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The Green Revolution and individualism: Evidence from Indonesia ☆

Yeonha Jung [a], Uyseok Lee [b], Gedeon Lim [c,*]

[a] Department of Economics, Sungkyunkwan University, Republic of Korea
[b] Vancouver School of Economics, University of British Columbia, Canada
[c] The University of Hong Kong, Faculty of Business and Economics, Pokfulam Rd, Hong Kong, China

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ABSTRACT

This paper studies the effects of the Green Revolution, one of the largest development projects in the late 20th Century, on individualism. We use a difference-in-differences approach to investigate how rapid technological and organizational changes in traditional agriculture reshaped cultural norms in Indonesia, where Green Revolution rollout was largely driven by centralized government interventions. Regions with greater exposure to Green Revolution policies experienced significant and persistent increases in individualism (as measured by a higher prevalence of infrequent names) decades after the end of the program. Results are not driven by pre-trends and hold across a battery of robustness checks. We further document suggestive, correlational evidence of a persistent fall in community funding for public goods, a key measure of collective action. Our findings suggest that technical change can lead to rapid and persistent changes in culture.

1. Introduction

The Green Revolution represents one of the most profound and rapid instances of technical change across the developing world, with far-reaching effects on economic development (Evenson and Gollin, 2003; Pingali, 2012; Gollin et al., 2021). While existing research has explored its impacts on various socioeconomic aspects, such as structural transformation (Gollin et al., 2021) and health outcomes (Bharadwaj et al., 2020; von der Goltz et al., 2020; Sekhri and Shastry, 2024), this study provides the first evidence of the short to medium-term effects of the Green Revolution on individualism—a key dimension of culture that has played an instrumental role in shaping economic and political organizations across societies (Heine, 2010; Cline and Williamson, 2017; Gorodnichenko and Roland, 2017; Schulz et al., 2019).

Historical accounts document that an implicit, macro-level objective of Western donors in supporting the Green Revolution was to partially induce social change (Cullather, 2004). Anthropologists have also long acknowledged the potential for increased individualism resulting from the Green Revolution's disruption of cooperative, interdependent practices and institutions (Alexander and Alexander, 1979; Grossman, 1984; Rigg, 1989) that had historically fostered collectivist culture (Geertz, 1956). Given the central role of such practices in shaping cultural norms and beliefs (Alesina et al., 2013; Talhelm et al., 2014; Ang and Fredriksson, 2017; Cao et al., 2021), the Green Revolution offers a compelling context for examining the interplay between policy-driven technical change, shifts in traditional practices, and cultural change.

We use the rollout of the Green Revolution in Indonesia to identify the effects of technical change on individualism. In a supplementary, cross-sectional analyses, we further test for effects on collective action—an important institution in developing countries for the co-production of public goods (Ostrom, 1996; Olken and Singhal, 2011). We hypothesize that, in line with anthropological studies, the Green Revolution disrupted communal practices, inducing a shift toward individualistic culture. Our main empirical strategy centers on a continuous difference-in-differences approach to compare outcomes across districts that were differentially exposed to a higher intensity of Green Revolution policies. From 1966 to 1983, the Indonesian Central Government implemented a series of national programs targeted solely at rice cultivation to achieve self-sufficiency in rice production. These programs introduced a suite of modern farming technologies, which disrupted traditional communal practices and undermined social bonds that had long sustained collectivist norms and beliefs in agricultural communities (Alexander and Alexander, 1979; Grossman, 1984; Rigg, 1989).

The Indonesian setting offers two key advantages. First, in terms of scale, Indonesia was unique among all rice-importing nations of South

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* Corresponding author.
E-mail addresses: yhjung0408@skku.edu (Y. Jung), uyseok.lee@student.ubc.ca (U. Lee), gedeonl@hku.hk (G. Lim).

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and Southeast Asia in the extent to which the Central Government expended political and economic capital in its centralized and large-scale implementation of Green Revolution policies. Second, a rich set of data exists. For the main analysis, we use individual-level data from the complete-count 2010 Indonesian Population Census (approximately 246 million individuals) to construct district-level measures of individualism as proxied by the share of children born with infrequent first names ("share of infrequent names" from hereon), a common approach in recent economics studies (Knudsen, 2019; Bazzi et al., 2020a; Fiszbein et al., 2022). Given that this measure has largely been used in Western settings, we conduct validation exercises and show that our share of infrequent names correlates strongly with self-reported individualistic attitudes in Indonesia from the World Values Survey. Beyond our main outcome variable of individualism, we also leverage the Indonesian Village Census to construct detailed measures of community funds across approximately 56,000 villages in the post-Green Revolution period. To the best of our knowledge, such detailed records do not exist in most other developing country contexts.

We measure district-level exposure to Green Revolution policies using changes in the share of acreage devoted to rice cultivation ("rice acreage share" from hereon) between 1963 and 1983 from Agricultural Censuses. These two time periods capture rice acreage shares just before and after the Green Revolution period. Though we do not have direct measures on changes in the adoption of modern farming technology during the Green Revolution period—and hence are unable to explicitly test for the disruption of communal practices as a key mechanism—we show that changes in rice acreage shares correlate strongly with two proxies of Green Revolution exposure measured in 1983: the number of households per hectare enrolled in BIMAS (the flagship government Green Revolution program); and the usage of high-yielding varieties, chemical fertilizers, and irrigation systems, all key components of the Green Revolution.

Nonetheless, an associated measurement concern remains: changes in *observed* rice acreage shares might reflect both the effects of Green Revolution policies arising from Central Government policy interventions *and* voluntary responses by farmers to changes in market conditions. To address this issue, we use *residual* rice growth as our main measure of Green Revolution exposure. Specifically, we employ a fractional logit framework to decompose changes in rice acreage share into two components: *potential* rice growth and *residual* rice growth (Jung, 2020; Fiszbein, 2022). Potential rice growth captures changes in rice acreage share driven by shifts in crop profitability conditions unrelated to the policy intervention; districts with higher potential rice growth may have expanded rice cultivation at a faster pace even in the absence of Central Government policies. In contrast, residual rice growth refers to the variation remaining after accounting for potential rice growth, which is likely more attributable to consequences of the Green Revolution policies.

Key to our identification strategy is the assumption that regional variation in Green Revolution policy interventions—proxied by residual rice growth—was uncorrelated with pre-treatment trends in individualism. For instance, if programs were differentially targeted towards areas where villagers had more positive or open attitudes towards the adoption of new technologies, and if such attitudinal differences were correlated with existing trends in individualism, this could introduce bias into our estimates.

The historical literature suggests that this was unlikely. Programs were largely designed and implemented in a top-down manner, leaving little room for villages to select in nor out of these programs (Hansen, 1972). Relatedly, we show that (i) conditional on district fixed effects and province-period fixed effects, there are no differential pre-trends in the share of infrequent names; (ii) results remain robust to controlling for time-varying effects of a host of initial local characteristics. Anthropological and historical studies suggest that geographical variation in program intensity was largely driven by differences in (i) geographical accessibility for the delivery of farming inputs; (ii) bureaucratic capacity of government officials and organizations (Hansen, 1972; Abdullah, 1982). These differences, if any, are unlikely to account for our results given that we control for district fixed effects. Nonetheless, we further address these and other related concerns in our robustness checks.

Districts that were more exposed to Green Revolution policies (as measured by residual rice growth from 1963 to 1983) experienced a marked increase in individualism, with effects persisting decades after the programs ended. Specifically, the share of infrequent names increased starting from children born during the height of the Green Revolution (1971–1975) and nearly doubled for the first cohort of children that were born to parents fully exposed to the Green Revolution (1986–1990). This positive effect on individualism persists and peaks with the last cohort (2005–2010) observable in 2010 Census. Importantly, effects dissipate when we use potential rice growth as a treatment variable in place of residual rice growth. This reinforces our preferred interpretation that residual rice growth more accurately captures district-level differences in program intensity.

