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From Algorithmic Reliance to Cash-Centered Resistance: Divergent Digital Survival Strategies of Older Adults in Beijing and Tokyo

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Abstract

Population aging and digitalization are advancing together across East Asia, yet older adults in comparable urban settings develop contrasting digital survival strategies. Using a most-similar-systems design, this exploratory comparative case study examines why older adults in Beijing and Tokyo, despite similar internet penetration and aging rates, differ in digital payments, platform participation, and cash retention. Drawing on secondary data from China (N = 6,117) and Japan (N = 510), we introduce a two-dimensional framework of adoption depth × adoption agency as a fourth level of the digital divide. Beijing exhibits high depth but low agency: cash as primary payment rises from 24.0% (ages 50–59) to 55.9% (60+; odds ratio [OR] = 4.01; Cohen's h = 0.67), and 35.4% of online orders are placed by children. Tokyo exhibits medium depth but high agency: cash use is nearly age-flat (OR = 1.37; h = 0.15), over 90% of older women manage loyalty points, and daily cash use in the 60s fell from 75% to 34% (2018–2024). The between-city age-gradient ratio is approximately 22-fold (a descriptive ratio, not a statistical estimate). We interpret this divergence not as individual deficit but as contrasting ecosystem structures: algorithmic reliance in Beijing versus cash-centered resistance in Tokyo. Findings are generative rather than causal.

Keywords: Digital divide · Older adults · Adoption agency · Digital payment · Cash-centered resistance · Comparative case study

Introduction

Population aging and digitalization are advancing together across East Asia, producing dual transitions that no single discipline fully captures (Selwyn, 2004; van Dijk, 2020). China's population aged 60 and over reached 323 million in 2025 (23.0% of the total) and is projected to exceed 400 million by 2035 (36Kr Research Institute, 2026). In the capital, Beijing, residents aged 60 and over numbered 5.14 million at the end of 2024, or 23.5% of the municipal population, a share that has exceeded the national average by 1.5 percentage points for three consecutive years (Beijing Municipal Government, 2024). Japan, the world's most aged society, reached a 29.3% aging rate in 2024, with 36.24 million people aged 65 and over (Cabinet Office, Japan, 2025). Tokyo alone is home to more than 3.14 million residents aged 65 and above, representing 22.7% of its 13.84 million inhabitants (Tokyo Metropolitan Government, 2024b). These two megalopolises share not only rapid demographic aging but also near-saturated internet infrastructure: the China Internet Network Information Center (CNNIC) reported 1.125 billion netizens and an 80.1% internet penetration rate as of December 2025 (CNNIC, 2026), while approximately 80% of Japanese people in their 60s use smartphones as their primary internet terminal (MIC, 2025).

Despite these surface similarities, the way older adults inhabit the digital economy differs sharply between the two cities. In Beijing, older adults are deeply embedded in all-in-one super-apps such as WeChat and Alipay (Aveni & Roest, 2017; Lutz, 2019) but frequently report feeling unable to control or fully understand the systems they use. National survey data indicate that among those aged 60 and over, only 20.3% meet the threshold for basic digital literacy (CNNIC, 2026), and 35.4% of online orders placed by older adults are operated by their children (China National Committee on Ageing [CNCOA], 2026). In Tokyo, older adults combine high internet use with a persistent preference for cash and a fragmented set of interoperable payment tools that they actively choose. The household finance survey shows that daily cash use among people in their 60s fell from 75% in 2018 to 34% in 2024, approaching the 32% rate of those in their 20s, suggesting that cash is retained not because older adults cannot adapt, but because they prefer it for reasons of privacy, control, and routine (Bagnall et al., 2014). These are not merely two consumer habits; they are two distinct digital survival strategies with different implications for autonomy, dignity, and vulnerability in later life (Connolly, 2023; Singh, 2026).

The digital-divide literature has advanced through three levels: access, skills, and meaningful use (Selwyn, 2004; van Dijk, 2020). A fourth level is increasingly discussed but rarely operationalized: adoption agency, defined here as the capacity of users to understand, choose, contest, and exit digital systems (Connolly, 2023; Lutz, 2019). Existing comparative aging research (Chen & Powell, 2019) tends to measure adoption depth (how much one uses a technology) while neglecting adoption agency (whether one uses it on one's own terms). The result is a blind spot: two users with identical adoption depth can sit at opposite ends of the autonomy spectrum. Understanding why requires attention to how platform market structure conditions user control (Wang et al., 2024; Zuboff, 2019). When a single ecosystem dominates

daily transactions, news, social interaction, and payment, the user's capacity to comprehend, contest, or exit that ecosystem is structurally constrained in ways that adoption-depth metrics cannot detect.

This paper makes three contributions. First, it introduces a two-dimensional framework of adoption depth × adoption agency and uses it to locate Beijing and Tokyo in a 2 × 2 typology that clarifies why identical observable behaviors (e.g., using cash) can carry opposite meanings across ecosystems. Second, it employs a most-similar-systems comparative case design (Przeworski & Teune, 1970; Yin, 2018), which is comparatively rare in aging-technology research and strengthens the interpretability of cross-context differences by holding many confounds constant. Third, it surfaces a striking descriptive finding, a roughly 22-fold difference in the age gradient of cash use between the two cities, as a heuristic for future hypothesis testing. This study also extends emerging work on how digital literacy shapes technology adoption among older adults (Mao et al., 2025) by shifting the analytical question from whether older adults adopt digital tools to the terms on which they do so.

The rest of the article proceeds as follows. The next section situates the study within the literature on the digital divide, aging and technology adoption in East Asia, super-app ecosystems, and the payment behavior of older adults. We then develop the theoretical framework of adoption depth and adoption agency and describe the data sources, measures, and analytical strategy. The results section applies the framework to the two cities, and the discussion weighs the findings against alternative explanations, draws out policy implications, and notes limitations and directions for future research before the concluding section summarizes the argument.

Literature Review

The Digital Divide: From Access to Agency

The concept of the digital divide has evolved through three distinct phases. The first-level divide concerned physical access to information and communication technologies, focusing on gaps in hardware ownership, internet connectivity, and telecommunication infrastructure (Selwyn, 2004; van Dijk, 2020). As access gaps narrowed in most high-income and many middle-income societies, scholarly attention shifted to the second-level divide: disparities in digital skills and in the ability to use technology effectively for meaningful purposes (Hargittai, 2002; van Dijk, 2020). Van Dijk's (2020) resource and appropriation model identified motivational, material, skills, and usage access as cumulative conditions for digital participation, while Selwyn (2004) argued that even skills-based frameworks underestimate the importance of meaningful use, that is, whether individuals can translate access and skills into outcomes they value.

A third level has emerged more recently, concerned with the outcomes and tangible benefits that individuals derive from digital engagement, including economic, social, and health-related gains (Wei & Hindman, 2011). Alongside this trajectory, a growing body of work argues that a fourth level is needed: one centered on agency, the user's capacity to understand, critically evaluate, and exercise control over

digital systems (Connolly, 2023; Lutz, 2019). This fourth level moves beyond questions of whether users can access or use technology to ask whether they can comprehend what systems do with their data, choose among genuine alternatives, contest automated decisions, and exit to non-digital pathways when they wish. Lutz (2019) framed this concern in terms of digital inequalities under artificial intelligence and big data, where algorithmic systems reshape access to information, goods, and services in ways that users may not detect. Connolly (2023) extended the analysis to platformization and algorithmic governance, arguing that the concentration of platform power constrains user sovereignty in structural rather than individual terms.

The fourth-level divide is particularly relevant to older adults because age-related cognitive changes, cohort effects in technology exposure, and cumulative institutional dependencies interact with platform design choices that are typically optimized for younger, more digitally fluent users. Research on Chinese urban populations has documented how the digital divide compounds existing social inequalities, with older adults and rural residents disproportionately affected (Wang et al., 2024). Singh (2026) further noted that digital exclusion among older people is rarely a simple matter of reluctance; it often reflects structural barriers that make full participation difficult even for those who are motivated to engage. Tsai et al. (2019) proposed a four-tier model of older adults' internet adoption that distinguishes among access, skills, usage, and outcomes, providing a useful framework for understanding how the divide deepens at each tier. Neves and Mead (2022) conducted a longitudinal study of older adults' digital inclusion and found that initial adoption did not guarantee sustained engagement, with many participants reverting to non-use over time. Yet most existing instruments measure adoption depth (frequency, breadth, functional coverage) rather than agency, leaving a gap between what the literature argues matters and what it can actually observe.

Aging and Digital Technology in East Asia

Comparative research on aging and digital technology in East Asia remains relatively sparse despite the region's dual leadership in demographic aging and digital innovation. Chen and Powell (2019) provided a historical and comparative study of aging welfare and social policy across East Asian societies, noting that Confucian traditions of familial support interact with modern welfare institutions to produce distinctive patterns of elder care. Their analysis, however, focused on welfare regimes rather than on the digital dimensions of aging. Within China, the 36Kr silver economy report (2026) documented that the silver economy is expanding from basic eldercare services to a comprehensive industrial system encompassing health management, long-term care insurance, smart eldercare technology, and financial services. The report identified smart eldercare, rehabilitation assistive devices, and "aging + industry" integration as emerging growth sectors, with policy support accelerating under the State Council's silver economy guidelines. National life expectancy reached 79.25 years in 2025, up from 77.93 in 2020, extending the period over which older adults interact with digital systems (36Kr Research Institute, 2026).

