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Cause or Consequence of Regional Prosperity?

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Philipp Breidenbach and Timo Mitze[1]

The Long Shadow of Port Infrastructure in Germany – Cause or Consequence of Regional Prosperity?

Abstract

Transport infrastructure is viewed as an important determinant of regional growth and development. While this prediction especially holds from a theoretical perspective based on endogenous growth theories, from an empirical perspective it is not easy to verify this causal link, though. The main reason for this difficulty is that it is hard to measure whether transport infrastructure is indeed the exogenous driver of regional development or whether it is rather an endogenous reflection of the higher transportation demand in prospering regions. In this paper, we analyse the long-run effect of port facilities on regional income levels in Germany. Since it is very likely that the "reversed causality" problem applies to our sample setting, we use an identification strategy that is based on exogenous longrun instruments. In particular, port facilities built before the industrial revolution (about 1850 in Germany) can be seen as an adequate instrument for current port infrastructure since they are exogenous to recent economic development. Using German regional data for 1991–2008, our results hint at a positive correlation between port locations and regional per capita GDP, but do not provide evidence for a causal relationship. For the regional variation of population levels as a more general indicator for agglomeration effects, the causal relationship running from port infrastructure provision to increasing population levels holds nonetheless.

JEL Classification: C26, R12, R40

Keywords: Port infrastructure; regional income; causal effects; IV

July 2013

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1. Introduction

Since the influential work of Aschauer (1989) and subsequent empirical contributions, economists and policy makers are referring to public infrastructure as a crucial input factor for regional development.[2] European regional policy, for instance, regards an adequate transport infrastructure as a prerequisite for sustainable development, where ports are typically presumed to foster the latter through growth externalities and agglomeration advantages. In this paper, we explicitly explore the causal effects of sea and river ports on regional distribution of per capita GDP and population levels across German counties.

In this endeavor, documenting a positive correlation between port locations and the regional income does not fully convince whether ports indeed contribute to local growth and development. It is rather unclear whether ports are really the exogenous source of variation in regional growth or whether causality may be the other way around, namely that a prospering regional economy simply displays a higher demand for transportation including waterway access. In this case, port facilities are rather a consequence of growth and any empirical estimation approach will inherently suffer from a reverse causality bias.

To address this reversed causality, we apply an instrumental variable (IV) approach and instrument the recent port infrastructure by the use of historical ports, which were established before industrial revolution (defined as pre-1850 era in Germany, see Hahn, 2005). Therefore, these historical ports were not built as a consequence of modern industrial demand which is very likely to make them exogenous with respect to our outcome variable (regional per capital GDP between 1991 and 2008). Our IV approach thus facilitates the causal analysis of the effects from ports on the level of regional economic activity and may be seen as a viable alternative to other identification strategies that seek to properly model the mutual dependence among variables such as the estimation of multi-equation systems.

[2] For a recent overview of the role of public infrastructure for economic development see, for instance, Romp and de Haan (2007).

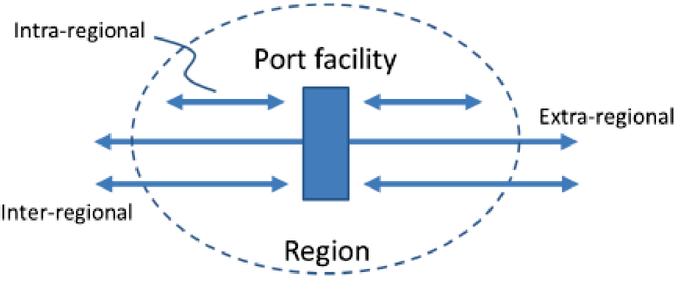
To preview our results, the standard OLS-type regression setup documents that today's port locations indeed positively correlate with the distribution of GDPpc in German districts. However, when applying the IV approach with historical ports, there is no evidence left. Thus, for the German case, ports seem to be a consequence of regional industrial development rather than its cause. The remainder of the paper is organized as follows. In the following section we briefly review the empirical literature on port infrastructure and regional economic development. Thereafter, Section 3 presents the underlying theoretical framework and outlines our empirical identification strategy. Section 4 describes the dataset and the model setup. The results – together with robustness checks – are presented in section 5, while Section 5 discusses the implications and finally concludes the paper.