Our findings hold across a battery of robustness checks.[1] First, our estimates are robust to controlling for time-varying effects of pre-Green Revolution district characteristics, including the proportion of farmland area; average farm size; land inequality; population density; and sex ratio (demographic composition). These results are important given the potential correlation between these characteristics and Green Revolution policies, including those described above. Second, the results are robust to changes in alternative local characteristics that proxy for competing channels: changes in population density, urban population ratio, educational attainment, fertility, family size, share of employment in agriculture, share of employment in trade-related sectors, the population share of migrants, and the ethnic fractionalization index, all measured during the Green Revolution period. This is consistent with our preferred interpretation that the expansion of rice cultivation and the disruption of traditional practices, rather than broader socioeconomic changes, played a central role in the observed increases in individualism. Third, we show that our results are not driven by selective migration. Identifying migrant households based on the birth districts of children, we examine whether those who migrated to areas more exposed to the Green Revolution exhibited more individualistic attitudes. The results indicate that while migrant families were more likely to hold individualistic attitudes than non-migrants, this tendency was not selective with respect to Green Revolution exposure. Moreover, we replicate the estimation using the name-based measure of individualism calculated for children from non-migrant families only, and the results remain unchanged. Combined with robustness to district-level proxies for migration, these results collectively suggest that selective migration is unlikely to drive our findings.

Importantly, these robustness checks do not rule out the potential role of alternative mechanisms. The disruption of communal practices may have operated through several interrelated pathways that our analysis cannot separately identify. From this perspective, the results should be viewed as indirect evidence consistent with our preferred interpretation, rather than as isolating a single mechanism.

We close by examining effects on cooperative effort and collective action, which have been found to play a central role in public goods provision across many developing countries (Baldwin, 2016; Ostrom, 1996; Olken and Singhal, 2011). We proxy local cooperative efforts using the prevalence of bottom-up village community funds measured from the Indonesian Village Census (Evers, 2000; Olken and Singhal, 2011; Martinez-Bravo, 2017; Lim, 2022). We conduct cross-sectional analyses and find a negative association between Green Revolution exposure and local cooperative efforts. Villages in districts more exposed to Green Revolution policies contributed a lower share of community

[1] We are unable to study the effects of changes in the acreage of non-rice crops given that the 1963 Agricultural Census does not record this information.

funds towards local, bottom-up public goods in 1993. Similarly, these villages continued to collect a lower share of community funds in 2003 (as a share of total village budgets)—decades after the end of the Green Revolution.

We make novel contributions to several strands of literature. First, building on the foundational ideas of Scott (1977), our findings shed new light on the determinants of individualism (versus collectivism). Existing studies have examined long-run determinants, such as historical migration (Knudsen, 2019), frontier resettlement patterns (Bazzi et al., 2020a), and agricultural practices (Ang, 2019; Fiszbein et al., 2022; Raz, 2025), all of which have demonstrated the remarkable persistence of values and beliefs driven by historical events. We build on this body of work by providing novel evidence that one-off, policy-driven technical change can alter the trajectory of cultural evolution (Munshi and Rosenzweig, 2006; Bau, 2021; Bau et al., 2023). We do so in the context of one of the most significant development projects in contemporary history that led to a rapid shift away from communal, agricultural practices.

Second, we build on a growing literature that has studied the positive economic effects of individualism, such as innovation (Gorodnichenko and Roland, 2017; Buggle, 2020), institutional quality (Cline and Williamson, 2017; Ang et al., 2021), and gender equality (Davis and Williamson, 2019). In contrast, we provide suggestive evidence for a potentially negative effect of individualism: decreases in the levels of cooperative norms and collective action (community funds) that are central to the production of public goods in less-developed societies (Ostrom, 1996). More broadly, our results provide evidence that policies that inadvertently foster a mismatch between socially transmitted traits (shaped by past events) and present-day environments may have unintended downstream consequences for institutions that rely on cooperative behavior (Nunn, 2022; McGuirk and Nunn, 2024).

Third, we contribute to the literature on the agrarian origins of contemporary culture (e.g., Alesina et al., 2013; Galor and Özak, 2016; Buggle, 2020; Fiszbein et al., 2022). This body of work has shown that customs and norms embedded in historical farming practices often lead to persistent attitudes and beliefs, even after the disappearance of these practices over centuries. We contribute by showing how rapid, large-scale technical change in agriculture can lead to changes in long-held values and beliefs. In particular, our findings are closely connected to the "Rice Theory of Culture", which identifies the labor-intensive, cooperative nature of historical rice agriculture relative to wheat agriculture as a deep determinant of contemporary collectivist versus individualistic culture (Talhelm et al., 2014; Talhelm and English, 2020; Talhelm and Dong, 2024). By focusing on Indonesia—where the Green Revolution focused solely on rice cultivation—our findings provide a novel perspective on how *within*-crop changes in agricultural practices can affect cultural formation.

Lastly, this paper sheds light on the broader implications of agricultural innovations introduced during the celebrated Green Revolution period. While existing literature has largely focused on structural transformation (Gollin et al., 2021) and health outcomes (Bharadwaj et al., 2020; von der Goltz et al., 2020; Sekhri and Shastry, 2024), we provide the first quantitative evidence that exposure to the Green Revolution had a substantive impact on the formation of individualistic culture. This finding corroborates both anthropological and historical accounts, which highlight how Western donors of foreign aid for the Green Revolution were motivated by the implicit objective of inducing social change (Cullather, 2004).

The remainder of our paper proceeds as follows. Section 2 describes the contextual background of the Green Revolution in Indonesia and outlines our hypothesis. Section 3 details data sources and measurement. In Section 4, we present our main findings on individualism, and Section 5 reports the estimated effects on collective action. Section 6 concludes.

2. The Green Revolution in Indonesia

This section provides an overview of the contextual background. Section 2.1 outlines the background and implementation of the Green Revolution in Indonesia. Section 2.2 explores its impact on the disruption of traditional communal practices, a key component of the hypothesis discussed in Section 2.3.

2.1. Overview

Background. The Green Revolution in Indonesia broadly refers to the widespread adoption of modern agricultural technology during the 1960s to the 1980s. This process was orchestrated by the Central Government that had set the goal of achieving rice self-sufficiency since as early as 1956 (Manning, 1987). Consequently, the Green Revolution in Indonesia was targeted exclusively at rice cultivation. It began in the early 1960s through various pilot programs. The first national program called *the Mass Guidance Program* (BIMAS) was officially launched in 1966 (Rieffel, 1969).

The national Green Revolution programs had two main components. First, they introduced and expanded the adoption of advanced farming technologies, such as fertilizer, pesticides, and high-yielding varieties (HYVs). Second, they facilitated access to credit, which enabled farmers to invest in the new agricultural inputs and practices. Ultimately, the Green Revolution was largely successful, leading to a 183% increase in rice production—from 8.3 million metric tons in the early 1960s to 23.5 million metric tons by the mid-1980s (Manning, 1987). This increase in rice production was driven not only by yield growth, but also by the geographic expansion of wetland rice cultivation (Mears and Afiff, 1968; Davidson, 2018). In 1983, President Suharto officially declared that Indonesia had achieved rice self-sufficiency.[2] In line with the historical timeline of the government programs, we consider 1966 to 1983 as the main operating period of the Green Revolution in Indonesia.

