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# Joining Forces or Going Solo?
# The Political and Economic Dynamics of Intermunicipal Cooperation

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*Abstract*

The emergence and dynamics of inter-municipal cooperation (IMC) remain complex despite extensive research. This study examines why and when municipalities engage in IMC across multiple services. Using data from Catalonia spanning a decade, we analyze both static and dynamic factors influencing IMC adoption. Our generalized linear mixed model reveals that population size, fiscal constraints, and political participation significantly affect cooperation patterns. Economies of scale are particularly relevant for services where cooperation is frequent, while their influence diminishes as economies of density are involved. The dynamic analysis using Cox proportional hazards models indicates that high public debt and low turnout accelerate IMC adoption. These findings enhance the understanding of IMC drivers and highlight the importance of distinguishing between service-specific, organizational, and political factors that influence the existence of cooperation versus those driving its timing. Our analysis across eight services confirms that no single delivery service approach fits all scenarios.

**Keywords:** Local Government; Intermunicipal Cooperation; Public services.

**JEL Classification:** H42; H44; H83; L33

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## Introduction

The suboptimal size of many municipalities has traditionally been seen as a relevant problem for local public service provision. The suboptimal size implies that a municipality is too small, and increasing production may make it possible to exploit economies of scale (Dixit, 1973). Amalgamations have been a type of political reform aimed at increasing the size of local jurisdictions, thereby improving their scale of operations (Swianiewicz, 2018). They have usually been imposed from the top down, and their results have been found to be well below expectations (Tavares, 2024), if not negative (Blom-Hansen et al., 2016; Tavares, 2024). A more selective and generally voluntary form of merger is interlocal collaboration or intermunicipal cooperation (IMC), through which two or more local governments jointly provide one or several services within their jurisdictions (Hulst and van Montfort, 2012). IMC has long been suggested as a tool to address problems of local suboptimality as it allows benefiting from improved economies of scale (Ostrom, Tiebout, and Warren, 1961), and potential spillovers -whether positive or negative- for other jurisdictions (Agranoff and McGuire, 2003).

IMC in service provision has emerged as a significant strategy for local governments to enhance service delivery efficiency (Elston, MacCarthaigh and Verhoest, 2018), and as a tool for improving quality, equitable access, and addressing challenges posed by limited resources and increasing demands (Warner, Aldag, and Kim, 2020). It is also presented as a mechanism that reconciles two fundamental principles of local government systems: on one hand, local autonomy and the quality of democracy, and on the other, efficiency and the optimal provision of services (Teles, 2016; Teles and Swianiewicz, 2018).

In line with IMC 's different dimensions, multiple factors influence its promotion and adoption. Bel and Warner's (2016) meta-regression reviewed all available multivariate empirical analyses to that point and found that fiscal constraints and spatial and organizational factors were generally influential, while economies of scale depended more on whether the study was a single service or multiservice. Almost all the studies reviewed in Bel and Warner (2016) were multi-service, US-based, and cross-sectional. Only a few studies were single-service and for European countries (solid waste in Spain and Germany), and also cross-sectional. Several services were analyzed separately in Leroux and Carr (2007), for roads, water and sewage in Michigan (USA), and by de Mello and Lago-Peña (2013) for several services in Brazil and Spain. Both studies used cross-sectional data. More recent studies also tend to be cross-sectional, whether single service (e.g., Arntsen, Torjesen, & Karlsen, 2018; Peixoto, Camões and Tavares, 2024), or for several services (Szmigiel-Rawska, Łukomska, and Tavares, 2020); or multi-service -i.e, aggregate level of cooperation in cities- (e.g., Rubado, 2023).[1]

Our article contributes to existing literature on drivers of IMC in several ways. First, we conduct a static explanatory analysis of factors associated with IMC in eight local public services, using data spanning a decade for the municipalities of Catalonia. Our rich database allows us to use a

[1] Interestingly, in Elston, Rackwitz and Bel (2024), a more dynamic approach to the drivers of IMC creation and sustainability has been applied, through a comparative qualitative analysis.

generalized linear mixed model (GLMM), a multilevel model particularly useful when data are clustered and both fixed and random effects are at hand. In this way, our research provides more robust results than previous literature. Second, we use a dynamic approach to better understand the temporal dimension of the decision to participate in IMC, using the Cox proportional hazards model for the eight services. Therefore, we contribute to both statistical and dynamic analysis of the factors explaining IMC. Our results allow us to draw important implications for public policy.

## Related literature and underlying theory

### *Inter-municipal cooperation*

Factors influencing collaborative agreements to provide local public services and the decision to promote or be included in any kind of intermunicipal provision solution can be considered as multifaceted; they encompass economic, political, institutional and social dimensions, and have been addressed from diverse perspectives. One of the primary drivers of inter-municipal cooperation is the pursuit of cost savings and efficiency gains, thus achieving 'collaborative efficiency' (Dixon and Elston, 2020; Zeemering, 2019). As local governments face fiscal and resource constraints, the potential for shared services to reduce operational costs becomes increasingly appealing. Bel and Warner (2015) highlight that the cost savings from inter-municipal cooperation are contingent on various factors, including the cost structure of public services and the governance framework at the local level. Bel and Sebő (2021) aimed to explain the differing empirical findings regarding the impact of inter-municipal cooperation (IMC) on service delivery costs. Within this framework, they also sought to assess the extent to which theoretical expectations about IMC contribute to understanding these variations. Particular focus was placed on hypotheses related to economies of scale, service-specific transaction costs, and governance arrangements.

