RUHR ECONOMIC PAPERS

Philipp Breidenbach

Ready for Take-off? The Economic Effects of Regional Airport Expansion

RUHR UNIVERSITÄT BOCHUM RUB rwi

#549

Imprint

Ruhr Economic Papers

Published by

Ruhr-Universität Bochum (RUB), Department of Economics
Universitätsstr. 150, 44801 Bochum, Germany

Technische Universität Dortmund, Department of Economic and Social Sciences
Vogelpothsweg 87, 44227 Dortmund, Germany

Universität Duisburg-Essen, Department of Economics
Universitätsstr. 12, 45117 Essen, Germany

Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI)
Hohenzollernstr. 1-3, 45128 Essen, Germany

Editors

Editorial Office

Ruhr Economic Papers #549

Responsible Editor: Roland Döhrn

ISSN 1864-4872 (online) – ISBN 978-3-86788-627-7

Ruhr Economic Papers #549

Philipp Breidenbach

Ready for Take-off? The Economic Effects of Regional Airport Expansion

Bibliografische Informationen der Deutschen Nationalbibliothek

Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über: *http://dnb.d-nb.de* abrufbar.

Das RWI wird vom Bund und vom Land Nordrhein-Westfalen gefördert.

http://dx.doi.org/10.4419/86788627
ISSN 1864-4872 (online)
ISBN 978-3-86788-627-7

Philipp Breidenbach[1]

Ready for Take-off? The Economic Effects of Regional Airport Expansion

Abstract

This paper analyzes whether the expansion of regional airports in Germany caused positive spillover effects on the surrounding economies, exploiting the deregulation of the European aviation market as a quasi-experiment. Such potential spillovers are often used as an argument for the substantial annual subsidies to airports. Previous evaluations often suffer from the problem of reverse causality, since investment decisions are based on the economic conditions of the region. By contrast, the aviation deregulation under the Single European Market-initiative provides an exogenous incentive for investing in the expansion of existing regional airports. A difference-in-differences approach is used to estimate the causal effects of this expansion on regional growth. The results are sobering, though, as there is no evidence for any positive spillover effects.

JEL Classification: R51, R42, H54

Keywords: Infrastructure investment; regional growth; airport effects

April 2015

1 RWI and RUB – I am grateful to Thomas K. Bauer, Roland Döhrn, Corinna Hentschker, Michael Kind, Alfredo Paloyo, Christoph M. Schmidt, Torsten Schmidt and Lina Zwick for valuable comments that helped to improve this manuscript. – All correspondence to: Philipp Breidenbach, RWI, Hohenzollernstr. 1-3, 45128 Essen, Germany, e-mail: philipp.breidenbach@rwi-essen.de

1. Introduction

During the past decades, German regional airports have expanded to a remarkable extent. Regional policy makers invested millions of Euros in airport facilities, aiming to ascertain that those fulfill the requirements of modern airports in an era of a rapidly growing aviation market. Contrary to those ambitious expectations, today nearly all German regional airports depend on substantial subsidies to cover their annual losses. Since the European Union decided that these subsidies violate European competition law, it will be prohibited after 2024 to use them to cover operational losses. These legal requirements will cause existential problems for a number of these regional airports.

Opponents of the subsidies feel vindicated by this decision, since in their assessment regional airports will never find their niche between the established large airports and will never reach profitability. Proponents of the airports argue that the narrow focus on the direct losses fails to recognize their importance for regional development. They emphasize positive spillover effects for the surrounding industry, alleging that service industries and high-tech branches particularly benefit from airport proximity (Sheard, 2014, Brueckner, 2003 and Button/Taylor, 2000). The argument of strong employment effects is used to justify the continued operation of these airports (Robertson, 1995).

It is difficult to analyze these airport effects empirically, since typically the expansion of regional airports is the outcome of economic and political deliberations in a real-world context, and not the result of an analytical experiment. Therefore, the question what counterfactual development an airport region would have realized without the expansion cannot be answered with ease. On the contrary, as the many attempts at the econometric evaluation of the (regional) growth effects of infrastructure investments demonstrates (e.g. Aschauer, 1989), the problems of reverse causality and unobserved (regional) heterogeneity are almost ubiquitous (e.g. Mukkala/Tervo, 2013, Button et al. 2010 and Green, 2007).

This paper exploits an abrupt change in the regulation of European aviation that can be interpreted as a quasi-experiment to overcome this difficulty. Specifically, the deregulation of the European aviation market in 1997 led to a substantially redesigned aviation market (Graham, 1995), providing a particularly strong incentive to expand German regional airports. Designed to strengthen competition on the airline market, this reform caused an increasing demand for take-off and landing slots at airports. Established international airports were not able not serve this increasing demand and, consequently, more airlines turned to operate from regional airports.

Contrary to investments driven by positive regional developments, this reform thus led to investments which were set by exogenous changes in the structure of the aviation market (Graham, 2010, Barrett, 2000) and can therefore be regarded as a (quasi-)experiment. The paper documents that several airports indeed invested extensively to prepare their regional airports for the needs of modern and international airlines and passengers. Furthermore, the location of German airports is closely linked to German military history since most of them were converted from military to civilian use in the past (Behnen, 2004). Their original location followed military strategies instead of economic reasoning (Cidell, 2003). These circumstances facilitate an analysis of exogenous airport expansions on the basis of a difference-in-differences-approach (DiD) which overcomes regional heterogeneity problems.

To the best of my knowledge, this is the first paper scrutinizing the recently discussed effect of regional airports expansions using an exogenous event as identification strategy.[2] The results are sobering. The estimations start with the application of a basic model, ignoring any potential endogeneity problems, which compares prosperity levels in regions with and without airports. Such a preliminary approach indeed suggest airport induced regional prosperity. However, when endogeneity problems are taken into account by exploiting the European deregulation of 1997, this effect vanishes. This result is confirmed by various robustness checks. There is simply no evidence that spillovers spreading out from such expansions of regional airports could justify their overwhelming subsidization.

The remainder of the paper is organized as follows. Section 2 summarizes the existing literature, emphasizing endogeneity issues and the institutional settings of the deregulation. Section 3 describes the data set and outlines the DiD. The results and various robustness checks are presented in section 4, and, finally, section 5 concludes.

2. EU aviation market reform as source of exogenous variation

2.1. Existing literature and conceptual challenges

Proponents of regional airports argue that airports act as a driving force of regional development, because airports tend to increase income and employment in the local economy (ELFAA, 2004). They typically focus on three transmission channels (see Button, 2010 for further subdivisions): (i) direct effects, realized through employment and investments at the airport, (ii) indirect effects, in the chain of suppliers of goods and services related to the airport, and (iii) induced effects which comprise the surplus of employment through spending of directly and indirectly employed individuals. Beside these three channels, airports are supposed to have a catalytic effect by improving productivity and attracting economic and touristic activities (e.g. EU Committee of the Regions, 2004, Cezanne/Mayer, 2003).