Rollout. A potential concern with our empirical analysis is that geographical variation in the rollout and intensity of Green Revolution programs may have been associated with pre-existing differences in cultural traits. For example, given political motives to garner public support following the end of Sukarno's rule in 1965, the Suharto Government might have implemented the program more intensively in poorer districts or those perceived as being more opposed to the new Suharto regime. If these local characteristics are correlated with pre-treatment trends in individualism, our estimates could be biased. Here, we describe various anthropological and historical studies which suggest that such differential targeting was unlikely.

The rollout of Green Revolution programs was centrally planned and administered through an extensive bureaucratic framework, aptly reflected in the name of the first national program, BIMAS, which stands for "mass guidance" (Rieffel, 1969; Manning, 1987). Importantly, districts and villages had little control over their participation in these programs. This suggests that geographical variation in the rollout of Green Revolution technologies was unlikely to have been correlated with local demand. As Rieffel (1969) notes:

> "One of the cliches often heard in discussions of BIMAS was that the petani [peasants] should be the "subject" rather than the "object" of the program. In other words, the petani should exercise control over the program, manipulating it to suit their needs instead of being pushed around by the program. ... In spite of the rhetoric, there was no evidence that the petani were playing any

[2] While self-sufficiency was declared in 1983, 1985 was the first year in which Indonesia was a net exporter of rice (Manning, 1987).

> more than a passive role; certainly targets for the program were derived from the desires of high-level planners rather than being aggregated from locally-determined objectives and capabilities. There were not even any institutional mechanisms through which the petani could participate in determining which plots would be eligible for the program" (pp. 129–130).[3]

Instead, geographical variation in program adoption appears to have been largely driven by differences in two key factors: (i) geographical accessibility for the delivery of farming inputs; and (ii) bureaucratic capacity of government officials and organizations (Rieffel, 1969; Abdullah, 1982).

In terms of geographical accessibility, foreign private companies were contracted to procure and deliver farming inputs directly to villages. Historical accounts highlight that local factors related to the potential success of the programs—such as agricultural suitability or farmer characteristics—were largely ignored in favor of cost savings and easier distribution of inputs to rural areas (Rieffel, 1969; Hansen, 1972; Bugow, 2021). A well-documented example is the case of the Swiss chemical company Ciba, which was contracted for the administration of BIMAS in Java during the late 1960s. A key input that Ciba provided was the aerial spraying of pesticides, which was most effectively deployed over large tracts of farmland. As a result, localities with larger and more consolidated paddy fields were disproportionately selected for the program managed by Ciba, irrespective of local demand for the inputs. As Rieffel (1969) notes: "the petani who participate in BIMAS CIBA [had] no choice in the matter".

To this end, our baseline regressions in Section 4 control for district fixed effects, which allows us to partial out the effects of time-invariant factors such as geographical accessibility and initial bureaucratic capacity. In addition, we show that our estimates are robust to controlling for interactions between time trends and pre-Green Revolution district characteristics that may be correlated with program rollout, including the proportion of farmland in the district, average farm size, land inequality, population density, and the sex ratio.

2.2. Disruption of communal practices

The introduction of modern production technologies through the rollout of the Green Revolution programs disrupted traditional communal practices, which forms the basis of our hypothesis on cultural change.[4] Drawing on the anthropological literature, this section explores three categories of agricultural practices that historically shaped collectivist norms and beliefs in Indonesia but were rendered obsolete due to the Green Revolution.

The labor exchange. The labor exchange was a system of mutual assistance in tasks between farmers and villagers. The high labor requirements of wetland rice cultivation required farmers to fulfill tasks using labor exchanges throughout the entire crop cycle.[5] The communal nature of the labor exchange was epitomized during the harvest, as participation in the harvest was traditionally a village-wide event (Collier et al., 1973, 1974; Alexander and Alexander, 1982). According to White (2000), the rice harvest was "the exemplar of agrarian social life and communal traditions".[6] Participating villagers were compensated through *bawon*, an in-kind payment of harvested rice. The bawon held social significance beyond its role as compensation, representing a "traditional social obligation" within the farmer-laborer relationship (Collier et al., 1974). The labor exchange has long been recognized by anthropologists as "a stronghold of mutual cooperation" that underlies the communal structure of Indonesian rice agriculture (Stoler, 1977).

However, the Green Revolution fundamentally transformed labor exchange practices, as farmers increasingly adopted the *tebasan* system —the sale of crops just prior to harvest.[7] This system broke the longstanding cooperative ties that farmers had to their villages. Unlike communal labor exchanges, tebasan typically involved middlemen (*penebas*) from outside the village, who were not bound by traditional communal norms within the community. These middlemen mostly brought their own laborers, excluding local villagers who had traditionally participated in the harvest as part of the communal labor network (Collier et al., 1974; Stoler, 1977). Following the increasing adoption of the tebasan system, the traditional labor exchange that had been "a stronghold of mutual cooperation" in the village declined.

Rice seed sharing. Prior to the Green Revolution, cooperative agricultural practices extended to the shared use of production inputs. Rice seed sharing was the practice of sharing quality seeds between farmers as a hedge against a poor harvest (Koentjaraningrat, 1967; Keyfitz, 1985; Partasasmita et al., 2019). Rooted in mutual trust, reciprocity, and shared responsibility, this practice functioned as an insurance mechanism to secure the availability of quality seeds for all farmers in the village. Seeds could be shared informally within farmer networks, or through more formal arrangements such as *lumbung desa* (rice bank) or *lumbung pari* (paddy rice storage).

The Green Revolution fundamentally disrupted these practices. With improved access to credit systems, modern seeds became readily available for purchase, reducing the reliance on communal seed-sharing arrangements. Furthermore, the widespread use of fertilizers and pesticides significantly reduced the risks associated with crop failure due to poor harvests, further diminishing the necessity of rice seed sharing. As Keyfitz (1985) aptly describes from his visits to an east Javanese village between 1953 and 1985, "On our earlier visit the *lumbung desa* (a rice bank) was an important institution often mentioned to us. ⋯ On the recent visit we heard nothing of a lumbung desa" (p. 699).

The communal feast. In addition to modes of production, communal rituals also played a role in reinforcing collectivist culture in traditional agricultural communities. In Indonesia, the *slametan* (communal feast) was a representative example, often held during important stages of the crop cycle (Geertz, 1956, 1957; Koentjaraningrat, 1967; Peacock, 1968). The ritual was performed in close groups of neighboring families and involved a variety of communal activities such as a shared meal, the preparation of offerings to deities, and the burning of incense. In rice farming, slametans would occur in tandem with local natural phenomena that were used to track the timing of the crop cycles, such as the appearance of star constellations, the flowering of certain plants, and animal behavior tied to climatic conditions (Koentjaraningrat, 1967; Iskandar and Iskandar, 2016, 2017).

[3] Acciaioli (1994) further describes how in village-level meetings, local *adat* (traditional law) leaders were only allowed to comment on plans that were *already independently* drawn up by the Agriculture Department, Public Works Department, People's Bank of Indonesia, Cooperatives Office, the Regency Government, and experts invited from agricultural institutes and universities.

[4] We define culture as the system of values, beliefs, and knowledge that affects human behavior and is transmitted between individuals (Nunn, 2021).

[5] Examples of specific labor exchange systems include *sambatan*, which provided meals to laborers while assisting with farming tasks, and *pakèhan*, where laborers initially worked in transplanting and returned later during the harvest. *Kedokan* was another arrangement that required participants to contribute labor throughout the entire crop cycle—land preparation, transplanting, and weeding—in order to partake in the harvest (Alexander and Alexander, 1979, 1982; White, 2000).

