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Abstract

After World War II, town twinning became popular, notably in Germany. This was mainly a reaction to the war experience, and it was aimed at creating renewed international understanding and co-operation between German cities and cities in other countries. The contacts created by town twinning also resulted in increased international access of the cities involved. This potentially stimulates growth in these cities compared to cities that do not have (as many) twinning partners. In this paper we investigate the effects of town twinning on population growth in German counties and municipalities. Our results show that German counties and municipalities that engage in town twinning often have had a significantly higher population growth compared to German cities that do not have twinning partners. Especially the number or intensity of twinning relations as well as town twinning with French cities, and with neighboring countries more generally, turn out to have a positive effect on city growth. We also find that the positive population growth effects of town twinning are confined to the larger German cities.

JEL-Code: F190, F200, J190, R120.

Keywords: town twinning, German cities, economic integration, population growth.

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1. INTRODUCTION

Shocks like the creation or abolition of national borders are associated with a change in market access. The fall of the Berlin wall in Germany in 1989 is an example of such a shock. This created sudden economic opportunities for cities along the former border between western and eastern Germany. After the reunification, these former "border" cities experienced higher population growth rates than more centrally located cities within Germany (Redding and Sturm, 2008, see also Ahlfeldt et al. 2012). Other examples of shocks are the expansion of the European Community (EC), later the European Union (EU). The increased economic integration between member countries and between new members increased market access for cities along the borders of the EU. Brakman et al. (2012) show for instance that the involved cities and regions along borders that experienced EC/EU economic integration were positively affected by this change in market access, which compensates, to some extent, the negative effect of being a (peripheral) border location.

In this paper we analyze so-called town twinning (hereafter, TT), which is another form of integration that might affect the international economic or market access of a city. TT involves co-operation, in the broadest sense, between towns or cities across national borders. Although TT has a long history, dating back to the 19th century, the heydays of TT began after WWII (Zelinsky, 1991, Furmankiewitcz, 2005, Clarke, 2009). The need between countries to reacquaint themselves with their former enemies was particularly felt in the post-war period, and in particular so in Germany. As a side effect of this largely politically motivated twinning episode, transaction costs between cities could be reduced. We hypothesize that the increased interaction between cities that became part of TT stimulate migration, and as a result population growth could be more pronounced compared to cities that had no or fewer international TT partners.

The central topic of this paper is to analyze whether TT indeed has a positive effect on population growth in German cities. To our knowledge the only empirical attempts to measure effects of TT are de Villiers et al.(2007) and Baycan-Levent et al. (2010), both based on the survey of municipal officials that were asked whether they considered TT successful. However, a full-fledged econometric analysis is missing. Our paper tries to fill this gap. Our argument is thus that twinning cities have advantages over other cities as they, by co-operating with each other,

reduce transaction costs and increase economic proximity. At the same time, the organization and maintenance of TT involves (coordination) costs so it is not a priori clear whether TT will be beneficial for the cities concerned. The difference between this paper and Redding and Sturm (2008) or Brakman et al. (2012), is that we do not put special emphasis on national borders, and do not analyze shocks, but focus on the evolutionary influence that TT has on city population growth. To this end we construct a complete dataset on TT for Germany. We focus on Germany because Germany – as we argue in section 2 - is the main actor in TT in post WWII Europe.

The paper is arranged as follows. In section 2 we briefly discuss the history of TT, and what it implies in practice. Section 3 describes the dataset. Our variables of interest are population growth and the TT in Germany with cities outside Germany. The estimation strategy is developed in section 4. The main estimation results are discussed in section 5. In general, and after also conducting a range of robustness checks, we do find evidence of a significant positive relationship between TT and German city growth, in particular when we take the number of TT relationships into account and focus on TT with French cities or cities in neighboring countries more generally. Finally, Section 6 concludes.

2. TOWN TWINNING: HISTORY, MOTIVES AND THEORY

TT is a relative old phenomenon.[2] The term was used as early as the 1850s to describe the cooperative activities of building transportation and other public infrastructure between for example the neighboring cities of Minneapolis and St. Paul, Minnesota, USA, (see Borchert 1961). The world fairs that were initiated in the 19th century also stimulated contacts between cities (Fighiera 1984, cited in Zelinsky, 1991). Following these early attempts many others followed in order to enhance cooperation between cities. For example, the foundation of the International Union of Local Authorities (IULA) at Ghent in Belgium in 1913 was specifically aimed at stimulating international cooperation between cities (Zelinsky, 1991). Ties between cities were also stimulated by ad hoc initiatives by city councils or private enthusiasts for more co-operations between cities (Clarke, 2009).

[2] We do not discuss co-operation between cities that were motivated by religious motives (missionary efforts), initiatives by freemasons, Rotarians and the like, as systematic data for these initiatives are lacking and because the initiatives are aimed at special interest groups.

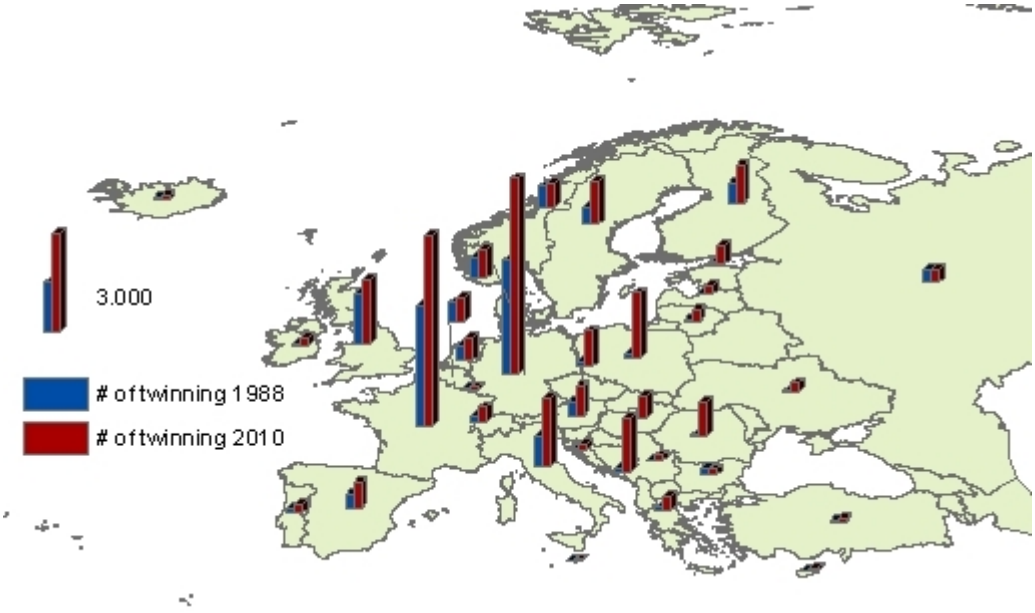
The concept of TT is as such rather opaque. It involves all sorts of interactions that are aimed to foster mutual understanding between the inhabitants of cities that take part in the initiatives, such as: bilateral visits of officials, musical events, language courses, or exchanges of letters between schoolchildren. However, it also encompasses the sharing of technical expertise, the sharing of knowledge and advice that have more direct economic consequences (Zelinsky, 1991). All these activities can result in a form of TT. The term town twinning is adopted from the relationship that existed between the twin cities of Minneapolis and St. Paul, Minnesota, USA, but increasingly was used to describe the relationship between international partner cities, which is how we will also use the term. As is clear from the historical overview in Zelinsky (1991), and, inter alia, Clarke (2009, 2010), TT is very much a European phenomenon. From Zelinsly (1991, Table 3, p.12), it can be deduced that the top-20 of countries in 1988 that are involved in international twinning is dominated by EU countries (15 out of the 20), and that the leading TT countries are France, the UK and Germany that together have almost 8500 twinning relations, which is comparable to the other 17 countries combined. Proximity is also important; most TTs take place with *neighborin*g countries (Zelinsky, 1991).

Data on TT show that it became very popular after WWII, especially during the 1950s (Falkenhain et al., 2012; Furmankiewicz, 2005; Jayne, 2011; Joenniemi and Sergunin, 2009; Papagaroufali, 2006; Vion 2002, Campbell, 1987; and Zelinsky, 1991). The promotion of the TT was one of the priorities of the Council of European Municipalities which explains the huge increase in the number of TTs in the 1950s. The WWII experience was a great stimulus for TT initiatives.[3] As a consequence, most of the TTs were between towns from countries that were enemies during WWII. Germany became the center of the twinning activities. By 2012, German municipalities together have over 5000 international twinning partners, mostly with European partners, especially France. The TT orientation towards France is not surprising if one realizes that France and Germany were arch-enemies in three main wars between 1870 and 1945 so post-

[3] See for a history of TT in some individual countries: for the UK -Clarke (2009, 2010, 2011) and Jayne (2011); for France - Vion (2002) and Campbell (1987); for Greece - Papagaroufali (2006); for northern Europe - Joenniemi and Sergunin (2009); and for Poland - Furmankiewicz (2005).

WWII peace policies in Western Europe focused on these 2 countries. During the cold war an ideological dimension was added to the motives to form partnerships; TT could help to promote understanding for different ideological systems. The latter initiatives were often met by distrust of more central governments (Clarke, 2010), and it is questionable whether these ideological forms of TT reduced transaction costs in a way that could stimulate population growth. Figure 1 shows recent data for town twinning in the European countries. The map shows that TT is most popular in Germany and France.