In this context, the relationship between promoting economies of scale and generating transaction costs has also been explored. In the case of inter-municipal cooperation, transaction costs tend to be high due to factors such as information gathering, coordination, negotiation, enforcement, and monitoring (Feiock, 2007). Hawkins (2017) highlights that the characteristics, specific activities, and nature of the collaboration significantly influence the impact of transaction costs. The number of members involved in the service delivery process is another critical factor. A higher number of members can lead to increased transaction costs, as trust becomes harder to establish (Bel and Warner, 2015; Tavares and Feiock, 2018). Additionally, coordination costs and challenges arising from the "multiple principal" problem also escalate (Blåka, 2017; Voorn, van Genugten, and van Thiel, 2019).

Bel and Warner (2016) emphasize that analysing intermunicipal cooperation requires a theoretical framework that goes beyond cost-efficiency concerns. Using a meta-regression approach, their research underscores the importance of addressing broader policy challenges, including organizational, structural, and spatial dimensions. Their findings reveal that while fiscal pressures may incentivize cooperation, such initiatives do not always lead to efficiency gains. Furthermore, in addition to improving efficiency, scholars have highlighted other key objectives

of cooperation, such as enhancing service quality, accessibility, and resilience (Aldag and Warner, 2018; Aldag, Warner and Bel, 2020; Warner, Aldag, and Kim, 2020). This dual focus on cost efficiency and service quality underscores the complexity of motivations behind IMC. Additionally, Leroux and Carr identify local economic factors, community characteristics, and demographic variables as essential elements that affect cooperation on public works (Leroux and Carr, 2007). These findings suggest that the unique context of each municipality, including its size, resources, and demographic composition, can shape its approach to inter-municipal cooperation.

### *Hypotheses and their underlying theory*

*Economies of scale*

The empirical literature on IMC has devoted substantial attention to the effect of population as a driving factor for such collaborations (Bel and Sebő, 2021; Bel and Warner, 2016). Population size relates to the optimal scale of the service, with implications for economies of scale (Dixit, 1973; Ladd, 1992). The decision to enter or forgo an IMC agreement hinges on the number of inhabitants, as cost considerations represent a key motivator for these partnerships (Arntsen, Torjesen and Karlsen, 2018; Bel and Warner, 2016). Economies of scale allow for decreases in average service delivery costs with increasing production. Smaller municipalities may be unable to capitalize on these scale benefits due to low demand, while larger municipalities may have already achieved optimal geographic scale within their own boundaries. Consequently, IMC can prove particularly advantageous for smaller municipalities (Hulst and van Montfort, 2012). Most of the empirical research on the population and IMC frequency relationship has uncovered a negative association (Bel, Fageda and Mur, 2014; Hefetz, Warner and Vigoda-Gadot, 2012; Levin and Tadelis, 2010).

However, it must be taken into account that the optimal size varies across services, and the relationship between population and cooperation becomes more ambiguous when considering multi-service cooperation (Bel and Warner, 2015, 2016). Furthermore, scale economies eventually become exhausted (Stigler, 1958). Beyond this point, average costs will not decrease with increasing population. Specifically, we anticipate that as population size increases, the probability of entering an IMC decrease, although this relationship is not linear.

While population size may effectively explain the existence of IMC, its role as an explanatory factor for IMC *emergence* -the dynamic aspect of cooperation- is less straightforward. The formation of an IMC arrangement requires not only an interested municipality but also the identification of a suitable partner who shares this interest in collaboration (Bischoff and Wolfschütz, 2021), and the easy movement of key actors between jurisdictions can also lead to the diffusion policy innovation (Mistur and Matisoff, 2024). Current empirical research emphasizes the significance of population dynamics among neighboring municipalities and the potential for mutual benefits. When such mutual benefits are absent, institutional arrangements tend to favor mergers over IMC (Seta, 2024). The potential for mutual benefits fundamentally depends on complementarities and service characteristics. For instance, in the domain of administrative tasks, municipalities situated within clusters of declining populations demonstrate higher rates of IMC initiation (Bischoff and Wolfschütz, 2021).

Given the existing theoretical insights and existing empirical evidence, we formulate our first hypothesis as follows:

$H_{1a}$: As improving economies of scale are positively associated with IMC, smaller municipalities are more likely to engage in cooperation.

$H_{2a}$: The association between economies of scale and population fades as the scale of operation increases.

*Fiscal constraints*

The theoretical approaches present compelling arguments for a positive relationship between fiscal constraints and IMC adoption. Given that municipalities typically operate under strict budget and debt constraints, policymakers are required to develop innovative solutions for efficient service delivery. IMC has emerged as a cost-saving tool, with empirical research demonstrating that fiscal constraints drive the formation of such arrangements (Warner and Hefetz, 2002). Politicians representing highly indebted municipalities show greater propensity to support IMC initiatives (Bergholz and Bischoff, 2018). Fiscal constraints, operationalized through various measures (most usually debt per capita or local wealth), have been consistently identified as a primary driver of IMC (Bel and Warner, 2016).

