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Transfers, Agglomeration and German Unification

Matthias Ross

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Contents

	Page
Abstract/Zusammenfassung	6
1 Introduction	7
2 Transfers to east Germany: Stylised facts	8
3 The model	10
4 Equilibrium	13
5 Transfers and agglomeration	17
6 Consequences for east Germany	23
7 Conclusion	25
References	27

List of Figures

Figure 1: Transfers and east German per capita GDP	9
Figure 2: Growth and Subsidies in east Germany	10
Figure 3: Domestic real wage relation and skilled labour share	15
Figure 4: Real net wage relation (RNWR) for various refunding of transfers	20
Figure 5: Transfers and long-run equilibria	22
Figure 6: Transfers guaranteeing convergence of the East	25

Abstract

This paper analyses in the framework of a 2-region economic geography model the impact of transfers on agglomeration of economic activity. Two main results can be derived: First, subsidies to the activity of firms are more efficient to avoid agglomeration than subsidies to consumers (social policy). Second, if a less developed region starts its catch up process first increasing and afterwards decreasing transfers are necessary to avoid agglomeration. Due to these results east Germany's slowdown of convergence may be a consequence of too less transfers and especially too less firm subsidies. Furthermore, if east Germany locates still at the first stage of convergence even increasing transfers would be necessary to guarantee convergence.

Zusammenfassung

Im Rahmen eines 2-Regionen Modells der „ökonomischen Geographie“ wird der Einfluss von Transfers auf die Konzentration wirtschaftlicher Aktivität untersucht. Zwei entscheidende Ergebnisse ergeben sich aus dem theoretischen Modell: Erstens sind Transfers, die für die Subventionierung von Unternehmen verwendet werden, wirkungsvoller als sozialpolitisch motivierte Transfers. Zweitens kann der Anpassungsprozeß einer geringer entwickelten Region in zwei Phasen eingeteilt werden, wobei während der ersten Phase zunehmende und während der zweiten Phase abnehmende Transfers erforderlich sind, um Einkommenskonvergenz zu gewährleisten. Im Lichte dieser theoretischen Ergebnisse können in der Konstanz der Transfers in die neuen deutschen Bundesländer und in der gleichzeitigen Abnahme der Unternehmenssubventionen weitere Erklärungen der mangelnden Einkommenskonvergenz gesehen werden. Befinden sich die neuen Bundesländer noch in der ersten Phase des Anpassungsprozesses, dann wären sogar steigende Transfers notwendig, um Konvergenz zu garantieren.

JEL classification: R12, F02, H7

Keywords: economic geography, economic integration, transfers, tax policy, east Germany

1 Introduction

More than 10 years after Unification east Germany is facing a break of GDP-per-capita convergence at a level of nearly 60% of west Germany. This is insofar remarkable as transfers from the west contribute significantly to east Germany's income. Following Sinn (2000) the two most important arguments explaining this unfavourable development are one the hand the above equilibrium wage level, put through by unions dominated from west Germany, and, on the other hand, generous subsidies to investment leading to an inefficient high capital-labour ratio. However, costs for labour and capital (because of subsidies) are still below the west German level and it is still questionable why the convergence process has come to an, at least temporary, end.

This paper offers a further explanation of the convergence break with arguments of the recent development in the field of economic geography. Extending a geography model by a government sector with the objective of granting transfers to the less developed region two main results will be derived. First, transfers that are used mainly for redistributing consumption between two regions are less efficient to guarantee convergence than transfers used as firms subsidies, or, more precise, than subsidies of the input factor which is responsible for agglomeration. Since human capital is the main source driving agglomeration, this theoretical result recommends a shift of subsidies towards (skilled) labour. Second, the convergence process of the less developed region can be separated in two stages. Starting initially at a low income, during the first stage increasing transfers are necessary to avoid sustainable agglomeration. Only if a critical level of development has been passed further convergence can be achieved by now decreasing transfers.

Since the seminal core periphery model of Krugman (1991) a growing number of contributions deepens the understanding of a broad variety of aspects in the field of economic geography (c.f. surveys of Puga and Ottaviano (1998), Ottaviano (1999), Masahisa and Thisse (1996) and Fujita, Krugman and Venables (1999)). Among these only a few concentrate on policy aspects and the impact of taxes and transfers. Andersson and Forslid (1999) show

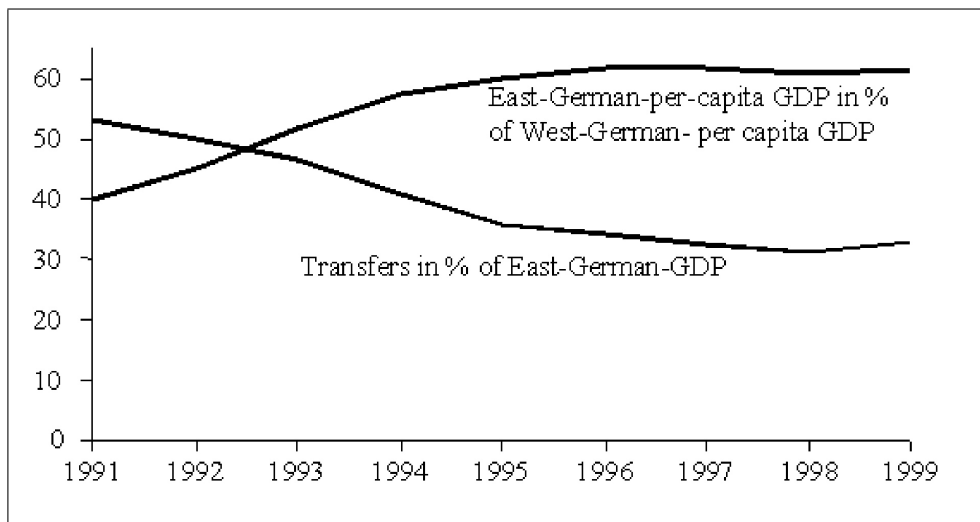
that there is a pressure in agglomeration models to tax the relatively immobile factor, although the externalities of agglomeration create some scope for taxation. Within a similar model Baldwin and Krugman (2000) discuss the European consequences of tax competition as a 'race to the bottom'. Both papers are closely related to this paper as they use the same model of Forslid and Ottaviano (1999) as a basis for their analysis. Nearly related is also a model of Ross (2001) analysing the impact of consumption taxes and firm taxes on agglomeration forces. Although his results concerning the impact of taxes are similar to this paper, within that model transfers are not considered. Finally it is worth to mention Martin (1999) who analyses the consequences of transfers in a two region agglomeration model of growth. He shows, that there may be a trade-off between growth and income disparity, at least if resources are shifted from the innovative production sector to the low income region.

