerably when compared to the original OLS model without the urbanisation regimes.

Most remarkably in these research results are the fact that the simple agglomeration hypothesis turns out to be too crude for the Dutch empirical data: not the largest cities show the highest correlation with the agglomeration indicators and firm's growth, but the medium-sized cities. These cities are characterised by positive links of sectoral diversity and the concentration of ICT firms with growth of these firms. This result is particularly interesting, because earlier studies on economic dynamics in the Netherlands (specifically ICT-firm dynamics) did not focus on these regimes (cf. Weterings and Van Oort, 2004). Also different from earlier studies is the fact that the spatial regime of Randstad-Intermediate zone-Periphery is not significant in describing growth differentials of ICT firms.

In table 4 the analysis is repeated for only the population of *incumbent* ICT firms only (those firms that were present in the Netherlands during the complete survey period 1996-2000).

The OLS model in column (1) shows that in general the significance of agglomeration indicators is the same as in the all-firms analysis. Sectoral diversity, own-sector specialisation and the competition indicator again are all significant attached to incumbent firm growth. However, local ICT firm competition has a negative effect on incumbent firm growth, in contrast to the positive effect of this indicator on all firm growth rates (see table 4) and new firm formation (see Van Oort and Atzema, 2004). Growth of incumbent ICT-firms is associated with relative larger ICT-firm size. Again, a spatial-lag or -error formulation appears unfruitful, because the of LM(ρ) and LM(λ) statistics do not indicate spurious signs of spatial dependence with the most important variables introduced. These variables capture the spatial autocorrelation significantly; the model does not gain from further autocorrelation-specifications. But also some remarkable differences with the all-firms analysis come to the fore. At the 10% significance level, the Randstad-Intermediate zone-National periphery regimes become significant. Especially the Intermediate zone has characteristics that are positively attached to growth in incumbent ICT firms. Especially the significant additional correlation of R&D intensity of firms in the intermediate zone regime sets the incumbent growth model apart from the all firms model. This is also the case in the connected-regime. Localized R&D-intensity can be interpreted as an additional source for learning externalities of incumbent ICT-firms in at least two urban regimes. On a lower spatial level, the municipal urban regimes (columns (4) and (5) in table 4) do not significantly contribute to the description of spatial variation in the growth of incumbent firms.

Table 3. OLS and spatial regime models for (log) *all* ICT firm growth rates in the Netherlands (n=580, 1996-2000, t-values in parentheses)

