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**MODELLING SERVICES SECTORS'
AGGLOMERATION WITHIN A NEW
ECONOMIC GEOGRAPHY MODEL**

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Modeling Services Sectors' Agglomeration within a New Economic Geography Model

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Abstract

This study investigates whether services sectors' agglomeration can be explained within a common New Economic Geography model by Krugman and Venables (1996). Special feature of this modeling is to account for the lower importance of intermediate goods received for the services sector, a fact that has been shown in Empirics for the European Union (Krenz (2010)). The results show different strengths of agglomeration for both the industrial and services sector depending on initial values of strength of intra-sectoral and inter-sectoral inputs, consumers' preferences, scale economies and transport costs. The lower extent of services sectors' agglomeration seen in Empirics can be explained within the model.

Keywords: Agglomeration, Services, New Economic Geography

JEL-Code: L80, R12

1. Introductory remarks

The idea of this study is to investigate dynamic agglomeration tendencies by incorporating a services sector—taking account of its special features—into a common New Economic Geography model by Krugman and Venables (1996). Krugman’s models considering an agricultural and an industrial sector or just two industrial sectors will be enhanced by focusing on both industries and services. The idea arose from the fact that Empirics (Krenz (2010)) show different agglomeration patterns for services sectors as well as different levels of importance of intermediate goods used for production. Since services are an important branch in the economy, making up most of an economy’s value added in a lot of countries worldwide, their special consideration within New Economic Geography modeling becomes a necessity.

Empirics have shown that intermediate goods’ intensity plays a less important role in explaining services’ agglomeration than it does for industrial agglomeration in the European Union (Krenz (2010)). One has to differentiate between intermediate products stemming either from a sector itself –called intra-sectoral inputs– or from another sector –inter-sectoral inputs. Taking a look at data from Eurostat in table 1 one can see that some services are characterized by fewer intra-sectoral inputs used¹. Among these services are sale, maintenance and repair of motor vehicles, retail trade, hotels and restaurants and public administration.

Models developed by Krugman and Venables² do either consider an agricultural and an industrial sector or two industrial sectors. It can be expected that by modeling an economy comprising both a services and an industrial sector and incorporating fewer intra-sectoral inputs to exist for the services sector, the model’s results will differ from those arising from common New Economic Geography modeling frameworks. In the following, I will show what happens if fewer intra-sectoral inputs were used for services’ production. The case of a lower share of inter-sectoral inputs is also addressed, for reasons of comparison, in one of the later chapters. For running the analysis, the Krugman and Venables (1996) model will be taken in this

¹Measured as values in millions of euros.

²Krugman (1991), Krugman and Venables (1995), Krugman and Venables (1996).

Table 1: Intra-sectoral and imported inputs for the services' sector in 2005

	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	Retail trade, except of motor vehicles and motorcycles; repair of household goods	Hotels and restaurants	Public admin and defense; compulsory social security
Own sectoral input	8756	2927	3586	3920
Inputs from industrial sectors higher than own sectoral input	Motor vehicles, trailers and semi-trailers: 17488	Rubber and plastic products: 2977 Coke, refined petroleum products and nuclear fuels: 3643 Pulp, paper and paper products: 3424 Food products and beverages: 4222	Food products and beverages: 71058	Other transport equipment: 8193 Machinery and equipment n.e.c.: 6862 Printed matter and recorded media: 4898
Imported inputs	5.29 percent	3.54 percent	5.1 percent	6.73 percent

Source: Own calculations based on Eurostat data, input-output tables, aggregate on 17 euro countries taken for the year 2005, final use table "use05bpea".

Note: Data for *own sectoral input* and *inputs from industrial sectors higher than own sectoral input* given in millions of euros, current prices; data for imported inputs given as percentage of total inputs (domestic and imported).

study. Further, based on Frohwerk's (2008) work on asymmetric transport costs, it is here assumed that imported services are being less dependent on transport costs compared to imported industrial goods. The description of the modeling framework follows Krugman and Venables (1996), Fujita et al. (1999), Klüver (2000) and Frohwerk (2008). I will talk about differences to the literature's models where it is adequate.

