

NEW INDUSTRIES AND WINDOWS OF LOCATIONAL OPPORTUNITY

A long-term analysis of Belgium

With 1 figure and 2 tables

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Zusammenfassung: Neue Industrien und das "Windows of Locational Opportunity"-Konzept. Eine Langfrist-Analyse Belgiens

Dieser Aufsatz stellt ein theoretisches Konzept ("Windows of Locational Opportunity" (WLO)) vor, das im Hinblick auf das Grundproblem der Wirtschaftsgeographie, den Standort neuer Industrien zu erklären, eine spezielle Perspektive anbietet. Das WLO-Konzept beschreibt die Ansiedlung neuer Industrien unter den Kriterien von Unbestimmtheit, Kreativität und Zufall. Kurz gesagt, dieses theoretische Konzept vertritt die Ansicht, daß sich beim Auftreten neuer Industrien „Zeitfenster“ für räumliche Entwicklungsmöglichkeiten eröffnen: Chancen der industriellen Entwicklung sowohl für führende als auch für rückständige Gebiete. Dies ist so, weil die Lokalisation neuer Industrien in der Anfangsphase ziemlich unabhängig von bereits in der Vergangenheit angelegten räumlichen Strukturen und Bedingungen stattfindet. Der Einfluß des Raumes wird aus mehreren Gründen als nicht voraussagbar und nur schwach ausgeprägt angesehen: es ist wenig wahrscheinlich, daß die neuen Standortanforderungen der neuen Unternehmen durch überkommene Standorte und deren Merkmale erfüllt sind, und ihre Entwicklung kann durch die unternehmerische Kreativität auch an ungünstigen Orten gesichert sein.

Gemäß den hinter diesem Konzept stehenden Prinzipien wird hier eine langfristige räumliche Analyse der belgischen Industrieentwicklung präsentiert. Als erstes wird empirisch aufgezeigt, daß die belgische Industriegeschichte der letzten zwei Jahrhunderte bewiesen hat, daß neu entstandene Industrien keinen besonderen Standorttypus für ihre Entwicklung benötigen. Wie nach dem WLO-Konzept zu erwarten, bieten neue Industrien sowohl für führende als auch für rückständige Gebiete ebenso wie für altindustrielle und für abgelegene Regionen Chancen. Zweitens unterstreicht eine tiefergehende Analyse von einigen ausgewählten neuen Industrien die Bedeutung von Kreativität und Zufall in der Anfangsphase ihrer Entwicklung. Hierbei wird das Hauptgewicht auf die Fragen gelegt, ob die räumliche Formation neuer Industrien mit der Schaffung wichtiger Voraussetzungen einhergeht, ob diese Kreativität neuer Industrien durch besondere Vorbedingungen in der betreffenden Region beeinflusst ist und (falls das so ist) ob diese örtlichen Gegebenheiten als Besonderheit dieser Region(en) angesehen werden können. Kurz gesagt, diese langfristige Analyse der belgischen Verhältnisse zeigt, daß einige der neuen Industrien sich ziemlich unabhängig von den besonderen, aus der Vergangenheit überkommenen räumlichen Vorbedingungen entwickelt haben. Ihre Ansiedlung ging einher mit einer gut ausgebildeten Fähigkeit, die erforderlichen Ressourcen selbst zu schaffen oder anzuziehen. Obwohl diese Kreativität tatsächlich auf besonderen Voraussetzungen in den betreffenden Regionen aufbauen konnte, können diese Bedingungen jedoch als im Raum allgemein verfügbar angesehen werden.

Summary: This article aims to set out a theoretical concept (the Window of Locational Opportunity concept), which provides a particular perspective with respect to the key problem in economic geography of how to explain the location of new industries. This WLO-concept describes the spatial formation of newly emerging industries in terms of indeterminacy, creativity and chance. In short, this theoretical concept holds the view that windows of locational opportunity tend to open up in the event of new industries: these are likely to provide opportunities of industrial development for both leading and backward regions. This is because the spatial formation of new industries during their initial stage of growth takes place rather independently of spatial structures and conditions laid down in the past. The impact of space is believed to be unpredictable and rather weak for several reasons: there is likely to be a poor match with the new requirements of new industries, their creative ability may safeguard their development in unfavourable places, while local conditions favourable to their development are likely to be of a generic nature.

Following the principles behind this concept, we present a long-term spatial analysis of Belgium. First, we demonstrate empirically that the industrial history of Belgium in the last two centuries showed that newly emerging industries do not require a particular type of region in order to develop. As expected by the WLO-concept, new industries provide opportunities for both leading regions and lagging regions, and for both old industrial areas and backward regions. Secondly, a more in-depth analysis of a few selected new industries underlined the importance of creativity and chance at their initial stage of development. By doing so, we focus attention on questions whether the spatial formation of new industries goes along with the creation of essential inputs, whether this creative ability of new industries is influenced by particular conditions in the region concerned, and (if so) whether these local conditions can be considered unique to the region(s) concerned. Broadly speaking, this long-term analysis of Belgium provides evidence that some of the new

industries emerged quite independently of specific spatial conditions accumulated in the past. Their spatial formation went along with a well-developed ability to generate or attract the required resources. Although this creative capacity could indeed build on particular conditions in the region(s) concerned, these conditions can often be considered to be widely available in space.