The paper is organised as follows. Section 2 discusses some stylised facts about size and structure of transfers as well as growth in east Germany confirming empirically the motivation of this paper. Section 3 develops an economic geography model incorporating taxes and transfers to redistribute income between two regions. Section 4 solves the model and discusses the classical forces of the geography literature implying the possible outcome of agglomeration and income disparity. Section 5 is dedicated to the question whether transfers and the structure of refunding and spending guarantee convergence although agglomeration forces are still at work. Section 6 discusses the theoretical results in the light of stylised facts on transfers and growth in east Germany. Finally, section 7 concludes.

2 Transfers to east Germany: Stylised facts

Figure 1 demonstrates that during the first years after German unification the new states observed high growth rates justifying the expectation of a continuous convergence of per capita income to west Germany. Since 1996 this development has come, at least temporary, to an end and growth rates do not

differ significantly between both German regions. Per capita income of east Germany stagnates at a level of nearly 60% of west Germany while simultaneously transfers from the west to the east remain on a roughly constant level of 4.5% in terms of west German GDP. In terms of east Germany's GDP the relative importance of these transfers is much higher. In 1999 transfers still cover about 30% of east German GDP. Concerning the structure of

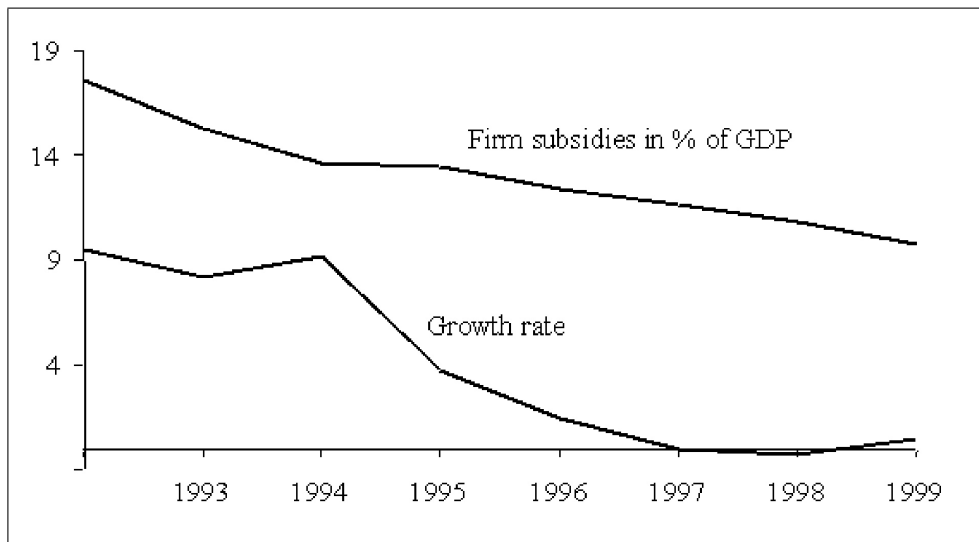


Source: KfW (2000)

Figure 1: Transfers and east German per capita GDP

transfers the largest and nearly constant part of about 50 % is assigned to the broad field of social policy (KfW, 2000). In contrast, direct subsidies to firms economic activity have declined continuously from 18% to 9% of GDP. But, despite this reduction, in 1999 subsidies in east Germany are still 4 times higher than in west Germany. Figure 2 presents this reduction as well as the east German decline of the GDP-growth. Together with the observations of figure 1 the question arises whether there is a relationship between the (temporary) break of convergence and the decline of firm subsidies, however, on a high level.

Broadly, this question may be answered in two ways. On the one hand, east Germany may be characterised by properties indicating so called conditional convergence (Barro and Sala-iMartin, 1995) or club-convergence



Source: KfW (2000)

Figure 2: Growth and Subsidies in east Germany

(Quah, 1997). Finding or determining corresponding properties someone may argue that east Germany is located on its individual long-run growth path. But, in the view of so many cultural, political and technological similarities with west Germany this line of reasoning gets very difficult. On the other hand, assuming the possibility of absolute convergence, the question may be answered by finding economic forces that outweigh these convergence forces. The arguments of Sinn (2000), union driven nominal wage convergence and generous investment subsidies, are useful explanations. Further explanations can be derived from the two-region economic geography model, presented below. This model incorporates forces stemming from externalities which may prevent convergence, even in case of transfers and availability of identical technologies.