However, despite strong theoretical foundations and widespread empirical support, correlational studies may fail to capture this relationship accurately. In practice, municipalities with high debt levels might face barriers to IMC participation, either due to their inability to make necessary investment commitments or their low attractiveness as potential partners (Dixon and Elston, 2020). Indeed, poorer municipalities may be considered by their neighbors as non-desirable partners (Kwon and Feiock, 2010; Rubado, 2023). Therefore, supplementing a static analysis with a dynamic one appears sensible, particularly as theoretical literature suggests a positive relationship wherein higher debt accelerates cooperation. The ambiguity interpreting correlational findings underscores the importance of examining both static and dynamic aspects of the fiscal constraints-IMC relationship. All in all, we follow the most common theoretical insight on fiscal constraints to specify our second hypothesis:

$H_2$: Fiscal constraints are positively associated with joining IMC

*Political incentives*

IMC is politically challenging (Krueger, Walker and Bernick, 2011). While city administrators may be more inclined to improve service efficiency, policymakers may fear losing political control with IMC and may therefore be less willing to engage in IMC (LeRoux and Pandey, 2011). Another relevant consideration may be institutional homogeneity (Feiock, 2007), which facilitates IMC.

Political characteristics of a municipality have been used to explain service delivery decisions (Gradus, Dijkgraaf and Budding, 2024). In particular, political participation has been seen as a

potential factor in the decision to join an IMC. Scholars within the management literature have emphasized that electoral turnout can shape the municipal decision to implement IMC. High turnout has been associated with reluctance to contract out services to private vendors, as IMC represents a means to exploit scale economies while maintaining municipal control (Garrone and Marzano, 2015). Blåka (2017) suggests that high voter turnout may indicate greater citizen participation and scrutiny, which could motivate cost-saving initiatives such as IMC. Therefore, this would lead us to expect more political participation -which we measure with electoral turnout- positively associated with participation in IMC.

Furthermore, we must take into account assessments of recent experiences of "quasi-obligatory cooperation" (see Tricaud, 2024 for France). The French experience suggests that state-mandated IMC has enabled both low and high levels of integration, the latter associated with lower voter turnout (di Porto, Parenti and Paty, 2024). [2] Thus, in addition to political participation affecting decisions to join the IMC, joining an IMC may in turn affect electoral participation. These dynamics further complicate the anticipated relationship between voter turnout and IMC. Given that Catalan municipalities are free to enter and leave IMC arrangements, we may anticipate a positive relationship between voter turnout and IMC.

H3a: Political participation will have a positive association with IMC

On the other hand, however, democratic consolidation depends on perceptions of institutional legitimacy which can be reinforced by institutional innovations such as IMC (Moehler and Lindberg, 2009). Hence, a politician's reaction to poor electoral outcomes (e.g., low voter turnout) and the corresponding need to strengthen legitimacy might be to innovate through IMC. Taking this into account, we formulate a second hypothesis related to political participation:

H3b: Political participation will negatively influence the choice of entering an IMC

Overall, expectations about the relationship between political participation and inter-municipal cooperation are ambiguous, and we see this as an empirical issue. Since endogeneity may be a potentially relevant concern in the relationship between cooperation and political participation, we later resort to a dynamic methodological approach, the Cox proportional hazards model, which allows us to assess this issue.

## Data and variables

Our research is based on data on inter-municipal Cooperation (IMC) from the *Observatori de Govern Local* (Local Governance Observatory), a comprehensive dataset maintained by the *Fundació Carles Pi i Sunyer* (Carles Pi i Sunyer Foundation) that has systematically documented

[2] In other countries, such as Italy, mandatory cooperation has been put in place (see Casula 2020, Arachi et al. 2024). However, the degree of implementation has not been as complete as in France, and we are not aware of any analysis on the effects of compulsory cooperation on electoral participation, other than di Porto, Parenti and Paty (2024).

patterns in the delivery of municipal public services for 20 years through regular annual surveys of Catalan municipalities. The earliest surveys included only municipalities with more than 5,000 inhabitants. Subsequently, municipalities with a population of more than 500 inhabitants were included, and the surveys were conducted biannually. We use information from seven surveys administered between 2011 and 2022.[3] The average coverage of these seven surveys was 96.2% (percentage of municipalities surveyed responding). The minimum rate was 90.7% in 2016, and the maximum was 99.5% in 2022.

The key variable of interest is the presence or absence of IMC in the provision of services for which the municipalities are responsible.[4] To ensure meaningful analysis, we established two selection criteria for services to be included in our analysis: (1) a minimum of 5% IMC rate in 2022 in Catalonia; and (2) data availability for at least two years. Eight services satisfied these parameters and were incorporated into our study. Listed in order of decreasing IMC frequency among providing municipalities >500, these are: waste treatment, waste collection, fire services, public library, drinking water, transport, civil protection, and sewage.

Table 1 displays the varying mandatory requirements of provision for these services, and the frequency of cooperation for each service in our sample.[5] Column 4 shows the frequency of cooperation for all municipalities in 2022. Notice that data for all municipalities have been available only since 2016, when the smallest municipalities were also included in the survey. By comparing frequency of cooperation in 2011 and 2022 in municipalities > 500 inhabitants (columns 1 and 2) we can see that IMC has expanded in all services (column 3) in the period that we analyze. Relative growth is relevant in almost all services, and extreme in some cases (for example, public libraries, civil protection, drinking water, transport and sewers). The only exception is waste treatment, which already had a very high IMC frequency since the first wave of data when the service was included.