[6] Similarly, Jay (1969) describes the harvest as an event where "all who hear of it may come join", with farmers taking "much pride in the size of the harvesting group attracted to its field", and Stoler (1977) states that harvesting rights were "often obligatory, and fall outside the more impersonal category of farm wage labor".

[7] Anthropologists argue that Green Revolution technologies rendered traditional village-wide harvesting practices increasingly inefficient due to the new rice crops from HYVs having shorter, thicker stalks and faster growth cycles (Collier et al., 1973, 1974; Rigg, 1989).

The anthropological literature highlights the slametan specifically as a key ritual reinforcing collective, interdependent norms and beliefs. According to Geertz (1956), "In the slametan the dependence of neighboring individuals upon one another and upon the crops of their fields is symbolized, and the necessity for inter-familial cooperation, behavioral predictability, and de-emphasis of individual peculiarities are underlined" (p. 140). Similarly Peacock (1968) asserts that "the slametan sanctifies and symbolizes mutual dependence and mystic unity of neighbors. During the slametan, few gestures signifying rank are used. Every participant feels part of one body" (p. 94).

However, the advent of modern farming technologies during the Green Revolution led to the decline of the slametan, as the customs and traditions used to track the stages of the crop cycle became obsolete. Crops became more resilient to local climatic conditions, crop cycles shortened, and yields ultimately increased (Partasasmita et al., 2019). An example of this is described by Soemardjan and Breazeale (1993) who explain the disappearance of the slametan performed around harvest:

> "Bimas has effectively put an end to the age-old customs of performing religious rituals for ensuring a bumper crop. Some of these rituals may still be performed here and there by way of habit, but the traditional roles of ritual specialists are no longer fully meaningful. Instead of relying on the magic of these ritual specialists, Indonesian farmers now depend on new agricultural technologies, including the use of specially cultivated hybrid seeds, fertilizers, and insecticides. Rational planning has replaced superstitions beliefs and customs" (p. 206).

2.3. Hypothesis

Cultural evolution. The literature widely documents that the Green Revolution disrupted communal practices that were central to traditional wetland rice cultivation. As highlighted in Section 2.2, these communal practices played critical roles in fostering collectivist values and beliefs, what Geertz describes as a culture of *shared poverty*: "a set of values which commit those who hold them to a communalistic rather than an individualistic approach to economic problems" (p. 141). How does culture evolve as these practices diminish?

Standard theoretical models of cultural evolution posit that the formation of a cultural trait depends on its relative returns, with higher-return traits being more likely to propagate (e.g., Boyd and Richerson, 1985; Bisin and Verdier, 2001, 2011).[8] This framework implies that as changes in agricultural practices alter the relative returns to different traits, the values and beliefs held by society adjust accordingly (i.e. culture evolves).

This prediction maps closely to the rollout of the Green Revolution in Indonesia. In the pre–Green Revolution environment, rice cultivation generated high returns to collectivist beliefs, as agricultural success depended critically on mutual cooperation and coordination.[9] With the advent of Green Revolution technologies, however, many of these collective arrangements became less efficient and increasingly costly to sustain, thereby reducing the relative returns to collectivist traits. As a result, the share of individuals holding collectivist values and beliefs is predicted to decline.

We take this prediction to the data by comparing rice-farming districts in Indonesia with differential exposure to the Green Revolution. Our hypothesis suggests that rice-farming districts more heavily exposed to the Green Revolution would have experienced a greater shift toward individualism (a decline in collectivism) following its implementation. Moreover, unless the rollout of the Green Revolution was systematically tied to the initial cultural trends of the districts, this shift should not be observable prior to the Green Revolution rollout, which we test for by looking at pre-trends.

Other potential channels. Because the Green Revolution transformed many dimensions of rural economic and social life simultaneously, the observed shift toward individualism could have resulted through channels beyond the disruption of communal agricultural practices. These channels are not necessarily mutually exclusive: some may have operated independently of the disruption of communal practices, while others may have been set in motion by that disruption itself. We discuss several competing mechanisms here, and Section 4.3 provides empirical evidence on their relevance to our findings.

Direct economic effects of the Green Revolution represent a broad class of alternative channels. For example, productivity growth in agriculture may have induced labor reallocation out of the agricultural sector (Alvarez-Cuadrado and Poschke, 2011; Bustos et al., 2016). Given that agricultural societies are often considered more collectivist than non-agricultural societies (Uchida et al., 2019), such structural transformation could independently contribute to a rise of individualism. Relatedly, the Green Revolution shifted farming from subsistence toward commercial production, deepening trade and market integration. A growing literature documents that market participation can supplant traditional values rooted in kinship and communal networks with more impersonal prosocial norms (Henrich et al., 2010; Agneman and Chevrot-Bianco, 2023; Enke, 2023), suggesting that the commercialization of rural agriculture could serve as an independent driver of cultural change.

Structural transformation and rising agricultural incomes may have further influenced broader modernization, including urbanization, improved infrastructure, increased education, and increased access to public services—each of which has been linked to the emergence of individualistic values (Inglehart and Oyserman, 2004; Hamamura, 2012; Santos et al., 2017). Educational expansion is particularly relevant in this context, given the documented effects of the Green Revolution on human capital accumulation (Foster and Rosenzweig, 1996, 2004), the concurrent INPRES school construction program in Indonesia (Duflo, 2001), and the potential link between education and individualistic culture (Triandis et al., 1988).

The Green Revolution also had significant effects on health outcomes, fertility, and family size (Bharadwaj et al., 2020; Gollin et al., 2021), all of which could be independent determinants of collectivist attitudes (Schwartz et al., 2010). In addition, selective migration could serve as an alternative channel (Varnum and Kitayama, 2011; Knudsen, 2019; Bazzi et al., 2020a; Raz, 2025). If individualistic households migrated selectively toward areas with greater Green Revolution exposure, it would lead to a spurious attribution of cultural change to agricultural technology adoption. In Section 4.3, we test for robustness to these channels and find suggestive evidence that they are unlikely to be central to our results.

Lastly, we note that traditional agricultural practices may shape culture beyond the disruption of cooperative norms. For instance, agricultural conditions have been shown to influence time preferences, as crops with longer growing seasons and higher returns to patience foster lower discount rates (Galor and Özak, 2016). Agricultural practices are also a natural setting for social learning: farmers historically relied on observing neighbors' practices and outcomes to inform decisions about planting, input use, and risk management (Foster and Rosenzweig, 1996; Raz, 2025). The role of social learning in our context

[8] The specific mechanisms of cultural transmission differ across models. For example, cultural traits may be passed from parents to children (vertical transmission) or adopted through imitation (horizontal transmission) (Boyd and Richerson, 1985; Bisin and Verdier, 2011).

[9] The influence of historical agricultural practices on individualist versus collectivist beliefs is well documented in the literature (Bardhan, 2000; Talhelm et al., 2014; Ang, 2019; Buggle, 2020; Fiszbein et al., 2022). This body of research consistently shows that agricultural conditions requiring cooperative practices—such as high labor intensity and irrigation-dependent cultivation—promote collectivist values and beliefs.

is, however, ex-ante ambiguous. On one hand, the decline in the usefulness of inherited traditions could have increased the marginal benefits of learning from neighbors rather than from past generations (Giuliano and Nunn, 2021). On the other hand, by shifting the locus of agricultural knowledge from horizontal peer networks to formal top-down channels, the Green Revolution may have reduced farmers' reliance on local social networks, weakening interpersonal bonds that sustained collectivist norms independently of changes in communal farming practices (Raz, 2025). Unlike the channels discussed above, these mechanisms are difficult to test directly, as they operate through the same changes in agricultural practices that underlie our main hypothesis. We therefore acknowledge them as plausible concurrent processes that may complement the disruption of traditional farming practices documented in Section 2.2.

