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ABSTRACT

Policy in the Pipeline: Identifying Regional Public Investment Priorities Using a Natural Experiment*

We identify regional public investment priorities by studying the development of the water pipe system in the largest district in Poland. For this purpose, we take advantage of a major administrative re-form, implemented on 1 January 1999, which substantially changed the structure of Polish local government and reduced the number of top-tier administrative regions from 49 to 16. We treat the reform as a natural experiment, and apply the difference-in-differences approach to study developments along the boundary of the new Mazovian voivodeship. We find strong and positive implications for the development of the water pipe system in municipalities within the Mazovian voivodeship compared with those just outside its boundaries. The overall post-reform difference in the length of the total water pipe network is 25% and the difference in the per-capita length of the network is 30%. Local public investment priorities at the voivodeship level, potentially related to effective use of EU funds, are the most likely determinants of these differences.

JEL Classification: H43, H73, P35

Keywords: public investment policy, water pipe system, administrative reform

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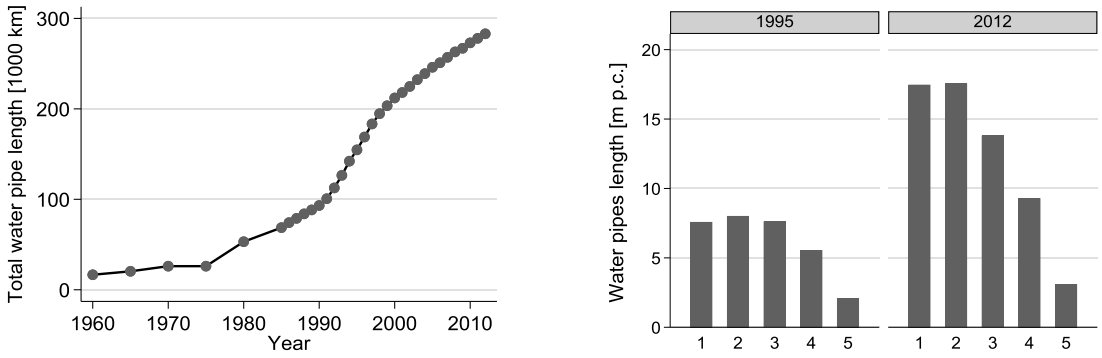
INTRODUCTION

Public infrastructure investments constitute one of the key elements of central and regional governments' economic policy. At a regional level in particular, the extent and distribution of local public investments can play a significant role both in shaping the local economic environment (Pereira, 2000; Aiello et al., 2012; Pereira and Pereira, 2015) and in determining the fate of local politicians (Brender, 2003; Martinussen, 2004). Usually, though, given several layers of local government, competing interests, parallel developments and complex decision-making processes, it is difficult to pin down the overarching strategy with regard to public investment that would clearly distinguish one region from others. In this paper, we take advantage of a unique combination of a regional approach to public investment priorities and a major administrative reform, to show direct consequences of a regional strategy on development of the network of water pipelines. The reform, implemented in Poland on 1 January 1999, substantially changed the structure of Polish local government. We use it here to identify the administrative driving force behind the observed developments and to link them to strategy at the top tier of local government.

Development of the water and sewage systems has been shown to have positive implications for health and mortality (Ferrie and Troesken, 2008; Kesztenbaum and Rosenthal, 2017) and public investment in water and sewage pipelines brings positive returns in terms of overall regional development (Pereira, 2000; Pereira and Pereira, 2015).[1] In this respect, Poland represents an interesting case in the analysis of the development of water systems, given the relatively low coverage of households at the end of communist rule in the late 1980s, in particular in rural areas, and the rapid changes that followed afterwards largely as a result of major public investment projects (see Figure 1a). The total length of the water pipe system increased by nearly 200% between 1990 and 2012. While the fastest growth took place in the early 1990s, extension of the pipelines continued at a rapid pace throughout the 2000s. Most of these developments were concentrated in rural areas (Pawełek, 2016).[2] This is evident from the municipality-level data presented in Figure 1b, in which we show the length of the water pipe system per capita in 1995 and 2012 for municipalities grouped by population density quintiles. While there have been increases across the five quintiles, they have been most noticeable in the municipalities with the lowest population density levels. The length of water pipes in the 20% least densely populated municipalities increased by about 130% over this period.

FIGURE 1. The water pipe network in Poland



a. Total length of water pipes in Poland, 1960–2012

b. Water pipe length per capita by population density quintile

Notes: Population density quintiles in Figure 1b are calculated for 1995.
Source: a: GUS (Polish central statistical office) Statistical Yearbooks; b: authors' calculations based on GUS local databank (BDL) data.

These changes provide an attractive background for the analysis of local government public investment strategies. As we show below, the combination of major public investment decisions and a unique natural experiment in the form of the administrative reform allows us to identify important differences in public investment priorities across local governments.

