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It's Not Right But It's Okay: On the Measurement of Intra- and International Trade Distances*

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Abstract

The measurement of the average intra-national distance has become the crucial issue in estimating the home bias in goods trade for countries for which no internal trade data exist. This note starts by discussing recent proposals to compute this measure. Exploring a detailed data set on the geographical distribution of economic activity in Germany, the paper finds that calculated distances are remarkably robust to alternative specifications. The analysis is then extended to international distances. The calculation of the average distance between Austria and Germany shows that the standard procedure of approximating these distances by the simple distance between the countries' capitals can yield seriously distorted results. Finally, the distance measures are applied to estimate the home bias in German trade, finding a border effect of factor 5-10.

Keywords: home bias, border effect, gravity model, distance

JEL code: F14, F15, R12

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I. Introduction

To what extent do borders matter for international trade? After John McCallum's (1995) striking finding that Canadian provinces trade on average about twenty times more with each other than with U.S. states of similar size and distance, this issue has attracted considerable attention. Basically, two lines of research can be distinguished. A first wave of papers is based on data from McCallum's original source, detailed input-output tables from Statistics Canada. Using a largely identical framework of trade between Canadian provinces and U.S. states, this work mainly aims to check the robustness of McCallum's finding for particular industries, different time periods and alternative regression specifications. The studies report a decline in border effects over time and find considerable differences in border effects across industries and provinces, but basically confirm McCallum's initial results (see Helliwell [1998, chapter 2] for an overview).

A second set of papers tries to move away from the Canadian experience and attempts to estimate border effects for other countries. The basic difficulty is, however, that the Canadian data set is very special in providing information on trade flows within a country. For most countries, information on the volume of goods transported internally over a particular distance is missing.[1] It is therefore one of the contributions of Shang-jin Wei (1996) to propose highly imaginative methods to overcome these difficulties. Specifically, Wei derives a country's total volume of intra-national trade by subtracting exports from total production and then approximates the average internal distance simply by one-quarter of the distance from the country's capital to the capital of the "nearest" neighbour. While the procedure to determine domestic sales, however, appears to be quite reasonable, his proposal to define the average distance over which domestic goods are transported is far more controversial. In fact, as Wei's approach is flawed, the measurement of the average intra-national trade

[1] Notable exceptions include the US and Germany. Data from the US Commodity Flow Survey are analyzed by Hillberry (1998) and Wolf (2000), while Nitsch (2000a) explores data on intra-German trade.

distance has become the crucial issue in estimating border effects.[2]

Noting several inconsistencies of Wei's procedure, Nitsch (2000b) proposes an alternative measure. He suggests to derive a country's average intra-national distance from the geographical size of the country, multiplying the square root of an area by some scaling constant. While there might be problems in countries with very special shapes (such as Chile and Norway) or in countries with a highly uneven spatial distribution of economic activity (such as Canada), he argues that this measure may work in most cases reasonably well. Helliwell and Verdier (2000) have then considerably refined the analysis. By calculating population-weighted average internal distances, they take a much more detailed account of a country's shape and structure.

This note discusses these recent proposals from a German perspective. In particular, it explores a detailed data set on the geographical distribution of economic activity in Germany. Further, it is argued that recent attempts to measure intra-national distances correctly also increase the need for more sophisticated measures of international distances. The paper therefore provides a robustness check for the standard method to determine international trade distances, calculating the population-weighted average distance between Germany and Austria. Finally, the detailed distance measures are applied to estimate the home bias in German trade.

The structure of the paper is as follows. Section 2 describes the data set in more detail. Section 3 examines the robustness of measures based on spatially disaggregated data, while section 4 discusses the applicability of making the average internal distance a function of country size. Section 5 then extends the discussion to international distances, computing the average distance between Austria and Germany. The estimate of the German home bias is presented in section 6, and section 7 concludes.

[2] The reason is that the estimated border effect is directly proportional to the assumed internal trade distance, with larger distances implying larger border effects.

II. Data

The main source of data is *Bundesamt für Bauwesen und Raumordnung* (1998), which provides detailed information on German regions. Unfortunately, not all data series are available at the diverse hierarchical levels so that I use two separate sets of German data. A first sub-set refers to West Germany's 327 counties (*Kreise*).[3] For these administrative regions, data on area, population, economic activity and tax revenues are available. A second compilation then comprises 1996 population data for all 550 West German cities with a population of more than 20,000, providing an even finer spatial disaggregation of population.
At later stages, several other data sources are used. For the calculation of the average trade distance between Austria and Germany, for instance, comparable city population data for Austria is needed which is taken from *Statistik Österreich* (1995). (West) German exports by country are compiled from detailed machine tables, supplied by the *Statistisches Bundesamt*. Finally, all other country specific data such as GDP and population are obtained from IMF's International Financial Statistics.