1 Introduction

There is widespread agreement that the economic system is currently undergoing fundamental change. This has also been taken notice by economic geographers who refer to dramatically shifting industrial fortunes of regions in the United States and some European countries during the last few decades (HALL 1985). Following SCHUMPETER, the idea predominates that the pervasive impacts of new technological breakthroughs should be held responsible for these regional dynamics, such as the structural decline of former leading industrial regions and the rise of so-called 'new growth' regions (REES 1979).

There are two topics at issue here that have also been debated in recent literature. The first one is whether new technological breakthroughs (the micro-processor) that give birth to new industries (the computer sector) are indeed expected to lead to major disruptions in the economic geography of major industrial countries. Are leading industrial regions by definition incapable of maintaining their once dominant positions because of inevitable problems of adjustment? Do new industries require so-called 'new growth' regions to develop and prosper because these localities are unlikely to suffer from old, inflexible structures? The second topic addresses a key problem to economic geographers: that is how to explain the location of newly emerging industries (MARKUSEN 1985; DICKEN a. LLOYD 1990). Do locational factors determine the place where new industries manifest themselves, do some locations provide a more favourable production environment than other places, or do new industries develop independently of existing spatial structures and environments?

The first objective is to present a theoretical concept, that is the *Window of Locational Opportunity* concept (abbrev. WLO-concept), which takes a particular stand towards both topics. In short, it describes the spatial formation of newly emerging industries in terms of indeterminacy, creativity and randomness: there is much uncertainty about their location because their spatial manifestation during the initial stage of growth is unlikely to be influenced by local structures and conditions in a predetermined way (BOSCHMA a. VAN DER KNAAP, forthcoming). In sum,

windows of locational opportunity tend to open up when new industries appear because these provide opportunities for both leading and backward regions. The second objective is to present a long-term spatial analysis of Belgium, in order to illustrate some of the theoretical statements of this WLO-concept.

The main features of the WLO-concept are briefly outlined in Section 2. By doing so, we specify the extent to which the spatial environment may exercise influence on or even determine the place where new industries emerge. We also discuss the work of SCOTT and STORPER (1987) and PEREZ and SOETE (1988) because their notions of (locational) window of opportunity are to some extent related to our concept with respect to both topics. Then, Section 3 provides some historical evidence from a spatial analysis of Belgium for some of the features of this WLO-concept. This analysis not only preoccupies with the problem whether newly emerging industries provide opportunities for both leading and backward regions, but is also concerned with the question whether the rise of new industries in a region may be related to specific conditions in the area concerned.

2 The concept of windows of locational opportunity

The notion of 'window of locational opportunity' has been introduced by SCOTT and STORPER (1987) in order to describe that the appearance of new fast-growing industries herald 'moments of enhanced locational freedom' (STORPER a. WALKER 1989, 75) in capitalist history. According to them, new industries tend to possess locational freedom for two main reasons. Their high returns on investment tend to free themselves from many locational constraints. For instance, required labour may be imported from elsewhere without any major problems despite the high costs involved. The other reason is that new fast-rising industries possess a 'locational capability' in order to organize and meet their specific and unique input-output requirements or 'locational specifications'.

The authors themselves have been rather reluctant to work out these ideas more thoroughly. For example, they do not specify the extent to which particular conditions in a region may stimulate this "factor-

creating or factor-attracting power" (STORPER a. WALKER 1989, 75). We stated elsewhere (BOSCHMA a. VAN DER KNAAP, forthcoming) that it may not be excluded that some new industries (in contrast to others) may build to some extent on spatial conditions, such as a local supply of labour when adjusting the local environment in accordance with their needs. Further, they only touch upon the possibility of 'chance' to be involved in the spatial formation of new industries at their early stage of growth (STORPER a. WALKER 1989, 82). At most, they state that history has shown that many places are often able to benefit from these new opportunities, and that it is hard to explain why only one or a few places will actually take the lead through a dynamic process of place-bound external economies. We will, however, argue that the notion of 'chance' can not only be related to the notion of locational freedom. In our view, the notion of 'chance' is relevant when particular conditions in space, which may stimulate this strategy of new industries to create their own inputs are likely to be widely available in space. This last point is similar to remarks made earlier by SCOTT, who used the notion of 'window of locational opportunity' to make clear that the leading position of Silicon Valley in the production of semiconductors was quite accidental at its early stage of growth in the 1950s because, at that time, "... combinations of equally favorable conditions existed at many other locations in the United States, and there is no especial reason why we should ascribe a markedly superior locational attractiveness to Santa Clara County at this time" (SCOTT 1988, 90).