A number of factors contributed to these developments and, as we show below, local governments' strategic priorities have played an important role in how fast the water networks expanded in different regions. To link developments in water pipeline expansion to a specific layer of local government, we take advantage of the Polish administrative reform that came into force on 1 January 1999. The reform reduced the number of top-tier administrative regions (voivodeships; NUTS 2 level) from 49 to 16 and created a large central voivodeship, the Mazovian voivodeship, with Warsaw—the country's capital—as its centre. In this paper, we use the peripheral municipalities in this voivodeship and compare their water infrastructure development with that of neighbouring municipalities that are on the other side of the Mazovian administrative border; these latter municipalities are part of voivodeships with other, economically weaker, regional centres. This set-up, combined with the availability of a long time series of municipality-level data, allows us to identify the role of a specific administrative structure in the development of the water system as an important element of public infrastructure. We can address the question of the degree to which local government structure influences developments in specific municipalities, including those on the periphery, and the

extent to which being included under the administrative power of one or another centre matters for specific developments at the municipal level.

In Section I, we present the key features of the 1999 Polish administrative reform and demonstrate the spatial set-up of our empirical exercise. We discuss the data used for the analysis and the analytical approach we take in Section II. This is followed by presentation of the results in Section III and conclusions in Section IV.

I. The 1999 Administrative Reform and the Mazovian Voivodeship

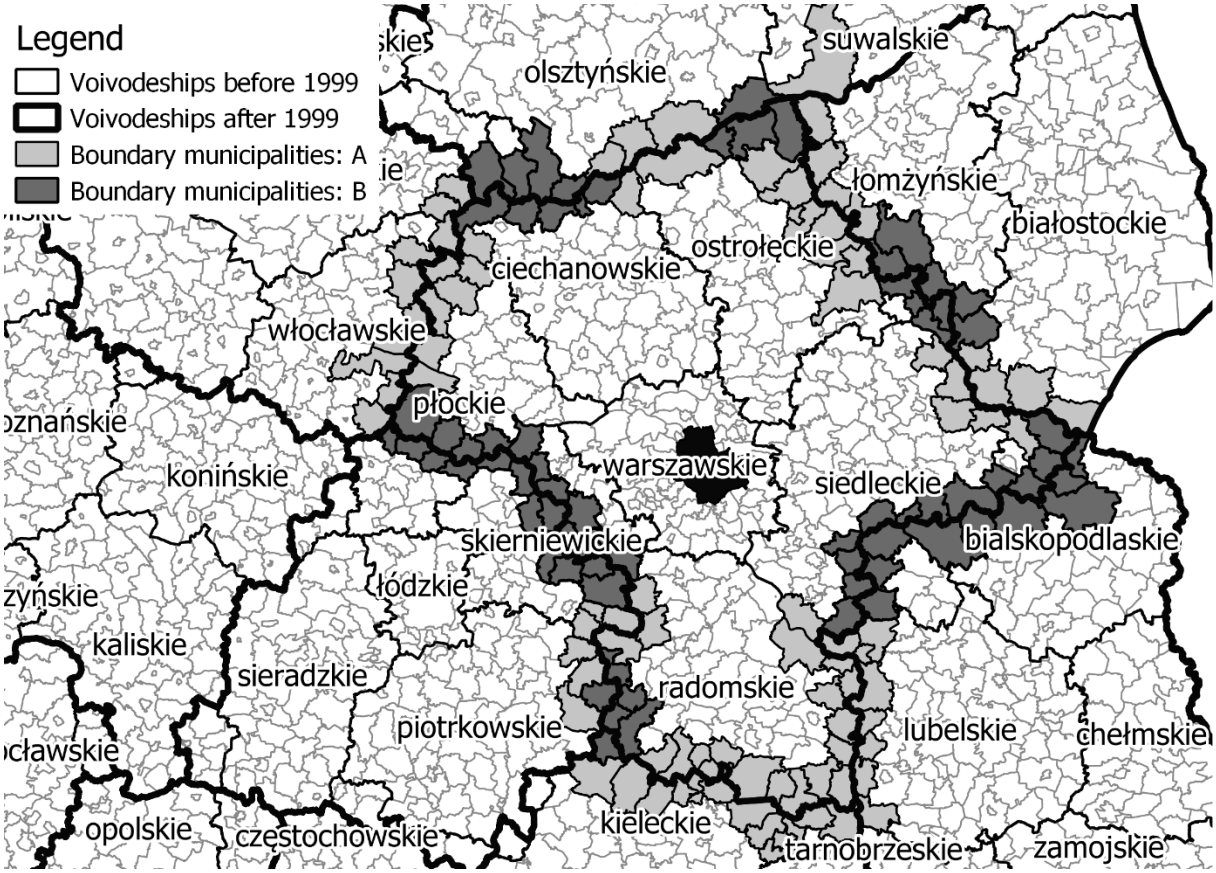
Major administrative reforms are infrequent, which given the scope and scale of the one implemented in Poland on 1 January 1999, makes it a unique point of reference. The reform changed the administrative design that had existed in Poland since a reform in 1975, structured along the lines of two tiers of local administration: the top tier, voivodeships (*województwa*), and the lower tier, municipalities (*gminy*). After the 1999 reform was implemented, the administrative design consisted of 49 voivodeships and 2,394 municipalities.[3] The role and responsibilities of local governments changed substantially with the political breakthrough of 1989, which led to a significant extension of municipal autonomy. Already prior to 1999, municipalities had been given responsibility over land use, planning, environmental protection, maintenance of public infrastructure, and ownership and maintenance of public educational and cultural facilities, public administration buildings and community housing. They had also gained financial independence with unlimited property rights, and were granted protection against legal intervention from the higher levels of government. The first democratic local elections to municipal government were held in May 1990.