III. Distribution-Based Distance Measure

In a first step, I use Helliwell and Verdier's (henceforth H&V) approach to calculate the average internal trade distance for (West) Germany. H&V's basic idea is quite intuitive. Applying a considerably extended version of the standard method to approximate international distances in gravity models (using the simple distance between the economic centers of the respective countries), they propose to compute the weighted average of all intra-national distances. In making their approach operational, however, H&V face at least two difficulties. First, a computation of *all* potential distances is impossible. Therefore, they suggest a few simplifications.

[3] There are two types of counties in Germany: 237 counties which comprise several cities and communities (*Landkreise*) and 90 cities which constitute itself a county (*kreisfreie Städte*).

In particular, they divide distances into four groups – intra-city distances, inter-city distances, distances between cities and rural areas, and distances between different rural areas – and then apply different techniques to approximate these distances separately. The simplifications, however, pose further problems. Simulations show, for example, that calculated distances for Canadian provinces depend strongly on the assumption about the distribution of the rural population.

Second, there is only limited data on the spatial distribution of economic activity. For Canada, for example, H&V have regionally disaggregated GDP data only for provinces. Hence, *within* provinces an appropriate measure of economic activity to calculate weighted distances is missing. As an alternative then, H&V use readily available population data and argue that regional differences in per capita income can be neglected.

In this note, I explore German county data to analyze the empirical relevance of a few potential problems of H&V's approach. My data set offers several advantages. For one thing, county data provide very detailed information on the geographic distribution of economic activity in Germany. As shown in figure 1, the 327 (West) German counties form a fine and regularly-sized grid, covering a total area of 248,100 km^2 (i.e., one-fortieth of Canada's area of 9,976,500 km^2). In addition, several measures of economic activity are available on county level. This allows to calculate a weighted average of intra-national distances for different weighting variables and then to compare the results with H&V's strategy of using population data as weights.

Following H&V, the average intra-national distance for Germany is calculated as the weighted average of internal trade distances classified into different groups. As counties, however, already provide a good geographic breakdown of economic activity, I distinguish between only two sorts of distances, distances within counties and distances between counties. Average intra-county distances are defined as a function of a county's land area, similar to H&V's procedure to compute intra-city distances. Specifically, starting from the assumption of a uniform distribution of economic activity,

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In the analysis, however, I do not distinguish between the

Nitsch (2000b) has argued that $\frac{1}{\sqrt{\pi}}$ (=0.564) times the square root of the area is a good approximation of the average internal distance (see also section IV of this note), which is also used here. For inter-county distances, I follow standard practice and use the great circle air distance between the pair of largest cities of the respective counties. The average internal trade distance for Germany is then computed as follows:

$$(1) \qquad d = \frac{\Sigma_i \left(\sqrt{\pi}^{-1} \sqrt{area_i}\ w_i^2\right) + \Sigma_{ij,\ i \neq j} \left(d_{ij}\ w_i\ w_j\right)}{\Sigma_{ij} \left(w_i\ w_j\right)}$$

where subscript *i* denotes county *i* and *w* is the weight.

Table 1 presents the results. The table shows the weighted average of intra-German distances in kilometers for different weighting variables, displaying separate results for intra- and inter-county distances. At least two observations are noteworthy. First, there is obviously very little variation in the results for different weighting variables. As shown, I have experimented with several measures of economic activity, ranging from employment data to measures of the counties' tax base. The results, however, were strikingly similar to average distances derived from population data. This finding suggests that regional differences in per capita income can indeed be ignored and provides strong support for H&V's approach of using population data as weights.

Second, intra-county distances, which are here approximated from an unrealistic assumption of evenly distributed economic activity, have only a very small influence on the overall results. This is, however, not surprising. In my sample, inter-county distances enter with 53,301 (=[327*326]/2) observations and, thus, with a much stronger weight than intra-county distances (327 observations).

In sum, it turns out that the weighted average of intra-national trade distances is not very sensitive to H&V's simplifications.

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types of counties.