Figure 1: The geography of town twinning in Europe



Source: own construction, based on Zelinsky (1988) and CEMR (2010)

Our brief overview of TT suggests that, in general, two motives for TT seem to stand out:

- A political motive; following WWII, TT was used as a tool in the process of reconciliation between former enemies (f.i. Falkenhain et al., 2012), Clarke, 2010, Vion, 2002).
- An economic motive; TT is aimed at economic co-operation and by doing so generates international flows of goods and people, because economic distance is reduced via the reduction in inter-city transaction costs (Grosspietsch, 2009, Jayne et al., 2011, Jayne et al. 2013).

In the literature on TT, few examples exist to measure the effects of TT empirically. De Villiers et al. (2007) and Baycan-Levent et al. (2010) use opinion polls among municipal officials. The results suggest that the success of TT depends on the existence of already existing relations with partner cities and similarities in the urban problems they face. Falkenhain et al. (2012), show that geographical proximity is an important factor for twinning density. Clarke (2009, 2010, 2011) uses narratives to analyze TT. Jayne et al. (2011) emphasize relational geography versus territorial geography where towns extend their boundaries through space and time.

This paper adds to this literature by explicitly measuring and estimating the effects of TT on city population growth for German cities. We hypothesize that TT increases international market access of cities by specifically reducing transaction costs between cities that have international partners and also reduces direct transportation costs between partner cities (see for the micro economic foundations, Redding and Sturm, 2008, Brakman et al. 2012). These positive effects of TT might outweigh the coordination costs of being engaged in TT such that TT can indeed have an overall positive effect on a city's population growth.

German cities involved in TT are located throughout Germany, implying that we do not focus on border effects per se, but concentrate on those cities or locations that have TT relations with foreign cities. The reduction in economic distance between these locations and foreign cities, *ceteris paribus*, is thought to stimulate local economies and boost population growth. A theoretical analysis of the effects can for instance be found in Brakman et al. (2009, ch. 11, table 11.4). In a twelve city simulation, based on a Krugman-type new economic geography model (Krugman, 1991), it can be shown that building 'a bridge' between pairs of cities, stimulates growth in cities on the two sides of the bridge. TT is expected to have a similar effect. Town twinning is not something which is enforced upon cities but it is a deliberate choice by cities whether or not to engage in mutual town twinning. They do so when the perceived economic and non-economic benefits are expected to outweigh the set up, and maintenance costs. The former can be looked upon as quasi fixed in the sense that these costs are lower when a German city has already more TT relationships, particularly so when the existing TT relationships are with cities in the same foreign country and if ceteris paribus these countries (and thus twinning cities) are

more nearby. This leads us to expect that the alleged positive growth effects of TT are larger for cities that have a larger number of TT relationships.

3. DATA SET

We focus our analysis on TT related to German cities. As discussed in section 2, Germany is the center of twinning activities and data for Germany are systematically available (in contrast to most other countries). The data are obtained from '*Rat der Gemeinden und Regionen Europas*', http://www.rgre.de/, and the German section of the Council of European Municipalities and Regions (CEMR). The sample includes over 5000 twinning relationships of over 600 German towns, cities and municipalities with locations around the world. The population data are obtained from the *Statistisches Bundesamt* http://www.destatis.de/. Our data cover the period 1976 to 2007. The population data relate to the municipalities level or the county level. If possible we use data for the lowest level of aggregation. The spatial units of the population data and the TT data differ and we refer to the Appendix (Table A11) as to how the population and TT data were matched so as to apply to the same spatial unit. We use *Kreise* as the smallest spatial unit of observation. Cities within Kreise that are involved in TT are aggregated. The data on spatial units are obtained from GFK GeoMarketing, http://www.gfk-geomarketing.de/.

Table 1 shows some summary statistics. The data for Germany cover two forms of TT relationships: partnerships and friendships. Partnership is a form of twinning in which the partners engage in activities based on contracts, whereas friendships are less far-reaching and are based on agreements with limited formal activities or projects. We therefore expect the effects of partnership TT on population growth to be relative stronger. Table 1 shows that number of twinning connections is larger than the number of twinning towns and cities; cities can and often do have more than one twinning relationship: 366 Germany towns and municipalities with complete coverage for all years did have 1502 twinning connections by 1976. This increased to 419 German towns having 3071 twinning connections in 1990 and 610 towns having 5067 twinning connections in 2007.

Table 1: German town twinning 1976-2007, partnerships and friendships

		all twinnings (partnership + friendship)		Partnership		Friendship	
	year	number	%	number	%	number	%
(a) Cumulative twinning towns and cities	1976	366	100%	357	98%	65	18%
	1990	419	100%	410	98%	122	29%
	2007	610	100%	579	95%	239	39%
(b) Cumulative twinning connections	1976	1502	100%	1426	95%	76	5%
	1990	3071	100%	2890	94%	181	6%
	2007	5067	100%	4565	90%	502	10%

Note: The percentages under partnership and friendship don't add up to 100% because of multiple partnerships or friendships per town.

Figure 2a shows the average numbers for German TT where 'all municipalities/counties' includes non-twinners as well, whereas, the group 'twinning municipalities/counties' include only those with at least one town twinning relationship. In 1976 twinning municipalities/counties had on average about 4.5 twinning partners. Including non-twinners reduces the average to about 3. By the year 2012, these numbers are 13 and 10, respectively. So for both groups a gradual increase in the average number of TT relationships is visible. Figure 2b shows the absolute number of municipalities/counties or Kreise with at least one twinning connection in the categories, partnership, friendship, or both, over time. In figure 2b, the '*partners'* and '*partners + friends*' are very similar because the same city which has partnership TT also typically has some friendship TT connections. This implies that partnership and friendship connections are not mutually exclusive.

Figure 2a: Mean number of twinning

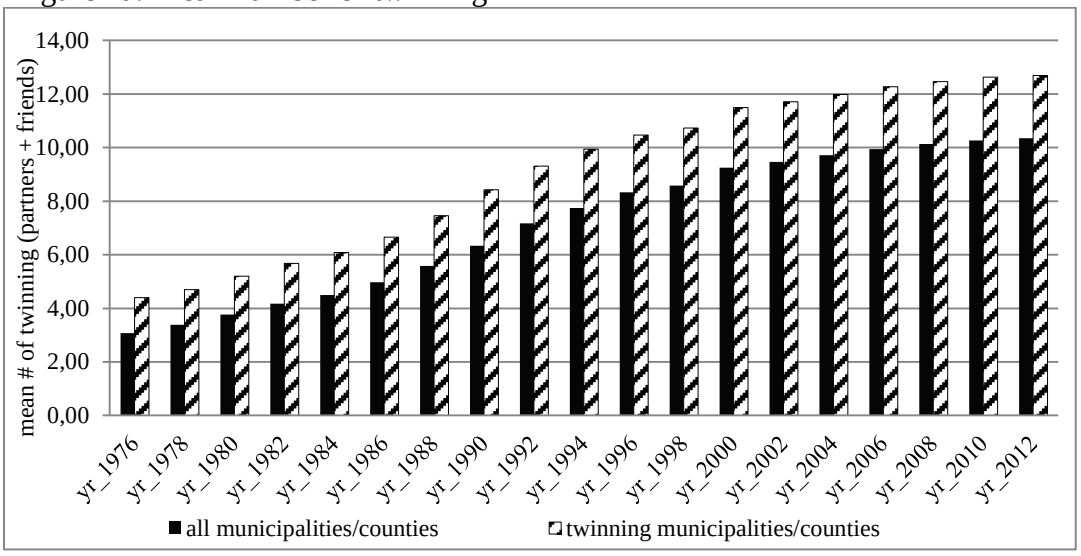
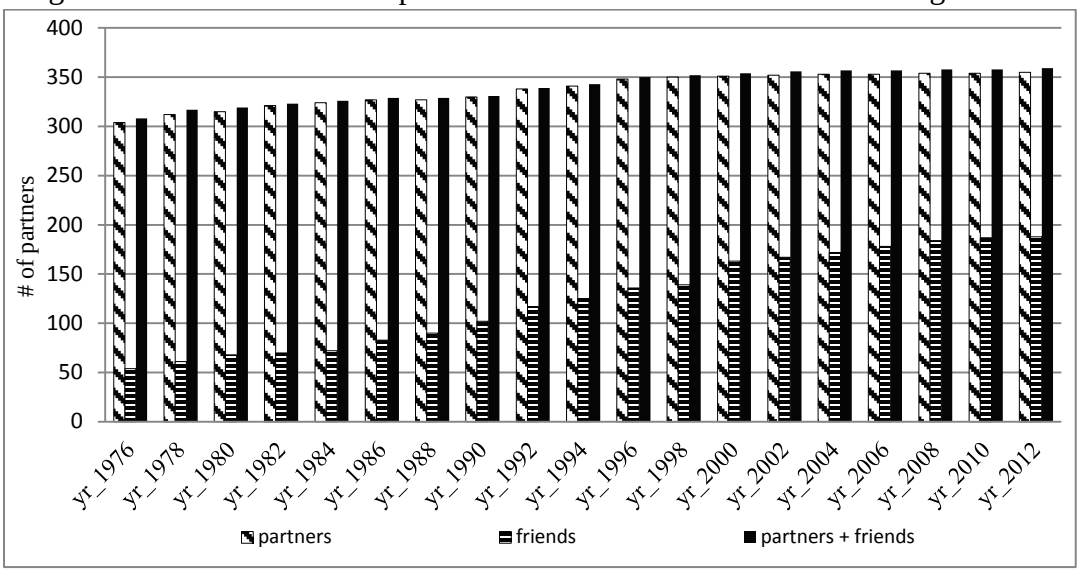
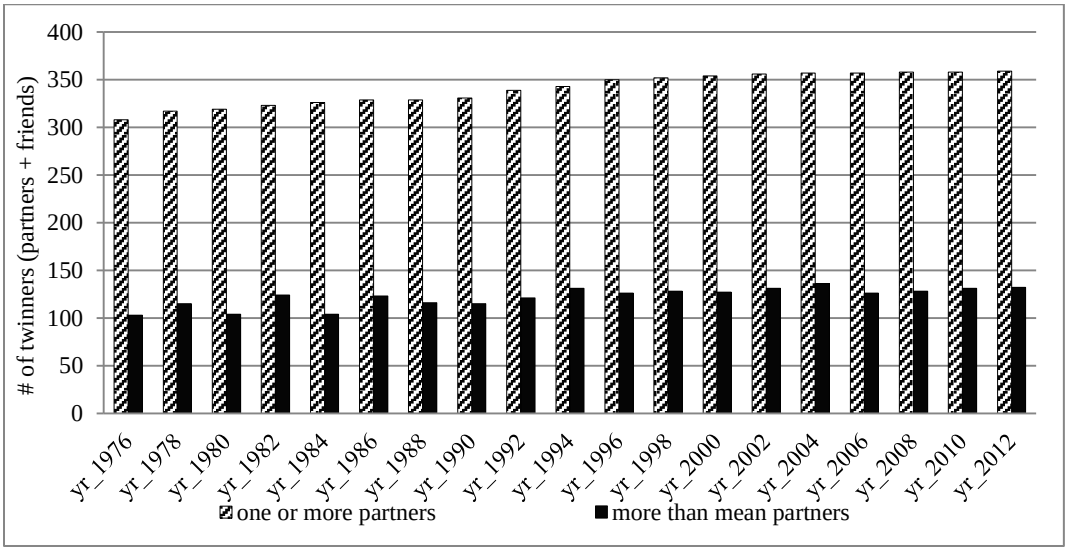