The notion of 'window of opportunity' has been applied by PEREZ and SOETE (1988) in the field of international trade theory. The concept reflects (temporary) situations of opportunity for countries to catch up in technology because fundamental new technology is conceived to break down existing development constraints or entry barriers for lagging countries. The attractive part of their approach is that they analyze in detail under what conditions this may occur. Although they account for the possibility of historical accidents, this does not imply that all countries possess an equal capacity to generate or imitate the fundamental new technology at a very early stage. In fact, PEREZ and SOETE (1988) get to the very root of the matter when they state that "catching up involves being in a position to take advantage of the window of opportunity temporarily created by such technological transitions" (PEREZ a. SOETE 1988, 460). Basic external conditions like scientific and technical knowledge, infrastructural facilities and institutional conditions are required to enable a process of technolog-

ical catching up because these all dampen the costs of entry. They talk about entry threshold levels below which costs for entrants would be too high but above which countries are potential candidates to absorb the new technology. At the initial stage of the life cycle of a new technology, the window of opportunity is (temporarily) open because the minimum threshold level is rather low, though countries require locational advantages and scientific and technical knowledge (often publicly available at universities).

However PEREZ and SOETE (1988) may be criticized for several reasons. It is striking that appropriate locations to host the new technology are regarded as essential by PEREZ and SOETE (1988) while the notion of 'locational advantages' is not clearly defined. It is hard to imagine what is meant by 'basic requirements', not in the least because empirical evidence is not provided for. These statements also underestimate the power of creative behaviour as stressed by STORPER and WALKER (1989). Further, it is quite remarkable that the minimum level of locational advantages required decreases in the course of time, which is quite opposed to the idea that a favourable production environment (locational economies) comes into existence as the development of new technology proceeds. Moreover, they start from a dynamic process of technical and industrial change in which levels of relevant skills and experience (and capital) become more important through learning processes in later phases which close the windows of opportunity. However, they have adopted a rather static view of catching up in technology because it merely means closing gaps. By the way, gaps are hard to define in case new needs (knowledge) are not assumed in advance. They define windows of opportunity in terms of catching up in technology because they are much preoccupied with the technological potentials of lagging countries. By doing so, they tend to ignore that these may open up for leading countries as well. In fact, this latter option is almost ruled out by them because many technologically advanced countries are believed to face difficulties when applying new technology because of heavy commitments to older technologies.

2.1 Discontinuity: spatial indeterminacy

To start with the outline of the main features of the WLO-concept, we focus attention on the discontinuous nature of newly emerging industries. New industries represent dramatic breaks with the past because their requirements in terms of inputs (natural resources, labour, capital and components), supply

of markets and infrastructural facilities are likely to differ fundamentally from the ones of techno-industrial structures laid down in the past. For example, knowledge, skills and institutions accumulated in the past are unlikely to be compatible with their new needs. The notion of spatial indeterminacy suggests that it is precluded that the ability of regions to adapt may be determined by any past experiences. Due to a mismatch with their new requirements, spatial practices and conditions accumulated in the past will not provide any stimuli to the development of new industries and, therefore, will not predetermine their place of emergence. In fact, newly emerging industries are likely to provide an opportunity for lagging regions to escape the vicious circle of former exclusion effects, while leading regions are denied to reap benefits from previous advantages related to a former leadership in order to divert into these new techno-industrial fields.

As STORPER and WALKER (1989) noticed, this notion of spatial indeterminacy contrasts with the Weberian location theory which claims that new industries will develop most rapidly in those regions where their static, pre-given locational needs are most consistent with existing local factors. These static models may be criticized on several grounds. They overlook the possibility that (new) needs of new industries are not there from outset but come into being (or may even be created) as these industries develop, they disregard the importance of 'generic' resources during their initial stages of growth, and they deny the existence of historical accidents.

2.2 *Spatial indeterminacy: human agency*

The previous notion of spatial indeterminacy leaves scope for human agency to be involved in the spatial formation of new techno-industrial structures. By doing so, this latter process becomes a highly dynamic growth process in which local production environments are shaped and transformed by the new industries themselves in accordance to their needs, relatively independently of spatial structures laid down in the past. When it is impossible for newly emerging industries to build on locally available conditions to support their development, they have to create their own mechanisms to satisfy their needs. According to STORPER and WALKER (1989, 71), "... industries are capable of generating their own conditions of growth in place, by making factors of production come to them or causing factor supplies to come into being where they did not exist before". This creative behaviour is undertaken out of necessity in order to com-

pensate for the mismatch explained above, which brings efficiency in the local production environment. This implies that favourable production environments are more likely results of, rather than preconditions for this dynamic growth process. It also implies that the 'selected' location is not necessarily the most efficient of all possible places in their initial stage of growth.