IV. Area-Based Distance Measure

In a next step, I examine the empirical robustness of Nitsch's (2000b) method to approximate intra-national distances. Unconvinced by Wei's (1996) initial approach in which a country's average internal distance depends on the location of two particular cities (of which one is, moreover, in a neighbouring country), he proposes to derive the potential distance for domestic trade from the geographical size of a country. Experimenting with hypothetical distributions and calculating mean distances among different structures of equally spaced points, he suggests that $\frac{1}{\sqrt{\pi}}$ (=0.564) times the square root of the area might be a good approximation for the average internal distance.[4]

Even though this procedure does not take such a detailed account of a country's internal distribution of economic activity as H&V's method does, it has at least the advantage that it is much less data intensive. In fact, a simple cross check with data for West Germany suggests that the measure gives a crude but useful approximation. The computed distance of 281 km ($=0.564*\sqrt{248{,}100\ km^2}$) is very close to the result of 278 km derived as the weighted average of 53,628 internal distances (see table 1).[5] To examine the empirical fit of the $0.564*\sqrt{area}$ rule in more detail, I apply both methods to calculate intra-regional distances for 30 West German governmental districts (*Regierungsbezirke*)[6] and then compare the results.

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[4] The formula is derived from a circular economy. In a circle, the radius is equal to $\frac{1}{\sqrt{\pi}}\sqrt{area}$.

[5] It should be noted that empirical regularities are well established in geography and earth sciences. Stølum (1996), for example, discusses the finding that the length of a river between two points is on average π times the shortest distance between these points.

[6] Governmental districts are the administrative classification below the state (*Bundesländer*) level. Usually, large or densely populated states are divided into 4-5 governmental districts, each comprising several counties. In case that a state is not divided into governmental districts (Saarland, Schleswig-Holstein, and the city states Bremen and Hamburg), the state itself is used as substitute. On a European level, this

I begin with H&V's procedure to compute the average population weighted distance. My data set comprises all 550 cities in West Germany with a population of more than 20,000 on January 1, 1996. The cities are grouped according to the governmental district in which they are located and then, for simplicity, only the weighted inter-city distance is computed (thereby ignoring other types of distances such as intra-city distances). Column 4 of table 2 reports the results. As shown, observations are missing for the two governmental districts which contain only one city with a population above 20,000 (Hamburg and Trier).

Column 5 then reports corresponding results for internal distances derived from the surface area of governmental districts. The main information of interest, however, is in column 6 which shows the difference (in km) between both distance measures. It turns out that in most cases the difference is below 10 km, suggesting that Nitsch's (2000b) method yields reasonable results for the majority of governmental districts. In 11 out of 28 cases, the difference is even smaller than 6 km. On the other end of the spectrum, however, there are also three notable outliers with a difference of more than 25 km. A detailed examination shows that these governmental districts display some specific and rather unusual characteristics. The city state of Bremen, for example, consists of only two isolated cities, Bremen and Bremerhaven. Mittelfranken is characterized by an unusually strong concentration of economic activity in which the three largest cities, Nürnberg, Fürth and Erlangen, form a single agglomeration. Oberbayern is dominated by München, which is more than ten times larger than the second largest city in the district, Ingolstadt.[7] Dropping these three observations from the sample raises the correlation coefficient between both distance measures from 0.48 to 0.80.

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definition corresponds to level two of Eurostat's Nomenclature of Territorial Units for Statistics (NUTS).

[7] Similar pictures emerge for other governmental districts with a large difference between both distance measures. Seven of the 13 largest cities in Stuttgart are located in the immediate surroundings of Stuttgart, with a distance of less than 15 km. In Darmstadt, population is strongly concentrated around the largest city Frankfurt.

Figure 2 presents a simple scatter plot of both distance measures. Besides illustrating the strong correlation between the two measures, the graph displays another interesting feature. The slope of the regression line is considerably smaller than one. In fact, as governmental districts are mostly designed of comparable size, area-based average distances for 22 of the 28 governmental districts are in the range from 40 to 60 km. According to H&V's much more detailed procedure, however, only 10 governmental districts have average distances in that range. Thus, the simple $0.564*\sqrt{area}$ rule gives a rough estimate based on an area's overall geographic size, but is unable to account for the wider variety of possible average trade distances introduced by the specific geographic location of economic activity.