3 The model

The model of this section bases on a general 2-region-agglomeration model of Forslid and Ottaviano (1999) which is an analytically solvable version of the original model of Krugman (1991). The innovation of the model is an

additional government sector in each region with two objectives. On the one hand government is redistributing income by taxation and subsidies, on the other hand government guarantees transfers between both regions. These transfers are financed by taxes of the source region and used for a corresponding tax reduction of the target region. Both regions are symmetric and to remind the motivation of the German unification they are called West and East. All East-variables are denoted by an asterix. Furthermore, to hold the theoretical presentation as simple as possible, the model is presented mainly from the perspective of the West. The symmetry property guarantees that the corresponding equations for the East can be similarly derived by exchanging variables with and without an asterix. If conditions differ between regions it is mentioned explicitly.

The economy in both regions consists of two sectors, a competitive sector producing a homogeneous good under constant returns of scale (CRS) and a monopolistic sector producing differentiated varieties under increasing returns to scale (IRS). In line with the literature, the CRS-sector is called traditional economy and the IRS-sector is called industry. Both sectors employ unskilled labour as variable input while each firm of the industrial sector requires additionally the fixed amount of one unit skilled labour, L . These fixed costs can be interpreted as headoffice or R&D costs. Unskilled labour is assumed to be immobile between both regions and to guarantee symmetry the unskilled labour supply of each region is assumed to be unity. In contrast, skilled labour is mobile in the long run, following real wage differences between both regions. Simplifying further, the overall skilled labour supply is normalised, too. Then, full employment requires that L skilled workers are employed in the West and $L^*=1-L$ skilled workers are employed in the East.

The homogenous traditional good A is traded without trade costs such that the competitive price is identical in both regions. Anchoring the price of A to unity implies that zero profits of the competitive traditional sector are only guaranteed if the unskilled wage level equals unity as well. In contrast, trade of industrial varieties requires usual "iceberg" trade costs $\tau \geq 1$ according to Samuelson (1954) implying that the export of the amount x requires the shipment of the amount τx .

All available varieties from the West and the East are combined to an intermediate good X which is consumed according to the constant returns Cobb-Douglas preferences

$$U = X^\gamma A^{1-\gamma}, X = \left(\int_{i=0}^{n+n^*} x_i^{\frac{\sigma}{1-\sigma}} di \right)^{\frac{1-\sigma}{\sigma}}, \quad (1)$$

where n and n^* denote the number of West- and East-firms producing each a differentiated variety, x_i . On the costs side the production of a variety x_i requires, as mentioned above, fixed and variable costs as well as taxes. Fixed costs stem from the fixed input of skilled workers each earning the wage w while the variable costs are given by the normalised unskilled wage level of unity and the input coefficient c . Firm taxes are assumed to account for a fraction T_F of fixed cost. Altogether, total costs of an industrial firm are given by:

$$C(x) = \frac{w}{1 - T_F} + cx, \quad (2)$$

where the subscript is suppressed for notational simplification. Assuming that the individual firm cannot influence the aggregate price level profit maximising with respect to (1) and (2) yields a producer price:

$$p = 1, \quad \text{if } c = \frac{\sigma - 1}{\sigma}, \quad (3)$$

which is equal for all firms in both regions. Note, that consumer prices differ from producer prices by the factor τ if varieties cross the regional border. Profits of each firm are assumed to be used completely for the wage income of the skilled employees, $0 = px - C(x)$. Solving for x yields the equilibrium output of each industrial firm:

$$x = \frac{\sigma w}{1 - T_F}. \quad (4)$$

Regional income consists only of wage income since traditional and industrial firm profits are zero. Considering additionally the proportional consumption tax, T_C , gross income, Y , and net income, Y_N , are given by:

$$\begin{aligned} Y &= (1 + Lw), \\ Y_N &= Y(1 - T_C). \end{aligned} \quad (5)$$

Finally, government budget must be equalised such that the sum of taxes or subsidies and transfers, R , is zero:

$$\begin{aligned} T_C Y + T_F C(x) &= R, \\ T_C^* Y^* + T_F^* C(x^*) &= -R, \end{aligned} \quad (6)$$

Since the model considers only two regions granted transfers R of the West correspond to the received transfers $-R$ of the East.

4 Equilibrium

Two kinds of equilibrium are determined by the model, a short-run equilibrium and a long-run equilibrium. The short-run equilibrium is characterised by a given distribution of skilled workers, L and $1 - L$, on the West and East. Then, the model above determines prices and wages clearing the product and labour market. Since real wages may differ between both regions, in the long-run skilled workers migrate to the region with the higher real wage. Therefore, two kinds of a long-run equilibrium are possible. Either the real wage difference has diminished such that:

$$\frac{wP^{-\gamma}}{w^*P^{*\gamma}} = 1, \quad (7)$$

or all skilled workers locate in the region with the higher real wage. Then, although the real wage relation (RWR) indicates an even higher skilled labour demand, migration stops as all skilled labour locates in the preferred region:

$$\frac{wP^{-\gamma}}{w^*P^{*\gamma}} \geq 1 \text{ and } L = 1 \text{ or } \frac{wP^{-\gamma}}{w^*P^{*\gamma}} \leq 1 \text{ and } L = 0. \quad (8)$$

Calculating the real wage difference of (7) and (8), which is the crucial determinant of migration, requires first the derivation of the prices, P, P^* , for intermediates. From the demand function (1) follows that expenditure shares are equal for each variety. Substituting the producer price of unity from (3) as well as additional trade costs for foreign varieties yields the prices of the intermediate X for the West and the East:

$$\begin{aligned} P &= (L + \Phi(1 - L))^{\frac{1}{1-\sigma}}, \\ P^* &= (\Phi L + (1 - L))^{\frac{1}{1-\sigma}}, \end{aligned} \quad (9)$$

where the parameter $\Phi = \tau^{1-\sigma}$ is used for notational simplification. In case of no trade costs $\Phi=1$, while prohibitive trade costs ($\tau = \infty$) imply $\Phi = 0$. Integration can be modelled by an increase of Φ up to unity.

