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Digital Subsidies and Public-Sector Performance: Evidence from Municipal Social Media

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Abstract

Governments devote substantial resources to digital transformation, yet causal evidence on whether digitalisation subsidies improve public-sector performance remains limited. This paper evaluates Italy's municipal digitalisation programme (PA Digitale 2026) using social-media data from official municipal pages. Exploiting staggered funding adoption across municipalities, we implement a difference-in-differences design to estimate effects on posting intensity, citizen engagement, and textual readability. We find that treated municipalities significantly boost their online presence, while evidence on engagement and readability is weaker, with readability following a catch-up trajectory over time. Results indicate that digital-capacity subsidies effectively close the first-level digital divide, while bridging the quality divide requires organisational learning and complementary interventions.

Keywords: *Digital divide; Italian municipalities; policy evaluation; social media; difference-in-differences.*

1. Introduction

A fundamental aspect of the digital age is the capacity to observe policy outcomes with greater expediency than traditional administrative data can facilitate. High-frequency digital traces have demonstrated this potential across macroeconomic monitoring, environmental enforcement, and behavioural research (Einav & Levin, 2014; Varian, 2014). At the same time, governments worldwide are funding the digital transformation of public administration, creating an urgent need to evaluate whether those investments deliver citizen-facing results (Yang et al., 2024).

Italy's National Recovery and Resilience Plan (NRRP) commits €6.74 billion to PA Digitale 2026, a programme financing digital infrastructure for public administrations. Because funding is disbursed through sequential calls, municipalities enter the programme at different points in time, creating a setting well suited for staggered causal evaluation (Roth et al., 2023). Despite

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growing interest in municipal digitalisation, most evaluations focus on back-office efficiency or technology adoption (Arduini et al., 2010), while citizen-facing outcomes remain underexplored.

This paper bridges these streams using social-media data from Italian municipalities' official pages to evaluate whether PA Digitale 2026 funding translates into observable changes in public communication. Guided by the multi-level digital-divide framework (van Dijk, 2005; Hargittai, 2002), we organise the analysis around three margins: (i) the extensive margin — whether funded municipalities adopt social media at all; (ii) the intensive margin — posting frequency and citizen engagement; and (iii) the quality margin — readability of institutional language, measured by the Gulpease index (Lucisano et al., 1988). Identification relies on staggered adoption and we implement multi-period difference-in-differences methods (Callaway & Sant'Anna, 2021).

2. Background

2.1. The multi-level digital divide in public administration

The concept of a digital divide has evolved from a binary distinction into a multi-layered framework. Van Dijk (2005) distinguishes access divides (physical availability of technology), skills divides (ability to use technology effectively), and usage divides (breadth of actual use). Hargittai (2002) formalised the "second-level digital divide," shifting attention from connectivity to competence. Most empirical applications focus on individuals, but the framework is equally relevant to organisations and local governments. Municipalities differ enormously in their digital readiness (Holzer & Kim, 2003), and prior work has documented persistent digital divides in e-government service provision that mirror inequalities in administrative capacity and fiscal resources (Mossberger et al., 2003).

2.2. Municipal digital capacity and civic communication

PA Digitale 2026 can be viewed as a place-based policy aimed at increasing municipal digital capacity through targeted funding (Barca, 2019). Social media provides a particularly suitable measurement channel: municipalities communicate directly with residents who can respond immediately, generating granular behavioural outcomes difficult to observe in administrative data alone (Mergel & Bretschneider, 2013). While many evaluations of digitalisation concentrate on technology adoption or administrative efficiency, citizen-facing outcomes are essential for assessing whether digital transformation improves public value (Twizeyimana & Andersson, 2019).

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3. Data and Methodology

3.1. Sample, treatment definition, and outcomes

The analysis considers Italian municipalities operating an official Facebook and/or Instagram page. We construct a municipality-year panel for 2009–2025. Treatment is defined from administrative records on the PA Digitale 2026 portal: a municipality is treated in the first year it receives funding. Sequential programme calls generate staggered treatment entry. The sample covers 4,493 municipalities with at least one active social-media page as of 2025 (56.9% of all Italian municipalities).