2. Literature Review

New Economic Geography models reach back to Krugman's investigations on increasing returns to scale and trade in his papers of (1979) and (1980). There, Krugman employed the Dixit and Stiglitz (1977) framework on monopolistic competition and product diversity. By modeling increasing trade in differentiated products, Krugman by that time offered a model which was being able to explain intra-industrial trade. In his (1979) paper Krugman shows that with increasing returns to scale agglomeration will occur due to factor mobility. Trade, instead, does not have to be existent. Instead if labor could migrate and there is no trade because of tariffs or transport costs, then labor would concentrate in the region that has a higher pop-

ulation, initially, usually offering a higher real wage and a greater variety of goods. Consequently, history would matter for the initial state of population and subsequent levels of agglomeration. In his (1980) model Krugman especially considered the involvement of transport costs. In doing so, he was able to explain localization of a firm producing under monopolistic competition: the firm will locate close to the largest market in order to reap off scale economies and to save transport costs. This firm will export the good which is characterized by a high domestic demand, a fact that Krugman called the *home market effect*. Krugman could show that trade is caused by increasing scale economies and does not need to occur because of different factor endowments or technology as has been the cause in Traditional Trade Theory. In 1991 Krugman published his seminal work on New Economic Geography. In this piece of work he could show that agglomeration constitutes an **endogenous** process: on the one hand manufacturing firms want to locate in the region with larger demand. They can save transport costs that way and realize scale economies. On the other hand demand is high in places where manufacturing firms locate. This is because living and producing next to (other) manufacturing firms will offer an opportunity to buy cheaper goods (inputs). These processes are called backward and forward linkages, respectively. Another explanation for the endogenous process lies in the description of two agglomerative, centripetal, and one deagglomerative, centrifugal, force(s). The centripetal forces are the price index and home market effect, the centrifugal force is the competition effect. The home market effect involves that with workers moving to a region expenditures will increase, being an incentive for firms to locate there, too. The price index effect makes agglomeration close to a larger market more attractive for consumers/ workers because more firms in the larger market will reduce the price index and thus real wages increase. The competition effect involves that if more firms move to a place, demand for an individual firm will decrease. Profits will thus fall and wages will decline, fewer workers would want to move to this region. In Krugman and Venables (1995) a model with one agricultural and one manufacturing sector (which is monopolistically competitive) is taken, besides final goods also intermediate goods are produced by the manufac-

turing sector and labor is immobile interregionally (in contrast to Krugman (1991)) and only mobile across sectors. Intermediate goods are the main force leading to agglomeration. This is because in this model intermediate goods' usage creates forward and backward linkages. Intermediate goods' production will locate in larger markets thus saving transport costs. This addresses the backward linkage. Final goods' production will locate close to intermediate goods' production, lowering production costs that way. This comprises the forward linkage. A core-periphery pattern with industry in the core and agriculture in the periphery will emerge. Countries in the periphery will suffer from declining real incomes. This happens because demand for labor increases in the industrializing region, thus increasing real wages in this region. As transport costs continue to fall, however, a convergence of real incomes might come into place with countries in the periphery gaining and those in the core losing. This might happen because lower wages are offered for production in the periphery, and lower transport costs will make it feasible for demand and supply to be apart from each other. Manufacturing would move to the periphery. Krugman and Venables (1996)—their model is taken for this study—consider two monopolistically competitive manufacturing sectors, intermediate goods taken for production for either good and labor being immobile across countries but mobile between sectors. The authors show that intermediate goods' usage creates forward and backward linkages, thus fostering agglomeration. Intermediate goods' production will locate in larger markets thus saving transport costs and making use of economies of scale. Final goods' production will locate close to intermediate goods' production, lowering production costs that way. It can be shown that every industry locates in a different country.

Frohwerk (2008) enhances the Krugman and Venables (1996) model by introducing asymmetric transport costs between the two sectors. He finds that decreasing transport costs in just one sector will lead to lower production costs of both sectors such that stable and instable equilibria like in the Krugman and Venables (1996) model would evolve. However, the production costs of the respective sector would decrease more than is the case for the other sector. This would make production

of this sector's good increase. Asymmetric transport costs would make one country producing both sectors' goods, so labor in this country would be distributed on both sectors. However, this crucially depends on the height and difference between both sectors' transport costs. If one sector's transport costs lie above the sustain point, the other sector ones have to be low enough in order to generate agglomeration.

The aim of this study is not to give an extensive review on all of the enhancements of New Economic Geography models which were to follow after Krugman's works. Having just set out the underlying relevant literature we will now come to the modeling framework and simulation results.