Wages can now be determined from the product market equilibrium by equalising supply and demand. Each firm produces an equilibrium amount given by (4) and faces foreign and domestic demand for its variety which can be derived from the utility function (1). Equalising supply and demand yields that product market equilibrium is guaranteed if:

$$\begin{aligned} \frac{w\sigma}{1-T_F} &= \frac{\gamma(1+Lw)(1-T_C)}{L+\Phi(1-L)} + \Phi \frac{\gamma(1+(1-L)w^*)(1-T_C^*)}{\Phi L+1-L}, \\ \frac{w^*\sigma}{1-T_F^*} &= \Phi \frac{\gamma(1+Lw)(1-T_C)}{L+\Phi(1-L)} + \frac{\gamma(1+(1-L)w^*)(1-T_C^*)}{\Phi L+1-L}. \end{aligned} \quad (10)$$

Both conditions contain the government variables T_F , T_F^* , T_C , and T_C^* . Since these variables must fulfil the budget constraints (6) for both regions two variables can be chosen to be endogenous while the remaining variables are exogenous. The next section is concerned with these assumptions while the remaining of this section analyses the model without government intervention to illustrate the impact of agglomeration forces. This is exactly the result of Forslid and Ottaviano (1999).

If government is inactive all tax and transfer variables are zero, and the two linear equations of (10) can be solved for w and w^* :

$$w = \frac{N(L)}{D(L)}, \quad w^* = \frac{N(1-L)}{D(L)}, \quad (11)$$

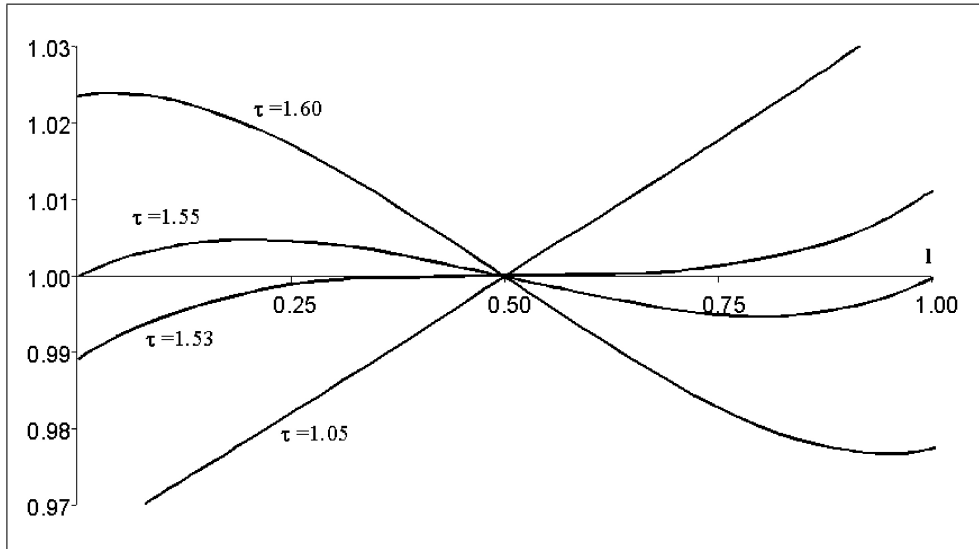
$$\begin{aligned} \text{with: } N(L) &= 2\sigma\Phi + (1-L)[\sigma(1-\Phi)^2 - \gamma(1-\Phi^2)], \\ D(L) &= (\sigma-\gamma)[[(\sigma-\gamma)-\Phi(\sigma+\gamma)](1-\Phi)L(1-L) + \sigma\Phi]. \end{aligned}$$

Now, the real wage relation (RWR) can be calculated easily from (11):

$$RWR = \frac{wP^{*\gamma}}{w^*P^\gamma} = \frac{N(L)}{N(1-L)} \left(\frac{P^*}{P} \right)^\gamma, \quad (12)$$

where P and P^* are given by (9) and $N(\cdot)$ is defined in (11). If the RWR is above unity, skilled workers and firms migrate from the East to the West,

below unity the reverse development occurs. Furthermore, if skilled labour is distributed equally across both regions, $L=L^*=0.5$, it can be seen immediately that numerator and denominator are identical and the RWR is unity. According to (7) the symmetric equilibrium is also a long-run equilibrium.



Parameters: $\gamma = 0.5, \sigma = 3$

Figure 3: Domestic real wage relation and skilled labour share

Figure 3 presents the RWR of (12) graphically for different distributions of labour and for certain levels of trade costs. In all cases the RWR gets unity at $L = 0.5$ indicating that the symmetric equilibrium is always a long-run equilibrium. But, the stability of this long-run equilibrium depends on the slope of the RWR-curve at the symmetric equilibrium. A negative slope, like in the case of $\tau = 1.6$ implies that any deviation of the symmetric equilibrium corresponds to a relatively higher real wage in the region with less skilled labour. But this induces migration back until the symmetric equilibrium is reached again. The symmetric equilibrium is stable. In contrast, a positive slope causes any deviation of the symmetric equilibrium to be intensified by further migration. Furthermore, if the symmetric equilibrium is unstable other stable long-run equilibria must exist with agglomeration in one of the two regions. For all trade costs below the critical level of $\tau=1.53$ only the extreme distributions where all industry is concentrated are stable long-run equilibria.