Outcomes are organised around three dimensions: (i) communication intensity (number of posts, posts with hyperlinks, and posts with images); (ii) citizen engagement (total likes and comments, and engagement per post); and (iii) content quality (the Gulpease readability index (0–100 scale, higher = more readable) and composition shares). Count outcomes are transformed using the inverse hyperbolic sine (IHS), asinh(y), which accommodates zeros and behaves like a log for large values (Burbidge et al., 1988; Bellemare & Wichman, 2020).

3.2. Identification and estimation strategy

We estimate causal effects using the Callaway & Sant'Anna (2021) staggered DiD estimator, which compares newly treated municipalities to not-yet-treated peers within the same period, avoiding "forbidden comparisons" that can bias standard two-way fixed effects (TWFE) estimates (Goodman-Bacon, 2021). Municipalities are grouped into cohorts by first treatment year, and we estimate group-time average treatment effects ATT(g, t). Pre-treatment parallel trends are assessed via event-study specifications normalised to the last pre-treatment period ($k = -1$).

4. Results

4.1. First-level divide: social-media adoption

The most striking finding concerns digital presence. The overall ATT on social-media adoption is 8.3 percentage points (p.p.) in the full sample and 9.6 p.p. when restricted to funded municipalities (both significant at 1%). Event-study plots confirm flat pre-treatment coefficients followed by a sharp post-treatment increase, consistent with the programme catalysing digital presence rather than rewarding pre-existing activity. These results provide robust evidence that PA Digitale 2026 closes the first-level digital divide.

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4.2. Second and third level divides: usage and quality

Table 1 reports overall ATT estimates from the Callaway & Sant'Anna (2021) estimator. At the intensive margin, posting intensity increases significantly (ATT = 0.231, $p < 0.05$), with effects ramping up over the years following funding receipt. Total engagement also responds positively (ATT = 0.276, $p < 0.10$), but engagement per post is small and not statistically significant, indicating that the rise in aggregate engagement is driven primarily by increased posting volume rather than greater per-post resonance. Posts containing hyperlinks increase significantly (ATT = 0.152, $p < 0.10$), while image-related outcomes are negative and insignificant, pointing to a compositional shift toward text-and-link-based content.

At the quality margin, the Gulpease readability index shows a positive ATT of 3.65 points (marginally significant). Event-study dynamics reveal that readability effects are small immediately post-treatment but point estimates trend upward over time, consistent with a gradual catch-up as municipalities adapt their communication style.

Table 1. Overall ATT estimates (Callaway–Sant'Anna estimator). Source: Authors' elaboration.

Outcome	Transform	ATT	Std. Error	95% CI	Sig.
Adoption	level	0.023	(0.013)	[−0.003, 0.049]	*
Posts	asinh(y)	0.231	(0.096)	[0.044, 0.418]	**
Engagement	asinh(y)	0.276	(0.145)	[−0.008, 0.560]	*
Engagement per post	asinh(y)	0.067	(0.066)	[−0.062, 0.197]	
Posts with link	asinh(y)	0.152	(0.084)	[−0.011, 0.316]	*
Posts with image	asinh(y)	−0.028	(0.081)	[−0.186, 0.130]	
Gulpease index	level	3.645	(2.009)	[−0.292, 7.583]	*
Share with link	level	0.008	(0.009)	[−0.010, 0.025]	
Share with image	level	−0.015	(0.011)	[−0.037, 0.006]	

*Notes: Overall aggregated ATT estimates from Callaway & Sant'Anna (2021). Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.10. Engagement = likes + comments. Gulpease: 0–100 scale (higher = more readable).*

