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## Ranking German regions using interregional migration - What does internal migration tells us about regional well- being?

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# Ranking German regions using interregional migration

What does internal migration tells us about regional well-being?

(Preliminary draft)

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## Abstract

This research project ranks German regions with help of interregional migration data instead of gross domestic product, household incomes, unemployment or quality of life estimates. Therefore we estimate regional utilities differentials for German states and planning regions following the approach of Nakajima & Tabuchi (2011). These estimates and derived regional rankings are strongly correlated with standard rankings. Further we ask whether observed migration is compatible with a spatial equilibrium which is rejected here. We also do not find evidence for regional convergence, given that our utility measures incorporates economic potential and non-market amenities like natural amenities or publicly provided goods.

*JEL Classification:* C25, J61, O18, R23, R32

*Keywords:* discrete choice model, interregional migration, regional convergence

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# 1 Introduction

How can we measure the wealth of a region compared to other regions and minimize possible biases by omitting some determinants or using erroneous weighting? This question has gained importance since the limitations of the gross domestic product (GDP) as standard measure of economic development and social progress are discussed in Stiglitz et al. (2009). For example, in 2010 the German Bundestag has established the Enquete-Commission “Growth, Prosperity, Quality of Life” which is to develop a general indicator of economic growth, welfare and quality of life.<sup>1</sup>

This development reflects the increasing awareness that individual utility or well-being depends on economic and non-economic factors, whereby their value may vary across time, regions and individuals. Therefore, the construction of an overall utility indicator is an unresolved challenge at the national and regional level. The latter is of primer interest because regional development policy is a matter of public concern in the European Union and Germany, where the equalization of living conditions is a constitutional mandate(German Basic Law, 1949).<sup>2</sup> Further the publicly promoted adjustment and catching up of East Germany is a mayor political challenge after German unification.

In this respect Faggian et al. (2012) discuss the inference of regional utility from revealed preferences using interregional migration data. This application of Samuelson (1948) and Tiebout (1956) assumes utility maximizing location decision of individuals (households), which can be extended for firms’ profit maximizing location choice, and links positive net migration in a region to an utility advantage of this region (Faggian et al., 2012, p.167ff). However, the authors are rather interested in the single determinants of regional utility than the construction of general utility measure. They ask whether amenities like e.g. weather and landscape, so called non-economic factors, or economic factors like income and labor market condition determine migration in the US and Europe. In Partridge (2010) this question is presented as a ”duel” between new economic geography (NEG) in

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<sup>1</sup>Further information on the proposed extension of the official German welfare measurement, see German Bundestag (2013)

<sup>2</sup>The European Cohesion Policy has the objective to strengthen economic and social cohesion by reducing regional disparities and harmonized regional development. It is enshrined in the Treaty on the Functioning of the European Union.

the spirit of Krugman (1991) and amenity migration by Graves & Linneman (1979) and Graves (1980). Partridge (2010) and Faggian et al. (2012) find that the incidence of natural amenities explain interregional migration and local growth better than economic factors. For this reason the NEG model is rejected.<sup>3</sup> In contrast, a study of Chen & Rosenthal (2008) emphasizes the relevance of income and employment opportunities.

In the European case Faggian et al. (2012) find that economic factors are dominant determinants of migration decisions (regional utility differentials) which is in line with Cheshire & Magrini (2006) and empirical tests of NEG models in case of Germany, Spain, Italy, Netherlands and UK (Crozet, 2004) and in case of Spain (Paluzie et al., 2009). Though Rodríguez-Pose & Ketterer (2012) provide evidence of amenity-related migration besides important role of economic and sociodemographic factors.<sup>4</sup> These ambiguous results suggest that people like *nice regions* offering *plenty of job opportunities* (Partridge, 2010, p. 514). Hence, people are likely to trade amenities off for real income and unemployment risk as discussed in Wrede (2012), who extends the quality of life model (QoL) of Rosen (1979) and Roback (1982) by a search-matching model. This trade-off seems to be essential in case of migration decisions, too.

We consider the above findings that regional utility measured by migration rates depend on economic factors in some cases and non-economic ones in some other cases (countries or different studies) as a strength and precondition in regard to an overall utility measure. Consequently, omitting or incorrect measurement of some attributes of utility does not result in biased utility estimates here. This is a serious problem in aggregated quasi-objective QoL indexes<sup>5</sup> (Buettner & Ebertz, 2009; Douglas & Wall, 1993; Faggian et al., 2012) and

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<sup>3</sup>One should point out that these findings are motivated by descriptive evidence and a review of other studies. While hedonistic quality of life estimates (Albouy, 2008), migration studies (Partridge et al., 2012) and simulation studies of migration (Rappaport, 2009) provide some evidence in this direction, other studies of migration inter-metropolitan migration (Greenwood & Hunt, 1989) and theoretical analysis of Storper & Scott (2009) find the opposite.

<sup>4</sup>In principle, the authors apply an extended version of Greenwood et al. (1991)'s estimation approach to European data at Nuts1 and Nuts2 level which is derived by extension of Faggian et al. (2012)'s spatial equilibrium model of location choice. Greenwood et al. (1991) is the first attempt to determine a regional quality of life but no overall regional utility indicator using migration data, so far we know.

<sup>5</sup>The US Places Rated Almanac (Savageau, 2011) or German RegionalRanking (INSM, 2009) are examples of QoL indexes which are based on the weighted aggregation of different economic and sociode-

may cause endogeneity in hedonistic QoL rankings in the spirit of Rosen (1979) and Roback (1982). These hedonistic QoL estimates are also based on revealed preferences but assume a spatial equilibrium with full equalization of overall utility across regions which is unrealistic due to costly migration (Nakajima & Tabuchi, 2011, p. 50) and persistent nonzero net migration rates.

Given these shortcomings the derivation of regional utility estimates from migration data is a promising approach. One of the first migration based ranking of regions is developed by Greenwood et al. (1991) who estimates states' QoL of non-economic factors in the US but not the overall welfare which on average can be utilized by living in some state. Douglas & Wall (1993) present a non-parametric QoL index of Canadian provinces. Their pairwise comparison of regional cross migration rates is the advantage (Douglas & Wall, 1993, 235) in contrast to a comparison of aggregate net migration with the national average in Greenwood et al. (1991). Besides, their QoL index is an overall utility index, so called standard of living (Douglas, 1997, p. 412), but their index is not free of arbitrariness.<sup>6</sup> Further studies (Douglas, 1997; Wall & Douglas, 1999; Wall, 2001) combine non-parametric and parametric approaches or develop parametric estimators with respect to a discrete choice model, incorporate migration costs in the estimation, and decompose standard of living with respect to QoL (non-economic factors) and economic factors and apply it to the US, Canada and UK. Despite of its appeal migration based regional ranking were more or less ignored in the past.<sup>7</sup>

The recent paper of Nakajima & Tabuchi (2011) revives the approach of Greenwood, Douglas and Wall. Nakajima and Tabuchi estimate regional utility differentials directly by means of gross interregional migration utilizing a more operational model than their pre-mographic indicators of well-being and regional (dis)amenities. Another critic on these indexes is an unavoidable degree of arbitrariness or subjectivity in their construction (Buettner & Ebertz, 2009, p. 90).

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<sup>6</sup>Both authors apply a simple scoring rules, which adds +1 to a region's score if their is positive net-migration from some other region. The regions are ranked with respect to these score. This scoring rule is an arbitrary choice of the authors and the ranking is only ordinal.

<sup>7</sup>Possible reasons may be difficulties to account for migration costs (especially non-pecuniary costs), for a strong attachment to *home regions* which cause low migration rates notwithstanding large economic and non-economic differentials between regions, and mismatch of gross and net migration flows. Missing availability of data may be a problem, too.

decessor.<sup>8</sup> This approach is promising due to its robustness, which is demonstrated using Japanese, US, Canadian migration data, and simplicity given a sound theoretical foundation. Furthermore, their approach can be applied to other research questions involving a valuation of non-market goods. Avery et al. (2012) use independently a similar approach in order to rank US colleges and universities.

Therefore, we estimate relative utility differentials of German states and planning regions using the Nakajima and Tabuchi model (NT). As far we know, we are the first using such a migration based utility indicator in case of German regions. However, revealed preference rankings using hedonic QoL estimates (Buettner & Ebertz, 2009; Rusche, 2010; Wrede, 2012) are available and provide an informative basis but they assume a spatial equilibrium and are only available for single years due to data limitations. The NT approach allows us to analyze the development of regional utility differentials, thereby spatial convergence, and test whether the assumption of a spatial equilibrium is justified. Overall, our estimates show a strong correlation with other welfare and QoL indicators. We do not find evidence for regional convergence and spatial equilibrium assumption must be rejected. Regional utility estimates seems to vary with age but not sex or nationality (German versus Non-German). We also find trends in gross migration and utility differentials which seems to coincide with business cycles. This interrelation is discussed in Karr et al. (1987) and Saks & Wozniak (2011). Thus some kind of filtering besides year dummies may be necessary.

In the following we will review the NT model in detail and discuss some of its shortcomings and critical assumptions, thereby we will refer to some findings of chapter 2. Before we discuss our relative utility estimates for German states and planning regions, chapter 3 describes our data. Chapter 4 discusses our estimates and asks whether the assumption of an interregional equilibrium is justified given estimated utilities and possible compensating differentials. Finally, we conclude and asses the prospects of the NT approach given our results.

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<sup>8</sup>Their model incorporates stylized facts of Japanese migration patterns, which are the existence of migration costs, incongruity of “high’ gross migration to low net migration rates, and transitivity of net migration (Nakajima & Tabuchi, 2011, p. 32ff). These stylized facts holds for Germany, too.