3. Data and measurement

Our empirical analysis requires two key variables across districts and time periods: (i) measures of Green Revolution exposure and (ii) measures of individualism. Section 3.1 introduces our proxy for local exposure to the Green Revolution programs, and Section 3.2 introduces the name-based index of individualism.

3.1. Exposure to the Green Revolution

Measurement. In our context, regional variation in the adoption of modern agricultural inputs and practices would be ideal for examining the cultural effects of the Green Revolution. In the absence of such data, one possible alternative is to use the shift in the share of agricultural land allocated to rice production (rice acreage share) as a proxy for district-level exposure to the Green Revolution. Given that the Green Revolution in Indonesia was exclusively focused on rice, increases in rice acreage shares during this period might serve as a reasonable proxy for the roll-out of modern farming technologies.

We further refine and validate our use of rice acreage shares in two respects. First, in place of observed changes in rice acreage shares, we use *residual rice growth* as our main treatment variable. Specifically, we use a fractional logit regression to decompose observed changes in rice acreage shares into a component determined by *potential* shifts in the profitability of rice farming based on agro-climatic suitability (*potential* rice growth), and a *residual* component that is orthogonal to the potential counterpart (*residual* rice growth). We interpret the latter as better reflecting exposure to the Green Revolution programs, which were implemented in a top-down manner orthogonal to local market conditions. Second, we validate this measure by showing that *residual* rice growth is strongly correlated with cross-sectional measures of household exposure to the BIMAS program and the adoption of Green Revolution technologies in 1983. In contrast, *potential* rice growth is largely uncorrelated with these measures.

Changes in rice acreage (1963–1983). The data on rice acreage shares for the pre- and post-Green Revolution periods are drawn from the 1963 and 1983 Agricultural Censuses. As discussed in Section 2.1, the launch of the BIMAS program in 1966 marked the start of the Green Revolution. Hence, 1963 is the first pre-treatment period in which we observe rice acreage shares. Similarly, 1983 is the first post-treatment period in which we observe rice acreage shares following the achievement of rice self-sufficiency in Indonesia (Manning, 1987; Sharifuddin et al., 2019).[10]

Construction of residual rice growth. In terms of measurement, observed rice acreage may have expanded between 1963 and 1983 for reasons beyond the Green Revolution. A leading concern is market-driven changes in rice production that are independent of program exposure. During the early phase of the Green Revolution in Indonesia, rice expansion partly resulted from farmers reacting to improved price stability and favorable market conditions as the government was pushing for rice self-sufficiency (Mears, 1981). For such farmers, increases in rice acreage may not reflect the adoption of modern farming technologies, but rather a profit-driven reallocation of resources toward rice, facilitated by expanding access to rice markets.[11]

Therefore, to better measure the technical change-driven component of rice expansion, we decompose changes in rice acreage share into two parts: one attributable to shifts in market conditions and the other attributable to remaining unexplained factors. We refer to the latter as *residual rice growth*, which captures changes in rice prevalence not explained by shifts in agro-climatic crop profitability.[12]

The construction of residual rice growth proceeds in two steps. First, we estimate separate fractional logit models for 1963 and 1983 to obtain: (i) the potential rice share, explained by profit-maximizing behavior, and (ii) the residual rice share, representing the remaining component of rice cultivation not accounted for by market forces.

$$\text{Rice}_{i,t} = \frac{e^{\phi'_{i,t}\lambda_t}}{1+e^{\phi'_{i,t}\lambda_t}} + \mu_{i,t}. \tag{1}$$

The estimation follows a standard crop choice model based on profit-maximizing planters as specified in Eq. (1).[13] For each period $t \in \{1963, 1983\}$, $\text{Rice}_{i,t}$ indicates the share of agricultural land allocated to rice production in district i. $\phi_{i,t}$ is a vector of crop suitabilities, as measured by agro-climatic potential yields provided by FAO-GAEZ (Fischer et al., 2021).[14] A period-specific coefficient λ_t maps crop-specific suitabilities into profitability under the national market environment in period t (e.g., crop prices).

We refer to the fitted value from this equation as the *potential rice share*. This captures the variation in rice acreage share explained by profit-maximizing choices, depending on district-level crop suitabilities $\phi_{i,t}$, and period-specific market conditions $\hat{\lambda}_t$.

$$\text{Potential Rice}_{i,t} \equiv \frac{e^{\phi'_{i,t}\hat{\lambda}_t}}{1+e^{\phi'_{i,t}\hat{\lambda}_t}}.$$

We define the *residual rice share* as the difference between the observed rice acreage share and its potential (profitability-driven) counterpart. By construction, residual rice share captures the portion of rice prevalence not accounted for by agro-climatic suitability and the national market environment in period t.

$$\text{Residual Rice}_{i,t} \equiv \text{Rice}_{i,t} - \text{Potential Rice}_{i,t} = \hat{\mu}_{i,t}.$$

[10] Therefore our sample consists of districts observed in both the 1963 and 1983 Agricultural Censuses rice acreage information. Districts excluded from the sample are primarily (semi-)urban areas in and around large towns, which lack records of rice acreage and overall crop production. In addition, we exclude the islands of Maluku and Papua as the former has no records in the Agricultural Censuses and the latter was not yet part of Indonesia.

[11] Such market-driven rice expansion typically involved incremental adjustments within traditional production methods rather than fundamental changes in farming technologies (Herdt and Capule, 1983; Dove, 1985).

[12] Our approach is similar to He et al. (2019). To study the effects of pollution on labor productivity, He et al. (2019) uses the residualized covariation in worker-level output and pollution that remains, *after* controlling for systematic seasonal variation, as their main source of identifying variation.

[13] The intuition is based on a discrete crop-choice model with a profit-maximizing farmer, proposed by Fiszbein (2022). Suppose that a farmer maximizes her profit $\pi_c = \phi_c\lambda + u_c$ where λ is a vector of crop-specific suitabilities. If the error term follows the Type 1 extreme value distribution, then the profit-maximizing probability of growing crop c is derived as $\frac{e^{\phi_i\lambda}}{1+e^{\phi'_i\lambda}}$, which we interpret as the share of acreage for crop c. For theoretical derivations, see Jung (2020).

[14] The model includes the suitability of rice and other major crops in Indonesia, including cocoa, oil palm, wheat, maize, coffee, and cassava. For rice suitability, we use potential yields under low-input technology for 1963 and high-input technology for 1983. This captures the changes in production conditions before and after the Green Revolution, which echoes the approach of Bustos et al. (2016, 2020).

Next, based on the decomposition results, we define:

$$\text{Potential rice growth} \equiv \text{Potential Rice}_{i,1983} - \text{Potential Rice}_{i,1963},$$
$$\text{Residual rice growth} \equiv \text{Residual Rice}_{i,1983} - \text{Residual Rice}_{i,1963}.$$

By definition, the sum of potential and residual rice growth equals the change in the share of rice acreage between 1963 and 1983. Potential rice growth captures changes in rice prevalence explained by shifts in profitability, as determined by crop-specific suitabilities and changing market conditions. Residual rice growth measures the remaining change in rice production, which we take to be more closely tied to the rollout of the Green Revolution programs.

Given our discussion that the Green Revolution rollout in Indonesia was likely orthogonal to market forces, we interpret residual rice growth as being more effective in capturing the consequences of the Green Revolution. Supporting this view, we show in the following section that cross-sectional proxies for Green Revolution exposure show a distinct association with residual rice growth, but not for potential rice growth.