3. Basic set-up

The household's utility function shall be composed of using both industrial and services products to a share of μ and $1 - \mu$. The original Krugman and Venables (1996) framework assumed equal shares for expenditures instead. Industrial and services' products shall be used by the firms interchangeably to the extent of ν . The industrial sector is supposed to receive from its own intermediate inputs to the extent of α . α shall be greater than ν . I model that the services sector does not make use of its own intermediate products. This is done because in Empirics a lower influence of intermediate goods' intensity on services sectors' agglomeration compared to industrial agglomeration has been detected.³ In table 1 the services sectors receiving fewer intra- than inter-sectoral inputs have been listed.⁴ Labor is distributed to both industrial and services' products to the extent of β_1 and β_2 . Labor is mobile across sectors, thus workers have abilities to work either in an industrial or in a services sector, but immobile internationally. Both sectors produce under monopolistic competition. Transport costs T are modeled as iceberg transport costs. This means a lower fraction of the shipped good will arrive in its destination. By shipping some parts of the good melt away like an iceberg does. A value of 1

³Shown in former work of mine.

⁴Modeling zero intra-sectoral inputs for services is a rather strong assumption in order to be able to figure out better the importance of these services' characteristics.

means that there are no transport costs, a value greater than 1 means there exist transport costs. It is further assumed that importing services from another country bears zero transport costs, referring to Frohwerk (2008) who investigated the case of asymmetric sectoral transport costs.⁵ ⁶ Further, table 1 shows that only a few services are imported, thus the amount of transport costs to be born might be considered to be little, anyway. Home and foreign country are symmetric, so the same aforementioned assumptions apply for both home and foreign country.

As concerns the demand side, households shall have a common Cobb-Douglas utility function:

$$U = M^\mu * D^{1-\mu}. \quad (1)$$

Households' expenditure on either an industrial or a services product shall be denoted by μ or $1 - \mu$, respectively. M is an index denoting quantities of differentiated products in the industrial sector, D is an index denoting quantities of differentiated products in the services sector. M and D are representable via sub-utility functions of CES-type, as is known from Krugman's models. Expenditure minimization yields that the marginal rate of substitution is equal to the relation of goods' prices, as is the case in Krugman's models:

$$\frac{m(a)^{\rho-1}}{m(z)^{\rho-1}} = \frac{p(a)}{p(z)} \quad (2)$$

$p(a)$ and $p(z)$ denote the prices for a product variant. $m(a)$ and $m(z)$ denote a consumer's consumed quantity of each product variants a and z of the industrial sector. The same holds for the services sector. Deriving the compensated demand function and getting expenditures for all variants of goods, one can derive price indices G_i

⁵Again this is a restrictive assumption, but will enable one to figure out this characteristic's importance in theoretical modeling.

⁶Ellison et al. (2010) point to lower transport costs for some services, for example for call center activities.

for both the industrial and the services' sector in both home and foreign country.

Production occurs under monopolistic competition. I differ from the Krugman and Venables (1996) model in having two different measures of unit costs C_i :

$$C_1 = w_1^{\beta_1} * G_1^\alpha * G_2^\nu \quad (3)$$

and

$$C_2 = w_2^{\beta_2} * G_1^\nu. \quad (4)$$

C_2 , my cost share for the services' product, differs from Krugman and Venables (1996) because I assume no intra-sectoral inputs received for this sector. Via profit maximization one can derive optimal prices and quantities for the two sectors. Here, in my modeling, I will have two different optimal prices since it is assumed that the services sector does not receive intermediate inputs from itself. Then:

$$p_1^* = w_1^{\beta_1} * G_1^\alpha * G_2^\nu \quad (5)$$

and the price of sector 2—the services sector—will be

$$p_2^* = w_2^{\beta_2} * G_1^\nu. \quad (6)$$

That means when setting their price firms in sector 2 will not have to consider prices for intra-sectoral inputs G_2 .

With the results on expenditure minimization and profit maximization the sectoral price indices can be written as:⁷

⁷Only home country's equations for sectoral price indices will be shown in the following. Since home and foreign country are symmetric, equations will structurally be the same.

$$G_1 = (L_1 \cdot w_1^{(1-\beta_1\sigma)} \cdot G_1^{-\alpha\sigma} \cdot G_2^{-\nu\sigma} + L_1^* \cdot w_1^{*(1-\beta_1\sigma)} \cdot G_1^{*-\alpha\sigma} \cdot G_2^{*- \nu\sigma} \cdot T^{1-\sigma})^{\frac{1}{1-\sigma}} \quad (7)$$

$$G_2 = (L_2 \cdot w_2^{(1-\beta_2\sigma)} \cdot G_1^{-\nu\sigma} + L_2^* \cdot w_2^{*(1-\beta_2\sigma)} \cdot G_1^{*- \nu\sigma} \cdot T^{1-\sigma})^{\frac{1}{1-\sigma}} \quad (8)$$