Figure 2b: Number of municipalities/counties with at least one twinning connection



Out of over 2000 German cities and towns, 366 have at least one twinning connection in 1976, and 610 cities and towns had a twinning relationship in 2007 (see table 1). Even after aggregating into the municipalities/counties or Kreise a large number of German Kreise still do not have any town twinning connection at all. In our estimations we also look at the *intensity* of twinning. Figure 2c gives a sense of the difference between town twinning as such and the intensity. The striped bars show whether German towns are engaged in town twinning at all by having at least one twinning connection, and the solid bars show the intensity by displaying the number of German Kreise with more than the mean number twinning connections. Figure 2c illustrates that the growth of German town twinning in our sample period occurred until 2000 and then leveled off. The number of towns with more than the average number of TT is approximately 120.

Figure 2c: Municipalities/counties with at least one (or mean) twinning



When it comes to the geography of the German TT counterparts, Table 2 shows that 36 % of all German TTs are with French cities; over 90 % of TTs are with European countries, including Russia.

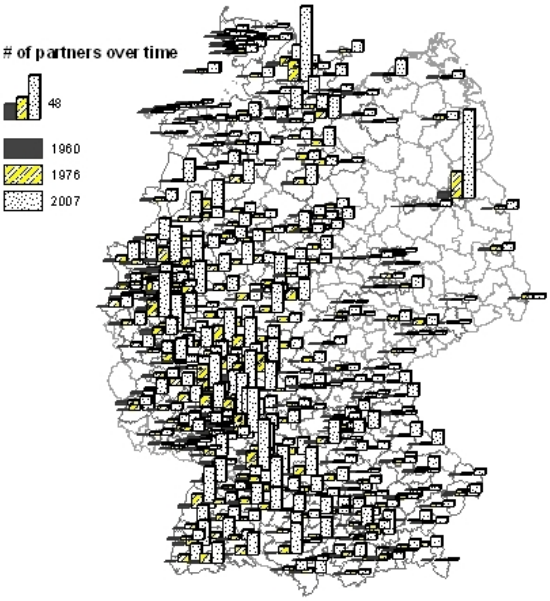
Table 2: Top 40 German twinning partners (98%), 2012

s.n.	Partner	# of	%	Cum.	s.n.	Partner	# of	%	Cum.
1	France	2054	36.41	36.41	21	Greece	34	0.60	92.27
2	Britain	440	7.80	44.21	22	Ukraine	32	0.57	92.84
3	Poland	417	7.39	51.60	23	Nicaragua	26	0.46	93.30
4	Italy	364	6.45	58.06	24	Romania	26	0.46	93.76
5	Austria	304	5.39	63.45	25	Lithuania	24	0.43	94.19
6	Hungary	251	4.45	67.90	26	Croatia	23	0.41	94.59
7	Czech Rep.	168	2.98	70.87	27	Latvia	21	0.37	94.97
8	USA	168	2.98	73.85	28	Luxemburg	20	0.35	95.32
9	Netherlands	167	2.96	76.81	29	Portugal	18	0.32	95.64
10	Russia	121	2.15	78.96	30	Slovenia	18	0.32	95.96
11	Belgium	120	2.13	81.08	31	Slovakia	16	0.28	96.24
12	Denmark	89	1.58	82.66	32	Estonia	15	0.27	96.51
13	Israel	79	1.40	84.06	33	Belarus	13	0.23	96.74
14	Turkey	76	1.35	85.41	34	Norway	13	0.23	96.97
15	Switzerland	72	1.28	86.69	35	Ireland	12	0.21	97.18
16	China	63	1.12	87.80	36	Burkina Faso	11	0.20	97.38
17	Finland	61	1.08	88.88	37	Bosnia&Her.	10	0.18	97.55
18	Sweden	57	1.01	89.90	38	Bulgaria	10	0.18	97.73
19	Japan	53	0.94	90.83	39	Ruanda	7	0.12	97.85
20	Spain	47	0.83	91.67	40	Serbia	7	0.12	97.98

Source: own calculation from the data

Within Germany, the twinning activities are historically concentrated in the western part of Germany, see Figure 3.

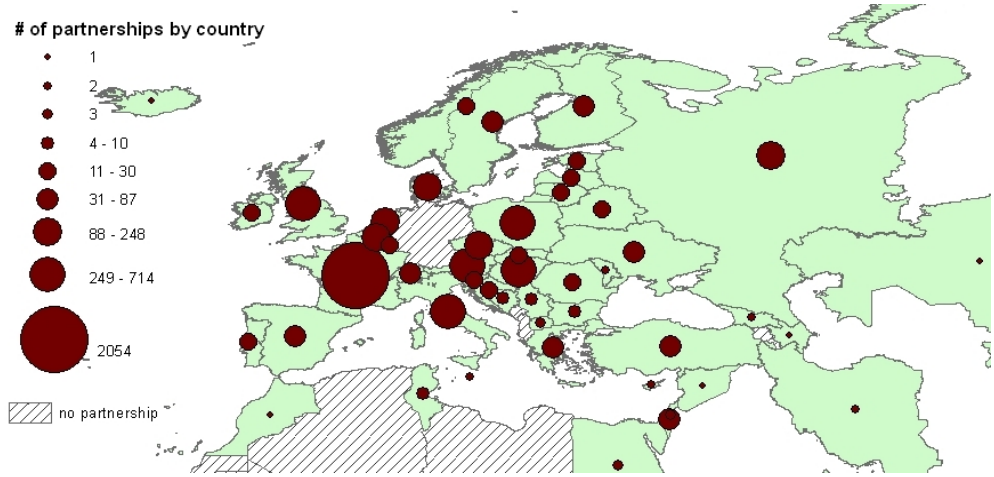
Figure 3: The geographical distribution of German twinning and time trend



Source: own calculation from the data

As a visualization of Table 2, Figure 4 shows the geographical distribution of the major twinning partners' countries and again illustrates the fact that the neighbors of Germany are most important for German TT.

Figure 4: Major twinning partner countries for Germany



Source: own calculation from the data based on absolute number of twinning partners

4. ESTIMATION STRATEGY

We apply a difference-in-differences (DID) method. Furthermore, we use instrumental variables to deal with reverse causality. Our main argument is that German twinning cities have advantages over non-twinning cities as they enter into agreements (local policy shock) that increase economic proximity by reducing transaction costs with the non-German partner cities and indirectly the countries involved, and as a result these German TT cities grow relatively faster. The DID approach can be used to analyze the effects of (non-)policy measures applied to sub-samples of the complete sample. The DID method allows for time-invariant unobserved differences between the control and treatment groups. In particular it removes differences in unobserved characteristics that are constant over time and that can affect the dependent variable, here population growth. The basic specification is (see also Brakman et al., 2012) for a discussion):

$$popgrowth_{m,t} = \phi\, twinning_{mt} + D_t + D_l + \varepsilon_{mt} \qquad (1)$$

$$popgrowth_{m,t} = \beta\, twinning_{mt} + \gamma\left(twinning_{m,t} \times partners_{m,t}\right) + D_t + D_l + \varepsilon_{mt} \qquad (2)$$

where $popgrowth_{m,t}$ is annual population growth of German municipality (or county) *m* at time *t;* $twinning_{mt}$ indicates whether a twinning relationship between a German municipality with international partner city exists. It equals 1 if the municipality has one or more international twinning partner(s) and 0 otherwise. We also include the number of partners explicitly assuming that the larger the number of partners, the larger the reduction in transaction costs; the value of $twinning_{mt}$ than equals to *number* of international partners. The variable $partners_{m,t}$ refers to a particular country or group of countries with which TT exists, like for instance only the sub-sample of French TT partner cities.