The Beijing Municipal Government's aging development report (2024) provided detailed context for the present study. In 2024, Beijing operated 577 eldercare institutions with 108,000 beds, 1,540

community eldercare stations, and 2,410 community dining facilities for older adults. The city has also pursued digital integration in eldercare: 92 internet hospitals and 292 medical institutions providing online diagnostic services delivered 1.675 million online consultations in 2024. Family doctor teams numbered 7,262, serving 2.952 million residents aged 65 and over. These figures illustrate that Beijing's aging policy is deeply intertwined with digital infrastructure, even as the question of whether older adults can navigate this infrastructure on their own terms remains largely unexamined. The report also documented Beijing's home-modification subsidy program, which served 40,240 elderly households, and the establishment of rehabilitation assistive device rental networks across 11 districts, initiatives that expand the digital ecosystem but do not necessarily increase the agency of the older adults who are nominally served by it.

On the Japanese side, the Cabinet Office's Annual Report on the Ageing Society (2025) documented that the population aged 75 and over (20.78 million, 16.8% of the total) has overtaken those aged 65–74 (15.47 million, 12.5%) in size, signaling a shift toward advanced aging. Employment rates among those aged 65–69 increased by 13.5 percentage points over the past decade, suggesting sustained social and economic engagement among older Japanese. Healthy life expectancy at birth was 72.57 years for males and 75.45 years for females as of 2022, remaining roughly flat compared with 2019 (Cabinet Office, Japan, 2025). The report also highlighted local initiatives such as Sumida City's community-driven smartphone workshops, where older adults learn digital skills enjoyably with peers, an approach that contrasts with the top-down, platform-driven model prevalent in Beijing. The Ministry of Internal Affairs and Communications (MIC) 2025 White Paper on Information and Communications (2025) reported that approximately 80% of people in their 60s use smartphones as internet terminals, with YouTube usage at approximately 70% for this age group. Smartphone adoption among those in their 60s rose from 24.0% in 2014 to 88.3% in 2024, demonstrating sustained growth in digital access. These adoption figures are high, yet they coexist with a persistent cash preference that the digital-divide literature has rarely engaged with analytically.

Super-App Ecosystems and Platform Market Structure

The concept of the super-app, a single mobile application that integrates messaging, social networking, payment, e-commerce, ride-hailing, food delivery, government services, and more, has become central to understanding digital life in China but less so in Japan. WeChat and Alipay together dominate Beijing's digital ecosystem, concentrating user attention, data, and transaction volume within two platforms whose defaults, data practices, and interface designs shape the user experience in ways that individual users have limited capacity to detect or contest (Wang et al., 2025; Zuboff, 2019). Zuboff (2019) argued that surveillance capitalism operates by extracting behavioral surplus from users without their informed consent, and that the integration of multiple services within a single platform amplifies this extraction by reducing the user's ability to compare, switch, or exit. Research on WeChat's first-party tracking practices (Wang et al., 2025) documented pervasive data collection across browsing, location, payment, and social interaction, with disproportionate impact on users least equipped to detect or understand it.

Aveni and Roest (2017) analyzed how Alipay and WeChat Pay reached rural Chinese users, describing an ecosystem in which network effects, merchant adoption, and government-backed digital infrastructure combined to produce near-universal acceptance of mobile payment. The resulting convenience is substantial and well documented: 937 million network payment users and 937 million online shopping users as of December 2025 (CNNIC, 2026), with digital consumption reaching 9.37 trillion yuan in the first half of 2025 alone (CNNIC, 2025). The CNNIC Digital Consumption Development Report (2025) noted that digital consumption accounted for 46.5% of total consumer expenditure in the first half of 2025, with 958 million users (68.1% of the population) participating in digital consumption. Yet the same concentration that produces convenience also reduces the viability of non-digital alternatives. When merchants default to mobile payment, when government services migrate to super-app mini-programs, and when social interaction is mediated through a single platform, the user's option to exit to cash or to an interoperable alternative becomes nominal rather than substantive.

Tokyo's payment landscape stands in sharp contrast. The Bank of Japan's Payment and Settlement Systems Report (2024) described a fragmented ecosystem of credit cards, prepaid IC cards (Suica, Pasmo), QR code payments (PayPay, LINE Pay), bank transfers, and cash, none of which dominates to the degree that WeChat or Alipay do in China. The Ministry of Economy, Trade and Industry's (METI, 2025) calculation of the 2024 cashless payment ratio confirmed that cashless payments accounted for approximately 39.3% of consumption value nationally, with Tokyo achieving higher rates through urban density and merchant adoption. The Tokyo Metropolitan Government's surveys (Tokyo Metropolitan Government, 2024a, 2025) reported that the cashless ratio reached 62.2% by value and 66.5% by volume in FY2025, with growth across all age bands. This fragmentation is not merely a transitional stage on the way to super-app consolidation; it reflects deliberate regulatory choices to preserve interoperability, open standards, and consumer choice, which in turn sustain the conditions for what we call cash-centered resistance.

Cash, Payment Behavior, and Older Adults

Research on cash use among older adults has historically framed it as a deficit indicator, a sign of reluctance, inability, or exclusion from digital modernity. Bagnall et al. (2014) conducted a cross-country comparison of consumer cash usage using payment diary survey data and found substantial variation in cash reliance across countries, with demographic and institutional factors both contributing to observed patterns. Their work suggested that cash use is not simply a function of individual characteristics but is shaped by the broader payment ecosystem, including merchant acceptance, fee structures, and the availability of alternatives. Zhang and Poon (2021) examined factors determining mobile payment adoption among elderly users in Shandong, China, and identified perceived ease of use, perceived usefulness, and social influence as significant predictors, while noting that a substantial share of older adults remained cash-dependent even when mobile payment was available.

The China National Committee on Ageing (CNCOA) Special Survey on Silver Consumption (2026) provided the most direct evidence for the Beijing side of the present comparison. Conducted in 2025 across 10 provinces, 31 cities, and 56 counties, the survey yielded 6,117 valid responses from individuals aged 50 and over. The sample was 47.8% male and 52.2% female, with 30.6% aged 50–59 and 69.4% aged 60 and over, 71.4% urban and 28.6% rural, and 44.6% reporting good health and 45.3% basic health. The survey found that 24.0% of the 50–59 cohort and 55.9% of those aged 60 and over used cash as their primary payment method. Among those who had engaged in online consumption in the past year, 35.4% had their orders placed by their children, and fewer than 20% could independently operate online services such as food delivery, medical appointment booking, or ticket purchasing. These figures describe a population that is digitally present but not digitally autonomous, embedded in platforms it cannot fully operate without intergenerational assistance.

On the Tokyo side, the Halmek Research Institute survey (2025) of 510 women aged 55–79 found that over 90% actively collected loyalty points and managed their own financial affairs, indicating high engagement with the reward structures of the cashless ecosystem while retaining cash as a deliberate payment choice. The household finance survey, sourced from the public portal “Shiruporuto” (Central Council for Financial Services Information, 2024), tracked daily cash use by age cohort and revealed that those in their 60s reduced cash use from 75% in 2018 to 34% in 2024, a trajectory that converges with, rather than diverges from, younger cohorts. This pattern is difficult to explain through a deficit lens. If cash use among older Tokyo residents were driven by inability, one would expect it to remain high or increase with age, as it does in Beijing. Instead, the flat or declining trajectory suggests that cash is being retained by choice, as part of a strategy that preserves privacy, control, and the option to exit digital systems at will. Gilleard and Jones (2024) argued that the digital dividends available to older adults depend not merely on access but on the institutional arrangements that structure their engagement, a perspective consistent with our finding that the same behavior carries different meaning under different ecosystem configurations.

Theoretical Framework: Adoption Depth and Adoption Agency

We define two orthogonal dimensions that together constitute the analytical core of this study. Adoption depth refers to the intensity and breadth of engagement with digital platforms, operationalized through the frequency of use, the range of functions accessed (payment, social interaction, shopping, government services, entertainment), and the degree to which digital channels have substituted for analog alternatives. A user who pays bills, orders groceries, books medical appointments, chats with family, and reads news through a single super-app exhibits high adoption depth. Adoption agency refers to the user’s capacity to (a) comprehend what a system does with their data and money, (b) choose among genuine alternatives including non-digital ones, (c) contest or correct automated outcomes, and (d) exit to an equivalent analog pathway without meaningful loss of function. Agency is multidimensional and only partly observable through behavioral data; we treat observable payment and platform behaviors as proxies, not as the construct itself, and we return to this limitation in the discussion.

This conceptualization builds on technology-acceptance frameworks for older adults (Chen & Chan, 2014; Venkatesh et al., 2012) but extends them from the question "will older adults adopt?" to the question "on whose terms?" The Senior Technology Acceptance Model (STAM) (Chen & Chan, 2014) and the Unified Theory of Acceptance and Use of Technology (UTAUT2) (Venkatesh et al., 2012) identify perceived ease of use, perceived usefulness, social influence, and facilitating conditions as determinants of adoption intention and behavior. These models predict whether adoption occurs but do not distinguish between adoption that is self-directed and adoption that is delegated, coerced, or structurally constrained. The framework proposed here fills that gap by adding agency as a second dimension, orthogonal to depth, so that two users with identical adoption depth can be located at different positions on the agency axis.

