

**Does regional digital transformation improve
individual well-being? Evidence from Japan**

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Abstract

As Internet use has expanded rapidly, understanding the relationship between digital technologies and well-being has become increasingly important. Beyond individual ICT adoption, digital transformation (DX)—defined as the broad changes driven by digital technologies across economic and social systems—has attracted growing attention. However, empirical evidence on whether regional DX improves well-being remains limited. Using longitudinal data from the 2021–2024 Survey on Satisfaction and Quality of Life in Japan by the Cabinet Office of Japan, this study examines the effects of regional DX on individuals’ life satisfaction. Regional DX is measured using the Regional DX Acceleration Lab policy and proxied by the number of municipalities adopting government-wide DX governance frameworks and comprehensive DX policy. The results indicate that while the DX Acceleration Lab policy does not generate statistically significant improvements in life satisfaction, broader municipal DX initiatives significantly enhance residents’ well-being. Subsample analyses reveal substantial heterogeneity by age group and educational attainment. Potential pathway analysis further suggests that the well-being effects of regional DX operate primarily through enhanced perceived economic security and improved institutional trust, rather than through immediate changes in employment conditions. These findings highlight that comprehensive, institution-wide DX strategies are effective in improving residents’ well-being.

1. Introduction

In recent years, as Internet use has become increasingly widespread, the adoption of “beyond GDP” measures (Stiglitz et al., 2009) has gained prominence, bringing well-being analysis to a more central position in scientific research (Suárez Álvarez & Vicente, 2023). Well-being is widely regarded as essential for fostering a healthy and productive society (Diener & Suh, 1997) and serves both as a fundamental value in individuals’ lives and as an indicator of social progress (Voukelatou et al., 2021). In economics, the field known as the “economics of happiness,” which examines well-being and happiness, has gradually expanded since the early 2000s, leading to the accumulation of a substantial

body of research (Sato, 2025).

Amid dramatic social changes in recent years—including the COVID-19 pandemic and the rapid development of generative AI—the adoption of digital technologies such as teleworking has expanded substantially. Moreover, digital transformation (DX), defined as the broad changes brought about by digital technologies across all aspects of human life (Stolterman & Fors, 2004), has attracted growing national and international attention. The accelerated diffusion of digitalization and information and communications technologies (ICT), further intensified by the pandemic, has profoundly reshaped everyday life (Kiviahho & Einolander, 2023).

While DX has fundamentally transformed business models and market structures (Verhoef et al., 2021), the academic literature has only recently begun to systematically examine digitization, digitalization, and digital transformation (e.g., Venkatraman, 2017). To date, research on digital change has remained largely concentrated within business and management disciplines (Verhoef et al., 2021), with limited attention to its broader social consequences. Existing studies have primarily focused on individual Internet use or specific digital tools, leaving the well-being implications of comprehensive DX processes largely unexplored, particularly at the regional level. Moreover, empirical evidence on the relationship between regional DX and subjective well-being remains especially scarce in the Japanese context.

To address these gaps, this study examines the effect of regional DX on residents' life satisfaction in Japan, a widely used indicator of subjective well-being and happiness (Kubiszewski et al., 2019) and a strong predictor of physical and mental health outcomes (Miller et al., 2019).

This study focuses on Japan for the following reasons. First, the promotion of regional DX in Japan is expected to foster a society in which citizens and businesses can fully benefit from digitalization through the development of new services, the sustainability of local communities, and improvements in well-being, as articulated in the “Vision for a Digital Garden City Nation.” Second, Japan's level of subjective well-being remains relatively low in international comparison. Data from the Gallup World Poll indicate that Japan's life satisfaction, measured on an 11-point scale, was below the OECD average in 2021–2022, with no substantial improvement compared to 2018–2019 (OECD, 2024).

Using longitudinal household survey data from the 2021–2024 Survey on Satisfaction and Quality of life by the Cabinet Office of Japan, this study empirically examines the effect of regional DX on individuals’ well-being, measured by life satisfaction. The results indicate that the Regional DX Acceleration Lab policy does not have a statistically significant effect on life satisfaction, whereas regional DX—proxied by the number of municipalities with a government-wide DX framework and a comprehensive DX policy—has a significantly positive effect on individuals’ life satisfaction. These findings are consistent by robustness checks. This study further demonstrates substantial heterogeneity in the effects of regional DX, showing that its impacts differ markedly across age groups and educational attainment levels. This study also finds that the positive effect of regional DX on individuals’ life satisfaction may be through two plausible channels: satisfaction with household income and assets and satisfaction with trust in politics, administration, and judiciary.

Compared with the existing literature, this study makes three main contributions. First, this study contributes to the literature on the relationship between ICT use and well-being. Over the past decade, although the impact of Internet use on individual well-being has gradually attracted the attention of scholars (Zhang et al., 2020), the relevant evidence such as DX remains scarce. This study measures regional DX using both policy frameworks and municipal initiatives, rather than relying solely on DX-related policies.

Second, this study contributes to a deeper understanding of the relationship between regional DX and individual well-being from multiple dimensions. Specifically, well-being is measured not only by overall life satisfaction but also in terms of satisfaction with employment conditions and wages, work–life balance, household income and assets, and trust in politics, administration, and judiciary. By examining these dimensions, this study captures the potential channels through which regional DX may enhance overall life satisfaction. Additionally, this study examines the effect of regional DX on life satisfaction across demographic groups such as age and educational attainment.

Third, this study employs panel data to mitigate endogeneity concerns arising from unobserved individual characteristics. While life satisfaction may be influenced by time-invariant factors such as personality traits and innate ability, much of the existing literature relies on (repeated) cross-sectional survey data and thus cannot adequately account for individual heterogeneity (Bartram, 2021; Luttmer, 2005; Matsushima &

Matsunaga, 2015; Nie et al., 2017; Oshio & Shimizutani, 2025). In contrast, by exploiting longitudinal variation and applying a fixed-effects (FE) model, this study controls for unobserved, time-invariant individual attributes, thereby providing more credible estimates of the effect of regional DX on well-being.

The remainder of this paper is organized as follows. Section 2 provides the background of the study, including the definition of digital transformation (DX), regional DX initiatives, and related policies in Japan. Section 3 reviews the existing literature on the effects of ICT on well-being and develops the hypotheses. Section 4 describes the data sources, variable definitions, and estimation strategy. Section 5 presents and discusses the empirical results. Section 6 concludes and outlines the policy implications.

2. Background

2.1 Definition of digital transformation

Following Stolterman and Fors (2004), DX is defined as “the changes that digital technology causes or influences in all aspects of human life.” This conceptualization is reflected in Japan’s Ministry of Internal Affairs and Communications (MIC) White Paper on Information and Communications (2021). In 2018, the Ministry of Economy, Trade and Industry (METI) published the Guidelines for Promoting Digital Transformation, which reframed DX from an abstract concept representing broad societal change into a concrete set of initiatives that firms are expected to undertake. Although definitions of “digital transformation” currently used in practice are not entirely consistent and vary across individuals and contexts (Shiotani & Onozaki, 2021), the definition of DX in MIC white paper follows its definition in the “Declaration to be the World’s Most Advanced IT Nation - Basic Plan for the Advancement of Public and Private Sector Data Utilization”.

According to this framework, digital transformation refers to the creation and flexible adaptation of new business models through the use of emerging digital technologies to achieve future growth and enhance competitiveness. It involves firms responding to dramatic changes in the external ecosystem—such as customers and markets—while driving transformation within the internal ecosystem, including organizational structures, corporate culture, and employees. By leveraging the third platform—namely cloud computing, mobility, big data and analytics, and social technologies—firms create value and establish competitive advantage by transforming

customer experiences in both digital and physical domains through new products, services, and innovative business models.

Similarly to digital transformation, the broader concept of digitalization encompasses the related notions of digitization and digitalization. The United Nations Development Programme (UNDP) defines these concepts as follows: digitization refers to the conversion of physical or analog information into digital formats, such as the automation of paper-based processes, while digitalization denotes the comprehensive transformation of an organization's business model to create improved ways of delivering services to clients and partners.

In other words, digitization refers to the introduction of digital tools to improve efficiency in specific processes within a firm, whereas digitalization involves transforming entire processes by incorporating digital technologies not only within the organization but also across the external environment and business strategy. In contrast, DX denotes initiatives that seek to reshape social institutions and organizational culture through the provision of new products and services and the development of new business models enabled by digital technologies. Past informatization/digitalization that have been implemented by enterprises (simple labor saving, automation, efficiency improvement or optimization using digital technologies) are far from DX. DX is a reform to create new values while breaking stereotypes in response to radical changes of society. We need to pay attention to the point that DX is a means for the enterprise to achieve specific goals and not the purpose itself.