2.3 *Spatial accidents: weak impacts of spatial environment*

We do not, however, claim that new industries have a complete freedom to locate anywhere. While spatial contexts vary from place to place because of different histories, it is not excluded that the capacity of regions to generate or attract new industries may also differ. This does not, however, exclude the possibility of chance events either. Before we turn to the way chance events are defined and specified in the WLO-concept, we first draw attention to the work of the economic historian CRAFTS (1977), who worked out two philosophical approaches of 'chance' when dealing with the problem why the Industrial Revolution took off in Great Britain, and not in other countries like France.

The first notion of chance is related to (the current) ignorance of the observer who analyzes a complex problem which is, in principle, knowable. In this case, observed results, like the spatial pattern of new industries, are believed to be the outcome of a logic which at present is not fully understood, but will be so in the near future (leaving no room for historical accidents). The second notion of chance is related to randomness, in which the explanatory factors are related to the dependent variable in a probabilistic way. This does not imply that 'anything goes': some events are more probable to occur than others. However, the observed result is not necessarily the superior, optimal, or the most likely one: the result is hard to predict beforehand even when we had knowledge of all relevant factors. This latter notion of 'chance' is much related to our concept, to which we will turn later.

Only recently, KRUGMAN (1991) and ARTHUR (1994) have adopted the notion of 'historical accident-plus-agglomeration' which mirrors much of previous work of Myrdal (1957) on cumulative causation. These approaches all seem to agree that a logic of self-reinforcing regional growth, based on agglomeration economies (or 'increasing returns') is predated by an initial stage of growth in which accidental events set in motion, or trigger the initial process of development. Traditionally, this has been related to heroic Schumpeterian entrepreneurs which undertake new things

against all odds (see FREEMAN a. PEREZ 1988). More recently, this has been associated with small, arbitrary events ('butterfly-effects' in chaos theory) which may lay at the roots of the formation of new durable structures (DOSI 1988; ARTHUR 1989). This implies that it is not only unpredictable where new techno-industrial developments emerge in space (besides their arbitrary and small nature, decisive factors are not known beforehand, only *ex post*) but also that it is the logic of growth in a local context which is essential to come to grips with the process of economic growth. Whereas the successive stage of growth has been described in a rather satisfactory way, the notion of 'chance' has been rather poorly developed, not in the least because it is hard to set up a theoretical framework which accounts for arbitrary and unpredictable factors that may influence the place where new industries emerge and develop (SCOTT 1988; DICKEN a. LLOYD 1990).

The WLO-concept incorporates chance events as follows. First, the WLO-concept states that it is uncertain and unpredictable where triggers (problems and opportunities) will induce the rise of new industries: there are innumerable numbers of potential triggers present in every possible type of region, while many incentives may have a non-local character (not unique to any particular type of region, such as high or low labour costs). Secondly, though it is not unlikely that a particular local environment may be more fit to the development of new industries than others, the WLO-concept claims that it may still be rather uncertain where these will sprang up. On the one hand, this is because the creative ability of new industries may safeguard their development in places where potentially favourable resources are lacking. The impacts of the local environment are likely to be of a rather weak nature due to the poor match with the new requirements of new industries mentioned before, while the presence of relatively high returns in the early stage of growth (technological inappropriability, patent protection) allows new industries to locate and survive in rather arbitrary places. On the other hand, another reason for this uncertainty about their location is that beneficial conditions that may facilitate the ability of regions to participate in these new industries are likely to be widely available in space due to their generic nature. The needs of new industries are often not given beforehand but come into being as their growth proceeds. In fact, their creative ability turns these generic resources (basic knowledge) into specific ones (specialized knowledge). In sum, the WLO-concept views the spatial formation of new industries as the accidental combination of personal initiatives triggered by arbitrary

(local or non-local) incentives, which develop in a local environment that is either hostile (urging the dynamic firms to create their own local conditions of growth) or offers favourable but widely available resources that ease the process of adjustment.

3 *A long-term spatial analysis of Belgium*

We will now provide evidence of the WLO-concept derived from a long-term spatial analysis of Belgium (BOSCHMA 1994). We first examined whether newly emerging industries have actually provided opportunities for both leading and backward regions in Belgium during the last two centuries, as expected by the WLO-concept. Then, we present an in-depth analysis of the spatial formation of a couple of newly emerging industries in Belgium with respect to the importance of creativity and chance during their initial stage of growth. This concerns questions like whether their spatial formation has gone along with the creation of essential inputs, whether this creative ability of new industries has been influenced by particular conditions in the region concerned, and (if so) whether these local conditions may be considered unique to the region(s) concerned.