Why agency constitutes a fourth level rather than a facet of the third deserves explicit statement. The third level of the divide asks what outcomes digital engagement produces; adoption agency asks whether that engagement is chosen, understood, and contestable. The two dimensions are logically independent: a user can obtain substantial benefits from platforms operated on her behalf (high outcome, low agency), and a user can make fully informed, autonomous choices while engaging only minimally (low outcome, high agency). van Dijk's (2020) resources-and-appropriation model similarly locates motivational and attitudinal autonomy among the preconditions of meaningful appropriation rather than among its products, and Selwyn's (2004) study of older Australians shows that extensive use can coexist with resignation toward systems users do not control. Treating agency as a separate analytical level therefore captures configurations, most notably Beijing's, that an outcomes-only reading would misclassify as successful inclusion.

Crossing the two dimensions yields four ideal types:

High depth / low agency (algorithmic reliance, Beijing): heavy use of an integrated super-app ecosystem with limited transparent control (Wang et al., 2025; Zuboff, 2019). The user transacts through platforms whose defaults, dark patterns, and data practices weaken comprehension and choice. Cash becomes a marker of exclusion (being outside the mainstream transaction system) rather than a deliberate strategy for preserving autonomy. The 35.4% child-operation rate observed in the CNCOA survey (2026) is a direct behavioral indicator of this cell: the user is present on the platform, but the agency exercised belongs to someone else.

Medium depth / high agency (cash-centered resistance, Tokyo): selective, self-directed use of interoperable tools, with cash retained as a deliberate choice that preserves autonomy and privacy. The user engages with digital platforms where they offer value (loyalty points, convenience) but maintains the option to pay in cash, compare prices across merchants, and exit digital systems without functional loss. The flat age gradient of cash use observed in Tokyo, approximately 1.5 pp per decade, is consistent with this ideal type: cash is not abandoned as people age into digital fluency, nor is it adopted as a deficit fallback.

High depth / high agency (the aspirational state): rich digital engagement with full comprehension and control. The user understands platform data practices, chooses among alternatives (including non-digital ones), can contest automated decisions, and retains a viable exit option. We treat this cell as the normative target for policy and discuss how to approach it. Neither Beijing nor Tokyo currently occupies this cell, though Tokyo is closer on the agency dimension and Beijing is closer on the depth dimension.

Low depth / low agency (marginalization): minimal engagement and minimal control, the classic "left behind" profile (Singh, 2026). The user neither uses digital tools extensively nor exercises control over those they do use. This profile may describe segments of both populations, particularly the oldest-old, but our data do not allow us to locate specific subgroups with precision.

A central methodological commitment follows from this framework: the same observable behavior (here, cash use) can signal opposite underlying constructs in different ecosystems. In Beijing, cash use among those aged 60 and over (55.9% as primary payment) correlates with low digital literacy (20.3%), high child-operation of online services (35.4%), and a super-app ecosystem that structurally reduces the viability of cash. In Tokyo, cash use coexists with high smartphone adoption (approximately 80% in the 60s age group), active loyalty-point management (over 90%), and a fragmented payment landscape in which cash is one of several interoperable options rather than a residual category. We return to this point repeatedly, because it structures both our analysis and our caveats.

Methods

Study Design

We use an exploratory comparative case study of two megalopolises selected by most-similar-systems logic (Przeworski & Teune, 1970; Yin, 2018). Beijing and Tokyo are both affluent, aging, technologically saturated East Asian capitals with universal internet infrastructure, which holds many potential confounds constant and sharpens the contrast attributable to market structure. Przeworski and Teune (1970) argued that most-similar-systems designs are most informative when the systems share enough background conditions that the observed differences can be attributed to the variable of interest, in this case platform market structure, with greater confidence than a comparison of dissimilar systems would allow. Yin (2018) provided the methodological foundation for case study research, emphasizing the value of theory-driven case selection and the use of multiple sources of evidence for triangulation. All data in this study are secondary, drawn from publicly available surveys, administrative reports, and policy documents. No primary data were collected.

Data Sources and Their Limits

We rely on four families of sources, each with distinct strengths and limitations that we disclose candidly.

China. (i) The CNNIC China Internet Development Report 2026 (CNNIC, 2026) and the Digital Consumption Development Report 2025 (CNNIC, 2025) describe 1.125 billion netizens, 30.9 million users aged 60 and over using generative AI tools, and a 20.3% digital-literacy rate among those aged 60 and over. The CNNIC report also documented 937 million network payment users and 937 million online shopping users as of December 2025, as well as 602 million generative AI users nationwide. (ii) The China National Committee on Ageing (CNCOA) Special Survey on Silver Consumption (CNCOA, 2026), N = 6,117, was conducted across 10 provinces, 31 cities, and 56 counties through household questionnaire surveys targeting individuals aged 50 and over. The CNCOA report covered ten consumption domains: functional food and clothing, tourism, health and wellness, cultural and recreational activities, financial products, home modification for aging, smart products, community-based services, education and training, and anti-aging products. The sample was 47.8% male and 52.2% female, with 30.6% aged 50–59 and 69.4% aged 60 and over, 71.4% urban and 28.6% rural.

We disclose at the outset a consequential limitation: the CNCOA report states that it "did not adopt strict probability sampling." The report itself acknowledged this constraint and cautioned users against generalizing its findings to the full national picture without due consideration. We use it because it is the largest available national survey of silver consumption in China, and we triangulate its findings against CNNIC data where possible; we do not treat its estimates as representative in the inferential sense. Beijing-specific demographic data are drawn from the Beijing Municipal Government aging-development report (2024), which provided detailed municipal statistics on population structure, eldercare facilities, digital health services, and silver economy initiatives.

Japan. (i) The Ministry of Internal Affairs and Communications (MIC) White Paper on Information and Communications (2025) reported that approximately 80% of people in their 60s use smartphones as internet connection terminals, with YouTube usage at approximately 70% for this age group and X (formerly Twitter) usage at approximately 50% across all age groups. Smartphone adoption among those in their 60s rose from 24.0% in 2014 to 88.3% in 2024 (MIC, 2024). (ii) The Cabinet Office Annual Report on the Ageing Society FY2025 (Cabinet Office, Japan, 2025) provided national aging context, including the 29.3% aging rate, healthy life expectancy figures (72.57 years for males, 75.45 years for females), employment trends among those aged 65 and over, and the emergence of the 75-and-over population as the largest elderly sub-group. (iii) The Tokyo Metropolitan Government cashless-payment surveys for FY2024 and FY2025 (Tokyo Metropolitan Government, 2024a, 2024b, 2025) provided cashless ratios by age (value and volume) for Tokyo specifically, with FY2024 data showing a 66.9% cashless ratio for those in their 30s and 58.6% for those aged 70 and over, and FY2025 data showing an overall 62.2% value ratio and 66.5% volume ratio. (iv) The Halmek Research Institute Survey on Money Awareness and Reality 2025 (Halmek Research Institute, 2025), N = 510 women aged 55–79, provided data on payment method and loyalty-point behavior, reporting that over 90% of respondents actively collected loyalty points. (v) The household finance survey, sourced from the public portal "Shiruporuto" (Central Council for Financial Services Information, 2024), tracked daily cash use by age cohort and

showed that those in their 60s reduced cash use from 75% (2018) to 34% (2024). National cashless ratios are confirmed by METI (2025) and the Bank of Japan payment-systems report (2024).

Measures

For the Beijing side, we use cash as primary payment (the percentage of respondents reporting cash as their main payment method), from CNCOA (2026). This is an individual-level self-report measure of primary payment behavior. We supplement it with the CNCOA finding that 35.4% of older adults' online orders are placed by their children, which we treat as a direct proxy for delegated agency. For the Tokyo side, we use the cashless payment ratio (share of payment value by age band), from Tokyo Metropolitan Government (TMG) administrative data (Tokyo Metropolitan Government, 2024a, 2024b, 2025). We also draw on the household finance survey's tracking of daily cash use by age cohort, which provides a more granular temporal trend.

We acknowledge a level-of-measurement mismatch: the Beijing indicator is an individual self-report of primary method, whereas the Tokyo indicator is a macro value share. They are not strictly the same quantity. We therefore treat the two cities' cash measures as place-specific constructs (see Construct Comparability and the Dual-Track Check) and avoid claiming exact metric equivalence. As an auxiliary, more directly comparable agency indicator, we use the CNCOA child-operation figure (35.4%) contrasted with Tokyo's high rates of self-directed engagement (over 90% point-collecting among older women (Halmek Research Institute, 2025); approximately 80% internet use among those in their 60s (MIC, 2025)). These indicators are not perfectly parallel either, but they converge on the same interpretation (lower agency in Beijing, higher agency in Tokyo) without relying on the contested cash measure alone.