The goal of the 1999 administrative reform was to further decentralise political power and increase public finance transparency. The reform reintroduced the middle tier of local government, the counties (*powiats*), responsible for the administration of institutions beyond the scope of a single municipality (e.g. hospitals, secondary schools, public roads, unemployment prevention and judiciary). Primarily, though, it reduced the number of voivodeships from 49 to 16 and granted the top tier of local administration the responsibility for overall regional development and regional infrastructure as well as for prospective management of EU funds. Following the reform, the administrative structure in Poland consisted of 16 voivodeships, 308 counties, 66 towns with county status and 2,478 municipalities. This structure has been in place, with minor modifications, since 1 January 1999 (for details, see Regulski (2003) and Swianiewicz (2010)).

For identification purposes, our analysis of the development of public infrastructure concentrates on the municipalities along the boundary of the largest of the newly created 16 districts, the Mazovian voivodeship with the country's capital, Warsaw, as its regional centre. The voivodeship was formed out of 314 municipalities, 47 of which belonged before the reform to the old Warsaw voivodeship and the rest to the voivodeships of Biała Podlaska (6), Ciechanów (45), Łomża (5), Ostrołęka (43), Płock (30), Radom (61), Siedlce (63) and Skierniewice (14).

Figure 2 shows a map of the Mazovian voivodeship with the boundary municipalities on either side marked in light and darker grey. The pre-reform voivodeships are demarcated with thin black lines while the new voivodeship boundaries are marked with bold lines. Warsaw is marked in black. One particular feature of the Polish administrative system at the municipal level is the distinction made for some municipalities between an urban core and a rural periphery, which from an administrative point of view are treated as separate municipalities. Since in reality these doughnut-like entities constitute integral economic units, for the purpose of the analysis we merge the urban and rural parts together and analyse them jointly as single municipalities. Overall, we identify 159 municipalities that lie along either side of the Mazovian boundary. Of these, we exclude 9 from the analysis because of significant boundary changes. The final sample therefore consists of 150 municipalities, including 11 entities formed by merging the doughnut municipalities. As we can see, part of the Mazovian boundary lines up along the borders of the old administrative system but a significant proportion of it cuts across the old voivodeships. Of the Mazovian boundary municipalities, about 50% on the inside and over 40% on the outside are municipalities that under the old system lined up with the old voivodeship borders. These are marked in the lighter shade of grey and are labelled as 'Boundary municipalities: A' to distinguish them from those for which the Mazovian voivodeship boundary cuts through the pre-1999 voivodeships ('Boundary municipalities: B', marked in darker grey). We distinguish between these two groups to allow for testing of the implications of potential historical factors which may be important for how the inside and outside municipalities developed after the reform.

FIGURE 2. Voivodeship boundaries before and after the 1999 reform and Mazovian boundary municipalities



Notes: Warsaw—the capital of the Mazovian voivodeship—is marked in black in the centre of the figure. The names of the pre-1999 voivodeships are placed over appropriate regions. The regional centres were Biała Podlaska for bialskopodlaskie, Ciechanów for ciechanowskie, Łomża for łomżyńskie, Ostrołęka for ostrołęckie, Płock for płockie, Radom for radomskie, Siedlce for siedleckie and Skierniewice for skierniewickie.
Source: Authors' compilation using data from the Polish national boundary register (PRG).