3.1 *A complex picture of spatial outcomes in Belgium*

In the foregoing, we concluded that there is much uncertainty about the place where new industries will sprang up. Major new technological breakthroughs pose opportunities for both leading and backward regions. Each type of region starts from a more or less equal position to host newly emerging industries despite the fact that their histories may differ considerably. Following this line of thought, the spatial manifestation of new industries is expected to show a complex diversity of outcomes which is hard to reconcile with some established theoretical frameworks. This uncertainty about the locus of new industries would not only contrast sharply with a logic of self-reinforcing tendencies of regional development inherent in traditional core-periphery theory of innovation. It would also be inconsistent with a catastrophic approach of industrial development, which expects backward regions to be the most likely candidates for new industries because core industrial regions would be too strongly orientated towards their techno-industrial legacy of the past (HALL 1985). If the long-term spatial analysis of Belgium would indeed reveal a lack of univocal outcomes, it would give support to the idea behind the WLO-concept that new industries

provide opportunities for both leading and backward regions.

We carried out two empirical exercises. On the one hand, we examined the extent to which the ability of Belgian regions to generate or attract newly emerging industries has been subject to fundamental change during the last two centuries. On the other hand, we specified how this capacity could be related to their previous levels of industrial development. In essence, it concerned the problem whether old industrial core areas and backward, peripheral regions are capable or not of participating in newly emerging sectors.

We used several criteria to select the new industries. The new sectors should not only have been new for Belgium at their time of emergence, but should also have expanded to some extent in Belgium soon afterwards. We selected three new industries during the period of the first Industrial Revolution: cotton, steam engineering and coal-based iron making. These emerged and developed in the first part of the nineteenth century in Belgium, and accounted for a total of about 26,000 people employed in 1846. The second period (the railway-phase) witnessed the rise of railways, steel making and inorganic chemicals (alkalis and coal-gas lighting) which together employed about 32,000 people in 1880. At the turn of the century (the second Industrial Revolution), major technological breakthroughs resulted in the emergence of new industries like heavy electrical engineering, automobiles and some branches of organic chemicals (synthetic fibres, photographic chemicals, synthetic fertilizers and aluminium), which led to the employment of 29,000 labourers in 1910. The fourth phase (mass-production phase) showed the rise of coal-based organic chemicals (such as pharmaceuticals, plastics, and oil-refining), light electrical engineering and electronics (radio) in the first part of the twentieth century, which amounted to a total of 26,000 new employment in 1947. Finally, micro-electronics (computers, telecommunication, information services), petro-chemicals, aircrafts and space and nuclear energy are the major new activities of the third Industrial Revolution in Belgium, which created new employment for about 68,000 people in 1990.

Tables 1 and 2 present the results of the most dynamic regions in Belgium with respect to their ability to develop newly emerging industries and their industrial position during the industrial epoch (Fig. 1). This has all been gauged by a traditional 'location quotient' method, which measures the regional shares in the employment in the new industries in Belgium (or in the manufacturing sector), as compared to the shares of the regions in the population of the country



Fig. 1: Map of the most dynamic regions in Belgium
Karte der dynamischsten Regionen in Belgien

as a whole. Quotients higher than one indicate that the performance of the regions exceeds the national average. Before turning to the results, a few comments deserve attention. There have been problems of measurement, such as the difficulty to isolate new sectors in the Census (see BOSCHMA 1994). Further, the established industries that underwent a complete technological transformation (such as glass making in which Belgium became a world leader in the nineteenth century) have been excluded from the analysis though it would have provided key information on the ability of regions to develop and apply the latest technology. Moreover, we did not measure the essential distinction between regions which succeed in generating new industries through their own endogenous capacity (based on own initiative and local firms) and regions which succeed through external resources (for instance, by attracting direct foreign investments). We will come to this later when attempting to explain the regional performances. Finally, the use of employment figures in this analysis is not beyond any doubt (BOSCHMA 1994).

Table 1 presents the main empirical results with respect to the long-term ability of Belgian regions to generate or attract newly emerging industries. As expected by the WLO-concept, the spatial manifestation of newly emerging industries in Belgium shows a complex diversity of outcomes during the past 150 years of industrialization. As a matter of fact, when we compare the ability of Belgian regions to develop new industries in the course of time, it seems that new industries provide opportunities for both leading and lagging regions. There is evidence of leading regions losing out their capacity to generate

Table 1: The capacity of the most dynamic regions to generate or attract newly emerging industries in Belgium at a few selected years, expressed as location quotients

Fähigkeit dynamischer Regionen neue Industrien in Belgien hervorzubringen oder anzuziehen, für ausgewählte Jahre dargestellt durch Standortquotienten					
	1846	1880	1910	1947	1990
<i>Old industrial areas</i>					
Charleroi	4.28	5.23	2.39	1.11	1.41
Liège	4.16	4.35	1.65	1.31	0.76
Philippeville	9.95	2.40	0.22	0.23	0.00
Ghent	4.58	0.32	0.68	0.76	0.59
Soignies	0.73	3.57	0.56	1.33	0.05
Thuin	0.81	2.47	0.49	0.29	0.03
Nivelles	1.11	2.03	4.66	0.46	0.33
Mons	0.47	0.15	1.45	0.42	0.93
<i>New industrial areas</i>					
Brussels	1.02	0.52	1.53	3.22	2.03
Antwerp	0.04	0.33	1.62	1.06	2.19
Leuven	0.23	0.79	0.64	1.74	0.33
Halle-Vilvoorde	0.01	0.16	0.64	0.85	3.50
Turnhout	0.01	0.01	0.19	0.17	1.91