Treating $twinning_{mt}$ as a dummy variable refers to what might be called the extensive margin of TT (is there any TT at all?), whereas treating $twinning_{mt}$ as the actual number of TT partners than refers to the intensive margin (how much TT is going on, the "volume" of TT relationships so to say). Given that TT also invokes (coordination) costs on the part of the German TT city, we expect that for German cities which are more heavily involved in TT, and thus have more

experience in setting up and maintaining TT relationships, the effect of TT on population growth to be stronger. Or on in other words we expect the effect of the intensive margin of TT to be stronger as compared to what we dubbed the extensive margin of TT. We thus also expect that the nature of the TT arrangement might matter; partnership TT would then be more relevant than friendship TT.

For the variable $partners_{m,t}$ we look at the following subsamples: French TT counterparts, TT with only neighboring countries, TT with European countries, TT with the founding fathers of the EU (EU 6), or the 1980s members (EC12) and the 1990s members (EU15). D_t, D_l and ε_{mt} indicate time dummies, location dummies and a stochastic error term. The time dummies are annual, whereas location dummies are related to the 15 states of Germany (*Bundesländer)* and as such capture unobserved characteristics of various states. The time dummies control for common shocks affecting the population growth throughout the sample. The DID approach is best used for comparable control groups (see Bertrand et al., 2002; and Cameron and Trivedi, 2005). By differentiating between large and small German counties and municipalities we also control for city size affects in our results. Furthermore, we estimate by using robust standard errors.

We also address the issue of reverse causality, that is, whether TT stimulates population growth or whether stronger economic performance and hence population growth are formalized in TT activities. We use data on the WWII destruction of German cities as instruments. Specifically, the level of destruction of residential houses, number of people killed, tax revenue loss and tons of rubble resulting from bombing of the Germany towns and cities during WWII are used as instruments. The motivation for these instruments is that especially cities that experienced WWII destruction directly or more intensively, are more motivated to strengthen ties between former enemies in order to increase mutual understanding and prevent future wars. The data for the instruments are obtained from Brakman et al. (2004). We employ the Sargan (1958) as well as Basmann (1960) test for Instrumental Variables over-identification (IV OI) to check the power of the instruments.

5. ESTIMATION RESULTS

5.1. The Baseline Results

Table 3 presents the baseline results when estimating equation (1) only. We thus use location fixed effects that are related to the 15 states in Germany. Each of the Kreise in our sample is part of one of the states, and because Kreise are a lower level of aggregation, states consist of more than one Kreis. The inclusion of state fixed effects captures the idea that states might have special treatments for TT (which are unobserved).[4] The columns indicated by dummy=1 correspond to equation (1), and capture whether TT exists at all, columns with intensity=n, capture the intensity of TT and uses 'n' the number of TT relationships explicitly. Furthermore, time dummies are used. We also differentiate between partnerships and friendships, as the ties between cities in a partnership are thought to be stronger.

Table 3: Twinning by German cities and population growth (full sample)

	partnerships + friendships		partnerships only		friendships only	
Variables	(dummy=1) (1)	(intensity=n) (2)	(dummy = 1) (3)	(intensity = n) (4)	(dummy = 1) (5)	(intensity = n) (6)
$Twinning_{mt}$	-0.0756	0.00675***	-0.0955*	0.00724***	0.108***	0.0208***
	(0.0566)	(0.00106)	(0.0559)	(0.00118)	(0.0218)	(0.00549)
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	11,191	11,191	11,191	11,191	11,191	11,191
R-Squared	0.119	0.119	0.119	0.119	0.119	0.119

Note: Robust standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1; intensity = n indicates number of twinning partner cities; dummy = 1 if a municipality is involved in TT.

The results for population growth for twinning as such are mixed (columns 1, 3, and 5). Only in the case of TT friendships, a significant and positive relation exists. When we measure TT by the number of TT contacts the population growth effect (the intensive margin of TT) is positive throughout (columns 2, 4, and 6).[5]

[4] Since we use state fixed effects this also deals with the difference in TT between the former states of West and East Germany prior to German re-unification in 1990.

[5] In order to exclude the possibility that we accidentally pick up urbanization with the twinning variable we looked at the relation between the two; correlation between (various definitions of) twinning and urbanization is low (between 0.08 and 0.28), only 31 of the top-100 twinning cities are also present in the top-100 fastest growing counties, and 54 of the top 100 twinning cities are in the top-100 largest counties.

As France is by far the most important twinning partner of Germany, we focus on France separately in Table 4; $partners_{m,t}$ stands for the TT partners between Germany and France. Separating France from TT in general shows that France dominates the positive population growth effects of TT. The twinning variable becomes ambiguous and is only significantly positive in columns (5) and (6). Having a partner in France is important for German cities; both from the extensive (column 3) and in particular from the intensive (column 4) margin perspective.[6] We include location fixed effects to separate eastern from western German cities.

Table 4: Twinning with France

	Partnerships + friendships		partnerships only		friendships only	
Variables	(dummy=1) (1)	(intensity=n) (2)	(dummy = 1) (3)	(intensity = n) (4)	(dummy = 1) (5)	(intensity = n) (6)
$Twinning_{mt}$	-0.218***	-0.00162	-0.244***	-0.00312	0.123***	0.0248***
	(0.0661)	(0.00204)	(0.0660)	(0.00235)	(0.0228)	(0.00630)
$Twinning_{mt} \times France_{mt}$[7]	0.441***	0.0170***	0.443***	0.0198***	-0.101**	-0.0377
	(0.0815)	(0.00436)	(0.0785)	(0.00475)	(0.0403)	(0.0246)
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	11,191	11,191	11,191	11,191	11,191	11,191
R-Squared	0.121	0.120	0.122	0.120	0.119	0.119

Note: Robust standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1

The conclusion is that TT has a small but detectable effect on population growth when the TT with French cities is involved. This effect is due to the more far reaching form of TT, partnerships. Twinning can stimulates population growth, but it seems relevant to focus on subgroups of TT relationships, here French cities. Results for other subsamples are presented in section 5.2 The question we will, however, address first is that of reverse causality; it could be the case that (trade) relations are good between groups of countries and their respective cities (which as such boosts population growth), and that these ties are formalized in TT. To address this, we use an instrumental variable estimation. As instruments we use the level of destruction of residential houses, the number of people killed, tax revenue loss, and tons of rubble resulting from bombing of the German towns and cities during the WWII by allied forces.

[6] Other neighboring countries give, in a qualitative sense, similar results. Results are available upon request.

[7] $France_{mt}$ = Share of France towns and cities in the total international twinning partners of a Germany municipality or county

The motivation to include war related instruments is that locations that were hit particularly hard by WWII could have been more motivated to get involved in TT than other cities. The perceived importance of mutual understanding in these cities is stronger than in others; see table A10 in the appendix for an analysis of the strength of the instruments. We used the instruments in three categories: 'a' = all the four instruments used together; 'b' = residential buildings loss, rubble per capita, and tax revenue loss, and 'c' = residential buildings loss, and tax revenue loss. Table 5 shows the results of the IV estimates when we estimate equation (1) with IV. It includes a full set of fixed effects. The results for the extensive margin are again ambiguous, but the intensive margin stands out. In all variants that deal with the *number* of twinning relations the effect of twinning is positive.

Table 5: All twinnings, IV estimates

	partnerships + friendships		partnerships + friendships		partnerships + friendships	
	(dummy=1)	(intensity=n)	(dummy = 1)	(intensity = n)	(dummy = 1)	(intensity = n)
Variables	(1)	(2)	(3)	(4)	(5)	(6)
$Twinning_{mt}$	-3.762***	0.0578***	-4.521***	0.0816***	-6.666***	0.0851***
	(0.875)	(0.00998)	(1.052)	(0.0118)	(1.515)	(0.0122)
Instruments	a	a	b	b	c	c
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	11,191	11,191	11,191	11,191	11,191	11,191
R-Squared	---	0.066	---	0.021	---	0.013
Sargan score (p-value)	21.60(0.000)	20.55(0.000)	16.69(0.000)	3.48(0.176)	4.89(0.027)	1.77(0.183)
Basmann score(p-value)	21.55(0.000)	20.50(0.000)	16.64(0.000)	3.47(0.177)	4.87(0.027)	1.76(0.184)

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The Sargan (1958) as well as Basmann (1960) test statistics show that the instrument 'a' doesn't meet the requirement of the over-identifying restriction. However, the instruments 'b' and 'c' fulfill the test of over-identification restriction when we consider the intensity of TT (columns (4) and (6). In these cases, the number of TTs has a positive and statistically significant effect on population growth.

Table 6 shows the IV estimates of table (4) with singling out France as the twinning partner. As in the other cases it includes a full set of fixed effects. In line with the estimation results in Table (4), the results indicate that the extensive margin as well as the intensive margin of TT with France is positive and significant. The tests for over-identifying restrictions show that the

instruments meet the requirement of the over-identifying restrictions.[8] Causal relationship is confirmed as all instrument combinations are valid; more specifically this involves columns (1), (3), (4) and (5), whereas in columns (2), and (6) instruments are not valid.