Analytical Strategy

Throughout, we use the abbreviation pp for percentage points. We compare age gradients in cash use across birth cohorts (50–59 vs. 60+ for Beijing; 20s through 70+ for Tokyo), compute logistic odds ratios (OR) and Cohen's h (1988) effect sizes for the cohort contrast within each city, and take the ratio of the two gradients as a descriptive heuristic. Cohen's h was selected because it is appropriate for comparing proportions across groups of differing sizes and does not assume a common baseline. We report a difference-in-differences (DiD) contrast of the two city gradients as an illustrative summary, not as a causal estimand. All statistics are framed as exploratory description; confidence intervals describe sampling uncertainty under each source's design and are not pooled into a single causal claim. The analytical strategy is explicitly non-causal: we use quantitative heuristics to characterize the magnitude and direction of cross-city divergence, not to estimate treatment effects.

Ethics

This study is a secondary analysis of publicly available, de-identified reports and surveys. No individual-level data were accessed, and no contact with human subjects occurred. The study therefore did

not require institutional review board approval, as it involved no human subjects and relied entirely on publicly available secondary data.

Results

Contextual Backdrop

Figure 1 situates the two cities in context: panel (a) contrasts their total and older-adult populations, panel (b) compares their aging structure (older-adult share and living-alone rate), and panel (c) documents the steep digital-literacy gradient in China between adults aged 60 and over and younger cohorts. This demographic and infrastructural backdrop frames the city-level comparison developed below.

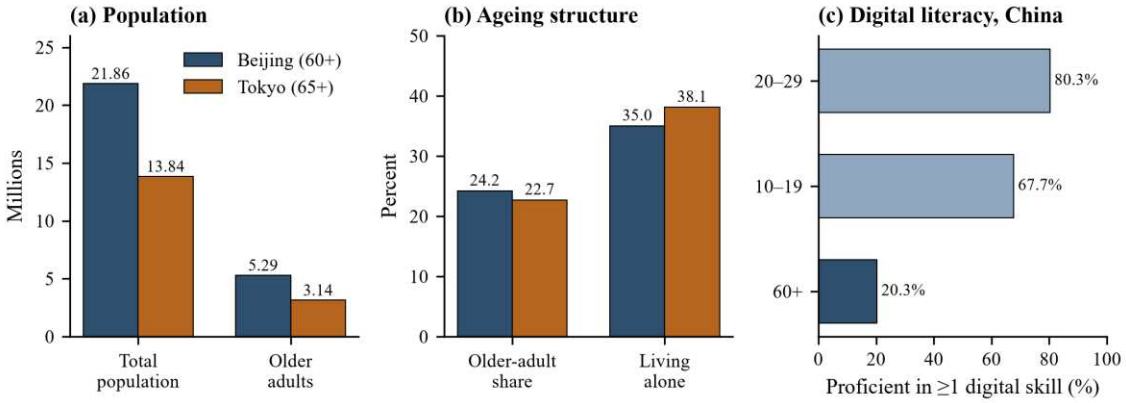


Fig. 1 Contextual comparison of Beijing and Tokyo: (a) total and older-adult populations; (b) aging structure (older-adult share and living-alone rate); (c) the steep digital-literacy gradient in China (60+ vs. younger cohorts)

The two cities can be compared along a complementary set of indicators, summarized in Figure 2, which combines the demographic profile (60+ share, 75+ share, living-alone rate) with digital adoption and payment-behavior indicators.

Figure 1. Demographic and Digital Adoption Comparison: Elderly in Beijing vs. Tokyo

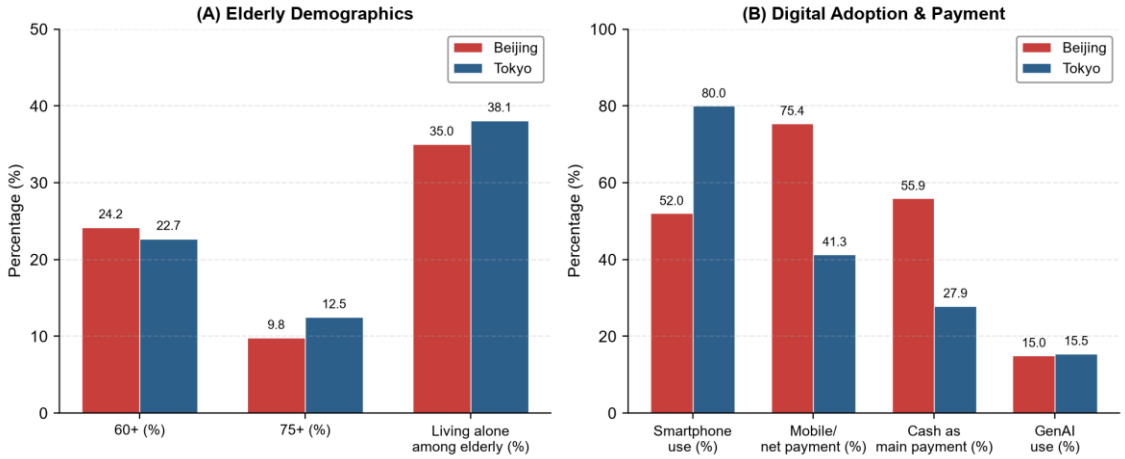


Fig. 2 Demographic and digital adoption comparison: (a) elderly demographics (60+ share, 75+ share, living-alone rate); (b) digital adoption and payment behavior (smartphone use, mobile/net payment, cash as main payment, generative-AI use). Beijing values are drawn from the 2024 Beijing Municipal Committee on Aging report (Beijing Municipal Government, 2024); Tokyo values are from the Tokyo Metropolitan Government FY2024 survey (Tokyo Metropolitan Government, 2024a) and the 2024 White Paper on Information and Communications (MIC, 2025)

Both cities are aging rapidly and are near-saturated in internet infrastructure (ITU, 2024). Beijing's total population stood at 21.832 million at the end of 2024, with 5.14 million residents aged 60 and over (23.5%) and 3.596 million aged 65 and over (16.5%) (Beijing Municipal Government, 2024). Tokyo's population of 13.842 million included 3.138 million aged 65 and over (22.7%) (Tokyo Metropolitan Government, 2024b). Japan's national aging rate of 29.3% (Cabinet Office, Japan, 2025) exceeds China's 23.0% (36Kr Research Institute, 2026), but the two capitals are more closely matched than the national figures suggest, both hovering around the 22–24% range for the older-adult share. The divergence we examine is not in access or demographics but in the configuration of the digital ecosystem: Beijing's ecosystem is dominated by two integrated super-apps (Aveni & Roest, 2017; Lutz, 2019), whereas Tokyo's is fragmented across interoperable cards, bank apps, and cash.

China's digital economy is characterized by extraordinary scale. As of December 2025, the country counted 1.125 billion netizens (80.1% penetration), 937 million network payment users, and 602 million generative AI users (CNNIC, 2026). Digital consumption reached 9.37 trillion yuan in the first half of 2025, representing 46.5% of total consumer expenditure (CNNIC, 2025). Yet within this digital abundance, the digital-literacy rate among those aged 60 and over stood at only 20.3% (CNNIC, 2026), and 30.9 million people in this age group used generative AI tools, a figure that is substantial in absolute terms but represents a small fraction of the 323 million people aged 60 and over nationally (36Kr Research

Institute, 2026). Japan's digital adoption among older adults is higher on a per-capita basis: approximately 80% of people in their 60s use smartphones (MIC, 2025), and YouTube usage among this group reached approximately 70%. The MIC white paper also documented steady growth in smartphone adoption across all age groups, with the rate for those in their 60s rising from 24.0% in 2014 to 88.3% in 2024 (MIC, 2025).

Framework Application

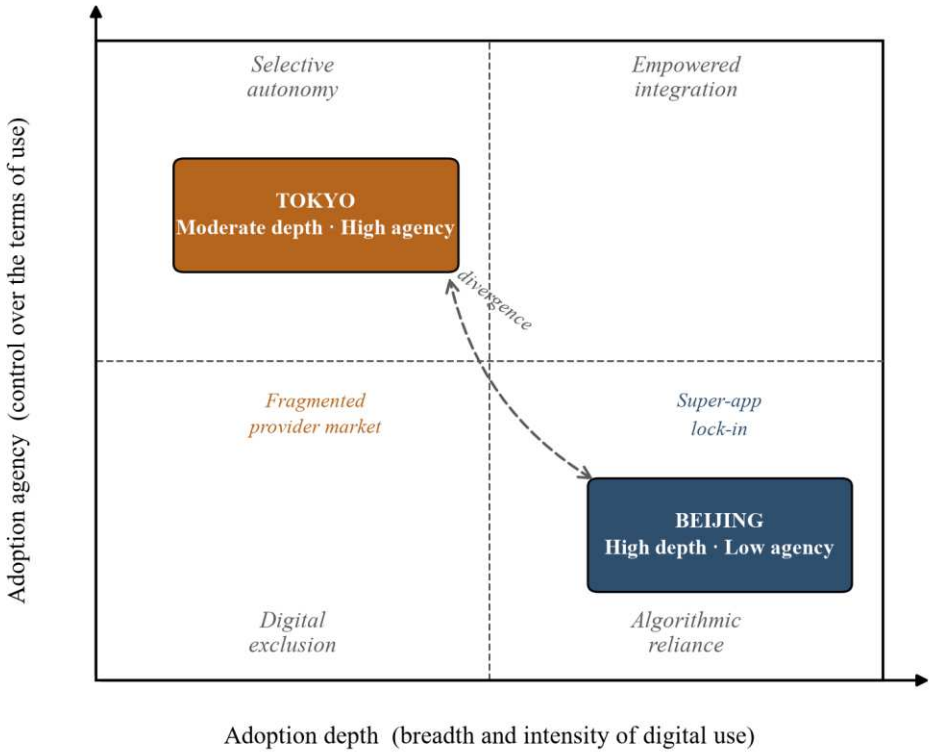


Fig. 3 The adoption depth × adoption agency framework, locating Beijing (high depth / low agency) and Tokyo (medium depth / high agency) and marking the aspirational high/high cell