II. ANALYTICAL APPROACH TO EXAMINING REGIONAL STRATEGIES

Identifying policy strategies at the voivodeship level

We use the 1999 administrative reform to distinguish the consequences of regional policies with a focus on developing the water system. We look at the differences in development of the length of water pipelines along the Mazovian administrative boundary and compare municipalities on either side by applying the difference-in-differences (DID) approach. The basic specification we estimate takes the following form:

$$(1) \qquad y_{it} = \alpha_0 + \beta_1 maz_i + \beta_2 after_{it} + \beta_3 maz_i * after_{it} + M_i + T_t + \varepsilon_{it},$$

where y_{it} is the length of the water network (per capita) for municipality i at time t, maz_i is the indicator of being within the current Mazovian voivodeship border, $after_{it}$ is a dummy indicator

of time after the implementation of the 1999 reform and maz_i*$after_{it}$ is the interaction between the two. M_i and T_t denote municipality and time fixed effects, while ε_{it} is the residual. (Since we estimate the model with year and municipality fixed effects, the maz_i and $after_{it}$ controls could be omitted, but we leave them in for clarity of the difference-in-differences presentation.) The key coefficient of interest is β_3, which is our DID estimator identifying whether being placed within the Mazovian voivodeship as a result of the reform differentiates the development of the water system in a municipality from that in municipalities outside the Mazovian boundary.

To examine the potential role of older historical arrangements, we distinguish between the effect of the new voivodeship boundary for the municipalities that used to line up with the pre-1999 voivodeship borders and the effect for those that did not, i.e. the light grey (A) and darker grey (B) municipalities in Figure 2 respectively. This requires a difference-in-difference-in-differences (DIDID) estimator allowing for a different effect for the 'B' municipalities (*Bmun*) which before the reform belonged to the same voivodeship. The estimated specification then takes this form:

$$(2) \quad y_{it} = \alpha_0 + \beta_1 maz_i + \beta_2 after_{it} + \beta_3 maz_i * after_{it} + \beta_4 Bmun_i + \beta_5 Bmun_i * after_{it} + \beta_6 Bmun_i * maz_i + \beta_7 maz_i * after_{it} * Bmun_i + M_i + T_t + \varepsilon_{it},$$

with β_7 being the coefficient that identifies the difference in the effect for the 'B' municipalities.

The main dependent variable in our estimation of equations (1) and (2) is the length of the water pipe system per capita, available from the time series of administrative data from the local databank (*Bank Danych Lokalnych*, BDL) maintained by the Polish central statistical office (GUS, 2017). The administrative data from the BDL at municipal level is available since 1995 and we use the time series up to 2012. This gives us information on four years prior to the implementation of the reform (1995–98) and fourteen years following its implementation (1999–2012).

Sample used for the analysis

We use data on municipality boundaries from 2017 taken from the Polish national boundary register (*Państwowy Rejestr Granic*, PRG).[4] As we were unable to obtain municipality boundaries for each year covered by the analysis, we had to exclude 9 municipalities for which there were significant boundary changes over the time covered by the analysis, as recorded in the municipality area data. Since the analysis covers the 18 years from 1995 to 2012 and

includes 150 local entities (139 single municipalities and 11 formed by merging 'doughnut' municipalities) in the full sample, we end up with up to 2,700 observations. Basic descriptive statistics for these municipalities are given in Table 1, while Table 2 presents average values for pre- and post-reform total population and the length of the water network per capita at municipal level. The statistics distinguish between the municipalities on the inside (*maz* = 1) and outside (*maz* = 0) of the Mazovian administrative boundary. Figure 3 illustrates the distribution of the outcome variables we use in the analysis, exhibiting a very clear log-normal pattern. Descriptive developments of the total water pipe network per capita in the inside and outside municipalities are presented in Figure 4, where we see a very clear pattern of much higher growth in the per-capita length of the network inside the Mazovian boundary. While prior to the administrative reform the length of the network per capita in the inside municipalities was lower, by 2012 the per-capita length of water pipes in the Mazovian municipalities was about a metre higher.

TABLE 1
SUMMARY STATISTICS FOR BOUNDARY MUNICIPALITIES, 1995–2012

	Boundary municipalities	Outside Mazovian (*maz* = 0)	Inside Mazovian (*maz* = 1)
Number of municipalities	150	73	77
of which 'B' municipalities	68	31	37
Average municipality area (km^2)	147.45	157.80	137.64
Average distance to Warsaw (km)	106.80	113.85	100.11

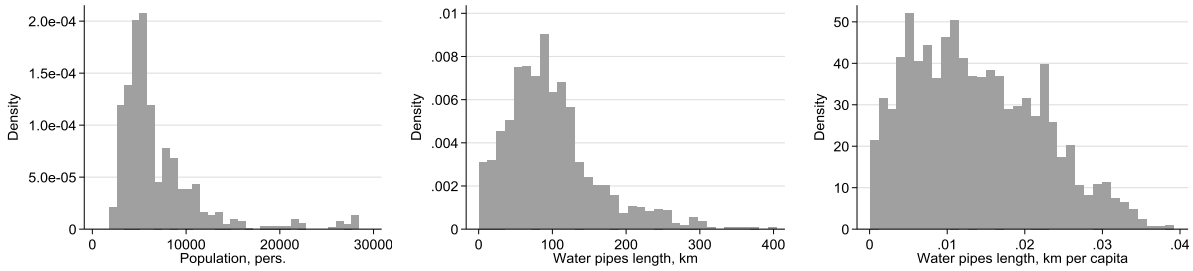
Notes: Distance to Warsaw is computed as the distance between municipality centroids.
Source: Authors' calculations using GUS local databank (BDL), Polish national boundary registry (PRG) and ArcGIS.

