PART I
Empirical Foundations

Never judge a book by its cover, as the saying goes. But for this book the cover already gives a fairly good idea about the book's aim and contents! Our book is about the uneven distribution of human and economic activity across space. This unevenness shows itself through the fact that human and economic activity is strongly concentrated or spiky. Most of the human and economic activity is restricted to a relatively few locations or places. The fact that we live in a spiky word manifests itself at multiple levels of aggregation or geographical scales, that is within and between cities, regions, and also countries. Before we turn to the economic explanations for the spiky world via an in-depth discussion of urban and geographical economics, Part I of the book provides the empirical foundations for this inquiry by presenting a wide range of stylized facts on the spatial distribution of human and economic activity. This is the topic of Chapter 1. Although the focus of our book is on urban and geographical economics as a guide to understand the spiky world in which we live, Chapter 2 discusses alternative explanations for spikiness based on the role of physical geography, history, and institutions. In Chapter 3 we introduce various measures of spatial concentration or inequality and also briefly delve into the empirical methods and issues that are useful to keep in mind and include in the reader's toolkit when trying to answer the question of what the main determinants of economic spikiness are in the remainder of the book.

1 A Spiky World

LEARNING OBJECTIVES

- Show that economic activity is unevenly distributed over space; this is what we call Spikiness.
- Show that Spikiness is visible on different levels of aggregation; at the global, country, and regional level.
- Show that Spikiness has a long history.
- Show that Spikiness and economic performance are highly correlated. This book explains this correlation.

What came before … (the 2001 and 2009 editions of our book)

This book follows in the footsteps of Brakman, Garretsen, and van Marrewijk (2001, 2009). In retrospect, the 2001 book came out when geographical economics (also known as new economic geography) was probably at its peak research-wise. Ten years after Krugman (1991) launched the core model of geographical economics, the 2001 book focused strongly on the key ingredients of this model and its first extensions. It paid far less attention to empirical research and alternative approaches to understanding the spiky world. The 2009 book made up for this, aided by a decade of burgeoning research, as far as the empirics of geographical economics was concerned. The 2009 edition of our book did, however, still pay less attention to the other main approach in mainstream economics to dealing with a spiky world: urban economics. The 2020 version of our book tries to remedy this by spending a large part of the book on urban economics while maintaining the two, in our view, basic strengths of the first two editions, an extensive discussion of geographical economics as well as, also compared to other books or monographs, a strong focus on examples, data, and empirical research. This means that the new edition of our book is in many ways similar to, but at the same time rather different from the first and second editions. Apart from a more balanced treatment of urban versus geographical economics, another main difference is that we pay more attention to

(even a whole chapter, see Chapter 3) measurement issues and empirical methods. This last choice reflects the fact that, if anything, the strongest progress in urban and geographical economics between 2009 and 2019 has been on the empirical side, and in particular on the use of new research designs and data sets.

When writing a book like ours, choices have to be made regarding the topics to focus on and also, given the target audience, what the analytical depth of the book should be. Given our choice to focus on the basic modern models and empirics of urban and geographical economics, we pay less attention to some other topics in the field of spatial economics, like transportation economics or the economics of housing. For those interested in the state of the art of spatial economics more generally, we refer interested readers to the comprehensive and up-to-date survey by Proost and Thisse (forthcoming). Given that our book aims to offer an *introduction* to urban and geographical economics, we also keep the discussion of the latest development in spatial economics, the so-called 'quantitative spatial economics' approach, rather minimal. In this approach many of the basic mechanisms upon which urban and geographical economics is grounded are combined into a single framework with rich (but also technically rather advanced) empirically quantifiable models that can address a whole range of questions regarding (changes in) the determinants of the spiky world. See Redding and Rossi-Hansberg (2016) for a short non-technical introduction[1] or the survey by Proost and Thisse (forthcoming, section 5.2) for details.