## 2 Theory and Estimation - Review of the NT Ranking

### 2.1 Individual migration decisions and gross migration rates

In the following we introduce the gross migration regional ranking approach of Nakajima & Tabuchi (2011, p. 35ff.) and present its microeconomic foundation. We start with individual utility maximization a la *Voting with one's feet* by Tiebout (1956) modeled by a discrete choice model in order to account for heterogeneous preferences concerning regional characteristics like e.g. income chances, natural amenities and public good provision.<sup>9</sup> Given residence in origin  $i$ , on average an individual will migrate to some destination  $j$  if

$$U_j - c_{ij} = \max_k \{U_k - c_{ik}\}, k = 1, \dots, n.^{10} \quad (1)$$

Individuals chose that destination  $j$  from a set of  $N$  regions which provides the largest (expected) net utility after pecuniary costs and non-pecuniary migrations costs  $c_{ij}$  in the tradition of Sjaastad (1962, p. 83ff). Assuming  $c_{ii} = 0$  non-migration and migration within a region are treated in the same way that implies a strong supposition if we consider higher regional aggregation levels like states or East and West Germany. However, it is standard in the literature. The utility of an individual  $p$  in region  $j$  is

$$U_{jp} = u_j + \epsilon_{jp}.^{11} \quad (2)$$

Thus, a region's deterministic utility  $u_j$  is its average welfare whereas the idiosyncratic term  $\epsilon_{jp}$  integrates heterogeneous preferences that are iid. distributed across the population with zero mean (Nakajima & Tabuchi, 2011, p. 35). For example, a negative  $\epsilon_{jp}$  of a person  $p$  versus a positive  $\epsilon_{jo}$  of some person  $o$  correspond to taste differences with respect to the same set of regional characteristics. Consequently, person  $p$  is more footloose to region  $j$

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<sup>9</sup>Besides unobservable variation in individual utilities, such a random utility model allows for uncertainty to the user due to unobservable characteristics, measurements errors and a functional misspecification (Anderson et al., 1992, p.31ff.).

<sup>10</sup>For the most part our notation refers to Nakajima & Tabuchi (2011).

<sup>11</sup>We add the suffix  $p$  for individual to stress variation in perceived utility within one region  $j$  across the population. We will omit it in the consideration of gross migration flows and ranking because they refer to average utilities.

than person  $o$  for some given  $u_j$ . An individual's probability to migrate from region  $i$  to  $j$  can be defined as

$$P_{ij} = \frac{\exp(u_j - c_{ij})/\alpha}{\sum_{k=1}^n \exp(u_k - c_{ik})/\alpha}. \quad (3)$$

This multinomial logit model (ML) is derived by assuming that  $\epsilon_{jp}$  follows the same double exponential distribution for each individual and region. The parameter  $\alpha$  captures the degrees of regional heterogeneous preferences.<sup>12</sup> For higher degrees of this heterogeneity,  $\alpha \rightarrow \infty$ , all regions are chosen with matching probabilities because location choice depends less on average utility differentials net migration costs (UD) but more on heterogeneous preferences. However, for  $\alpha \rightarrow 0$  we have deterministic choices with respect to UD. Falck et al. (2012, p. 231) derive the same specification for migration probabilities within a gravity model of regional migration but they rather take  $\epsilon_{jp}$  as heterogeneity of the idiosyncratic shocks that refers to unobserved individual-specific regional features than  $\epsilon_{jp}$  as heterogeneity in regional preferences. Both approaches are legitimate but heterogeneous preferences seem more appropriate with respect to preference changes across life cycle (McAuley & Nutty, 1982; Evans, 1990; Goetzke & Rave, 2013) or gender- and educational-specific preferences (Schneider & Kubis, 2010; Kroehnert & Vollmer, 2012). The ML model requires the assumption of independence from irrelevant alternatives (IIA) (Anderson et al., 1992, p.45). The IIA property says that the relative probability of migration to regions  $j$  or  $k$  does not change if some region  $l$  enters or leaves the set of possible destinations (Dahlberg & Ekloef, 2003, p. 4). The possible violation of this may be attributed to individuals' inability to distinguish between some regions (Cushing & Cushing, 2007, p. 6ff) or the omitting of neighboring foreign regions given e.g. the European Freedom of Movement.

In principle, the IIA assumption can be tested by a Hausman-type specification test (Hausman & McFadden, 1984). Davies et al. (2001, p. 344) do not reject IIA property for U.S. states with respect to a conditional logit model (CL)<sup>13</sup>. In case of German counties and a

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<sup>12</sup>The double exponential distribution is given by  $F(x) = P(\epsilon_{jp}) = \exp[-\exp(\frac{-x}{\alpha-\gamma})]$  and  $\gamma \approx .05772$  where its mean is zero and its variance is  $\pi^2/6 \times \alpha^2 \approx 1.6649 \times \alpha^2$ . Hence the variance of  $\epsilon_{jp}$  and the degree of heterogeneity of preference is increasing in  $\alpha$ . (Anderson et al., 1992, p. 39ff)

<sup>13</sup>The shortcoming of the IIA assumption applies similarly to ML and CL models where the latter is generalization of the first (McFadden, 1973, p. 114)



grouped CL model Schneider & Kubis (2007) report that the IIA assumption is rejected but coefficients of different specifications are very similar. Dahlberg & Ekloef (2003) and Cushing & Cushing (2007) investigate the possibility of an erroneous IIA assumption by comparing CL with models relaxing the IIA requirement. They find statistical different but qualitatively comparable coefficients. Therefore and insomuch our approach focuses on fixed regional effect, whose inclusion is considered as remedy to IIA violation (Guimaraes et al., 2004, p. 7), and higher levels of aggregation (states and planning regions), the IIA assumption seems acceptable.

Given a "correct" specified individual probability of migration  $P_{ij}$ , the expected gross migration  $m_{ij}$  from  $i$  to  $j$  can be derived by a gravity equation

$$m_{ij} = L_i L_j P_{ij}, \text{ with } P_{ij} \text{ independent of } L_i, L_j \text{ and } i, j \in 1, \dots, n \quad (4)$$

where  $L_i(L_j)$  is the labor market size or total population of the origin (destination).<sup>14</sup>

This derivation of expected gross migration is unbiased with respect to the aggregation of regions (Nakajima & Tabuchi, 2011, p. 36). Given any utility level, omitting  $L_j$  favors large regions because large regions attract immigrants by many locations to move (Wall, 2001, p. 7-8) whereas omitting  $L_i$  positively biases utility estimates of small regions due to a lower number of potential emigrants.

Another question is the treatment of distance-related migration costs. It is indisputable that migration costs increase with distance (Schwartz, 1973; Greenwood, 1975) and corresponding empirical evidence for Germany is provided by Falck et al. (2012) and Schneider & Kubis (2010). Nevertheless, we prefer the omission of distance related migration costs for estimating regional utility levels and a formal motivation for this utilizing the ML model is provided by Nakajima & Tabuchi (2011, p. 36-39).

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<sup>14</sup>Nakajima & Tabuchi (2011, p. 36) emphasize that "  $P_{ij}$  is the probability when an individual in region  $i$  chooses region  $j$  if she receives equal *equal* opportunities with respect to, say a job offer or admission to a school." This "equal opportunities" refer to the notion that each destination is a set of locations to which an individual from origin  $i$  migrates with the same chance  $P_{ij}$  (Wall, 2001, p. 7). Likewise an origin is a set of locations of which each is occupied by an individual. The probability of emigration is equal across all these locations. Note, that Douglas (1997, p. 418ff.) derives this gravity-type model assuming a regional equilibrium that is  $u_i = u_j$ . In so far the proposed ranking approach may be biased in case of a serious regional disequilibrium and barriers to migration (Douglas, 1997, p. 422)

Consider the following thought experiment (Nakajima & Tabuchi, 2011, p. 36) of three same sized regions ( left, town and right) that are located at a line (one dimensional space), e.g. a city/metropolitan area  $t$  and its suburbs/periphery  $r$  and  $l$ . Assume that distance dependent migration costs are symmetric but distance from peripheral  $r$  to  $l$  are larger than between center  $t$  and periphery, thus  $c_{rt} = c_{tr} = c_{tl} = c_{lt} = c^*$  but  $c_{rl} = c_{lr} = c \gg c^*$ . Applying the standard concept of an interregional equilibrium including equivalent deterministic utilities across regions, we expect balanced gross migration/zero net migration between regions on average. But the incorporation of individual utility shocks and distance-related costs contradict this notion. There will be positive net migration to  $t$  because  $t$  is more attractive than  $l$  ( $r$ ) for individuals from  $r$  ( $l$ ) with respect to lower migration costs  $c^*$  and any realization of utility differentials (induced by shocks mentioned above). This case will hold true for any random utility model (RUM) of (2) without necessity of an explicit distribution assumption if idiosyncratic shocks  $\epsilon_j$  are iid.<sup>15</sup> Therefore, the basic identification of regional utility difference  $\text{sign}(\Delta(u_{ij}) = \text{sign}(u_i - u_j) \rightarrow \text{sign}(\Delta m_{ij}) = \text{sign}(m_{ji} - m_{ij})$  is flawed.

