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Spatial interactions in local public debt. Evidence from Poland

Monika Banaszewska[1]

Abstract

The aim of the paper is to investigate spatial interactions among the debt of 2,442 municipalities in Poland over the period 2005–2020. Using the dynamic spatial Durbin model with two-way fixed effects, it provides empirical evidence of positive spatial interactions. It is estimated that an increase in debt per capita in a given municipality by PLN 100 is related to an increase in the debt per capita in neighbouring municipalities by PLN 8–10. The result is robust to the various specifications of spatial weight matrix (contiguity vs. inverse-distance with a cut-off). It is also found that municipal debt in Poland suffers from high persistence over time. Keywords: municipalities, dynamic spatial Durbin model, debt persistence.

Keywords

- municipalities
- dynamic spatial Durbin model
- debt persistence

JEL codes: H74, H77

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[1] Department of Public Finance, Institute of Finance, Poznań University of Economics and Business, al. Niepodległości 10, 61-875 Poznań, Poland, monika.banaszewska@ue.poznan.pl, https://orcid.org/0000-0003-2787-9986.

Introduction

Spatial interactions among local budgetary policies are predicted using various causal mechanisms. The main lines of argumentation include fiscal competition, yardstick competition and the spill-over hypothesis. The first hypothesis attributes co-movements in fiscal decisions to inter-municipal competition for mobile capital and labour (Agrawal, 2015; Janeba & Todtenhaupt, 2018; Wilson, 1999). The second one ascribes spatial interactions to political competition. Tax burden, the scope and quality of local public services, etc. in neighbouring municipalities constitute a 'yardstick' by which to assess the performance of authorities in a given municipality (Besley & Case, 1995; Dubois & Paty, 2010; Ferraresi, 2021). According to the latter, local activities that create external effects either lessen or strengthen the need for specific actions in neighbouring municipalities (De Siano & D'uva, 2017; Ferraresi et al., 2018; Ogawa & Wildasin, 2009).

There is an abundance of empirical studies documenting spatial interactions with respect to local taxes and local expenditures (for a recent review please consult: Agrawal et al., 2022). They fail to provide a comprehensive picture of local competition if municipalities are eligible to incur debt (Borck et al., 2015). Yet, while there are numerous studies on internal (e.g., demographic structure) and external (e.g., legal constraints) drivers of municipal debt, the spatial context of debt issuance is largely ignored (Balaguer-Coll et al., 2016; Działo et al., 2019; Ehalaiye et al., 2017; Navarro-Galera et al., 2017). This research gap calls for further empirical analyses also because of the fact that sustainable debt is key for the sustainable local public finance (Bröthaler et al., 2015; Fan & Lv, 2012; Uryszek, 2018). Local public debt is without doubt of concern to fiscal policymakers in the European Union as numerical fiscal rules that directly or indirectly limit subnational public debt are in force in 21 out of 27 Member States (as of the year 2022) (European Commission, n.a.), including Poland, whose municipalities are the object of this study. Additionally, the strength of spatial interactions offers indirect evidence of whether the issue of soft budget constraints should be a concern. If municipal authorities predict to obtain central government aid in case of financial problems, they more eagerly engage in fiscal competition so one should expect a high spatial coefficient on debt (Borck et al., 2015). The contribution of this paper to the existing literature is twofold. First, the paper adds to an emerging strand in the empirical literature on spatial interactions concerning debt (Germany: Borck et al., 2015; Spain: Balaguer Coll & Toneva, 2019; China: Han et al., 2022; Liu et al., 2022). Second, it accounts for the extension of preliminary spatial analysis for Poland by Kopańska and Kopyt (2018), who employed cartograms, Moran I statistics and tools to identify hot (cold) spots with respect to municipal debt.

Poland is a suitable testing ground. First, there is uniform fiscal legislation with respect to local deficit and public debt. Second, Polish municipalities actively utilise their right to incur debt. As an illustration, in the period under study (the years 2005–2020) there were fewer than 4% municipality–year observations with debt equal to zero. On average, in the period mentioned, debt accounts for 23.8% of municipal revenues.