As can be seen, a sector's price index G depends positively on its own price index and all other price indices (home and foreign country's ones). This can be explained by the price indices influencing marginal costs, thus influencing the price setting of a firm.⁸ Further, the price index positively depends on transport costs T . This set of price indices differs from Krugman and Venables (1996) in that I consider no intra-sectoral inputs for the services' sector. Further, I do not explicitly control for different transport costs for the two sectors as Frohwerk (2008) does (which would mean taking T_1 and T_2). T is the same in all of the equations. However, since leaving out G_2^* from equation (7) does not alter the height of transport costs for equation (8) –they are still T – I can thus model that (though both services and industrial intermediates are used for producing the industrial good (see equation (7)) and so both price indices enter the equation) now transport costs do not amount to $T_1 * T_2$ but only to T , thus transport costs for services being lower, and this framework having a value of 1 for the services input imported from another country in equation (7).

A sector's expenditures for products, labeled E , are comprised by expenditures of private households and those of firms for intermediate goods. They are given by:

$$E_1 = (w_1 \cdot L_1 + w_2 \cdot L_2) \cdot \mu + \frac{\alpha \cdot w_1 \cdot L_1 + \nu \cdot w_2 \cdot L_2}{\beta_1} \quad (9)$$

⁸Via the Amoroso-Robinson relationship the optimal price is determined by setting marginal costs equal to marginal revenue. So, the optimal price depends on marginal costs, the total cost function depends on the two sectors' price indices, and each price index involves domestic and imported inputs.

$$E_2 = (w_2 \cdot L_2 + w_1 \cdot L_1) \cdot (1 - \mu) + \frac{\nu \cdot w_1 \cdot L_1}{\beta_2} \quad (10)$$

Taking a look at equations (9) and (10) one can see that home country's households' expenditures are divided to a share of μ for industrial goods and to a share of $1 - \mu$ for services' products. The Krugman and Venables (1996) model instead made households consume to a share of one half from each sector. $w_{h1} \cdot L_{h1} + w_{h2} \cdot L_{h2}$ is total income Y (with L denoting the labor input and w denoting the wage) which is spent on consumption. The last term in the equations describes firms' expenditure on intermediate goods. In Krugman and Venables (1996) the share of labor taken for production is the same for both sectors. In my modeling, as can be seen, labor input shares differ, that is β_1 for producing the industrial good and β_2 for producing the service. Equation (9) shows for expenditures in home for the industrial good that in the nominator of the last term the extent of labor compensation spent by firms is given (that is $\alpha \cdot w_{h1} \cdot L_{h1}$ due to intra-sectoral inputs and $\nu \cdot w_{h2} \cdot L_{h2}$ due to inter-sectoral inputs for the industrial sector). As can be seen, in my modeling there is no term for intra-sectoral inputs for the services' sector (see equation (10)).

The wage equations are:

$$w_1 = (\beta_1 \cdot (G_1^{\sigma-1} \cdot E_1 + G_1^{\star\sigma-1} \cdot E_1^* \cdot T^{1-\sigma}))^{\frac{1}{\beta_1\sigma}} \cdot G_1^{\frac{-\alpha}{\beta_1}} \cdot G_2^{\frac{-\nu}{\beta_1}} \quad (11)$$

$$w_2 = (\beta_2 \cdot (G_2^{\sigma-1} \cdot E_2 + G_2^{\star\sigma-1} \cdot E_2^*))^{\frac{1}{\beta_2\sigma}} \cdot G_1^{\frac{-\nu}{\beta_2}} \quad (12)$$

As can be seen, transport costs reduce foreign countries' expenditures on industrial products E_1^* and wage w_1 in the home country for the industrial sector (as can be seen from equation (11), higher transport costs mean a reduction in foreign country's

expenditures for the industrial good –since the term $(1 - \sigma)$ is negative– and taking the lower value of the expression in the brackets to the power of $\frac{1}{\beta_1 \sigma}$ will reduce the value of w_1). I differ from Krugman and Venables (1996) in not having own services inputs and therewith its price index G_2 for the services sectors’ wages. I further assume that importing services from the other country is not bearing transport costs. This would correspond to assymetric transport cost modeling as is known from Frohwerk (2008) and be different from my formal modeling of transport costs for the price indices in equations (7) and (8).

4. Dynamics

In the short-run, employment is fixed and wages will differ. For the long-run the assumption of labor being mobile across sectors involves that if wage in one sector is higher than in another sector, workers will move over to the sector offering a higher wage. This will happen until wages between both sectors equalize. So in the long-run an equilibrium will emerge where wages in both sectors are equal to each other.⁹

For a dynamic investigation, the employment of sector 1 in home country at a given employment of sector 1 in foreign country needs to be computed where home country’s wages for both sectors are equal to each other.