Explanatory variables	(1) OLS	(2) OLS, macro-zoning regimes			(3) OLS, connectedness regimes		(4) OLS, urban regimes I		(5) OLS, urban regimes II		
		Randstad	Int. zone	Periphery	Connected	Unconnect.	Urban	Non-urban	Large cities	Medium-sized	Small cities
CONSTANT	2.849	2.408	-0.923	2.565	3.031	2.736	2.999	2.600	3.586	2.999	2.600
	(6.103)	(1.968)	(-0.468)	**(2.138)**	**(4.902)**	**(3.974)**	**(6.275)**	(1.630)	**(1.993)**	**(6.258)**	(1.630)
CONCENTRATION ICT FIRMS	0.838	1.341	1.061	0.837	0.886	1.103	0.851	-0.229	-0.741	0.851	-0.229
	(2.942)	**(2.312)**	**(2.398)**	(1.286)	**(2.214)**	**(2.609)**	**(2.828)***	(-1.301)*	(-1.438)*	**(2.820)***	(-1.301)*
CONCENTRATION MANUFACTURING	-0.557	0.626	-0.642	-0.531	-0.338	-0.755	-0.594	-0.021	-0.130	-0.594	-0.021
	(-4.023)	**(-2.228)**	**(-2.707)**	**(-2.280)**	**(-2.113)**	**(-3.675)**	**(-3.839)**	(-0.793)	(-0.180)	**(-3.829)**	(-0.793)
CONCENTRATION BUSINESS SERVICES	1.195	0.995	0.571	1.585	0.906	-1.218	1.203	-0.381	0.478	1.203	-0.381
	(2.637)	**(2.387)**	(0.895)	**(1.962)**	(1.314)*	(-1.942)*	**(2.466)***	(-0.679)*	**(2.258)**	**(2.460)**	(-0.679)*
LACK OF DIVERSITY	-2.723	0.604	-2.397	-2.634	-2.870	2.396	-3.079	2.052	3.320	-3.079	2.052
	(-2.994)	(0.176)	**(-2.349)**	(-1.297)	**(-2.107)***	(1.643)*	**(-3.773)***	(1.541)*	(1.375)*	**(-3.763)***	(1.541)*
SIZE ICT FIRMS (COMPETITION)	0.815	0.963	1.098	0.524	1.023	-0.758	0.595	0.882	-0.635	0.594	0.882
	(2.424)	(1.512)	**(1.973)**	(0.785)	**(2.059)***	(-1.634)*	(1.760)	(0.892)	(-0.443)	(1.755)	(0.892)
SIZE ALL FIRMS (COMPETITION)	-1.137	0.039	-1.991	-1.178	-1.423	-1.209	-1.252	-1.338	-1.888	-1.253	-1.338
	(-2.602)	(0.421)	**(-3.749)**	(-1.230)	**(-2.171)**	**(-2.019)**	**(-2.664)**	(-0.901)	(-0.848)	**(-2.656)**	(-0.901)
R&D INTENSITY	0.045	-0.334	0.422	0.639	0.072	-0.237	0.137	-0.794	-0.818	0.138	-0.794
	(0.131)	(-0.451)	(0.854)	(0.827)	(0.145)	(-0.476)	(0.368)	(-0.725)	(-1.140)	(0.368)	(-0.725)
Sum. Statistics											
R^2	0.0643		0.0978		0.0888		0.0828			0.093	
LM (BP)	1.938 (0.164)		3.053 (0.217)		4.570 (0.032)		3.858 (0.044)			4.773 (0.092)	
LM (ρ)	0.265 (0.606)		-		-		-			-	
LM (λ)	0.276 (0.599)		-		-		-			-	
Chow-Wald	-		2.134 (0.309)		1.677 (0.061)		1.258 (0.026)			0.960 (0.085)	

Values of log-likelihood are not comparable over populations of all and old establishments. Following Anselin *et al*. (1995), LM (ρ) and LM (λ) are statistics for the presence of a spatial lag in the dependent variable and in the residual respectively, with a critical value of 3.84 at the 5 per cent level of significance (marked +). LM (BP) tests for homoscedasticity of regression errors using the Breusch-Pagan Lagrange multiplier test for normal distributed errors. The spatial weight matrix used is w_1 (row standardised), probability levels (p-values) are presented in the tables. Significant p-levels are printed in bold. The spatial Chow-Wald test is distributed as an F variate and tests for structural instability of the regression coefficients over regimes (Anselin 1995, page 32). Significant results (95 per cent confidence interval) of the spatial Chow-Wald in general and on individual coefficients (rejection of H_0 of joint equality of coefficients over regimes) are marked (*). All variables are log transformed and corrected for extreme values. The variables concerning ICT FIRMS are calculated on the population of all ICT firms.

Table 4. OLS and spatial regime models for (log) *incumbent* ICT firm growth rates in the Netherlands (n=580, 1996-2000, t-values in parentheses)