TABLE 2
MEAN VALUES OF ANALYSED OUTCOMES FOR BOUNDARY MUNICIPALITIES BEFORE AND AFTER THE REFORM

	Pre-reform: 1995–98			Post-reform: 1999–2012		
	All	*maz* = 0	*maz* = 1	All	*maz* = 0	*maz* = 1
Population	10,566.22	12,861.46	8,390.21	10,381.78	12,680.85	8,202.15
Length of water pipes (metres per capita)	8.17	9.10	7.30	15.35	15.55	15.15

Notes: maz = 0: outside the Mazovian voivodeship; *maz* = 1: inside the Mazovian voivodeship.
Source: Authors' calculations using GUS local databank (BDL).

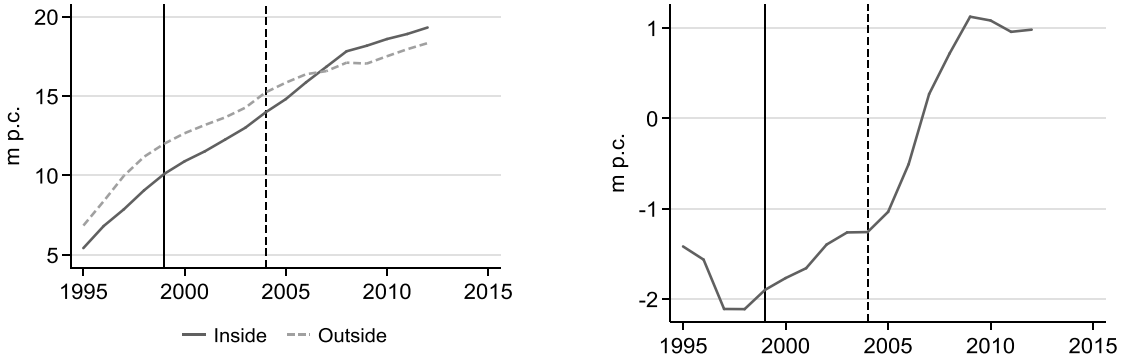
FIGURE 3. Distributions of total population and water pipe network (for all boundary municipalities for years 1995–2012)



a. Population **b. Length of water pipe network** **c. Length of water pipe network per capita**

Source: Authors' calculations using GUS local databank (BDL).

FIGURE 4. Length of water pipe network per capita: boundary municipalities



a. Length of network per capita **b. Difference in length of network per capita (inside – outside)**

Notes: Length in metres per capita (m p.c.). The vertical solid line indicates 1999 (the year of the reform) and the vertical dashed line indicates 2004 (the year Poland joined the EU).
Source: Authors' calculations using GUS local databank (BDL).

III. RESULTS

Tables 3 and 4 present results of estimating equations (1) and (2) in two specifications – using (log) total and per-capita water pipe network length at the municipal level as dependent variables. Table 3 presents results of the DID specification as in equation (1), while the results in Table 4 refer to the DIDID specification as in equation (2). In each case, we show estimations conducted for two separate spans of the post-reform period. The first covers the full period under analysis—i.e. between 1999 and 2012—which means the results represent the post-reform overall average, while the second focuses on the years 2005–12. In the latter case, the estimation uses a later period, allowing for gradual adjustment in the initial years after the reform. At the same time, this is the period of the initial eight full years of Poland's membership of the EU, which given the voivodeships' responsibility for the management and distribution

of EU funds, may be significant from the point of view of differentiation in local policies along the voivodeship boundary. The tables only report the estimated values of the coefficients of interest, i.e. β_3 in the case of equation (1) and β_3, β_5 and β_7 in the case of equation (2). Given the distributional features of the dependent variables, the estimations use log values. All regressions include municipality and year fixed effects, we cluster the standard errors at municipality level (see Cameron and Miller, 2015) and per-capita specifications have been weighted by municipality population size.

TABLE 3
RESULTS: MAZOVIAN BOUNDARY AND WATER PIPE NETWORK

Post-reform time frame		Length of water pipes	
		log	p.c. log
1999–2012	*maz*after* (β_3)	0.254***	0.302***
	(standard error)	(0.0315)	(0.102)
	N	2,682	2,682
2005–12	*maz*after* (β_3)	0.336***	0.381***
	(standard error)	(0.0378)	(0.124)
	N	1,788	1,788

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All estimations include year and municipality fixed effects. Standard errors are clustered at municipality level. Per-capita estimations are weighted by the size of the population. The number of observations is reduced due to zero values for a small number of municipality/year combinations.
Source: Authors' calculations using data from GUS local databank (BDL).