We supplemented this core dataset with several control variables: *Population, Population squared, Debt per capita* and *Voter turnout,* which we explain and discuss next.

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[3] The latest waves of the survey -since 2016- also included municipalities with fewer than 500 inhabitants. Our analysis considers only municipalities with a population greater than 500 inhabitants in all the years of our estimation, because we want to ensure the homogeneity of the sample over time. We take 2011 as the first year in our sample due to the availability of homogeneous data for control variables. For the sake of completeness, we have included the municipality of Barcelona (originally excluded from the survey), because we had information available for all the years and services studied here.

[4] Our analysis focuses on interlocal (horizontal) cooperation and does not include services for which cooperation is intergovernmental -vertical- (e.g., social services), as the drivers of both types of cooperation are not comparable (i.e., due to mandatory regional regulations for vertical cooperation).

[5] A few municipalities responded to the surveys that had both individual and cooperative provision in one service (or in several). In these cases, the observation was excluded from services and years for which the response given by the municipality was hybrid.

Table 1. Services included in the analysis

| Service | Threshold for mandatory provision | IMC 2011 >500 (1) | IMC 2022 >500 (2) | Growth rate (%) (3) | IMC 2022 All (4) |
|---|---|---|---|---|---|
| Waste treatment | Municipalities > 5,000 | 65.1 | 67.7 | 4.0 | 73.0 |
| Waste collection | All municipalities | 38.8 | 53.5 | 37.9 | 62.7 |
| Fire services | Municipalities > 20,000 | 10.2 | 11.7 | 14.7 | 10.9 |
| Public library | Municipalities > 5,000 | 1.7 | 10.9 | 541.2 | 9.3 |
| Drinking water | All municipalities | 4.9 | 10.6 | 116.3 | 9.5 |
| Transport | Municipalities > 50,000 | 5.4 | 10.3 | 90.7 | 8.7 |
| Civil protection | Municipalities > 20,000 | 1.7 | 6.0 | 252.9 | 10.3 |
| Sewerage | All municipalities | 3.1 | 5.6 | 80.6 | 4.0 |

Note: The service may also be provided by municipalities that are not legally obliged to provide it.
The first year with data for waste treatment and fire services is 2014.
Source: Authors, based on data from the Observatory of Local Government.

*Population:* Economies of scale are related to the volume of service, and the population served is a common measure used to approximate the scale of operation, when data on the production of the service is not available, as is the case for most of the services we analyze. Population indicates the inhabitants of each municipality in the corresponding year.

*Population squared*: This variable was intended to capture the non-linear form of scale economies.

*Debt per capita:* Debt per capita is the most common indicator employed to measure fiscal constraints that municipalities face. Another common measure is municipal wealth (which indicates fiscal capacity). However, per capita income data at the municipal level are not available for municipalities with fewer than 1,000 inhabitants in most years of our sample, so we would experience a large reduction in our database if we used it, especially affecting municipalities that operate on a smaller scale. Debt per capita indicates the local public debt per inhabitant

*Voter turnout:* Among the different forms of expression of political participation, electoral participation in local elections is the most relevant in terms of decisions on local public services. Voter turnout indicates the participation rate (%) in the municipal election immediately preceding each year in the database.

Notice that we do not include variables related to service-specific transaction costs because we analyze services separately. Therefore, they do not vary between observations. However, we use service-specific transaction costs to discuss the results. Along the same lines, we do not include transaction costs related to institutions because in almost all cases cooperation is developed

through delegation to city councils, all with the same governance rules.[6] Table 2 provides an overview of the main variables, sources and expectations; table 3 displays the descriptive statistics for the main variables.

Table 2. Overview of the main variables

| **Independent Variable** | **Description** | **Source** |
|---|---|---|
| IMC | Dummy variable = 1 if the municipality participates in IMC, and 0 otherwise | FCPiS & Own calculation |
| Dependent Variables | | |
| Population | Total population of the municipality | Idescat |
| Population$^2$ | Population squared | Idescat |
| Debt p.c. | Debt per capita in the municipality | INE |
| Turnout | Voter turnout rate in the municipality | Idescat |

Notes: *FCPiS:* Fundació Carles Pi I Sunyer; *Idescat*: Institut d'Estadística de Catalunya; *INE*: Instituto Nacional de Estadística (Spain)

Table 3. Descriptive statistics of the main variables

| Variable | Mean | SD | Min | Max | N |
|---|---|---|---|---|---|
| IMC | 0.27 | 0.44 | 0.00 | 1.00 | 21,857 |
| Population | 15,206.88 | 78,918.79 | 502.00 | 1,664,182.00 | 21,857 |
| Debt p.c. | 68.07 | 73.60 | 0.00 | 1,857.03 | 21,827 |
| Turnout % | 66.65 | 9.59 | 38.05 | 95.45 | 21,857 |
| Year | 2,016.67 | 3.55 | 2,011.00 | 2,022.00 | 21,857 |

## Factors explaining cooperation: Methodology and Results

First, we investigate the primary drivers of IMC adoption. This static analysis focuses on identifying the key determinants that influence whether a municipality participates in cooperative arrangements. For this purpose, we use multilevel modeling techniques, i.e., multilevel analysis.