2.2 Regional digital transformation in Japan: municipal DX and community DX¹

The Ministry of Internal Affairs and Communications (MIC) promotes regional DX from both the perspectives of “municipal DX” and “community DX”. Municipal DX refers to efforts to improve residents' convenience and enhance administrative efficiency through measures such as the digitalization of administrative procedures and data integration within local governments. Community DX, by contrast, aims to address regional challenges by leveraging digital technologies.

As key initiatives related to regional DX, the MIC emphasizes (i) securing and developing digital human resources and (ii) establishing DX promotion frameworks

¹ https://www.soumu.go.jp/denshijiti/digital_transformation.html

through prefecture–municipality collaboration. Regarding the securing and development of digital human resources, strengthening digital capacity within local governments has become an urgent priority for advancing regional DX. Accordingly, the Municipal DX Promotion Plan explicitly includes provisions for the recruitment and development of human resources².

Regarding DX promotion frameworks through prefecture–municipality collaboration, amid a nationwide shortage of digital professionals in both the public and private sectors, many small municipalities face substantial challenges in advancing DX, often relying on only a limited number of staff to manage all DX-related initiatives. To ensure steady progress in these municipalities, it is essential to establish collaborative promotion frameworks in which prefectural governments actively support municipal DX efforts, including through the recruitment, training, and sharing of digital personnel.

In the “Priority Plan for the Realization of a Digital Society” approved by the Cabinet on June 13, 2025, measures were included to strengthen the MIC’s support so that all prefectures can collaborate with municipalities and develop human resource pools to provide DX-related assistance in response to municipal needs³.

Regarding key initiatives related to municipal DX, a broad range of reforms aimed at modernizing local administration have been implemented. These include the implementation of the Municipal DX Promotion Plan, front-office reforms to enhance citizen-facing services, the standardization and integration of local government information systems, the promotion of the My Number system and My Number Card usage, strengthened cybersecurity measures, the adoption of AI and RPA technologies, the digitalization of public fund collection through eLTAX, and the expansion of telework within municipal administrations.

With regard to DX at the community level (community DX), the MIC has established a portal website to disseminate information on advanced ICT-based solutions for addressing local challenges, targeted at local governments and private-sector stakeholders, as well as on support programs provided by the MIC. In addition, reference collections of case studies on the digitalization of local communities have been developed

² https://www.soumu.go.jp/main_content/001053408.pdf

³ https://www.digital.go.jp/assets/contents/node/basic_page/field_ref_resources/5ecac8cc-50f1-4168-b989-2bcaabffe870/cd4e0324/20250613_policies_priority_outline_03.pdf

to showcase practical implementation examples.

2.3 Institutional framework and national policies for digital transformation in Japan

2.3.1 Basic Act on the Formation of a Digital Society⁴

The Basic Act on the Formation of a Digital Society was enacted in recognition of the fact that building a digital society is essential for strengthening Japan's international competitiveness, enhancing citizens' convenience, and addressing pressing national challenges, including rapid population aging and declining birth rate. The Act establishes the fundamental principles and basic policy directions for promoting DX, clarifies the responsibilities of the national government, local governments, and private entities, and provides for the establishment of the Digital Agency as well as the formulation of a Priority Plan for the Formation of a Digital Society. Through these measures, the Act aims to promote DX in a swift and strategic manner, thereby contributing to the sustainable and sound development of the Japanese economy and the realization of citizens' well-being.

2.3.2 The Vision for a Digital Garden City Nation⁵

The Vision for a Digital Garden City Nation is a vision that "aims to resolve the issues faced by rural areas through digital implementation, realizing a fulfilling life where everyone can enjoy the benefits of digitalization without anyone being left behind." It seeks to create vibrant and attractive regions that preserve local richness while offering levels of convenience and appeal comparable to, or distinct from, those of urban areas. Specifically, the initiative promotes the creation of new digital-enabled services and collaborative business models across domains such as daily life and local industries, with the goal of delivering the benefits of digitalization to residents in regional communities.

2.4 Regional DX Acceleration Lab⁶

In line with Japan's vision for "Society 5.0", DX is expected to extend beyond individual firms to encompass entire local communities through the diffusion of digital technologies and the strengthening of regional competitiveness. Against this backdrop, the Ministry of

⁴ https://laws.e-gov.go.jp/law/503AC0000000035?occasion_date=20250401

⁵ https://www.digital.go.jp/policies/digital_garden_city_nation

⁶ https://local-iot-lab.ipa.go.jp/dx_acceleration_lab/

Economy, Trade and Industry (METI) and the Information-technology Promotion Agency (IPA) established the Regional DX Acceleration Lab to accelerate regional DX initiatives. According to the official guidelines for the Regional DX Acceleration Lab, the outline of the initiative is as follows:

(1) Purpose

In the era of “Society 5.0”, the future society envisioned by Japan, digital technologies are expected to be widely disseminated and embedded throughout regional communities. Beyond firm-level transformation, DX is anticipated to be realized across entire regional ecosystems, thereby strengthening the competitive advantage of regional industries and enterprises.

Small and medium-sized enterprises (SMEs) and mid-sized firms form the backbone of the Japanese economy, accounting for 99.7% of all firms, approximately 70% of employment, and more than 50% of value added. For these firms, DX is indispensable for survival and sustainable growth. However, in many regions, industries and SMEs face significant bottlenecks—particularly shortages of human resources, information, and financial capital—which hinder their understanding and effective utilization of digital technologies. As a result, it is often difficult for firms to promote DX independently, and external organizational and professional support is required.

In light of these challenges, the Ministry of Economy, Trade and Industry (METI) and the Information-technology Promotion Agency, Japan (IPA) institutionalized the “Regional DX Acceleration Lab” initiative to accelerate regional DX efforts nationwide. The selected labs are expected to function as regional facilitators that promote collaboration among support organizations. Through these activities, the program aims to generate a virtuous cycle leading to the sustainable development of regional economies. Selected Regional DX Acceleration Labs are eligible—upon request—for the following forms of support:

- ✓ Authorization to use the official “Regional DX Acceleration Lab” mark
- ✓ Public relations support through the official portal site and lab-related events
- ✓ Dispatch of mentors to assist in the realization and development of regional projects and enterprises
- ✓ Opportunities to network with other Regional DX Acceleration Labs and key regional stakeholders across Japan

(2) Secretariat

The initiative is administered by the Ministry of Economy, Trade and Industry (METI) and the Information-technology Promotion Agency, Japan (IPA).

(3) Selection Criteria and Designation

Initiatives are designated as Regional DX Acceleration Labs if they utilize data and digital technologies to address regional challenges and enhance the competitive advantage of regional industries and firms, based on customer and societal needs, thereby contributing to regional economic development and improvements in well-being.

The following 31 regions were selected as the first cohort of Regional DX Acceleration Labs (in order of application):

Tsuyama City (Okayama Prefecture), Sapporo City (Hokkaido), Kushiro City (Hokkaido), Kitakyushu City (Fukuoka Prefecture), Semboku City (Akita Prefecture), Saitama Prefecture, Tsubame City (Niigata Prefecture), Saga Prefecture, Kitami City (Hokkaido), Gunma Prefecture, Muroran City (Hokkaido), Sendai City (Miyagi Prefecture), Oita Prefecture, Kashiwazaki City (Niigata Prefecture), Tottori Prefecture, Iruma City (Saitama Prefecture), Gifu Prefecture, Ota Ward (Tokyo), Kaga City (Ishikawa Prefecture), Nobeoka City (Miyazaki Prefecture), Kota Town (Aichi Prefecture), Ibaraki Prefecture, Nagaoka City (Niigata Prefecture), Shizuoka Prefecture, Mie Prefecture, Yamagata Prefecture, Hakusan City (Ishikawa Prefecture), Nagano Prefecture, Hakodate City (Hokkaido), Osaka City (Osaka Prefecture), and Ehime Prefecture.

3. Literature review and hypotheses development

3.1 The relationship between well-being and various factors

The relationship between well-being and various factors has been studied for many years. For instance, Chen (2012) identifies a positive relationship between subjective well-being and educational attainment, a finding also supported by Blanchflower and Oswald (2004) and Frey and Stutzer (2000). Other factors that improve subjective well-being include social capital (Helliwell & Putnam, 2004; Portela et al., 2013), membership in organizations (Pichler, 2006), physical and psychological health (Dolan, 2008) and income (Powdthavee, 2010; Headey et al., 2008). Beyond individual and household characteristics, institutional factors have been shown to enhance individual life satisfaction (Frey & Stutzer, 2000; Bjørnskov et al., 2010). Conversely, researchers have

identified macro-level factors that negatively affect well-being, including unemployment (Frey & Stutzer, 2002), higher inflation (Di Tella et al., 2001), and greater income inequality (Alesina et al., 2004).