2. Port infrastructure and economic development: A classification of the literature

A highly developed public infrastructure level is seen as a prerequisite for economic growth given that industries can only prosper with adequate access to their markets (Rietveld 1989). Ports are viewed as one of the most important infrastructure amenities since they create jobs and prosperity themselves and they provide transportation-possibilities for other goods. Exclusively focusing on sea-ports, Acemoglu et al. (2005) point out the relevance of port access for differences in the evolution of European countries in the 15th and 16th century.

While there is little doubt regarding the beneficial overall effects of port infrastructure on (inter-)national economic development, less evidence is known with regard to the question in how far port infrastructure also leads to regional output and productivity effects. As Button (1998) shows for the more general case of transport infrastructure facilities, regional outcomes are most likely influenced by three types of effects: i.) intra-regional effects, ii.) extra-regional transit effects and iii.) inter-regional trade effects (Figure 1).

Figure 1: Impact channels of port infrastructure on region



Source: Own figure adapted from Button (1998).

Intra-regional effects include both, demand side effects due to investments in a port facility and its maintenance as well as supply side effects given that port infrastructure can be seen as an additional input factor in the regional production function. If a port facility principally nevertheless serves mainly transit purposes, it is unlikely to create a great deal of regional value added. Such extra-regional effects are more likely to increase the productivity of the set of regions as a whole rather than providing regional advantages. Finally, as pointed out in Button (1998), if the infrastructure facility serves to facilitate trade flows into and from the region, then the impact on regional output through such inter-regional effects strongly depends upon the region's comparative and competitive advantages.

Recent contributions on the local and regional effects of port facilities can be separated in three major strands. The first one takes a particular focus on the analysis of port efficiency, where the key question of analysis is the direct effect of institutional changes in port authorities or in the local setup of a port (e.g. Cheon et al. 2009 or Brooks et al. 2011). These studies have high relevance for the administrative units of maritime amenities; however, they cannot give any hint on the regional effect of a port since only changes over time in the outcome effect are considered, while the long-run level effect of the port itself is not in the scope of the analysis.

Empirical case studies, as second strand, explicitly evaluate single projects and they are applicable for ex-ante and ex-post studies. These studies take both direct and indirect effects (neighbors, other branches or environment) into account (e.g. Gripaios et al. 2005, OECD 2002). While a case study, by definition, evaluates the circumstances for one special case of a region, the transferability and generalization of these results is rather limited. They are also quite susceptible to the particular study design, which further complicates any comparability across cases and their obtained results (de Jong & Van Wee 2007).

Finally, a broader approach is the conduct of structural evaluations. This strand tries to establish general economic statements by comparing a number of regional units – treated in comparison to non-treated – and includes a range of control variables in the empirical estimation setup in order to isolate the causal effect of interest. Conducting a structural analysis means to give up the very detailed perspective of a case study. However, the gain of this type of analysis is the potential generalization of the obtained results. Port economics and related disciplines have mostly failed in providing proper estimation designs to isolate causal linkages (Ferrari et al. 2012). Only very few studies explicitly address the necessary construction of the counterfactual situation to account for causal effects.

3. Theoretical Model and Estimation Approach

As Button (1998) points out, the importance of public infrastructure as an element in the economic development process has long been disputed. Thereby both, demand and supply side considerations should be taken into account: While a demand side – Keynesian – centered theory of regional development indicates that causality runs from economic exploitation to income and infrastructure generation, in a neoclassical view, economic development is typically supply driven, where transport and other infrastructure are seen as important input factors in the production function.