However, obtaining empirical evidence for such airport effects is a challenging task. Arguably, the simplest method for examining whether the existence of an airport affects growth in the surrounding region – a direct comparison of growth between airport- and non-airport-regions – will lead to biased estimates, due to omitted regional heterogeneity. Even though one might be able to control for a wide range of observable variables, this identification strategy would still be prone to suffering from unobservable heterogeneity, in particular embodied in such regional pre-conditions which are likely to be correlated with the existence of an air-

[2] The US aviation deregulation act (1978) has been exploited as exogenous given changes of air services (Blonigen/Cristea (2012) but as shown below, this reform did not mark comparable changes for regional airports.

port. Since the location of an airport is not random, there might be higher probability for the erection of an airport in a prospering region. In this context, the application of fixed effects estimations in panel data frameworks (Islam, 1995) is of little help since the existence of an airport is a fixed effect itself.

Focusing on airport activities, such as flights, passengers or cargo development (Florida et al., 2012) helps to introduce further variation in the dataset. However, as long as increased activities do not have an experimental exogenous character, it is not possible to distinguish whether improving regional conditions influence airport activity as found by Goetz (1992) and Dobruszkes et al. (2011) or vice versa as suggested by the airport proponents. Specifically, this problem occurs if future regional development is anticipated and airport expansions are based upon it. In this case, time series analyzes, e.g., provided by Green (2007), Mukkala/Tervo (2013) or Button/Yuan (2013) cannot help to identify a leading and a following process.[3]

More promising identification strategies can be derived from exogenous events. Brueckner (2003) and Sheard (2014)[4], for instance, apply the concept of instrumental variables in their analyses. However, finding exogenous events or proper instruments which are able to predict airport size but do not correlate with regional circumstances is a challenging task. Bloningen/Cristea (2012) consider the US "Aviation Deregulation act"[5] in 1978 which was endorsed to promote competition in the aviation market as an exogenous event. Acting under market pressure after the reform, airlines focused their activities on the central airports since subsidies for peripheral connections were cut. These shifts initiated remarkable increases and decreases in the various airports' activities (Burghouwt/Hakfoort, 2001), exogenous from the respective regional development. Based on the deregulation act, Bloningen/Cristea (2012) observe that increasing airport activities affect population growth, per capita income and employment positively.

Although, their paper offers a promising methodological approach for the evaluation of general airport effects the setup is less relevant for the particular examination of regional airport effects. Their study is restricted to the examination of exogenously induced growth of big airports in central metropolitan areas. By definition, regional airports (in the scope of this paper) are rather small and they are located in less central areas. Therefore, effects obtained

---

[3] Beside this, the applied Granger causality tests do only give a hint for potential economic causality (Mukkala/Tervo, 2013).

[4] Sheard (2014) exploits the US 1944 National Airport Plan, which marks an exogenous component of the size of today's airports without being directly influenced by the later development of the US cities.

[5] Since the pre-reform aviation market in the US did not really hold as an example for an open market but rather offered a high degree of governmental regulations, the deregulation act led to substantial shifts in the market structure. The market situation was described by obstacles such as peripheral connections with higher governmental subsidies than attained ticket turnarounds on the one hand and other 'hot connections' where only a limited number of flights were allowed although there was a demand for much more flights on the other hand (Bloningen/Cristea, 2012). Since this setup was not sustainable for the rapid development of the aviation, US government passed a radical reform of the system for 1978. See Bloningen/Cristea (2012) for a detailed description of this reform.

from the US deregulation act cannot be translated to the expansion of regional airports and the growth effects of the surrounding regions.

2.2. EU aviation market reform

Encouraged by the apparent success of market deregulations in the US, in 1983 the European Commission started a deregulation initiative, the Single European Aviation Market (Graham, 1997). The post-reform period in the US demonstrated how enhanced competition could lead to an increase of suppliers and flights and, decreasing prices. The deregulation of the European market was split into three separate steps. The first two steps were implemented in 1988 and 1990 (Graham, 1995) and were characterized by rather small changes such as the permission of bilateral intra-EU agreements, the validity of competition rules for the aviation and implementation of three bounded fare zones which allowed tickets to be supplied below the standard minimum fares (Schenk 2004: 95ff).[6]

Substantial changes in the structure were initiated by the third step (Graham, 1997). This included the harmonization of the airline licensing processes, entire liberalization of ticket fares and the abolition of capacity regulations between member states. The involved suspension of all cabotage-restrictions[7] opened the market for a range of new airlines (Schenk 2004: 98). These trends changed the market dramatically since a substantial number of airlines entered the German market as further competitors, leading to an increased number of flights (see Thompson, 2002 for France). Nevertheless, slots (for departures and arrivals), ground operation services and booking systems represented a bottleneck for the operation of increasing traffic. National carriers enjoyed grandfathering rights for the slots and services without convincing “use it or lose it” rules (Schenk, 2004). Thus, the appropriate access of new competitors to the established airports was hindered and they had to divert their business to regional airports.

The increased number of competitors and the shortage of slots at established airports provided strong incentives to regional policy makers to engage into airport expansion. Graham (1997) documents substantial benefits for regional airports and for the newly emerging regional airlines.[8] Furthermore, the reform incentivized regional policy makers to expand the airports right in 1997 when new airlines entered the market and increased the demand for the services of regional airports to conduct their operations. Thus, the reform forms a (quasi-)experiment, since the timing of the expansions was determined by legislation, not by economic considerations. Germany implemented the regulation as late as possible in the beginning of 1997, for years after it passed European Council in 1993. This long period ensures that planners had enough time to prepare the airports for the increasing demand for services. Moreo-

[6] See Graham (1995/1997) for detailed description of the first two reform steps and Schenk (2004) for their concrete implementation in the German case.

[7] Cabotage restrictions interdict the provision of a national route by non-domestic airlines. On international routes only the domestic airlines from one of the connected countries is allowed to provide the route.

[8] Section 3 provides evidence for actual investments at German regional airports in this time.

ver, pre-reform adjustment of the air-services (Ashenfelter's Dip problem, Ashenfelter 1978) could not occur since the restrictive regulations were still intact.

The scope of the reform strengthens its interpretation as an exogenous event with respect to regional development. The European Commission intended to intensify competition between airlines (Graham, 1998), while the incentives for regional airport expansions were only side effects of the reform. This contrasts with regional policy measures which are specifically designed to compensate for disadvantages of the targeted regions. As Behnen (2004) points out, the reform did not only cause a revolution in the sky but, especially in Germany, also on the ground.

Moreover, the initial location of German regional airports is also quite unrelated to the economic circumstances surrounding them, since most of the today's regional airports have served as military bases in some stages of their existence, before they were converted into civilian use (Behnen, 2004). Therefore, their location was not driven by the economic needs of a region or favorable economic pre-conditions (Cidell, 2003), but was rather based on military strategies and the associated distribution of the air force.

Taken together, the military background of the initial locations of regional airports, the encompassing scope of the reform which did not intend to support the regional airports, and the exogenous impetus leading to the investments into regional airport expansion form three arguments which facilitate the examination of the causal effects of airport expansions on regional prosperity.

