The Core-Periphery model

Optional Assignment for course ‘Spatial and Transport Economics’ (2007-2008)

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The core model of the new economic geography was developed by Krugman in the early 1990s. The key reference is Krugman (1991).\(^1\) The model studies the location of industrial activity in a two-region context. The location of agricultural activity is taken as given. The industrial sector that is subject to increasing returns to scale is modeled by means of the Dixit-Stiglitz model of monopolistic competition. The model is very elegant and parsimonious, but it is impossible to solve it analytically due to its highly non-linear nature.

Solving a highly non-linear system of equations as the one that is derived in Chapter 3 of Brakman et al. is difficult. However, in order to properly characterize the equilibrium of the model a solution is of course required and requires simulation. Luckily, the computer nowadays provides us with possibilities for solving complex non-linear models. As is correctly emphasized by Brakman et al. in their book, the development of a simulation model oftentimes remains implicit in many research papers. The book by Brakman et al. is an important exception in that respect. Solving highly non-linear systems of equations can be done in several ways. Brakman et al. use Gauss, a powerful but not very user-friendly programming language. An alternative that is somewhat more user-friendly but that still requires familiarity with a programming language is GAMS.\(^2\) Still another possibility on which we will rely in this course is using the Solver-routine in EXCEL. A simple simulation tool has been developed in EXCEL for the purpose of solving the core-periphery model. This tool is at the heart of this assignment.\(^3\)

The aim of this assignment is to (i) familiarize you with the simulation approach to the Core-Periphery model and (ii) get insight in the forces that determine agglomeration and in the

\(^2\) For those of you who are familiar with GAMS, a program is available that can be used to solve the Core-Periphery model and which is available upon request.
\(^3\) You are of course free to use other software. This may require your own development of a simulation model.

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outcomes of the model. It complements parts of chapter 4 of the textbook *An Introduction to Geographical Economics* by Brakman et al.

The assignment consists of 5 exercises (see below). Exercise 1 is an introductory exercise, intended to help you get acquainted with the simulation tool. Making the exercises is an excellent preparation for the exam and helps in fully understanding the model. In case you hand in your assignment before October 9, you will get feedback on your answers.

**The simulation program**

The simulation program is made available as an EXCEL file with the name CorePeriphery_2007.xls. A handout describes how to use the tool (CorePeriphery_Handout.pdf). Read this handout carefully before getting started.

**Parametrization**

To make the exercises in this assignment, you may want to choose a particular baseline parametrization of the model. For example, $\delta = 0.35; \rho = 0.80; T = 1.55$. But of course, you can vary here if you like. All other parameters of the model take the benchmark values as described in Table 4.1 in the book by Brakman et al.

**Exercise 1.**

Solve the model for the above-given parametrization of the model. Describe the equilibrium/equilibria graphically as well as in words. Consider the effect of varying transport costs by constructing and describing a graph similar to Figure 4.2 in the book. Describe the comparative statics characteristics of the model with respect to transport costs in your own words.

**Exercise 2. The role of farmers**

Farmers play an important role in the core-periphery model although their role oftentimes remains somewhat underexposed in the discussion of the model. In this exercise, you will study in some more detail the role of farmers in the core-periphery model.
a. All results derived in the book by Brakman et al. are based on the assumption that agricultural workers are evenly distributed over the two regions ($\phi_1 = \phi_2 = 0.5$). Solve the model under the alternative assumption that ($\phi_1 = 0.475$ and $\phi_2 = 0.525$). Describe the resulting equilibrium/equilibria. Explain the effect of introducing asymmetry in the allocation of farmers on the equilibrium outcome of the model in words. Provide intuition.

b. Characteristic for the development of modern economies is the shrinking of the agricultural sector. Take the benchmark parametrization for your group and show the effect of a shrinking share of farmers on the equilibrium outcome of the model. Describe the effects in words and provide intuition.

Exercise 3. Determination of the break and sustain points.
Characteristic for the core-periphery model is that multiple stable equilibria can arise. As is explained in the book, there is only a limited range of values for transport costs for which such multiple equilibria exist. This range is characterized by the so-called break- and sustain points. You are asked to determine the break and sustain points for your specific parametrization of the model (see before). Illustrate your answer graphically.

Exercise 4.
As is discussed in chapter 3 of the book, four different groups of actors can be distinguished in the model (viz. farmers and manufacturing workers at home and in the foreign country). Take your answer in question 2a as a starting point. Consider what happens to the welfare of members of the four groups when you move from a static equilibrium with $\lambda = 0.02$ up to a static equilibrium with $\lambda = 0.98$. Will each and every group always gain from moving from a short-run unstable equilibrium towards a long-run stable equilibrium? Explain your answer. Characterize the preferred equilibria for the four groups.

Describe what the results imply for the desirability of regional-economic policies. More specifically, describe reasons why regional policies might be desirable (and for whom). Furthermore, describe concrete possible policy measures that could be used.
Exercise 5.
Although the model is highly stylised, one may try to calibrate the model, meaning that one looks for parameter values that are ‘realistic’. Considering the key-parameters described in Table 4.1, what are in your view realistic parameter values? As an example of an attempt to calibrate the transport cost, consider Box 3.3 in the book. In providing an answer, you are free to specify a particular country and/or sector.

Note: you need not provide concrete numbers for all parameters, but you should at least clearly describe what the parameter captures and how you could go about in using empirical evidence to put some numbers to the parameters. Or alternatively, you may point at some oversimplifications in the model that prevent you from properly putting numbers to some of the parameters.