The structure of paper is as follows. Section 1 reviews the existing theoretical and empirical literature. Section 2 introduces the institutional background. Then, in Section 3 data, methods and research hypotheses are described. Section 4 presents the results of empirical analysis and a discussion. Finally, some concluding remarks are presented in the Conclusions.

1. Literature review

Basically, debt (stock variable) is the sum of previous deficits (flow variable). Nevertheless, in practice, this relationship is much more complex and is modified *inter alia* by foreign exchange fluctuations and higher-tier government bailouts. The previous literature documents numerous determinants of local public debt, which are summarized in Figure 1. They include both internal and external factors. The former factors include, for instance, revenue

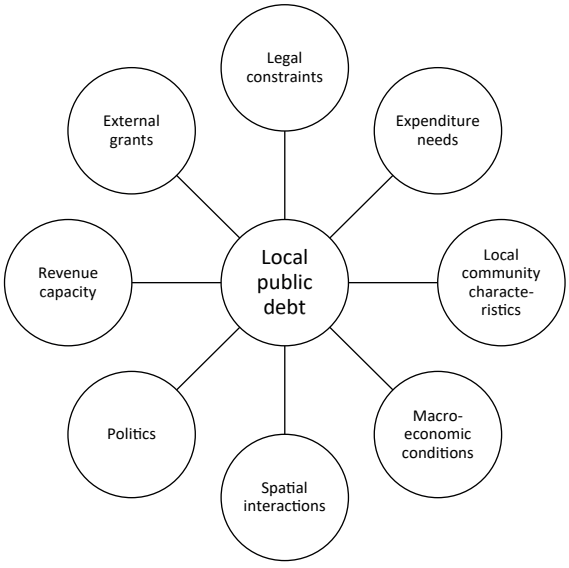

Figure 1. The overview of determinants of local public debt

Source: own work on the basis of (Balaguer-Coll et al., 2016; Działo et al., 2019; Ehalaiye et al., 2017; Navarro-Galera et al., 2017).

capacity and local community characteristics, whereas the latter encompass macroeconomic conditions and external grants, among others. Figure 1 shows that they are not limited to fiscal and economic determinants since budgetary decisions are made by politicians, who intend to maximise their voter support and/or maximise local community well-being.

Although the impact of demographic, fiscal, socio-economic and political determinants has to be kept in mind, the focal point of the analysis in this current paper are interactions among neighbouring municipalities with respect to debt. Hence, it is advisable to discuss possible underlying mechanisms. According to the hypothesis of fiscal competition, local government units try to attract mobile capital and labour with the use of lower taxes and/or extra expenditures (Agrawal, 2005; Janeba & Todtenhaupt, 2018; Wilson, 1999). Consequently, one can expect (at least in the short term) a positive spatial correlation with respect to municipal debt. Another explanation of spatial co-movements in fiscal policies is provided by the hypothesis of yardstick competition. This hypothesis is formulated under the assumption according to which the aim of local authorities is to maximize the probability of re-election. Since there are no absolute measures to assess the incumbent's performance, the situation in neighbouring municipalities serves as a "yardstick" to voters considering whether to support the incumbent. Knowing that local politicians mimic tax cuts and expenditure increases in neighbouring municipalities (Besley & Case, 1995; Dubois & Paty, 2010; Ferraresi, 2021). Despite different incentives, the effect in the form of spatial debt interactions is the same as in the case of fiscal competition. The positive spatial co-movements of municipal debt are predicted. The third line of argumentation ascribes spatial co-movements in budgetary variables to external effects. This time the sign of respective spatial coefficient is not unambiguous as fiscal decisions in a given municipality may either lessen or strengthen the need for specific actions in neighbouring municipalities depending on the type of external effect: positive or negative (De Siano & D'uva, 2017; Ferraresi et al., 2018; Ogawa & Wildasin, 2009).