The decision to pay more attention to urban economics in the third edition of our book also reflects the fact that in the last decade or so the research in urban economics has flourished relative to research in geographical economics. As will become clear from this new version of our book, the main models, mechanisms, measures, and methods of urban and geographical economics are by now so much intertwined that they should not be treated separately, but should be seen as representing complementary approaches to analyse and understand the spiky world. In doing so, we are also better able to deal simultaneously with urban, regional, and international dimensions of the spiky world. The urban implications are naturally more at home in urban economics, whereas geographical economics, with its firm footing in international trade theory, offers a more natural platform to analyse the *relations* between different locations, such as the uneven spatial distribution of human and economic activity within countries but also across the globe (Head, Mayer, and Ottaviano, 2017).

The fact that we try to pack urban and geographical economics alongside a more extensive discussion of examples and empirical methods into a single book also implies that we cannot cover all topics that could be included in a book like

[1] See Redding and Rossi-Hansberg (2017) for an advanced introduction to quantitative spatial economics.

this. Compared to the 2009 book, we trimmed down the parts on international economics, and did the same for alternative approaches to urban and geographical economics, like economic geography or regional science. We also updated the book. We did so not only by including many studies that saw the light after 2009, but also by updating and extending the data and examples used. And even though geographical economics is still at the heart of the book, its discussion is now more concise and restricted to basically only Part III of the book whereas the previous two editions largely dealt with geographical economics only. The shift to focus more on other topics and notably more on urban economics is in our view also a fair reflection of the fact that urban economics has gained more prominence vis-à-vis geographical economics since the days when we wrote the 2001 and 2009 books.

What hopefully remains true for the third edition is that it is of interest to students and scholars not only from urban and geographical economics but also from international economics and business, economic geography, and regional science. The fact that we offer an 'introduction' does not imply we avoid models or shy away from more difficult concepts. It indicates that we have attempted to write a book that is also accessible to readers who are new to the fields of urban and geographical economics. Although we discuss and use various modelling approaches, we have also tried to keep the required technicalities to a minimum in the new book. Whenever needed we make use of technical notes to give background information on derivations and the like. Similarly, we make ample use of special interest boxes to highlight certain topics and insights.

1.1 Introduction

As the title of the book signals, this book is about *urban and geographical economics*.

The urban economics literature uses micro-economic forces to better understand spatial phenomena at the urban level, both within cities and between cities. Think, for example, why different types of economic activities are in different parts of the city, why rents are higher in the city centre, how population density varies across the city, why certain ethnic or income groups are segregated in different parts of the city, or why different cities are specializing in certain types of activities (manufacturing, finance, entertainment, and so on).

The geographical economics literature uses micro-foundations to better understand macro-economic forces at the regional level and the role of economic interactions for determining these macro-economic variables.[2] The key question is to

[2] We introduced the term 'geographical economics' in 2001 in the first version of our book (Brakman, Garretsen, and van Marrewijk, 2001), as an alternative for the dated term 'new economic geography'. The term 'geographical economics' better reflects that the models are about introducing geography in economic models, rather than the other way around. This is the central topic of Chapter 7.

determine what kind of interactions of economic variables (transport costs, elasticity of demand, and share of income spent on mobile activity) are responsible for the agglomeration of economic activities, or not. From a historical point of view, this literature tries to better understand how agglomeration of economic activity has evolved over time.

The premise of this book is that it is appropriate to analyse these two strands of literature in a similar framework because of the fractal nature of spatial economic forces: similar powers are at work at different spatial scales, giving rise to similar patterns of uneven distribution and interaction. This first chapter, entitled *A Spiky World*, introduces this fractal nature by analysing the distribution of people and economic activities at different spatial scales or levels of aggregation.[3]

The remainder of this chapter is organized as follows. Section 1.2 provides an overview of the large number of people on our planet. Section 1.3 analyses uneven distributions at the global level, section 1.4 at the country level, and section 1.5 within countries. Next, section 1.6 provides a historical overview of urban development, section 1.7 of more recent urban development, and section 1.8 of the link between urbanization and income levels. Section 1.9 introduces two regularities (regarding distribution and interaction). Finally, section 1.10 concludes with an overview of the remainder of the book.

1.2 Many People

As of 11:30 a.m. coordinated universal time on 3 January 2019 there were 7,674,551,061 people alive on planet Earth according to www.worldometers.info/world-population/, which provides a world population clock and detailed information per second on births, deaths, and population for countries and the world as a whole based on the United Nations Population Division (2017, medium variant) data. On that day and time, the world population increased by about 108,000 people, the result of 185,000 births minus 77,000 deaths.