Explanatory variables	(1) OLS	(2) OLS, macro-zoning regimes			(3) OLS, connectedness regimes		(4) OLS, urban regimes I		(5) OLS, urban regimes II		
		Randstad	Int. Zone	Periphery	Connected	Unconnect.	Urban	Non-urban	Large cities	Medium-sized	Small cities
CONSTANT	2.409	2.117	2.336	2.607	2.361	2.454	2.519	1.278	2.736	2.519	1.278
	(5.882)	**(2.209)**	**(3.731)**	**(3.316)**	**(3.754)**	**(4.479)**	**(5.808)**	(0.664)	(1.430)	**(5.778)**	(0.664)
CONCENTRATION ICT FIRMS	0.728	0.802	0.539	1.235	0.422	1.097	0.674	1.038	0.398	0.675	1.038
	(3.904)	**(2.022)**	**(2.040)**	(2.745)	**(2.043)**	**(3.852)**	**(3.494)**	(1.604)	(0.471)	**(3.476)**	(1.604)
CONCENTRATION MANUFACTURING	-0.812	-0.595	-0.710	-0.886	-0.335	-1.313	-1.030	0.251	-0.227	-1.030	0.251
	(-2.238)	(-0.809)	(-1.271)	(-1.315)	(-0.653)	**(-2.531)**	**(-2.702)**	(0.176)	(-0.497)	**(-2.688)**	(0.176)
CONCENTRATION BUSINESS SERVICES	0.322	0.908	0.231	1.190	0.546	-0.892	0.970	1.662	1.819	-0.970	1.662
	(1.481)	(1.167)	(0.831)	(1.937)	(0.380)	(-1.876)	**(1.962)**	(1.589)	(1.066)	(-0.957)	(1.589)
LACK OF DIVERSITY	-2.280	1.342	-2.516	-2.238	-2.436	1.923	-2.438	0.587	-2.727	-2.438	0.587
	(-2.873)	(1.549)*	**(-2.173)***	(-1.409)*	**(-2.088)***	(1.540)*	**(-2.949)**	(0.196)	(-0.733)	**(-2.934)**	(0.196)
SIZE ICT FIRMS (COMPETITION)	-0.388	-0.604	-0.184	-0.108	-0.796	0.049	-0.789	0.378	0.087	-0.789	0.378
	(-0.633)	(-0.537)	(-0.177)	(-0.072)	(-0.871)	(0.058)	(-1.145)	(0.826)	(0.023)	(-1.139)	(0.826)
SIZE INDUSTRIAL FIRMS (COMP.)	-0.426	-0.350	0.112	-0.475	0.078	-1.012	-0.495	0.584	-1.255	-0.495	0.584
	(-1.013)	(-1.672)	(0.180)	(-0.587)	(0.127)	(-1.738)	(-1.123)	(0.368)	(-0.498)	(-1.117)	(0.368)
SIZE SERVICE FIRMS (COMP.)	-0.056	1.543	-0.825	-0.884	-1.040	0.607	0.157	-1.085	-0.784	0.157	-1.085
	(-0.088)	**(3.296)***	(-0.828)*	(-1.868)*	(-1.097)	(0.688)	(0.234)	(-1.214)	(-0.476)	(0.232)	(-1.214)
R&D INTENSITY	0.270	-0.402	0.506	-0.003	0.529	-0.159	0.216	1.024	0.774	0.216	1.024
	(1.192)	(-0.781)*	**(2.631)***	(-0.005)*	**(2.659)***	(-1.049)*	(0.897)	(1.442)	(0.758)	(0.893)	(1.442)
Sum. Statistics											
R^2	0.1469	0.1898			0.1845		0.1634		0.1700		
LM (BP)	0.304 (0.481)	4.251 (0.092)			1.958 (0.162)		3.845 (0.049)		4.823 (0.089)		
LM (ρ)	0.851 (0.356)	-			-		-		-		
LM (λ)	1.746 (0.186)	-			-		-		-		
Chow-Wald	-	1.459 (0.083)			1.184 (0.089)		1.110 (0.352)		0.766 (0.755)		

See technical explanation below table 3.

In general we can conclude that the relations found work out most profoundly in urban environments. This conclusion confirms the urban setting of the endogenous development theories as outlined in section 2. But different definitions of urbanisation appear to be significant for the growth of incumbent ICT firms and ICT firms in general. Column (2) in table 4 shows that the intermediate region most notably 'exhibits' the significant set of agglomeration economies for incumbent firms, as opposed to the National periphery and (to a lesser extent) the Randstad region. The model fit is considerably better than in the original OLS model. Both the incumbent and all firms' analyses show the significance of the connected spatial regime, as opposed to the unconnected regime. Column (5a-c) in table 3 shows that within the municipal urban regime, especially medium-sized cities are characterised by significant agglomeration indicators. The analyses show that urbanisation matters for ICT firm growth on different scales of urban analyses in the Netherlands, both defined by contiguous proximity (captured by the spatial variation of the explanatory variables in the econometric models) and by the spatial heterogeneous regimes. This considerably extends the current debate on urbanisation and localisation externalities, which focuses mainly on proximity based spillovers and knowledge transfer only.