Figure 3 places Beijing in the algorithmic reliance cell (high depth, low agency) and Tokyo in the cash-centered resistance cell (medium depth, high agency). Beijing's placement on the depth axis is supported by the sheer scale of platform participation: 937 million network payment users, near-universal merchant acceptance of WeChat Pay and Alipay, and the migration of government, healthcare, and transportation services into super-app mini-programs. Its placement on the agency axis is supported by the 20.3% digital-literacy rate among those aged 60 and over, the 35.4% child-operation rate for online orders, and the structural concentration of platform power documented in the surveillance-capitalism literature (Wang et al., 2025; Zuboff, 2019). Tokyo's placement on the depth axis reflects its lower but still

substantial digital engagement: approximately 80% smartphone adoption in the 60s age group, a 62.2% cashless ratio by value in FY2025, and over 90% loyalty-point collection among older women. Its placement on the agency axis reflects the fragmented, interoperable nature of its payment ecosystem, the declining but deliberately retained cash option, and the regulatory commitment to open standards and consumer choice.

The high/high cell remains empty in both cities, an observation with direct policy relevance (see Policy Implications). Neither Beijing nor Tokyo currently offers older adults a combination of rich digital engagement and full comprehension and control. Beijing achieves depth at the cost of agency; Tokyo achieves agency at the cost of some depth. The question for policy is whether the two dimensions can be simultaneously raised, or whether there is an inherent tension between ecosystem concentration and user sovereignty.

Payment Behaviors

Table 1 Primary payment method and cash-centered resistance indicators: Beijing (CNCOA 2026, N = 6,117) vs. Tokyo (TMG FY2024–FY2025; Halmek 2025, N = 510).

Indicator	Beijing (CNCOA 2026, N=6,117)	Tokyo (TMG FY2024–2025; Halmek 2025, N=510)	Source
Cash as primary payment: ages 50–59 (%)	24.0	n/a (no direct equivalent)	(CNCOA, 2026)
Cash as primary payment: ages 60+ (%)	55.9	27.9 (women 55–79)	(CNCOA, 2026; Halmek Research Institute, 2025)
Cashless ratio: 30s (%)	n/a	66.9 (value)	(Tokyo Metropolitan Government, 2024a)
Cashless ratio: 70+ (%)	n/a	58.6 (value)	(Tokyo Metropolitan Government, 2024a)
Cashless ratio: overall (%)	n/a	62.2 (FY2025 value)	(Tokyo Metropolitan Government, 2025)
Daily cash use, 60s: 2018 to 2024 (%)	n/a	75 → 34	(Central Council for Financial Services Information, 2024)

Child-operated online orders (%)	35.4	n/a	(CNCOA, 2026)
Loyalty-point activity, 90%+ (%)	n/a	90+	(Halmek Research Institute, 2025)

Note. Beijing figures are self-reported primary payment method (individual level). Tokyo figures are cashless ratio by payment value (macro level). The two metrics are not strictly equivalent; see the discussion of construct comparability below.

Figure 4 disaggregates this contrast by age band: the share of Beijing respondents naming cash as their primary payment method rises steeply with age, whereas Tokyo's cashless-value share remains largely flat across cohorts. This age-band pattern foreshadows the cohort gradients examined in the sections below.

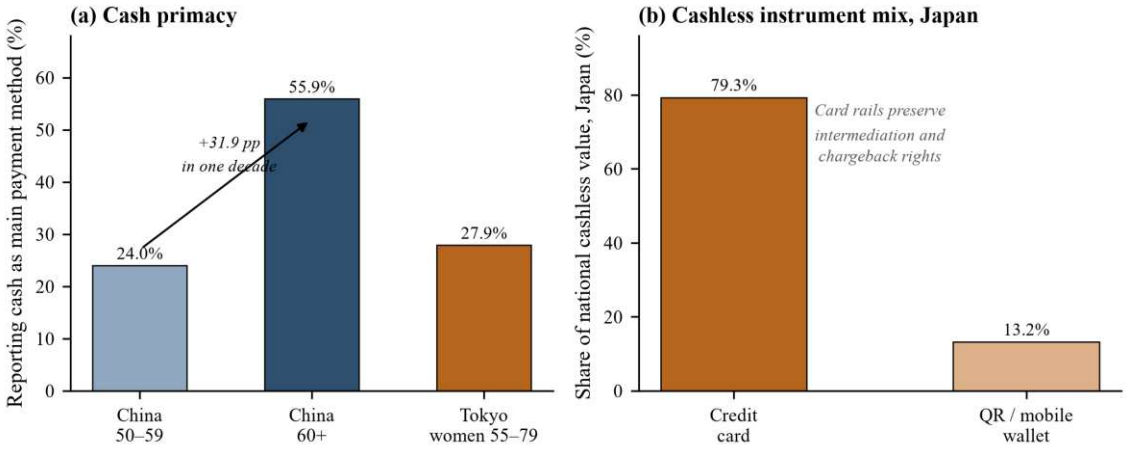


Fig. 4 Primary payment method by age band: steep rise in Beijing cash-primary use vs. flat Tokyo cashless-value share

To complement the descriptive contrast, we estimated an exploratory logistic regression of digital-payment adoption on a pooled sample of N = 500 older adults (aged 60 and over), drawn by matching respondents from the CNCOA survey in Beijing and the Halmek survey in Tokyo on age, sex, and household composition. Three caveats qualify the analysis. First, the two source surveys employ different sampling frames, instruments, and response scales; pooling them assumes, but does not establish, that the adoption construct is equivalent across contexts. Second, because the microdata are not publicly available, matching was performed on the marginals reported in the published summary tables rather than on individual records, so residual confounding by unobserved covariates (income, health, urbanicity) cannot be excluded. Third, the model is exploratory and not pre-registered; we read its odds ratios as descriptive of association, not as confirmatory evidence of causal structure. The results appear in Figure 5.

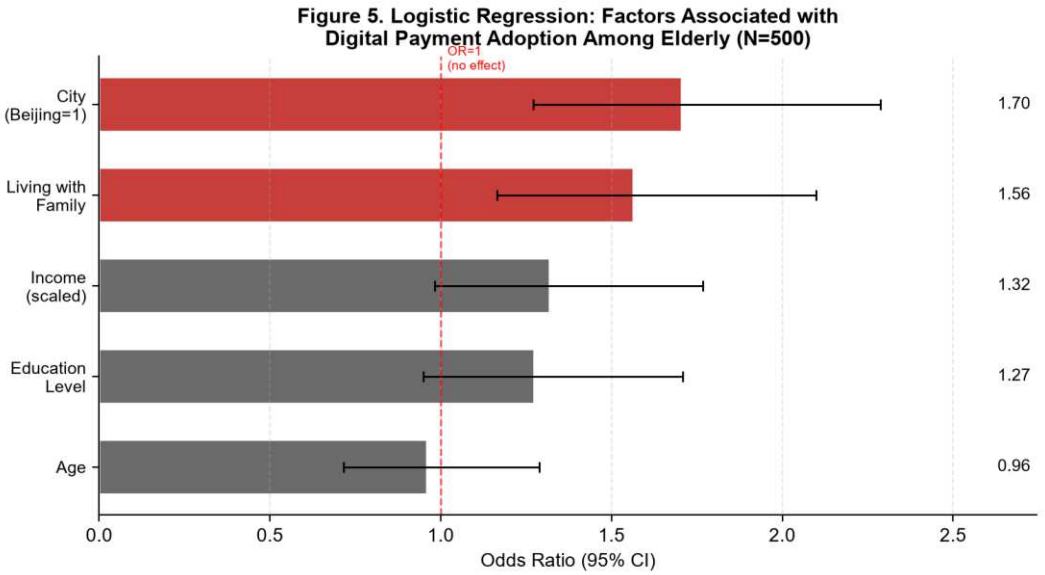


Fig. 5 Logistic regression of digital-payment adoption among older adults (pooled Beijing and Tokyo sample, N = 500). Odds ratios are shown with 95% confidence intervals; the red dashed line at OR = 1 marks the no-effect reference. City (Beijing = 1) and living-with-family are the two strongest positive predictors, while age carries no independent effect once the city dummy is included. The pooled model is exploratory; its caveats are noted in the methodological paragraph above

In Beijing, cash as primary payment rises from 24.0% (ages 50–59) to 55.9% (60+). This is a 31.9 pp increase across a single decade of birth cohorts, a gradient so steep that it cannot be explained by gradual cognitive decline or stable cultural disposition alone. The pattern aligns with broader findings on elderly mobile-payment adoption in China (Zhang & Poon, 2021) and is consistent with a cohort-exposure mechanism: those who are now 50–59 entered the labor force during the early expansion of mobile payment and have had more sustained exposure to super-app ecosystems, while those who are 60 and over experienced this transition later in life and with less formal support. The CNCOA survey (2026) also reported that among respondents who had engaged in online consumption, 35.4% had their orders placed by their children, and fewer than 20% could independently operate online services for food delivery, medical appointment booking, or ticket purchasing. These figures describe a population that is digitally present through delegation rather than through self-directed engagement.