3.2 The relationship between ICT and well-being

Digital technologies are reshaping daily life and exerting profound influences on both individual and societal well-being. As these technologies become increasingly embedded in everyday activities, it is essential to examine both their positive and negative effects. In the literature, the terms digital technologies and digitalization are generally used to encompass a broad range of digital tools and applications when examining their impacts on well-being. These technologies include, but are not limited to, digital devices (e.g., computers, smartphones, and other IT gadgets), social media, video games, technology-enabled healthcare, artificial intelligence (AI), and the Internet of Things (IoT) (Lee & Žarnic, 2024).

Several previous studies have shown that digitalization and ICT can have many positive impacts on well-being (Nie et al., 2021; Sims et al., 2017; Ganju et al., 2015). For instance, Sansovini and Magida (2025) demonstrated a positive correlation between technology acceptance and employee well-being and mental health. Similarly, Maiti and Awasthi (2020) construct an index of ICT exposure and find that greater ICT penetration improves aggregate well-being outcomes. Nevertheless, the relationship between Internet use and well-being remains inconclusive and highly heterogeneous, depending on life domains, individual characteristics, and the purpose and application types of Internet use (Bartikowski et al., 2018; Castellacci & Tveito, 2018; Coleman et al., 2015).

Other studies have shown that the use of digital technologies and ICT can adversely affect well-being. Digital technologies in organizational contexts have been linked to stress, technostress, anxiety, strain, and burnout (Salanova et al., 2014). Pfaffinger et al. (2022) further show that ICT-enabled constant connectivity blurs the boundaries between work and private life, making psychological detachment and recovery more difficult. Consistent with these findings, intensive Internet use is associated with lower levels of subjective well-being (Nie et al., 2017), and excessive social media use has also been found to negatively affect well-being (Büchi et al., 2019).

Some other studies point to more complex and context-dependent effects of digital technologies. For example, Nazareno and Schiff (2021) find that automation and

AI adoption are associated with lower stress levels but adverse health outcomes and mixed effects on job satisfaction. Similarly, Valtonen et al. (2025) show that AI adoption does not directly influence employee well-being but affects it indirectly through work-related factors such as task optimization and workplace safety.

Beyond individual ICT usage, recent studies have begun to examine broader processes of digitalization and DX at the organizational, regional, and societal levels. Unlike narrow technology adoption, DX involves the comprehensive integration of digital technologies into economic and social systems, reshaping service delivery, institutional efficiency, and social interactions (Stolterman & Fors, 2004; Verhoef et al., 2021). Emerging evidence suggests that such systemic digitalization may enhance well-being through improved public service accessibility, enhanced labor market efficiency, and greater institutional trust (Kiviaho & Einolander, 2023; Li et al., 2023; Rui et al., 2026).

However, empirical research directly linking regional DX to well-being remains limited. One notable exception is Zhao et al. (2024), who construct a regional DX index—covering infrastructure, application, platform development, and digital penetration—and find a U-shaped relationship between DX and employment quality, with initial negative effects followed by sustained improvements over time. Given this gap, it remains unclear whether and to what extent regional DX initiatives translate into improvements in individual well-being. Addressing this question is particularly important in the context of Japan, where regional DX is expected not only to promote economic development but also to improve residents' well-being.

3.3 Hypotheses development

Regional DX is expected to influence individual well-being through several interconnected channels. By digitalizing public administration, expanding digital infrastructure, and promoting the adoption of digital technologies across communities, regional DX can reduce transaction costs, improve access to information and services, and enhance labor market matching. These changes may increase economic opportunities and improve the efficiency and transparency of public service. Moreover, the digitalization of administrative procedures and information services can reduce time costs and uncertainty in daily life while improving individuals' access to public and private services. Such improvements may enhance individuals' perceived control over their life

circumstances and overall living conditions, which are important determinants of subjective well-being. Based on these mechanisms, regional DX is expected to generate positive effects on individuals' overall life satisfaction.

H1. Regional digital transformation improves individuals' overall life satisfaction.

Regional DX may also influence individual well-being through labor market outcomes. The diffusion of digital technologies expands telework opportunities, improves job matching through online platforms, and enhances firm productivity through digital adoption. These developments can improve working conditions, job stability, and wage prospects, particularly in regions previously constrained by geographic disadvantages. As employment quality and income expectations are key determinants of subjective well-being, improvements in digital-enabled labor market functioning are expected to raise individuals' satisfaction with employment conditions and wages. Based on these mechanisms, regional DX is expected to improve individuals' satisfaction with employment conditions and wages.

H2. Regional digital transformation improves individuals' satisfaction with employment conditions and wages.

Regional DX can enhance households' economic security through multiple channels. Improvements in digital public services and administrative efficiency reduce transaction costs and uncertainty in accessing social benefits, tax services, and employment-related information, thereby strengthening households' financial stability. Moreover, regional DX may foster local economic development and productivity, contributing to more stable income opportunities and improved asset accumulation. These improvements are expected to increase individuals' satisfaction with their household income and assets. Based on these mechanisms, regional digital transformation is expected to improve individuals' satisfaction with household income and assets.

H3. Regional digital transformation improves individuals' satisfaction with household income and assets.

Finally, regional DX is expected to influence institutional trust and perceptions of governance quality. The digitalization of public services enhances transparency, accountability, and responsiveness of local governments, while streamlined

administrative procedures reduce bureaucratic burdens and improve the efficiency of public service. Improved access to legal and administrative information also strengthens individuals' confidence in political and judicial institutions. As trust in public institutions is a key component of subjective well-being and social cohesion, improvements in digital governance are expected to increase individuals' confidence in political, administrative, and judicial institutions. Based on these mechanisms, regional digital transformation is expected to strengthen individuals' trust in political, administrative, and judicial institutions.

H4. Regional digital transformation improves individuals' satisfaction with trust in politics, administration, and judiciary.

4. Methodology

4.1 Data

This study uses panel data from the 2021–2024 waves of the Survey on Satisfaction and Quality of Life⁷ conducted by the Cabinet Office of Japan. The survey aims to capture the structure of Japan's economy and society from the perspective of individuals' satisfaction (well-being) and to inform policy design and evaluation. It targets registered internet panel monitors aged 15 to 89 residing in Japan and has been conducted annually since 2019. While the first and second waves drew on different samples, the survey has followed a longitudinal panel design from the third wave (2021) onward. Information on the first cohort of the Regional DX Acceleration Lab, consisting of 31 municipalities, is collected from the official website of the Ministry of Economy, Trade and Industry (METI)⁸. Data on municipal DX are obtained from the Survey on the Promotion of Administrative Informatization in Local Governments conducted annually by the Ministry of Internal Affairs and Communications (MIC)⁹.

⁷ The data for this secondary analysis, “Survey on Satisfaction and Quality of Life, 2021-2024 (Cabinet Office)” was provided by the Social Science Japan Data Archive, Center for Social Research and Data Archives, Institute of Social Science, The University of Tokyo.

⁸ <https://www.meti.go.jp/press/2023/04/20230404001/20230404001.html>

⁹ https://www.soumu.go.jp/denshijiti/060213_02.html No official English version is available; all translations are by the author.

4.2 Variables

The dependent variable is life satisfaction. Life satisfaction was measured on an 11-point scale from 1 (0 points) to 11 (10 points) using the questionnaire item: “Overall, how satisfied are you with your current life? If 0 indicates ‘not at all satisfied’ and 10 indicates ‘very satisfied,’ what score would you give?”

The key independent variables capture prefecture-level DX promotion policies, including exposure to the Regional DX Acceleration Lab policy, the establishment of cross-governmental DX governance frameworks, and the implementation of comprehensive DX policies. Exposure to the Regional DX Acceleration Lab policy is measured by a dummy variable equal to one if either the prefecture itself or at least one municipality within a prefecture was designated as a DX Lab site after 2023, and zero otherwise. The cross-governmental DX governance framework¹⁰ is proxied by the number of municipalities within a prefecture that have introduced cross-governmental DX coordination frameworks. The comprehensive DX policy is measured by the number of municipalities within a prefecture that have formulated comprehensive DX policy plans.

The selection of control variables is informed by the existing literature on the determinants of well-being (Blanchflower & Oswald, 2004; Dolan et al., 2008; Piao et al., 2021). Control variables include age, gender, years of education, marital status, employment status, income level category, and asset level category.

Table 1 Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Satisfaction (Dependent variables)					
Overall life satisfaction	36,382	6.802	2.351	1	11
Satisfaction with employment conditions and wages	36,382	5.823	2.217	1	11
Satisfaction with work–life balance	36,382	6.375	2.135	1	11
Satisfaction with household income and assets	36,382	5.921	2.333	1	11
Satisfaction with trust in politics, administration, judiciary	36,382	5.395	2.161	1	11
DX promotion (Independent variables)					

¹⁰ A governance structure for promoting DX in which, under the leadership and internal management of the governor and vice governor at the prefectural level, and the mayor and deputy mayor at the municipal level, all departments coordinate and collaborate across the organization (e.g., the establishment of a DX promotion headquarters or interdepartmental coordination councils).