Most of the recent contributions that intend to identify long-run effects rely on the neoclassical approach through the specification of some form of production function analysis. Starting from a generalized Cobb-Douglas type production function with capital and labor as basic inputs, this function can be easily extended to include stocks of (port) infrastructure as an additional input as

$$Y_{it} = f(K_{it}, L_{it}, I_{it}) \quad (1)$$

where $Y_{i,t}$ denotes the production output of region i at time t, which is specified as a function of capital (K), labor (L) and supportive infrastructure (I). The "new" (or endogenous) growth theory provides an appropriate vehicle to analyze the regional long-run effect of public infrastructure on output (growth). While in a neoclassical world shocks in infrastructure can only have a transitory effect given exogenous technical progress, according to theories of endogenous growth public infrastructure can actually raise the steady-state per capita income level (see, for instance, Barro and Sala-i-Martin, 2003). The implication of alternative long-run steady state income levels of regions due to differences in the equipment with port infrastructure among other factors shall be tested in the following.[3]

We focus on regional GDPpc as our outcome variable reflecting long-run regional prosperity of German NUTS3 districts which are comparable to U.S. counties. Our approach is thus in line with the economic-demographic impact analysis (Musso et al. 2007). We include a broad set of $k=1,\dots,K$ control variables ($x_{i,t-1}$), which are mainly motivated by the specification of the stylized production function approach according to eq.(1). Our main interest lies on estimating the impact of a binary dummy which captures the existence of a regional port (D_i). Using a log-linear model specification[4], our basic regression equation is

$$\ln(GDPpc_{it}) = \beta_k \ln(x_{k\,it-1}) + \delta D_i + \varepsilon_{it}, \quad (1)$$

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[3] In models predicting a polarization of economic activity due to agglomeration forces, even long-run differences in the output growth rates in course of infrastructure externalities may be observed. For an overview of the literature on these New Economic Geography (NEG) models see, for instance, Brakman et al. (2009). In the empirical setup, we will test for output growth effects of port facilities as well.

[4] Certain controls are not transformed in logs, since the interpretation of coefficients might be less intuitive in logs (e.g. shares in percentage). See Table 1 for details.

where $i=1,\ldots,N$ is the cross-sectional and $t=1,\ldots,T$ is the time dimension, β_k and δ are regression coefficients to be estimated, and $\varepsilon_{i,t}$ is an independent and identical distributed error term (i.i.d.). Regarding the set of control variables, we use different economic indicators such as the investment intensity, employment levels, average firm size and population density as well as further regional dummies.

The direction of the link between economic growth and infrastructure amenities remains unclear ex ante. That is, ports might indeed be the initial infrastructure endowment, which subsequently leverages the economic upswing of a region. Nevertheless, ports may also be the result of industrial development and may tend to be built in those districts where the economy has a need for such infrastructure investment. In the latter case, the infrastructure is then merely a reflection of regional development and not its cause.

Basically, this endogeneity problem can be handled in two ways: Either a system of equation is estimated, which treats each variable as being dependent ex-ante and then tries to test for exogeneity of certain factors. The main problem of this approach is that system estimation is rather complex and sensitive to model misspecifications and it needs a rather long time-series. Alternatively, an identification approach can be conducted that builds upon long-run instruments in order to isolate the causal effect of a certain variable.