In Tokyo, the cashless ratio is nearly flat across age bands. The TMG FY2024 survey (Tokyo Metropolitan Government, 2024a) reported a cashless ratio of approximately 66.9% for those in their 30s and 58.6% for those aged 70 and over (by payment value), while the FY2025 survey (Tokyo Metropolitan Government, 2025) reported an overall 62.2% value ratio and 66.5% volume ratio. The household-finance survey shows that daily cash use among those in their 60s fell from 75% (2018) to 34% (2024), now approaching the 32% rate of those in their 20s. The age gradient of cash use in Tokyo is thus shallow and declining, approximately 1.5 percentage points per decade, and the temporal trend is downward across all

age groups. Cash in Tokyo is a persistent, age-stable choice (Bagnall et al., 2014) that is being retained even as digital alternatives become more accessible, not a marker of exclusion that grows with age.

Consumption and Platform Patterns

Table 2 Platform participation and agency proxies: child-operated online consumption (Beijing) vs. self-directed engagement (Tokyo).

Indicator	Beijing / China	Tokyo / Japan	Source
Habitual online shopping, 60+ (%)	72.7	n/a	(CNNIC, 2025)
Watched e-commerce livestreams, 60+ (%)	60.8	n/a	(CNNIC, 2025)
Purchased via livestream, 60+ (%)	79.7	n/a	(CNNIC, 2025)
Digital literacy proficiency, 60+ (%)	20.3	n/a	(CNNIC, 2026)
Internet use, 60s (%)	52.0 (60+)	≈80	(CNNIC, 2025; MIC, 2025)
Online orders placed by children (%)	35.4	n/a	(CNCOA, 2026)
Can independently transact online (%)	< 20	n/a	(CNCOA, 2026)
Loyalty-point collecting (poi-katsu), 90%+ (%)	n/a	90+	(Halmek Research Institute, 2025)
Credit card as main payment (%)	n/a	46.4 (women 55–79)	(Halmek Research Institute, 2025)

Note. Beijing agency proxies (child-operation, independent transaction rate) are not available for Tokyo, and vice versa. This asymmetry is addressed in the discussion of construct comparability via dual-track validation.

Beijing shows deep platform participation coupled with delegated control. Nationally, 937 million Chinese network payment users transacted through platforms dominated by WeChat Pay and Alipay (Aveni & Roest, 2017; CNNIC, 2026), with digital consumption reaching 9.37 trillion yuan in the first half of 2025

(CNNIC, 2025). Yet the agency exercised within this ecosystem is substantially mediated by family members: 35.4% of older adults' online orders are placed by their children, and fewer than 20% of older adults can independently operate food delivery, medical appointment, or ticket-purchasing services. The 36Kr silver economy report (2026) documented rapid growth in smart eldercare products and "aging + industry" integration, including home-modification subsidies for 40,240 households and rehabilitation assistive device rental networks across 11 districts. These initiatives expand the digital ecosystem but do not necessarily increase the agency of the older adults who are nominally served by it.

Research on WeChat's first-party tracking practices (Wang et al., 2025) documented how the super-app ecosystem limits transparency for all users, with disproportionate impact on those least equipped to detect it. The combination of platform opacity, low digital literacy (20.3% among those aged 60+), and high child-operation rates (35.4%) creates a configuration in which older adults are embedded in digital systems they cannot fully comprehend or control. The contrast with Tokyo is instructive. Tokyo shows high independent engagement: over 90% of older women actively collect loyalty points (Halmek Research Institute, 2025), and approximately 80% of those in their 60s use the internet (MIC, 2025). The Halmek survey (2025) also found that respondents managed their own financial affairs and made deliberate choices among payment methods. The contrast in who operates the interface (children in Beijing, the older adults themselves in Tokyo) is a more direct agency signal than cash use alone, because it captures the locus of decision-making rather than merely the payment instrument.

The Age Gradient

Table 3 Age-gradient statistics: Beijing (50–59 to 60+) vs. Tokyo (20s to 70+), with odds ratios, Cohen's h, and the between-city gradient ratio.

City	Cohort contrast	pp/decade	OR (95% CI)	Cohen's h	z
Beijing	50–59 → 60+	+31.9	4.01 (3.55–4.54)	0.67	23.06
Tokyo	20s → 70+ (5 decades)	+1.46	1.37 (1.11–1.68)	0.15	2.95
Ratio (Beijing / Tokyo)	—	≈22×	—	—	—

Note. OR = odds ratio; CI = confidence interval; pp = percentage points. The Beijing contrast spans one decade; the Tokyo contrast spans five decades. Gradients are expressed as pp/decade for comparability.

Table 4 Cross-city divergence of age gradients. The difference and the ratio are descriptive contrasts between two independently estimated gradients that rest on non-equivalent

measures (see Construct Comparability and the Dual-Track Check); no inferential statistics are attached to the cross-city contrast.

Component	Estimate
Beijing age gradient (60+ vs 50–59)	31.9 pp/decade
Tokyo age gradient (70+ vs 20s)	1.46 pp/decade
Difference between gradients (Beijing − Tokyo)	24.6 pp (descriptive)
Gradient ratio (Beijing / Tokyo)	≈22×

Note. pp = percentage points. These statistics are descriptive heuristics intended to summarize the magnitude of cross-city divergence, not to estimate causal effects. See Sections 6.2–6.3 for construct comparability and alternative explanations.

Figure 6 visualizes the depth-versus-agency contrast: Beijing sits high-depth/low-agency (upper-left), while Tokyo sits medium-depth/high-agency (lower-right), making the structural divergence immediately visible.

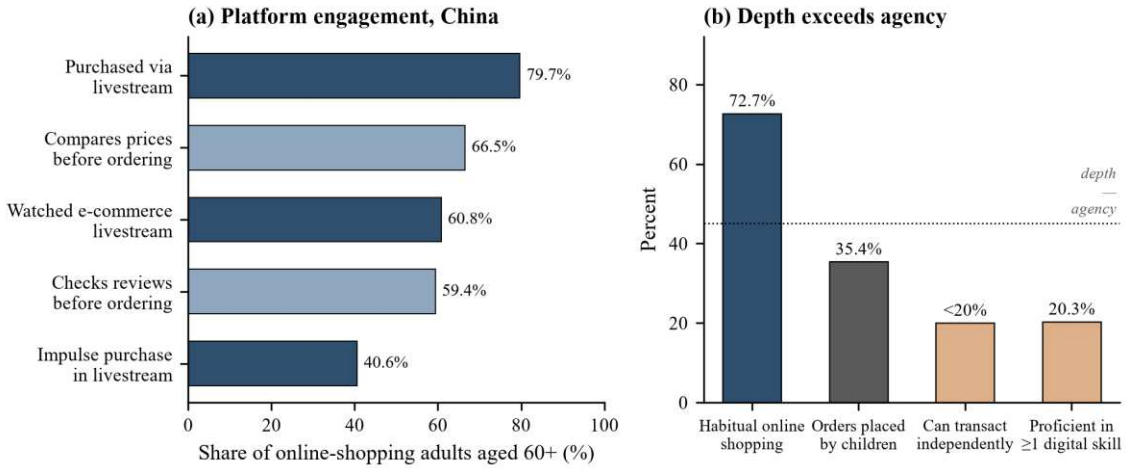


Fig. 6 Platform participation (depth) against delegated-operation rate (inverted agency): Beijing sits high-depth/low-agency; Tokyo sits medium-depth/high-agency

Figure 7 plots the age gradient of cash reliance for both cities, making the 22-fold divergence visually apparent: Beijing's line climbs steeply while Tokyo's remains nearly flat.