This rather self-evident identification approach refers to equation 3 and 4, which say that  $P_{ij} > P_{ji}$  if  $u_j > u_i$  and thus  $m_{ij} > m_{ji}$ . This holds for more general specifications of utility rankings (Douglas & Wall, 1993, p. 232). Nakajima & Tabuchi (2011, p. 33f.) call this relationship *payoff monotonicity* which requires transitivity of net migration flows in

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<sup>15</sup>This general property of RUMs results from choice probabilities being a function from differences of deterministic utilities and costs (Ben-Akiva & Lerman, 1985, p. 57). More formal, compare a individual in  $t$  and its migration probabilities to  $r$  and  $l$  using (2) that is in the first case

$$P_{tl} = Pr(U_l - c^* > U_t | U_l - c^* > U_r - c^*) = Pr(\epsilon_l - \epsilon_t > c^* | \epsilon_l > \epsilon_r)$$

and in the second case

$$P_{tr} = Pr(U_r - c^* > U_t | U_r - c^* > U_l - c^*) = Pr(\epsilon_r - \epsilon_t > c^* | \epsilon_r > \epsilon_l)$$

to someone in  $l$  moving to  $t$  and  $r$  with

$$P_{lt} = Pr(U_t - c^* > U_l | U_t - c^* > U_r - c) = Pr(\epsilon_l - \epsilon_t > c^* | \epsilon_l > \epsilon_r)$$

and otherwise

$$P_{lr} = Pr(U_r - c > U_l | U_r - c > U_l - c^*) = Pr(\epsilon_r - \epsilon_t > c^* | \epsilon_r > \epsilon_l).$$

Given iid. assumption, we have on  $\epsilon$ ,  $P_{tr} = P_{tl}$  but  $P_{lt} > P_{lt}$  due to  $c > c^*$  and  $P_{lt} > P_{tr}$  that means positive net migration to  $t$  despite of deterministic utility equivalence ( $u_t = u_l = u_r$ ).

order to construct a transitive regional utility ranking.<sup>16</sup> But this identification strategy works only fine in case of two regions, in a system of more regions we must accurately control for distance related migration costs, that can be impossible due to missing direct observability (Bayer et al., 2009, p. 4) and a possible correlation with regional utilities by market potential (Nakajima & Tabuchi, 2011, p. 37). For all these reasons, we follow the eliminate migration costs in the model as shown by Nakajima & Tabuchi (2011).

## 2.2 Regional utilities and their ranking

In principle, an estimation equation can directly utilize eq. 4 which relates observed gross migration rates to unknown regional utilities and migration costs. Similar estimators are used by e.g. Falck et al. (2012) and Wall (2001). These authors take account of migration costs by indicators like e.g. distance measure or proxies of cultural distances. Whereas Greenwood et al. (1991) simply ignore migration costs, Nakajima & Tabuchi (2011, p.38) assumes that  $c_{ij} = \hat{c}$ , which is independence of distances, and  $c_{ii} \ll \hat{c} \forall i \neq j$  and approximate eq. 4 with

$$\begin{aligned}
 m_{ij} &= L_i L_j \frac{\exp(u_j - c_{ij})/a}{\exp(u_i - c_{ii})/a + \sum_{k \neq i} \exp(u_k - c_{ik})/a} \\
 &\approx L_i L_j \frac{\exp u_j/a}{\exp(u_i + c')/a} \\
 \text{and } c' &= -c_{ii} + c_{ij} \forall i \neq j.
 \end{aligned} \tag{5}$$

The last term of the denominator in the first line cancels out because it can be assumed to be small in regard of clear empirical evidence that migration is a rare event in an individual's life.<sup>17</sup> A potential bias in estimations is an overestimation of an origin's utility  $u_i$  relative to a destination's  $u_j$  which increases for lower level of regional utility.<sup>18</sup> In a

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<sup>16</sup>For any combination of regions  $i, j, k \in n$  the transitivity of the deterministic regional utilities like an ordering  $u_i > u_j > u_k$  coincides with  $\Delta m_{ji} > 0, \Delta m_{jk} > 0$  and  $\Delta m_{ik} > 0$ . Therefore we can test to some degree the model's appropriateness by checking the transitivity of net migration flows in the data.

<sup>17</sup>E.g. only 2.9% of the population migrate on average between Japanese prefectures (Nakajima & Tabuchi, 2011, p. 1.1) and intercounty migration amounts to 3.1 % of German population in 2009.

<sup>18</sup>If we knew  $m_{ij}, c', L_i$  and  $L_j \forall i, j$ , we could identify  $u_i$  and  $u_j$  by rearranging eq. 6

$$\frac{m_{ij}}{L_i L_j} = \frac{\exp u_j/a}{\exp(u_i + c')/a} \text{ but the "true" specification given eq. 5 is}$$

next step  $c'$  and also  $L_i$  are eliminated and equation 5 is linearized by

$$\ln \frac{m_{ij}}{m_{ji}} = 2(u_j - u_i)/a \quad (6)$$

Considering the last steps, we can relax the assumption of distance-independent migration costs (Nakajima & Tabuchi, 2011, p. 37). It is sufficient to assume  $c_{ij} = c_{ji}$  which seems to be more realistic and is in line with Wall (2001). An argument in favor of the stricter assumption may concern the approximation in eq. 5. Possible approximation biases are less serious if differences in the denominator of origins in eq. 4 are restricted to exchange of utilities in first and second term but not to different migration costs. A direct application of eq. 6 for estimating absolute regional utilities by linear regressions is impossible due to perfect collinearity. Nakajima & Tabuchi (2011, p. 39) derive a parametric estimator of relative regional utilities using eq. 6 as remedy for this. The final NT-ranking is based on these relative utility estimates which are without harm to the ranking but restricts the analysis of utility differences.

One appeal of eq. 6, the base of the NT Ranking, is its robustness with respect to aggregation bias of regions and simplicity in contrast to former utility estimators (Nakajima & Tabuchi, 2011, p. 38). The *price* is rather the assumption of an explicit distribution for the individual probability of migration in eq. 3 than the approximations in eq. 5. The former contributions in this field avoid such a structural assumption that might be favorably. However, the respective regional utilities have a pure ordinal interpretation (Wall, 2001, p. 8) which is justified for non-parametric rankings in Douglas & Wall (1993) and Douglas (1997). In case of the parametric rankings of Wall & Douglas (1999) and Wall (2001) an inconsistency between the ordinal theoretical model and the parametric ranking results from its empirical specification. The parametric NT-ranking is in turn not restricted to an ordinal interpretation and thus allows us to analyze the (relative) size of regional disparities. This property is a substantial advantage and allows simple convergence analysis.

Since the utilities  $u_i$  correspond to no natural units (Douglas, 1997, p. 420), their inter-

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$$\frac{m_{ij}}{L_i L_j} = \frac{\exp u_j/a}{\exp(u_i+c')/a + \sum_{k \neq i} \exp(u_k - 2\hat{c})/a} \text{ using } c_{ij} = \hat{c} \ \forall \ i \neq j.$$

Hence for the absent term for alternative destinations the numerator has to decrease or the denominator to increase in 4, which corresponds to up-/downward bias in  $u_i/u_j$ . Since the second term of 5's denominator is larger for regions with a lower utilities, their estimates are more biased.

pretation depends on the effect of utility differences on respective outcome measures like prices in hedonic models or the ratio of migration flows in our case. Whereas a hedonic valuation, a price of  $u_i$ , is meaningful on its own<sup>19</sup>, the interpretation of eq. 6 that an one unit increase of  $u_j$  for a constant  $u_i$  increases the ratio  $m_{ij}/m_{ji}$  by  $\exp(2/a)$  percent is ambiguous.<sup>20</sup> For this reason one might argue that the NT Ranking converges to a ranking of net migration rates controlling for regional size like Greenwood et al. (1991) and that it is tautological because gross migration ratios are explained by gross migrations ratios using a regional fixed effect without adding further information. Despite of a possible high correlation between such rankings (Douglas, 1997, p. 429), the NT Ranking utilizes information on pairwise relations of regions which is otherwise ignored. Consequently, the first argument is false. The criticism of tautology is basically true but beyond that the microeconomic foundation of Nakajima & Tabuchi (2011) above motivates suitability for utility measurement. Furthermore, we can establish relations between (relative) utility differences and disparities in e.g. amenities, income or labor market performance of regions by theory.

### 2.3 Regional Disparities and Spatial Equilibrium

The relative utility estimates derived from eq. 6 can be used in further analysis besides a regional ranking. One interesting question that is not explored in detail is the explanation of the estimated regional disparities using income changes, labor market conditions, differences in taxes or public good provision and single regional (dis-)amenities and hedonic valuations of these determinants of utility. Some recent papers like Bayer et al. (2009) and Sinha & Cropper (2013) estimate locational choice model in order to identify marginal value of climate as rate of substitution between real wages and climate.<sup>21</sup>

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<sup>19</sup>Unfortunately, as mentioned these approaches are disputable due to missing data and a set of an unrealistic assumptions (Wall, 2001).

<sup>20</sup>We can neither identify  $a$  in our estimation nor say that migration from  $i$  to  $j$  increases or decreases from  $j$  to  $i$ . Therefore the effect of an utility difference has no direct economic interpretation in absolute or relative terms.

<sup>21</sup>We are neither interested in the valuation of a single amenity nor we can offer a superior solution with respect to a correct choice of determinants of utility or functional form of the utility function. Such specifications are often rather ad hoc (Nakajima & Tabuchi, 2011, p. 39) and depend on data availability.