There are two agglomeration forces within the model at work which can be separated as follows: Consider, for instance, that one skilled worker moves from the East to the West, destroying the symmetric equilibrium. Since this employee shifts also his spending from the East to the West total demand in the West increases since now the former trade loss (export from West to East) can be saved. But increased demand implies also higher profits, enabling each firm to offer higher wages inducing even more skilled employees to migrate to the West. This is the first agglomeration force which is also called backward linkage as the circular causality leading to an increased real wage in the West stems from an increased demand. Trade costs strengthen the backward linkage since they increase the saved trade loss of the West.

Alternatively, someone can argue, that the marginal migrant from the East to the West increases the number of firms in the West because of its fixed input property within the production function. More firms go ahead with more locally available varieties and a lower price level. As a consequence real wages increase and even more employees migrate to the West. This is the second agglomeration force, and, since this argument focuses on the cost situation of the firms, this force is called forward linkage. Again, trade costs strengthen the forward linkage as they intensify the relative regional impact of the number of varieties on the price level.

Besides these agglomeration forces there are also stabilising forces or dispersion forces at work. Consider again, that one marginal skilled worker leaves the symmetric equilibrium by moving from the East to the West. Other variables assumed to be constant this development can be interpreted in two ways. First, the additional skilled worker in the West increases labour supply such that competition between employees forces nominal wages to fall. Second, the new employee may open up a new firm, while now an increased number of producers compete for a given demand. Firm profits decrease and each firm is willingly to pay only a lower nominal wage. In both cases, increased competition is the stabilising force reducing the nominal wage of the West.

So far, the discussion has concentrated on the stability of the symmetric

equilibrium. But, in case of integration of two different developed regions the interesting question arises, under which circumstances the less developed region will be able to catch up to the rich region. Consider for instance that initially no skilled labour locates in the East ($L = 1$). Whether this concentrated equilibrium is also a stable long-run equilibrium can now be analysed at the right endpoints of the curves of figure 3. Below a critical level of trade costs, called sustain point, the RWR will always be above unity indicating stability of the concentrated equilibrium (note, the RWR of (12) is defined from the perspective of the West relative to the East). In figure 3 the sustain point is $\tau_{sus} = 1.55$ implying that for all trade cost levels below τ_{sus} the less developed region is unable to catch up.

5 Transfers and agglomeration

Transfers affect the location of firms and structure of the equilibrium only indirectly by size and structure of taxes in the source region and of subsidies in the target region. Furthermore it must be distinguished between the short run impact and the long run impact. In the short run skilled labour is immobile such that that transfers and the tax structure cannot influence the regional number of firms. In the long run, however, migration occurs according short-run net wage differences that may be controlled by the tax and subsidy structure and the transfer level.

Beginning with the short run impact of transfers, the net income of the West is given by (5). Substituting the equilibrium wage which can be derived from (10) as well as the government budget constraint (6) yields the regional net income of the West:

$$Y_N = 1 + L \frac{N(L)}{D(L)} - R \left(1 + \frac{(\sigma - \gamma)\gamma(1 - L)L(1 - \Phi^2)}{D(L)} \right), \quad (13)$$

with $N(\cdot)$ and $D(\cdot)$ from (11). Somehow surprising, in the short run regional net income depends only on the size of transfers and not on the structure of taxes. Furthermore, the net income reduction is larger than the transfers themselves, since the last bracket term is always above or equal to unity.

This multiplicative effect stems from the fact that besides the direct income reduction additionally industrial demand is lowered. Transfers shift demand to the East such that each firm in the West faces a lower local demand and a higher foreign demand. But, since foreign demand is charged additionally by trade costs, the net effect is negative such that firms in the West pay lower wages to their skilled employees. Only if trade costs are zero the income reduction corresponds to the transfer size.

Although the structure of taxes does not influence on the regional net income, there is an measurable effect on the intra-regional distribution of income. In order to demonstrate this effect consider first the case, where transfers are financed only by consumption taxes. Then, government budget constraint (6) simplifies to:

$$T_C = \frac{R}{1 + Lw}, \quad (14)$$

and the nominal wage in the West, w_C , can be calculated from (10):

$$w_C = \frac{N(L) - R(1 - L)(\sigma - \gamma)(1 - \Phi^2)}{D(L)} \quad (15)$$

Since nominal wages in the agricultural sector are unity, (15) describes also the relative wage relation of industrial and agricultural sector. As long as trade is costly ($\Phi < 1$), consumption taxes reduce the relative earnings of the industrial workers compared to the agricultural workers. Again, this is the multiplicative effect of the demand shift to the East.

Consider now the case where transfers are financed only by firm taxes. Then, government budget constraint (6) simplifies to:

$$T_F = \frac{R}{R + Lw}, \quad (16)$$

and the nominal wage in the West can be calculated again from (10):

$$w_F = \frac{N(L) - R\sigma(\sigma - \gamma)((1 - L)(1 - \Phi)^2 + \Phi/L)}{D(L)} \quad (17)$$

Comparing now w_F from (17) and w_C from (15) yields that transfers financed by firm taxes reduce the industrial wage more than transfers financed by

consumption taxes. Intuitively this is also clear since the economy consists of less firm tax payers than consumers. And, if a given amount of transfers is financed by less tax payers, each must pay a higher rate.

Thus, in the short run transfers reduce the income of the financing region and, depending on the tax structure, change the income distribution within the region. Although analysis above has considered only the transfer granting region, here the West, all argument hold also in the receiving region but with an opposite sign.