3. Data and Identification Strategy

The DiD approach provides a sound identification strategy for the evaluation of the potential regional growth effects which might have been induced by the deregulation of the aviation market. Since the dataset[9] contains annual information on German counties (NUTS 3 level) for the period from 1991 to 2008, the pre-1997 years serve as pre-treatment period and the latter as treatment period. The demarcation into treatment and control regions is more challenging. Obviously, those regions with a regional airport are regarded as the treatment group. As the research question focusses on the effects for regional airports and detailed reactions of established (international) airports on the deregulation remain unclear, such regions with international airports are omitted in the evaluation.[10]

For this purpose, the distinction between international and regional airports has to be defined. The main definition of regional airports in this paper relies on the pre-reform passenger figures provided by the German Airport Association (ADV). All those airports with less than one million passengers in 1996 are included in the treatment group as regional airports. This arbi-

[9] Economic variables are taken from the Federal Institute for Research on Building, Urban Affairs and Spatial Development BBR (2009) and BBR (2011).

[10] Possibly they were also positively affected by the reform and gained higher efficiency of their traffic.

trary definition is extensively tested in the robustness checks which contain varying thresholds from 0.5 million to 5 million passengers per year. Less promising distinctions are the airports' legal permissions (which are subdivided into international and regional permissions)[11] or the categorization of its members provided by the ADV itself (which suffers from self-selection problems).[12] German counties without a regional or an international airport serve as the control group.

The growth of GDP per labor force (GDPpl) is the most promising indicator which can capture the range of assumed spillovers from regional airports to regional prosperity. Therefore, the growth of nominal GDP per labor force is used as the main outcome variable.[13] Since the GDP per labor force may also have some minor shortcomings[14] further estimations in the robustness checks are applied with the growth of total GDP, GDP per capita and employment as dependent variables.

In contrast to the majority of airport evaluations which exploit terms of air services (Allroggen/Malina, 2014), this paper focusses on the pure existence of infrastructure captured in a cross sectional treatment dummy (a_i) turning 1 if the region has a regional airport and 0 otherwise. The time dummy (t_t) indicates the post-treatment era and their interaction (DiD_{it}) marks the variable of interest, the DiD indicator. Starting with a pure DiD as first estimation, a varying set of controls (x_{kit}) is subsequently included to provide an indication of the robustness of the estimates.

An increasing set of control variables can account for regional heterogeneity will tend to improve the precision of the estimates. However, especially in the context of regional economics, the inclusion of controls is problematic as they might themselves be an outcome of the treatment (Angrist/Pischke (2008)[15], Becker et al. 2014). In the context of airport expansions this is relevant for, e.g., regional investments which might be increased by the expansions. Developments of these "bad controls" which are driven by the treatment may bias the estimated effect of the treatment on the outcome variable, due to the correlation between the bad control and the outcome variable.

The lagged level of population, population density and employment are included as controls. Furthermore, the lagged level of the left hand side variable, the level of GDP per labor force, is included. This is standard for models based on neoclassical theory but poses problems

[11] However, the offered flight destinations do not justify this distinction. International flights are also provided from those airports which are legally defined as regional airports. See destinations of, e.g., Dortmund-Wickede (http://www.dortmund-airport.com/f2a0c5cf806929ea/passengers-visitors)

[12] The robustness checks also include estimations defining the the legally defined regional airports as treatment group.

[13] GDP can only be provided on current price level since there is no information on price indices for the deflation on the chosen level of regional entities (Destatis, 2015)

[14] Under the strict assumption of a fixed capital stock, the GDP per labor force may decrease by the increase of employment.

[15] Angrist/Pischke (2008) denote those control variables as "bad controls".

regarding its implicit dynamic component. Since the outcome ($gy_{i,t}$ =ln($y_{i,t}$)-ln($y_{i,t-1}$)) correlates with the model's error term (ε_{it}), the regressor ($y_{i,t-1}$) also correlates with the error term, leading to biased estimates (see Nickell 1981 or Baltagi 2008 for an overview). As Bruno (2005) shows, the dynamic corrected fixed effect estimator based on an initial Blundell/Bond (1998) estimation provides satisfactory results for rather short samples periods. Results based on this estimation method are presented in the appendix.

The estimations are based on the following model.

$$gy_{i,t} = \delta_1 a_i + \delta_2 t_t + \delta_3 DiD_{it} + \beta_1 \ln(y_{i,t-1}) + \sum_{k=2}^{K} \beta_k \ln(x_{i,t-1,k}) + \varepsilon_{i,t} \quad (1)$$

where $i=1,\ldots,N$ is the cross-sectional and $t=1,\ldots,T$ is the time dimension, β_k and δ_1, δ_2 and δ_3 are regression coefficients to be estimated, and $\varepsilon_{i,t}$ is an independent and identically distributed error term (i.i.d.). All economic variables are taken from BBR (2011). Estimation is based on the model being transformed into first differences, thereby excluding the individual a_i

$$\Delta gy_{i,t} = \delta_2 \Delta t_t + \delta_3 \Delta DiD_{it} + \beta_1 \Delta \ln(y_{i,t-1}) + \sum_{k=2}^{K} \beta_k \Delta \ln(x_{i,t-1,k}) + u_{i,t} \quad (2)$$

with $u_{it} = \varepsilon_{i,t} - \varepsilon_{i,t-1}$.

The host county of an airport might not be the right delineation for capturing the airport's economic contribution. Typically, airports are not located in the center of counties; this especially holds for airports located in bigger cities. They are rather situated in the periphery of cities or in adjacent counties. Thus, simply considering the host counties of airports as relevant regional unit is not appropriate, since their economic effects spread out to adjacent regions (i.e., spillovers cross county borders). This problem is tackled by defining imputed airport regions which deliberately construct buffers around the airport's reference point (see Paloyo et al. 2010 for details).

The chosen radius of 15 kilometers roughly represents the mean radius of German counties. Thus, the buffer size is rather small.[16] The paper concentrates on the regional effects in the immediate proximity of an airport. Furthermore, since many local municipalities provide large shares of the subsidies and they justify this by the positive spillovers, such small buffers are the right demarcation for the objective of this paper. Thus, hinterland effects are intentionally disregarded in this approach. Whether air transport supply has a positive overall impact on Germans economy is a separate question.

The economic characteristics of these airport buffers are defined by the variables of those administrative counties which are located in the buffer. Precisely, the buffer variables are defined by the within-buffer weighted means, with the respective spatial shares serving as

[16] The following results are not sensitive to a variation of buffer sizes from 10 to 30 kilometer (with exception of the 30km-definition, not shown in the paper, but available upon request).

weights. Since nearly all airport buffers consist of more than one county (the only exception is Hannover-Langenhagen), the number of observations is much smaller than the number of regions.[17] Although Düsseldorf-Weeze and Memmingen are regional airports today, they are ignored in the empirical analyses, since they did not serve as regional airports in 1997. Weeze was opened in 2003 while civilian use in Memmingen started in 2004. All these limitations reduce the original sample size of 413 German counties to 271 observed regional units. An overview on the regional and international airports as well as a map with the buffers is provided in Figure A.1 in the appendix.