As in the Krugman and Venables (1996) model the dynamic behavior can be depicted by graphs. On the horizontal axis home labor force L_1 and L_2 will be shown, on the vertical axis foreign labor force L_1^* and L_2^* . Employment in sector 1 is measured from the left bottom corner, moving to the right or up indicating more employment in sector 1. The home country’s and foreign country’s curves are displaying distributions of labor where wages across sectors are equalized, that is for home $w_1 = w_2$ or for foreign country $w_1^* = w_2^*$. Below the foreign country’s curve wages in sector 1 are bigger than for sector 2 in foreign country such that labor would move to sector 1. Above that line wages in sector 1 are lower than for sector 2 for foreign country, so workers would move to sector 2. Left of the home country’s curve wages in sector

⁹See Krugman and Venables (1996), p. 963.

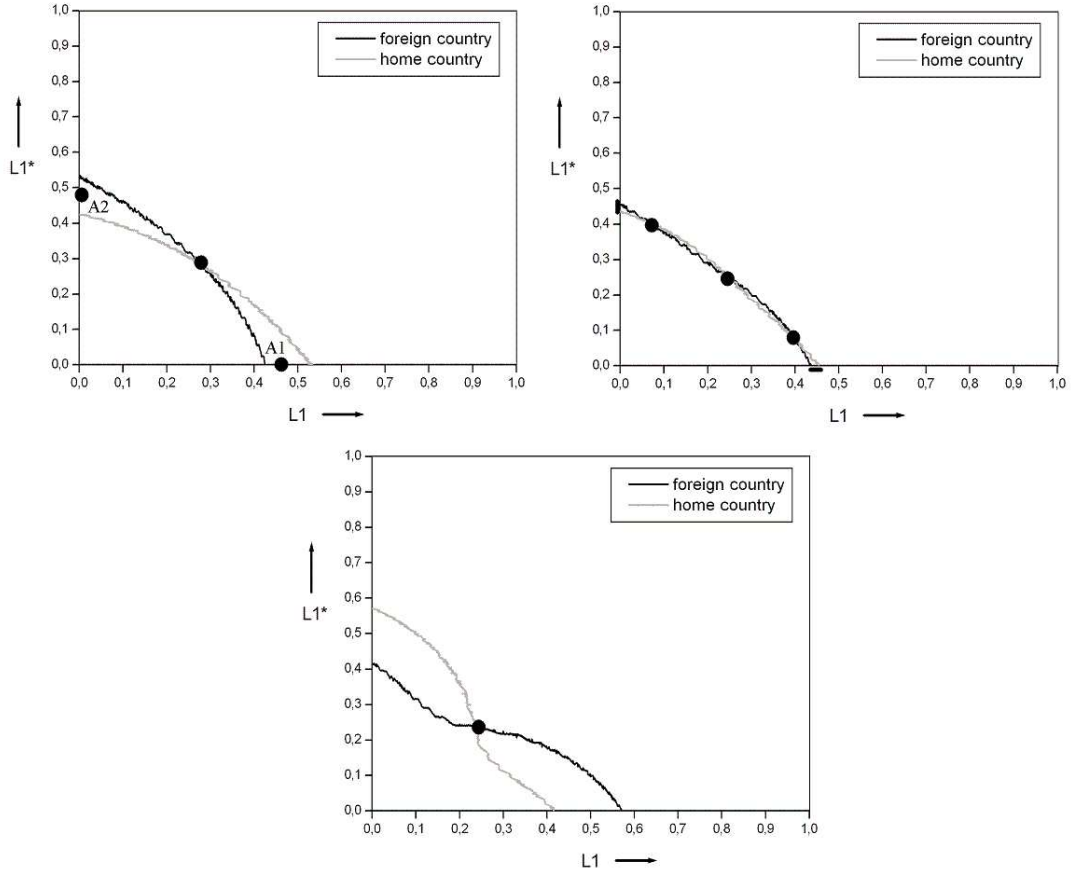
1 are bigger than in sector 2, so workers would want to move to sector 1, right to that curve wages in sector 1 are lower than in sector 2, workers would move over to sector 2. Points in the upper left and lower right corner are specialization points of countries. Middle-high transport costs are determined by the sustain- (upper limit for transport costs) and the break-point. At the sustain-point agglomeration is possible, at the break-point agglomeration is necessary.