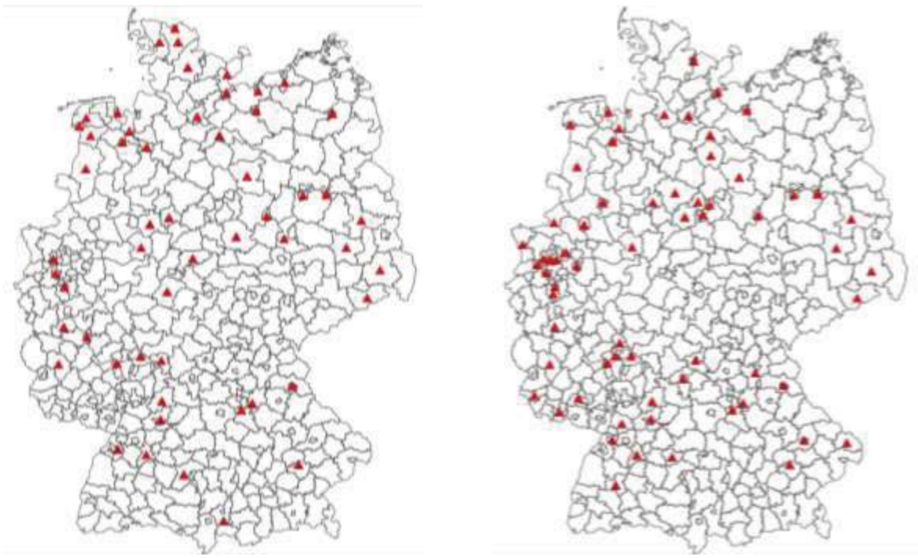
Such instruments need to fulfill two important requirements: First, they should be sufficiently correlated with the instrumented variable in order to allow for a meaningful interpretation of the results. Second, the instruments need to be exogenous with respect to the outcome variable in the final estimation equation in order to avoid any endogeneity bias. Recent research has shown that the use of meaningful historical instruments may indeed be a good guess to overcome the endogeneity problem. Falck et al. (2011), for instance, argue that the location of baroque opera houses is exogenous to economic performance today, while one can still use these instruments to estimate the effect of cultural amenities on the regional distribution of human capital employees (Falck et al. 2011).

A similar argument should also apply to those port amenities which are built before the onset of the industrial revolution. We thus have good reasons to take the historical facilities as exogenous source of variation to proxy the effect of current port locations on regional economic prosperity. Ports were mainly built in those places, where the local natural conditions made a harbor possible and more importantly, they were not built to reflect future industrial demands, e.g., the transportation of iron ore for steel production in the Ruhr area. A map of actual and historical port facilities shows the broad distribution of ports over the German counties and the high persistence of the facilities in 1850 and today, which highlights the first requirement, namely the correlation between instrument and instrumented variable (Figure 2). Computing a simple correlation coefficient (ρ) for actual and old port locations reveals a fairly high value of ρ=0.45.

Under these circumstances the historical ports serve as a suitable instrument for the actual location and the causal effect of port amenities can be properly estimated by a natural IV approach. Of course, the choice of an instrument can always be tackled. To further validate our approach, we will also use statistical criteria available to check whether our instruments works both in terms of relevance and exogeneity as outlined above.

Figure 2: Port's locations 1850 and today

Historical Ports (existing in 1850) **Actual Ports**



Source: Destatis (2008) and Kunz (2000)

Our estimation procedure can be summarized as follows: First, we regress the binary indicator for the current port infrastructure (D_i) on a second indicator variable which identifies NUTS3 regions with historical ports (D_i^{old}) and further controls as outlined in eq. (3). The fitted values ($\hat{D}_i$) of this first-step regression are then inserted in the final equation to explain regional GDPpc as shown in eq. (4) (for IV-details see e.g. Abadie et al. 2002) as

$$D_i = \gamma_k \ln(x_{k,it-1}) + \phi D_i^{old} + u_{it} , \qquad (1)$$

$$\ln(GDPpc_{it}) = \beta_k \ln(x_{kit-1}) + \delta \hat{D}_i + \varepsilon_{it} , \qquad (1)$$

where γ_k and ϕ are further regression coefficients, u_{it} is an i.i.d. error.

Up to this point, our variable of interest - the port dummy - underlies a quite narrow spatial definition. To account for the fact that the economic benefit of port infrastructure is not restricted to the local economy but may also affect its economic hinterland (Clark et al. 2004), in an alternative specification we use the geographical distance for each district to the next historical harbor as the policy variable in the regression equation.

