1 INTRODUCTION

1.1 History

This book is about regional economic theory and modelling, but it stems from a long history of applied empirical research in a field that I was not educated in. Graduated as an economist in macro-economics, mathematics and sociology, I am afraid I did not know anything about regional science when I started my professional career as a regional economic researcher at the FNEI\textsuperscript{1} institute in 1983. As a consequence, my introduction to the theory of regional and spatial economics has been inductive and largely lead by the practical problems I encountered. Starting from scratch with a team of young inexperienced economists with hardly any background on regional economic modelling other than some basic input-output techniques, we had to build a regional forecasting model that would capitalize on a new set of interregional input-output tables that had just become available for the Northern provinces of the Netherlands. We were able to present a first model version and a regional economic forecast in 1985 (Stelder et al. 1985,1986).

It took a few years for me to find out that our ignorant inductive approach had resulted in something close to a Miyazawa type demo-economic model, but we did a little more than just reinventing the wheel. The distinctive feature of the model ISAM\textsuperscript{2} we developed, the input-output growth rate approach presented in chapter 2, was new, and has proven to be a very effective tool in input-output simulation models in the years that followed.

My transfer from the FNEI to the University of Groningen in 1989 enabled me to spend some more time on theory and getting familiar with the regional science literature, but the emphasis in my work was on applied economic research for the northern region and input-output table construction. The market share of theoretical research was further reduced during two fascinating years I spent in Indonesia working on regional models for government investment planning in 1992 and 1993 at the central planning bureau BAPPENAS in Jakarta. There not only theory but also the technical/empirical work had to be defended against the heavy workload of day-to-day regional policy formulation. A normal workday at BAPPENAS would be something like recoding raw export statistics in the morning, running a model simulation at lunchtime and writing a speech for a government official in the afternoon. Thanks to the large database of interregional input-output tables, however, I managed to build an operational long-term simulation model in a relatively short time. As chapter 3 describes, the specific Indonesian situation required a different model, in which the growth rate approach from chapter 2 is still used, but

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\textsuperscript{1} Federation of Northern Economic Institutes (FNEI, 1972-1988), a cooperation between the provincial governments of Groningen, Friesland and Drenthe and the University of Groningen in applied regional economic research for the Northern Netherlands.

\textsuperscript{2} ISAM is the Dutch abbreviation for integrated sector and labour market model.
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complemented with long term simulation constraints, government spending, supply-side elements and endogenized investment.

Back in the Netherlands, some Indonesian input-output model innovations I had worked on could be incorporated in our Dutch regional models and I got involved in a large research project in 1994 and 1995 that needed a long term simulation model for regional development policy in the Netherlands in which both the questions asked and the technical model issues involved were surprisingly similar with the Indonesian situation: a long term regional economic policy simulation with many interacting links with other disciplines such as demography, housing, transportation networks etc. Chapter 4 describes how parts of the Indonesian model were used and linked to other independent model blocks for firm migration, land use, traffic congestion and last but not least, an overall cost-benefit model for a regional deconcentration scenario.

Despite the great success of the project measured by public publicity and the effect it had on regional policy reformulation in the Netherlands, my personal impression afterwards was that only a modest progress was made in terms of model building. The model had been blown up to a large conglomerate of non-integrated models with many different ad-hoc constructed model blocks. I decided to turn away from pragmatic ad-hoc model building for a while and go back to the theoretical literature to look for - as Lakatos would say - new paradigms that offer more problem solving with less complexity. It was then that I got fascinated by the agglomeration model of Krugman (1991a), who combined a simple but rigid theoretical framework with a wide range of possible empirical implementations, many of them exactly of the kind we needed in our research projects. It became clear to me that the main issues of our last mentioned project, which were regional (de)concentration, congestion and the effects of a supposed autonomous shift of population from a congested region to a non-congested region, could have been modelled in a Krugman-type framework too, probably in a less comprehensive way but with much more model consistency.

The model proposed by Krugman has been inspiring a whole strand of literature that has become known as New Economic Geography (NEG). Contrary to the input-output approach, the NEG-literature is still fairly theoretical. When it comes to empirical applications, NEG still has a long way to go, as most authors in this field admit themselves. Fujita (1999), for example, compares NEG with aerospace technology and stated that "we are still in the Wright brothers phase of learning how to fly". In chapter 5 and 6 I examine the possibilities of the NEG approach, in order to find out how far it can bring us in applied regional economic research and how it can answer questions of regional policy. Chapter 5 shows some experiments which different variants of the Krugman model in abstract two-dimensional economic spaces. In chapter 6 the options for empirical geographical implementations are examined and the results of a large empirical model for Europe are presented.