However, we focus on the development of regional disparities over time. It is of special interest whether these decrease or not and what we can say about validity of a neoclassical spatial equilibrium assumption or ongoing agglomeration with respect to e.g. models of new economic geography in Fujita et al. (2001), selective migration and externalities (Paluchowski, 2011). Our analysis must bear in mind that migration not only represents utility difference but may also drive them.<sup>22</sup> For example, Huber & Tondl (2012) provide evidence of positive effect of immigration on regional GDP per capita growth of European Nuts2 region but not on convergence, Kubis & Schneider (2009) discuss similar findings for German counties, and Niebuhr et al. (2012) find a convergence of regional unemployment due to interregional migration. Since such studies are partial analyzes and do not consider overall utility, they do not allow conclusions on the development on regional utility/standard of living defined in eq. 2.

Traditional economic convergence analysis examines the growth of GDP per capita at the cross-country or the regional level with help of absolute and conditional  $\beta$ -convergence. These analyzes are based on the Solow Growth model and its extension in e.g. Mankiw et al. (1992).<sup>23</sup> Although it would be interesting to apply this approaches using individual utility estimates and also justified to some extent by assuming a spatial equilibrium model like e.g. Faggian et al. (2012, p. 167ff), our restriction on relative estimates of regional utility render this impossible. Instead we can examine the convergence of utilities using the standard deviation of relative utilities and test whether the dispersion of regional utilities increase or decreases over the years using linear regressions with a trend variable (Nakajima & Tabuchi, 2011, p. 40). The shortcoming of this approach is that we distinguish between a decline in utility disparities due to utility increase in disadvantaged regions versus a utility decrease in advantaged regions in absolute terms. In principle, this approach

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Interested readers can find a discussion of possible attributes for German counties in Buettner & Ebertz (2009).

<sup>22</sup>As long as we assume that individuals anticipate on average correctly the influence of their own and other people's migration decisions on regional utility, this is without consequences. Otherwise we should interpret our utility estimates in terms of an average perceived or expected utility which may deviate from finally realized utilities in the spirit of Harris & Todaro (1970).

<sup>23</sup>A detailed discussion of regional convergence analysis can be found in Eckey et al. (2007, p. 48ff) or a detailed overview in Barro & Sala-i-Martin (2003).

corresponds to the concept of  $\sigma$ -convergence for GDP per capita in Barro & Sala-i-Martin (1991, p. 112). In addition, nonparametric techniques, so-called distribution dynamics, might be used to examine how the regional utilities evolve over time. A respective analysis for regional GDP convergence is conducted by Juessen (2009) and find substantial convergence during 1992-2004.<sup>24</sup>

Besides the discussed new insides in the convergence of German regions, relative utility estimates can be used to test the existence of a spatial equilibrium. Originally purposed by Greenwood et al. (1991, p. 1385ff), such tests are conducted in studies of Douglas, Wall, Tabuchi and Nakajima. Assuming a neoclassical spatial equilibrium model in the spirit of Roback (1982) and described by Faggian et al. (2012) or Rodríguez-Pose & Ketterer (2012) in terms of a locational choice model, we expect the deterministic regional utility  $u_j$  of eq. 2 in all  $n$  regions to be

$$u_j = u_i = u^* \forall i, j \in 1 \dots n. \quad (7)$$

Since we do not specify a detailed utility function in eq. 2 we now extend this to

$$\begin{aligned} U_{jp} &= u_j(I_j, R_j) + \epsilon_{jp} \text{ for an individual } p \\ \text{and } E(U_{jp}) &= u_j(I_j, R_j) \text{ with } E(\epsilon_{jp}) = 0. \end{aligned} \quad (8)$$

In this simple specification  $I_j$  is the real income of individual in region  $j$  and  $R_j$  aggregates all other regional attributes that contribute to  $u_j$ . The regional utility  $u_j$  corresponds to an indirect utility function of an average individual (Faggian et al., 2012, p. 167). Basic properties of  $u_j$  are  $\frac{\partial u_j}{\partial I_j} > 0$  and  $\frac{\partial u_j}{\partial R_j} > 0$ . The latter assumes  $R_j$  increasing (decreasing) in attributes with a positive (negative) effect on utility. Further  $R_j$  is assumed to be time-invariant, which holds for short periods, thus regional disparities in  $R_j$  must be compensated by real income differences in a spatial equilibrium (Roback, 1982, p. 1260). Using eq. 7 and differentials from eq. 8, the compensating income of region  $j$  is given by

$$I_j^* = \frac{u^* - \partial u / \partial R \times R_j}{\partial u / \partial I} \quad (9)$$

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<sup>24</sup>A respective analysis of the estimated relative utilities is missing so far, but seems a valuable extension of Nakajima & Tabuchi (2011). Sensible results are rather expected for planning regions than states with respect to observation size.

where additive separability and constant marginal utilities are assumed for simplicity.<sup>25</sup> Having relative utility estimates with respect to eq. 6 and data on regional income, we can estimate marginal utilities and calculate  $I_j^*$ . The spatial equilibrium assumption is by comparing  $I_j^*$  and actual income  $I_j$ . Possible test-statistics are a  $\chi^2$  contingency-test (Greenwood et al., 1991), t-test with a  $H_0 : I_j^* = I_j$  or the correlation of  $I_j^*$  (Wall & Douglas, 1999) and  $I_j$  (Nakajima & Tabuchi, 2011). The power of these tests is limited due to the former simplifications and omission of e.g. the housing market which excludes unconditional rejections of spatial equilibrium (Nakajima & Tabuchi, 2011, p. 44).

### 3 Data and descriptive results of interregional migration in Germany

The main data source is the county migration statistics (Kreiswanderungsstatistik) of the German statistical office between 1991-2009 that are gross migration flows between each possible pair of German counties per year and different age groups. In addition, we can separate between German or Non-German and sex after 2000.<sup>26</sup> We aggregate county data at the level of 97 German planning regions of 2006,<sup>27</sup> which can be treated as regional labor markets, and 16 federal states. The state data can be extended to 2010 for sex and nationality but not for age-groups using the data of German Statistical Office (2012). We do not consider counties as regional unit because we find zero migration flows in one or both directions for many country pairs. In these cases eq. 6 is not defined.<sup>28</sup> Besides, a possible bias of our utilities due to spatial autocorrelation or the omission of migration costs should be less severe for states or planning regions. While we can examine states for

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<sup>25</sup>These assumptions are appropriate for small variations of  $I$  and  $R$  and correspond to the empirical approach in chapter 4.

<sup>26</sup>This data is only available at request from the German Statistical Office.

<sup>27</sup>The Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) defines these spatial planning areas with respect to interregional commuting and guidelines of the states. The actual definition of 2009 cannot be used because county data does not correspond to it before 2007. For further details, see BBSR (2013).

<sup>28</sup>For example, 27,78% of all country pairs have only migration in one direction and in addition 14,96% of country pairs have no migration in 2001. Other years are similar.



the full period 1991-2010, analysis of planning regions are restricted to the period 1996 - 2005 due to several amalgamations of counties in East Germany. Given that our data is based on the official population register<sup>29</sup>, its quality is rather high.

One problem is the special status of the municipality Friedland in the county *Göttingen* from where many ethnic Germans of the former UDSSR after arriving in Germany were distributed across the country. The official migration statistic is not adjusted for these migration movement. The potential bias might be small in case of interstate migration, but in case of planning regions we decided to exclude the county *Göttingen* for our analysis. Generally, the German population is considered to be less interregional mobile than the US or British population but comparable mobile than the EU average (Bonin et al., 2008, p. 28ff). Especially, low skilled worker lack in mobility (Arntz, 2011, p. 137). Figure 1 shows the total gross and net migration of total population for interstate, inter-planning region and intercounty migration. Not surprisingly, gross and net migration rates decrease with higher aggregation levels which can be explained by higher migration costs and a higher likelihood of pure residential changes at the county level versus simultaneous changes of residence and job at planning region or state level.

*Figure 1 about here*

Gross migration rates are rather constant across time with the exemption of the decline after 2000 at the county level. The increase of planning regions gross migration rates between 1991 - 1996 is an artifact due to an imperfect matching of East German counties and planning regions. The declining trend of net migration volumes after 2001/2002 refers to peak of the second wave of East-West German emigration which started 1997(Uhlig, 2008, p. 520). Given total German population, the annual average probability to migrate between states is 1.3% and only slightly higher for planning regions and counties that is comparable with 1.1% for US states (Nakajima & Tabuchi, 2011, p. 33).

*Table 1 about here*

In addition, the small ratio of net to gross migration, 13-24% depending on the aggregation level, suggests that amongst other heterogeneous preferences and individual life-cycle

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<sup>29</sup>German states register laws demand to notice one's change of residence at the new residence's registry office (Melderechtsrahmengesetz (MRRG), 1980)

determine migration decisions. Thus  $a$ , which is introduced as determinant of the idiosyncratic attachments to regions in eq. 3, is rather high. Again, this finding is in line with the results for the US or Japan of Nakajima & Tabuchi (2011). Nevertheless, the considerable size of annual net migration flows and the persistence of their directions, in particular from East to the West, over time suggests the existence of considerable difference in standard of living between German region.

*Figure 2 about here*

Figure 2 demonstrates that Southern German states are preferred destinations which may especially reflect their attractive labor markets. After a balanced in and out migration in the last decade, Northern German and city states seems to be more attractive while net migrations of central German West states like Hessian are decreasing. As mentioned before the emigration from East Germany is a prevailing feature of interregional migration.

*Figure 3 about here*

The comparison of states and planning regions in figure using net-migration between 1996 to 2005 with respect to population in 1996 shows that the gains and losses are considerable. Besides, we find winners and losers of interregional migration also within states and relative population changes are more pronounced at lower regional level given a maximum gain of 11.86% compared to 3.81%. Overall the analysis of both aggregation level seems promising, but the analysis for planning regions are restricted by the relative short time period of 10 years. For this reason, our focus is at the state level.