4. Model setup and dataset

We use annual data for the period 1991–2008 and 413 German NUTS3 districts. Regarding the estimator choice, in the benchmark specification we use a pooled-OLS model with standard errors clustered by regions. Since we are interested in estimating the parameter δ for the time-invariant indicator of port infrastructure, we cannot use panel estimators (e.g. fixed effects) since they would wipe out the time-invariant port variable as well. However, to overcome biases due to unobserved heterogeneity (Islam 1995), we include a broad set of control factors (Table 1).

There is a considerable degree of heterogeneity among the GDPpc of German NUTS3 districts; the mean income for the sample period is 23,578 Euro. About 16% of German districts have an actual port; about 15% of regions had a port before 1850.[5] Since port facilities were not accurately defined in the historical data, we focus on those facilities which have a capability for ships heavier than 50 tons.

[5] Historical ports are taken from Kunz (2000). Port locations in counties are always shifted in the center of the county, while we are not able to observe inner-county effects. Therefore, distances in counties with a harbor are defined as zero. We use the centroid of the county-city as county-centroid instead of the geographical center.

Table 1: Data and descriptive statistics

Variable	Measured as	Mean	Std. Dev.
GDPpc	Per capita Income level	23578	9784
POP	Population (in 1000)	198.55	224.681
Actual port facilities	Port Dummy (actual)	0.1622	0.3687
Historical port facilities	Port Dummy (historical)	0.1501	0.3572
Distance to rec. ports	Distance to next port (actual) in km	40.08	31.65
Distance to hist. ports	Distance to next port (old) in km	38.48	27.07
Investment intensity	Investment per employee in manufacturing sector(in logs)	8.8051	0.4596
Employment growth	Growth rate of Employment (in %)	0.35	1.79
Firm size	Avg. firm size in manufacturing sector (employees)	4.7759	0.4613
Wage	Avg. annual gross wages in manufacturing (logs)	10.3097	0.2458
Agriculture	Share of agricultural sector employment (in %)	3.66	2.93
Manufacturing	Share of employees in manufacturing (in %)	24.51	11.11
Human capital	Share of employment with tertiary education degree (in %)	7.14	3.36
Population density	Population density	0.0140	0.0922
Migration	Dummy indicating a positive net migration balance	0.6312	0.4825
Students	Share of Students (per 1000 inhabitants)	18.6787	39.4920
West Germany	Dummy for former West-Germany	0.7893	0.4078
Urban Municipality	Dummy for a district-free city (*kreisfreie Stadt*)	0.2688	0.4433
Settlement Structure	Set of regional dummies for regional settlement structure ranging from 1 = highly agglomerated to 9 = highly peripheral		

Source: All economic variables are taken from the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR 2011).

As outlined above, we further control for investment-intensities, employment, firm-sizes, wages, employment shares in agriculture and manufacturing, human capital, population density and migration. Further variables are included to proxy time-fixed regional effects: (i) a binary dummy variable indicating whether the region belongs to former West German districts, (ii) whether the region is an independent urban municipality (kreisfreie Stadt) and finally (iii) a set of indicators for the regional settlement structure ranging from centers of an agglomerated area to rural areas in the periphery (BBSR 2009). To control for time-effects in the observation period, we include year dummies.

5. Results and Robustness Checks

The first column of Table 2 reports our benchmark model, the pooled OLS according to eq. (2), which uses the dummy variable for recent port facilities. The second column documents the OLS results for the distance-based variables. The estimation results reported in column 3 refer to our favored IV approach using the historical presence of ports as instrument for the current port infrastructure.