Table 6: Twinning with France, IV estimates

	partnerships + friendships		partnerships + friendships		partnerships + friendships	
Variables	(dummy=1) (1)	(intensity=n) (2)	(dummy = 1) (3)	(intensity = n) (4)	(dummy = 1) (5)	(intensity = n) (6)
$Twinning_{mt}$	-0.720***	-0.0734***	-0.737***	-0.153***	-0.745***	-0.154***
	(0.106)	(0.0163)	(0.108)	(0.0261)	(0.109)	(0.0262)
$Twinning_{mt} \times France_{mt}$	1.997***	0.163***	2.049***	0.324***	2.076***	0.326***
	(0.280)	(0.0327)	(0.287)	(0.0526)	(0.290)	(0.0529)
Instruments	a	a	b	b	c	c
Year effects	yes	Yes	yes	yes	yes	Yes
Location fixed effects	yes	yes	yes	yes	yes	Yes
Observations	11,191	11,191	11,191	11,191	11,191	11,191
R-Squared	0.074	0.071	0.072	---	0.072	---
Sargan score (p-value)	3.05(0.383)	23.88(0.000)	2.26(0.322)	4.23(0.121)	1.81(0.178)	4.05 (.044)
Basmann score(p-value)	3.04(0.385)	23.82(0.000)	2.26(0.324)	4.21(0.122)	1.80(0.180)	4.03 (.045)

Note: Standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1

The literature suggests that large urban locations are not only more efficient than smaller ones, but they have also an advantage in innovation, and their economies can grow faster than smaller locations, see also Ludema and Wooton (1999) who show that trade liberalization initially benefits larger agglomerations. We therefore define German municipalities that are smaller than the median population size as small, and those that are larger than the median population size as large (see Table A2 and A3 in the appendix). Without using instruments introduced above, TT has positive effects for large and small municipalities, particularly when we account for the intensity of twinning (for example see Table A2 as well as Table A9). After instrumenting, however, the significant and positive TT effects only remain valid for *large* municipalities (table A3), we return to this difference between large and small cities in the next sub-section.

Timing could also be a factor. We looked at early versus late twinning (see table A5). We choose 1960 and 1970 as dividing line to discriminate between early and late TT. These dates distinguish

[8] After separating partnership and friendship for each group of instruments, the results remain consistent and the instruments, in general, remain valid. For instance, see table A1 for the separate estimates using the instruments group 'b'.

between the original but limited EU integration and the time when EU expansion started (with UK, Ireland and Denmark becoming the members in 1973 which was followed by other countries joining the EU in the 1980s, 1990s and 2000s). Table A5 in the appendix presents the results using instruments 'a' and 'c'. The results for instrument 'b' are not reported for space reasons and because they are very similar with the results for instrument 'a'. Tables A4 (no instruments) and A5 (instruments) in general show that early TT has a stronger effect than later TT, although the effects remain positive over the whole period.

5.2. Additional Estimations and Robustness Checks

As German TT with France turns out to be important for the effects of TT on German population growth, we now investigate whether EU connections more generally are important for the impact of twinning. Countries that are more involved in German TT twinning than other countries are for instance the countries that are (founding) members of the EC/EU. The original six members of the pre-1973 European Communities (EC6) are: Belgium, France, Luxembourg, the Netherlands, Italy, and (West) Germany; the EC9 includes the EC6 as well as United Kingdom, Ireland, and Denmark who joined in 1973; EC12 includes the EC9 as well as Greece, Spain and Portugal who joined in the 1980s; the EU15 of includes EC12 members as well as Finland, Austria, and Sweden who joined in 1995; and EU25 includes the EU15 as well as Cyprus, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovenia, and Slovakia who joined EU since 2004 (for more details see Brakman et. al., 2012). Estimating separately for the '*partnership + friendship*', '*partnership only*' and '*friendship only*' gives a similar pattern of results as above; i.e., the results are stronger for partnerships than friendships. The results in Table 7 combine the IV estimation results of both TT partnerships and friendships; i.e., '*partnership + friendship*'. Controlling for the EC (or EU) membership shows that now only the extensive margin of TT, so the number of TT relationships, with the EC6 member countries has a significant effect trough out all estimations but the sign is now negative. However, in the EC6 case, the instruments are weak implying that there is no strong evidence of TT with the EC and EU members leading to higher population growth (see also Tables A6 and A7).

Table 7: Twinning with the EC and EU countries, IV estimates

	EC6		EC12		EU15		EU25	
Variables	(dummy=1) (1)	(intensity=n) (2)	(dummy=1) (3)	((inten=n) (4)	(dummy=1) (5)	((inten=n) (6)	(dummy=1) (7)	(inten=n) (8)
$Twinning_{mt}$	-1.380***	0.289***	0.793	0.432***	0.732	0.411***	2.159***	0.200***
	(0.437)	(0.0793)	(0.544)	(0.0990)	(0.550)	(0.0924)	(0.626)	(0.0472)
$Twinning_{mt} \times EC(.)$	1.871***	-0.0101***	-1.224	-0.0127***	-1.134	-0.0112***	-3.135***	-0.0045***
	(0.622)	(0.00283)	(0.763)	(0.00297)	(0.769)	(0.00256)	(0.874)	(0.00111)
Instruments	a	a	a	a	a	a	a	a
Year effects	yes	yes	yes	yes	yes	yes	yes	yes
Location effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	11,191	11,191	11,191	11,191	11,191	11,191	11,191	11,191
R-Squared	0.084	---	0.078	---	0.082	---	---	---
Sargan score (p-val)	45.33(0.00)	17.09(0.001)	51.39(0.000)	5.72(0.126)	52.05(0.00)	7.08(0.070)	36.29(0.00)	26.16(0.00)
Basmann score(p-v)	45.31(0.00)	17.04(0.001)	51.40(0.000)	5.70(0.127)	52.06(0.00)	7.05(0.070)	36.25(0.00)	26.11(0.00)

Note: Standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1; *EC(.) = **(**EC6, EC12, EU15, EU25**)***

After observing the differences between the effects from twinning with France and TT with the various historical compositions of the EC and EU countries, geographical proximity or contiguity also could be a factor. Countries that are nearby in a geographical sense are also ceteris paribus near in other respects, like a common culture and it may be relatively more easy (or less costly) to set up TT relationships with these countries (recall also that these countries, like France, were typically invaded by Germany during WWII). From Table 2 we can see that in addition to France, 7 neighboring countries (with additionally 1200 TT relationships) are in the top-15 of German TT partners. The results are presented in Table 8.

Table 8: Twinning with Neighboring countries, IV estimates

	Partnerships + friendships		partnerships + friendships		partnerships + friendships	
Variables	(dummy=1) (1)	(intensity=n) (2)	(dummy = 1) (3)	(intensity = n) (4)	(dummy = 1) (5)	(intensity = n) (6)
$Twinning_{mt}$	-0.710***	-0.0896***	-0.724***	-0.123***	-0.737***	-0.128***
	(0.102)	(0.0160)	(0.104)	(0.0195)	(0.105)	(0.0200)
$Twinning_{mt} \times Neighbor_{mt}$	1.289***	0.147***	1.319***	0.198***	1.345***	0.206***
	(0.176)	(0.0241)	(0.180)	(0.0294)	(0.182)	(0.0302)
Instruments	a	a	b	b	c	c
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	11,191	11,191	11,191	11,191	11,191	11,191
R-Squared	0.104	0.092	0.103	0.074	0.102	0.071
Sargan score (p-value)	1.64(0.651)	12.50(0.006)	0.92(0.632)	2.62(0.269)	0.12(0.730)	1.06(0.303)
Basmann score(p-value)	1.63(0.653)	12.45(0.006)	0.91(0.633)	2.63(0.269)	0.12(0.731)	1.06(0.304)

Note: Robust standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1

We find positive and significant of both extensive and intensive margin of TT, that is the number of town twins (columns 2 4 and 6) on population growth which is not very surprising given the dominance of (neighbor) France for German TT, recall Table (6).[9]

Dividing the sample into large and small locations shows that the results are again only significant for the larger municipalities, see Table 9. This supports the argument that large urban locations are not only more efficient than smaller ones, but also have an advantage in innovation, and grow faster than smaller locations.