So it should be fair to say that my recent work contains more theory and pure numerical experiments at the cost of empirical reality, but with 15 years of practical model building behind me I do want keep its practical possibilities in mind. Once on a conference I was
even criticised for this when I discussed my models with professor Fujita, one of the leading theorists in this field, who advised me “don’t worry too much about reality”. I disagree because my guess is that NEG will indeed be capable to answer real empirical questions.

The five chapters to come are better understood in the broader context of the relevant literature in regional science. In addition, some specific issues need to be discussed that are important for interregional and spatial agglomeration modelling. The remaining sections of this chapter deal with these issues subsequently.

1.2 The choice of paradigm

With this historical background it will be no surprise that this book discusses various theories and types of models instead of one specific strict economic theory or paradigm. As such, I am a typical representative of the regional science discipline, which has always been more pragmatic and interdisciplinary orientated than rigid monodisciplinary mainstream economics. Interestingly, one of the most important claims of the just mentioned outsider Paul Krugman - who is a representative of what he himself calls the “flagship field of international economics” - is that regional economics\(^3\) is highly relevant to general (neoclassical) economic theory. Once reformulated in the NEG context, he is convinced that regional economics has finally entered the core of mainstream economics, which I am inclined to paraphrase as something like “we are all regional economists now”. Whether it is true that today the majority of mainstream economists are convinced of the relevance of the regional and spatial dimension in their models of not, NEG has given the regional science tradition a step forward. Some regional scientists, however, are less amused and do not see anything more in NEG than a simplified mathematical reformulation of insights already obtained a long time ago\(^4\). In that view, NEG is just another way of looking things and not a unifying theory of scattered insights obtained elsewhere.

So there still is a wide regional science kaleidoscope of theories available to us. The relevant ones for this book I would like to identify as specific fields, not as strict theories in the positivist Popperian sense, but more as tools of analysis or paradigms à la Kuhn/Lakatos. An important common denominator of all chapters in this book, however, is the interregional perspective of the modelling more than one region in their mutual interdependence. I have never worked with models for one region only or with multiregional models that treat regions independently. Mutual interdependence between regions and sectors implies interregional trade- and interregional i-o modelling with econometric/ input-output frameworks (EC-Io) and computable general equilibrium (CGE) analysis as directly related fields. In addition, both from a policy and modelling point of view, (inter) regional labour markets always play an important role, which means

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\(^3\) Krugman in fact uses the term "economic geography" (Krugman, 1991b).

\(^4\) "Referees tell me that it’s obvious, it’s wrong, and anyway they said it years ago". Krugman quoted in Isserman (1996).
that demography, labour market participation, migration and integrated demo-economic modelling are important. Finally, as already mentioned, agglomeration theory is the main subject in the last chapters. The choice for a specific modelling approach depends on the availability of time series and/or detailed cross-sectional databases, the relevance of the supply side and the importance of overall model consistency, three subjects to which I will now turn.

1.3 Time and detail

In regional economics - by definition one could claim – there is always the need for more detail than in macro or microeconomics without the spatial dimension. First, local data are needed if one is a regional economist in the most elementary way: applying mainstream economics to a region instead of a country. Second, if more then one region is studied, we must introduce space as a dimension and a variable in our model. Third, if not only multiple regions themselves, but also their interaction is modelled, we need additional spatial theory and data about this interaction. Every regional modeller will recognise this fundamental trade-off, if not dilemma: do we choose the “horizontal” perspective of the time series approach by getting together as much time-series data we can get at the cost of regional detail, because regional time-series are only available for just a few regional variables? Or do we choose the “vertical” alternative of getting a detailed cross-section description of the region(s) in question at one or only a few moments in time?

In general, regional economics tends to be relatively “vertical”. When the econometric time-series approach, which is common practice in most macro economic models, cannot be used because regional time-series are not available, it is not surprising that many regional model builders have concentrated their efforts on the cross-section alternative. Hence, sectoral disaggregation and input-output analysis have been more popular among regional economists than among their macro-colleagues (Rose & Miernyk, 1989). In addition, the regional industrial structure is often one of the main causes of regional differences in economic development at the macro level. Whether a region is dominated by agriculture, manufacturing or services makes all the difference in the world when it comes to regional forecasting. For example, a well known result from various shift-and-share studies (SAS) is that even when industries at a low disaggregation level do not perform very different from the same type of industries across regions (a low "shift" factor), the aggregated performance of each region at the macro level can still be very different, simply due to the fact that one region has more industries of a specific type within its borders than an other region (a high "share" factor)\(^5\).