In Fig. 1, we plot the district-level correlation between observed rice growth and our two decomposition measures: potential and residual rice growth. Both measures are positively correlated with observed rice growth, indicating that both market-driven and non-market-driven forces contributed to the expansion of rice production between 1963 and 1983.[15] This underscores the importance of the decomposition in isolating changes in rice production that were not driven by market forces, as such changes were less likely to have been tied to the Green Revolution and technical change.[16]

We emphasize that this decomposition does not draw a sharp distinction between Green Revolution and non–Green Revolution sources of rice expansion. The adoption of Green Revolution technologies need not have been entirely orthogonal to local market conditions. For instance, if high-yielding varieties diffused in part as a response to differences in agro-climatic suitability and the profitability of rice farming, then part of the exposure to the Green Revolution—and some of the channels through which it may have shaped culture—would be absorbed by potential rather than residual rice growth. However, this possibility is unlikely to substantially affect our interpretation. Our validation exercise shows that cross-sectional proxies for the adoption of Green Revolution technologies—BIMAS enrollment and the use of high-yielding varieties in 1983—are strongly associated with residual rice growth but not with potential rice growth (Table 1). Empirically, the market-driven expansion captured by potential rice growth carries little of the observable dimension of Green Revolution exposure, suggesting that this concern is quantitatively limited in our setting.

Also, we do not claim that variation in residual rice growth is solely a consequence of the Green Revolution. Residual rice growth may reflect local shocks to rice production that, while orthogonal to crop suitability and national market conditions, are driven by factors other than the rollout of Green Revolution programs. However, such factors would introduce systematic bias only if they directly affected individualism independent of the Green Revolution, which we view as unlikely. Taken together, residual rice growth is an imperfect but preferable measure of local exposure to these programs. Observed rice growth conflates program-driven expansion with the profit-driven expansion determined by crop suitability and market conditions, factors that may in turn be correlated with other local conditions. Residual rice growth, by contrast, is likely orthogonal to these factors. Given the absence of data directly measuring local policy interventions, we therefore treat residual rice growth as our best available indirect proxy for local exposure to the Green Revolution. Section 4.3 further shows that our findings are robust to a battery of initial local characteristics and alternative socioeconomic changes during the Green Revolution, further alleviating related concerns.

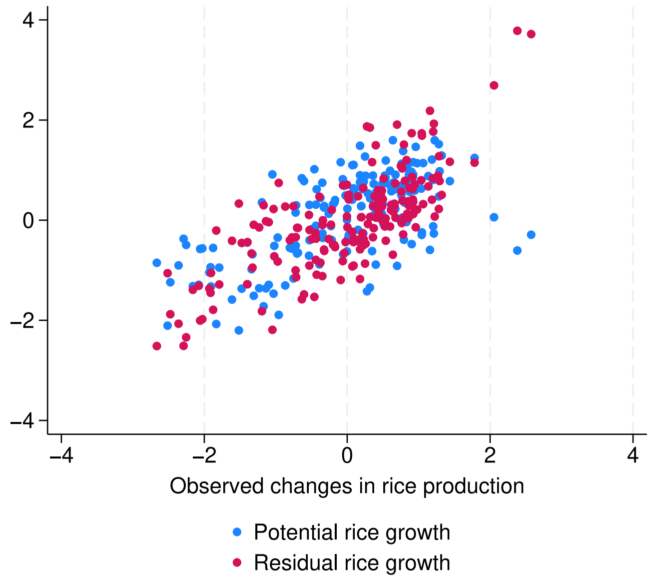


Fig. 1. Residual and potential rice growth.
Notes: This figure plots the observed changes in rice acreage shares between 1963 and 1983 against potential rice growth (in blue), and residual rice growth (in red) for Indonesian districts in the 1963 and 1983 Agricultural Censuses. All values are standardized. Potential and residual rice growth are calculated by decomposing observed changes in rice acreage shares. Potential rice growth captures changes in rice acreage share that are attributable to agro-climatic suitability and non-local market conditions. Residual rice growth (orthogonal to potential growth) captures the variation due to district-specific factors. See Section 3.1 for more details. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Validation. We test the validity of residual rice growth as our main measure of exposure to Green Revolution roll-out using a number of additional variables from the 1983 Agricultural Census. We first look at a direct measure of enrollment into the BIMAS program: the number of agricultural households enrolled in BIMAS. Next, we construct an index of Green Revolution technology adoption from a principal component analysis of three measures of agricultural technology usage: the number of households using HYVs per hectare, average fertilizer usage per hectare, and the share of irrigated land. We use the first principal component as the index for Green Revolution technology adoption.[17]

A caveat is that these variables are only available in 1983 (the final phase of the Green Revolution), and thus only provides us with cross-sectional variation in Green Revolution exposure. Nevertheless, these measures would still be informative about differential exposure to the Green Revolution stemming from rollout between 1963 and 1983, if pre-Green Revolution levels of new technology use were relatively homogeneous across districts. In this case, the 1983 measures should be correlated with residual rice growth, our main measure of Green Revolution exposure.

We aggregate each measure at the district level and estimate Eq. (2):

$$Y_i = \alpha + \beta\ \mathrm{GR}_i + X'_{geo,i}\gamma + X'_{se,i}\lambda + \delta_p + \epsilon_i. \tag{2}$$

[15] Residual rice growth explains 42% and potential rice growth explains 58% of the total variation in observed rice growth.

[16] Outliers may still raise concerns. The plot indicates that the influence of residual rice growth was smaller in regions with the largest increases in rice production. To address the potential influence on our estimation, Appendix A.3 tests the robustness of our results to excluding outlier districts.

[17] All three measures load positively on the first component and explain 60% of the total variance across the three measures.

Table 1
Residual rice growth and exposure to the BIMAS program.

Dep. var.: number of BIMAS households per hectare of agricultural area				
	(1)	(2)	(3)	(4)
Observed rice growth	0.170***			
	(0.038)			
Residual rice growth		0.129**		0.129***
		(0.057)		(0.034)
Potential rice growth			−0.117	−0.003
			(0.181)	(0.147)
Observations	173	173	173	173
R-squared	0.19	0.20	0.18	0.20
Geoclimatic controls	Y	Y	Y	Y
Initial socioeconomic controls	Y	Y	Y	Y
Province fixed effects	Y	Y	Y	Y

Notes: This table reports standardized coefficients estimated from Eq. (2). The outcome variable is the number of BIMAS households per hectare of agricultural area. The explanatory variable in column 1 is the observed change in rice acreage share between 1963 and 1983. Columns 2 and 3 use residual and potential rice growth, respectively, based on the decomposition method presented in Section 3.1. Column 4 employs both residual and potential rice growth as explanatory variables. Standard errors are adjusted following the Conley (1999) method, with a distance cutoff of 200 km.

The outcome variable, Y_i, is the validation outcome in district i from the 1983 Agricultural Census. GR_i denotes different measures of rice expansion—observed, potential, and residual growth—depending on the specification. To validate our decomposition approach, the expectation is that outcome, Y_i, should be correlated with *residual* and not potential rice growth. $X_{geo,i}$ is a vector of geoclimatic controls, including agricultural land suitability, terrain ruggedness, distance to the nearest river and coastline, temperature, precipitation, and latitude. $X_{se,i}$ includes initial socioeconomic characteristics that may influence both agricultural production and local cultural traits: population density, average farm size, the share of farmland, farm size inequality, and the female ratio, all derived from the 1963 Census.