As can be seen from figure 1 at a low level of transport costs ($T=1.5$) 3 equilibria emerge, one instable equilibrium with about one third of manufacturing employment and two thirds of services' employment in home and in foreign. The two other, stable, equilibria comprise either home having some manufacturing and some services' employment and foreign being 100 percent specialized in services (point A1) or foreign having some manufacturing and some services' employment and home being 100 percent specialized in services (point A2). In contrast to Krugman and Venables the instable equilibrium is not symmetric. Further, there is not full agglomeration existing for the equilibria lying on the axes.

At medium levels of transport costs ($T=2.2$) one can see that 5 equilibria emerge. As is the case for low levels of transport costs equilibria involve either a share of about one third of manufacturing employment for both countries (1 stable equilibrium), some manufacturing and some services for one and 100 percent services for the other country (2 stable equilibria lying on the axes), or some manufacturing and some services in one country and mostly services' employment in the other country (2 instable equilibria). In contrast to Krugman and Venables there is no symmetric equilibrium and the equilibria on the axes are not indicating full agglomeration.

For a high level of transport costs only one stable equilibrium emerges. There is no agglomeration of either industries or services, the employment shares respond to consumers' preferences in about one third of manufacturing. Again, there is no symmetric equilibrium which is in contrast to Krugman and Venables.

Figure 1: Equilibria for labor distribution



Source: Own graphic based on own simulations run with 1000 iterations. $\Sigma=4$, $\alpha=0.5$, $\eta=0.1$, $\mu=0.33$.
Transport costs for graph in the upper left corner: $T=1.5$, in the upper right corner: $T=2.2$ and at the bottom: $T=4.0$.
Note: The curves depict for a given employment L of one sector x in country d the employment of sector x in country c given that wages for both sectors of country c are equal; sector 1=industry, sector 2=services; countries: home and foreign.

5. Discussion

Results show that agglomeration tendencies are comparable to common New Economic Geography model settings employing agricultural and industrial sectors, only. However, here consumers' preferences, the height of transport costs, no transport costs assumed for imported services and the fact that the services sector will not receive intermediate goods from its own sector, will influence the model's results. It has been seen that at high levels of transport costs no agglomeration will occur. Forward and backward linkages are not strong enough to lead to agglomeration (see Krugman and Venables (1996)). The distribution of labor shares for industrial goods or services depends on initial consumers' preferences.

At middle-high levels of transport costs 5 equilibria evolve. If industries and ser-

vices are distributed relatively unequally in the beginning, they will agglomerate more and more. If they are relatively equally distributed, then they will develop according to consumers' preferences in either industrial or services' products, thus being less agglomerated.

At low levels of transport costs there exist 3 equilibria. The equilibrium with equal manufacturing/ services' employment shares for the two countries is unstable, stable equilibria lie on the axes. If industries and services were in the beginning very unequally distributed across the two countries, then their distribution would move further to the specialization points lying on the axes. The degrees of specialization further depend on consumers' preferences in the beginning. If consumers preferred services goods over industrial products ($\mu = 1/3$) then foreign country specializes to some extent in industrial products and some other in services products and home country specializes 100 percent in services, or home country specializes to some extent in industrial goods and some other in services products and foreign country specializes 100 percent in services. So there would not be full agglomeration of sectors in one country only, the industrial sector is present in one country, only, but services will be produced in both countries. One country would exclusively produce services, the other country both services and industrial goods.

Higher consumers' preferences for industrial products lead to clearer agglomeration tendencies (for example $\mu = 1/2$ and $\mu = 2/3$). Then the country that produces industrial products would give up producing services to a greater extent.¹⁰

The explanation for these tendencies could be the following. Let's assume that initially home produces just the industrial good and foreign country the services' good. Reducing transport costs will lead to lower price indices in equations (7) and (8). Production costs for both goods will decrease. Let's assume firms in home want to produce services goods. Since no services' inputs are used for services, the price index for services can be expected to be lower than the price index for industries

¹⁰Not shown here. Results are available from the author upon request.

for one country.¹¹ Production of services is cheaper, they will be more and more produced. Further, real wages in the service sector might increase due to the lower price index. Thus, workers would like to work in the services sector, as well. Consequently, the services sector will not just be located in the foreign but also in the home country. Home country has both industrial and services' production. This explained the forward linkage effect. The backward linkage effect means that more workers moving to home country, willing to work in the services sector increases expenditures (see equations (9) and (10)), thus more services firms would like to localize in home country, too.