Taking a closer look at column 1, we can see that for most of the control variables the estimated coefficients turn out to be statistically significant and display an economically meaningful sign. Urban municipalities for example tend to display a higher GDPpc by some 28.4% in average. Obviously this cannot be a causal statement. Rather it is much more likely that a city with a high GDPpc may turn into an urban municipality eventually. A similar mechanism of reversed causality might also operate to bias the estimated effect of a port facility reported in column 1. The effect of the port variable in the first column therefore merely estimates a correlation, but not a causal effect.

<<Table 2 about here>>

Switching to the second column shows, that a positive hinterland-effect is not present since the distance to the next port does not show any correlation with GDPpc. This result stands in contrast to other studies, which assess the port effects as underestimated since they disregard those hinterland-effects (Clark et al. 2004).

Since today's ports do not show any sign of a significant hinterland effect, we do not report the associated IV estimation.[6] Column 3 shows that in the IV estimation – although the mean effect becomes larger – the coefficient loses its statistical significance. Thus, as soon as we explicitly address the possible endogeneity bias, we do not find a positive causal effect of ports on today's regional GDPpc distribution.[7] The estimates rather suggest that the positive correlation documented in the baseline regression is merely a reflection of economic well-being, most specifically a higher industrial demand for waterway infrastructure. Same results also hold for a basic OLS approach with historical ports as included regressor without relying on a two stage IV approach.[8]

In order to evaluate the quality of our regression approach, we will discuss the results of two important post-estimation tests. A first test is related to the issue of spurious regression for non-stationary variables. Since we are using the level information as dependent variable over a long time period, the output variable may be integrated of order $I(1)$ and thus follows a stochastic trend. In this case, the residuals of the regression would have to be stationary to warrant the interpretations of the model as the long-run specification of a set of cointegrated variables. If this assumption was violated, level estimation may serve spurious results and a transformed system with stationary variables (e.g. growth rates) would be suitable. In order to test the stationarity, we conduct a Fisher-type panel unit root test according to the Choi (2001) approach which can be used for large N settings. As the results in Table 2 show, for all three specifications the null hypothesis of unit-roots in the residuals of all panel units can be rejected at reasonable confidence levels.

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[6] As expected, these estimations do not show significant port effects either. Estimation details can be obtained from the authors upon request.

[7] These results also hold if we use the annual deviations from national GDPpc as endogenous variable. We also estimated a regression model with annual growth rates of per capita GDP as outcome variable. In this specification the port variable turned out to be statistically insignificant as well. Regression results can be obtained from the authors upon request.

[8] Estimation results can be obtained from the authors upon request.

Second, in order to test for the appropriateness of our chosen IV estimation approach, we also check for the relevance and exogeneity of our chosen instrument set. With regard to instrument relevance in the first-step according to eq. (3), we apply the Angrist-Pischke (2009) multivariate F-Test as a diagnostic tool for whether a particular endogenous regressor is weakly identified. As the results show, the null hypothesis of weak identification is strongly rejected by means of a large value for the underlying F-test.[9]

As further robustness tests we also estimate analogous model specifications focusing on the regional distribution of city sizes. The relative distribution of population levels may be seen as an alternative indicator for the long-run growth externalities induced by port infrastructure. Moreover, compared to the evolution of GDPpc, cities evolve rather slowly over time and are less affected by institutional changes (such as the transformation of the Eastern-German economy from a socialist to a free market structure). Thus, German city sizes may thus represent an even longer-run view on agglomeration effects. As shown in Brakman et al. (2004) for a different historical setup, the distribution of German city sizes after bombing during WW2 shows that the development of cities follows a relatively stable time path following a shock. Thus, given the GDPpc distribution may be subject to political interventions, the analysis of population levels driven by transport infrastructure endowments may add additional insights.

<<Table 3 about here>>

Thus we estimate OLS and IV models for regional population levels with basically the same set of regression variables as for GDPpc, which now also enters as an additional control variable.[10] As the results in column 1 of Table 3 show, we again find a positive correlation between population size and current port infrastructure. However, compared to the case of GDPpc, the positive effect remains

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[9] The F-test statistic can be compared to the Stock and Yogo (2005) critical values for the Cragg-Donald F statistic with K=1 (in our case, the critical value for 10% maximal IV size is 16.38.)