The results clearly show that water infrastructure development as reflected in the length of the water pipe system has been substantially greater inside the Mazovian boundary (Table 3). The estimates suggest that relative to the municipalities outside the boundary, the change in the total water pipe network is 25.4% greater in the Mazovian municipalities and the per-capita difference is as high as 30.2%. The divergence grows over time and the numbers are as high as 33.6% and 38.1% respectively once we analyse the later period, i.e. 2005–12. Moreover, we find no differences in terms of growth of the water pipe network between the groups of municipalities that did and did not lie along the former voivodeship boundaries (Table 4), suggesting that both groups of these Mazovian municipalities benefitted from belonging to the voivodeship.

TABLE 4
RESULTS: MAZOVIAN BOUNDARY AND WATER PIPE NETWORK, A AND B MUNICIPALITIES

Post-reform time frame		Length of water pipes	
		log	p.c. log
1999–2012	*maz*after* (β_3)	0.258***	0.230*
	(standard error)	(0.0424)	(0.125)
	*maz*after*Bmun* (β_7)	–0.0146	0.195
	(standard error)	(0.0634)	(0.196)
	*Bmun*after* (β_5)	0.0436	0.0358
	(standard error)	(0.0455)	(0.116)
	N	2,682	2,682
2005–12	*maz*after* (β_3)	0.346***	0.310**
	(standard error)	(0.0509)	(0.152)
	*maz*after*Bmun* (β_7)	–0.0273	0.194
	(standard error)	(0.0760)	(0.242)
	*Bmun*after* (β_5)	0.0514	0.0525
	(standard error)	(0.0545)	(0.141)
	N	1,788	1,788

Notes and source: See Table 3. *Bmun* (see equation (2)) – an indicator for boundary municipalities that do not lie along the pre-1999 voivodeship boundaries ('Boundary municipalities: B' in Figure 2).

Robustness analysis

Our interpretation of these results is that the administration of the Mazovian voivodeship gave greater priority to the development of the water pipe system in its municipalities compared with those in the surrounding regions. The stress on developing this network was highlighted in the Mazovian development strategy documents (Strzelecki and Mazowieckie Biuro Planowania Regionalnego, 2006; Struzik, 2018), and our results show that the Mazovian administration did in fact make it an important priority.

The high level of investment in water pipes was not only focused on the most peripheral municipalities along the voivodeship boundary. This is reflected in a robustness test where we repeat the estimation of equation (1) using a placebo boundary within the Mazovian voivodeship drawn between the Mazovian municipalities along the current official boundary and the next layer of localities towards the centre of the voivodeship. The results are given in Table 5. We find no statistically significant differences in the development of the water system for municipalities within the voivodeship. A graphical representation of the estimates from

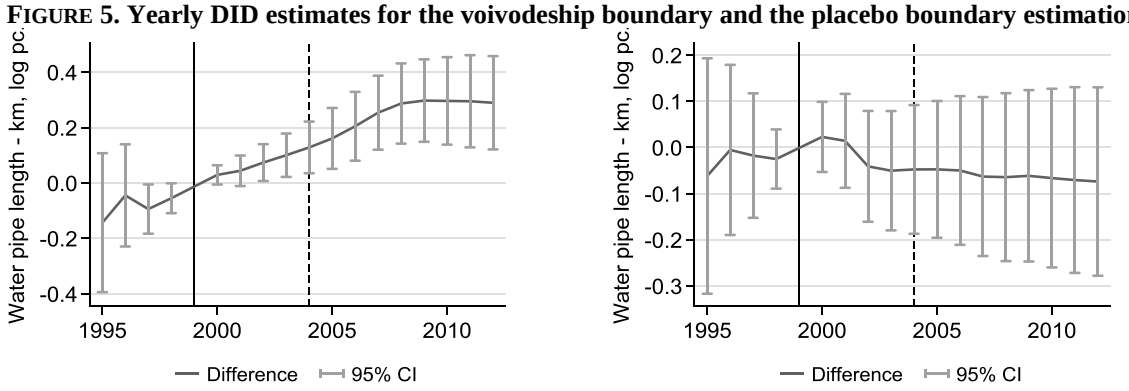
equation (1) with disaggregated time effects by year for the baseline and placebo estimations is presented in Figure 5.