The results emerging from simulations done for figure 1 display a lower level of agglomeration for the industrial sector than would be expected by consumers' given preferences for manufacturing goods μ . The instable equilibrium does not lie in the point $(\frac{1}{3}, \frac{1}{3})$, but in a lower distribution share of employment across countries. This could be explained by a higher real wage offered from the services sector which makes it more attractive for employees to work rather in the services sector. This becomes clear looking at equations (11) and (12). Services wages do in this model not depend on transport costs. If this were the case, then wages would be lower. Further, the price index for services inputs $G_2^{\frac{-\alpha}{\beta_2}}$ does not enter the services' wage equation, thus services' wage does not experience any further reduction, wage is not multiplied by the term $G_2^{\frac{-\alpha}{\beta_2}}$ which lies in this model between 0 and 1 (according to the strength of intra-sectoral and inter-sectoral linkages α and ν).

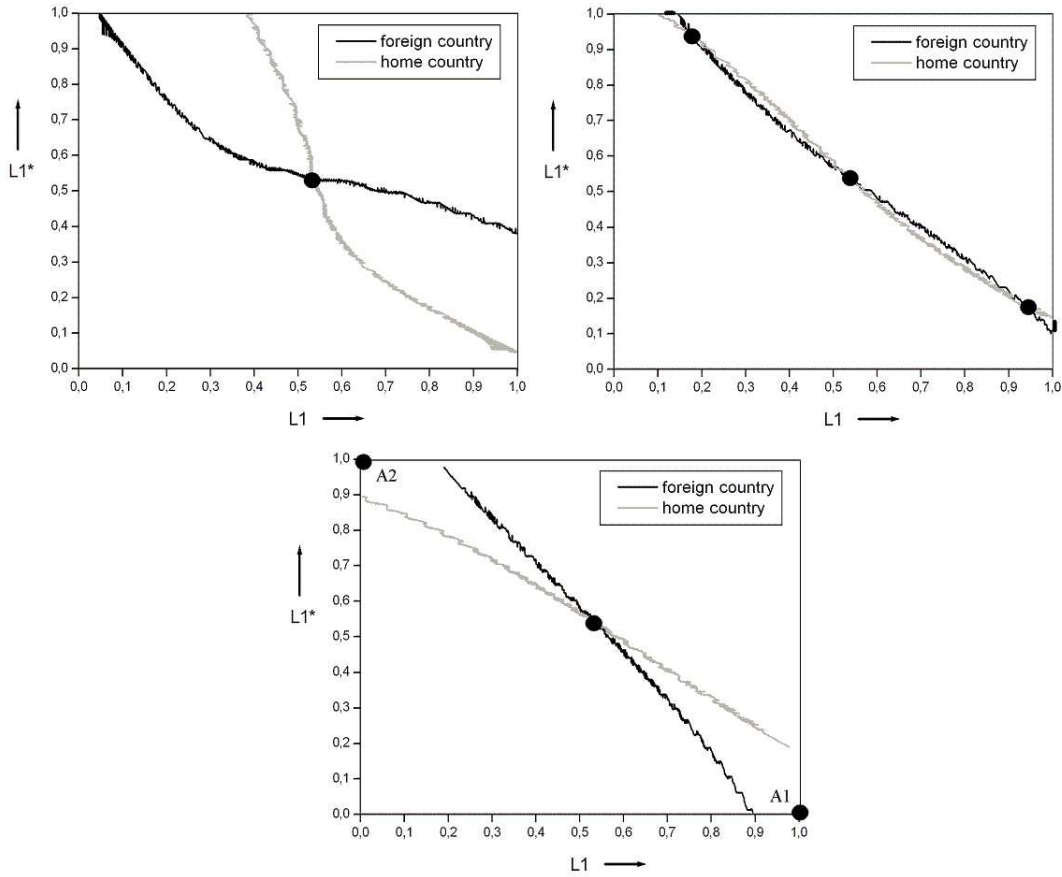
6. The case of a lower share of inter-sectoral inputs for services

What if the services sector primarily receives intermediate inputs from its own sector than from the industrial sector? This is the case for several services like post and telecommunications or financial intermediation, for example. Modeling this situation, inter-sectoral inputs for services are set to zero. Only intra-sectoral inputs

¹¹In Frohwerk (2008) instead, different sectors' transport costs made one sector's price index to become lower.

are thus important for the services sector, the input share is α . The assumption taken before that import of services is costless is being dropped here. The idea behind is that in this modeling framework services are more highly demanded as inputs due to the higher importance of **intra-sectoral** inputs for services and per se for industries' products such that the transport of services from another country might cause more costs compared to the case of modeling fewer intra-sectoral inputs for services. Formally, there will not be a differentiation between sectoral transport costs anymore, T is taken for each equation of prices and wages for each country. The resulting equilibria will be shown with the following graphic.¹²

Figure 2: Equilibria for labor distribution



Source: Own graphic based on own simulations run with 1000 iterations. Sigma=4, alpha=0.5, $\eta_y=0.1$, $\eta_x=0.66$. Transport costs for graph in the upper left corner: $T=4.0$, in the upper right corner: $T=2.2$ and at the bottom: $T=1.5$. Note: The curves depict for a given employment L of one sector x in country d the employment of sector x in country c given that wages for both sectors of country c are equal. sector 1=industry, sector 2=services; countries: home and foreign.