But in this respect there seems to be a business cycle in regional economics. From the early years of Isard (1960) until the 1980s input-output models have been one of the most popular tools of analysis. In i-o models a detailed database of the economic

structure of the region at one moment of time plays a dominant role. Time series of comparable i-o tables hardly exist at the regional level other than in the form of small sets of i-o tables for less than 5 years with considerable time gaps between them and important differences in data sources and methods of construction\(^6\). With improved time-series becoming available, and stimulated by the rapid developments in macro-econometric models, more regional i-o models have become embedded in the so-called integrated EC+IO approach, which has made regional economics much more horizontal. If we follow the impression from the overview by Rey (2000), however, the number of these integrated models today is not as large as we would expect after such a long time. Instead, during the 1990s regional models of the CGE-type, which has brought us firmly back in the "vertical" tradition, have largely outnumbered them.

1.4 The role of the supply side

Traditionally there has been a weak treatment of the supply side and prices in the vertical regional models due to a strong emphasis on demand, economic structure and i-o. In line with the rise of supply-side economics during the 1980s, a revival of equilibrium analysis has taken place in the form of applied or computable general equilibrium (AGE or CGE) models, both in regional economics as well as elsewhere (Dervis et al., 1982; Scarf & Shoven, 1984; Robinson & Roland-Holst, 1988; Partridge & Rickman, 1998). Returning to Walras, in a CGE framework model solving takes place in the form of finding clearing prices on disaggregated markets by industry, region and in some cases also for disaggregated categories of labour. Beaumont (1990) argued that this is the way regional economics should go, not because we want to rebaptize ourselves as equilibrium economists but because we can model both demand effects and supply constraints in a consistent way. Rather than econometric forecasting models, CGE is usually referred to as a category of simulation models that calculate the integrated effects of an external shock. In national CGE models, simulation of a change in tax regulation is a popular implementation. New infrastructure projects and environment policies are important topics in regional CGE implementations (Kilkenny, 1998; Li & Rose, 1995).

For the Dutch ISAM model (chapter 2) a CGE version was never developed for various reasons. The three provinces are relatively small (each 2-3% of the total national economy) and open, which allows the simple assumption of perfectly elastic supply of imported capital and intermediate goods, in particular in the short run. Furthermore, the regions modelled have permanently been facing relatively high unemployment and consequently abundant labour supply. Other relevant factors like industrial sites have also been widely available\(^7\).

\(^6\) For a discussion on the Dutch regional i-o tables see Oosterhaven (1980) or Eding e.a. (1995). At the national level the Netherlands may be the only country in the world that has an exceptionally long time series of annual national i-o tables from 1948 onwards (Tilanus & Rey, 1964).

\(^7\) Chapter 4 gives more specific attention to regional industrial sites.
For the Indonesian model (chapter 3) a CGE approach was considered because it needed to project long term regional development in which it was obvious that regional, sectoral and national supply constraints had to be taken into account. The required detail of 27 provinces and 10 sectors, however, would have made a CGE model simple too large to handle given the data, staff and computer facilities available at the time (1993). Apart from this, the suitability of CGE models for long term forecasting is questionable. As Partridge and Rickman (1998) point out, a long-term projection usually implies projecting a growth path, where parameters may need to be changed along the way. A CGE model can build this path as a comparative static's implementation for each year but it would require a very labour intensive process of re-benchmarking and finding the counterfactual equilibrium for each subsequent year\(^8\). In our Indonesian case a more pragmatic solution was chosen by letting regional investment follow regional demand and production with a one-year time lag, either through adjustment of the capital stock or by means of a direct investment/GDP ratio.

The Dutch model discussed in chapter 4, which was build in 1996 for simulating a deconcentration scenario for the Northern Netherlands over a period of 25 years, uses roughly the same technique. In the most recent years interregional CGE models are also becoming operational in the Netherlands (Knaap & Oosterhaven, 2000; Oosterhaven, Knaap, Ruigrok & Tavasszy, 2001).

1.5 Modules, integration and consistency

A distinctive feature of many regional economic models is their interdisciplinary approach and modular structure with different modules representing separate model blocks such as regional production, productivity and employment, the housing market, interregional migration and the labour market. Regional labour markets in particular play a dominant role because of the larger importance of the labour market in a regional policy setting than in a national policy setting. As far as the labour market itself is concerned, national models concentrate much more on the function of wages as an equilibrating mechanism, whereas regional models concentrate more on quantity adjustments. This reflects the fact that interregional wage differences are smaller as well as more stable than international wage differences, whereas (geographical) mobility is much more important at the regional level. In national models, e.g., international migration effects are usually considered exogenous (Bodkin, Klein & Marwah, 1991). As a consequence, many regional models contain a strong demo-economic element (Batey & Weeks, 1987; Oosterhaven & Dewhurst, 1990; Madden & Trigg, 1990).