Table 9: Twinning with Neighboring countries, IV estimates (small vs large German cities)

	partnerships + friendships		partnerships + friendships		partnerships + friendships	
Variables	(dummy=1) (1)	(intensity=n) (2)	(dummy = 1) (3)	(intensity = n) (4)	(dummy = 1) (5)	(intensity = n) (6)
			Small Municipalities			
$Twinning_{mt}$	-0.0420	-0.0641	-0.0418	-0.0683	-0.0221	-0.0570
	(0.351)	(0.0752)	(0.351)	(0.0770)	(0.359)	(0.0789)
$Twinning_{mt} \times Neighbor_{mt}$	0.595	0.0885	0.595	0.0938	0.565	0.0797
	(0.482)	(0.0935)	(0.482)	(0.0957)	(0.495)	(0.0980)
Instruments	a	a	b	b	c	c
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	4,588	4,588	4,588	4,588	4,588	4,588
R-Squared	0.055	0.053	0.055	0.052	0.055	0.053
Sargan score (p-value)	0.73(0.867)	2.03(0.566)	0.73(0.694)	1.96(0.375)	0.66(0.417)	1.54(0.214)
Basmann score(p-value)	0.72(0.868)	2.02(0.569)	0.72(0.670)	1.95(0.378)	0.65(0.419)	1.53(0.216)
			Large municipalities			
$Twinning_{mt}$	-0.856***	-0.0992***	-0.908***	-0.145***	-0.911***	-0.148***
	(0.0632)	(0.00832)	(0.0655)	(0.0112)	(0.0655)	(0.0114)
$Twinning_{mt} \times Neighbor_{mt}$	1.465***	0.167***	1.549***	0.235***	1.554***	0.240***
	(0.0804)	(0.0122)	(0.0849)	(0.0166)	(0.0851)	(0.0168)
Instruments	a	a	b	b	c	c
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	4,526	4,526	4,526	4,526	4,526	4,526
R-Squared	0.306	0.376	0.192	0.376	0.182	0.181
Sargan score (p-value)	18.99(0.000)	59.45(0.000)	8.46(0.015)	5.55(0.062)	7.36(0.007)	0.82(0.365)
Basmann score(p-value)	18.87(0.000)	59.62(0.000)	8.39(0.015)	5.50(0.064)	7.30(0.007)	0.81(0.367)

Note: Standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1

[9] Results (not presented) with non-neighbouring countries are negative, that is, the further away the less effect a Twinning relation has.

In Tables 10 and 11, we provide alternative results for twinning with France and with neighboring countries in general. Instead of dividing the sample into small and large municipalities, we include a city size dummy. The dummy 'Large_1970s' is based on the initial population size (in the 1970s) and includes a city if the city size was larger than the median size. In columns (3) and (6) we use the share of the initial population size as 'Share_1970s'.

Table 10: Twinning with France, additional IV estimates (partnerships + friendships)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
			Twinning dummy =1			
$Twinning_{mt}$	-0.737***	-0.727***	-0.738***	-0.737***	-0.727**	-0.738**
	(0.0766)	(0.0951)	(0.0990)	(0.2450)	(0.3296)	(0.3640)
$Twinning_{mt} \times France_{mt}$	2.049***	2.002***	2.025***	2.049***	2.002***	2.025***
	(0.1832)	(0.1743)	(0.1814)	(0.6613)	(0.6462)	(0.7295)
Instruments	b	b	b	b	b	b
Year effects	Yes	Yes	Yes	Yes	Yes	yes
Location fixed effects	Yes	Yes	Yes	Yes	Yes	yes
Large_1970s		0.0085			0.0085	
		(0.0319)			(0.0494)	
Share_1970s			0.0329			0.0329
			(0.0898)			(0.1418)
St. Errors	robust	robust	robust	cluster-robust	cluster-robust	cluster-robust
Observations	11,191	9623	9623	11,191	9623	9623
R-Squared	0.072	0.047	0.046	0.072	0.047	0.046
IV OI test score (p-value)	5.601(0.061)	1.466(0.480)	1.379(0.502)	Na	Na	na
			Twinning intensity = n			
$Twinning_{mt}$	-0.153***	-0.228***	-0.536***	-0.153*	-0.228*	-0.536
	(0.0237)	(0.0349)	(0.1394)	(0.0834)	(0.1351)	(0.8137)
$Twinning_{mt} \times France_{mt}$	0.324***	0.428***	0.956***	0.324**	0.428*	0.956
	(0.0413)	(0.0581)	(0.2337)	(0.1619)	(0.2404)	(1.4157)
Instruments	b	b	b	b	b	b
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Location fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Large_1970s		0.0854			0.0854	
		(0.0536)			(0.2384)	
Share_1970s			3.1214***			3.1214
			(1.0351)			(6.4731)
St. Errors	robust	robust	robust	cluster-robust	cluster-robust	cluster-robust
Observations	11,191	9623	9623	11,191	9623	9623
R-Squared	--	--	--	--	--	--
IV OI test score(p-value)	11.687(0.003)	8.023(0.018)	0.640(0.726)	na	na	na

Note: Standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1; IV OI test: Instrumental Variables over-identification test. na = not available since IV OI test is not available with cluster robust errors.

Our data set starts in 1976. For both the size dummy and the initial population share variable, we used the first available year of data. For instance, if year 1976 data is missing for a municipality, then we use 1977 population as initial population, and so on until the end of 1970s. In both Tables 10 and 11, we use the IV estimation using instruments 'b'. Columns (1) through (3) use robust standard errors; whereas, Columns (4) through (6) use *clustered* robust standard errors to account for the possibility of spatial interdependence. Columns (1) and (4) show the results with the two types of standard errors. Columns (2) and (5) account for the initial size in the form of the city size dummy. In columns (3) and (6) we use the share of the initial year population.

Table 11: Twinning with Neighboring countries, additional IV estimates (partnerships + friendships)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
			Twinning dummy =1			
$Twinning_{mt}$	-0.724***	-0.664***	-0.676***	-0.724***	-0.664**	-0.676**
	(0.0730)	(0.0880)	(0.0906)	(0.2159)	(0.2833)	(0.2999)
$Twinning_{mt} \times Neighbor_{mt}$	1.319***	1.294***	1.311***	1.319***	1.294***	1.311***
	(0.1102)	(0.1066)	(0.1097)	(0.3069)	(0.3156)	(0.3444)
Instruments	b	b	b	b	b	b
Year effects	yes	yes	yes	yes	yes	Yes
Location fixed effects	yes	yes	yes	yes	yes	Yes
Large_1970s		0.0536*			0.0536*	
		(0.0294)			(0.0298)	
Share_1970s			0.0895			0.0895
			(0.0888)			(0.1141)
St. Errors	robust	robust	robust	cluster-robust	cluster-robust	cluster-robust
Observations	11191	9623	9623	11191	9623	9623
R-Squared	0.103	0.085	0.084	0.103	0.085	0.084
IV OI test score (p-value)	2.610(0.271)	0.689(0.709)	0.753(0.686)	na	na	Na
			Twinning intensity = n			
$Twinning_{mt}$	-0.123***	-0.147***	-0.187***	-0.123***	-0.147***	-0.187*
	(0.0146)	(0.0171)	(0.0249)	(0.0442)	(0.0541)	(0.1038)
$Twinning_{mt} \times Neighbor_{mt}$	0.198***	0.221***	0.274***	0.198***	0.221***	0.274*
	(0.0201)	(0.0229)	(0.0327)	(0.0663)	(0.0766)	(0.1412)
Instruments	b	b	b	b	b	b
Year effects	yes	yes	yes	yes	yes	Yes
Location fixed effects	yes	yes	yes	yes	yes	Yes
Large_1970s		0.0812**			0.0812	
		(0.0342)			(0.1012)	
Share_1970s			0.7850***			0.7850
			(0.2001)			(0.9599)
St. Errors	robust	robust	robust	cluster-robust	cluster-robust	cluster-robust
Observations	11191	9623	9623	11191	9623	9623
R-Squared	0.074	0.045	0.019	0.074	0.045	0.019
IV OI test score(p-value)	6.879(0.032)	1.586(0.453)	3.161(0.206)	na	na	Na

Note: Standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1; IV OI test: Instrumental Variables Over-identification test. na = not available since IV OI test is not available with cluster robust errors.

The main message from Tables 10 and 11 is that the positive effects of TT (with neighboring countries) are still present. The results suggest that German municipalities or countries twinning with France have on average about 2 percent higher population growth than non-twinning municipalities over the sample periods (see the top half of table 10). The effect is around 1.3 percent when we look at twinning with all neighboring countries (see the top half of table 11). When we look at intensity of twinning, the effects are smaller in both cases (see the bottom half of tables 10 and 11).

6. CONCLUSIONS

Although Town Twinning (TT) has been around for a long time it really took off after WWII. In the post-WWII period, TT was aimed at political reconciliation and enhancing mutual understanding between former enemies, in particular so for Germany. If successful, TT could be looked upon as reducing the economic distance between the cities that are involved in these initiatives, which can be seen as to stimulate the growth of the cities involved in TT. Existing research on TT is to a large extent descriptive and we add to this literature by explicitly focusing on the quantitative consequences of TT, that is, for the case of Germany we estimate whether TT stimulates population growth in the cities that are involved in TT.

We focus on Germany because Germany became the main actor in TT after WWII. Applying a difference-in-differences approach, and distinguishing between the extensive margin of TT (whether TT exist at all for a given city) and the intensive margin (the number of TT relations), our results show that German counties and municipalities that engage in town twinning often have had a significantly higher population growth compared to German cities that do not have twinning partners. Especially the number or intensity of twinning relations as well as town twinning with French cities, and with neighboring countries more generally, turn out to have a positive effect on city growth. We also find that the positive population growth effects of town twinning are confined to the larger German cities. Town twinning could facilitate relocation or migration of workers and firms to more optimal locations. As cities get more productive, they are likely to grow faster.