There are only a few studies closely related to the topic of this paper. They deserve a review in more detail. Borck et al. (2015) analyse the spatial interactions with respect to local debt using the sample municipalities in the two largest German states, Bavaria and North Rhine-Westphalia, in the years 1999–2006. They employ various analytical tools: the panel spatial lag (SAR) model, the panel spatial Durbin model with FE, and the dynamic panel spatial Durbin model with FE. Their main finding is that spatial coefficient ranges from 0.16 to 0.33. An analogous research question is addressed by Balaguer Coll and Toneva (2019). This time the subjects of the analysis are municipalities located in the Valencian Community (Spain) in the year 2015. Since the dataset encompasses a single year, the set of regressions includes S2SLS and spatial lag (SAR) models. The estimation of the spatial coefficient (0.30–0.32)

is coherent with the upper bounds in the paper by Borck et al. (2015). Despite the different research sample and analytical approach, the estimations point to a fairly similar strength of the identified spatial relationship. According to these papers, an increase in debt in a given municipality by 1 EUR translates into a debt higher, on average, by 0.16–0.33 EUR in neighbouring municipalities. As for non-European research samples, Han et al. (2022) investigate spatial interdependencies in bond issuance among Chinese prefectural-level cities'. The estimate for the respective spatial coefficient is far below those determined for European municipalities, as it amounts to 0.08. Another study on Chinese subnational government units is that by Liu et al. (2022), who investigated provincial debt in China in the period 1999–2016. In contrast to previously mentioned studies, in their paper a log-log model is adopted. It is estimated that an increase in per-capita debt by 1% causes per-capita debt in neighbouring provinces to increase by 0.1–0.5%.

It is also worth mentioning a preliminary study in this field conducted by Kopańska and Kopyt (2018). As in the current paper, their analysis encompasses all Polish municipalities, albeit over a shorter time span (the years 2006–2016 versus the years 2005–2020). The analytical tools employed by Kopańska and Kopyt (2018) are static and descriptive, including cartograms, Moran I statistics and the identification of hot/cold spots. The research results can be summarized as follows: there is a positive spatial correlation in municipal debt; hot-hot spots are located mainly in western and northern Poland; cold-cold spots—in central and eastern Poland.

The bottom-line result emerging from the existing literature is that municipalities follow their neighbours in debt issuance. At the same time, one should not lose sight of a wide array of other possible drivers of local public debt originating from both a given subnational government and its neighbours.

2. Institutional background

Municipalities are fundamental to the functioning of three-tier local government in Poland[2]. Just to illustrate, they hold an 80% share in overall local government spending. They are responsible for numerous services crucial for the everyday life of their inhabitants, such as water supply, primary schooling and local roads.

Polish municipalities are allowed to incur debt for the sake of their investment projects. At the same time, they cannot go bankrupt. Debt which cannot be paid back by a local government unit is taken over by the State Treasury.

[2] As of 2023, there are 16 voivodeships, 314 counties and 2,477 municipalities.

This creates a clear incentive to neglect revenue collection, overspend and incur excessive municipal debt (Kornai et al., 2003). Hence, there are centrally mandated limits on municipal deficit and debt. They fall into two main categories: quantitative and qualitative. As for the former group, in the period 1999–2013, all local government units were subject to uniform thresholds: debt-to-revenues ratio not exceeding 60% and debt-repayments-and-debt--service-to-revenues ratio no higher than 15%. Since 2014, they have been replaced with an individual indebtedness limit, which serves as proxy for debt repayment capacity. The scope for borrowing has been linked to the ratio of current surplus to municipal revenues in the past. Initially, the individual indebtedness limit was based on three-year budgetary averages, and starting from 2020, this period has been prolonged to seven years.

There are also a few qualitative rules: the golden fiscal rule (which has become binding in 2011), the obligation to service debt at least once a year, the ban on foreign currency debt (with some exemptions), the rule that discounts on debt instruments cannot exceed 5% of their nominal value, and the ban on interest capitalization. Supervision of debt issuance and adherence to relevant fiscal rules is performed by specialised central government bodies (the Regional Audit Chambers) (Act, 2009; Banaszewska, 2018; Galiński, 2015).

The consequences of breaching deficit and debt rules are varied. In the first step, the municipality is obliged to prepare and execute a restructuring program. If misconduct prolongs and there is no hope for debt recovery, more severe actions take place. The municipal council and/or mayor may be dismissed. The utmost penalty is the dissolution of an excessively indebted municipality[3]. In general, the fiscal rules imposed on Polish sub-national governments are assessed highly and meet the standards outlined in the OECD Recommendation on Budgetary Governance (OECD, 2021). The current paper will provide empirical contribution to the discussion whether debt rules faced by Polish municipalities effectively mitigate the problem of soft budget constraints. As such, it can be of interest for policymakers in other countries.