The available data allows to check whether aggregated interregional migration flows fulfill *payoff monotonicity* discussed in chapter 2.1. Therefore, we checked the transitivity condition for all possible combinations of three regions<sup>30</sup> with  $i \neq j \neq k$  using the sign of the net migration flows  $\Delta m_{ij}$ ,  $\Delta m_{ki}$  and  $\Delta m_{kj}$ . If we observe that  $\Delta m_{ij} > 0$  and  $\Delta m_{jk} > 0$  but  $\Delta m_{ik} < 0$ , the transitivity of migration flows and thus the transitivity of aggregate utility preferences  $u_i$  will not hold in this case. To a limited degree intransitives are possible due to measurement errors, imperfect information of migrants, randomness of migration in a spatial equilibrium and heterogeneity in preference that is not captured by  $a$  in eq. 3, (Douglas, 1997, p. 422f) and as mentioned distance-related migration costs.

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<sup>30</sup>The number of possible 3-combination is 560 (147440) for states (planning regions) per year.

*Table 2 about here*

The violation of the transitivity is limited. For states it is on average between 6% and 10% for planning regions. Again this finding is comparable with results of Nakajima & Tabuchi (2011) The lower degree of validity of transitivity at the level of planning regions can be explained by e.g. the higher relevance differences in distance-related migrations costs or measurement errors whose distortion effect is large for small migration flows. We also find that the degree of intransitivity is larger for West German planning regions (not reported here). One possible explanation is the randomness of migration for more similar regions. Altogether, these findings do not suggest that intransitivity in migration imposes a problem for our ranking.

Further data used in the next section encompasses information on gross domestic product (GDPCAP), primary and disposable income (PINCCAP & (DISPINCCAP) per capita and gross wage per employee (GWEMP). These data is taken from the National Accounts of States (Volkswirtschaftliche Gesamtrechnung der Länder (VGRdL), 2013) using the revision of 2011 and WZ2003. <sup>31</sup> In addition, we use data from the German Statistical Offices from Genesis-Online (2013) to take account of unemployment rates (UnempEMP) and inflation at the state level<sup>32</sup> in robustness checks. Some descriptive statistics at the level of German states are given in table 3. With respect to planning regions the regional disparities are significantly larger (not reported here).

*Table 3 about here*

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<sup>31</sup>The latest date revision of February 2013 using WS 2008 is not used for comparability reasons.

<sup>32</sup>Since some states do not provide an own inflation rates and no official data is publicly available before 1995, we included states' inflation rates calculated by the RWI Essen (Forschungsdatenzentrum Ruhr am RWI, 2013). We checked this data as far as possible by requests to the states' statistical offices.

## 4 Discussion of results

### 4.1 Estimation of regional utilities

Regional utilities of eq. 6 can only be estimated in relative terms due to perfect multicollinearity with help of the estimation equation of Nakajima & Tabuchi (2011, p.39):

$$\ln \frac{m_{ij}}{m_{ji}} = \sum_{k=2}^n b_k D_k + \epsilon_{ij} \quad (10)$$

and  $D_k = 1$  if  $k = j$ ,  $D_k = -1$  if  $k = i$  and otherwise  $D_k = 0$ .

Besides the left hand side and the omission of income differential, this estimation approach is similar to Wall (2001). Since one region dummy  $D_1$  for some region<sup>33</sup> must be omitted in eq. 10, we have  $b_k = (u_k - u_1)2/a$  which estimated by separate OLS regressions for each single year without a constant. Table 4 reports average results for estimated  $b$  for the total sample of states between 1991-2010.<sup>34</sup>

*Table 4 about here*

Overall, the results are comparable to estimates of Nakajima & Tabuchi (2011) with respect to US, Japan or Canada in regard of explanatory power, size and significance. Furthermore, the general high significance of the estimates and the explanatory power increases after 2000. Given the estimate  $b_k$ , we can construct our ranking of states where Bavaria is at the top and Saxony-Anhalt at the bottom. Beyond that it is rather impossible to interpret any  $b_j$ , because an interpretation not only depends on  $a, b_i$  and  $u_1$  of the omitted region. We also report exemplarily the results for different age-groups in 2000 at the state level in table 5.

*Table 5 about here*

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<sup>33</sup>The regional ranking and all other further analysis does not change in regard of the omitted region. We omit Schleswig-Holstein in case of state level analysis

<sup>34</sup>Many studies exclude the first years after unification because of the effects related to the transition of East Germany. Given separate estimations for  $b$  for each year, there is no need to restrict the sample period at this step.

These estimated coefficients demonstrate that the evaluation of regional utilities varies, across age groups and the estimations perform better for working-age population with respect to the adjusted  $R^2$ . The results also reflect the low mobility of older workers/pensioners and the relevance of job chances. These findings are in line with the results of Schneider & Kubis (2010). Therefore, we can say that the assumption of  $a$  to be equal for individuals is disputable. Nevertheless, the correlations of utilities between total population and all age groups with exception of people above 50 are strong. At least about 0.89 for people below 50 but only 0.28 for people above 65(Pens).

The results for planning regions are comparable but have considerable lower explanatory power. Between 1996 and 2005 the average adjusted  $R^2$  is 0.56 and estimated  $b$  have a similar variance of 0.004. The coefficients are highly significant on average (detailed results can be delivered on request), too. Figure 4 illustrates the estimates for the total population and age-group above 65 (Pens) in 2000 with help of map.

*Figure 4 about here*

The considerable different distribution of blue planning regions for total population and pensioners corresponds to the results for states. Furthermore, both maps provide evidence of within state variation of regional utilities which corresponds to regional difference in income, labor markets and non-market amenities.

## 4.2 Standardized Utilities, Spatial Convergence and Equilibrium

Nakajima & Tabuchi (2011, p.40) propose a standardization of the estimated  $b$  in order to examine the development of regional utilities over time. Their so called standardized utility which does not depend on the omitted region in eq. 10 but on the annual average coefficient  $b$  with  $\bar{b} = \frac{1}{n} \sum_k^n b_k$  defined as:

$$\hat{u}_j \equiv (u_j - \bar{u})2/a = (u_j - \frac{1}{n} \sum_{k=1}^n u_k)2/a = b_j - \bar{b}. \quad (11)$$

We determine  $\hat{u}_j$  for e.g. each state and consider the change of relative utility in figure 5.<sup>35</sup>

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<sup>35</sup>We want to acknowledge that relative utilities are determined as multiple of  $2/a$ . We ignore this in the following analysis and assume  $a/2 = 1$  for simplicity.

*Figure 5 about here*

The development of states' utility does not provide clear evidence for some overall trend with exemption of East German states. Their relative utility disadvantage compared to West German states has substantially decreased today. The exemption is a temporary utility decrease that corresponds to second wave of East German out-migration. For this reason, we see the need in future work to control whether relative utility increase of East German states is due to a decrease of potential migrants. Furthermore, figure 5 shows that some regions like Rhineland-Palatinate have lost considerable in relative terms whereas e.g. Schleswig-Holstein starting at the bottom is at the top today. The NT Ranking identifies considerable variation in regional across time and between states or respectively planning regions. For the latter, we omit detailed results here.

In the following we consider the question of regional convergence and not the performance of single regions. As discussed in chapter 2 and suggested by Nakajima & Tabuchi (2011) we use the standard deviation of  $\hat{u}_i$  that is the so called UD Index:

$$UD \equiv \sqrt{\frac{1}{n} \sum_{k=1}^n (u_i - \bar{u})^2} = \sqrt{\frac{1}{n} \sum_{k=1}^n (b_i - \bar{b})^2} \quad \text{for } 2/a = 1. \quad (12)$$

We find no clear trend in  $UD$  for German states and planning regions which corresponds to our former findings. Neither we find no evidence for dis-/convergence using figure 6 nor by as simple linear regression of  $UD$  with respect to a trend variable.

*Figure 6 about here*

Although figure 6 suggests a strong decrease in regional disparities between 1991 and 2010, the volatility of  $UD$  is very considerable between 1995 - 2010. The strong convergence from 1991 to 1994 can be regarded as an one-time effect of reunification due to large transfers to East Germany and a jump of east German wages (Uhlig, 2008, p.518f). This result differs from convergence studies in regard of GDP per capita like Juessen (2009) but are in line with Eckey et al. (2007) who predict a persisting gap between north and south Germany. However, the comparability of these studies is limited due to different time periods. Inasmuch we find no regional convergence, we ask whether we can reject the existence of a

spatial equilibrium. While modern growth theory supports different steady states of output/productivity (GDP) per capita in equilibrium, neoclassical spatial equilibrium theory with migration predicts the equalization of utilities across regions. Given our discussion in chapter 2, we follow Nakajima & Tabuchi (2011, p.43f) and determine compensating differentials  $I^*$  of eq. 9 by estimating

$$u_{jt} = \beta I_{jt} + \sum_{k=2}^n \gamma_k R_k + \sum_{t=t_1}^{t_2} \delta_t Y_t + e_{jt} \text{ for } j = 1, \dots, n \text{ and } t = t_1, \dots, t_2 \quad (13)$$

and calculate

$$I_{jt}^* = \frac{1}{\hat{\beta}} \left( \sum_{k=1}^n \frac{\hat{u}_{kt}}{n} - \hat{\gamma}_j R_j - \hat{\delta}_t Y_t \right) \text{ for } t = t_1, \dots, t_2. \quad (14)$$

We use the log of real GDP per capita<sup>36</sup> as proxy of income  $I_{jt}$ ,  $R_j$  is the regional fixed effect and the time dummies  $Y_t$  control for the business cycle. Our results for states do not provide any conclusive evidence because  $\hat{\beta}$  changes sign for different time periods and is rarely significant. We think the low number of observations and explanatory power of regional and time fixed effects may be the reason. Table 6 reports the results in column 2 for eq. 13 and GDP per capita. The positive sign of  $\hat{\beta}$  has the expected direction, is highly significant but adjusted  $R^2$  hardly changes compared to an regression using only regional and time fixed effects in column 1.