[10] We also include population density as explicit control variable in the estimation approach in order to compare the absolute size of cities for regional units with comparable population density levels.

intact if we estimate the model by IV. This indicates that port infrastructure has a positive causal long-run effect on the region's population level, which is not driven by the current industrial structure of German regions. Interestingly, if we use distances from ports we find that there is an adverse effect on the hinterland of the port location. That is, the negative regression coefficient indicates that port cities tend to poach population levels from their geographical surroundings. As before, the post estimation tests do not indicate any misspecification of our chosen estimation setup. All in all, these estimation results have some important implications for regional policy making, which will be addressed in the concluding section.

6. Conclusion and policy implications

The aim of this paper was to find general statistical evidence for a causal effect of port infrastructure on the distribution of regional income and population levels. Since infrastructure investments are often built for industrial needs, an empirical ex-post evaluation strategy, ignoring the reversed causality problem is likely to deliver biased estimates. To address this bias, we have used an IV approach based on historical port amenities which had already existed before the process of industrial revolution has started. Consequently, these ports can be seen as an exogenous variation in infrastructure equipment since they are not necessarily located in geographical areas where industry has a higher demand for an enlarged infrastructure.

Our estimation results, however, do not confirm a long-run causal transmission channel from port infrastructure to regional per capita GDP levels. Although we indeed find a positive correlation between today's port amenities and the regional GDPpc, when using an exogenous long-run instrument of historical ports this link breaks down. The latter result, in fact, indicates that the observed positive income shift of districts with ports is merely a consequence of other locational variables than its cause. Analyzing the impact of port facilities on population levels, we nevertheless find a positive causal link based on our IV approach. Given that population levels can be expected to change in a more sluggish way compared to per capita GDP (and are less affected by policy interventions), the latter result may indicate that there is at least a somewhat long shadow of port infrastructure on regional development - indicating that ports are an important factor for the shape urban structures but their role for regional income allocation seems is limited.

Overall, the rather mixed empirical evidence on the causal link from port infrastructure to regional prosperity begets the question, whether regional policy should desist from port infrastructure investment support. The answer is: Certainly not. If there is an industrial demand for a better infrastructure, policy makers should also put effort on its realization. However, as long as such projects are purely based on supply side considerations with and do not reflect regional (potential) demand for such facilities, our results indicate to be cautious in terms of viewing ports as the essential initial stimulus to increase the region's long-run development path.

Of course, our approach is not without limitations though. For instance, one needs to stress that our results do not imply the absence of overall positive output effects of port infrastructure. Our findings just indicate that these effects are not bounded to be local in nature and instead are likely to be beneficial for the whole economy triggering all regions in a similar way – irrespective of whether they host a port or not. Furthermore, we are not able to fully condense the result to a marginal effect of establishing a port whose magnitude is exactly interpretable with our broad identification strategy. However, it gives a strong hint on the potential reversed (two-way) causality problem among port infrastructure and regional development and calls for further studies that tackle this issue empirically.