3. Data, methods and research hypothesis

This paper seeks to verify the existence of spatial interaction with respect to local government units in Poland. The research sample consists of 2,442 out of 2,479 municipalities. The research method necessitates a strictly balanced panel so that some units are dropped due to missing data. The period under

[3] These sanctions are not only *de iure*. As a clear example, one municipality (Ostrowice) was liquidated due to excessive indebtedness (Wichowska, 2019).

research spans from 2005 to 2020. The beginning of this period is consistent with the implementation of local government finance reform.

Building on the existing literature on fiscal and yardstick competition, it is hypothesized that there are positive spatial interactions with respect to debt among Polish municipalities. Additionally, in line with the previous research, a set of demographic, socio-economic, fiscal and political control variables is introduced. This includes population size, squared population size, the share of young inhabitants, the share of old inhabitants, unemployment, revenue capacity, previous vote share and average salary. A description of these variables, along with data sources, is presented in Table 1. Their descriptive statistics and correlation matrix are shown in Table A1 and Table A2 in the Appendix.

Due to an arguable time persistence in debt levels, the regressions control for time-lagged dependent variable. As regards the impact of population size, it is expected that up to a certain population size a municipality benefits from economics of scale and beyond this size congestion costs start to prevail. In order to capture this non-linear relationship, both population size and its squared term are included in the regressions. The high share of young population signals favourable development conditions. In such circumstances, municipal

Table 1. Variable description and data sources

Variable name	Description	Source
Dependent variable		
Debt per capita	per capita municipal debt as of the end of year in constant 2020 prices	Ministry of Finance database
Independent variables		
Population size	the number of inhabitants	Statistics Poland Local Data Bank
Share of young	the share of people under 18 years old in total population	Statistics Poland Local Data Bank
Share of old	the share of people above 60/65 years old (women/men) in total population	Statistics Poland Local Data Bank
Unemployment	the ratio of the unemployed to working-age population	Statistics Poland Local Data Bank
Revenue capacity	revenue index utilized for the sake of vertical and horizontal equalization	Ministry of Finance database
Previous vote share	the share of votes obtained by incumbent mayor in 1st round of previous elections	National Electoral Commission database
Average salary	average monthly gross wages and salary in constant 2020 prices (at county level)	Statistics Poland Local Data Bank

Source: own work.

debt issuance is not only acceptable but even desirable if it finances socially-beneficial investments, for instance, the construction of new kindergartens and the extension of water supply lines. The opposite (negative) relationship with municipal debt is expected with respect to the share of old inhabitants. The logic of an individual indebtedness limit at local level in Poland is that the better is the fiscal stance of a given municipality (its so-called debt repayment capacity), the higher is its permitted debt. Therefore, one may predict that municipal debt per capita increases with municipal revenue capacity. The other two economic variables that indirectly point to the local fiscal situation are unemployment and average salary. The expected relationship between local public debt and unemployment (average salary) is negative (positive). Finally, the empirical model controls for a political variable: the share of votes on the incumbent mayor in the first round of previous elections. It is expected that the incumbent that enjoys higher voted support is less inclined to compete for votes with the use of lax budgetary policy which points to a negative coefficient on the respective control.

The fiscal variables presented in Table 1 were retrieved from the Ministry of Finance database (Ministry of Finance, n.a.), demographic and socio-economic data come from the Statistics Poland Local Data Bank (Statistics Poland, n.a.) and the political variable is taken from the National Electoral Commission dataset (National Electoral Commission, n.a.). As Table 1 shows, for the sake of comparability across units and over time, the dependent variable (debt) is expressed as per capita municipal debt (in PLN) at the end of year in constant