*Table 6 about here*

Our comparisons of  $I_{jt}^*$  to  $I_{jt}$  do not provide evidence for a positive, but a negative correlation of -0.72, thus we reject existence of an spatial equilibrium for German region. Generally, the finding of a spatial disequilibrium is not surprising given the German reunification and observed persistence of migration patterns. Besides, the studies of Greenwood et al. (1991), Wall & Douglas (1999), Wall (2001) and Nakajima & Tabuchi (2011) reject a spatial equilibrium for the US, UK, Japan and Canada. Thus the neoclassical spatial equilibrium model is disputable.

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<sup>36</sup>We deflate nominal values using states inflation rates but results do not qualitatively change using the federal price index.

### 4.3 Robustness

We performed several analysis to check the robustness of our analysis that are not reported in detail here. We estimated utility differentials separately for male and females, and German and Foreigners. The results do not change qualitatively and the rankings are strongly correlated. We also compared our regional rankings with other standard of living rankings like the quality of life ranking of Buettner & Ebertz (2009). The respective correlations are about 0.7 and significant.

Furthermore, we checked the relationship between our standardized regional utilities and other economic outcome variables. Table 6 reports the respective results. We find that the coefficients of further income proxies like gross wages and the regional labor market conditions using unemployment rates have the expected sign and are significant. The spatial equilibrium assumption is also rejected for these variables.

## 5 Conclusion

Our results provide evidence that it is possible to rank German regions using migration data in a sensible way. The presented results are first steps in ongoing evaluation of this utility measures. There some open questions that need to be considered in detail like the rather strong assumption of an identical  $a$  across the population. The dependency of utility estimates with respect to age-groups contradicts this assumption. Furthermore, it is necessary to explore the determinants of relative utilities in more detail. Albeit this includes more or less ad hoc specification of relevant variables. Migration based utility estimates are a promising approach at the regional level because migration data is measured at the level of municipalities whereas other standard of living indicators like GDP per capita are often imputed at lower regional levels. Furthermore, comparable income or GDP data is often not available for longer time periods due to changing imputation methods. Migration data is free of this problem. And what is a better indicator of overall regional satisfaction than individuals decision to stay or move? In principle, every kind of migration costs can be considered as forgone utility of staying at home and from this perspective mobility is costless and not impeded in any way.



## A Tables

Table 1: Descriptive statistics for interregional migration

<b>Variable</b>	<b>mean</b>	<b>sd</b>	<b>min</b>	<b>max</b>
<i>States from 1991 - 2010 (annual averages)</i>				
Gross Migration	1047536	25976.95	995128	1092230
Net Migration	138875.3	40405.64	82098	263393
Net to Gross Migration	.1322556	.036315	.0773077	.2411516
Gross Migration to Population	.0127834	.0003411	.0122345	.0136062
<i>Planning Regions from 1996 - 2009 (annual averages)</i>				
Gross Migration	1753997	29818.59	1703438	1793138
Net Migration	265769.9	55544.37	190545	333147
Net to Gross Migration	.1513518	.0304962	.1069899	.1869732
Gross Migration to Population	.0213248	.0003975	.0206633	.0218669
<i>Counties from 1991 - 2009 (annual averages)</i>				
Gross Migration	2614940	77267.34	2476827	2702816
Net Migration	631896.6	113999.6	441251	777526
Net to Gross Migration	.2412007	.0409023	.1718111	.297227
Gross Migration to Population	.0319037	.0008768	.0303477	.0329514

*Source:* Own calculations for data of German Statistical Office (2012).

Table 2: Validity of transitivity for migration flows

<b>Year</b>	<b>States<sup>1</sup></b>	<b>Planning Regions<sup>1</sup></b>
1991	96.4	.
1992	93.4	.
1993	96.6	.
1994	89.3	.
1995	90.0	.
1996	91.8	87.4
1997	89.1	86.8
1998	91.8	89.8
1999	93.6	90.6
2000	94.6	91.4
2001	95.7	92.4
2002	94.5	91.4
2003	93.9	90.1
2004	95.5	89.4
2005	95.2	89.5
2006	97.0	.
2007	95.4	.
2008	96.1	.
2009	96.8	.
2010	94.6	.
Avg.	94.1	89.9

Share of non-violated transitivity conditions in %.

*Source:* Own calculations.

Table 3: Descriptive statistics for income and other controls in 1991-2010

Variable	mean	sd	min	max
Gross Domestic Product <sup>1,2</sup>	26688.3	5589.287	9921.378	46400.97
Primary Income <sup>1,2</sup>	20026.56	3408.197	9911.987	27566.34
Disposable Income <sup>1,2</sup>	17228.95	2006.641	10417.45	22923.81
Gross Wages <sup>2</sup>	26611.4	2960.88	16185.7	32373.58
Unemployment rate <sup>2,3</sup>	11.37%	6.47%	3.46%	45.72 <sup>4</sup> %

<sup>1</sup> Data in Euro per capita; <sup>2</sup> Summary statistics using population weights;

<sup>3</sup> Unemployment rates corresponds to the ratio registered unemployed persons to all employees

<sup>4</sup> This high value relates to an error in the original data for Berlin

*Source:* Volkswirtschaftliche Gesamtrechnung der Länder (VGRdL) (2013) and Genesis-Online (2013)

Table 4: Average estimation results German States 1991-2010

	States							
	SH	HH	NS	BBH	NRW	H	RP	BW
<b>Coeff. <i>b</i></b>	.	.237	-.012	.0.079	-.005	.054	.100	.081
	BY	SL	B	BB	MVP	S	SA	T
<b>Coeff. <i>b</i></b>	.195	-.180	.011	-.0.491	-.405	-.375	-.575	-.417
Obs.=120 per year; Adj. $R^2$ =.76; Variance of $b$ =.005 (SD of $b$ =.071)								

*Note:* Estimated coefficients are on average highly significant with  $p = 0.001$ .

Table 5: Coefficient  $b$  of states in 2000 for various age-groups

State	above 65	51-65	31-50	26-30	19-25	0-18	All
Schleswig-Holstein	.	.	.	.	.	.	.
Hamburg	-.5786	-.5378	.0787	.53	.6652	.0067	.216
Niedersachsen	-.2062	-.199	-.1526	-.0842	-.1655	-.1658	-.1576
Bremen	-.3936	-.2944	-.1355	.2016	.1304	.0142	-.0324
Nordrhein-Westfalen	-.5438	-.4392	-.0736	.1697	.0958	.0115	-.0618
Hessen	-.4753	-.4487	.0174	.3087	.1257	-.0504	.003
Rheinland-Pfalz	-.0474	-.0288	.0659	.0115	.103	.0947	.0381
Baden-Württemberg	-.1471	-.1427	.1646	.2713	.2284	.1546	.1386
Bayern	.0551	.1353	.2966	.3752	.3331	.2479	.2748
Saarland	-.3587	-.1037	-.3151	-.3317	-.0487	-.1532	-.2446
Berlin	-.1199	-.3927	-.1667	.4471	.412	-.3617	-.0071
Brandenburg	.2012	-.3133	-.5333	-.4733	-.9046	-.6804	-.5956
Mecklenburg-Vorpommern	.1292	-.1109	-.4978	-.46	-.8065	-.7215	-.5793
Sachsen	-.0152	-.4768	-.5683	-.3852	-.6558	-.8119	-.5906
Sachsen-Anhalt	-.5312	-.6722	-.8296	-.7215	-1.0015	-.9763	-.8857
Thüringen	-.1405	-.4832	-.5637	-.4415	-.6736	-.7364	-.6005
<i>Further regression statistics</i>							
Variance of $\hat{b}$	.0202	.0124	.0072	.0076	.0053	.0118	.0058
Adj. $R^2$	.3986	.4758	.772	.8273	.9242	.7618	.8353

*Note:* 120 observations given by 2-combination with 16 states

Estimated coefficients are on average highly significant with  $p = 0.001$

Table 6: Utility Explained by regional economics outcome

Dep. Var.	(1)	(2)	(3)	(4)	(5)	(6)
	No $I_{jt}$	GDPCAP	UnempEMP	logcpiPINCCAP	GWEMP	DISPINCCAP
utility		0.0244*** (12.06)				
utility			-0.181** (-2.93)			
utility				0.0252*** (12.35)		
utility					0.0240*** (12.14)	
utility						0.0252*** (12.16)
Observations	970	970	970	970	970	970
Adjusted $R^2$	0.825	0.830	0.842	0.830	0.830	0.830

Fixed effects for regions and time included and clustered S.E for planning regions. T-values in parentheses.