Sources: Manufacturing Census of 1846, 1880, 1910 and 1947, and Social Security Statistics of 1990 (see BOSCHMA (1994) for an evaluation of these data sources)

new industries (old industrial areas like Liège, Nivelles and Ghent in the twentieth century), of old industrial regions consolidating their position (areas like Liège and Charleroi in the nineteenth century), of newcomers grasping new opportunities (Antwerp and Brussels at the turn of the century, Leuven, Turnhout and Halle-Vilvoorde in more recent times), and of lagging regions that were never able to participate (a large group of peripheral regions not mentioned in Table 1).

Table 2 shows the main empirical outcomes with respect to the question whether industrial core regions in Belgium are more capable of participating in these newly emerging industries than peripheral regions. As expected, the results presented in Table 2 tend to confirm the conclusions made earlier. When we confront the ability of Belgian regions to develop new industries with their industrial performance of a few decades before, once again, a clear-cut picture is lacking. There is evidence of both good and poor capacities of old industrial regions to diversify into (related or unrelated) new techno-industrial fields. There are industrial regions like Charleroi, Liège (except for the most recent period) and Soignies (nineteenth century) with good innovative performances,

whereas old industrial areas like Verviers, Ghent, Mons (except for the late nineteenth century), Soignies (both in the late nineteenth and late twentieth century) and Liège (late twentieth century) showed rather poor innovative performances. The same applies to peripheral (i.e. non-manufacturing) regions, of which some succeeded to participate in newly emerging industries (Nivelles in the nineteenth century, the regions of Brussels and Antwerp in the late nineteenth and first part of the twentieth century, the regions Halle-Vilvoorde and Turnhout in the late twentieth century), whereas other peripheral regions such as Halle-Vilvoorde and Turnhout in the nineteenth and early twentieth century (amongst a large group of regions not mentioned in the table) continued to fail.

The previous analysis demonstrates that when new industries appear, windows of opportunity seem to open up for many regions regardless of their innovative and industrial performance in the past. However, this is not necessarily true. The lack of unequivocal outcomes may still imply that specific local conditions determine the place where new industries emerge. In fact, newly emerging industries may differ with respect to their locational needs, and therefore may sometimes require old industrial regions and sometimes peripheral regions to develop. In either of these cases, the windows of locational opportunity might have been closed from the beginning (except for the particular type of region concerned). Further, it would be premature, or even misleading to conclude that the core-periphery theory (or catastrophe theory) of innovation holds because core industrial regions happen to show a good (or bad) performance. In fact, an in-depth analysis is required to find out whether the rise of a new industry in a region developed quite spontaneously or could be related to specific conditions in the area concerned. This would also shed light on the problem of external origins versus endogenous sources of newly emerging industries in regions. We shall turn to these matters in the next section.

3.2 Creativity and chance in Belgium

We now briefly present the results of an in-depth analysis of the spatial formation of a few selected newly emerging industries in Belgium. For each of these industries, we explored whether specific conditions (labour, capital, knowledge, raw materials and other inputs, markets, institutions) influenced the place where these manifested themselves. It concerned questions like whether their spatial formation went along with the creation of essential inputs,

Table 2: *The industrial performance of the most dynamic regions (a) and their capacity to generate or attract newly emerging industries (b) in Belgium at a few selected years, measured as location quotients*

Industrielle Effizienz dynamischer Regionen (a) und ihre Fähigkeit, neue Industrien in Belgien hervorzubringen oder anzuziehen (b), für ausgewählte Jahre dargestellt durch Standortquotienten

	1846 (a)	1880 (b)	1880 (a)	1910 (b)	1910 (a)	1947 (b)	1947 (a)	1990 (b)
Charleroi	2.32	5.23	2.11	2.39	1.66	1.11	1.65	1.41
Liège	1.64	4.35	1.62	1.65	1.56	1.31	1.36	0.76
Soignies	1.50	3.57	1.74	0.56	1.33	1.33	1.57	0.05
Philippeville	1.55	2.40	0.89	0.22	0.93	0.23	0.67	0.00
Verviers	1.79	0.09	1.55	0.81	1.25	0.45	1.08	0.44
Ghent	1.00	0.32	1.09	0.68	1.09	0.76	1.14	0.59
Mons	1.77	0.15	1.63	1.45	1.42	0.42	1.38	0.93
Nivelles	0.63	2.03	0.96	4.66	0.93	0.46	0.95	0.33
Brussels	1.03	0.52	0.93	1.53	0.90	3.22	1.15	2.03
Antwerp	0.96	0.33	0.78	1.62	0.67	1.06	1.04	2.19
Halle-Vilvoorde	0.38	0.16	0.52	0.64	0.64	0.85	0.82	3.50
Turnhout	0.62	0.01	0.58	0.69	0.77	0.17	0.69	1.91