TABLE 5
RESULTS: PLACEBO BOUNDARY AND WATER PIPE NETWORK

Post-reform time frame		Length of water pipes	
		log	p.c. log
1999–2012	*maz*after* (β_3)	–0.0432	0.191
	(standard error)	(0.0383)	(0.117)
	N	2,668	2,668
2005–12	*maz*after* (β_3)	–0.0599	0.226
	(standard error)	(0.0450)	(0.143)
	N	1,779	1,779

Notes and source: See Table 3.

FIGURE 5. Yearly DID estimates for the voivodeship boundary and the placebo boundary estimations



a. Voivodeship boundary: total length of water pipes, p.c. (log)

b. Placebo boundary: total length of water pipes, p.c. (log)

Notes: Estimations include municipality fixed effects and are weighted by the size of the population. Standard errors are clustered at municipality level. The vertical solid line indicates 1999 (the year of the reform) and the vertical dashed line indicates 2004 (the year Poland joined the EU).
Source: Authors' calculations using data from GUS local databank (BDL).

IV. CONCLUSION

Clear identification of regional public policy priorities in Poland remains a significant challenge due to mixed responsibilities of different levels of local government and complex decision-making processes as well as potential endogeneity of regional investment strategies. We circumvent these challenges using a combination of regional responsibility for public investments and a major administrative reform implemented in Poland on 1 January 1999. Using the reform as a natural experiment, we study developments in the water pipe network at municipal level and identify them as a clear public investment priority in the Mazovian voivodeship, the largest top-tier administrative district in Poland established as a result of the reform.

Our approach relies on comparing developments in the water pipe network before and after the reform in municipalities on both sides of the Mazovian boundary using a difference-in-differences approach. We find strong and significant differences in the length of the network in the municipalities that were integrated into the Mazovian voivodeship, with overall network growth about 25% greater in these municipalities than in the neighbouring municipalities just outside the Mazovian boundary. Moreover, we find no significant differences between the border municipalities within the central voivodeship and those further inside, which points towards across-the-board prioritisation of water network development in the Mazovian voivodeship.

Effective use of European Union funds available to Polish local governments already prior to the country's entry into the EU on 1 May 2004 could have been a factor in the rapid expansion of the water network in the Mazovian voivodeship. For example, when we consider the SAPARD programme, and in particular its scheme 3.1 focused on water provision and purification, the Mazovian voivodeship implemented many more projects than its neighbouring voivodeships.[5]

The clear result from our study is that, as far as developing a specific public infrastructure in the form of a water pipe network is concerned, it was beneficial for municipalities to be included in the largest central voivodeship. This applies primarily to the peripheral municipalities which, as the reform took shape, could have ended up on either side of the new voivodeship boundary. The results stress an important role for regional government policy and the implications of varying policy priorities for socio-economic developments at the municipal level.

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REFERENCES

AGENCJA RESTRUKTURYZACJI I MODERNIZACJI ROLNICTWA (2006). *SAPARD - wybrane efekty realizacji pomocy przedakcesyjnej w Polsce*. Warszawa: Agencja Restrukturyzacji i Modernizacji Rolnictwa.

AIELLO, F., IONA, A. and LEONIDA, L. (2012). Regional infrastructure and firm investment: theory and empirical evidence for Italy. *Empirical Economics*, 42, 835-62. https://doi.org/10.1007/s00181-010-0445-9

BENNETT, D. (2012). Does clean water make you dirty? Water supply and sanitation in the Philippines. *Journal of Human Resources*, 47, 146-73. https://doi.org/10.1353/jhr.2012.0008

BRENDER, A. (2003). The effect of fiscal performance on local government election results in Israel: 1989–1998. *Journal of Public Economics*, 87, 2187-205. https://doi.org/10.1016/S0047-2727(02)00045-2

CAIRNCROSS, S., HUNT, C., BOISSON, S., BOSTOEN, K., CURTIS, V., FUNG, I.C.H. and SCHMIDT, W.-P. (2010). Water, sanitation and hygiene for the prevention of diarrhoea. *International Journal of Epidemiology*, 39, 193-205. https://doi.org/10.1093/ije/dyq035

CAMERON, A.C. and MILLER, D.L. (2015). A practitioner's guide to cluster-robust inference. *Journal of Human Resources*, 50, 317-72. https://doi.org/10.3368/jhr.50.2.317

DEVOTO, F., DUFLO, E., DUPAS, P., PARIENTÉ, W. and PONS, V. (2012). Happiness on tap: piped water adoption in urban Morocco. *American Economic Journal: Economic Policy*, 4 (4), 68-99. https://doi.org/10.1257/pol.4.4.68

DUFLO, E., GREENSTONE, M., GUITERAS, R. and CLASEN, T. (2015). Toilets can work: short and medium run health impacts of addressing complementarities and externalities in water and sanitation. NBER Working Paper 21521.