5 Conclusions

Two questions have been central in this paper. First, we wanted to determine which measurable agglomeration factors are connected to new firm formation and incumbent firm growth in the ICT industry in the Netherlands. Second, our analysis focused on the conceptual spatial configurations that best describe patterns of new firm formation and incumbent firms' growth. We asked ourselves what additional role network-based spatial regimes (such as urban hierarchy, labour market areas, national core-periphery distinctions) play compared to the localised proximity-thesis stressed in the literature. In turn our approach has been applied to the hypothesis that large(r) cities or urban regions are breeding grounds for entrepreneurship because of localised knowledge spillovers. In the end we are able to answer the question whether entrepreneurship as measured by the *growth* of firms in the dynamic ICT industry is differently related to the spatial externalities debate than new firm formation rates in this industry. In this section we answer these questions according to the research outcomes presented in the previous sections and draw some conclusions.

Our answer to first question – which measurable agglomeration factors are connected to new firm formation and incumbent firm growth in the ICT industry in the Netherlands – is not so straightforward as is expected in the debate. In contrast to new firm formation (see Van Oort and Atzema, 2004), incumbent firm growth is not positively affected by ICT firm competition. The effects of the diversity and concentration measures are positively related to incumbent firm growth, just as with new firm formation in the ICT industry. These outcomes do neither fully support nor fully contradict the theories of knowledge spillovers, attributed to Marshall-Arrow-Romer, Porter, and Jacobs. As indicated, the determinants of technological change have become subject of further theorizing in endogenous development theory, which led to the advent of new growth models. These models also include research & development (R&D) as an important additional inputs affecting growth. Firm-internal (and not so much urban bounded, firm-external) knowledge became regarded as an endogenous core input for economic growth as well. As spillovers imply the possibility of under-investment in knowledge (as firms recognize the danger of knowledge leaking towards competitors), government policy increasingly focused on providing subsidies for especially R&D-intensity of firms in the Netherlands. We introduced a R&D-indicator in the models, with which we additionally tested for the influence of R&D on growth of ICT firms. It turned out that localized R&D-intensity as an additional source of learning externalities is attached to incumbent firm growth in two dominating urban regimes. R&D-levels are not significantly related to firm growth in general.

The elements for answering the second research question - what spatial configuration describes the incumbent firm growth patterns best - come from descriptive and econometric analyses. Especially the insignificance of spatial lag estimators in the models presented in section 5 indicate that unlike for new firm formation, incumbent firm growth in the Dutch ICT industry is not significantly related to proximity and contiguity based spatial autocorrelation. At the same time, the change-of-slope econometric analyses of section 5 show that urbanisation defined in spatial heterogeneous (network-based, non-contiguous) regimes matters less for incumbent firm growth than for firm formation on different spatial scales of analyses in the Netherlands. Most remarkably in these research results is the fact that the simple agglomeration hypothesis (larger cities show higher growth rates) turns out to be too crude for the Dutch empirical data: not the largest cities show the highest correlation with the agglomeration indicators and firm's growth, but the medium-sized cities. On a regional level, firms in the so-called Intermediate zone have better growth performances than firms in the national core region, the Randstad. These in size second-ranked cities and regions are characterised by positive links of concentration of ICT firms, sectoral diversity, and R&D intensity with growth of incumbent firms. These results are particularly interesting, because earlier studies on economic dynamics (specifically ICT-firm dynamics) did not focus on these regimes.

Most studies of location determinants have focused on employment growth in general and innovation intensity. Relatively few studies have looked at the component of employment growth arising from establishment births and growth. The relative importance of various types of externalities in fostering new firm formation and firm growth, locally as well as among more geographically dispersed areas, has implications for the formulation and interpretation of endogenous growth models. Our analyses have shown a marked difference between the effects of agglomeration economies on new firm formation and incumbent firm growth in the Dutch ICT industry (as studied by analysing the all-establishments and incumbent establishments populations of firms). For example, local ICT firm competition has a positive effect on new firm formation, but a negative effect on incumbent firm growth. The other agglomeration indicators have the same effect on both new firm formation and incumbent firm growth, they only differ in magnitude (stronger effects of ICT firm concentration, business services concentration, and all firm competition on new firm formation). In general, agglomeration economies have stronger effects on new firm formation than on growth of incumbents in the ICT industry. The distinction between these two indicators of entrepreneurship thus contributes to the spatial externalities debate. No satisfying formulation has been developed (yet) to incorporate life-cycle aspects (of entrepreneurship) fully in endogenous growth models (Acs et al, 2003). This paper has showed that there clearly is a rationale to do so.

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