Average population density in the world in 2018 is about 58 persons per square kilometre. If you are part of a family with two children and land were evenly distributed, your family could have about 7 hectares (or 17 acres) at its disposal. Most of our readers will probably look around in amazement to conclude that they do not own an area close to this size. The reason is simple: the world population

[3] The idea that the 'world is spiky' and the visualizations (see the book cover) that go along with this idea are due to the work by Richard Florida (http://martinprosperity.org/author/richard-florida/), who coined the phrase 'spiky world' in his books and in a 2005 article in *The Atlantic Monthly* to counteract the then influential idea by the American journalist Thomas Friedman that modern-day globalization would lead to a flat world where agglomeration and geography would become ever less relevant.

is unevenly distributed as people tend to cluster together across space, and the question is why?

There are many reasons why people cluster together. Sociological: you like to interact with other human beings. Psychological: you are afraid to be alone. Historical: your grandfather already lived where you live now. Cultural: the setting here is unlike anywhere else in the world. Geographical: the scenery is breath-taking and the beach is wonderful. The focus in this book is on the economic rationale behind clustering or agglomeration.

In a sense an economic motive behind population clustering might be a pre-requisite for other motives as psychological, sociological, cultural, and historical motives may have largely developed in response to an economic motive that brought people together to live in villages and cities. Before analysing some details of urban development in section 1.6, we first briefly describe some of the characteristics of clustering of economies at a regional scale.

1.3 Global Regions

The World Bank provides a lot of information at the country level in the World Development Indicators online (www.worldbank.org). We use this information as a basis for discussion throughout this book. For presentation and discussion purposes it is sometimes useful to group countries together in bigger regions. Based on historical, cultural, and geographic information, the World Bank identifies seven main regions, as listed in Table 1.1. The East Asia and Pacific (EAP) region consists of 32 countries and includes such diverse countries as China, Japan, Indonesia, and Australia. The Europe & Central Asia (ECA) region consists of 49 countries, including the core European countries, such as France, Germany, and the UK, and Central Asian countries, such as Kazakhstan and Russia. The Latin America & Caribbean

Table 1.1 Overview of the World Bank regions

Code	Region	Examples of countries included	#
EAP	East Asia and Pacific	China, Japan, Indonesia, Australia	32
ECA	Europe & Central Asia	UK, Germany, France, Russia	49
LAC	Latin America & Caribbean	Brazil, Mexico, Argentina	35
MNA	Middle East & North Africa	Egypt, S Arabia, Algeria	21
NAM	North America	USA, Canada	3
SAS	South Asia	India, Pakistan, Bangladesh	8
SSA	Sub-Saharan Africa	Nigeria, S Africa, Ethiopia	48

Source: World Development Indicators online; # = number of countries.

(LAC) region consists of 35 countries. It includes virtually all American countries south of the USA, such as Mexico, Brazil, and Argentina. From a geographical point of view, a cut at Panama would have been understandable. The World Bank decided to include Mexico and the Central American countries in the LAC region in view of the historical and cultural links. Therefore, the North American (NAM) region consists of only three countries: USA, Canada, and Bermuda. The Middle East & North Africa (MNA) region is the link between Europe and Africa and consists of 21 countries, including Egypt, Saudi Arabia, and Algeria, and thus stretches partly over the African and Asian continents. The remainder of Africa (48 countries) is grouped together in the Sub-Saharan Africa (SSA) region. It includes Nigeria, South Africa, and Ethiopia. The final region is South Asia (SAS), which consists of eight countries, including India, Pakistan, and Bangladesh.

Table 1.2 provides some information on selected variables for the World Bank regions. The top part of the table reports the share of the world total (in per cent) for land area, population, and income. The key aspect to focus on is the wide variation in these numbers. South Asia, for example, is home to 23.7 per cent of the world population, but only generates 8.9 per cent of the world income using only 3.7 per cent of the world land area. Similarly, Sub-Saharan Africa consists of 18.2 per cent of the world land area, is home to 13.9 per cent of the world population, but only generates 3.1 per cent of the world income. North America, on the other hand, consists of 14.1 per cent of the world land area and can generate 17.1 per cent of the world income with only 4.8 per cent of the world population. These variations are partially reflected in the bottom part of Table 1.2, which provides indices (in per cent) for the World Bank regions relative to the world average for selected variables.