Table 2: Estimation results: Regional GDPpc levels

Dependent Variable: **Log of GDPpc**	I Actual Ports Dummy/OLS	II Actual Ports Distance/OLS	III Historical Ports Dummy/IV
Port-variable	**0.0586****	**0.0003**	**0.0984**
	(0.0253)	**(0.0003)**	**(0.0686)**
Investment intensity	0.0251*	0.0304**	0.0222
	(0.0135)	(0.0136)	(0.0147)
Employment growth	0.0041*	0.0039	0.0043*
	(0.0025)	(0.2537)	(0.2509)
Firm size	0.0504	0.0702*	0.0403
	(0.3731)	(0.038)	(0.0384)
Wage	0.3113***	0.3167***	0.3054***
	(0.0899)	(0.091)	(0.0897)
Agriculture	-0.0169***	-0.0172***	-0.0164***
	(0.005)	(0.0049)	(0.0051)
Manufacturing	0.0053***	0.0046***	0.0056***
	(0.0011)	(0.0012)	(0.0012)
Human capital	0.0389***	0.0367***	0.0397***
	(0.0078)	(0.0076)	(0.0078)
Population density	0.1436**	0.1557**	0.1372**
	(0.0618)	(0.0609)	(0.0614)
Migration	0.0249**	0.026**	0.0252**
	(0.0114)	(0.0116)	(0.0113)
Students	0.0003	0.0004	0.0003
	(0.0003)	(0.0003)	(0.0003)
West Germany	0.3069***	0.3054***	0.3084***
	(0.0516)	(0.0517)	(0.0514)
Urban municipality	0.284***	0.281***	0.2871***
	(0.0421)	(0.0425)	(0.0422)
Dummies for settlement structure	Yes	Yes	Yes
Dummies for sample years	Yes	Yes	Yes
No. Of Groups	413	413	413
No. Of Obs.	5035	5035	5035
Fisher-type cointegration test for Choi (2001)	6.9157 (p-val.: 0.00)	7.1707 (p-val.: 0.00)	6.7414 (p-val.: 0.00)
Angrist-Pischke F-Test F(1, 412)			28.26 (p-val.: 0.00)

Note: ***,**,*= denote significance at the 1%-, 5%- and 10%-level. Standard-errors in brackets.

Table 3: Estimation results: Regional Population levels

Dependent Variable: Log of POP	I Actual Ports Dummy/OLS	II Actual Ports Distance/OLS	III Historical Ports Dummy/IV
Port-variable	**0.2536*** **	**-0.0015** **	**0.6620*** **
	(0.0722)	**(0.0007)**	**(0.2234)**
GDPpc	0.0942	0.1638	-0.0008
	(0.1194)	(0.1222)	(0.1329)
Investment intensity	0.0641*	0.0738**	0.0369
	(0.0349)	(0.0363)	(0.0412)
Employment growth	0.0007	-0.0007	0.0035
	(0.0048)	(0.0049)	(0.0051)
Firm size	-0.0707	-0.0365	-0.1697
	(0.0927)	(0.0093)	(0.1181)
Wage	0.7631***	0.7964***	0.7399***
	(0.2821)	(0.2914)	(0.2768)
Agriculture	-0.0267**	-0.0301***	-0.0285***
	(0.0123)	(0.0126)	(0.0131)
Manufacturing	-0.0082**	-0.0099***	-0.0041
	(0.0032)	(0.0033)	(0.0039)
Human capital	0.0083	0.0059	0.0216
	(0.0150)	(0.0157)	(0.0156)
Population density	0.0458***	0.0463***	0.0800
	(0.0144)	(0.0152)	(0.0618)
Migration	-0.0188	-0.0175	-0.0251
	(0.0274)	(0.0272)	(0.0304)
Students	-0.0005	-0.0006	-0.0005
	(0.0007)	(0.0007)	(0.0007)
West Germany	-0.2571*	-0.2905*	-0.1988
	(0.1429)	(0.1505)	(0.1373)
Urban municipality	-1.2378	-1.2864***	-1.1205***
	(0.1267)	(0.1295)	(0.1308)
Dummies for settlement structure	Yes	Yes	Yes
Dummies for sample years	Yes	Yes	Yes
No. Of Groups	413	413	413
No. Of Obs.	5035	5035	5035
Fisher-type cointegration test for Choi (2001)	19.860 (p-val.: 0.00)	17.833 (p-val.: 0.00)	8.8042 (p-val.: 0.00)
Angrist-Pischke F-Test F(1, 412)			27.44 (p-val.: 0.00)

Note: ***,**,*= denote significance at the 1%-, 5%- and 10%-level. Standard-errors in brackets.

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