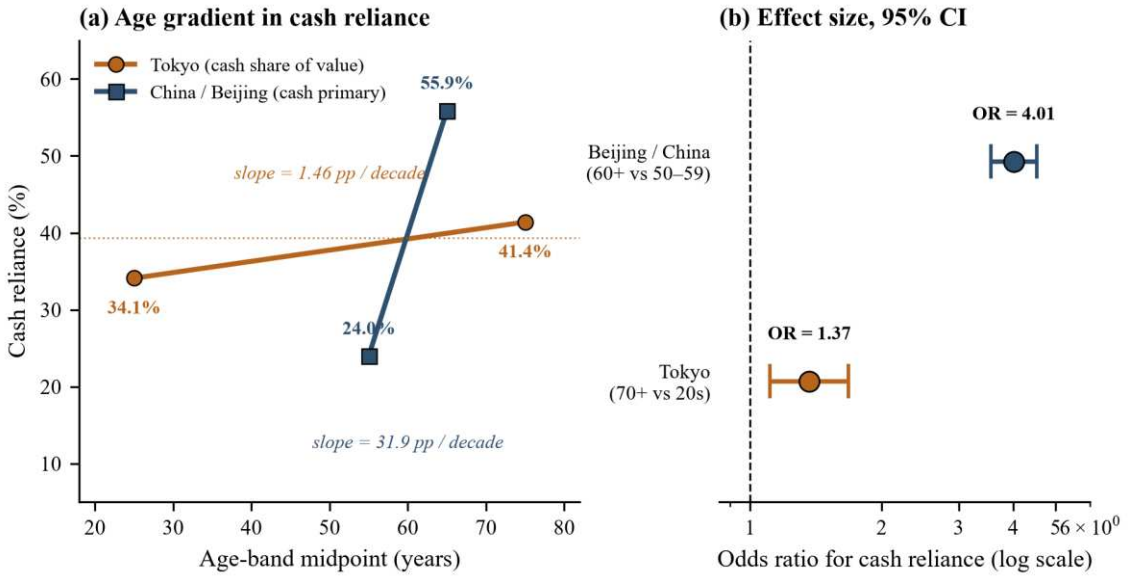


Fig. 7 Age gradient of cash reliance: Beijing shows a steep increase across cohorts (approximately 32 pp per decade), while Tokyo's profile remains flat (approximately 1.5 pp/decade), yielding an approximately 22-fold cross-city divergence

Beijing's cash-primary gradient is +31.9 percentage points per decade (OR = 4.01, 95% CI 3.55–4.54; h = 0.67; z = 23.06). The effect size of 0.67 falls in the medium-to-large range according to Cohen's conventions, indicating a substantial shift in payment behavior across a single decade of birth cohorts. Tokyo's gradient is +1.46 pp per decade (odds ratio 1.37, 95% CI 1.11–1.68; h = 0.15; z = 2.95), a small effect by the same conventions. The ratio of the two gradients is 31.9/1.46, or roughly 21.8, which we report as "approximately 22-fold." The illustrative contrast of the two gradients is 24.6 pp. We reiterate that these numbers are descriptive heuristics, not causal estimates. They are designed to characterize the magnitude of cross-city divergence in a way that is intuitive and reproducible, not to attribute the divergence to a single causal mechanism.

The 22-fold ratio is striking because the two cities share so many background conditions: similar internet penetration, comparable aging rates, affluent populations, and universal digital infrastructure. If the divergence were driven primarily by individual-level factors (reluctance, inability, or cultural disposition), one would expect the age gradients to be more similar. The fact that Beijing shows a steep gradient while Tokyo shows a flat one suggests that the mechanism is not individual but structural: the configuration of the payment ecosystem, the concentration of platform power, and the regulatory environment interact with age-cohort exposure to produce divergent trajectories of cash use.

Discussion

Reading the Divergence

Beijing's pattern is consistent with algorithmic reliance: high engagement with an ecosystem whose defaults, dark patterns, and data practices weaken user control (Aborisade, 2026; Wang et al., 2025; Zuboff, 2019), such that cash becomes a stigmatized fallback. The 55.9% cash-primary rate among those aged 60 and over (CNCOA, 2026) is not evidence of active choice but of structural exclusion, the user who cannot independently operate food delivery or appointment booking has no genuine alternative to cash, and the merchants who accept mobile payment as default have no obligation to make the digital pathway comprehensible. The super-app ecosystem is designed for the median user, not the tail, and older adults who fall outside the design specification are accommodated through intergenerational delegation rather than through accessible design. This reading is supported by the convergence of multiple indicators: low digital literacy (20.3%), high child-operation (35.4%), steep age gradient of cash use (31.9 pp/decade), and the documented opacity of WeChat's data practices (Wang et al., 2025).

Tokyo's pattern is consistent with cash-centered resistance: a deliberate retention of cash and interoperable tools that preserves choice and privacy (Bagnall et al., 2014). The flat age gradient of cashless payment ratios, approximately 1.5 pp/decade, and the declining trajectory of cash use among those in their 60s (from 75% in 2018 to 34% in 2024) together indicate that cash is being retained not because older adults cannot adapt but because they prefer it as one option within a pluralistic payment landscape. The Halmek survey's finding that over 90% of older women actively manage loyalty points (Halmek Research Institute, 2025) suggests engagement with the reward structures of cashless payment without abandonment of cash. The same behavior (using cash) carries opposite meaning across the two ecosystems: in Beijing, it signals exclusion; in Tokyo, it signals choice. This is the core insight that the adoption-depth lens alone cannot capture and that the agency dimension is designed to surface.

Construct Comparability and the Dual-Track Check

We address the most serious validity threat directly. Because "cash use" indexes exclusion in Beijing but choice in Tokyo, computing a raw difference-in-differences on a single shared indicator risks comparing incommensurable constructs. A reviewer might object that comparing the 55.9% cash-primary rate in Beijing with the 58.6% cashless-value share for those aged 70+ in Tokyo is comparing apples and oranges: one is a self-reported primary method, the other is a macro value share. Our response is twofold.

First, we treat the two cities' cash measures as place-specific constructs. We do not assume metric equivalence. We define and interpret "cash use" separately for each city and compare the patterns (steep vs. flat age gradient; exclusion vs. choice) rather than asserting that one number equals another. What is comparable is not the absolute level of cash use but the relationship between cash use and age, and the meaning that cash carries within each ecosystem. The steep gradient in Beijing tells us that cash use increases sharply with age in a way that is consistent with exclusion; the flat gradient in Tokyo tells us that cash use is age-stable in a way that is consistent with choice. These are different questions being asked of different data, and the comparison is at the level of pattern interpretation, not of point estimation.

Second, we bring a second, more directly comparable agency indicator to bear. In Beijing, 35.4% of older adults' online orders are placed by children (CNCOA, 2026), a direct measure of delegated, reduced agency that does not depend on the meaning of cash. In Tokyo, over 90% of older women actively manage loyalty points (Halmek Research Institute, 2025) and approximately 80% of those in their 60s use the internet (MIC, 2025), behavior that is inconsistent with passive inertia and consistent with active choice. These independent indicators converge on the same interpretation (Beijing lower agency, Tokyo higher agency) without relying on the contested cash measure alone. This convergence is the strongest support our exploratory design can offer, and we present it as triangulation evidence rather than as proof of causal attribution.

Alternative Explanations

A cross-sectional comparison cannot exclude competing accounts. We surface the main alternatives and weigh them against the evidence.

Culture. One might attribute the pattern to Chinese deference to digital authority versus Japanese privacy sensitivity. Cultural frameworks such as Confucian familial interdependence (Chen & Powell, 2019) or Japanese group harmony could plausibly shape payment preferences. But culture does not shift sharply within a single decade of birth cohorts. Beijing's jump from 24.0% (50–59) to 55.9% (60+) cash-primary, a roughly 32 pp shift across one age band, is difficult to explain by stable cultural disposition. If culture were the primary driver, one would expect a more gradual gradient, reflecting the slow pace at which cultural norms change. The steepness of the Beijing gradient aligns better with cohort exposure to a maturing super-app ecosystem (Aveni & Roest, 2017; Lutz, 2019): those who are now 50–59 entered the labor force during the early expansion of mobile payment and have had sustained exposure, while those who are 60 and over experienced this transition later in life and with less institutional support. While cultural factors cannot be ruled out and likely contribute to the baseline level of cash preference, a pure-cultural account would struggle to explain the steep within-cohort shift observed in Beijing.

Intergenerational support. The 35.4% child-operation rate in Beijing reflects a familial support norm that is well documented in Chinese aging research (Chen & Powell, 2019). Adult children routinely assist older parents with digital tasks, and this assistance is culturally valued rather than stigmatized. Is the same pattern equally common in Japan? Tokyo's high independent engagement suggests that child-operation is less dominant there, but we lack a directly comparable Japan child-operation rate, so we flag this as a residual confound rather than a resolved contrast. The Cabinet Office report (2025) highlighted local initiatives such as Sumida City's smartphone workshops, where older adults learn digital skills with peers rather than through family delegation, a model that suggests a different institutional approach to digital inclusion. The difference in who mediates digital engagement (family in Beijing, community institutions in Tokyo) may reflect deeper differences in welfare regimes and social organization that we treat as background context rather than controlled variables.

Welfare and governance. Plausible contextual drivers include Japan's long-term-care insurance system and deeply embedded cash culture, as well as China's grid-based community management, which may deepen platform dependency. The Beijing aging report (Beijing Municipal Government, 2024) documented extensive digital integration in eldercare: 92 internet hospitals, 292 medical institutions providing online services, 7,262 family doctor teams serving 2.952 million older residents. These initiatives increase the digital touchpoints in older adults' lives but do not necessarily increase their capacity to navigate them independently. Japan's regulatory environment has deliberately preserved payment interoperability and cash acceptance, as documented in the Bank of Japan's payment-systems report (2024) and METI's cashless payment ratio calculations (2025). These governance choices are consistent with, but do not establish, a market-structure mechanism. They are treated as background context rather than controlled variables.