Treated (Regional DX Acceleration Lab)	36,382	0.301	0.459	0	1
DID (Regional DX Acceleration Lab \times Post)	36,382	0.140	0.347	0	1
Government-wide framework to promote DX	36,382	21.907	15.088	2	102
Comprehensive policy for promoting DX	36,382	16.686	12.080	0	73
Individual characteristics					
Age	36,382	43.055	16.983	15	89
Gender	36,382	1.503	0.500	1	2
Years of education	36,382	14.334	2.022	9	18
Marital status	36,382	0.521	0.500	0	1
Employment status	36,382	1.520	0.825	1	3
Income category (five levels)	36,382	3.243	1.100	1	5
Asset category (six levels)	36,382	3.202	1.758	1	6

4.3 Estimation strategy

To examine the effect of regional DX on individuals' well-being, this study adopts two baseline empirical models. First, it employs a two-way fixed-effects (TWFE) difference-in-differences (DID) approach to estimate the effect of the Regional DX Acceleration Lab policy by comparing pre- and post-treatment outcomes across treated and untreated prefectures. Ideally, the Regional DX Acceleration Labs and non-Labs should be randomly selected, so the policy effect can be estimated through Equation (1):

$$LifeSatisfaction_{ijt} = \beta_0 + \beta_1(DX_lab_j \times Post_t) + \beta'X_{it} + \mu_i + \gamma_t + \varepsilon_{ijt}, \quad (1)$$

where $LifeSatisfaction_{ijt}$ denotes life satisfaction of individual i residing in prefecture j in year t , DX_lab_j is a treatment indicator equal to one if prefecture j contains at least one municipality designated as a Regional DX Acceleration Lab and $Post$ denotes the post-policy period. X_{it} denotes a set of control variables including age, gender, years of education, marital status, employment status, income level category, and asset level category. μ_i is individual fixed effect, γ_t is year fixed effect, and ε_{ijt} is an idiosyncratic error term. β_1 is the estimated coefficient.

However, in reality, the selection of policy targets is often not random. Likewise, a potential concern is that the designation of Regional DX Acceleration Lab municipalities is unlikely to be random. Municipalities selected for the program may

systematically differ from non-selected ones in terms of administrative capacity, fiscal resources, existing digital infrastructure, and political commitment to innovation. These characteristics may also be correlated with residents' well-being levels and trends, raising concerns about selection bias and reverse causality.

While the TWFE-DID framework controls for time-invariant individual heterogeneity and common macroeconomic shocks, differential pre-treatment trends across prefectures may still bias the estimates. To address this concern, this study examines the parallel trends assumption using event-study specifications. The validity of the DID estimator relies on the parallel trends assumption—that, in the absence of the Regional DX Acceleration Lab policy, outcome trends in treated and control prefectures would have followed similar trajectories prior to the policy implementation. This study assesses this assumption through an event-study design.

It should be noted that the Regional DX Acceleration Lab policy was primarily implemented at the municipal level, although a subset of selected labs operated at the prefectural level (e.g., Saitama, Mie, and Ehime). In the empirical analysis, a prefecture is defined as treated if at least one municipality within the prefecture was selected as a DX Lab site in 2023. Accordingly, the treatment variable captures prefecture-level exposure to the policy, while the outcome is measured at the individual level. This definition allows for potential spillover effects through administrative coordination and diffusion of digital practices across municipalities within the same prefecture.

Second, this study employs the two-way fixed-effect (TWFE) model to analyze the effects of regional DX, measured by the number of municipalities having framework and comprehensive policy for promoting DX.

$$LifeSatisfaction_{ijt} = \beta_0 + \beta_1 Municipal_DX_{jt} + \beta' X_{it} + \mu_i + \gamma_t + \varepsilon_{ijt}, \quad (2)$$

where $Municipal_DX_{jt}$ captures the intensity of DX initiatives at the prefecture level, proxied by the number of municipalities implementing DX-related institutional frameworks and policy strategies.

The model specified in Equation (2) is a linear fixed-effects model. A large body of research treats subjective well-being measures—typically recorded on continuous scales such as 0–10—as approximately cardinal and estimates them using ordinary least

squares (OLS) (e.g., Di Tella et al., 2001; Gray et al., 2021; Luttmer, 2005; Stevenson & Wolfers, 2008). Linear probability models are also commonly applied in the empirical literature, particularly when happiness or life satisfaction measures are dichotomized or modeled in terms of category-specific outcome probabilities (e.g., Natali, et al., 2018; Zhang et al., 2025). To account for the ordinal nature of the well-being measures, this study additionally estimates a fixed-effects ordered logit model in Section 5.2 as a robustness check.

5. Empirical results

5.1 Baseline results

Table 2 reports the baseline TWFE DID estimates of the effects of the Regional DX Acceleration Lab policy on individuals' well-being, measured by life satisfaction. The coefficient on the interaction term (DX Lab×Post) is positive but statistically insignificant, suggesting that the policy does not have a discernible effect on residents' life satisfaction. One possible explanation for the statistically insignificant baseline effect is the timing of the policy implementation. The first cohort of the Regional DX Acceleration Lab policy was selected in 2023. Although the policy aims to promote regional economic development and improve well-being through the use of data and digital technologies, it is likely that such initiatives require time before their effects materialize. In other words, there may be a time lag between policy adoption and observable improvements in individuals' life satisfaction.

Table 2 Baseline TWFE DID Results

VARIABLES	(1) Life satisfaction
DX Lab×Post (DID)	0.056 (0.039)
Age	-0.058 (0.066)
Age_sq	0.047 (0.031)
Edu_years	0.019

	(0.030)
Married	0.338***
	(0.085)
Student	0.296**
	(0.122)
Not employed	-0.128*
	(0.067)
1-3 million income	0.115
	(0.088)
3-5 million income	0.143
	(0.087)
5-10 million income	0.224**
	(0.095)
10 million and more income	0.273**
	(0.105)
1-3 million asset	0.093*
	(0.046)
3-5 million asset	0.109**
	(0.052)
5-10 million asset	0.130**
	(0.055)
10-20 million asset	0.116*
	(0.061)
20 million and more asset	0.164**
	(0.072)
Constant	7.608**
	(2.859)
Observations	25,530
R-squared	0.828
Individual FE	Yes
Year FE	Yes
Clustered by	panelid & pref

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 3 reports the baseline TWFE estimates of the effects of regional DX on individuals' well-being, measured by life satisfaction. Regional DX is proxied by the number of municipalities with a government-wide DX framework and a comprehensive DX policy. The coefficient on the Gov-wide DX Framework is positive and statistically significant at the 5% level in column (1), suggesting that the presence of a government-wide DX framework is associated with a discernible increase in residents' life satisfaction. Similarly, the coefficient on the Comprehensive DX Policy is positive and statistically significant at the 10% level in column (2), indicating that the adoption of a comprehensive DX policy is associated with higher life satisfaction.

The positive association between regional DX and individuals' life satisfaction can be interpreted through several potential channels. First, the advancement of digitalization in local governments is likely to reduce residents' time costs and psychological burdens by simplifying administrative procedures, such as online applications, one-stop services, and digitalized consultations. Second, regional DX may improve access to essential public services, including healthcare, long-term care, childcare support, and disaster-related information. These improvements in service efficiency, service accessibility, and perceived security are likely to translate into higher levels of life satisfaction. Finally, measuring regional DX by the number of municipalities adopting digital governance frameworks and comprehensive DX policies captures not only individual municipal efforts but also broader regional spillover effects. As administrative systems become increasingly standardized and interconnected across municipalities, residents and businesses operating across local borders may benefit from more seamless public services. These regional externalities can amplify the welfare gains from DX beyond single jurisdictions, making improvements in life satisfaction more pronounced at the regional level.