*Methodology*

Our policy adoption model is used to understand how differences among municipalities affect the adoption of IMC for services. The general model is the following:

$$IMC_{i,s,t} = f\left(Population_{i,t}, Municipal\ debt_{i,t}, Electoral\ turnout_{i,t}\right) \qquad (1)$$

[6] In a minority of cases in which cooperation is implemented through mancommunities (or through the metropolitan area of Barcelona), the cooperation is also governed jointly. Interlocal contracts are extremely rare in Catalonia, which reduces the disparity in governance-related transaction costs.

Here, $IMC_{i,s,t}$ is a binary variable that represents whether a municipality $i$ of the municipalities in year $t$ over the period of 2011-2022 was involved in IMC for the service $s$ of the eight services considered in this analysis.

We estimate this model using a generalized linear mixed models (GLMM) and the "glmer" function in R. Mixed models, also known as multilevel, random-coefficient, or hierarchical models, represent a generalization of linear and generalized linear modeling. As Gelman (2006) notes, these techniques provide -to varying degrees- an improvement over classical methods. This regression approach allows us to model the log odds of the binary outcome variables as a linear combination of the explanatory variables. The GLMM technique is particularly useful when data are clustered and both fixed and random effects are at hand.

Compared to conventional fixed or random effects logistic regression, the GLMM method offers several key advantages. It can properly account for necessary random or fixed effects, as well as address issues of non-independence in the data. In contrast, logistic (or probit) regression with clustered standard errors can adjust for non-independence but lacks the capacity to incorporate random effects. The widespread presence of hierarchical structures or repeated observations has contributed to the growing popularity of multilevel models across diverse disciplines, particularly in the social, educational, and medical sciences where nested datasets are commonplace (Asampana Asosega et al., 2024).

Let $imc_{ijt}$ be the binary response variable of the $j$th service in the $i$th municipality at year $t$ indicating whether municipality was part of or not of an IMC arrangement in that service. Our model equation can be expressed as follows:

$$logit\big(\Pr\big(imc_{ijt}=1\big)\big)=\beta_0+\beta_1*Population_{ijt}+\beta_2*Population_{ijt}^2+\beta_3*Debt_{ijt}+\beta_4*Turnout_{ijt}+u_i+v_t+e_{ijt} \quad (2)$$

Here, $\beta_0$ is the intercept, that represents the baseline log-odds when all the predictor variables have a value of 0. The other fixed effects include $\beta_1$, that represents the effect of the population size on the outcome, $\beta_2$ allows for non-linear effects of the population, $\beta_3$ is the effect of the turnout percentage on the outcome and $\beta_4$ is the effect of debt per capita. There is also a random intercept for each municipality $i$, that captures the unobserved heterogeneity across municipalities represented by $\mathrm{u_i} \sim \mathcal{N}(0, \sigma_{\mathrm{u}}^2)$. Additionally, there is a random intercept for each year $t$ accounting for year-specific effects given by the term $v_i \sim \mathcal{N}(0, \sigma_v^2)$ and last $e_{ijt}$ is the error term.

Furthermore, to address non-linear relationships and improve model convergence, variables exhibiting significant skewness underwent logarithmic transformation for positive skewness and exponential transformation for negative skewness, followed by standardization. All variables were subsequently standardized to ensure comparability across measures. We inspected the variance inflation factor for the estimation of each service, to check for potential multicollinearity concerns. We found average VIF and all individual VIFs below two in all services.

*Results*

To examine the primary drivers of IMC, we estimated the GLMM specified in Equation 1. The GLMM approach is well-suited for this analysis, as it can handle the hierarchical structure of the data (municipalities nested within years) as well as the binary nature of the IMC decision. Table 4 reports the results, which provide insights into the factors influencing IMC across various public services.[7] The coefficients represent the relationship between the predictors *Population, Population squared, Debt p.c., Turnout.,* and the likelihood of IMC across different public services.

Generally, the effect of population shows a consistent pattern across all the services for which cooperation is more frequent (waste treatment, waste collection and transport). Firefighters, public library, drinking water, civil protection and sewage show no significant relationship between cooperation and population. Interestingly, drinking water has a positive and statistically significant association with population. For most services, therefore, larger municipalities are generally less likely to engage in IMC, as expected. The relationship between population and cooperation appears to be weaker in the case of services that rely heavily on buildings for citizens' use (e.g., firefighters as public library), or physical networks (e.g., sewage or drinking water).

As for the squared population variable, only the services in which cooperation is more frequent show a strongly significant coefficient: waste treatment and waste collection. The likelihood of the IMC stops decreasing in the population at a certain point, and then starts to increase again, may suggest a U-shaped relationship in these services. This dynamic is different for services where cooperation is less frequent, for which the squared population tends to be not significant at all.

Turning now to the relationship between municipal *Debt p.c.* and IMC, we observe that the coefficient tends to be negative, and in half of the cases the association is statistically significant: waste treatment, transport, public library and sewage. Overall, little can be said in general terms about the effect of public debt on cooperation. It may well be that studies conducted with the aggregate level of cooperation (for example, percentage of municipality expenditure spent on cooperative delivery) are more appropriate for analyzing a potential effect of debt on cooperation.