¹²Note that the graphs in figure 2 just give approximations because several outliers emerged during the simulations. They were discarded from drawing the curvatures. Increasing the number of iterations run should deliver smoother curves.

From figure 2 one can see that in the case of high levels of transport costs industries and services will be distributed in each country following the consumers' preferences for industrial and services' products. There is no agglomeration existent. At middle-high levels of transport costs 5 equilibria emerge. In case industries and services were relatively unequally distributed in the beginning, the industrial sector would not become fully agglomerated in either country. Either foreign has only industry and home country has mostly services and some industry (point in the upper left side) or home country has only industry, foreign has mostly services and some industry (point in the lower right side). So, the industrial sector is still dispersed compared to services. This might be explained by transport costs involved in making up services' wages here. If transport costs are quite high, then wages might be not high enough for the services sector as to make working in the services sector more attractive than working in the industrial sector. So, both countries would keep industrial goods' production. Only with decreasing transport costs, agglomeration tendencies will change, due to changing prices and wages. In case industries and services were relatively equally distributed in the beginning, the sectors would become relatively dispersed across countries, staying close to consumers' preferences.

In case of low levels of transport costs the same tendencies for agglomeration as in the Krugman and Venables (1996) model will occur. Basically, equilibria are possible where industries are exclusively agglomerated in foreign country and services in home (point A2) or industries are fully agglomerated in home and services in foreign country (point A1). A third equilibrium lies close to consumers' preferences in manufacturing goods. Obviously, forward and backward linkages are at work which can be described in a manner known from Krugman's models. The greater importance of intra-sectoral inputs not only for the industrial sector, but here also for the services' sector makes it more advantageous for firms locating close to own sector's firms because they can thus receive cheaper intermediate goods. If in the beginning home specialized in industry and foreign in services, and home considered producing services, as well, then home would have to import services from foreign

country. Transport costs involved in importing services in this model setting would increase the price index for services, thus production would become more expensive. Then real wages will decline and workers would not want to work in services in home country; the equilibrium of home country specializing in industry and foreign country in services would be preserved. This constitutes the forward linkage effect. The backward linkage effect comprises that fewer workers want to move to the services sector in home country, then expenditures shrink, thus fewer services firms would want to localize there.

As has been seen in the chapters before, with the modeling of fewer **intra-sectoral** inputs received for the services sector and imports of services being less dependent on transport costs than industrial goods would be, a clear message on services sector's fewer agglomeration could be gained. Here instead, fewer **inter-sectoral** inputs used for producing services will generate the results known from New Economic Geography models where full agglomeration of a sector in one country, only, would be achieved. Transport costs then, however, would have to be at a low level.

7. Conclusion

Taking account of services and certain characteristics (fewer intra-sectoral inputs, imported services less dependent on transport costs), this study shows that New Economic Geography modeling would point to agglomeration tendencies of both industrial and services sectors, however the modeling indicates that agglomeration of services would be less intensive. This is what can be shown by Empirics and is found in reality: services are less agglomerated. The mechanism behind is that with decreasing transport costs production costs for both sectors would decrease. However, the price index for the services sector will become smaller than for the industrial sector since no services inputs are assumed to be used for services production. Thus, assuming that in the beginning services were localized in foreign country and industries in home country, firms would want to produce more services in home country. Services sector's real wages would increase, workers would want to work in

the services sector, too. More workers moving to a region would increase expenditures on services products, which is an incentive for services' firms to move close to workers, as well. Thus, both countries will have services' production, services are less agglomerated. In practise—as has been shown descriptively—this services sector might be the retail trade sector (selling activities to consumers) which does not use a lot of intermediate products of its own sector and per se transport costs should not play a big role for this service since retailing activities need to be in the proximity of the consumer, so less trade of retailing activities will be the case. And retail trade is not being agglomerated a lot. The same is true for sale and repair of motor vehicles, hotels' and restaurants' services and public administration.

In future work, this study could be enhanced by using a different approach of modeling product differentiation. The ideal variety approach would be an interesting alternative modeling procedure. In this approach consumers and firms would show a demand only for certain product variants, those they prefer to receive. Utility would not increase with the number of product variants but with the preferred product variant(s) met.

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