Table 3 Baseline TWFE Results

VARIABLES	(1)	(2)
	Life satisfaction	
Gov-wide DX framework	0.003** (0.002)	
Comprehensive DX policy		0.003*

		(0.002)
Age	-0.058	-0.059
	(0.066)	(0.066)
Age_sq	0.047	0.048
	(0.031)	(0.031)
Edu_years	0.019	0.019
	(0.030)	(0.030)
Married	0.339***	0.339***
	(0.085)	(0.085)
Student	0.302**	0.301**
	(0.123)	(0.122)
Not employed	-0.128*	-0.129*
	(0.067)	(0.067)
1-3 million income	0.117	0.117
	(0.088)	(0.088)
3-5 million income	0.144	0.144
	(0.087)	(0.087)
5-10 million income	0.225**	0.225**
	(0.095)	(0.095)
10 million and more income	0.274**	0.276**
	(0.105)	(0.105)
1-3 million asset	0.093*	0.093*
	(0.046)	(0.046)
3-5 million asset	0.109**	0.109**
	(0.052)	(0.052)
5-10 million asset	0.129**	0.130**
	(0.056)	(0.056)
10-20 million asset	0.116*	0.116*
	(0.061)	(0.061)
20 million and more asset	0.166**	0.165**
	(0.072)	(0.072)
Constant	7.449**	7.517***
	(2.771)	(2.778)

Observations	25,530	25,530
R-squared	0.828	0.828
Individual FE	Yes	Yes
Year FE	Yes	Yes
Clustered by	panelid & pref	panelid & pref

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

5.2 Results of robustness checks

Psychologists and sociologists typically treat happiness scores as cardinal and comparable across respondents, and therefore estimate OLS regressions on levels and changes in happiness. In contrast, economists often assume only ordinal comparability and have primarily relied on ordered latent response models, which do not adequately account for time-invariant individual traits. To address this issue, following Ferrer-i-Carbonell and Frijters (2004), this study employs fixed-effects ordered logit models.

Table 4 presents fixed-effects ordered logit estimates of the effects of regional DX on individuals' life satisfaction. The coefficient on the interaction term (DX Lab×Post) is positive but statistically insignificant, indicating that the Regional DX Acceleration Lab policy does not have a discernible effect on residents' life satisfaction. By contrast, the coefficients on the Gov-wide DX framework and the Comprehensive DX Policy are positive and statistically significant. These results suggest that broader municipal DX initiatives—proxied by the number of municipalities with government-wide DX frameworks and comprehensive DX policies—significantly improve individuals' life satisfaction, consistent with the findings reported in Tables 2 and 3.

Table 4 Results of robustness checks by FE ordered logit models

VARIABLES	(1)	(2)	(3)
	Life satisfaction		
DX Lab×Post (DID)	0.102 (0.0711)		
Gov-wide DX framework		0.00752*** (0.00256)	

Comprehensive DX policy			0.00651** (0.00297)
Age	-0.137 (0.0993)	-0.134 (0.0988)	-0.135 (0.0991)
Age_sq	0.112** (0.0562)	0.111** (0.0563)	0.112** (0.0563)
Edu_years	0.0225 (0.0387)	0.0218 (0.0385)	0.0222 (0.0384)
Married	0.357*** (0.130)	0.360*** (0.130)	0.359*** (0.130)
Student	0.199 (0.186)	0.205 (0.185)	0.201 (0.185)
Not employed	-0.190* (0.0986)	-0.193** (0.0981)	-0.195** (0.0979)
1-3 million income	0.223 (0.140)	0.228 (0.140)	0.228 (0.140)
3-5 million income	0.232 (0.145)	0.235 (0.145)	0.235 (0.145)
5-10 million income	0.365** (0.155)	0.365** (0.155)	0.366** (0.155)
10 million and more income	0.412** (0.170)	0.412** (0.170)	0.416** (0.170)
1-3 million asset	0.182** (0.0734)	0.184** (0.0735)	0.184** (0.0736)
3-5 million asset	0.157* (0.0809)	0.158* (0.0808)	0.157* (0.0811)
5-10 million asset	0.204** (0.0909)	0.204** (0.0910)	0.203** (0.0911)
10-20 million asset	0.186* (0.101)	0.187* (0.101)	0.186* (0.101)
20 million and more asset	0.261** (0.119)	0.262** (0.120)	0.259** (0.120)
Observations	37,553	37,553	37,553
Individual FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Clustered by	Prefecture	Prefecture	Prefecture
Wald chi2	243.9	319.1	373
Log likelihood	-13497	-13495	-13497

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

5.3 Results by heterogeneous group

To further examine heterogeneity in the effects of regional DX on individuals' life satisfaction, this study conducts subsample analyses by age group and educational attainment. This approach is motivated by the expectation that both access to digital services and the channels through which regional DX affects well-being vary systematically across demographic and socioeconomic groups.

From a life-cycle perspective, younger individuals are more likely to benefit from improvements in administrative convenience, digital service usability, and labor-market-related opportunities such as telework and skill-enhancing technologies. Middle-aged individuals, in contrast, often face greater administrative demands related to childcare, education, and, in some cases, eldercare, making reductions in transaction costs and service accessibility particularly relevant for their well-being. For older adults, enhanced access to healthcare services, long-term care coordination, and timely public information through digital platforms may play a central role in improving perceived security and overall life satisfaction.

Educational attainment further shapes individuals' capacity to utilize digital services and benefit from technological innovations. Individuals with higher education levels generally exhibit greater digital literacy and are more capable of adopting new digital tools, potentially allowing them to extract larger economic and convenience gains from DX initiatives. Conversely, individuals with lower educational attainment may face greater barriers to digital access and usage, which could limit the well-being benefits of regional DX or make them more dependent on inclusive and user-friendly public service designs. Examining heterogeneity by educational attainment thus enables an assessment of whether regional DX generates digital dividends or exacerbates digital divides in subjective well-being.

Moreover, differences in digital literacy and the inclusiveness of DX initiatives across age cohorts may further contribute to heterogeneous policy effects. By examining

separate age groups—those aged 40 or younger, 40–60, and 60 and above—this study aims to identify which populations benefit most from municipal DX and to shed light on the underlying mechanisms driving these differences.

5.3.1 Age-group heterogeneity

Table 5 reports heterogeneity in the effects of regional DX across age groups. Columns (1)-(3) show the results of the Regional DX Acceleration Lab policy. The coefficient is positive and statistically significant only among individuals aged 60 and above (Column (3)), while no significant effects are observed for younger or middle-aged groups. This pattern suggests that initiatives implemented through the Regional DX Acceleration Labs to promote local economic development and well-being primarily benefit older residents. A plausible explanation is that digitalization of public services substantially reduces administrative and mobility burdens for elderly individuals, who face higher access costs to healthcare, government offices, and local services. In contrast, younger cohorts, who are already digitally proficient and rely less on public service interactions, experience limited marginal gains in life satisfaction.

Columns (4)-(6) show the results of the government-wide DX framework. The coefficient on the Gov-wide DX framework is positive and statistically significant at the 5% level only among individuals aged 40 or below (Column (4)). The establishment of a comprehensive, cross-departmental framework to promote DX contributes to the diversification and enhancement of contact points between residents and local government (front-office services), as well as to the standardization and integration of municipal information systems. The results suggest that these efforts particularly increase life satisfaction among residents under the age of 40.

Columns (7)-(9) show the results of the comprehensive DX Policy. The coefficient on the Comprehensive DX Policy is insignificant across all age groups. In contrast to the government-wide DX framework, the coefficient on the comprehensive DX policy is less stable across age groups. While the full-sample estimates indicate a weakly positive association with life satisfaction, the age-stratified results show no clear positive effects across age groups.

Table 5 Heterogeneous effects across age groups

	age<40	40<age<60	60<age	age<40	40<age<60	60<age	age<40	40<age<60	60<age
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Life satisfaction								
DX Lab×Post (DID)	-0.120 (0.079)	0.116 (0.071)	0.200*** (0.058)						
Gov-wide DX framework				0.009** (0.004)	-0.004 (0.003)	0.003 (0.003)			
Comprehensive DX policy							0.007 (0.005)	-0.003 (0.003)	0.004 (0.003)
Age	-0.280 (0.229)	-0.388** (0.180)	0.255 (0.249)	-0.286 (0.230)	-0.375** (0.181)	0.241 (0.255)	-0.293 (0.230)	-0.377** (0.181)	0.248 (0.254)
Age_sq	0.193 (0.198)	0.400*** (0.133)	-0.159 (0.155)	0.208 (0.199)	0.393*** (0.134)	-0.150 (0.158)	0.204 (0.199)	0.395*** (0.134)	-0.154 (0.158)
Edu_years	-0.004 (0.044)	0.060 (0.049)	0.003 (0.092)	-0.005 (0.044)	0.060 (0.049)	0.000 (0.092)	-0.005 (0.044)	0.060 (0.049)	0.001 (0.091)
Married	0.310**	0.388**	0.086	0.318**	0.388**	0.088	0.316**	0.389**	0.088