Table 1 presents results using the number of agricultural households enrolled in BIMAS. Observed rice expansion during the Green Revolution is positively associated with BIMAS enrollment (Column 1). Importantly, in line with our expectations, this relationship appears to be primarily driven by residual rice growth: the coefficient for residual growth is strongly positive (Column 2), while the coefficient for potential growth is negative but statistically insignificant (Column 3). In Column 4, we include both potential and residual rice as explanatory variables in a horserace regression. Given that the sum of residual and potential growth equals the total change in rice acreage share, this specification allows for a direct comparison of their relative contributions. The coefficient for residual growth remains positive and of similar magnitude, while the correlation between potential growth and BIMAS exposure becomes negligible. This provides strong evidence that residual rice growth potentially captures the variation in rice expansion, linked specifically to the adoption of new production practices from the Green Revolution roll-out.

The same patterns are observed when using the index of Green Revolution technology adoption. Table 2 presents results and shows that, again, technology adoption is positively correlated only with residual rice growth, both when using residual rice growth as a standalone explanatory variable and in a horserace regression that additionally includes potential rice growth.[18]

These results suggest that residual rice growth closely captures our variation of interest—that of rice expansion linked to the adoption of new production practices, introduced through the Green Revolution. Accordingly, throughout the rest of the paper, we use residual rice growth as a baseline proxy for local exposure to the Green Revolution.

While BIMAS enrollment and measures of technology adoption are likely to be accurate measures of Green Revolution roll-out, they are only available in 1983, potentially raising concerns that these measures might reflect fixed local characteristics and precluding us from using them as our main treatment variable. Nevertheless, we show in Appendix B that estimates using BIMAS exposure as our main treatment variable are consistent with the baseline findings based on residual rice growth. We interpret this as further evidence that supports the validity of our research design.

3.2. Measuring individualism

Infrequent names. We measure district-level individualism using the prevalence of infrequent first names. This method draws on the intuition that uncommon names reflect the cultural attitudes of parents who place greater value on their child standing out rather than fitting in (Twenge et al., 2010; Varnum and Kitayama, 2011), an approach that has been applied to various contexts in the economics literature (Knudsen, 2019; Bazzi et al., 2020a; Fiszbein et al., 2022; Jung, 2025).

Ideally, the individualism measure for each period would be constructed using the corresponding census data from that time. However, due to data limitations, we track individualism over time using the year of birth and birth district of individuals in the complete-count Indonesian Census of 2010, which includes the names of all 246 million individuals in the population.[19] To avoid bias due to heterogeneity in naming practices across ethnicities, we exclude all individuals of foreign origins.[20]

The measure of individualism is constructed in two steps. First, we rank names by popularity for each 5-year birth cohort. To account for the possibility of different naming practices across regions, name frequencies are counted at the province level. Second, for each district within a province, we calculate the share of individuals whose names are outside of the top 25 most frequent names in their birth cohort. In Appendix A.5, we show that our baseline results remain robust to alternative definitions of frequent names.

[18] In Appendix C, we report the estimates of Eq. (2) when using each measure of Green Revolution technology adoption as separate outcomes—results exhibit similar patterns.

[19] This approach involves a potential limitation, as individuals who died before 2010 are not reflected in the data. However, unless survival rates are systematically correlated with the level of individualism in a given birth district, this attrition would not bias our measure of individualism.

[20] The Census codes the following ethnicities as foreign: American; Australian; Indian; English; Japanese; Korean; Malaysian; Pakistani; Filipino; Singaporean; Thai; and Dutch. In addition, we exclude individuals of Chinese ethnicity. These individuals comprise 1.2% of the entire 2010 census. In Appendix A.5, we further show that counting name frequency across more granular ethnic groups, even within the native-origin population, does not affect the results.

Table 2
Residual rice growth and Green Revolution technology adoption.

Dep. var.: Green Revolution intensity (PCA of HYVs, fertilizer, irrigation)				
	(1)	(2)	(3)	(4)
Observed rice growth	0.189*			
	(0.099)			
Residual rice growth		0.127**		0.140**
		(0.061)		(0.071)
Potential rice growth			−0.046	0.080
			(0.112)	(0.140)
Observations	173	173	173	173
R-squared	0.44	0.44	0.40	0.44
Geoclimatic controls	Y	Y	Y	Y
Initial socioeconomic controls	Y	Y	Y	Y
Province fixed effects	Y	Y	Y	Y

Notes: This table reports standardized coefficients estimated from Eq. (2). The outcome variable is the first principal component of the three measures that proxy Green Revolution technology adoption: the number of households using HYVs per hectare of agricultural area; average usage of fertilizer per hectare of wetland paddy farming; and the share of irrigated land. The explanatory variable in Column 1 is the observed change in rice acreage share between 1963 and 1983. Columns 2 and 3 use residual and potential rice growth, respectively, based on the decomposition method presented in Section 3.1. Column 4 employs both residual and potential rice growth as explanatory variables. Standard errors are adjusted following the Conley (1999) method, with a distance cutoff of 200 km.

Validation. Name-based measures of individualism have been widely used in the economics literature (Knudsen, 2019; Bazzi et al., 2020a; Fiszbein et al., 2022; Jung, 2025), supported by extensive validation across contexts ranging from Western to Asian settings (Twenge et al., 2010; Ogihara et al., 2015; Cai et al., 2018; Knudsen, 2019; Bao et al., 2021; Ogihara, 2025).[21] However, their validity in the Indonesian context has not yet been examined, which might raise concerns about the interpretation of our empirical analysis. To address this gap, we conduct a validation exercise using data from the World Values Survey (WVS).

We examine whether respondents in regions with a higher prevalence of infrequent names exhibit more individualistic attitudes. The estimation follows Eq. (3). For each individual i living in island k and surveyed in wave w, the dependent variables ($Y_i^{k,w}$) are derived from questions related to individualism and collectivism. X_i is a vector of fixed effects for gender, age, ethnicity, marital status, educational attainment, and income groups, and δ_w denotes survey-wave fixed effects. ShrNonTop25_k represents the share of names outside top-25 frequent names in island k. This validation exercise therefore relies essentially on variation across six islands, the only within-country geographical units available in the WVS data. We acknowledge that reliance on the island-level variation poses a limitation of the exercise. Nevertheless, conditional on a range of individual-level controls, a strong correlation between the island-level share of infrequent names and cultural attitudes of respondents would provide a useful validity check for the name-based approach in the Indonesian context. Since the relevant WVS questions are available across the 2001, 2006, and 2018 waves, we use the share of infrequent names calculated from the 2001–2005 birth cohort throughout the regressions. For ease of interpretation, all outcome variables are transformed into binary indicators.

$$Y_i^{k,w} = \alpha + \beta \text{ShrNonTop25}_k + \gamma' X_i + \delta_w + \epsilon_i \tag{3}$$

Fig. 2 shows the results for five WVS questions that capture core dimensions of individualism. *Independence* reflects whether respondents consider independence an important quality for children. The positive coefficient suggests that parents in islands with higher prevalence of infrequent names place greater emphasis on independence. Consistent with this, *Sense of belonging*—indicating how close respondents feel to their local community—shows a negative coefficient, suggesting a weaker collectivist attitudes. These patterns are corroborated by the remaining three variables: *Locus of control*, measuring whether respondents believe they have free choice and control over their lives; *Pro-competition* attitudes, which capture the extent to which respondents view competition as beneficial rather than harmful; *Self-responsibility*, reflecting the perceived importance of individual responsibility relative to government responsibility. All three measures are positively associated with the share of infrequent names, indicating more proactive attitudes in regions with higher prevalence of infrequent names.[22]

Taken together, the results provide consistent evidence supporting the validity of our approach: the prevalence of infrequent names exhibits significant associations across five key dimensions of individualism. Despite the limited island-level variation, these results alleviate concerns about the use of name-based measures of individualism in the Indonesian context.