Sources: see Table 1

whether this creative ability of new industries has been influenced by particular conditions in the region concerned, and (if so) whether these local conditions could be considered unique to the region(s) concerned. In other words, we assessed the importance of indeterminacy, creativity and chance during their initial stage of growth, which are key notions of the WLO-concept outlined in Section 2.

As far as indeterminacy is concerned, we examined whether new industries could build on the local environment when organizing their required inputs (labour, capital, technological knowledge, raw materials, other supplies) and supplying their markets. With respect to creativity, we made an effort to determine the extent to which new industries had to rely on their creative ability in order to mobilize or attract the necessary but missing resources themselves. The importance of creativity would be confirmed if: (1) the recruitment of skilled labour had been achieved through on-the-job-training, the start-up of new learning trajectories, the creation of new (or the adaptation of old) educational institutes, and the inflow of external labour, (2) the mobilization of capital had been secured through the use of family capital, ploughed back profits, the establishment of new (or the restructuring of old) suppliers of capital, and the import of external capital, (3) new technological knowledge had been gathered through practical experience, the start-up of new technological trajectories, the formation of new (or the adjustment of existing) research and development facilities, and the inflow of external knowledge, (4) new major inputs were

produced in-house, new suppliers were formed (or existing suppliers restructured), and new key supplies were imported from elsewhere, (5) new markets came into being, and external (non local) markets were supplied, and (6) new institutions (e.g. infrastructure, regulations) were created and old institutions reformed. With respect to chance, we explored whether particular favourable conditions, when conceived to be important or even necessary in the region(s) concerned, were also available in those regions where the new industries failed to develop.

Before we turn to the results, a few comments on the analysis will suffice here. Though a detailed study of a large body of literature on the process of industrialization of Belgium provided much relevant information, it was a difficult task to determine whether indeterminacy, creativity and chance were involved in the spatial formation of each of the new industries in Belgium (BOSCHMA 1994). There are no decisive criteria, let alone exhaustive information available, to assess the extent to which burdens and benefits derived from the past did have a major impact on the course of events in the regions concerned. Further, there is always the danger of entering into a chicken-and-egg controversy when determining the extent to which the rise of new industries in a particular region depended on local conditions accumulated in the past, and to what extent these actually created their own supportive conditions. Moreover, the large number of potential factors, which may shape the long-term adaptability of regions makes it even more complicated to assess the relative importance of each of these factors.

We will successively present in a very brief way the results of an analysis of five industries which emerged in Belgium since the early nineteenth century: coal-based iron making, cotton, electric engineering, automobiles and micro-electronics. Broadly speaking, the examples tend to illustrate and support the remarks made earlier about the importance of creativity and chance in space (see in detail, BOSCHMA 1994). However, this was less the case for other sectors which are not treated here. For example, the new steelmaking industry was erected on the foundations of local complexes of steam engineering and coal-based iron making, which largely determined its location in the late nineteenth century.

3.2.1 *The first Industrial Revolution*

In the first part of the nineteenth century the *new coal-based iron industry* mainly emerged on major coal and ore fields in Liège and Charleroi, dictated by the relatively high costs of transport of these bulky materials as a result of poor transport facilities. The local proximity of these natural resources was a prerequisite, which explained the collapse of traditional (charcoal-based) iron regions in the south-east part of Belgium. However, it was not sufficient on its own for regions to develop this new industry. In fact, the new industry witnessed a strong creative ability to generate or attract a supportive local environment which was, to a high degree, lacking in the areas concerned. A required (skilled) labour force was locally recruited through the import of foreign labour, a system of apprenticeship and on-the-job training, and learning by doing. The supply of large amounts of capital was largely secured by ploughed-back profits, external capital and the establishment of new joint-stock banks. A strong local network of complementary activities like steam engineering and metal working developed alongside (or were vertically integrated by the huge firms), while the construction of large infrastructure facilities (canals and railways) was largely an outgrowth of this new development. Another reason for the rejection of an *ex ante* superior adaptability of regions endowed with a ready access to the required natural resources was the fact that other coal regions like Mons participated only in a poor way. Further, other (generic) conditions like the existence of (metallurgical) markets and experienced (metal-processing) labour in their immediate surroundings, which might have facilitated the process of adjustment, could be considered to be widely available in space in the early nineteenth century.