## B Figures

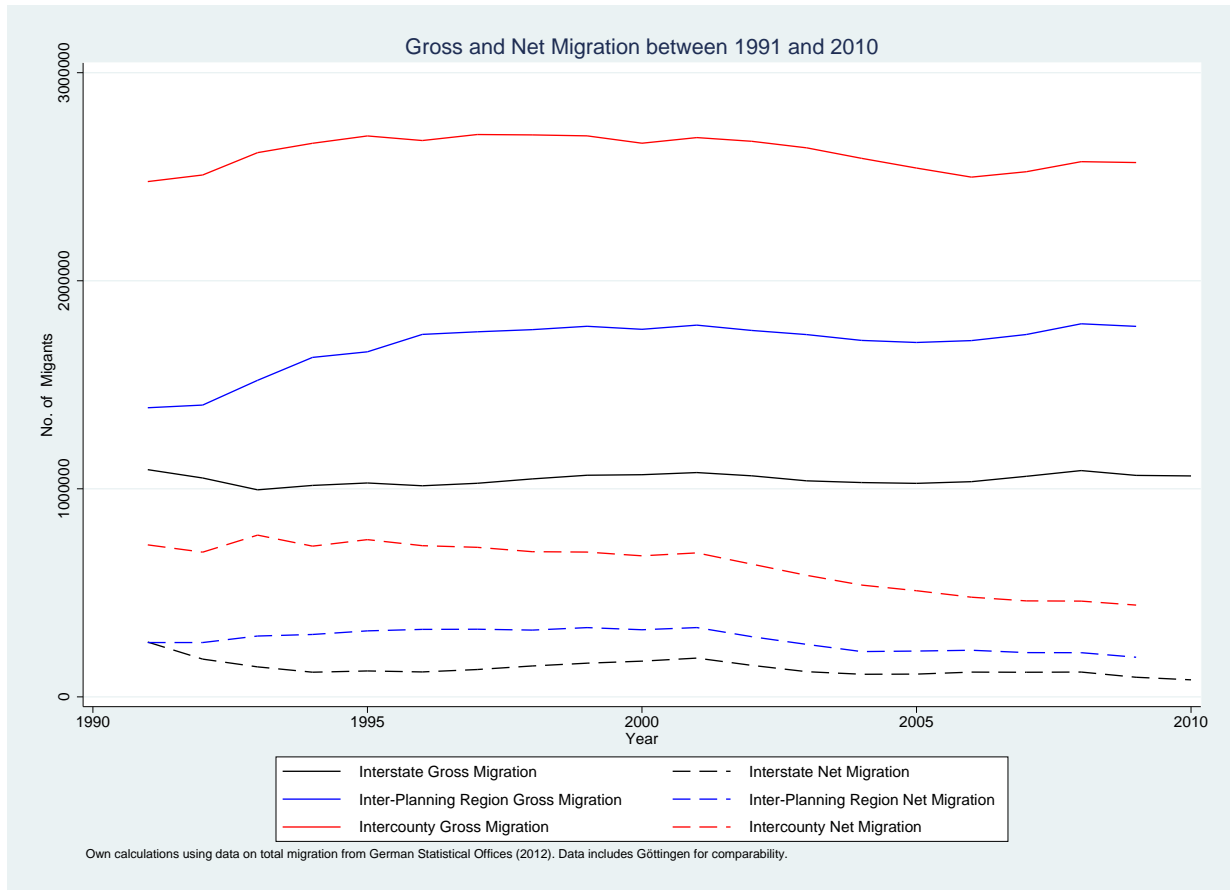


Figure 1: Comparison of gross and net migration Rates for different regional levels