Descriptive statistics of the sample are provided in Table 1. It appears that regions with a regional airport and those without these facilities do not differ substantially. The mean GDP per labor force growth is 0.002 percentage points higher in the airport regions.[18] The airport and non-airport regions do not differ substantially in almost all the variable means, as the t-test in the last column documents. Only the log of population and employment display higher means in the airport regions.

Table 1: Descriptive Statistics for airport and non-airport regions

	Airport regions (24)		Non-Airport regions (247)		
	Mean (Std.Dev.)	Min/ Max	Mean (Std.Dev.)	Min/ Max	t-statistic
GDP (growth)	0.030 (0.039)	-0.041/ 0.218	0.028 (0.039)	-0.260/ 0.252	-0.505
GDPpl (growth)	0.027 (0.037)	-0.036/ 0.211	0.025 (0.039)	-0.262/ 0.294	-0.621
GDPpc (growth)	0.033 (0.039)	-0.040/ 0.222	0.029 (0.040)	-0.241/ 0.261	-1.065
GDPpl ($x10^3$)	48.725 (8.333)	21.502/ 68.455	49.804 (8.650)	17.702/ 90.099	1.808*
GDPpc ($x10^3$)	23.431 (6.399)	7.429/ 37.273	23.608 (9.071)	6.230/ 76.558	-0.102
ln(employment) lagged	4.258 (0.884)	1.807/ 5.739	4.100 (0.540)	2.915/ 6.861	-9.198***
ln(Population)	5.007 (0.793)	2.821/ 6.525	4.893 (0.546)	3.649/ 7.184	-7.904***
Density ($x10^3$)	0.006 (0.009)	0.000/ 0.066	0.010 (0.033)	0.001/ 1.027	2.061**

Note: All variables are taken from BBR (2011). ***,**,* denote significant differences at the 1%-, 5%- and 10%-level.

---

[17] The buffers are also constructed for the international airports which are ignored in the further course of the analyses.

[18] Closer examination of the minimal growth rates in non-airport regions show that these are outliers which are supposed to be artificially constructed by corrections of the official statistics.

The investment activities at German regional airports reflect the incentives which the deregulation of the aviation market provided to regional policy makers. Various types of investments were undertaken; airports expanded their terminals or runways and better connections to public transport were established. In addition, some airports provided regular air-services with scheduled flights for the first time after the reform. Only for three of the 24 regional airports, there are no explicit investments found for 1997 and the adjacent years.[19]

4. Results

To provide a first impression, results from a basic estimation setup demonstrate whether airport regions display a higher GDP per labor force than non-airport-regions.[20] Note that the motivation for these estimations is merely to illustrate the endogeneity bias of such a setup in comparison to the subsequent identification strategies, based on the (quasi-)experiment. Focusing on this preferable identification approach, a DiD model is estimated after the common trend assumption is tested. These baseline estimations are followed by various robustness checks to consider three crucial issues of the identification: First, the Ashenfelter's Dip problem, second the sensitivity to changes of the definition and the spatial demarcation of the treatment group and third changing definitions of the control group. A number of secondary tests are presented in the appendix.

4.1. Estimation results

The first impression in Table 2 shows that the existence of an airport – unconstrained on international or regional (column (i) and (ii)) – clearly correlates with the level of regional GDP per labor force. The specification including control variables (column (ii)) suggests that the GDP per labor force is 3.5% higher compared to regions without an airport. Omitting all international airports from the sample reduces this effect to 1.9% in column (iv), although it remains significant. However, these findings can only draw an incomplete picture, since the estimation approach disregards any endogeneity problems.

---

[19] Excluding these three regions from the estimations does not change the following results.

[20] In contrast to subsequent DiD-estimations based on the growth of the GDP per labor force, this estimation is based on the its level values since potential airport induced growth effect faded in after their opening and they should show up in higher level values today.

Table 2: Pooled-OLS without DiD for all and regional airports

Dependent Var: Log of GDPpl	**All airports (i)**	**(ii)**	**Regional Airports (iii)**	**(iv)**
Airport	**0.040*** (0.009)**	**0.035*** (0.004)**	**-0.015 (0.009)**	**0.019*** (0.004)**
West Germany		0.347*** (0.011)		0.158*** (0.012)
ln(Population)		0.005*** (0.001)		0.002* (0.001)
ln(Population-Density)		0.036*** (0.003)		0.032*** (0.003)
State-Dummies	N	Y	N	Y
County-type	N	Y	N	Y
Time Dummies	N	Y	N	Y
No. of Regions	287	287	271	271
No. of Obs.	4845	4495	4624	4288

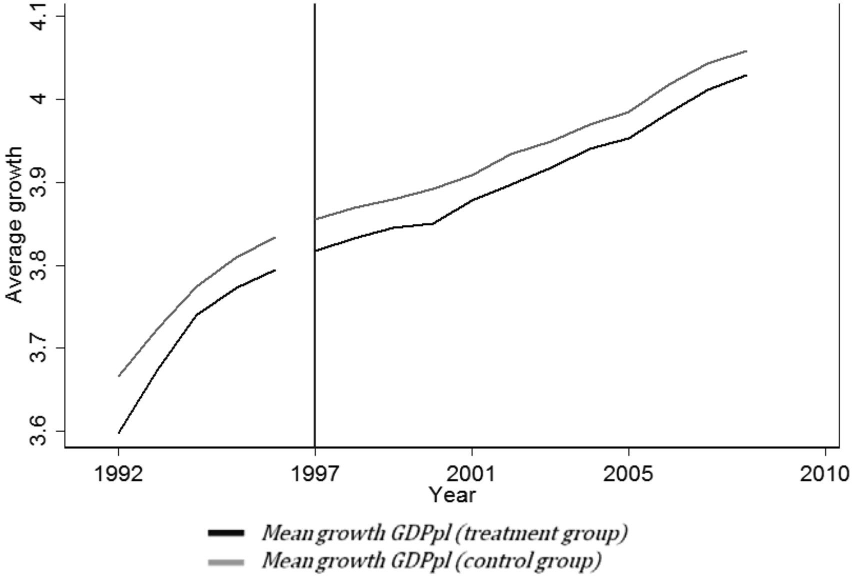
Note: ***,**,* denote significance at the 1%-, 5%- and 10%-level. Robust standard errors clustered on county-level in parentheses.

To support the application of the DiD approach, Figure 1 displays the growth of the GDP per labor force separately for treated and non-treated regions. The basic assumption of the DiD implies that both groups would have developed equally in the absence of the treatment. Since this is an assumption on the counterfactual it cannot be statistically tested. A visual inspection of Figure 1 shows only minor level differences in the pre-treatment development which can be captured by regional fixed effects (Angrist/Pischke, 2008), therefore the DiD seems to be a suitable method.