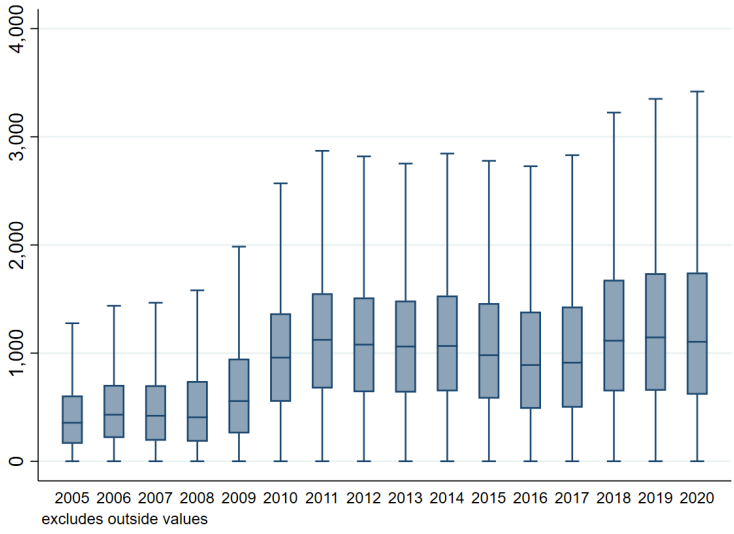

Figure 2. Municipal debt per capita in the years 2005–2020 (in PLN, in constant 2020 prices)

Source: own work.

2020 prices. The correction for inflation also applies to the average salary. It is the sole variable that varies only at county level.

As can be seen in Figure 2, the years 2005–2020 saw a general upward trend with respect to debt per capita (in constant 2020 prices) over the period under analysis. Along with the growing average indebtedness level, there was an increase in its dispersion. Figure 2 also points to disproportionate hikes in debt per capita in the years 2010 and 2018. The political economy explanation for these hikes is not fully credible, as municipal elections took place not only in 2010 and 2018 but also in 2006 and 2014.

In order to get a spatial overview, Figure 3 presents an average municipal debt per capita in the years 2005–2020. There is a considerable spatial variation with respect to the variable of interest. The incidence of relatively highly indebted municipalities is disproportionately high in north-western Poland. The visual inspection of Figure 3 also suggests the existence of some cold-cold and hot-hot spots, which are identified analytically by Kopańska and Kopyt (2018). On average, municipalities in north-western Poland are relatively rich so that, in line with the logic of individual indebtedness limit, they are allowed to incur more debt. It seems that richer municipalities make use of the extra fiscal space mandated by law. This tentative claim finds support also in correlations between municipal debt per capita and proxies of its budget (economic) stance (i.e. revenue capacity, unemployment, average salary). As can be seen in Table A2, municipal debt is positively related to revenue capacity and average salary. The opposite sign is documented for a correlation with the share of the unemployed in working-age population.

The dynamic spatial Durbin model with fixed effects is employed to make it possible to simultaneously account for spatial and time lags in the dependent variable, spatial lags in the independent variables, and also unobserved individual and time effects. The data is transformed according to the method described by Lee and Yu (2010). Dynamic model is preferred to the static version since debt is a stock variable. Its value in a given year depends heavily on the previous year's level. Estimations are performed with the use of the Stata xsmle command. The empirical model has the following form:

$$y_{it} = \tau\, y_{it-1} + \lambda \sum_{j=1}^{N} w_{ij} y_{jt} + \beta\, x_{it} + \theta \sum_{j+1}^{N} w_{ij} x_{jt} + u_i + \varphi_t + \varepsilon_{it}$$

where:

y_{it-1} – time-lagged dependent variable,

w_{ij} – elements of weight matrix,

$\sum_{j=1}^{N} w_{ij} y_{jt}$ – linear combinations of space-lagged dependent variable,

x_{it} – vector of independent variables,

$\sum_{j+1}^{N} w_{ij} x_{jt}$ – linear combinations of space-lagged independent variables
u_i – individual fixed effects,
φ_t – time-fixed effects,
ε_{it} – error term.

