

### **Appendix: NEG as a Parable**

In the canonical core-periphery model (Krugman 1991) unskilled labor is spatially immobile and is used to produce agriculture (A) under a CRS technology with perfect competition. Also, A is traded interregionally without transport costs. So, the law of one price applies to A. There is no capital.

Skilled labor is spatially perfectly mobile, and is used to produce manufactures (M) under imperfect competition. Interregional trade in M is subject to transport costs. As M increases, there are more varieties and prices of M decrease due to the “market crowding effect”. However, because skilled workers spend some of their income locally, there is a “market size effect”, which induces pecuniary scale economies. The latter increases the demand for skilled labor, which induces inward migration and agglomeration, which may be catastrophic (M is produced in one region).

The assumptions that skilled workers are perfectly mobile but unskilled workers are immobile, that agriculture is traded without friction in contrast to manufactures, that skilled workers move without friction across space but the goods they produce do not, that unskilled workers produce A but not M, while skilled workers produce M but not A, should not be taken literally. These asymmetries are intended as a parable to motivate a theory of spatial general equilibrium. This theory has three key components. The first is a fixed factor, (unskilled labor), which ensures that output is positive everywhere. In the case of catastrophic agglomeration, all manufactures are produced in one region, but agriculture is produced everywhere. The second is a mechanism to ensure that space matters (transport costs). The third is a mechanism to induce agglomeration (the market size effect). In the absence of transport costs, space would be seamless and have no economic consequences.

Theories of spatial general equilibrium require assumptions to make space matter. Roback (1982) assumed that amenities are spatially heterogeneous and that individuals are prepared to pay for superior amenities. The present paper is based on this assumption. She also assumed that homogeneous output is produced everywhere with a CRS technology and that capital is perfectly mobile. Although there is no agglomeration in her model, Glaeser et al (2001) endogenized amenities and Beenstock and Felsenstein (2010) endogenized TFP, giving rise to agglomeration. Land serves as Roback’s fixed factor. It is not clear why despite its seniority the

Roback model has proved less popular than NEG despite the fact that unlike NEG it is analytically tractable, makes fewer assumptions, and has the same research agenda. However, NEG and Roback are different paradigms.

Various attempts have been made to make NEG analytically tractable for two spatial units (Baldwin et al 2003). The “footloose entrepreneur” (FE) model (Baldwin et al. chapter 3, Forslid and Ottaviano 2003) modifies some assumptions in the canonical NEG model. Specifically, unskilled workers who remain spatially immobile are assumed to work in the M as well as the A sectors, but skilled workers continue to work only in the M sector. Whereas in the canonical NEG model production had only variable costs (skilled workers), in the FE model there are fixed and variable costs. The fixed costs refer to skilled workers, who act as entrepreneurs in setting up and managing businesses. The variable costs refer to unskilled workers. Whereas unskilled workers are perfectly mobile between the A and M sectors within space, they are immobile across space. Skilled workers continue to be perfectly mobile across space; they reside and consume wherever their utility is larger. This means that skilled workers may work in one region but consume in another. This also means that the market size effect only works through unskilled workers rather than skilled workers as in NEG.

For example, skilled worker from region 2 set up businesses in region 1, triggering market crowding effects in region 1. The demand for unskilled workers increases in region 1, which raises their wages and induces market size effects because they consume in region 1. Where do the skilled workers from region 2 consume? Because they can commute between regions 1 and 2, they might consume in region 2. For this reason, migration plays a weaker role in FE than in NEG because the market size effect operates through the income of the fixed factor, i.e. the unskilled. It also simplifies NEG because skilled wages in each region are proportionate to the sum of spending per variety in both regions.

Although the FE model delivers analytical solutions for regional wages, it does not deliver analytical solutions for the regional distribution of manufacturing (Baldwin et al., p 103-4). Nevertheless, it is far more tractable than the canonical NEG model.

FE preserves the parable of NEG by retaining its three key components. However, NEG and FE are different although related theories. The same applies to the

“footloose capital” (FC) model (Baldwin et al. chapter 2), which is analytically tractable. In FC workers are homogenous (equal skill) and are spatially immobile. The market for A is the same as in NEG and FE except that production depends on labor instead of unskilled labor. In the M sector, production is the same as in FE except the role of skilled workers is undertaken by capital, i.e. fixed costs are capital and variable costs are labor. Returns to capital belong to its owners who invest their capital to get the highest return. This means that owners of capital consume in their own region even if the return is from another region.

It should be obvious by now that because these assumptions preserve the parable in FE the analytical tractability of FC should be similar to FE. Footloose capital almost plays an identical role to footloose entrepreneurs. The main difference is that whereas entrepreneurs may choose where they consume, the owners of capital have no choice; they must consume where they live. This makes FC more tractable than FE because there is less circularity. Specifically, the spatial allocation of M has an analytical solution in FC but not FE.

Strictly speaking, FC is not a model of spatial general equilibrium because it does not allow internal migration. Preserving the NEG parable in this way destroys its spirit and purpose. This criticism applies *a fortiori* to the constructed capital (CC) model of NEG (Baldwin et al. chapter 6) in which not only is labor spatially immobile, so is capital. The CC model forms the basis of a regional growth model in which the only connection between regions is through trade. However, this is completely divorced from spatial general equilibrium theory, which ever since Roback (1982) has attached importance to labor and capital mobility as well as trade.