Taken together, the results from West German governmental districts suggest that a simple method based on multiplying the square root of an area by a scaling constant gives in most cases a reasonable approximation of the average internal distance. Not surprisingly, the results are the better the more regularly shaped the area and the more evenly distributed the economic activity.

V. International Distances

Recent attempts to develop sophisticated measures for intra-national trade distances partly shift the focus back to the measurement of *inter*-national distances. Here it has become standard procedure to approximate the average distance between a pair of countries by the simple distance between the capital cities of the respective countries (see, for example, Frankel [1997]). In fact, frequent experimentation with alternative specifications did not affect the basic results in gravity regressions. Hamilton and Winters (1992), for example, compute separate distances for sea transport (between the countries' main ports) and overland transport (from the port to the economic center) and yield conventional estimates. Frankel (1997, p. 65) cites evidence that there is little difference in the results whether distance is measured between the most populous cities or the geographical centers.

However, while the procedure of using simple distances between city pairs might give a useful approximation for countries which are far apart so that the specific city location in the country has only a limited effect on the overall distance between the two countries, the method could yield seriously distorted results for shorter distances which strongly depend on the exact geographic location of the city pair. An extreme case is the distance between the Republic of Congo and the Democratic Republic of Congo (the former Zaire) whose capitals, Brazzaville and Kinshasa respectively, are located on opposite sides of the river Congo and, thus, only 4 km away. Researchers usually deal with this issue by substituting border locations with more centrally located cities.[8] It remains questionable, however, whether these ad hoc corrections cure the shortcomings of the simple city pair approach.

To explore the empirical fit of this method, I apply H&V's detailed procedure to calculate the weighted distance between Austria and (West) Germany. Specifically, I compute the weighted average of the distances between 550 (West) German cities with a population of more than 20,000 and 69 Austrian cities with a population of more than 10,000. The result is then compared with standard approximations for the average distance between Austria and Germany.

Table 3 reports the results. The first row shows that the average weighted distance between Austria and Germany, based on 37,950 (=550*69) observations, is 609 km. This result, however, differs markedly from the approximations often used in the literature. With a value of 728 km, the simple distance between the capitals turns out to be considerably larger (by one-fifth) than the "correct" average distance. The pair of largest cities yields an even worse result. In sum, the comparison suggests that the widely used and fairly undisputed procedure of approximating international distances by the distance between a single pair of cities can produce misleading results.

The extent of the possible distortion may depend on a number of factors, such as country size, the shape of the country, and

[8] Examples include the U.S. where both the capital (Washington) and the largest city (New York) are located on the east coast and Chicago is often used instead as an approximation for the country's economic center.

the degree of urban concentration. However, the problem appears to be most acute for neighboring countries with a wide variety of cross-country distances. This observation is important for two related reasons. First, while measurement issues do obviously not affect the basic results in gravity models which cover a large number of countries, these models are often applied to analyze regional aspects such as the effects of regional trading blocs. Parameter estimates on variables included to control for these issues, however, could be affected by wrong distance data. Second, there is a growing tendency to estimate regional gravity models. The focus on trade flows within a single region, however, increases the need for accurate distance data.

A natural solution to this problem is the general application of H&V's approach also to international distances. This would, however, require an immense effort. It is therefore probably a useful approximation to compute weighted distances only for neighboring countries. Moreover, the calculation could be based on an easily manageable sample of the countries' five largest cities. Row 2 of table 3 shows that the result of this reduced data set comes remarkably close to the average distance obtained from the full sample. In any case, a more careful approximation of international trade distances is needed.

VI. An Estimate of the German Home Bias

Finally, the "correct" distance measures can be applied to estimate the home bias in German goods trade. The basic idea is to determine whether a typical (West) German firm ships more goods to domestic customers than to otherwise equal foreign customers. Applying then a standard gravity framework, trade flows are controlled for distance, economic size, per capita income, a common land border and the effects of preferential trade arrangements. Specifically, I estimate an equation of the form:

$$(2)\quad \ln(Exports_i) = \alpha + \gamma\, Home + \beta_1 \ln(Distance_i) + \beta_2 \ln(GDP_i) + \beta_3 \ln(GDP\ per\ capita_i) + \beta_4\, Adjacency + \beta_5\, European\ Union + \varepsilon_i$$

where *Exports*$_i$ are (West) German exports to country *i*, *Home* is the dummy for intra-German trade, and *Adjacency* and *European Union* are dummies for importers that share a common border with Germany and are a member of the European Union, respectively. Following Wei (1996), (West) Germany's trade with itself is calculated by subtracting its total exports from its total production. As West Germany's total exports, however, also include shipments to East Germany for which data are only available until 1994, the empirical analysis is confined to the period 1992-94. Finally, *Distance*$_i$ is the great circle distance between Frankfurt and importer *i*'s capital, except for Germany's neighbors and other large European trading partners (Italy, Spain, Sweden, the United Kingdom), for which the average population-weighted distance between the countries' five largest cities is used.