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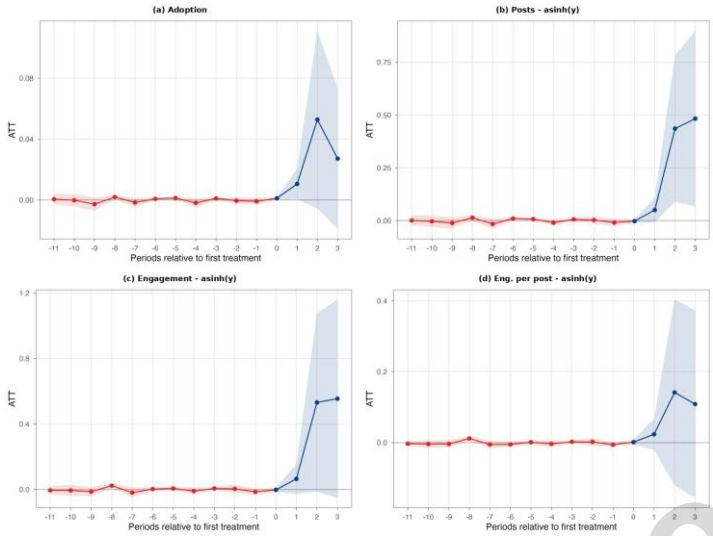


Figure 1. Event-study estimates: adoption and communication intensity. Source: Authors' elaboration. Notes: Each panel plots event-study coefficients from the Callaway & Sant'Anna (2021) staggered DiD design, where k denotes years relative to first funding receipt (k = 0). The reference period is k = −1. Red markers = pre-treatment periods; blue markers = post-treatment periods. Shaded areas are 95% pointwise confidence intervals. Panel (a): adoption (binary indicator). Panels (b)–(d): asinh(y) transformation. Engagement = likes + comments.

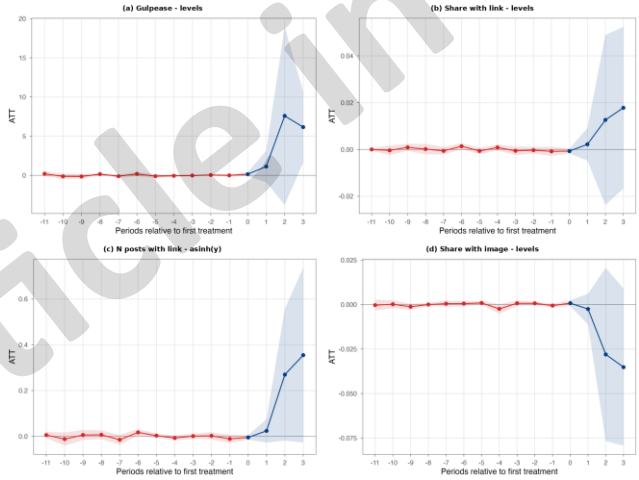


Figure 2. Event-study estimates: communication quality and content composition. Source: Authors' elaboration.
Notes: Each panel plots event-study coefficients from the Callaway & Sant'Anna (2021) staggered DiD design. Panel (a): Gulpease readability index (levels, 0–100). Panel (b): share of posts with hyperlink. Panel (c): number of posts with at least one link, asinh(y). Panel (d): share of posts with image. All Instagram posts are classified as image posts.

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5. Discussion and Conclusion

This work provides causal evidence on how targeted digitalisation subsidies interact with multiple levels of the municipal digital divide. The core finding is one of decreasing effectiveness across divide levels. At the first level, PA Digitale 2026 has a strong and robust effect: the programme brings municipalities into the digital public sphere. At the second level, funded municipalities post more frequently and generate more total engagement, with effects that ramp up gradually. At the quality margin, the evidence is weaker: engagement per post shows no significant effect, and readability follows a catch-up trajectory, initially lower among recently funded municipalities but gradually converging.

Three important messages emerge. First, digital-capacity subsidies can effectively close the first-level digital divide in public administration. Without the programme, a substantial fraction of Italian municipalities would likely remain absent from digital communication channels. Second, access is necessary but not sufficient: the rise in aggregate engagement is driven by increased posting volume rather than greater per-post resonance, suggesting the subsidy operates mainly through the supply of content, not through an improvement in its quality or citizen appeal. Third, closing the access divide initiates a catch-up process at the quality level, municipalities that recently came online tend to use more complex language but gradually converge toward more readable communication as they gain experience.

For policy, these findings suggest that digital-infrastructure subsidies alone are insufficient to fully realise the public-value benefits of municipal digitalisation. Complementary investments in digital skills, communication training, and governance capacity are needed. More broadly, the study demonstrates that social-media traces can serve as scalable, near-real-time outcome measures for evaluating place-based digital policies wherever local governments maintain an active online presence.

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