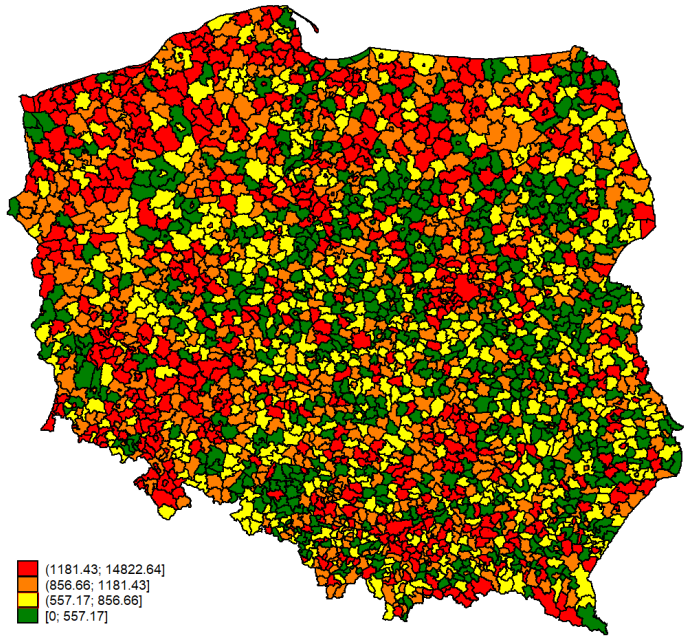

Figure 3. Average municipal debt per capita in the years 2005–2020 (in PLN, in constant 2020 prices)

Source: own work.

The key element of any spatial regression analysis is to define neighbouring municipalities. In the baseline approach, municipalities sharing a common border are treated as neighbours. In the alternative approach, the distance between the centroids of neighbours should not exceed a given threshold. In the current paper, three forms of spatial weight matrices are employed:

- contiguity binary row-normalized weight matrix,
- inverse-distance row-normalized weight matrix with a cut-off of 20 km,
- inverse-distance row-normalized weight matrix with cut-off of 25 km.

In the first spatial weight matrix (contiguity binary weight matrix), all neighbours are given equal weights. The weights in the second and third type of spatial weight matrix (inverse-distance weight matrix) are inversely related to the distance between municipal centroids. If this distance exceeds the 20 (25) km

threshold, the weight equal to zero is assigned. As a result of row-normalization, the sum of weights for given municipality's neighbours equals 1.

4. Results and discussion

The spatial Durbin model nests the spatial autoregressive model (SAR) and spatial error (SEM) models. Likelihood ratio (LR) tests are utilized to determine the most appropriate specification among the three models mentioned. They verify as to whether the spatial Durbin model can be simplified to the spatial autoregressive model (H_0: $\theta = 0$; H_1: $\theta \neq 0$) or spatial error model (H_0: $\theta + \rho\beta = 0$; H_1: $\theta + \rho\beta \neq 0$) (Elhorst, 2010; LeSage & Pace, 2009). The results of these tests are displayed in Table 2.

Table 2. Comparisons between SAR, SEM and SDM model specifications

Comparison	Test statistics	Choice
Contiguity binary row-normalized weight matrix		
SAR vs. SDM H_0: $\theta = 0$; H_1: $\theta \neq 0$	$\chi^2 = 24.19^{***}$ (0.001)	SDM is preferred
SEM vs. SDM H_0: $\theta + \rho\beta = 0$; H_1: $\theta + \rho\beta \neq 0$	$\chi^2 = 25.22^{***}$ (0.001)	SDM is preferred
Inverse-distance row-normalized weight matrix (cut-off: 20 km)		
SAR vs. SDM H_0: $\theta = 0$; H_1: $\theta \neq 0$	$\chi^2 = 26.49^{***}$ (0.000)	SDM is preferred
SEM vs. SDM H_0: $\theta + \rho\beta = 0$; H_1: $\theta + \rho\beta \neq 0$	$\chi^2 = 28.90^{***}$ (0.000)	SDM is preferred
Inverse-distance row-normalized weight matrix (cut-off: 25 km)		
SAR vs. SDM H_0: $\theta = 0$; H_1: $\theta \neq 0$	$\chi^2 = 30.89^{***}$ (0.000)	SDM is preferred
SEM vs. SDM H_0: $\theta + \rho\beta = 0$; H_1: $\theta + \rho\beta \neq 0$	$\chi^2 = 33.24^{***}$ (0.000)	SDM is preferred

Notes: Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Number of codes: 2,442. Number of observations: 36,630.