Strictly speaking, this framework gives only a very imprecise estimate of the German home bias since I have only one observation for internal trade in each year. The coefficient on the *Home* dummy therefore simply captures the residual. The efficiency of the estimation is improved, however, by combining observations for the years 1992, 1993 and 1994 and employing the method of seemingly unrelated regression (SUR). Specifically, I estimate a system of three year-specific equations with constant parameters across the years but allow for separate intercepts for each year.

The results are shown in table 4. Although there is no a priori reason to expect the border effect to vary across different country samples[9], I report separate results for various combinations of trading partners. Column 1 then presents the regression based on a sample of (West) Germany's neighbor countries. The basic results are fairly standard. The coefficients on distance and income take the expected signs and are statistically significant, implying that economic size and distance play significant roles in Germany's bilateral trade. Moreover, the empirical fit of the gravity regression is

[9] Anderson and Smith (1999), for example, extend McCallum's (1995) and Helliwell's (1996) analysis of Canada-U.S. regional trade flows to trade with other countries and find that

excellent, with adjusted R^2's above 0.9. The key variable of interest, however, is the measure of the home bias. The coefficient on the *Home* dummy is 1.55 and statistically highly significant. This estimate indicates that (West) Germany's trade with itself exceeds its exports to an otherwise identical neighbor country by factor 4.7 (=exp[1.55]), which is about one-half of the Nitsch (2000b) estimate of factor 7-10 for the European Union.

Apart from being an approximation of the average border effect in the European Union, however, Nitsch's (2000b) result is also based on trade between a larger set of countries which might have affected the result. To explore then to what extent the difference in the estimated home bias is due to different sample sizes, columns 2 and 3 repeat the regression for alternative sets of European countries. It turns out that the estimated border effect is indeed larger when more distant countries are included. Extending, for example, the sample to cover the bilateral trade flows between (West) Germany and all European countries increases the border effect to factor 6.2 (=exp[1.82]). This result suggests that, contrary to Anderson and Smith's (1999) finding for Canada, the distance variable does not fully capture the trade-reducing effect of being a more remote customer. Proximity and cross-border networks obviously lower the estimated home bias in relation to trade with neighbor countries than measured relative to more distant countries. However, coefficients on additionally included dummy variables intended to measure the trade-enhancing effects of a common border and a preferential trade arrangement are statistically insignificant.

A further extension of the sample to include also inter-continental trade flows should then strongly confirm this finding. It is therefore surprising that, in a regression which includes all countries for which data are available, the estimated coefficient on the *Home* dummy actually falls to 1.33 and is statistically significant only at the 10% level (column 4). As shown in column 5, however, this result is solely due to more-than-proportionate trade with very small countries. Excluding all countries with a GDP of less than 10 bn. US

Canada's border with the U.S. is neither larger nor smaller

dollar raises the estimated home bias to factor 10.5 (=exp[2.35]).
In sum, the estimated extent to which (West) Germany trades more with itself than with a foreign country of equal size and distance is basically consistent with Nitsch's (2000b) initial result of an average home bias in the European Union of factor 7-10.

VII. Summary

This note discusses recent proposals to measure the average intra-national distance. Exploring a detailed data set on the geographical distribution of economic activity in Germany, different methods are applied to compute average internal distances. The aim is to analyze the sensitivity of the calculation techniques to the proposed specifications.
The results are basically supportive for both Helliwell & Verdier's (2000) and Nitsch's (2000b) methods. It turns out that H&V's approach of calculating a population-weighted average distance is robust for the usage of alternative weighting variables. Except for extreme cases of areas with a very unregular geographic shape or a very uneven population distribution, Nitsch's much less data intensive measure provides a reasonable approximation of the average internal distance.
The analysis is then extended to international distances. Applying H&V's procedure to compute the average distance between Austria and Germany, the paper shows that the standard method of approximating international distances in gravity models yield seriously distorted results. Instead of using simple distances between the countries' capitals, it is suggested to compute weighted distances at least for neighbor countries.
Finally, the "correct" distance measures are applied to estimate the home bias in German goods trade. The estimated border effect of factor 5-10 strongly confirms Nitsch's (2000b) earlier findings for the European Union.