	(0.130)	(0.146)	(0.222)	(0.131)	(0.146)	(0.221)	(0.131)	(0.146)	(0.221)
Student	0.341**	-0.863**	0.271	0.365**	-0.862**	0.341	0.360**	-0.863**	0.333
	(0.139)	(0.360)	(0.829)	(0.140)	(0.359)	(0.819)	(0.140)	(0.362)	(0.818)
Not employed	-0.331***	0.012	-0.066	-0.318***	0.014	-0.062	-0.320***	0.015	-0.062
	(0.114)	(0.108)	(0.101)	(0.114)	(0.109)	(0.101)	(0.114)	(0.108)	(0.101)
1-3 million income	-0.040	0.125	0.239	-0.041	0.124	0.230	-0.038	0.126	0.228
	(0.149)	(0.164)	(0.146)	(0.149)	(0.165)	(0.146)	(0.149)	(0.165)	(0.147)
3-5 million income	-0.001	0.183	0.136	-0.003	0.183	0.128	0.000	0.185	0.128
	(0.162)	(0.161)	(0.144)	(0.162)	(0.162)	(0.146)	(0.162)	(0.162)	(0.146)
5-10 million income	0.099	0.331*	0.160	0.098	0.329*	0.152	0.101	0.331*	0.151
	(0.165)	(0.170)	(0.142)	(0.165)	(0.171)	(0.143)	(0.166)	(0.171)	(0.143)
10 million and more income	0.046	0.540***	0.226	0.041	0.535***	0.215	0.048	0.537***	0.215
	(0.182)	(0.197)	(0.207)	(0.181)	(0.199)	(0.207)	(0.182)	(0.198)	(0.206)
1-3 million asset	0.125*	0.071	0.109	0.129*	0.074	0.108	0.127*	0.074	0.109
	(0.071)	(0.084)	(0.104)	(0.071)	(0.085)	(0.104)	(0.071)	(0.085)	(0.104)
3-5 million asset	0.115	0.090	0.137	0.122	0.094	0.139	0.120	0.093	0.139
	(0.080)	(0.098)	(0.099)	(0.079)	(0.099)	(0.100)	(0.079)	(0.099)	(0.100)
5-10 million asset	0.188**	0.053	0.209*	0.194**	0.055	0.212*	0.192**	0.053	0.212*
	(0.077)	(0.096)	(0.118)	(0.076)	(0.097)	(0.119)	(0.076)	(0.097)	(0.120)
10-20 million asset	0.239**	-0.024	0.186	0.243**	-0.021	0.186	0.240**	-0.022	0.186
	(0.102)	(0.106)	(0.119)	(0.102)	(0.107)	(0.120)	(0.101)	(0.107)	(0.120)

20 million and more									
asset	0.096	0.241**	0.180	0.109	0.247**	0.176	0.102	0.247**	0.176
	(0.149)	(0.115)	(0.124)	(0.150)	(0.115)	(0.125)	(0.150)	(0.116)	(0.125)
Constant	12.912**	14.235**	-2.926	12.542**	13.801**	-2.535	12.828**	13.800**	-2.727
	(6.066)	(6.426)	(10.447)	(5.791)	(6.276)	(10.557)	(5.792)	(6.301)	(10.527)
Observations	9,444	8,639	6807	9,444	8,639	6,807	9,444	8,639	6,807
R-squared	0.786	0.848	0.855	0.786	0.848	0.855	0.786	0.848	0.855
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustered by	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

5.3.2 Educational heterogeneity

Table 6 reports heterogeneity in the effects of regional DX across educational attainment groups. Columns (1)-(3) show the results of the Regional DX Acceleration Lab policy. Although the coefficients are positive across all education groups, none of the estimates are statistically significant, suggesting that the direct welfare effects of the DX Acceleration Lab initiative are not systematically differentiated by educational attainment.

Columns (4)-(6) show the results of the government-wide DX framework. The coefficient is positive and statistically significant at the 5% level for individuals with high school education or below (Column (4)) and for those with university education or above (Column (6)), while no significant effect is observed for the vocational and junior college group. This pattern indicates that the establishment of a comprehensive cross-departmental DX governance structure disproportionately benefits both lower- and higher-educated residents. The framework facilitates the diversification and improvement of resident-government contact points (front-office services) and the integration of municipal information systems, which may reduce transaction costs for less-educated individuals while simultaneously expanding digital service utilization opportunities for highly educated users.

Columns (7)-(9) show the results of the comprehensive DX Policy. The coefficient is positive and statistically significant only among individuals with university education or above (Column (9)). This suggests that comprehensive DX policy may primarily enhance life satisfaction among highly educated residents who are likely to possess greater digital skills and informational capacity to take advantage of newly introduced digital initiatives.

Age	-0.067 (0.067)	0.073 (0.114)	-0.111 (0.121)	-0.065 (0.067)	0.074 (0.115)	-0.109 (0.121)	-0.068 (0.067)	0.075 (0.115)	-0.113 (0.121)
Age_sq	0.047 (0.049)	0.070 (0.079)	0.031 (0.040)	0.049 (0.049)	0.070 (0.080)	0.032 (0.040)	0.048 (0.049)	0.069 (0.080)	0.033 (0.040)
Edu_years	0.003 (0.124)		0.143* (0.079)	0.004 (0.124)		0.142* (0.079)	0.004 (0.124)		0.142* (0.079)
Married	0.427*** (0.156)	0.275* (0.149)	0.333*** (0.120)	0.432*** (0.155)	0.275* (0.149)	0.333*** (0.120)	0.431*** (0.156)	0.275* (0.149)	0.332*** (0.120)
Student	-0.289 (0.429)	-0.091 (0.235)	0.506*** (0.132)	-0.307 (0.428)	-0.090 (0.234)	0.517*** (0.133)	-0.299 (0.429)	-0.090 (0.234)	0.515*** (0.132)
Not employed	-0.205* (0.105)	-0.115 (0.136)	-0.038 (0.101)	-0.208* (0.106)	-0.118 (0.136)	-0.034 (0.101)	-0.207* (0.106)	-0.116 (0.136)	-0.037 (0.101)
1-3 million income	-0.003 (0.144)	0.399* (0.204)	0.134 (0.142)	-0.000 (0.145)	0.401* (0.205)	0.132 (0.142)	-0.001 (0.145)	0.402* (0.204)	0.132 (0.142)
3-5 million income	-0.028 (0.156)	0.384* (0.218)	0.253* (0.129)	-0.026 (0.157)	0.387* (0.219)	0.252* (0.128)	-0.028 (0.156)	0.387* (0.219)	0.252* (0.129)
5-10 million income	0.102 (0.167)	0.485** (0.206)	0.292** (0.137)	0.105 (0.168)	0.490** (0.206)	0.292** (0.136)	0.103 (0.168)	0.488** (0.206)	0.292** (0.136)

10 million and more									
income	0.098 (0.167)	0.406 (0.271)	0.359** (0.141)	0.094 (0.168)	0.413 (0.271)	0.357** (0.141)	0.096 (0.168)	0.413 (0.271)	0.359** (0.141)
1-3 million									
asset	0.035 (0.084)	-0.029 (0.098)	0.195** (0.078)	0.037 (0.085)	-0.031 (0.098)	0.197** (0.078)	0.036 (0.084)	-0.030 (0.099)	0.196** (0.078)
3-5 million									
asset	0.112 (0.095)	-0.003 (0.119)	0.159** (0.076)	0.113 (0.095)	-0.004 (0.120)	0.159** (0.076)	0.112 (0.096)	-0.003 (0.120)	0.159** (0.076)
5-10 million									
asset	0.056 (0.100)	-0.063 (0.113)	0.212** (0.084)	0.055 (0.100)	-0.066 (0.113)	0.213** (0.084)	0.055 (0.100)	-0.064 (0.114)	0.213** (0.084)
10-20									
million asset	-0.008 (0.140)	0.014 (0.128)	0.205** (0.097)	-0.011 (0.141)	0.009 (0.128)	0.208** (0.097)	-0.009 (0.141)	0.011 (0.128)	0.207** (0.097)
20 million and more									
asset	0.015 (0.134)	0.079 (0.150)	0.230* (0.121)	0.013 (0.135)	0.077 (0.150)	0.234* (0.122)	0.014 (0.135)	0.078 (0.150)	0.232* (0.122)
Constant	8.202*** (2.728)	0.986 (3.614)	8.304 (5.378)	7.891*** (2.690)	1.054 (3.593)	7.980 (5.189)	8.088*** (2.700)	1.036 (3.586)	8.158 (5.203)

Observations	7,694	5,569	11,526	7,694	5,569	11,526	7,694	5,569	11,526
R-squared	0.846	0.823	0.823	0.846	0.823	0.823	0.846	0.823	0.823
Individual									
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustered by	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

5.3.3 Parallel trend test

Although the baseline TWFE DID estimates of the effects of the Regional DX Acceleration Lab policy on individuals' life satisfaction presented in Table 2 show statistically insignificant results, Table 7 show that the coefficient is positive and statistically significant among individuals aged 60 and above. Given the statistically significant DID estimates, it is essential to assess the validity of the parallel trends assumption. The DID identification strategy relies on the parallel trends assumption—that, absent the Regional DX Acceleration Lab policy, life satisfaction in treated and control prefectures would have followed similar trends prior to the policy implementation. To assess this assumption, this study conducts an event-study analysis that traces the dynamic effects of the policy around the implementation year and examines whether there are any pre-treatment differences in trends between the two groups. Specifically, we estimate the following event-study specification:

$$LifeSatisfaction_{it} = \alpha + \sum_{l=-2, l \neq -1}^1 d_l \beta_l + X_{it} \gamma + \mu_i + \lambda_t + \varepsilon_{it} \quad (l = -2, 0, 1)$$

where $LifeSatisfaction_{it}$ denotes individual i 's life satisfaction in year t . d_l is defined as $Treated_j \times \mathbb{1}[RelYear_t = l]$, where $Treated_j$ equals one if prefecture j contains at least one municipality designated as a Regional DX Acceleration Lab site. l measures the number of years relative to the policy implementation year, and the year immediately prior to treatment ($l=-1$, corresponding to 2022) is omitted as the reference category. X_{it} includes the same set of time-varying individual controls as in the baseline specification. μ_i denotes individual fixed effects, λ_t denotes year fixed effects, and ε_{it} is an idiosyncratic error term. β is the estimated coefficient.