This impression is corroborated by “placebo regressions” with altered definitions of the treatment in the robustness tests. Note further, that a simple “before and after” analysis of airport regions instead of a DiD would provide misleading results since it only focuses on the higher growth of GDP per labor force among airport regions after the reform without accounting for the quite similar development of the control regions over time.

Figure 1: CTA, Treatment and non-Treatment growth rate

(Annual GDP per labor force growth rate)



The main results in Table 3 do not show a statistical significant expansion effect of the regional airports on growth. The variable of interest (DiD-estimator) which accounts for reform-induced growth remains insignificant. The growing number of control variables does not have any influence on the statistical significance of the DiD coefficient. These results are confirmed by rather similar results in Table A.1 which consider the dynamic correction of the fixed effect model as proposed by Bruno (2005). Since the dynamic correction initially atarts from a Blundell-Bond (1998) estimation which also faces some shortcomings, e.g., potentially imprecise estimators in a rather small cross-sectional (Bruno 2005), and since the dynamic component seems not to bias standard fixed effect estimations, the further estimations are based on the standard fixed effect model.

Table 3: DiD-Fixed effects for regional airports

Dep. Variable: GDPpl growth	(i)	(ii)	(iii)	(iv)
DiD-estimator	**-0.004**	**-0.004**	**-0.003**	**-0.002**
	(0.008)	**(0.004)**	**(0.005)**	**(0.003)**
Post-Treat	-0.023***	0.004***	0.002	0.003
	(0.002)	(0.001)	(0.002)	(0.002)
ln(GDPpl) lagged		-0.160***	-0.149***	-0.295***
		(0.008)	(0.009)	(0.012)
ln(employment) lagged		0.092***	0.054**	-0.079***
		(0.017)	(0.022)	(0.022)
ln(Population) lagged			0.084***	0.126***
			(0.026)	(0.032)
ln(Density) lagged			-0.000	-0.001**
			(0.001)	(0.001)
Constant	0.042***	0.261***	-0.035	0.844***
	(0.002)	(0.076)	(0.105)	(0.134)
Time Dummies	N	N	N	Y
No. of Regions	271	271	271	271
No. of Obs.	4352	4352	4288	4288

Note: ***,**,* denote significance at the 1%-, 5%- and 10%-level. Robust standard errors clustered on county-level in parentheses.

4.2. Robustness Tests

Potential weaknesses of the main results are tested in the following robustness checks. First, the estimations of a DiD might be biased since reform effects are anticipated and pre-reform adjustments to the new scenery take place (Ashenfelter's Dip). Although airport planners did anticipate the reform they could not benefit from pre-reform adjustments since the market situation could not change notably before the deregulation. Therefore, an earlier investment did not lead to advantages in the pre-reform period. Nevertheless, construction measures which were required before the deregulation to provide adequate infrastructure may bias the results. This bias may be twofold, on the one hand reform-induced constructions may have caused pre-reform growth and therefore bias the expansion effect downwards. On the other hand, airport operations may have been reduced due to such constructions in pre-reform years leading to an upward bias of the estimated expansion effect.

The Ashenfelter's dip problem concerns the pre-reform years. Since the expansion effects may have taken time to spread out and to attract airport activities (and since some investments were not completed in time) the first two post-treatment years are excluded in further estimations. The results of the two strategies are presented in Table 4, column (i) and (ii) focus on the Ashenfelter's dip and exclude the years 1996 and 1995, the latter columns exclude the years 1997 and 1998. Table 4 shows that the estimated DiD coefficients remain insignificant when excluding these years.

Table 4: DiD-Fixed effects with excluded years

(Dependent Variable: Growth of GDPper labor force)

Exclusion of…	1996	1995&1996	1997	1997&1998
DiD-estimator	**-0.005**	**-0.007**	**-0.002**	**-0.002**
	(0.004)	**(0.005)**	**(0.003)**	**(0.003)**
Post-Treat	0.009***	0.019***	0.016***	0.010***
	(0.003)	(0.004)	(0.003)	(0.003)
ln(GDPpl) lagged	-0.296***	-0.305***	-0.293***	-0.291***
	(0.013)	(0.013)	(0.012)	(0.012)
ln(employment) lagged	-0.082***	-0.077***	-0.080***	-0.075***
	(0.024)	(0.026)	(0.024)	(0.024)
ln(Population) lagged	0.132***	0.133***	0.128***	0.134***
	(0.033)	(0.035)	(0.033)	(0.032)
ln(Density) lagged	-0.001**	-0.001*	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.824***	0.830***	-0.293***	-0.291***
	(0.137)	(0.140)	(0.012)	(0.012)
Time Dummies	Y	Y	Y	Y
No. of Groups	271	271	271	271
No. of Obs.	4024	3760	4021	3754

Note: ***,**,* denote significance at the 1%-, 5%- and 10%-level. Robust standard errors clustered on county-level in parentheses.

As second robustness check, the treatment group is varied by the definition of the threshold between regional and international airports. Since the assumption to treat all airports (listed by the ADV) with at most one million passengers per year as regional airports might be crucial, this threshold is varied from 0.5 million to 5 million passengers in columns (i)-(v) in Table 5. Since those airport regions with passenger numbers above the threshold are excluded from the estimations, the number of included regions and observations increase with an increasing threshold. The last column restricts the treatment group on the legally defined regional airports independent of the respective passenger numbers.[21] The results in Table 5 show that the DiD coefficient is robust to the different definitions of the treatment group.

[21] The estimations in Table 4 cover the same controls as column (iv) in Table 3. Thus, results of column (ii) (1 million passengers) equals column (iv) in Table 3.

Table 5: DiD-Fixed effects for regional airports

Dep. Variable: GDPpl growth	Treatment-Threshold: Max. passengers per year 0.5 million	1 million	2 million	2.5 million	5 million	Legally defined
DiD-estimator	**-0.002**	**-0.003**	**-0.003**	**-0.004**	**-0.004**	**-0.005**
	(0.003)	**(0.003)**	**(0.003)**	**(0.003)**	**(0.003)**	**(0.004)**
Post-Treat	0.009***	0.003	0.003	0.003	0.009***	0.009***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
ln(GDPpl) lagged	-0.296***	-0.296***	-0.294***	-0.296***	-0.296***	-0.294***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
ln(employment) lagged	-0.082***	-0.082***	-0.080***	-0.082***	-0.081***	-0.079***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.023)
ln(Population) lagged	0.131***	0.131***	0.130***	0.132***	0.132***	0.131***
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
ln(Density) lagged	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.834***	0.837***	0.830***	0.830***	0.824***	0.810***
	(0.133)	(0.133)	(0.132)	(0.132)	(0.131)	(0.131)
Time Dummies	Y	Y	Y	Y	Y	Y
No. of Regions	270	271	276	278	279	264
No. of Obs.	4288	4320	4368	4400	4416	4160

Note: ***,**,* denote significance at the 1%-, 5%- and 10%-level. Robust standard errors clustered on county-level in parentheses.