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than the border with the rest of the world.

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Table 1: Calculating Distances Using Different Weighting Variables

Weighting Variable	Average Intra-County Distance	Average Inter-County Distance	Average Intra-National Distance
Population	14.18	281.11	278.32
Worker	12.74	282.59	279.07
Gross value added	12.06	282.01	277.18
Tax revenue	12.65	279.62	275.14
Income Tax	13.45	280.58	277.03

Note: The table shows the weighted average of internal trade distances (in km) for Germany based on data from 327 West German counties and using different weighting variables.

Table 2: Calculating Distances Using Different Calculation Methods

Region Regierungsbezirk (1)	Area km2 (2)	# of cities >20,000 (3)	Pop.-weighted intra-reg. dist. (4)	0.564*sqrt(Area) (5)	Difference (4)-(5) (6)
Arnsberg	7999	47	41.4	50.5	-9.1
Braunschweig	8097	16	52.8	50.8	2.0
Bremen	404	2	55.4	11.3	44.1
Darmstadt	7445	40	29.2	48.7	-19.5
Detmold	6518	28	34.7	45.5	-10.8
Düsseldorf	5288	44	30.4	41.0	-10.6
Freiburg	9357	17	67.5	54.6	12.9
Giessen	5381	8	34.1	41.4	-7.3
Hamburg	755	1	-	15.5	-
Hannover	9048	26	38.3	53.7	-15.4
Karlsruhe	6919	24	48.0	46.9	1.1
Kassel	8289	6	57.0	51.4	5.6
Koblenz	8093	6	46.2	50.8	-4.6
Köln	7365	53	39.7	48.4	-8.7
Lüneburg	15244	15	73.1	69.7	3.4
Mittelfranken	7246	9	18.3	48.0	-29.7
Münster	6902	32	54.1	46.9	7.2
Niederbayern	10331	4	65.1	57.3	7.8
Oberbayern	17529	18	49.5	74.7	-25.2
Oberfranken	7231	7	50.3	48.0	2.3
Oberpfalz	9691	6	50.0	55.5	-5.5
Rheinhessen-Pfalz	6831	13	51.2	46.6	4.6
Saarland	2570	14	21.9	28.6	-6.7
Schleswig-Holstein	15732	19	66.5	70.8	-4.3
Schwaben	9993	11	62.3	56.4	5.9
Stuttgart	10558	35	38.3	58.0	-19.7
Trier	4922	1	-	39.6	-
Tübingen	8918	15	61.4	53.3	8.1
Unterfranken	8533	5	50.5	52.1	-1.6
Weser-Ems	14959	28	78.9	69.0	9.9