In the long run skilled labour is mobile and migrates to the region with the higher real net wage which, as derived above, can be influenced by tax and subsidy policy. Four cases concerning the different tax and subsidy structure are thinkable. The first two cases are characterised by either consumption taxes or firm taxes in the source and target region, while the second two cases are characterised by the combinations firm taxes/ consumption subsidies and consumption taxes/firm subsidies. But, since the latter two cases differ only with respect to the sign of the transfers they can be analysed at once. Therefore, three alternatives remain for the further analysis.

In the first case transfers are financed by consumption taxes in the West and used for a corresponding consumption tax reduction in the East. Using the nominal wage of (15) as well as the corresponding nominal wage of the East yields a real net wage relation (RNWR) of:

$$RNWR_{C,C} = \frac{w_C (1 - R/(1 + Lw_C))}{w_C^* (1 + R/(1 + (1 - L)w_C^*))} \left[\frac{\Phi L + 1 - L}{L + \Phi - \Phi L} \right]^{\frac{\gamma}{1-\sigma}}, \quad (18)$$

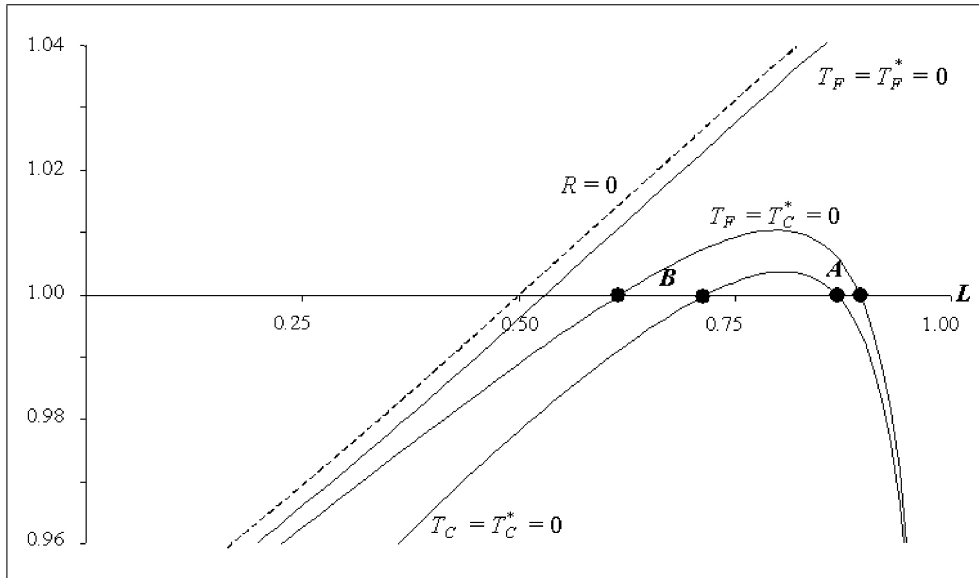
where w_C is defined in (15). In the second case transfers are financed by firm taxes and used for corresponding firm subsidies. Now the RNWR gets:

$$RNWR_{F,F} = \frac{w_F}{w_F^*} \left[\frac{\Phi L + 1 - L}{L + \Phi - \Phi L} \right]^{\frac{\gamma}{1-\sigma}}, \quad (19)$$

where w_F is defined in (17). The third case is characterised by consumption taxes in the West and firm subsidies in the East while now the RNWR is given by:

$$RNWR_{C,F} = \frac{w_C (1 - R/(1 + Lw_C))}{w_C^*} \left[\frac{\Phi L + 1 - L}{L + \Phi - \Phi L} \right]^{\frac{\gamma}{1-\sigma}}. \quad (20)$$

Equations (18) to (20) determine the RNWRs for all alternatives of the tax-subsidy structure. Figure 4 presents these relationships graphically. Consider first the case where transfers are financed by and used for a corresponding reduction of consumption taxes ($T_F = T_F^* = 0$). Compared with the dashed curve describing the reference case without transfers the RNWR shifts only marginally rightwards. Furthermore, the absolute impact of transfers on the RNWR is mainly independent of the labour distribution implying that a given level of transfers is the less efficient the more unequal both regions are. For the parameters of figure 4, for instance, a reverse of the RNWR in favour of the East is only guaranteed near to the symmetric labour distribution, or, in other words, if both regions are not too unequal.



Parameters: $\gamma = 0.5, \sigma = 3, \tau = 1.1, R = 0.002$

Figure 4: Real net wage relation (RNWR) for various refunding of transfers

More efficient to avoid agglomeration are policies where transfers are used for corresponding firm subsidies (eqs.(19), (20)). Both curves of figure 4 indicate a stronger reduction of the RNWR than in the consumption subsidy case discussed above. Furthermore, and this is the most striking difference, efficiency of transfers to avoid agglomeration increases the more unequal both regions are. This creates, at least for the parameters of figure 4, an additional stable but asymmetric long run equilibrium at point *A* while simultaneously