Furthermore, the size of the buffers which mark the treated regions around the airports is varied. The radius of the treatment-buffer is doubled (30 km) to observe potential effects in a larger group of regions. Based on this enlarged buffer size, the DiD coefficient turns slightly negative (presented in column (i) of Table 6). In addition, one might be concerned that the stable unit treatment value assumption (SUTVA) is violated in the estimations setup. If the regions within treatment buffer affect the outcome of the adjacent control regions by some negative or positive spillovers, the coefficient of the treatment estimator is biased.

To overcome this problem, again the 15 km buffers are considered as treatment group. But, to prevent a direct transition from treatment to control group, all regions within the 30 km buffer but outside the 15 km buffer are ignored and neither considered as members of the treatment nor the control group. Thus, spillovers from treated regions cannot directly influence the control group (column (ii) of Table 6). This estimation does not show a significant result.

Table 6: DiD-Fixed effects varied buffer size

(Dependent Variable: Growth of GDPper labor force)

	(i) 30 km buffer	(ii) Excluded ring from 15-30 km
DiD-estimator	**-0.005***	**-0.005**
	(0.003)	**(0.003)**
Post-Treat	0.005*	0.012***
	(0.003)	(0.003)
ln(GDPpl) lagged	-0.295***	-0.004
	(0.012)	(0.005)
ln(employment) lagged	-0.080***	-0.150***
	(0.022)	(0.013)
ln(Population) lagged	0.127***	0.054
	(0.031)	(0.033)
ln(Density) lagged	-0.001**	0.087**
	(0.001)	(0.035)
Constant	0.849***	0.814***
	(0.135)	(0.200)
Time Dummies	Y	Y
No. of Groups	271	154
No. of Obs.	4288	2426

Note: ***,**,* denote significance at the 1%-, 5%- and 10%-level. Robust standard errors clustered on county-level in parentheses.

Third, one might be concerned that the broad delineation of the control group which comprises all German regions without an airport is inappropriate. As discussed in section 2, airports might be located in regions with specific economic characteristics. Hence, if these characteristics determine the probability for having an airport on the one hand and the growth expectations over the treatment period on the other hand, the empirical strategy, may lead astray. In econometric terms, the characteristics of the control variables may not overlap between the treatment regions and a critical mass of control regions in the sample. According to this concern, control regions which differ substantially from the airport regions in their regional characteristics would have to be excluded from the estimation.

In the spirit of a matching approach, a propensity score is estimated based on a probit model.

$$p_i = \sum_{k=1}^{K} \beta_k \ln(z_i) + v_i \qquad (3)$$

On the left hand side, the dummy p_i indicates if a region has an airport (p_i=1) or not (p_i=0). On the right hand side, z_i indicates a very broad set of regional controls, β_k are the related coefficients to be estimated and, v_i is an i.i.d. error term. Since variation over time does not really offer further information, the model is estimated with observations of the year 1996, the last pre-reform observation. The estimated outcomes ($\hat{p}$) indicate a regional probability for hosting an airport. The range of the estimated airport probabilities ($\hat{p}$) of the airport regions decides which regions enter the control group.[22] Only those non-airport regions with a ($\hat{p}$) within the range of ($\hat{p}$) of airport regions are considered in the control group. Regions with an exceptionally low probability for having an airport are excluded.

Table 7: Probit for the Airport probability

(Dependent Variable: Airport Dummy)

Dependent Var.: Airport Dummy	**(i)**
ln(GDP)	20.465**
	(8.762)
ln(GDPpw)	-1.935
	(1.981)
ln(GDPpl)	-16.391*
	(8.529)
Positive migration	1.046**
	(0.458)
ln(Population)	-0.564**
	(0.257)
ln(Density)	-19.591**
	(8.785)
West Germany	-0.205
	(1.121)
Constant	-16.706***
	(5.971)
County Types	Y
Federal State Dummies	Y
Lowest $\hat{p}$ of apt. region	**0.015**
Highest $\hat{p}$ of apt. region	**0.975**
No. of Obs	287

Note: ***,**,* denote significance at the 1%-, 5%- and 10%-level. Robust standard errors in parentheses.

As Table 7 shows, the range of predicted airport probabilities ($\hat{p}$) for airport regions cover a spectrum from 1.5% to 99.8%. This result suggests that there is basically no region which has

[22] To give an example, if the lowest predicted airport probability of an airport region is 50%, all those control regions with a probability below 50% are excluded from the following DiD estimation.

no realistic probability for hosting an airport. Thus, the broad selection of the control groups poses no problems.[23] This finding supports the argument that the military background of most airports is much more important for airport location than any economic considerations.

Further robustness checks are provided in the appendix. Table A.2 presents two "placebo regressions" which refer to a hypothetical deregulation event during the pre-treatment period ignoring all post-treatment observations and another hypothetical deregulation event during the post-treatment period ignoring all pre-treatment observations. While an artificial treatment during the pre-treatment period strengthens the previously discussed common trend assumption, the latter artificial treatment can rather indicate effects of the treatment which fade in after a certain time. The years 1994 and 2000 are chosen for the hypothetical reform. In both cases, the coefficient of the DiD remains insignificant.

To ensure that these results are not based on the lower productivity of new jobs caused by the airport expansion, regressions with the growth of total GDP growth, GDP per capita growth and growth of the employment as dependent variables are applied and reported in Table A.3 (column (i)-(iii)). None of these changes leads to diverging findings. To avoid the deterioration of the aviation market after 9/11, the sample period ends 2001 in column (iv) which does not change the observed results.

5. Conclusion

The EU Commission has recently announced that subsidization of airports which merely survive due to substantial public support will be prohibited after 2024. Since most of the smaller and regional airports in Germany are currently subsidized, they are facing severe problems for their future existence. Proponents of the regional airports emphasize the importance of positive spillovers on employment and economic growth throughout the region. This paper probes if German regional airports indeed generate a better economic performance in their environment.

Investments in infrastructure such as airports are an outcome of economic performance and future economic expectations and, correspondingly, evaluations suffer from the related endogeneity problems. The deregulation of the European aviation market marks an exogenous event which can be seen as a (quasi)-experiment for the expansion of regional airports. An increasing number of airlines demanded further operation slots in Germany and shifted to the regional airports. And those airports prepared their infrastructure with massive investments to fulfill the airlines' requirements, quite independent from the contemporaneous economic conditions. Furthermore, the military background of most regional airports makes their location less dependent on the economic conditions in their environment.

Based on the assumed exogeneity of the expansion, a DiD is applied which conducts the period after the reform in 1997 as treatment period. For the spatial definition of the treat-

[23] The associated DiD without the regions with a probability below 1.5% is not shown here.

ment, regional buffers with a radius of 15km are constructed around the airports. Ignoring the possible endogeneity problems would lead to a positive estimation of airport effects on the GDP per labor force. This appears to drive earlier positive findings such as Allroggen/Malina (2014). However, when taking into account the preferred deregulation-based identification strategy, the estimated effects are negligible.