Table 3: Calculating International Distances Using Different Calculation Methods

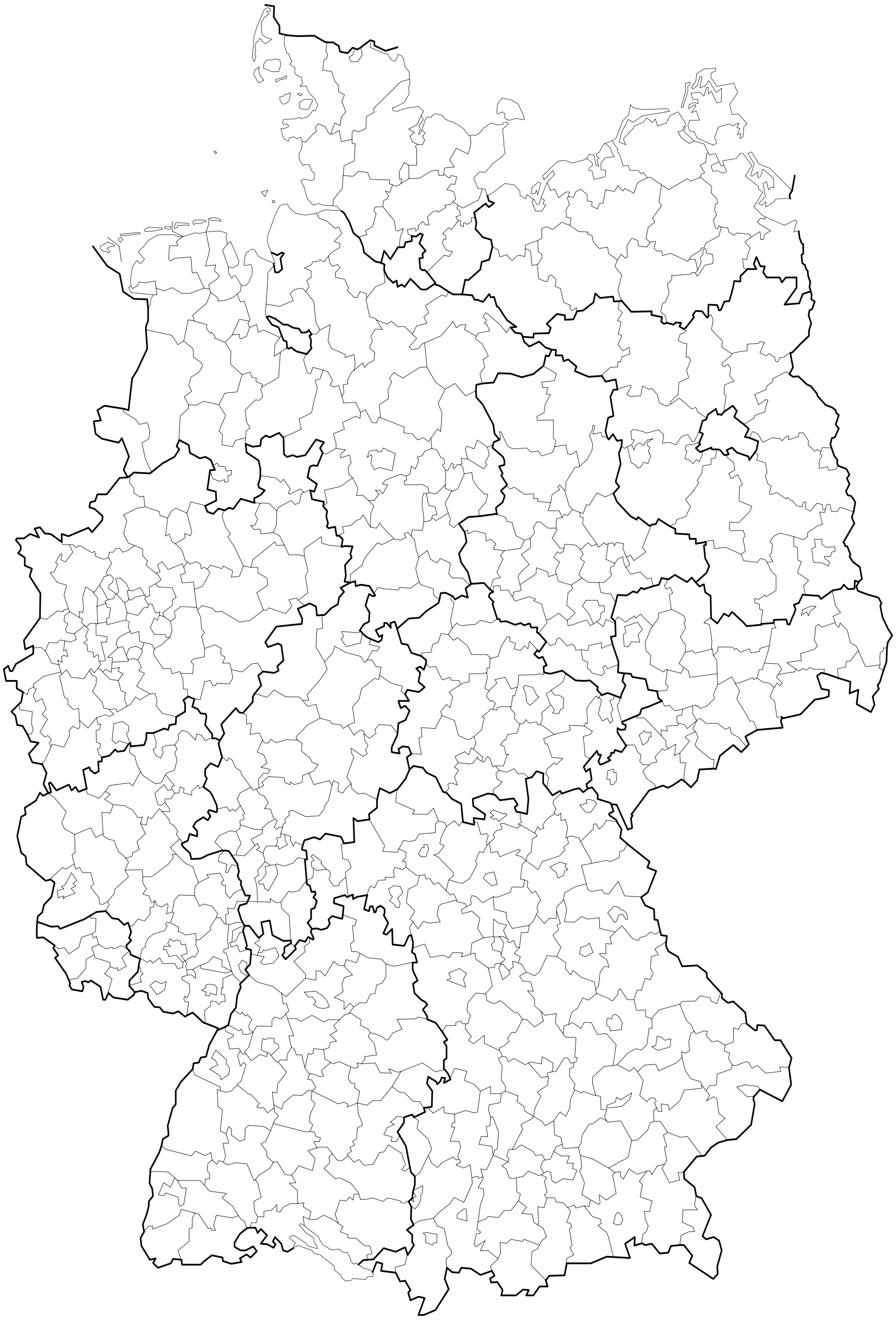
	Data points for Germany	Austria	Distance
Weighted average			
Full sample	550 cities	69 cities	609 km
Five largest cities	Hamburg, Munich, Cologne Frankfurt/Main, Essen	Vienna, Graz, Linz Salzburg, Innsbruck	606 km
Selection criterion			
Capital	Bonn	Vienna	728 km
Largest city	Hamburg	Vienna	744 km

Note: The table shows the average distance (in km) between (West) Germany and Austria based on different calculation methods.