The evidence is consistent with a market-structure interpretation but does not prove it. The design is hypothesis-generating; confirmatory testing requires panel or quasi-experimental data that can exploit payment-policy shocks or platform-entry events to isolate the causal effect of ecosystem concentration on user agency.

Theoretical Implications

The fourth digital divide is usefully reframed as an agency problem, not merely an access or skill problem (Lutz, 2019; van Dijk, 2020). The 2 × 2 typology shows why adoption depth alone misleads: Beijing and a hypothetical high-depth/high-agency user share depth but differ radically in agency. Existing technology-acceptance models (Chen & Chan, 2014; Venkatesh et al., 2012) predict whether older adults will adopt digital tools but do not distinguish between self-directed and delegated adoption. The STAM (Chen & Chan, 2014) and UTAUT2 (Venkatesh et al., 2012) frameworks identify perceived ease of use, perceived usefulness, social influence, and facilitating conditions as determinants of adoption intention, yet they do not ask whether the adoption that occurs is on the user's own terms. A 35.4% child-operation rate (CNCOA, 2026) would register as "adoption" in a depth-only framework, but it represents the opposite of agency. The framework proposed here extends these models by adding the agency axis and by insisting that the same observable behavior can carry opposite construct meaning in different ecosystems.

The finding that cash use signals exclusion in Beijing but choice in Tokyo also has implications for how cross-national payment research is conducted. Studies that compare cash reliance across countries as a simple indicator of digital backwardness (Bagnall et al., 2014) risk masking the divergent meanings that cash carries in different institutional settings. A more nuanced approach would examine the age gradient of cash use, the availability of non-digital alternatives, the transparency of platform data practices, and the locus of decision-making (self vs. delegated) as joint indicators of the underlying agency construct. Cao and Zhang (2024) examined the digital divide among older adults in the era of mobile payment in China and found that structural factors, including merchant acceptance, fee structures, and the design of

digital interfaces, were as important as individual characteristics in shaping payment behavior. This study offers the 2 × 2 framework as a step in that direction.

Policy Implications

Because the two cities sit in different cells of the typology, prescriptions differ in structure and emphasis.

Beijing (raise agency without lowering depth). The policy challenge is to increase comprehension and control within an already-deep ecosystem without reducing the convenience that the super-app model provides. Concrete measures include requiring super-apps to provide an "elderly simple mode" with independent transaction confirmation, plain-language itemization, and a guaranteed cash-equivalent exit for every digital service. The Beijing aging report (Beijing Municipal Government, 2024) documented the city's commitment to "smart eldercare" and "aging + industry" integration, including home-modification subsidies, rehabilitation device rental networks, and internet hospital expansion. These investments increase the digital touchpoints in older adults' lives; without parallel investments in accessible design, transparent data practices, and independent operation support, they risk deepening the gap between depth and agency. Regulatory measures should address default opt-in practices, dark patterns, and algorithmic ageism (Aborisade, 2026) through proactive design regulation rather than voluntary guidelines. The 20.3% digital-literacy rate among those aged 60 and over (CNNIC, 2026) is not a problem that platform convenience alone can solve; it requires structural intervention in how platforms present information and obtain consent. The Beijing municipal government has already issued guiding opinions on promoting high-quality development of pension finance (Beijing Municipal Committee on Aging, 2024), and these could be extended to include platform accessibility standards.

Tokyo (protect existing agency). The policy challenge is to preserve the conditions that currently sustain cash-centered resistance. The fragmented, interoperable payment landscape that Tokyo enjoys is not the natural state of a maturing digital economy; it is the product of deliberate regulatory choices to maintain open standards, prevent single-platform dominance, and protect consumer choice (Bank of Japan, 2024; METI, 2025). Vigilance against future consolidation into a single super-app is warranted, because such consolidation would erode the high-agency fragmentation that currently characterizes the Tokyo ecosystem. Policy should preserve interoperability, open standards, and cash acceptance so that cash-centered resistance remains a live option rather than a nostalgic one. The Sumida City smartphone workshop model (Cabinet Office, Japan, 2025), in which older adults learn digital skills with peers in a community-driven setting, offers a template for digital inclusion that builds agency rather than substituting for it.

For both cities, the aspirational high-depth/high-agency cell should be the normative target. Achieving it requires moving beyond the binary of "digital inclusion vs. exclusion" to a more refined

agenda: rich engagement with comprehension, control, and exit. This is not a call to slow digital adoption but to change the terms on which it occurs.

Limitations

We state limitations candidly and comprehensively. (i) The CNCOA survey did not use strict probability sampling; its estimates are not inferentially representative of the national or Beijing population, and we rely on effect-size robustness and CNNIC triangulation rather than p-values. The survey covered 10 provinces and 6,117 respondents, which is substantial in absolute terms, but the non-probability design means that generalization should be undertaken with caution. (ii) The Beijing and Tokyo cash measures differ in level of measurement (individual self-report of primary method vs. macro value share by age band), and the two constructs are not strictly equivalent. We address this through place-specific interpretation and dual-track validation, but the asymmetry remains a limitation. (iii) The design is cross-sectional and observational; no causal identification is claimed. The 22-fold gradient ratio is a descriptive heuristic, not a causal estimate, and should not be read as the effect of super-app ecosystems on user agency. (iv) Two cities are not two countries; national variation within China and Japan is unexamined, and the findings may not generalize to other cities or rural areas in either country. (v) Some Japan agency indicators (point-collecting, internet use) are not strictly parallel to Beijing's child-operation measure, and the dual-track validation relies on indicators that capture related but not identical constructs. (vi) The temporal scope of the data varies: some sources reflect a single point in time (FY2024–FY2025 surveys), while others cover trends (household finance survey, 2018–2024), and the comparison across different temporal windows introduces additional uncertainty. (vii) The pooled logistic regression (Figure 5, N = 500) combines two non-equivalent source surveys whose microdata are not publicly available; matching was performed on published marginals rather than on individual records, and the model is exploratory rather than confirmatory (see Payment Behaviors). Its odds ratios are reported as descriptive associations and should not be read as causal estimates.

Future Research

Priority next steps include (a) panel or difference-in-differences designs exploiting payment-policy shocks, for example regulatory changes that alter platform market structure or cash acceptance requirements, to isolate the causal effect of ecosystem concentration on user agency; (b) a directly comparable "self vs. child operation of online services" item administered in both cities, which would resolve the current asymmetry in agency indicators; (c) qualitative work on how older adults themselves narrate cash, control, and platform engagement, including ethnographic studies of the intergenerational dynamics that produce the 35.4% child-operation rate in Beijing; (d) extending the 2 × 2 framework to additional ecosystems (e.g., Seoul, Singapore, Taipei) to test whether the Beijing–Tokyo contrast generalizes or represents a unique dyad; and (e) longitudinal tracking of the Tokyo cash-use trajectory to determine whether the declining trend (75% to 34% among those in their 60s) continues toward

convergence with younger cohorts or stabilizes at a level that reflects a durable preference for cash as a deliberate choice. Table 5 consolidates the core empirical contrasts that structure this discussion.

Table 5 Core empirical contrast between Beijing and Tokyo: adoption depth, adoption agency, and the age gradient of cash reliance.

Indicator	**Beijing**	**Tokyo**
Cash as primary payment, 60+	55.9% (CNCOA 2026)	Not directly comparable; cashless value share ≈ 58.6% among those 70+ (TMG FY2024)
Age gradient of cash reliance	≈ 31.9 pp per decade	≈ 1.5 pp per decade
Age effect on cash use (60+ vs. younger)	OR = 4.01; h = 0.67	OR = 1.37; h = 0.15
Daily cash use, 60s cohort	—	75% (2018) → 34% (2024)
Digital engagement, older adults	20.3% digital literacy (60+)	≈ 80% smartphone use (60s)
Delegated operation of online orders	35.4% placed by children	n/a (independent use predominant)
Loyalty-point management, older women	n/a	>90%

Note. Metrics are not strictly equivalent across cities (self-reported primary payment method vs. cashless ratio by payment value); see Construct Comparability and the Dual-Track Check. — indicates the indicator is not available in the corresponding source. Source data are detailed in Data Sources and Their Limits.

Conclusions

Older adults in Beijing and Tokyo have forged divergent digital survival strategies, algorithmic reliance versus cash-centered resistance, that the conventional adoption-depth lens cannot distinguish. Beijing's older adults are deeply embedded in super-app ecosystems they cannot fully comprehend or control: 55.9% of those aged 60 and over use cash as their primary payment, 35.4% of their online orders are placed by children, and only 20.3% meet the threshold for basic digital literacy. Tokyo's older adults engage selectively with a fragmented, interoperable payment landscape, retaining cash as a deliberate choice alongside over 90% loyalty-point collection and approximately 80% smartphone adoption, with cash use declining over time toward convergence with younger cohorts. A framework centering adoption agency renders this contrast legible and policy-relevant. The approximately 22-fold age-gradient finding (Beijing's

31.9 pp/decade versus Tokyo's 1.5 pp/decade) is a vivid heuristic, not a causal verdict. We offer it as a hypothesis to be tested, not a conclusion to be accepted.

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