A broad set of robustness checks strengthens these findings. The results are robust to a change of the definition of regional airports, various demarcations of the control and treatment groups, avoidance of an Ashenfelter's dip by the exclusion of years around the deregulation, and changes of the dependent variable. A reason for these sobering results might be the overwhelming opportunity costs of the airport operation. Since many municipalities spent high amounts in the operation of the airports, this capital is tied up by the airport and other – possibly better investments – are precluded. This overall result is supported by a recently published report of the European Court of Auditors that detected severe unsuccessful subsidized airport-projects in southern European countries with sobering cost-benefit relations (EUCA 21/2014).

Note that the evidence presented here does not suggest any conclusions regarding the effects of international airports. It may be the case that airports need to exceed a certain threshold to fade out spillovers. Furthermore, the high density of airports in Germany may be a reason for the results, since further benefits of an expanded airport might be rather low in a dense airport network. Besides the advances of the applied identification strategy, this might be a further explanation for the differing findings in this paper compared to existing literature for other countries.

Based on the economic effects, this paper does not confirm concerns of regional politicians that regions will suffer once airport subsidies will be cut. Since the expansion of airports had no positive effects, a downscaling of activities towards sustainable airports without subsidies is not supposed to have major negative effects on the surrounding municipalities. In addition, the provision of better regional air transport infrastructure does not seem to be a promising instrument to stimulate growth in lagging regions.

References

Allroggen, F., & R. Malina, 2014. Do the regional growth effects of air transport differ among airports?. Journal of Air Transport Management, 37, 1-4.

Angrist, J. D., & J. S. Pischke, 2008. Mostly harmless econometrics: An empiricist's companion. Princeton university press.

Arbeitsgemeinschaft Deutscher Verkehrsflughäfen (ADV), 2015, Verkehrszahlen – Archiv. Online available: http://www.adv.aero/verkehrszahlen/archiv/

Aschauer, D. A., 1989. Is public infrastructure expenditure productive?. Journal of Monetary Economics, 23, pp. 177–200.

Augurzky, B., Bauer, T. K., & Schaffner, S. (2006). Copayments in the German Health System-Do They Work?. RWI Discussion Papers: 43.

Baltagi, B. (2008). Econometric analysis of panel data (Vol. 1). John Wiley & Sons.

Barrett, S. D., 2000. Airport competition in the deregulated European aviation market. Journal of Air Transport Management, 6(1), 13-27.

BBR (Federal Office for Building and Regional Planning), 2011. Laufende Beobachtungen des Bundesinstituts für Bau-, Stadt- und Raumforschung, various issues. Bundesamt für Bauwesen und Raumordnung, Bonn.

BBR (Federal Office for Building and Regional Planning), 2009. Siedlungsstrukturelle Kreistypen. Published online: http://www.bbsr.bund.de.

Becker, S. O., Boeckh, K., Hainz, C., & L. Woessmann, 2014. The Empire Is Dead, Long Live the Empire! Long-Run Persistence of Trust and Corruption in the Bureaucracy. The Economic Journal. (online first)

Blonigen, Bruce A. & Cristea, Anca D., 2012. Airports and Urban Growth: Evidence from a Quasi-Natural Policy Experiment(No. w18278). National Bureau of Economic Research.

Brueckner, J.K. 2003. Airline traffic and urban economic development. Urban Studies 40 (8): 1455-1469.

Bruno, G. S., 2005. Estimation and inference in dynamic unbalanced panel-data models with a small number of individuals. Stata Journal, 5(4), 473.

Burghouwt, G., J. Hakfoort, 2001. The evolution of the European aviation network, 1990–1998, Journal of Air Transport Management, Volume 7, Issue 5, Pages 311-318

Button, K. J., Doh, S. and Yuan, J., 2010. The role of small airports in economic development, Journal of Airport Management, 4, pp. 125–136.

Button, K. & Taylor, S., 2000. International air transportation and economic development. Journal of Air Transport Management 6: 209-222.

Button, K., & Yuan, J., 2013. Airfreight transport and economic development: an examination of causality. Urban Studies, 50(2), 329-340.

Cezanne, W., and A. Mayer, 2003. Flugplatz als Wirtschaftsfaktor-Möglichkeiten und Formen der Landeplätze als Wirtschaftsfaktor, Analyse der im Land vorhandenen Situation.

Committee of the Regions, 2004. Own-initiative opinion of the Committee of the Regions on 'Low-cost airlines and territorial development'. Official Journal of the European Union. (2004/C 318/02). Brussels

Cidell, J., 2014. The role of major infrastructure in subregional economic development: an empirical study of airports and cities. Journal of Economic Geography

Cidell, J., 2003. The conversion of military bases to commercial airports: existing conversions and future possibilities. Journal of Transport Geography 11, 93–102.

Destatis, 2015. Regionaldatenbank Deutschland. Erläuterung Bruttoinlandsprodukt, Bruttowertschöpfung. Published Online: https://www.regionalstatistik.de/genesis/online

European Low Fares Airline Association, 2004. Liberalization of European Air Transport: The Benefits of Low Fares Airlines to Consumers, Airports, Regions and the Environment. Brussels

Goetz A.R. 1992. Air passenger transportation and growth in the U.S. urban System, 1950-1987. Growth and Change 23:218-242.

Graham, B., Guyer, C., 1999. Environmental sustainability, airport capacity and European air transport liberalization: irreconcilable goals?. Journal of Transport Geography 7, 165–180.

Graham, B., 1998. Liberalization, regional economic development and the geography of demand for air transport in the European Union. Journal of Transport Geography, 6(2), 87-104.

Graham, B., 1997. Regional airline services in the liberalized European Union single aviation market. Journal of Air Transport Management, 3(4), 227-238.

Graham B., 1995. Geography and Air Transport. Wiley, Chichester.

Green, R. 2007. Airports and economic development. Real Estate Economics 35:91-112.

Frédéric Dobruszkes, Moritz Lennert, Gilles Van Hamme, 2011. An analysis of the determinants of air traffic volume for European metropolitan areas, Journal of Transport Geography, Volume 19, Issue 4, Pages 755-762

Mawson, J., 1997. Air transport liberalization in the European Union: an assessment. Regional Studies, 31(8), 807-812.

Mukkala K., Tervo H., 2013. Air transportation and regional growth: which way does the causality run?. Environment and Planning A 45(6) 1508 – 1520

Nickell, S. (1981). Biases in dynamic models with fixed effects. Econometrica: Journal of the Econometric Society, 1417-1426.

Nijkamp, P., Geenhuizen, M., 1997. European transport: challenges and opportunities for future research and policies. Journal of Transport Geography 5, 4-11.

Paloyo, A. R., Vance, C., & Vorell, M. 2010. The regional economic effects of military base realignments and closures in Germany. Defence and Peace Economics, 21(5-6), 567-579.