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8. APPENDIX

Table A1: Twinning with France, IV estimates (With IV IV set b variables)

	partnerships + friendships		partnerships only		Friendships only	
Variables	(dummy=1) (1)	(intensity=n) (2)	(dummy = 1) (3)	(intensity = n) (4)	(dummy = 1) (5)	(intensity = n) (6)
$Twinning_{mt}$	-0.737***	-0.153***	-0.774***	-0.180***	-1.523***	-0.694***
	(0.108)	(0.0261)	(0.111)	(0.0311)	(0.345)	(0.133)
$Twinning_{mt} \times France_{mt}$	2.049***	0.324***	2.027***	0.357***	11.26***	6.719***
	(0.287)	(0.0526)	(0.286)	(0.0590)	(2.347)	(1.240)
Instruments	b	b	b	b	b	b
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	11,191	11,191	11,191	11,191	11,191	11,191
R-Squared	0.072	---	0.071	---	---	---
Sargan score (p-value)	2.26(0.322)	4.23(0.121)	2.99(0.224)	5.23(0.073)	1.36(0.507)	0.34(0.844)
Basmann score(p-value)	2.26(0.324)	4.21(0.122)	2.98(0.225)	5.21(0.074)	1.35(0.509)	0.34(0.844)

Note: Standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1

Table A2: Twinning with France (small vs large)

	partnerships + friendships		partnerships only		friendships only	
Variables	(dummy=1) (1)	(intensity=n) (2)	(dummy = 1) (3)	(intensity = n) (4)	(dummy = 1) (5)	(intensity = n) (6)
			Small Municipalities			
$Twinning_{mt}$	0.249	-0.00727	0.242	-0.0117*	0.111***	0.0275**
	(0.168)	(0.00530)	(0.166)	(0.00632)	(0.0347)	(0.0112)
$Twinning_{mt} \times France_{mt}$	0.235*	0.0214**	0.236*	0.0265***	-0.0879	-0.0311
	(0.137)	(0.00873)	(0.130)	(0.00961)	(0.0596)	(0.0396)
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	4,588	4,588	4,588	4,588	4,588	4,588
R-Squared	0.083	0.082	0.083	0.082	0.081	0.081
			Large municipalities			
$Twinning_{mt}$	-0.242***	0.00535**	-0.264***	0.00639**	0.123***	0.0152**
	(0.0520)	(0.00210)	(0.0526)	(0.00256)	(0.0251)	(0.00668)
$Twinning_{mt} \times France_{mt}$	0.643***	0.0152***	0.661***	0.0159***	-0.0703	0.000140
	(0.0621)	(0.00372)	(0.0607)	(0.00425)	(0.0513)	(0.0300)
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	4,526	4,526	4,526	4,526	4,526	4,526
R-Squared	0.443	0.439	0.445	0.440	0.430	0.428

Note: Robust standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1

Table A3: Twinning with France, IV estimates (small vs large)

	partnerships + friendships		partnerships + friendships		partnerships + friendships	
Variables	(dummy=1) (1)	(intensity=n) (2)	(dummy = 1) (3)	(intensity = n) (4)	(dummy = 1) (5)	(intensity = n) (6)
			Small Municipalities			
$Twinning_{mt}$	0.0351	-0.0355	0.0353	-0.0429	0.0258	0.0932
	(0.343)	(0.0934)	(0.343)	(0.0991)	(0.344)	(0.151)
$Twinning_{mt} \times France_{mt}$	0.691	0.0641	0.690	0.0753	0.710	-0.0548
	(0.675)	(0.141)	(0.675)	(0.150)	(0.676)	(0.100)
Instruments	a	a	b	b	c	c
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	4,588	4,588	4,588	4,588	4,588	4,588
R-Squared	0.053	0.053	0.053	0.052	0.053	0.051
Sargan score (p-value)	1.20(0.753)	2.72(0.436)	1.20(0.549)	2.67(0.263)	0.86(0.355)	1.82(0.178)
Basmann score(p-value)	1.19(0.756)	2.70(0.440)	1.19(0.552)	2.65(0.266)	0.85(0.357)	1.80(0.180)
			Large municipalities			
$Twinning_{mt}$	-0.961***	-0.102***	-1.011***	-0.202***	-1.012***	-0.203***
	(0.0736)	(0.0114)	(0.0766)	(0.0234)	(0.0767)	(0.0235)
$Twinning_{mt} \times France_{mt}$	2.308***	0.229***	2.423***	0.430***	2.426***	0.431***
	(0.137)	(0.0224)	(0.145)	(0.0465)	(0.145)	(0.0467)
Instruments	a	a	b	b	c	c
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	4,526	4,526	4,526	4,526	4,526	4,526
R-Squared	0.260	0.048	0.243	---	0.242	--
Sargan score (p-value)	8.76(0.033)	75.72(0.000)	1.25(0.535)	5.32(0.070)	0.85(0.355)	4.97(0.026)
Basmann score(p-value)	8.70(0.034)	76.23(0.000)	1.24(0.539)	5.28(0.071)	0.85(0.357)	4.93(0.026)

Note: Standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1

Table A4: Twinning with France (early vs late twinners)

	reference year 1960		reference year 1970	
Variables	(early) (1)	(late) (2)	(early) (3)	(late) (4)
$Twinning_{mt}$	-0.398***	-0.0551	-0.309***	0.0520
	(0.0385)	(0.0535)	(0.0430)	(0.0916)
$Twinning_{mt} \times France_{mt}$	0.878***	0.240**	0.601***	0.0354
	(0.0869)	(0.104)	(0.0586)	(0.193)
Year effects	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes
Observations	11,191	11,191	11,191	11,191
R-Squared	0.122	0.119	0.123	0.119

Note: Robust standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1;

Table A5: Twinning with France, IV estimates (early vs late twinners)

	reference year 1960		reference year 1970		reference year 1960		reference year 1970	
Variables	(early) (1)	(late) (2)	(early) (3)	(late) (4)	(early) (5)	(late) (6)	(early) (7)	(late) (8)
$Twinning_{mt}$	-1.240*** (0.177)	-1.833*** (0.292)	-0.855*** (0.114)	-4.67*** (1.372)	-1.319*** (0.186)	-1.973*** (0.310)	-0.870*** (0.116)	-11.41*** (4.213)
$Twinning_{mt} \times France_{mt}$	3.319*** (0.499)	4.609*** (0.711)	2.105*** (0.295)	14.15*** (4.094)	3.547*** (0.524)	4.953*** (0.756)	2.148*** (0.301)	34.30*** (12.58)
Instruments	a	a	a	a	c	c	c	c
Year effects	Yes	yes	yes	yes	yes	yes	yes	yes
Location fixed effects	Yes	yes	yes	yes	yes	yes	yes	yes
Observations	11,191	11,191	11,191	11,191	11,191	11,191	11,191	11,191
R-Squared	0.086	---	0.086	---	0.081	---	0.085	---
Sargan score (p-value)	7.34(0.062)	2.69(0.441)	2.70(0.441)	15.43(0.002)	5.13(0.024)	0.02(0.890)	2.02(0.154)	0.27(0.600)
Basmann score(p-value)	7.32(0.063)	2.68(0.443)	2.69(0.443)	15.39(0.002)	5.11(0.024)	0.02(0.890)	2.015(0.156)	0.28(0.600)

Note: Standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1;

Table A6: Twinning with the EC and EU countries, (whole Sample)

	EC6		EC12		EU15		EU25	
Variables	(dummy=1) (1)	(intensity=n) (2)	(dummy= 1) (3)	(intensity=n) (4)	(dummy= 1) (5)	(intensity=n) (6)	(dummy=1) (7)	(intensity= n) (8)
$Twinning_{mt}$	-0.444*** (0.0724)	0.0106*** (0.00195)	-0.467*** (0.0835)	0.0121*** (0.00238)	-0.483*** (0.0870)	0.0127*** (0.00246)	-0.528*** (0.0898)	0.0126*** (0.00285)
$Twinning_{mt} \times EC(U)_j$	0.529*** (0.0653)	-0.000137*** (5.25e-05)	0.551*** (0.0858)	-0.000161*** (5.63e-05)	0.573*** (0.0920)	-0.000166*** (5.38e-05)	0.635*** (0.0969)	-0.000139** (5.46e-05)
Year effects	yes	yes	yes	yes	yes	yes	yes	yes
Loc. fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	11,191	11,191	11,191	11,191	11,191	11,191	11,191	11,191
R-Squared	0.122	0.119	0.122	0.119	0.122	0.119	0.122	0.119

Note: Robust standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1; $EC(U)_j \in$ ***(EC6, EC12, EU15, EU25)***

Table A7: Twinning with the EC and EU countries, IV estimates (whole Sample, IV c)

	EC6		EC12		EU15		EU25	
Variables	(dummy=1) (1)	(inten = n) (2)	(dummy=1) (3)	(inten = n) (4)	(dummy=1) (5)	(inten = n) (6)	(dummy=1) (7)	(inten = n) (8)
$Twinning_{mt}$	-5.144*** (1.023)	0.529*** (0.146)	17.92** (6.995)	0.589*** (0.146)	19.72** (8.076)	0.575*** (0.139)	5.106*** (1.154)	0.569*** (0.129)
$Twinning_{mt} \times EC(U)_j$	7.268*** (1.463)	-0.0186*** (0.00521)	-25.35** (9.852)	-0.0174*** (0.00437)	-27.80** (11.34)	-0.0157*** (0.00385)	-7.270*** (1.616)	-0.0132*** (0.00303)
Instruments	c	c	c	c	c	c	c	c
Year effects	yes	yes	yes	yes	yes	yes	yes	yes
Location effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	11,191	11,191	11,191	11,191	11,191	11,191	11,191	11,191
R-Squared	---	---	---	---	---	---	---	---
Sargan score (p-val)	7.86(0.005)	1.80(0.179)	0.004(0.952)	0.33(0.566)	0.005(0.944)	0.77(0.379)	14.38(0.000)	0.66(0.418)
Basmann score(p-v)	7.84(0.005)	1.80(0.180)	0.004(0.952)	0.33(0.567)	0.005(0.944)	0.77(0.380)	14.33(0.000)	0.65(0.419)