World average income per capita in 2016 was $16,171 (PPP current international $), but the variation between global regions is large. The average person in Sub-Saharan Africa earns only 22 per cent of the world average income level, while the average person in North America earns 354 per cent, or almost 16 times as much. Similarly, the average person in South Asia earns 37 per cent of the world average income, while people in Europe and Central Asia earn five times as much (192 per cent).

The average person in the world has 0.19 hectares of arable land available (1,942 m^2). The variation at the global region level ranges from 55 per cent of the world average in East Asia and Pacific to 283 per cent in North America, or five times as much. Note that the low score in Sub-Saharan Africa for income per capita cannot be explained by a lack of arable land available as this is above the world average (110 per cent). Moreover, the amount of arable land available in South Asia is low (61 per cent), as it is in East Asia and Pacific. Perhaps it would be wise to take the fertility of land into consideration, as these are the only two global regions above the world average population density of 57.4 people per km^2, namely 164 per cent in East Asia and Pacific and an enormous 645 per cent in South Asia. The latter is 19 times higher than the population density in North America.

Table 1.2 Selected characteristics of World Bank regions, 2016

	EAP	ECA	LAC	MNA	NAM	SAS	SSA	World level
Share of world total (per cent)								
Land area	18.8	21.2	15.4	8.7	14.1	3.7	18.2	129.7 million
Population	30.9	12.3	8.6	5.9	4.8	23.7	13.9	7,442 million
Income	32.5	23.5	7.9	7.1	17.1	8.9	3.1	120.4 trillion
Index relative to world average (per cent)								
Income per capita	105	192	92	121	354	37	22	16,171
Arable land	55	192	143	64	283	61	110	0.19
Population density	164	58	55	68	34	645	76	57.4
CO_2 emissions	127	139	62	124	329	29	17	5.0
Urban population	106	131	147	119	151	62	70	54.3
Exports	99	145	76	133	48	63	97	28.6
Death rate	94	133	78	65	106	93	124	7.6
Birth rate	72	65	90	122	64	108	193	19.1
Population growth	57	19	98	160	36	118	239	11.4
Life expectancy	105	108	105	102	110	95	83	71.9

Source: data from World Development Indicators online, most recent in period 2014–2016; land area in km^2; income and income per capita in GNI PPP current international $; arable land in hectare per person; density in people per km^2; emissions in metric tons per capita; urban population as percentage of total; exports of goods and services as percentage of GDP; death rate and birth rate are crude per 1,000 people; population growth (crude natural) = birth – death; life expectancy at birth in years; for region abbreviations: see Table 1.1.

How polluting are the different global regions? If we take CO_2 emissions per capita as an indicator, then the average person in the world emits 5.0 metric tons per year. This is below the world average in Sub-Saharan Africa (17 per cent), South Asia (29 per cent), and Latin America (62 per cent). Perhaps not surprisingly, these are also the regions where income per capita is below the world average. This helps explain why pollution per person is highest in North America at 329 per cent of the world average, or 19.5 times as high as in Sub-Saharan Africa.

The share of the population living in cities (urban population) is 54.3 per cent for the world. This is below the world average in South Asia and Sub-Saharan Africa. It is particularly high in North America, Europe, and Latin America. The variation, however, is less extreme than for most of the other variables, namely only 2.4 times higher in North America than in South Asia. The same holds for the exports of goods and services (relative to income), which is 28.6 per cent of income for the world and is three times higher in Europe than it is in North America.

The last four variables in Table 1.2 are related to demographics. The world average crude birth rate is 19.1 per 1,000 people, which is lowest in North America (64 per cent of the world average) and highest in Sub-Saharan Africa (193 per cent, or three times higher). The world average crude death rate is 7.6 per 1,000 people, which is lowest in the Middle East & North Africa (65 per cent of the world average) and highest in Europe (133 per cent, or twice as high). Note that the death rate in Europe is high because of its aging population, while it is high in Sub-Saharan Africa for medical and sanitation reasons. The combination of birth rates and death rates leads to the (natural) population growth rates also reported in Table 1.2 (which thus excludes migration flows). The world average crude population growth rate in 2016 was 11.4 per 1,000 people (or 1.14 per cent). It was lowest in Europe (19 per cent of the world average) and highest in Sub-Saharan Africa (239 per cent, or 12.4 times higher). Finally, the world average life expectancy at birth in 2016 was 71.9 years. Here the variation is less extreme, ranging from 83 per cent of the world average (59.9 years) in Sub-Saharan Africa to 110 per cent (79.1 years) in North America (1.3 times higher).