Robertson, J.A.W. 1995. Airports and economic regeneration, Journal of Air Transport Management, Volume 2, Issue 2, June 1995, Pages 81-88

Sheard, N., 2014. Airports and urban sectoral employment. Journal of Urban Economics, 80, 133-152.

Thompson, I., 2002. Air transport liberalisation and the development of third level airports in France, Journal of Transport Geography, Volume 10, Issue 4, December 2002, Pages 273-285

Van Praag, B. M. S. and B. E. Baarsma, 2005. Using Happiness Surveys to Value Intangibles: The Case of Airport Noise. The Economic Journal, 115: 224–246.

Vickerman, R., Spiekermann, K., Wegener, M., 1999. Accessibility and economic development in Europe. Regional Studies 33: 1-15.

Table A.1: Corrected DiD- Fixed effects (Bruno, 2005)

Dep. Variable: GDPpl level	**(ii)**	**(iii)**	**(iv)**
DiD-estimator	**-0.006**	**-0.003**	**-0.003**
	(0.005)	**(0.005)**	**(0.004)**
Post-Treat	0.008***	-0.011***	0.003
	(0.002)	(0.002)	(0.003)
ln(GDPpl) lagged	0.899***	0.916***	0.761***
	(0.005)	(0.006)	(0.008)
ln(employment) lagged	0.109***	0.023	-0.084***
	(0.01“)	(0.017)	(0.018)
ln(Population) lagged		0.175***	0.196***
		(0.025)	(0.025)
ln(Density) lagged		-0.000	-0.001
		(0.001)	(0.001)
Time Dummies	N	N	Y
No. of Regions	271	271	271
No. of Obs.	4352	4288	4288

Note: ***,**,* denote significance at the 1%-, 5%- and 10%-level. Robust standard errors clustered on county-level in parentheses.

Table A2: Placebo Regressions (DiD-Fixed effects)

(Dependent Variable: Growth of GDPper labor force)

	(i) Hypothetical Treatment in 1994 (excluding t >1996)	(ii) Hypothetical Treatment in 2000 (excluding t <1997)
DiD-estimator	**-0.007** **(0.006)**	**0.001** **(0.003)**
Post-Treat	0.010*** (0.004)	0.058*** (0.004)
ln(GDPpl) lagged	-0.434*** (0.021)	-0.327*** (0.020)
ln(employment) lagged	-0.097 (0.060)	-0.056** (0.028)
ln(Population) lagged	0.672* (0.388)	-0.004 (0.042)
ln(Density) lagged	-0.620 (0.418)	-0.001 (0.001)
Constant	4.779 (4.314)	1.531*** (0.166)
Time Dummies	Y	Y
No. of Groups	271	171
No. of Obs.	1056	3232

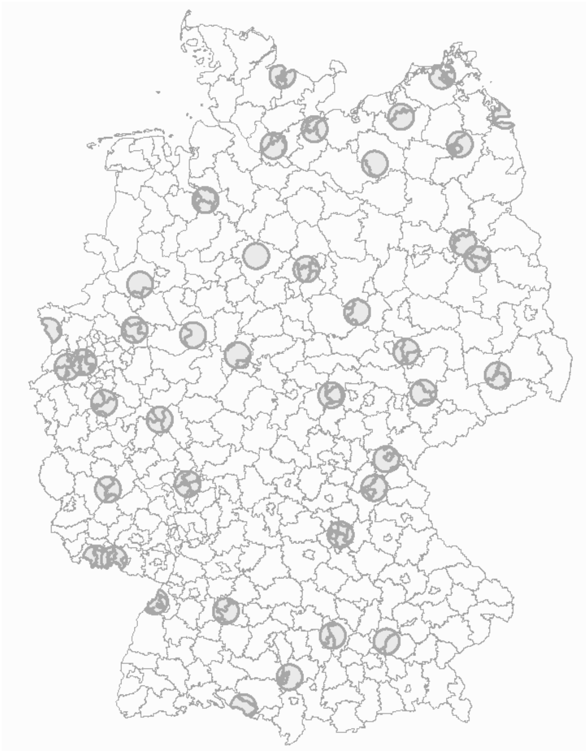
Note: ***,**,* denote significance at the 1%-, 5%- and 10%-level. Robust standard errors clustered on county-level in parentheses.

Table A.3: Various robustness check (DiD-FE)

Dep. Variable: GDPpl growth (or see column headline)	(i) Dep. Var. GDP growth	(ii) Dep. Var. GDPpc growth	(iii) Dep. Var. Employment growth	(iv) Skipped after 2001	(v) Regional Airports legally defined	(vi) Biggest Passen-ger surplus (10 Apt)
DiD-estimator	**-0.004**	**-0.005**	**-0.002**	**-0.001**	**-0.005**	**-0.011*****
	(0.005)	**(0.005)**	**(0.003)**	**(0.003)**	**(0.004)**	**(0.003)**
Post-Treat	0.008***	0.008***	0.005***	0.020***	0.009***	0.009***
	(0.003)	(0.003)	(0.001)	(0.004)	(0.003)	(0.003)
ln(GDPpl) lagged	-0.293***	-0.290***	0.002	-0.377***	-0.294***	-0.293***
	(0.014)	(0.014)	(0.006)	(0.016)	(0.012)	(0.013)
ln(employment) lagged	-0.202***	-0.220***	-0.122***	-0.103***	-0.079***	-0.079***
	(0.025)	(0.025)	(0.010)	(0.033)	(0.023)	(0.023)
ln(Population) lagged	0.219***	0.283***	0.092***	0.227***	0.131***	0.128***
	(0.039)	(0.037)	(0.016)	(0.051)	(0.031)	(0.032)
ln(Density) lagged	-0.001*	-0.001*	0.000	-0.003***	-0.001**	-0.002***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
Constant	0.883***	0.627***	0.039	0.736***	0.810***	0.816***
	(0.152)	(0.148)	(0.067)	(0.237)	(0.131)	(0.134)
Time Dummies	Y	Y	Y	Y	Y	Y
No. of Groups	271	271	271	272	264	257
No. of Obs.	4288	4288	4288	2384	4160	4072

Note: ***,**,* denote significance at the 1%-, 5%- and 10%-level. Robust standard errors clustered on county-level in parentheses.

Figure A.1: Airport and the respective buffer regions



Regional Airports

- Altenburg
- Augsburg
- Bayreuth
- Braunschweig-Wolfsburg
- Dortmund
- Erfurt-Weimar
- Frankfurt-Hahn
- Friedrichshafen
- Hof
- Karlsruhe
- Kassel-Calden
- Kiel
- Lübeck
- Magdeburg
- Mönchengladbach
- Münster
- Neubrandenburg
- Paderborn
- Rostock
- Saarbrücken
- Schwerin
- Siegerland
- Stralsund-Barth
- Zweibrücken

International Airports

- Berlin-Schönefeld
- Berlin-Tegel
- Bremen
- Dresden
- Düsseldorf
- Frankfurt am Main
- Hamburg
- Hannover
- Köln/Bonn
- Leipzig/Halle
- München
- Nürnberg
- Stuttgart