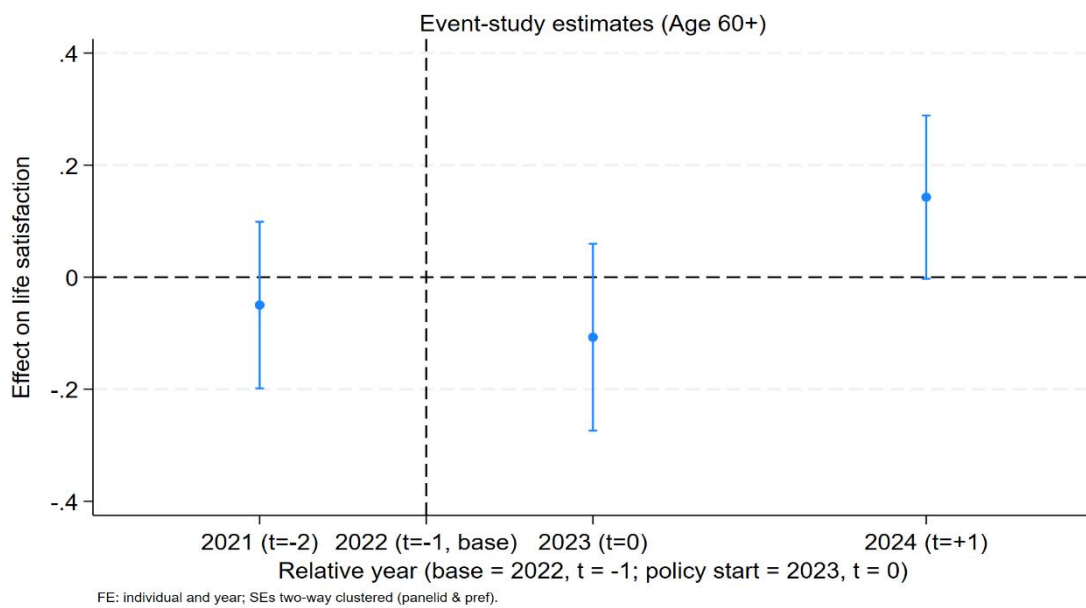
Figure 1 presents the estimated coefficients β_l along with their confidence intervals. The coefficients on the lead term ($l=-2$) is statistically indistinguishable from zero, indicating no evidence of differential pre-treatment trends between treated and control prefectures prior to the introduction of the Regional DX Acceleration Lab policy. This visual evidence supports the validity of the parallel trends assumption underlying the DID framework. This visual evidence is complemented by a formal test of the parallel trends assumption. The F-test fails to reject the null hypothesis that the pre-treatment interaction term is equal to zero ($F = 0.46$, $p = 0.503$), suggesting no statistically

significant pre-trend differences between the two groups. However, because only one pre-treatment period is available, this test provides limited evidence and should be interpreted with caution.

In the implementation year ($l = 0$), the estimated effect is small and statistically insignificant, suggesting no immediate impact of the policy on life satisfaction. In contrast, following the policy implementation in 2024 ($l = 1$), the post-treatment coefficient becomes positive and statistically significant, indicating that the well-being effects of the Regional DX Acceleration Lab policy materialize with a short time lag.

Because the sample includes only one post-treatment period, the event-study estimates primarily reflect short-run effects. Future research with longer follow-up periods will be necessary to assess the persistence and long-term impact of the Regional DX Acceleration Lab policy on individual well-being.

Figure 1 Event-study estimates for individuals aged 60 and above



5.4 Results of potential pathways

Baseline results suggest that the effects on life satisfaction may differ between the Regional DX Acceleration Lab policy and broader municipal DX frameworks and initiatives. As life satisfaction is a multidimensional concept, it is important to examine the channels through which regional DX may improve overall well-being. Although data

limitations prevent a strict causal mediation analysis, this study explores potential mechanisms by employing domain-specific satisfaction measures—namely satisfaction with employment conditions and wages, work–life balance, household income and assets, and trust in political, administrative, and judicial institutions—as outcome variables. By estimating the effect of regional DX on these distinct dimensions, we shed light on the potential pathways linking DX to overall life satisfaction.

Table 7 presents the effects of the Regional DX Acceleration Lab policy on domain-specific satisfaction outcomes. The DID estimates indicate that the regional DX Acceleration Lab policy significantly increases satisfaction with household income and assets, while no statistically significant effects are observed for satisfaction with employment conditions and wages, work–life balance, or trust in political, administrative, and judicial institutions. It is plausible that the Regional DX Acceleration Lab policy fosters expectations of future regional economic development, thereby enhancing individuals’ perceived economic security.

Table 7 Results of potential pathways

VARIABLES	(1) Satisfaction with employment	(2) Satisfaction with work–life balance	(3) Satisfaction with household income and assets	(4) Satisfaction with trust in government
DX Lab×Post (DID)	0.044 (0.043)	0.037 (0.046)	0.079* (0.040)	0.053 (0.042)
Age	0.046 (0.055)	0.022 (0.043)	0.063 (0.048)	0.017 (0.042)
Age_sq	-0.033 (0.034)	-0.012 (0.032)	-0.035 (0.031)	-0.007 (0.032)
Edu_years	0.010 (0.032)	0.011 (0.028)	0.008 (0.023)	0.011 (0.029)
Married	0.224*** (0.083)	0.129 (0.084)	0.054 (0.072)	0.054 (0.085)
Student	0.295** (0.136)	0.242** (0.103)	0.291** (0.123)	0.276** (0.107)

Not employed	-0.320*** (0.073)	-0.272*** (0.066)	-0.108* (0.062)	-0.070 (0.069)
1-3 million income	0.030 (0.088)	0.080 (0.084)	0.073 (0.084)	0.067 (0.072)
3-5 million income	0.112 (0.099)	0.154* (0.088)	0.140 (0.089)	0.099 (0.081)
5-10 million income	0.180* (0.100)	0.193* (0.100)	0.202** (0.086)	0.099 (0.089)
10 million and more income	0.248** (0.115)	0.197 (0.130)	0.238** (0.104)	-0.058 (0.103)
1-3 million asset	0.042 (0.051)	0.090* (0.051)	0.137** (0.052)	0.068 (0.056)
3-5 million asset	0.087 (0.054)	0.127** (0.053)	0.199*** (0.050)	0.131** (0.050)
5-10 million asset	0.112* (0.056)	0.129** (0.061)	0.222*** (0.059)	0.174*** (0.061)
10-20 million asset	0.080 (0.067)	0.128 (0.082)	0.286*** (0.064)	0.112 (0.078)
20 million and more asset	0.069 (0.073)	0.141* (0.076)	0.421*** (0.073)	0.137* (0.078)
Constant	4.046** (1.841)	5.232*** (1.312)	3.348** (1.610)	4.429*** (1.321)
Observations	25,530	25,530	25530	25530
R-squared	0.747	0.739	0.811	0.725
Individual FE	Yes	Yes	Yes	Yes

Year FE	Yes	Yes	Yes	Yes
Clustered by	panelid & pref	panelid & pref	panelid & pref	panelid & pref

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 8 reports the effects of municipal DX frameworks and comprehensive DX policies on domain-specific satisfaction outcomes. The results indicate that the establishment of a government-wide DX framework significantly improves satisfaction with household income and assets, while no significant effects are observed for employment satisfaction or work–life balance. Furthermore, comprehensive DX policies not only enhance satisfaction with household income and assets but also significantly increase trust in political, administrative, and judicial institutions. Taken together, these findings suggest that municipal digital initiatives primarily operate through improvements in perceived economic security. The positive association between comprehensive DX policies and trust in political, administrative, and judicial institutions is consistent with the notion that greater visibility of digital public services and enhanced administrative transparency strengthen citizens’ confidence in public institutions.