SAR – spatial autoregressive model; SEM – spatial error model; SDM – spatial Durbin model.

Source: own work.

First, it was checked whether any of coefficients on spatially lagged independent variables differs from zero. Since the null hypothesis was rejected,

SDM is preferred to SAR. In the second step, it was verified whether spatial relationships are identified only with respect to the error term. Again, the null hypothesis was rejected. It implies the superiority of SDM over SEM. As can be seen in Table 2, the choice of SDM does not change if the contiguity binary weight matrix is replaced with an inverse-distance one, with a 20- and 25-kilometer cut-off, respectively. Summing up, all tests unequivocally point to SDM as the preferable model specification.

The results from baseline regressions are compiled in Table 3. Each row represents estimations of the coefficients on time- and spatially lagged debt per capita with the use of a given specification of spatial weight matrix, respectively: contiguity-binary, inverse-distance with a 20-km cut-off, inverse-distance with a 25-km cut-off. Several observations can be made on the basis of Table 3. First, no matter which spatial weight matrix is employed, there is evidence of strong time persistence in municipal debt. The respective coefficients are statistically significant and slightly smaller than 1. This corroborates the relevance of dynamic specification. Second, the coefficients on space-lagged dependent variables are much lower in absolute values, as they do not exceed 0.1. Still, in all regressions they turn out to be statistically significant. This result supports our research hypothesis, according to which there is a spatial interaction with respect to debt among municipalities in Poland. Third, the estimated regressions explain the vast majority (approximately 70%) of variations in municipal debt per capita in the years 2005–2020.

Table 3. Main regression results for municipal debt per capita

Spatial weight matrix	Time lagged debt per capita	Space lagged debt per capita	Controls	Year FE	Unit FE	*R* squared
Contiguity binary row-normalized	0.902*** (0.00771)	0.0765*** (0.0107)	YES	YES	YES	0.737
Inverse-distance row-normalized (cut-off: 20 km)	0.902*** (0.00768)	0.0770*** (0.0150)	YES	YES	YES	0.745
Inverse-distance row-normalized (cut-off: 25 km)	0.901*** (0.00771)	0.0978*** (0.0166)	YES	YES	YES	0.736

Notes: Robust standard errors in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Number of codes: 2,442. Number of observations: 36,630.

Source: own work.

Control variables also deserve a comment. It is important to stress that the coefficients on spatially and time-lagged control variables cannot be interpreted directly. Therefore, a set of simulations was run to determine respective long-run, short-run, direct, indirect and total effects in the model em-

ploying the contiguity weights matrix. The results are summarised in Table 4. Surprisingly, the significant effects are identified only in a few instances.

Table 4. Short-run and long-run effects of control variables on municipal debt per capita

Variables	Short-run direct effect	Short-run indirect effect	Short-run total effect	Long-run direct effect	Long-run indirect effect	Long-run total effect
Population size	–0.00428 (0.00440)	0.000202 (0.00436)	–0.00408 (0.00563)	–0.0515 (0.0542)	–0.136 (0.354)	–0.187 (0.388)
Squared population size	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Share of young	7.994* (4.178)	3.290 (5.633)	11.28* (5.812)	103.5** (47.60)	392.5 (401.8)	496.0 (423.8)
Share of old	0.546 (2.789)	–14.28*** (4.712)	–13.73*** (4.948)	–26.16 (35.79)	–579.0 (558.2)	–605.1 (578.4)
Unemployment	1.145 (3.347)	0.414 (4.525)	1.559 (2.287)	14.56 (33.21)	44.08 (248.2)	58.64 (254.8)
Revenue capacity	0.0113 (0.0112)	0.0229** (0.0112)	0.0342** (0.0150)	0.186 (0.140)	1.233 (1.272)	1.418 (1.354)
Previous vote share	0.0383 (0.228)	–0.494 (0.318)	–0.455 (0.308)	–0.578 (2.603)	–16.86 (28.07)	–17.44 (29.23)
Average salary	0.0622 (0.0395)	–0.0682 (0.0469)	–0.00600 (0.0216)	0.590 (0.381)	–0.806 (1.615)	–0.215 (1.580)

Notes: Robust standard errors in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Number of codes: 2,442. Number of observations: 36,630.