Table 4: Estimating the Home Bias in German Goods Trade, 1992-94

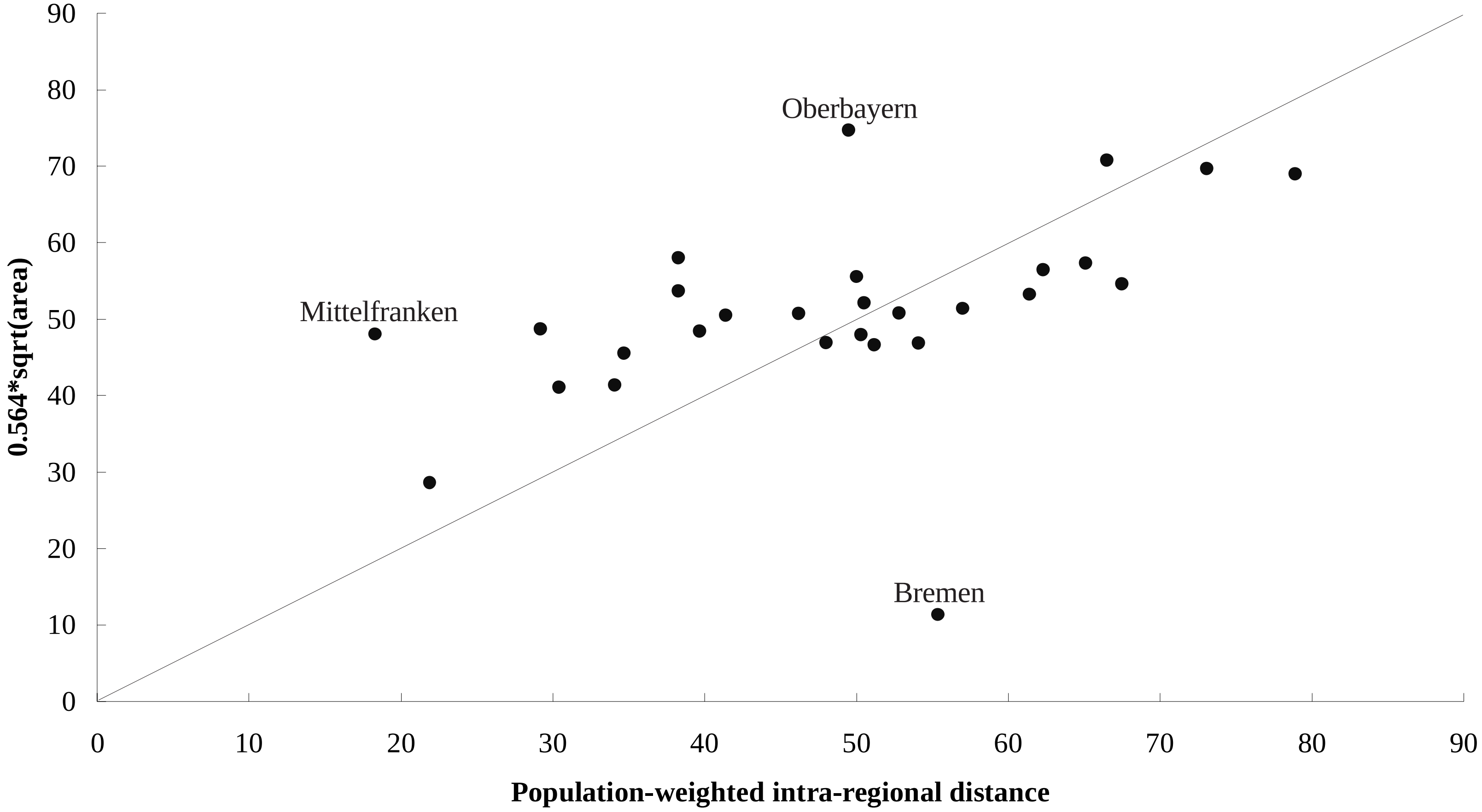
Sample:	(1) Neighbor countries	(2) Western Europe	(3) Europe	(4) World	(5) World GDP>10bn. US$
Home	1.555**	1.714**	1.820**	1.327#	2.354**
	(0.492)	(0.431)	(0.422)	(0.761)	(0.714)
ln(Distance)	-1.090*	-0.934**	-0.911**	-0.918**	-0.619**
	(0.465)	(0.226)	(0.170)	(0.078)	(0.087)
ln(GDP)	0.684**	0.825**	0.816**	0.990**	0.765**
	(0.117)	(0.047)	(0.041)	(0.031)	(0.063)
ln(GDP per capita)	0.093	-0.309**	-0.054	-0.086#	0.072
	(0.492)	(0.106)	(0.050)	(0.044)	(0.067)
Adjacency		0.275	0.257	0.279	0.633**
		(0.227)	(0.200)	(0.292)	(0.220)
EU		-0.198	0.017	-0.191	0.031
		(0.136)	(0.144)	(0.274)	(0.250)
# of observations	8 x 3	19 x 3	32, 34, 34	149, 152, 148	67, 68, 67
S.E.R.	.46,.48,.46	.34,.32,.32	.56,.42,.38	.97,1.01,.78	1.02,.90,.69
Adj. R^2	.92,.91,.91	.97,.97,.97	.95,.96,.97	.90,.88,.93	.74,.77,.86

Notes: All results are based on SUR estimation. Standard errors are in parentheses. **, *, # denotes significant at 1%, 5% and 10% level, respectively. A detailed list of countries included in the regressions can be obtained from the author on request.



Note: In contrast to the analysis in the paper, the map also covers the territory of former East Germany. Solid lines denote state (Bundesländer) boundaries.

Figure 1: Map of Counties in Germany



Note: Data taken from Table 2, columns(4) and (5).

Figure 2: Comparing Helliwell & Verdier's and Nitsch's Approach to Determine Intra-National Distances