Table 8 Results of potential pathways

VARIABLES	(1) Satisfaction with employment	(2)	(3) Satisfaction with work–life balance	(4)	(5) Satisfaction with household income and assets	(6)	(7) Satisfaction with trust in government	(8)
Gov-wide DX framework	0.002 (0.002)		0.002 (0.002)		0.005*** (0.002)		0.003 (0.002)	
Comprehensive DX policy		0.001 (0.002)		0.002 (0.002)		0.004* (0.002)		0.006** (0.003)
Age	0.047 (0.055)	0.046 (0.055)	0.022 (0.043)	0.021 (0.043)	0.064 (0.048)	0.062 (0.048)	0.017 (0.042)	0.016 (0.042)
Age_sq	-0.033 (0.034)	-0.032 (0.034)	-0.012 (0.032)	-0.012 (0.032)	-0.035 (0.031)	-0.034 (0.031)	-0.007 (0.032)	-0.006 (0.033)
Edu_years	0.010 (0.032)	0.010 (0.032)	0.011 (0.028)	0.011 (0.028)	0.009 (0.023)	0.009 (0.023)	0.011 (0.029)	0.011 (0.029)
Married	0.225*** (0.083)	0.224*** (0.083)	0.129 (0.085)	0.130 (0.084)	0.055 (0.072)	0.054 (0.072)	0.055 (0.084)	0.055 (0.085)
Student	0.298** (0.136)	0.296** (0.135)	0.244** (0.103)	0.245** (0.103)	0.299** (0.121)	0.298** (0.121)	0.282** (0.107)	0.285** (0.107)

Not employed	-0.320***	-0.320***	-0.272***	-0.272***	-0.108*	-0.108*	-0.069	-0.069
	(0.074)	(0.074)	(0.065)	(0.066)	(0.062)	(0.062)	(0.069)	(0.069)
1-3 million income	0.031	0.031	0.081	0.082	0.075	0.075	0.068	0.069
	(0.088)	(0.088)	(0.084)	(0.084)	(0.084)	(0.084)	(0.072)	(0.072)
3-5 million income	0.113	0.113	0.154*	0.155*	0.141	0.141	0.099	0.100
	(0.100)	(0.100)	(0.088)	(0.088)	(0.089)	(0.089)	(0.081)	(0.081)
5-10 million income	0.181*	0.181*	0.194*	0.194*	0.203**	0.204**	0.100	0.101
	(0.100)	(0.100)	(0.100)	(0.100)	(0.086)	(0.086)	(0.089)	(0.089)
10 million and more income	0.249**	0.249**	0.198	0.199	0.239**	0.240**	-0.057	-0.055
	(0.115)	(0.115)	(0.130)	(0.130)	(0.104)	(0.104)	(0.103)	(0.103)
1-3 million asset	0.042	0.042	0.090*	0.090*	0.138**	0.137**	0.069	0.069
	(0.052)	(0.052)	(0.051)	(0.051)	(0.052)	(0.052)	(0.056)	(0.056)
3-5 million asset	0.087	0.087	0.127**	0.127**	0.199***	0.199***	0.131**	0.131**
	(0.054)	(0.054)	(0.054)	(0.054)	(0.050)	(0.050)	(0.050)	(0.050)
5-10 million asset	0.112*	0.112*	0.129**	0.129**	0.222***	0.222***	0.174***	0.174***
	(0.056)	(0.056)	(0.061)	(0.061)	(0.059)	(0.059)	(0.061)	(0.061)
10-20 million asset	0.080	0.080	0.128	0.128	0.287***	0.287***	0.112	0.112
	(0.067)	(0.067)	(0.082)	(0.082)	(0.064)	(0.064)	(0.078)	(0.078)
20 million and more asset	0.069	0.069	0.141*	0.141*	0.422***	0.421***	0.138*	0.137*

	(0.073)	(0.073)	(0.076)	(0.076)	(0.073)	(0.073)	(0.079)	(0.079)
Constant	4.004**	4.038**	5.156***	5.187***	3.233**	3.323**	4.315***	4.385***
	(1.808)	(1.799)	(1.292)	(1.291)	(1.577)	(1.578)	(1.296)	(1.307)
Observations	25,530	25530	25,530	25,530	25,530	25,530	25,530	25,530
R-squared	0.747	0.747	0.739	0.739	0.811	0.811	0.725	0.725
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustered by	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref	panelid & pref

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

6. Conclusions

Although mobile Internet and digital technologies have become integral to daily life worldwide, empirical evidence on the effects of ICT and DX—a comprehensive transformation process driven by ICT—on well-being remains limited. While it is theoretically posited that regional DX may influence residents' well-being, empirical evidence specific to the Japanese context is still scarce. Using panel data from the Survey on Satisfaction and Quality of Life, this study examines the effect of regional DX on residents' life satisfaction, which is often applied to measure subjective well-being or happiness (Kubiszewski et al., 2019). This study employs DID methods, as well as FE models, to address potential endogeneity issues.

Three main findings have emerged from this study. First, baseline results indicate that the effects of regional DX on individuals' life satisfaction differ between the Regional DX Acceleration Lab policy and broader municipal DX frameworks and initiatives. More specifically, while the TWFE-DID results of the Regional DX Acceleration Lab policy does not have a significant effect on individuals' life satisfaction, the TWFE results implies that regional DX proxied by the number of municipalities with a government-wide DX framework and a comprehensive DX policy have significantly positive effects on individuals' life satisfaction. Robustness checks by FE ordered logit models have confirmed these conclusions. This study provides the first empirical evidence on the well-being effects of regional DX in Japan. Although there are few studies directly examine the effects of regional DX on individuals' well-being, our results align with previous research on the effects of ICT on well-being conducted in other countries (Maiti & Awasthi, 2020; Nevado-Peña et al., 2019; Zhao et al., 2024).

Second, results by heterogeneous groups reveal that the effect of regional DX varies by age group and educational attainment. More specifically, while the Regional DX Acceleration Lab initiative significantly improves life satisfaction only among individuals aged 60 and above, government-wide DX governance frameworks generate positive effects mainly for individuals aged 40 or below. Differences by educational attainment further reveal uneven distributional impacts. While the DX Acceleration Lab shows no systematic variation across education groups, government-wide DX frameworks benefit both lower- and higher-educated individuals, whereas comprehensive DX policy strategies improve life satisfaction only among highly educated residents.

Overall, these findings suggest that regional DX enhances well-being through distinct policy channels and that more advanced digital initiatives may risk reinforcing well-being inequalities without complementary inclusion measures.

Third, the potential pathway analysis reveals that the mechanisms through which regional DX affects individuals' life satisfaction differ between the Regional DX Acceleration Lab policy and broader municipal DX frameworks and initiatives. Specifically, the DX Acceleration Lab primarily increases satisfaction with household income and assets, which can be interpreted as improvements in perceived economic security. In contrast, insignificant effects are observed for satisfaction with employment conditions and wages or work–life balance, suggesting that expectations of financial stability—rather than direct labor-market outcomes—constitute the main transmission channel of this policy. Broader municipal digital initiatives, by comparison, enhance life satisfaction through improvements in both perceived economic security and trust in politics, administration, and the judiciary. These patterns are consistent with the view that the expansion of digital public services and more efficient administrative processes strengthen institutional confidence and overall governance quality. Overall, the results indicate that regional DX improves individuals' life satisfaction primarily through enhanced financial security and improved perceptions of governance, rather than through immediate changes in employment environments.

These findings yield important policy implications. While the Regional DX Acceleration Lab policy alone may not generate immediate improvements in overall life satisfaction in the short run, prefectural governments can more effectively enhance residents' well-being by encouraging municipalities to establish government-wide DX governance frameworks and implement comprehensive DX strategies that translate digital investments into tangible improvements in public services and institutional performance.

This study is, however, subject to several limitations. First, this study does not fully address the endogeneity issues inherent in the causal relationship between regional DX and residents' life satisfaction. Although the FE specification mitigates time-invariant unobserved heterogeneity—such as stable personality traits—it does not fully eliminate endogeneity concerns. Time-varying unobserved factors and potential reverse causality may still bias the estimated effects. Future research should consider employing alternative

models, such as instrumental variable (IV) method and machine learning method to further investigate the causal relationship. Second, the post-treatment period for the DX Acceleration Lab policy is limited to one year, restricting our ability to capture potential dynamic or long-run effects. DX policies may require time to generate measurable improvements in residents' well-being. Continued data accumulation and longer-term evaluations are therefore necessary to fully assess the sustained impact of regional DX initiatives.

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