[7] Note: The results from the multilevel model estimation must be taken with caution in the case of the Transport service, due to computational singularities stemming from minimal temporal variation in service provision patterns within municipalities. While we observed cross-sectional heterogeneity in transport service delivery across local governments, the temporal stability within individual municipalities hinders the robustness model estimation.

*Table 4. GLMM results for factors influencing IMC*

| | Waste treatment | Waste Collection | Transport | Fire | Libraries | Civil protection | Drinking water | Sewer |
|---|---|---|---|---|---|---|---|---|
| Intercept | 4.882*** | -0.039 | 0.046 | -10.229*** | -11.221*** | -11.277*** | -10.771*** | -10.765*** |
| | (0.500) | (0.330) | (0.430) | (0.914) | (0.665) | (1.001) | (0.609) | (0.680) |
| Population | -3.063*** | -8.642*** | -1.171+ | 1.787 | 0.211 | -3.510 | 0.899 | 1.444 |
| | (0.616) | (1.243) | (0.632) | (1.310) | (1.033) | (2.262) | (0.662) | (0.906) |
| Population$^2$ | 0.180** | 1.443*** | 0.096 | -0.341 | -0.040 | 0.256 | 0.060 | -0.225 |
| | (0.065) | (0.238) | (0.082) | (0.347) | (0.259) | (0.751) | (0.069) | (0.256) |
| Debt per capita | -0.385** | -0.167 | -0.585* | -0.283 | -0.479+ | -0.218 | -0.294 | -0.605* |
| | (0.147) | (0.120) | (0.250) | (0.387) | (0.278) | (0.240) | (0.203) | (0.286) |
| Turnout | 0.802*** | 0.422** | 1.441*** | 1.239+ | 0.510 | -0.014 | 0.659* | 0.378 |
| | (0.179) | (0.147) | (0.297) | (0.639) | (0.337) | (0.307) | (0.272) | (0.345) |
| SD (Intercept municipality) | 6.747 | 5.176 | 5.037 | 22.935 | 16.873 | 15.248 | 11.876 | 12.043 |
| SD (Intercept year) | 0.107 | 0.338 | 0.000 | 1.087 | 0.599 | 0.380 | 0.483 | 0.288 |
| # Observations | 2673 | 3951 | 1046 | 850 | 2864 | 2256 | 4097 | 4090 |
| % IMC among providers | 73.2 | 55.1 | 38.3 | 36.8 | 11.6 | 9.7 | 7.6 | 4.4 |
| R2 Marginal | 0.121 | 0.535 | 0.590 | 0.011 | 0.002 | 0.028 | 0.009 | 0.006 |
| R2 Conditional | 0.941 | 0.949 | - | 0.994 | 0.989 | 0.986 | 0.977 | 0.978 |
| AIC | 1877.0 | 2933.4 | 847.5 | 623.9 | 903.3 | 711.7 | 1025.0 | 723.4 |
| BIC | 1918.2 | 2977.4 | 882.2 | 657.1 | 945.0 | 751.7 | 1069.2 | 767.6 |
| RMSE | 0.21 | 0.23 | 0.21 | 0.12 | 0.13 | 0.13 | 0.13 | 0.11 |

Notes: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

.- Percentage IMC among providers only takes into account the municipalities where the service is actually provided, thus better illustrating the frequency service-related frequency. Recall that municipalities that do not provide the service are excluded from the estimations.

.- Robust standard errors in parenthesis.

*Voter turnout* shows positive associations with IMC in most services, with variations in economic and statistical significance. This relationship is stronger and more significant in services where cooperation is more frequent (waste treatment, waste collection, transport, firefighters), and it is also significant for drinking water. These patterns suggest that civic engagement generally is correlated with higher probability of IMC, especially in services of high public visibility and direct citizen impact such waste management, water, transport, and fire.

The marginal $R^2$ values, representing the variance explained by fixed effects alone, show considerable variation across services, suggesting that the observable characteristics of *Population, Debt p.c. and Turnout* explain a substantial portion of IMC decisions in the services where cooperation is more frequent. In contrast, in services for which cooperation is less frequent we find lower marginal $R^2$, indicating that our explanatory variables alone explain very little of the IMC variation in these services. However, the conditional $R^2$ values, which include both fixed and random effects, hence also the year and municipality effects, are consistently high across all services, indicating that municipality-specific and temporal factors are crucial for explaining cooperation patterns. The model fit statistics (AIC and BIC) allow for comparison across services, with lower values indicating better fit while penalizing model complexity. The RMSE values, representing the standard deviation of prediction errors, are relatively low across all services, indicating good predictive accuracy.

## Dynamic analysis of cooperation: Methodology and Results

Our second analytical approach examines the factors that either accelerate or delay IMC implementation. This dynamic approach centers on variables that significantly impact the *timing* of cooperation adoption. Survival analysis using time-to-event outcomes can be very informative considering that it gives more insights, beyond just stating whether an event occurred. This approach effectively tackles the presence of units whose event outcomes become unobservable; or that due to the limited period of observation, we don't observe an event happening although it might happen after. Using "censoring" survival analysis can handle this issue (George, Seals and Aban, 2014).