In the early nineteenth century the rise of the *new cotton industry* took place in the Ghent region, where the firms drew upon favourable conditions related to local linen trades, such as readily available pools of skilled entrepreneurs and experienced labour. The mobilization of required labour was further facilitated by the domestic 'putting-out' system, which had led to an accumulation of skills and experience in a semi-capitalist organization of production. However, these conditions could not be regarded sufficient for regions to participate in this new industry: large parts of the provinces of Flanders endowed with similar conditions were unable to participate. Further, the new cotton firms relied on their capacity to create or attract the necessary resources lacking in the area. The new skills needed for working with cotton and the new textile machines were not only generated locally through practical experience and 'on-the-job-training' in the firms themselves, but were also imported from Britain. Local sources of capital were of minor importance because capital requirements were relatively small while traditional owners of funds were highly reluctant to invest in this new industry. The capital needed was largely furnished by the firms themselves through family capital and internal sources of finance (profits). Moreover, the growth of the new cotton industry in the area necessitated the supply of other key inputs like textile machines, raw cotton and heavy chemicals (Leblanc soda, bleaching powder), which were either imported or produced locally (especially in the case of machine-building firms).

3.2.2 *The second Industrial Revolution*

In the late nineteenth and early twentieth century the new industries of *electrical engineering* and *automobiles* emerged in a range of areas in Belgium, which is, in itself, evidence of a situation of open windows of locational opportunity. Both old industrial regions (Charleroi and Liège) and industrial newcomers like Antwerp and Brussels were capable of reaping the economic benefits from these new industries, because entry barriers with respect to technological knowledge, skills and capital were, in general, rather low. All of these (rather urbanized) areas had developed a tradition of metalworking, engineering and instrument trades, from which were drawn experienced labour, entrepreneurs, parts and components needed in the new industries. At that time, however, this particular (rather generic) condition was anything but confined to the regions that actually experienced their development and growth in Belgium, which

lends further support to their rather accidental appearance in space. Moreover, the proximity of capital did not favour one place or another in particular because capital was widespread, the required amount of capital was often small, and the high levels of profit largely satisfied the need for new finance.

3.2.3 *The third Industrial Revolution*

The spatial formation of the *micro-electronic sector* in the postwar period differs fundamentally from the former cases. It reflects a general trend of an increasing spatial division of labour. The dynamic elements in the micro-electronic sector like control, research and high-skilled functions of large (often multinational) corporations are largely concentrated in the metropolitan region of Brussels (including the surrounding region of Halle-Vilvoorde), where these developed in the vicinity of universities, research institutions and labour supplies possessing scientific and technical knowledge and skills. Though much creativity (knowledge, skills) is involved, these particular conditions seem to have exerted a major influence on this location, leaving few opportunities for other regions. By contrast, the production plants of large (often multinational) corporations in this sector enjoyed a high degree of locational freedom in Belgium because the need to be part of such a dynamic environment is small due to the standardization of technology, the routinization of productive operations and the possibility to internalize external linkages. These located in a number of (often peripheral) regions like Turnhout and Bruges where generic conditions like a flexible, low-skilled labour force and infrastructural facilities were at their disposal. The provision of grants and financial assistance by the Belgian government in a wide range of backward and declining regions during the postwar period may have encouraged the decision of externally-owned (foreign) plants to invest in those type of regions, given their locational freedom.

4 *Conclusion*

We have set out the main features of a theoretical perspective which attempts to explain why it is rather uncertain and unpredictable where new industries emerge in space. According to this approach, their spatial formation during the initial stage of growth takes place rather independently of spatial structures and conditions laid down in the past. The impact of space is believed to be unpredictable and rather weak

for several reasons: there is likely to be a poor match with the new requirements of new industries, their creative ability may safeguard their development in unfavourable places, while local conditions favourable to their development are likely to be of a generic nature. This WLO-concept claims that windows of locational opportunity tend to open up when new industries appear: newly emerging industries are likely to provide opportunities of industrial development for both leading and backward regions.

Following this principle, we presented a long-term spatial analysis of Belgium. The industrial history of Belgium in the last two centuries showed that newly emerging industries do not require a particular type of region in order to develop. As expected by the WLO-concept, new industries provide opportunities for both leading regions and lagging regions, and for both old industrial areas and backward regions. Further, a more in-depth analysis of a few selected new industries underlined the importance of creativity and chance at their initial stage of development. Broadly speaking, their rise could not, or could only to a limited extent, be related to location-specific conditions carried over from the past. Their spatial formation went along with a well-developed ability to generate or attract the resources needed. Although this creative capacity might have been influenced by particular conditions in the region(s) concerned, these conditions could often be considered to be widely available in space.

We think that future research should focus more on the problem of how to define, specify and measure empirically indeterminacy, creativity and chance in space. This is not only because these are likely to be key notions to come to grips with the essence of spatial change, but also because the insights acquired may well be incorporated into the promising framework of evolutionary theory.

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