SR – short-run; LR – long-run.

Source: own work.

As can be seen in Table 4, in the short run both the share of young inhabitants and revenue capacity are found to increase the level of municipal debt. The opposite is true for the share of old inhabitants. This implies that municipalities in an area characterised by favourable fiscal and demographic conditions are more willing to cover their expenditures with the use of debt. This observation indicates that local fiscal rules in Poland serve their purpose. In line with the logic of individual indebtedness index, there is a positive correlation between debt issuance and debt repayment capacity.

In contrast to the share of young population, the total effects of the share of old population and revenue capacity are driven by spill-over effects. Moreover, the positive impact of the share of young population sustains in the long run, albeit only with respect to a direct effect. In general, it was fo-

und that the socio-economic, demographic, fiscal and political controls does not exert a significant long-run effects on municipal debt.

Conclusions

The paper analyses spatial interactions among Polish municipalities. The research hypothesis of the existence of spatial local debt interactions has found empirical support. It has been documented that spatial interactions in Poland are not limited to tax policies. The empirical analysis shows that debt spatial interactions are statistically significant. It is estimated that increasing debt per capita in a given municipality by PLN 100 is related to an increase in the debt per capita in neighbouring municipalities by PLN 8–10. This result remains relatively stable, no matter which form of spatial weights matrix is employed (contiguity vs. inverse-distance with a cut-off). Spatial coefficients are comparable to those estimated by Han et al. (2022) for the debt of cities in China, and by Banaszewska (2022) with respect to car tax in Poland, although this is smaller than those estimated for debt in their German or Spanish counterparts, respectively: (Borck et al., 2015) and (Balaguer Coll & Toneva, 2019). There are at least two plausible explanations for this cross-country difference. First, Polish voters are more critical towards the idea of municipal authorities incurring debt. Second, local debt rules in Poland are more effective in curbing excessive municipal spending and/or overly lenient local tax policies. No matter which mechanism is in place, the result is that the risk of widespread municipal debt default is mitigated. Therefore, the institutional framework in Poland can serve as a benchmark for policy makers in other developing countries.

There is also evidence of a strong persistence in debt levels. In addition, the empirical results point to the positive short-run indirect impact of the share of young inhabitants, as well as revenue capacity and the negative impact of the share of old inhabitants. This observation supports the argument that municipal debt in Poland serves as an instrument of local development policies.

The current study is limited in the sense that it does not encompass debt incurred by municipally owned companies. Their indebtedness plays a significant role in some larger municipalities (Białek-Jaworska, 2022). A promising avenue for further research is harnessing spatial methods to analyse other fields of local government activities, such as the diffusion of environmental policies.

Appendix

Table A1. Descriptive statistics

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
Debt per capita	39072	949.453	851.889	0	42015.84
Population size	39072	15502.95	50990.81	1286	1790000
Squared population size	39072	2.84e+09	6.41e+10	1650000	3.22e+12
Share of young	39072	20.005	2.756	9.744	34
Share of old	39072	17.525	3.58	6	43.6
Unemployment	39072	8.281	4.343	0.6	35.345
Revenue capacity	39072	1005.378	927.427	163.08	38483.64
Previous vote share	39072	56.82	17.165	12.526	97.14
Average salary	39072	3655.309	681.977	2034.895	8920.41

Source: own work.

Table A2. Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt per capita (1)	1.000								
Population size (2)	0.166	1.000							
Squared population size (3)	0.089	0.852	1.000						
Share of young (4)	–0.208	–0.147	–0.060	1.000					
Share of old (5)	0.116	0.078	0.047	–0.721	1.000				
Unemployment (6)	–0.113	–0.091	–0.039	0.238	–0.233	1.000			
Revenue capacity (7)	0.196	0.095	0.051	–0.177	0.090	–0.253	1.000		
Previous vote share (8)	0.015	–0.091	–0.026	0.107	–0.034	–0.086	–0.007	1.000	
Average salary (9)	0.277	0.152	0.096	–0.426	0.379	–0.501	0.406	0.015	1.000

Source: own work.

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