While survival analysis has its origins in life sciences and medical research, it is also frequently employed to study questions in economics or public administration. In the context of policy reforms and innovations such as IMC, hazard models prove useful in identify the factors driving their emergence (Bergholz, 2018; Bischoff and Wolfschütz, 2021). Discrete time survival models have also been utilized to examine financial and political factors behind privatization of municipal services (Zafra-Gómez et al., 2016), timing of amalgamation in Japan (Nakazawa and Miyashita, 2013), or timing of land development in Poland (Reyman and Maier, 2022).

By exploring this temporal dimension, we gain insights into the processes underlying IMC formation. To unpack the dynamic relationships between IMC and the explanatory variables we turn to survival analysis, specifically employing the Cox proportional hazards model (Cox, 1972) for each of the eight services. The model equation for each service is initially as follows:

$$\lambda\,(t) = \lambda_0(t)\exp\left(\beta_1 * Population_{ijt} + \beta_2 * Population_{ijt}^2 + \beta_3 * Debt_{ijt} + \beta_4 * Turnout_{ijt}\right) \quad (3)$$

In this specification, the $\lambda_0(t)$ represents the baseline hazard when all the covariates are equal to zero. It can be interpreted as the probability that the unit of observations experiences the event (IMC) at time $t$ even though all the other covariates are 0. The quantities of $\exp(\beta_i)$ are referred to as the hazard ratios. If the value of $\exp(\beta_i)$ is greater than one, or equivalently, $\beta_i$ is greater than zero, as the value of the corresponding covariate $x_i$ increases, the event probability increases, hence the probability of survival decreases.

Table 5 shows the results from the Cox proportional hazards models, which provide further insights into the factors influencing the timing of intermunicipal cooperation (IMC) across various public services. To interpret the results, it is important to recall that this method assesses how different variables affect the time until an event occurs (in our case participation in IMC for a given service). Therefore, positive coefficients indicate increased hazard –higher probability of event occurrence. So, factors with a positive coefficient accelerate the IMC adoption, while negative coefficients suggest factors that delay cooperation.

In the previous sections we could observe that the effect of *population* tended to be important in explaining why municipalities cooperate, and population seems to be relevant also in explaining when IMC occurs. In five of the eight services, we found that population is negatively and significantly related to the speed of adoption of cooperation for those municipalities that were not cooperating in 2011 but entered into cooperation in the following years. This includes public library, for which no relationship with population was found before, but now we find that timing of cooperation is negatively associated with population. In contrast, no population effect on the timing of cooperation was found for other services that are less population-sensitive in general, such as fire and sewage. Nor for drinking water, for which the population showed a positive and significant association with cooperation.

Higher *public debt p.c.* tends to accelerate the adoption of IMC. We find a positive effect from debt on the timing of adoption in all services, and in all cases but sewage, with relevant levels of significance. While our previous static analysis did not allow us to draw robust conclusions about the effect of debt on cooperation, our results from the dynamic analysis show that public debt accelerates the adoption of cooperation. This suggests that financial pressure motivates municipalities to seek cost-sharing arrangements and to explore cost savings through cooperation. Consequently, joining IMC could lead to debt reduction, which would help understand our per capita debt results in the static estimates (table 4)

*Table 5. CPH results for factors influencing the timing of IMC*

| | Waste Treatment | Waste Collection | Transport | Fire | Libraries | Civil Protection | Drinking Water | Sewer |
|---|---|---|---|---|---|---|---|---|
| Population | -0.286*** | -0.285*** | -0.553*** | -0.211+ | -0.187 | -0.489* | 0.006 | 0.153 |
| | (0.066) | (0.072) | (0.116) | (0.119) | (0.135) | (0.194) | (0.126) | (0.180) |
| Population² | -0.016 | -0.014 | 0.183+ | 0.099 | -0.067 | 0.141 | -0.059 | 0.058 |
| | (0.041) | (0.044) | (0.099) | (0.089) | (0.086) | (0.139) | (0.107) | (0.144) |
| Debt p.c. | 0.136*** | 0.166*** | 0.231** | 0.255* | 0.236* | 0.286** | 0.219* | 0.185 |
| | (0.041) | (0.042) | (0.089) | (0.099) | (0.103) | (0.104) | (0.100) | (0.136) |
| Turnout % | -0.303*** | -0.388*** | -0.179 | -0.191 | -0.482** | -0.105 | -0.052 | -0.347 |
| | (0.073) | (0.067) | (0.127) | (0.141) | (0.164) | (0.148) | (0.175) | (0.222) |
| # Obs. | 720 | 766 | 298 | 323 | 641 | 625 | 775 | 776 |
| AIC | 6435.8 | 6087.9 | 1384.2 | 1226.7 | 964.4 | 853.5 | 816.5 | 538.7 |
| BIC | 6454.1 | 6106.5 | 1399.0 | 1241.8 | 982.3 | 871.2 | 835.1 | 557.3 |
| RMSE | 0.54 | 0.66 | 0.68 | 0.55 | 0.35 | 0.34 | 0.29 | 0.26 |

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Robust standard errors in parentheses.

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Turning now to *voter turnout*, for all services we observe a negative coefficient, which is statistically significant only for waste treatment, waste collection and public libraries. Lower voter turnout is thus associated with a higher probability of cooperation, meaning that municipalities with less civic engagement tend to accelerate the adoption of cooperation. This result is somewhat contradictory to the participation result we most frequently found in the static analysis: positive and significant association between participation and cooperation. Suggesting, again, that joining IMC may increase political participation. Further research is needed, indeed.