Note: Standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1; $EC(U)_j \in$ ***(EC6, EC12, EU15, EU25)***

Table A8: Twinning with the EC and EU countries, IV estimates (early vs late)

	EC6		EC12		EU15	
Variables	(early) (1)	(late) (2)	(early) (3)	(late) (4)	(early) (5)	(late) (6)
$Twinning_{mt}$	2.364***	-0.402***	16.44***	-0.403***	19.72**	-0.343***
	(0.715)	(0.0717)	(6.149)	(0.0730)	(8.076)	(0.0718)
$Twinning_{mt} \times EC(U)_j$	-4.352***	0.0516***	-23.34***	0.0616***	-27.80**	0.112***
	(1.268)	(0.00723)	(8.687)	(0.00879)	(11.34)	(0.0171)
Instruments	c	c	c	c	c	c
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	11,191	11,191	11,191	11,191	11,191	11,191
R-Squared	---	0.082	---	0.057	---	---
Sargan score (p-value)	17.70(0.000)	2.84(0.092)	0.002(0.958)	3.25(0.071)	0.005(0.944)	4.02(0.045)
Basmann score(p-value)	17.65(0.000)	2.83(0.093)	0.003(0.958)	3.24(0.072)	0.005(0.944)	4.00(0.046)

Note: Standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1; *$EC(U)_j$ Є (EC6, EC12, EU15); early(late) = before(after) joining EC6/EC12/EU15*

Table A9: Twinning with Neighboring countries (small vs large)

	partnerships + friendships		partnerships only		friendships only	
Variables	(dummy=1) (1)	(intensity=n) (2)	(dummy = 1) (3)	(intensity = n) (4)	(dummy = 1) (5)	(intensity = n) (6)
			Small Municipalities			
$Twinning_{mt}$	0.142	-0.0186***	0.156	-0.0204***	-0.0521	-0.0380***
	(0.216)	(0.00610)	(0.213)	(0.00753)	(0.0402)	(0.0141)
$Twinning_{mt} \times Neighbor_{mt}$	0.322*	0.0317***	0.292	0.0326***	0.294***	0.164***
	(0.187)	(0.00859)	(0.179)	(0.00994)	(0.0443)	(0.0255)
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	4,588	4,588	4,588	4,588	4,588	4,588
R-Squared	0.084	0.082	0.083	0.082	0.082	0.082
			Large municipalities			
$Twinning_{mt}$	-0.494***	-0.0190***	-0.523***	-0.0229***	0.0122	-0.0235***
	(0.0568)	(0.00318)	(0.0585)	(0.00392)	(0.0322)	(0.00866)
$Twinning_{mt} \times Neighbor_{mt}$	0.869***	0.0477***	0.895***	0.0538***	0.201***	0.118***
	(0.0567)	(0.00469)	(0.0589)	(0.00561)	(0.0365)	(0.0197)
Year effects	yes	yes	yes	yes	yes	yes
Location fixed effects	yes	yes	yes	yes	yes	yes
Observations	4,526	4,526	4,526	4,526	4,526	4,526
R-Squared	0.464	0.449	0.464	0.449	0.433	0.431

Note: Robust standard errors in parentheses; ***P < 0.01; **P < 0.05; *P < 0.1

Table A10: Correlations: twinning and the instruments

	Twinning	residential buildings loss %	rubble per capita tons	tax revenue loss %	# of casualties by war
Twinning	1.0000				
residential buildings loss %	0.1503***	1.0000			
rubble per capita	0.1288***	0.9223***	1.0000		
tax revenue loss %	0.1291***	0.8429***	0.8755***	1.0000	
# of casualties by war	0.0740***	0.4593***	0.5274***	0.5090***	1.0000

*** = significance at 1% level

Table A11: Merging Twinning and population data

(1) Twinning data: 2614 cities and towns & 610 of them involved in twinning latest by 2007

		twinning						
	year	……..	1975	1976	1977	1978	1979	……..
	city/town	……..	……..					
1	Abtsgmünd	……..	……..	0	0	0	0	……..
2	Achberg	……..	……..	0	0	0	0	……..
3	Achern	……..	……..	0	0	1	1	……..
4	Adelberg	……..	……..	0	0	1	1	……..
5	Adelmannsfelden	……..	……..	0	0	0	0	……..
6	Adelsdorf	……..	……..	0	0	0	0	……..
7	Adendorf	……..	……..	0	0	0	0	……..
8	Adenstedt	……..	……..	1	1	1	1	……..
9	Adlkofen	……..	……..	0	0	0	0	……..
10	Affalterbach	……..	……..	0	0	0	0	……..
11	Ahlen	……..	……..	0	0	0	0	……..
12	Ahorn	……..	……..	1	1	1	1	……..
13	Aicha vorm	……..	……..	0	0	0	1	……..
14	Aichach	……..	……..	0	0	0	0	……..
15	Aidenbach	……..	……..	0	0	0	0	……..
16	Aken (Elbe)	……..	……..	0	0	0	0	……..
17	Albbruck	……..	……..	1	1	1	1	……..
18	Albersdorf	……..	……..	0	0	0	0	……..
19	Albersweiler	……..	……..	0	0	0	0	……..
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2601	Zeulenroda-	……..	……..	0	0	0	0	……..
2602	Zeven	……..	……..	0	0	0	0	……..
2603	Zierenberg	……..	……..	1	1	1	1	……..
2604	Zirndorf	……..	……..	1	1	1	1	……..
2605	Zittau	……..	……..	1	1	1	1	……..
2606	Zornheim	……..	……..	0	0	0	0	……..
2607	Zschopau	……..	……..	1	1	1	1	……..
2608	Zülpich	……..	……..	2	2	3	3	……..
2609	Zuzenhausen	……..	……..	2	2	2	2	……..
2610	Zweibrücken	……..	……..	1	1	2	2	……..
2611	Zwickau	……..	……..	1	1	1	1	……..
2612	Zwiefalten	……..	……..	1	1	1	1	……..
2613	Zwingenberg	……..	……..	1	1	1	1	……..
2614	Zwönitz	……..	……..	0	0	0	0	……..

(2) Population data: 440 municipalities/ counties

		Population/year			
	muncipalty/county(kreis)	1976	…	2006	2007
1	Aken (Elbe)	287619	…..	310267	310093
2	Aachen, Stadt	242453	…..	258208	258770
3	Ahrweiler	109435	…..	130467	129520
4	Aichach-Friedberg	91399	…..	127446	127531
5	Alb-Donau-Kreis	155694	…..	190233	190189
6	Altenburger Land		…..	106365	104721
7	Altenkirchen (Westerwald)	122066	…..	136425	135752
8	Altmarkkreis Salzwedel		…..	96040	94545
9	Altötting	92825	…..	109227	108789
10	Alzey-Worms	95552	…..	126328	126058
11	Amberg	46934	…..	44618	44394
12	Amberg-Sulzbach	94605	…..	108159	107683
13	Ammerland		…..	115891	116626
.	.	.	.	.	.
.	.	.	.	.	.
435	Wuppertal	405369	…..	359237	358330
436	Würzburg (Land)	146046	…..	159978	160222
437	Würzburg (Stadt)	112584	…..	133906	134913
438	Zollernalbkreis	173554	…..	192722	192138
439	Zweibrücken	35978	…..	35219	34842
440	Zwickau		…..	97832	96786

(3) # 1 & (2) merged: one or more rows of twinning data from #1 are added and matched with data in #2, resulting in:

	muncipalty/county(kreis)	Population				twinning				
		1976	…..	2006	2007	…..	1976	1977	1978	1979	….
1	Aken (Elbe)	287619	…..	310267	310093	…..	0	0	0	0	….
2	Aachen, Stadt	242453	…..	258208	258770	…..	0	0	0	0	….
3	Ahrweiler	109435	…..	130467	129520	…..	3	4	4	4	….
4	Aichach-Friedberg	91399	…..	127446	127531	…..	2	2	2	2	….
5	Alb-Donau-Kreis	155694	…..	190233	190189	…..	1	2	2	3	….
6	Altenburger Land	na	…..	106365	104721	…..	0	0	0	0	….
7	Altenkirchen (Westerwald)	122066	…..	136425	135752	…..	3	3	3	3	….
8	Altmarkkreis Salzwedel		…..	96040	94545	…..	0	0	0	0	
9	Altötting	92825	…..	109227	108789	…..	1	2	2	2	….
10	Alzey-Worms	95552	…..	126328	126058	…..	3	3	4	4	….
11	Amberg	46934	…..	44618	44394	…..	0	0	0	0	….
12	Amberg-Sulzbach	94605	…..	108159	107683	…..	0	0	0	0	….
13	Ammerland	na	…..	115891	116626	…..	1	1	1	1	….
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434	Wuppertal	405369	…..	359237	358330	…..	2	3	3	3	….
435	Würzburg (Land)	146046	…..	159978	160222	…..	0	2	2	2	….
436	Würzburg (Stadt)	112584	…..	133906	134913	…..	4	4	4	5	….
437	Zollernalbkreis	173554	…..	192722	192138	…..	3	3	3	4	….
438	Zweibrücken	35978	…..	35219	34842	…..	1	1	2	2	….
439	Zwickau	na	…..	97832	96786	…..	1	1	1	1	….
440	Zwickauer Land	na	…..	128630	127192	…..	0	0	0	0	….