FERRIE, J.P. and TROESKEN, W. (2008). Water and Chicago's mortality transition, 1850–1925. *Explorations in Economic History*, 45, 1-16. https://doi.org/10.1016/j.eeh.2007.06.001

GUS (2017). Bank Danych Lokalnych [WWW document]. https://bdl.stat.gov.pl/BDL/start

KESZTENBAUM, L. and ROSENTHAL, J.-L. (2017). Sewers' diffusion and the decline of mortality: the case of Paris, 1880–1914. *Journal of Urban Economics*, 98, 174-86. https://doi.org/10.1016/j.jue.2016.03.001

MARTINUSSEN, P.E. (2004). Government performance and political accountability at subnational level: the electoral fate of local incumbents in Norway. *Scandinavian Political Studies*, 27, 227-59. https://doi.org/10.1111/j.1467-9477.2004.00105.x

MYCK, M. and NAJSZTUB, M. (2019). Implications of the Polish 1999 administrative reform for regional socio-economic development. CenEA Working Paper 1/2019.

PAWEŁEK, J. (2015). Water management in Poland in view of water supply and sewage disposal infrastructure development. *Infrastruktura i Ekologia Terenów Wiejskich / Infrastructure and Ecology of Rural Areas*, II/2/2015, 367-76. https://doi.org/10.14597/INFRAECO.2015.2.2.029

PAWEŁEK, J. (2016). Degree of development and functionality of the water supply and sewage systems in rural Poland. *Barometr Regionalny*, 14, 142-9.

PEREIRA, A.M. (2000). Is all public capital created equal? *Review of Economics and Statistics*, 82, 513-18. https://doi.org/10.1162/rest.2000.82.3.513

PEREIRA, A.M. and PEREIRA, R. (2015). Is all infrastructure investment created equal? The case of Portugal. College of William and Mary, Department of Economics, Working Paper 156.

REGULSKI, J. (2003). *Local Government Reform in Poland: An Insider's Story*. Budapest: Local Government and Public Service Reform Initiative.

STRUZIK, A. (2018). Realizacja polityki rozwoju województwa mazowieckiego w latach 1998–2018. *MAZOWSZE Studia Regionalne*, 25, 93-114. https://doi.org/10.21858/msr.25.06

STRZELECKI, Z. and MAZOWIECKIE BIURO PLANOWANIA REGIONALNEGO (2006). *Strategia rozwoju województwa mazowieckiego do roku 2020 (aktualizacja)*. Warszawa: Mazowieckie Biuro Planowania Przestrzennego i Rozwoju Regionalnego.

SWIANIEWICZ, P. (2010). If territorial fragmentation is a problem, is amalgamation a solution? An East European perspective. *Local Government Studies*, 36, 183-203. https://doi.org/10.1080/03003930903560547

NOTES

[1] A number of papers focusing on developing countries stress the importance of water supply, though water on its own—i.e. without improvements in sanitation—may have ambiguous effects on health (Cairncross et al., 2010; Bennett, 2012). Devoto et al. (2012) show that water provision can have significant implications for welfare, while Duflo et al. (2015) stress the importance of combining water with sanitation for the reduction of diarrhoea.

[2] Around 90% of urban areas were covered by water supply pipes by the beginning of the 1990s (Pawełek, 2015). Similarly extensive developments happened in the areas of sewage system networks and water treatment. The proportion of households connected to tertiary water treatment (i.e. final water treatment before discharge of

effluent to the receiving environment) in Poland went up from 4.1% in 1995 to 58.9% in 2015, and the proportion of households with access to either primary, secondary or tertiary treatment grew from 41.5% to 72.6% in this period (source: Eurostat). Unfortunately, due to lack of availability of a consistent time series of data at the municipal level, we cannot examine the development of sewage systems using the approach we take for water pipes.

[3] This description of the details of the 1999 reform as well as the process that led to it is based on the detailed account of Regulski (2003). For an extended summary, see Myck and Najsztub (2019).

[4] Changes in TERYT codes (the codes used in the PRG) were included based on a TERYT changes dataset compiled by Tomasz Żółtak from Warsaw University and made available for download from his personal website (https://tomek.zozlak.org/inne/podz_teryt/podz_teryt.php), accessed on 20 September 2016.

[5] SAPARD—the Special Accession Programme for Agriculture and Rural Development—was initiated in 1999 and operated until 2006. Apart from this programme, Poland benefitted from several other pre-accession funds (Struzik, 2018), in particular PHARE (promoting socio-economic change in candidate countries) and ISPA (EU funds for country-level infrastructure investment). The total number of contracts signed within scheme 3.1 of the SAPARD programme in the Mazovian voivodeship was 453, compared with the following numbers in neighbouring voivodeships: kujawsko-pomorskie 254; lubelskie 373; łódzkie 263; podlaskie 240; świętokrzyskie 305; and warmińsko-mazurskie 148 (information based on Agencja Restrukturyzacji i Modernizacji Rolnictwa (2006)).