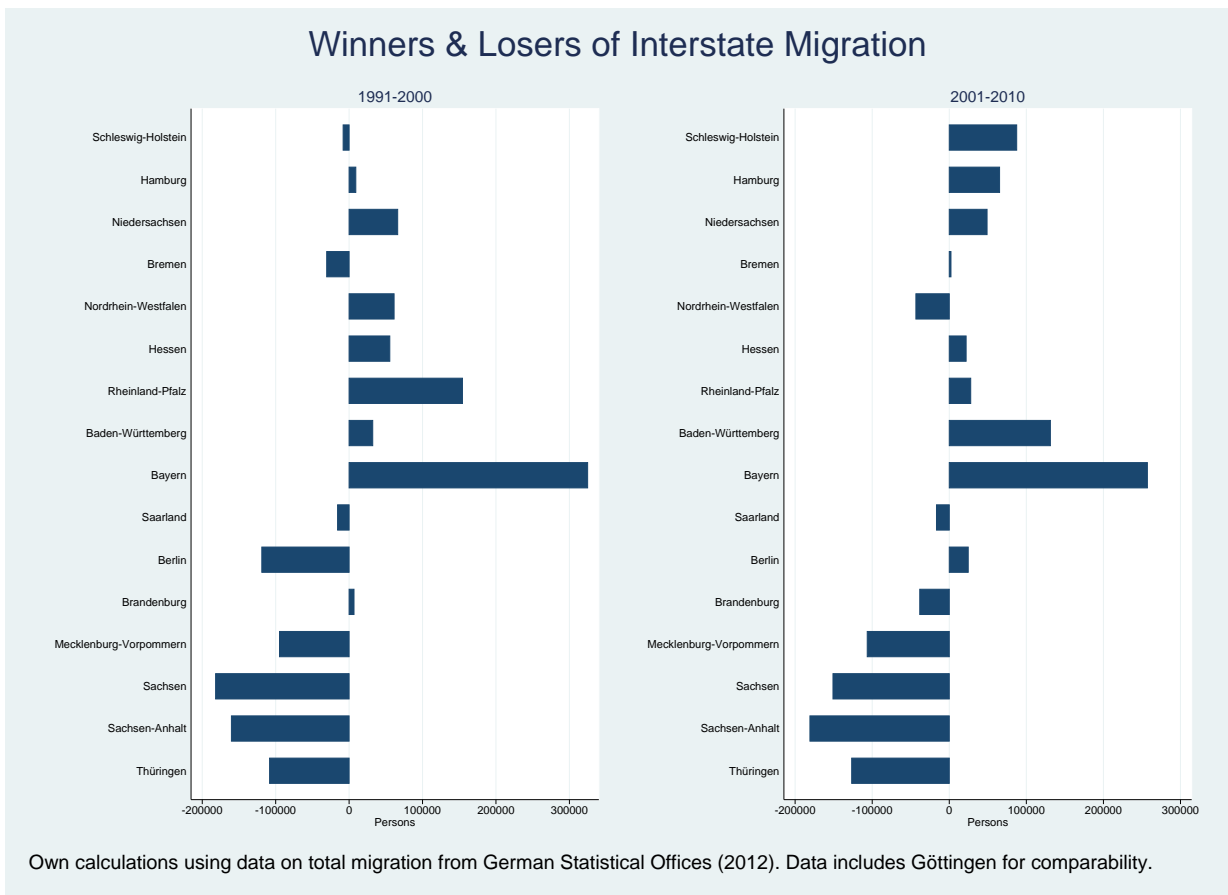


Figure 2: Distribution of migration gains and losses across German states

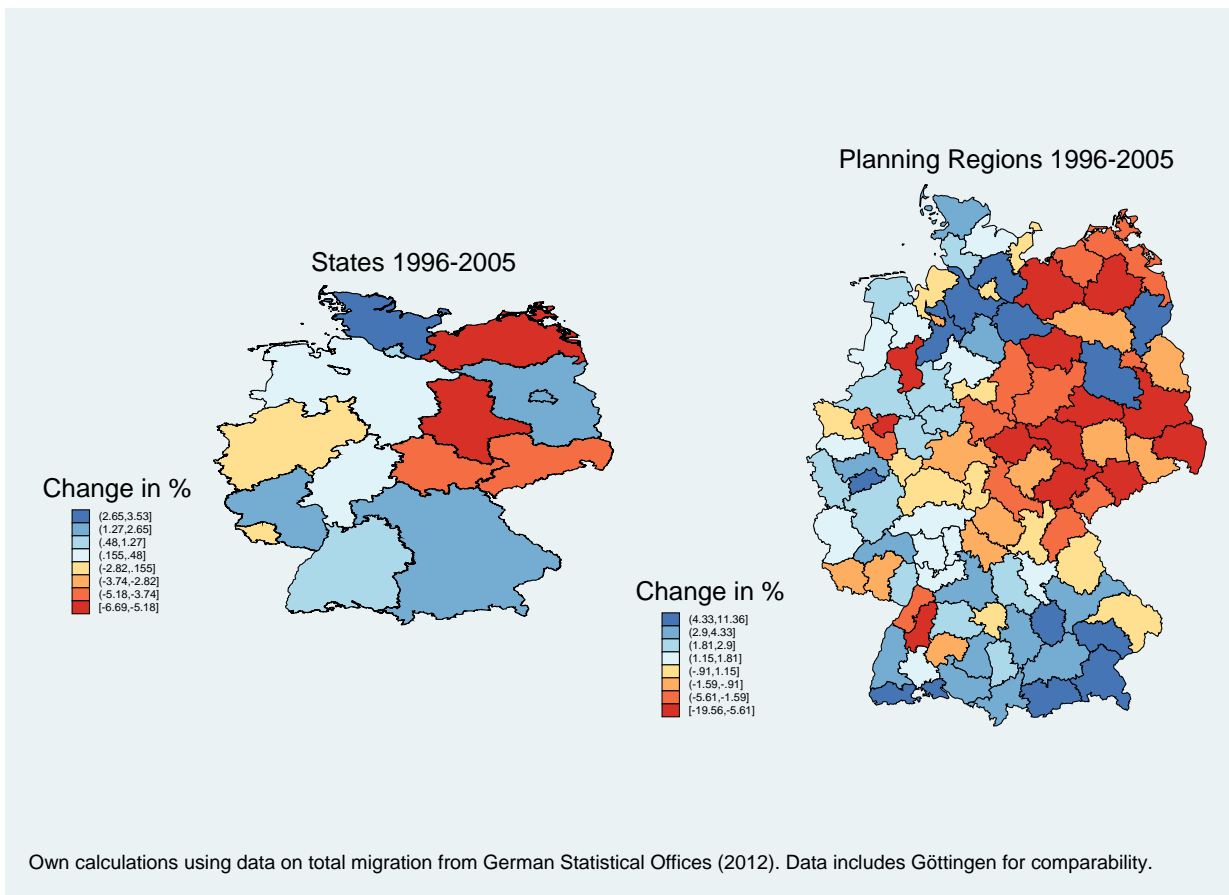


Figure 3: Population change by interregional Migration



## Results for 2000

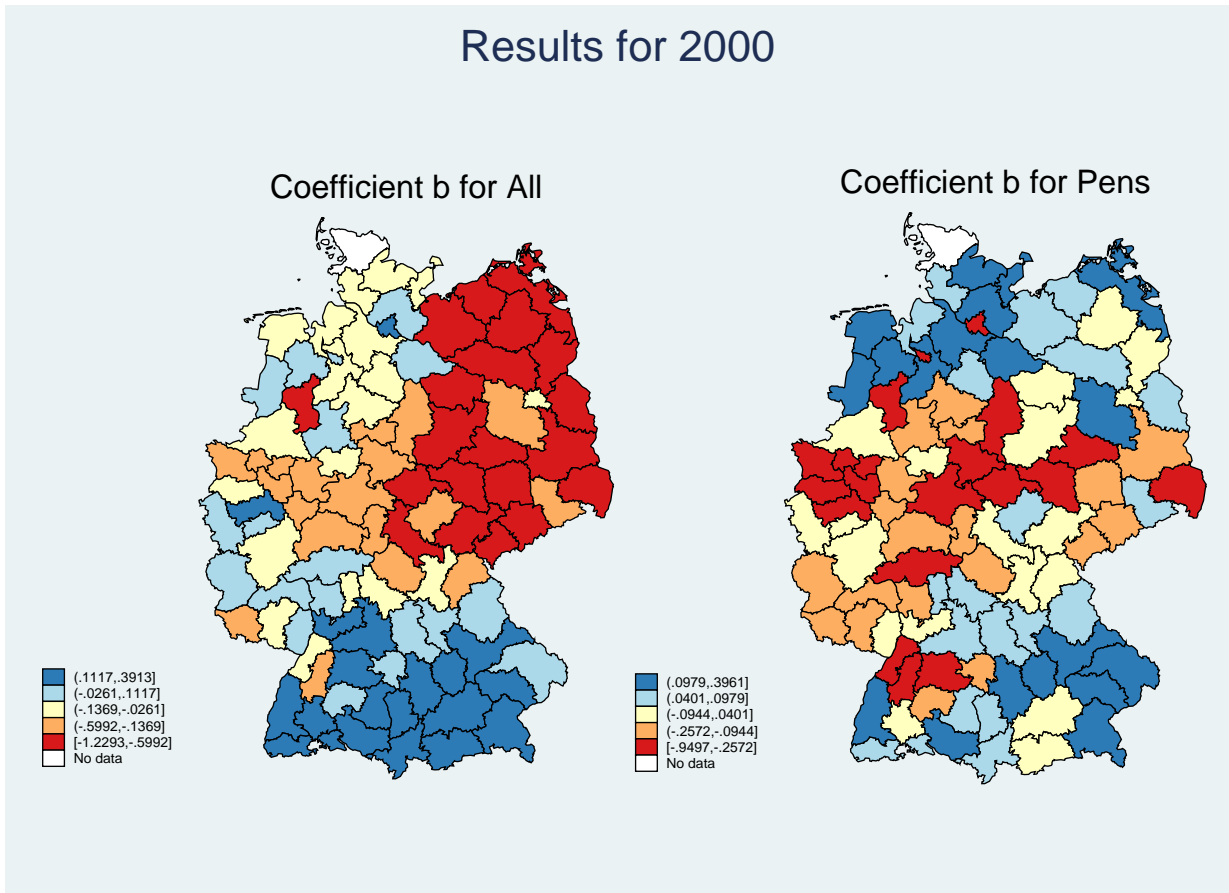


Figure 4: Coefficients  $b$  of planning regions in 2000 for total population and pensioners

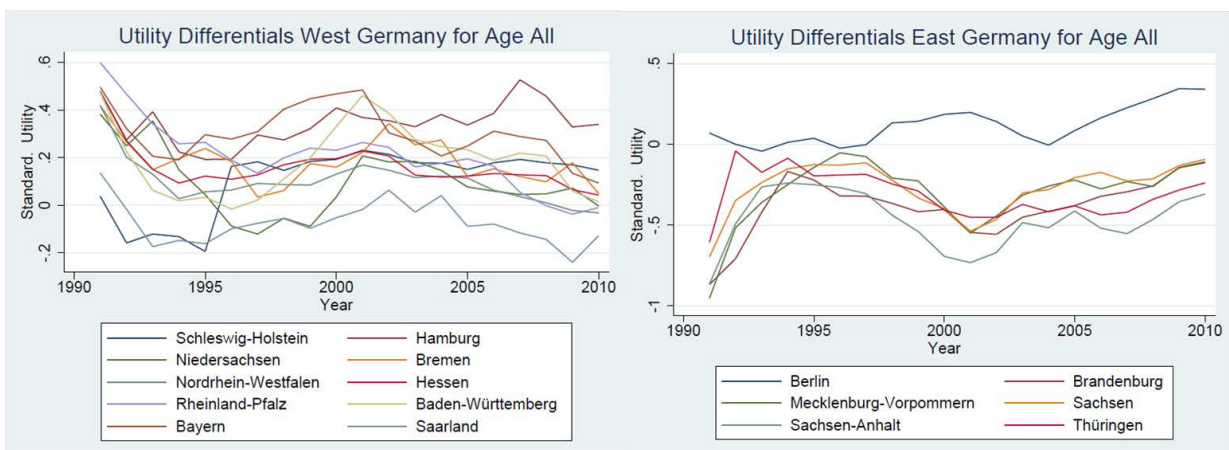


Figure 5: Standardized utilities of German states

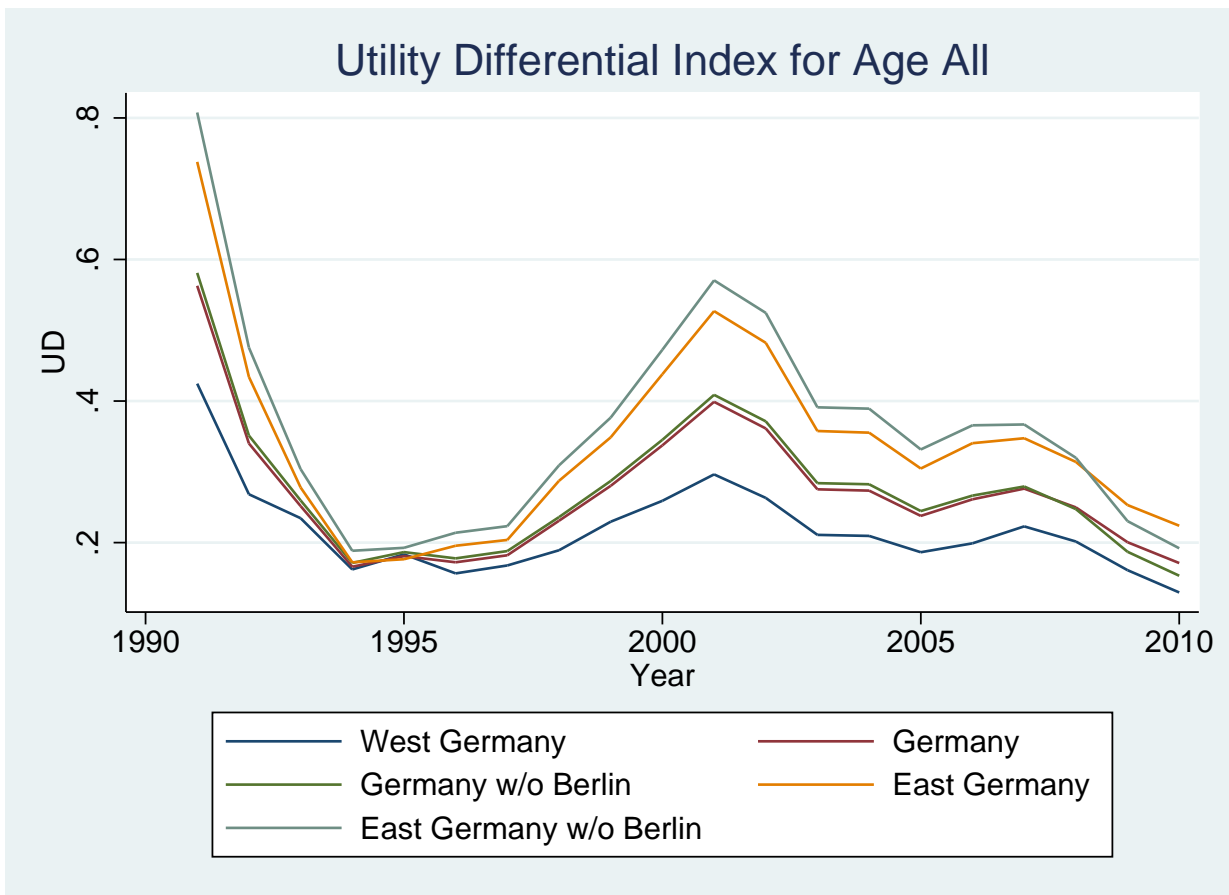


Figure 6: Utility differential index for German states

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