We emphasize in this section the variation of economic and population variables at the global regional level using the seven main regions identified by the World Bank. Even at this highly aggregated scale we note that the distribution of population and economic activity is highly uneven, with relatively empty areas as well as densely populated areas and with large variations in income levels per person. We now go one geographical step further by looking at variations at the country level.

1.4 Countries

As the central piece left over after the break-up of the Soviet Union, the Russian Federation, henceforth Russia for short, is still by far the largest country in the world in terms of land area. With 16.4 million km^2, or 12.6 per cent of the world total, Russia is about 75 per cent larger than China, the world's second-largest country. Other large countries are Canada, the USA, and Brazil. Because of the most frequently used methods for projecting the world globe on a flat piece of paper, most people tend to underestimate the size of the African land area. To avoid this problem and get a better indication of the land area at different locations Figure 1.1*a* provides a simple equilateral projection of bubbles proportional to a country's total land area, where the centre of the bubble is located at the country's geographic centre. For discussion purposes, the figure displays individual country data and at the same time groups the countries together in the seven regions of the World Bank. Figure 1.1*a* clearly illustrates the size of the African continent as many African countries are large in area. Taken together, the African countries

account for more than 23 per cent of the world's total area. If we realize that Russia (for its land area at least) and Kazakhstan are in Asia, we also note that Europe is rather small in total land area (the sum of the other bubbles is not so large).

Two Asian countries, China and India, clearly stand out in terms of total population. Together they have 2.7 billion inhabitants in 2016, or about 36 per cent of the world total population, where China takes care of 18.5 per cent and India of 17.8 per cent. The USA, ranked third with 323 million inhabitants, has only about 4.3 per cent of the world population (less than a quarter of India's population). Other Asian countries also have large populations, such as (ordered): Indonesia, Pakistan, Bangladesh, Japan, the Philippines, and Vietnam. Note that we do not include Russia in this list of Asian countries, even though its largest land mass is in the Asian continent, because the largest share of its population is on the European continent. Figure 1.1*b* illustrates the distribution of the world's population across the globe. When we compare it with Figure 1.1*a* on the distribution of land area we notice that the Americas shrink substantially, while Asia (in contrast) becomes much more important. This holds in particular for South Asia and the countries in East Asia and Southeast Asia.

Figure 1.1*c* focuses on the economic power of countries as measured by GDP corrected for purchasing power parity (PPP). With $21.3 trillion, China is the world's largest economy in 2016; this represents about 17.7 per cent of the world total. The USA is the second largest economy as it generates 15.8 per cent of the world total. India is third (with 7.2 per cent) and Japan fourth (with 4.6 per cent). When we compare panel *c* of Figure 1.1 (on income) with panels *a* and *b* (on land area and population) we note that the African and South Asian bubbles shrink substantially, while the European bubbles become larger. All Sub-Saharan African countries taken together, for example, only generate 3.1 per cent of the world's income level (even after correcting for low prices), which is less than the income level generated in Germany alone (3.4 per cent). If we combine the income generated in the 28 European Union countries, we arrive at 17.2 per cent of the world total, which is second only to China (and larger than the USA). Our next step in this section is to focus on relative measures at the country level related to land area, population, and income, by analysing population density and income per capita.

Figure 1.2 illustrates the enormous differences in population density in 2016 at the country level. The figure is constructed as follows. First, we rank the 215 included countries (which represent about 99.5 per cent of the world population) from lowest population density to highest population density.[4] Second, we calculate a percentage rank for each country, starting from 0 for the country with the lowest density (Greenland) to 100 for the country with the highest density (Macao)

[4] The largest missing country / region is Taiwan (population 23.5 million) as it is not part of the United Nations.