It is not surprising, therefore, that the pre-eminent work of Sir Richard Stone (1968, 1970, 1971) on sectoral analysis, input-output analysis and demo-economics has been

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\(^8\) A CGE model must be calibrated on a base-year, for which the dataset is reproduced. This benchmark is then compared with another model run with a set of exogenously changed variables. This second equilibrium is called the counterfactual. See Dervis et al. (1982) for a basic introduction on CGE models.
of substantial influence in the field of regional modelling. However, as Stone himself pointed out, the combined use of different techniques such as input-output analysis, econometrics and demographic models can lead to problems of consistency and raises the question of how a consistent integrated approach can be achieved (Stone, 1970; Anselin & Madden, 1990; Oosterhaven & Stelder, 1995d).

Again, there may be a parallel with the “business cycle” in regional modelling mentioned above. With limited regional time series available, the econometric approach can lead to eclecticism and many model blocks, more or less independent from each other, guided by the available data. The CGE approach is more attractive in this respect in the sense that all variables must be solved simultaneously in one model leaving less room for eclectic and/or independent model blocks. Our own research on regional issues for the Northern Netherlands in fact has moved from eclectic model building (Elhorst et al., 1999) towards more integrated CGE models (Knaap & Oosterhaven, 2000). In this book, more specific attention to the consistency issue is presented in chapter 4, where it is especially relevant.

1.6 Outline

Besides this chapter, the various fields of regional science that are relevant for the subsequent chapters will not receive a full length discussion on their present state of the art in a separate chapter because excellent overviews have regularly been published by others (Isard, 1998; Hewings & Jensen, 1986; Rose & Miernyk, 1989; Lane, 1993; Jensen & West, 1995; Rey, 2000; Partridge & Rickman, 1998). Instead, the main relevant issues will be discussed in each chapter separately.

Chapter 2 is devoted to the history and present version of ISAM, the interregional model for the Northern Netherlands. ISAM is a typical “vertical” model using detailed regional cross section information. At its core is an interregional input-output model for 4 regions: the three northern provinces Groningen, Friesland and Drenthe, and the rest of the Netherlands. Its main application has been short-term forecasting of the regional economy through top-down regionalisation of existing national forecasting scenarios for expenditures, production and employment. The supply side of the labour market in ISAM, however, is largely bottom-up using independent regional forecasts for population, labour market participation and migration.

Next, in chapter 3 the SSDM model is presented which is a rewritten Indonesian version of ISAM. The main difference with ISAM is a supply-side extension, an endogenous government expenditure block and the fact that SSDM has mainly been used for long-term policy scenario simulations. Its mere size and data requirements are other points of difference: while ISAM is a 4-region/32-sector model, SSDM handles 27 regions and 25 sectors in a full interregional context. Because of its long-term character SSDM has endogenous updating routines of sectoral structure, interregional trade and expenditure
patterns, some of them based on time series econometrics, which makes the model more "horizontal" than ISAM.

Chapter 4 gives a summary of a Dutch research project on long-term regional development and its impact on national efficiency. The question under study is how a spatial deconcentration scenario effects overall national welfare with respect to productivity, employment, housing, environment and traffic congestion. For this scenario simulation various independent model blocks have been used, a Dutch modified version of the Indonesian SSDM being just one of them. Others blocks refer to land use, environment, congestion and the housing market.

Next, in chapter 5 the focus shifts towards pure agglomeration theory. The New Economic Geography approach (NEG) is examined on its possibilities as an endogenous central places model when applied to 2-dimensional economic spaces of various shapes. One of the most interesting results is that an NEG implementation with this type of economic space can produce endogenous agglomeration patterns looking very similar to central place theory, but with a totally different theoretical framework.

Chapter 6 takes a next step towards an NEG model that could be used for answering the kind of questions asked in chapter 4. The main extension discussed here is the implementation of an NEG model as a geographical grid. With GIS techniques a large NEG model for Europe is built that is capable of simulating asymmetric agglomerations of the kind we see in reality. A separate discussion is devoted to the possibilities of the model to give a measure of how mere economic factors have contributed to the historical development of agglomerations in Europe.

Finally, chapter 7 evaluates the models in the preceding chapters following the main theoretical dichotomy between interregional i-o analysis on the one hand (chapter 2-4) and the NEG approach on the other (chapter 5-6).