## Discussion

This study provides valuable insights into the complexity of factors shaping IMC in public service delivery. By employing a comprehensive analytical approach that combines both static and dynamic perspectives, we uncover nuanced relationships between population size, voter turnout, municipal debt, and the adoption and timing of IMC arrangements.

Consistent with prior research, we tend to find that smaller municipalities are generally more likely to engage in IMC in the services for which cooperation is more frequent. Population, however, tends not to be significant for services where cooperation is less frequent. In general, however, we most often find in our dynamic analysis that the smaller the population, the faster the adoption of cooperation. Interestingly, this is not the case for drinking water, which shows a positive and statistically significant association with population. This cannot be explained with a lack of provision by small municipalities, because provision is compulsory for all municipalities. The most likely explanation lies in a common structural characteristic of water services: their strong and complex physical network characteristics. Cooperation would require sharing specific physical networks, and this is more suitable for contiguous urban areas than for sparsely populated rural communities.

Our empirical analysis implies a U-shaped pattern for population in the services where cooperation is more frequent: waste treatment, waste collection, and transportation, although with less significance for the latter. While economies of density (network) may be one explanation for the cooperation of larger municipalities in transport services (i.e., municipalities in the Barcelona metropolitan area), economies of scale are not a likely explanation for waste treatment and collection. These two services are provided by virtually all municipalities (although waste treatment is only mandatory for those with a population of over 5,000), and economies of scale are exhausted with population. It may well be that larger municipalities in different territorial areas (e.g., counties) engage in cooperation as a way of expressing or maintaining political or institutional leadership, which may not be a suitable option for medium-sized municipalities in each of these areas. Overall, we find that smaller municipalities, which have more to gain from economies of scale, show a higher propensity for cooperation. Additionally, particularly for waste-related services, we find support for a non-linear relationship. Thus, our findings are consistent with hypotheses H1a and H1b for the services where cooperation is more widespread. H1a, however, does not hold for those services where density is more relevant than volume (i.e., those

with physical networks, such as drinking water and sewage) and for those that smaller municipalities provide less frequently (e.g., public libraries).

The influence of municipal debt on IMC decisions is complex. Our static analysis shows mixed results, with a few services exhibiting a negative relationship with debt others no significant association, we argued in the previous section that it might be caused by the static nature of the multi-level analysis and lack of causal inference. Furthermore, we argued that single service analysis may be less apt than more aggregate analysis (e.g., share of cooperation expenditures among overall municipal expenditures) to robustly study the effect of debt on cooperation. This picture is clarified by the dynamic analysis, which points to a more consistent pattern. Higher debt levels tend to accelerate the adoption of IMC in almost all services; therefore, high debt level leads to IMC, not the other way around. This also lends support to the notion that fiscal constraints are a key driver of cooperation. This finding aligns with the theoretical perspective that municipalities facing tighter budgetary conditions are more inclined to explore cost-saving strategies through collaborative arrangements. Hence, although the static analysis seems to show mixed results with respect to H2, the dynamic analysis confirms that higher debt levels consistently accelerate IMC adoption, thus overall supporting our hypothesis.

Another notable finding is the consistently positive relationship between voter turnout and the probability of IMC. This pattern aligns with the notion that more engaged and politically active communities may be more receptive to institutional innovations like IMC, which can enhance municipal efficiency and organizational capacity. However, the dynamic analysis paints a somewhat different picture, because lower voter turnout is associated with an acceleration in the timing of IMC adoption. This perhaps suggests a reverse causality: lower voter turnout positively influences the adoption of cooperation, to promote legitimacy through policy innovation. Cooperation then has a positive influence on electoral participation. Regarding the competing hypotheses about political participation, H3a and H3b, our findings do not allow us to definitively reject either hypothesis. Instead, our results suggest a more complex relationship and the need for more nuanced theoretical frameworks and empirical evaluations to test these relationships. Future research could substantially advance our understanding of how political participation shapes and is shaped by cooperative arrangements.

## Conclusion

We investigated both static and dynamic factors that can affect IMC. To this end, we employed two distinct analytical strategies. First, we used generalized linear mixed models for our static analysis. We found that population was generally negatively related to cooperation, although the relationship was opposite in the case of drinking water. Second, we employed survival analysis using time-to-event outcomes for our dynamic analysis. In addition to confirming the negative relationship between population and cooperation, our dynamic analysis showed that fiscal constraints (measured in debt per capita) and political legitimacy and change accelerated the adoption of cooperation.

Overall, this study makes several important contributions to the literature on intermunicipal cooperation. By disentangling the static and dynamic determinants of IMC, we provide a more comprehensive understanding of the multifaceted forces shaping collaboration in public service delivery. The findings highlight the need to consider both organizational and political factors, as well as the unique characteristics of different public services, when analyzing the antecedents and dynamics of IMC. Overall, our study shows that while participating in IMC depends on the factors that have previously been found and we confirmed the key drivers, the *timing* of IMC is a different decision. In that case, the political context is much more important. Indeed, the relationship between political processes, political participation and inter-municipal cooperation requires further research, possibly including mixed quantitative and qualitative analyses.

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