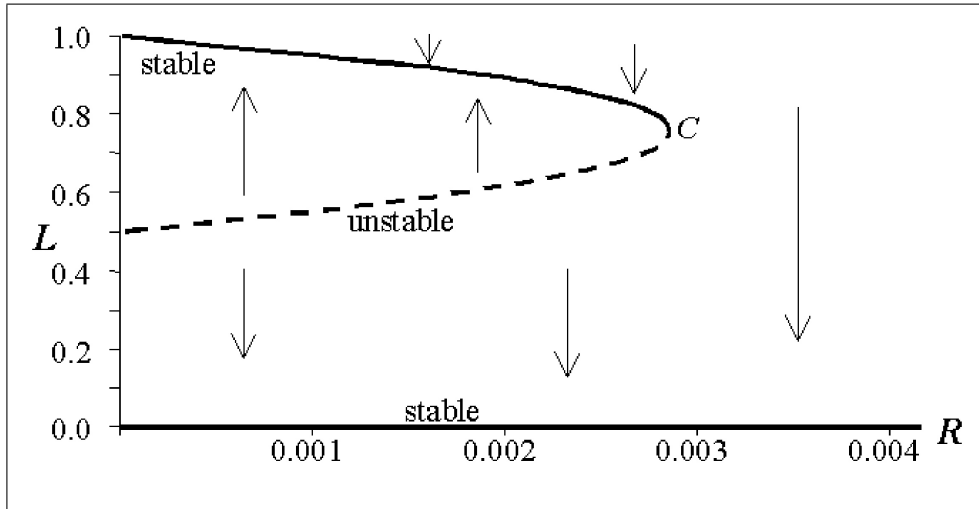
the former unstable symmetric equilibrium shifts to the right (B).

In order to understand the forces guaranteeing stability at the new long-run equilibrium A consider an initial distribution without any skilled labour in the East ($L = 1$). The first firm moving now from the West to the East receives all transfers guaranteeing a RNWR below unity. But, the more firms move to the East, the less subsidies each firm receives such that income convergence of the East goes ahead with a decrease of the power of transfers. From A on leftwards agglomeration forces dominate again such that stability is guaranteed.

Comparing now the three policies, mostly efficient to avoid agglomeration are transfers financed by firm taxes and used for a firm tax reduction. Least efficient are transfers financed by consumption taxes and spent for consumption subsidies. In between locates the mixed policy where transfers are financed by consumption taxes and used for firm subsidies. Although less efficient, this policy has the advantage that consumption taxes are less distorting for the refunding region. If policy must be justified by acceptability also in the source region, this seems to be the mostly realistic case.

The parameter choice is crucial for the outcome of figure 4. If transfers increase above the level of $R=0.002$ the curve of the RNWR shifts even more downwards such that the existence of a any stable or unstable long run equilibria (A , B) is not guaranteed anymore. Figure 5 presents the general relationship between the transfer level and the existence of stable and unstable equilibria for the realistic third policy case. Again, low trade costs are assumed, $\tau=1.1$, and the arrows describe the direction of migration.

Without transfers, the three long-run equilibria can be found as intersection points with the y -axis. The symmetric long-run equilibrium at $L = 0.5$ is unstable while both concentrated equilibria at $L = 0$ and $L = 1$ are stable. Increasing transfers hurt now the West and favour the East. Therefore, the long-run equilibrium with all industry in the East ($L = 0$, bold curve overlays the x -axis) preserves independent of the (positive) transfers level. But, the other long-run equilibrium with agglomeration in the West ($L = 1$)



Parameters: $\gamma = 0.5, \sigma = 3, \tau = 1.1$

Figure 5: Transfers and long-run equilibria

moves downwards while, simultaneously, the unstable symmetric equilibrium shifts upwards. If transfers reach a critical level, denoted by the point C , stable and unstable equilibrium collapse. Any further increase of transfers goes ahead with the existence of only one remaining long-run equilibrium in the East. Transfers are large enough to guarantee the RNWR being always below unity, independent of the employment distribution. Convergence of the less developed East is always guaranteed.

Thus, if the policy objective is to avoid agglomeration, transfers must guarantee a location below or to the right of the dashed line. Then, the RNWR is less than unity and migration of skilled workers ensures an increasing economic activity in the East. Above the dashed line either transfers are too low or too less skilled labour locates in the East. Migration forces both regions to move to the long-run equilibrium with agglomeration in the West. The upper bold curve denotes this equilibrium.

Finally it is worth to mention briefly the impact of the transfer policies on aggregated real income and welfare. Comparing (13) for the West and the East yields that transfers increase the nominal income of the receiving region by the same amount as the nominal income in the granting region decreases. Since there is no aggregated nominal impact any real effect must depend only

on the regional price levels. If the West locates more skilled labour than the East, the price level is also lower than in the East and any transfers from the West reduce the aggregated real income. The opposite occurs, of course, in the case of transfers from the less developed East to the West. Furthermore, since preferences are modelled by the constant returns Cobb-Douglas function (1), aggregated utility behaves in the same way. Any transfers from the more developed West to the less developed East reduce aggregate welfare. Therefore, the policy goals of aggregate welfare maximising and equalising regional incomes cannot be achieved simultaneously.

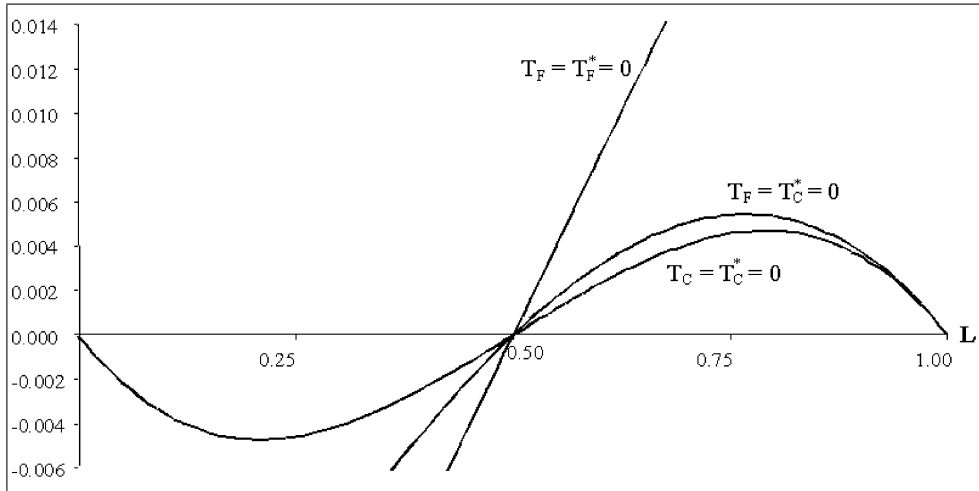
6 Consequences for east Germany

Recent literature in the field of economic geography concentrates mainly on the consequences of integration, namely a continuous decrease of trade costs, incorporating all costs of doing business over space. Concerning the development in east Germany this integration process seems to be less important since political and monetary unification in 1990 has removed at once most of the trade barriers which existed before. But does this mean that there are no costs of doing business in space anymore? Pure transport costs exists still although they should be assumed to be at a very low level similar to transport costs within regions of a country. But there are also other costs of doing business in space, like complex communications costs or the adjustment to different cultures, the varying availability of technological innovation or simply a less positive image of the corresponding region. Therefore it seems to be reasonable to assume positive trade costs between east and west Germany although these costs should be on a low level.

Remember now the two main stylised fact about the development of east Germany in the last 10 years. First, per capita income convergence has stopped on a level significantly below per capita income of west Germany. Second, transfers to east Germany stay on constant high level while the share of transfers which is used for firm subsidies has been reduced constantly over time. A large share of transfers is used for the purpose of social policy.

The high proportion of transfers used for social policy can be seen as a redistribution of income from west to east Germany, similar to the impact of consumption subsidies within the model above. But, the theoretical framework judged consumption subsidies to be less efficient for convergence than firm subsidies. Furthermore, consumption subsidies guarantee convergence only if they are on a very high level or if both regions are not too dissimilar. Therefore, from the theoretical perspective transfers with the intention to mitigate social problems are insufficient to provoke convergence of the still very dissimilar east Germany.

The second stylised fact concerns the decreasing firm subsidies in east Germany. On the one hand, especially since 1996 this observation may be a result of a changed investment subsidy policy (Sinn, 2000), on the other hand it is only a statistical fact, that, if the total amount of transfers remains constant over time, the growth of the first years up to 1996 must decrease the share of subsidies per GDP-unit. But, again in the light of the model, this decrease of firm subsidies may be too much, such that subsidies cannot compensate east German firms for the agglomeration forces pushing economic activity to west Germany. The theoretically necessary size of transfers guaranteeing convergence can be derived from the non-linear (in R) equations (18) to (20) by solving numerically for R while assuming the RNWR to be unity. Figure 6 presents the numerical results distinguishing again between the three policy alternatives. First, it can be observed that the necessary size of transfers in case of consumption subsidies increases substantially the less developed the East is. This confirms the result above, that social policy transfers are an expensive and less efficient instrument to avoid agglomeration. Second, both policies where transfers are used for a corresponding firm subsidy require a reverse U-shaped relationship between the level of transfers and the degree of development. Starting the convergence process of the East at a very low income level, for instance $L=1$, ($\Leftrightarrow L^*=0$) first increasing and later on decreasing transfers are necessary to guarantee convergence. From this theoretical view and if east Germany is situated still at the first stage, the observed decreasing firm subsidies may be insufficient to guarantee further convergence.



Parameters: $\gamma = 0.5, \sigma = 3, T_C = 0, T_F^* = 0$

Figure 6: Transfers guaranteeing convergence of the East

Summarising the results of this section, it can be stated that transfers are mostly efficient if they favour the factors which create externalities and which are responsible for agglomeration. If human capital turns out to fulfil this property in east Germany a shift from subsidies of physical capital and social purposes towards human capital may strengthen the convergence process. However, even an optimum policy requires initially an increasing amount of transfers. In this sense, the observed overall constant amount of transfers from west to east Germany combined with decreasing firm subsidies may be insufficient to guarantee convergence.

7 Conclusion

The aim of this paper is to offer an additional explanation for the break of the east German income convergence. For this purpose a two region economic geography model has been developed considering a government sector with the objectives of taxation, granting subsidies and transfers. Three important results have been derived. First, mostly obvious, transfers in general are an appropriate policy to compensate for agglomeration forces hindering two regions from income convergence. Second, direct subsidies to the activity

of firms are more efficient than transfers used as subsidy for consumption (social policy). Finally, the necessary amount of transfers used for firm subsidies varies depending on the status of convergence. During a first stage of convergence increasing transfers are necessary to take the rapidly increasing number of firms into consideration. Afterwards, convergence goes ahead with a decreasing proportional increase of firms while also the necessary amount of transfers declines.

Applying these theoretical results on the situation of east Germany offers additional explanations for the insufficient income convergence. The observed decreasing firm subsidies could offset the west German agglomeration forces only in the first years after unification. Later on the increased economic activity in the east reduced the relative power of the subsidies. Particularly, if east Germany is judged to locate still at the first stage of convergence even increasing transfers are necessary. Only if a critical income level has been passed convergence goes ahead with decreasing transfers.

Finally it is worth to mention that the impact of transfers within the model depends mainly on the property that firm taxes favour the mobile factor skilled labour. Physical capital has been neglected to hold the model as simple as possible, although similar theoretical results can be expected. However, whether physical or human capital is more important for agglomeration must be answered by corresponding empirical research.

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