Trends in individualism. To examine the distribution of the name-based measure of individualism and its overall trends, Fig. 3 presents boxplots of the share of infrequent names by birth cohort. The plots are drawn for the 241 districts included in the baseline specification, across the sample period of the analysis from 1941 to 2006 at 5-year intervals. The figure suggests that the share of infrequent names remained stable during the 1940s and 1950s, with the median at around 0.85 and interquartile values of approximately 0.8 and 0.9. However, the overall distribution shifts gradually downward from the 1960s onward. By 2006, the median had declined from approximately 0.85 to 0.80, and the mean from 0.81 to 0.77.[23]

[21] Similar trends have also been found in Latin America (Fan et al., 2025).

[22] The survey-based outcome variables are constructed as follows. *Independence* is derived from question A029, which asks respondents whether they consider independence an especially important quality for children to learn at home. *Sense of belonging* is based on question G255, which asks respondents how close they feel to their village, town, or city on a four-point scale ranging from "not close at all" to "very close". The variable equals one if the respondent reports feeling close or very close. *Locus of control* draws on question A173, which asks respondents to rate how much freedom of choice and control they feel they have over their lives on a 1–10 scale. The variable equals one if the respondent reports a high level of perceived control, defined as a response of 9 or above. *Pro-competition* is based on question E039, which asks respondents to rate their view of competition on a 1–10 scale, where 1 indicates that competition is good and 10 that it is harmful. The variable equals one if the respondent selects the strongest pro-competition response. *Self responsibility* is based on question E037, which asks respondents to place their views on a 1–10 scale between individual and government responsibility. The variable equals one if the respondent selects the strongest preference for individual self-reliance over government support.

[23] The mean share of infrequent names in our sample is slightly higher than that typically observed in Western contexts. For example, Bazzi et al. (2020a) report a county-level *average* of 76.6% for the share of infrequent names. However, these figures are not directly comparable across countries,

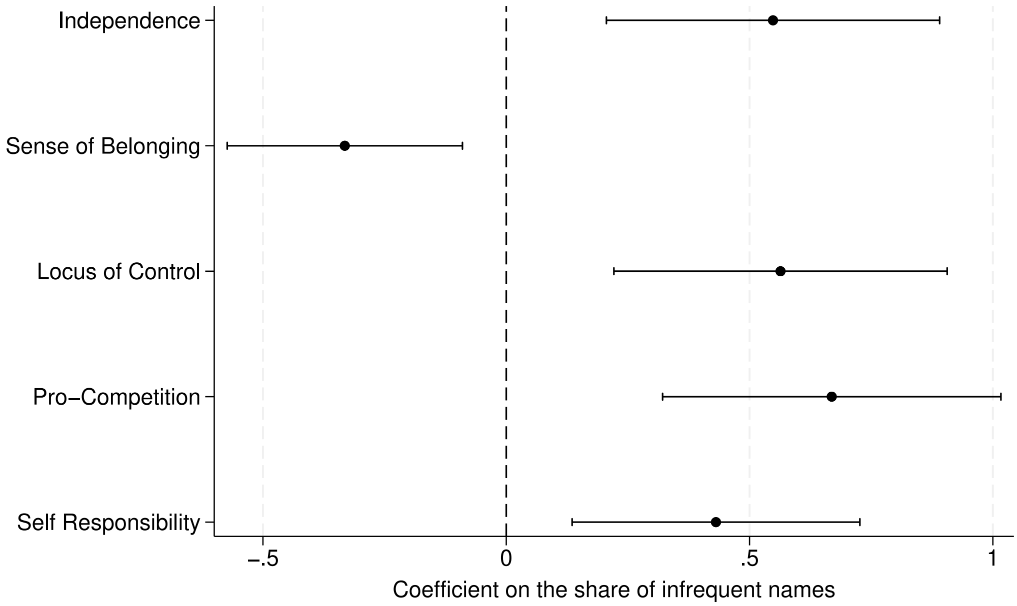


Fig. 2. Validation of the measure of individualism: World Values Survey questions.
Notes: The figure shows the results of individual-level regressions using the island-level share of infrequent (outside the top 25) names as the explanatory variable. All specifications include fixed effects for gender, age, ethnicity, marital status, educational attainment, income, and survey wave. 95% confidence intervals are based on heteroskedasticity-robust standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The gradual decline from the 1960s is consistent with a set of mutually reinforcing forces that strengthened collective identity in Indonesia during the New Order period. State ideology was one factor. The New Order regime actively promoted *Pancasila* and its associated ethos of *gotong royong* (mutual cooperation) as the ideological foundation of social life, elevating communal solidarity and national unity over individual distinctiveness (Bowen, 1986). Nation-building efforts reinforced this shift: transmigration programs that resettled millions of Javanese families to the outer islands from the 1970s onward were launched with the stated goal of integrating diverse ethnic groups into a unified nation (Hoey, 2003).[24]

Islamization was another operating force. The 1960s marked a sustained expansion of Islamic organizational capacity, which strengthened communal religious networks and reinforced group conformity in subsequent decades (Bazzi et al., 2020b). This laid the groundwork for an Islamic resurgence from the 1970s onward, as formerly nominal (*abangan*) Muslims increasingly adopted orthodox practices and formed a more cohesive religious group identity (Hefner, 2011; Ricklefs, 2012). This religious convergence had a direct influence on naming practices: as orthodox practice spread, Arabic and Islamic names became increasingly prevalent, raising the frequency of common names (Kuipers et al., 2017). Part of the aggregate decline in the share of infrequent names may therefore reflect growing commonality in naming rather than a change in individualistic values.

These aggregate forces do not pose a threat to our identification strategy. Our baseline specification controls for the province-by-period fixed effects, which absorb any nationwide or province-wide trends in naming patterns, such as the consequences of the New Order ideology or religious homogenization. These forces would bias our estimates only if they differentially affected district-level individualism in a manner correlated with residual rice growth within provinces, which we view is unlikely. Moreover, we assess this possibility directly in Section 4.3, showing that our results are robust to excluding all individuals with Arabic-origin names, and are unlikely to be explained by migration patterns, and other socioeconomic changes over the Green Revolution period.

Lastly, this aggregate decline does not necessarily diminish the magnitude nor policy relevance of our findings. The effect we uncover is a *relative* effect: it reflects the extent to which more exposed districts became more individualistic than less exposed districts within the same province and cohort, set against the broader collectivizing trend of the period. If anything, the fact that a policy-induced increase in individualism is detectable even as nationwide forces pushed in the opposite direction further highlights the indelible cultural imprint left by the Green Revolution.

4. Green Revolution and individualism

This section presents empirical evidence on the effects of local exposure to the Green Revolution on individualism over time. Section 4.1 introduces the estimation strategy, followed by our baseline findings in Section 4.2. Section 4.3 addresses robustness to alternative mechanisms.

4.1. Estimating equation

We examine the effects of the Green Revolution programs on individualism using a continuous difference-in-differences specification in Eq. (4). INDIV_{it} indicates the level of individualism in district i during period t, measured by the share of infrequent (outside the top 25 most

given differences in the underlying sample populations. Including Bazzi et al. (2020a), studies using the name-based measure of individualism in the US typically restrict their samples to white US-born children with white US-born parents, a relatively homogeneous group in terms of ethnic origins. In our case, although the sample is likewise limited to native-born children, the ethnic background of the population is considerably more diverse, which likely leads to greater variation in naming practices. For this reason, the share of infrequent names is more appropriate for analyzing within-country trends or regional differences than for comparing average cultural characteristics across countries.

[24] Bazzi et al. (2019) show that ethnic fractionalization resulting from the resettlement program fostered national integration, while polarization had the opposite effect. Given that the transmigration program likely increased fractionalization at the national level, it may have contributed to the observed decline in individualism by strenthening collective national unity.

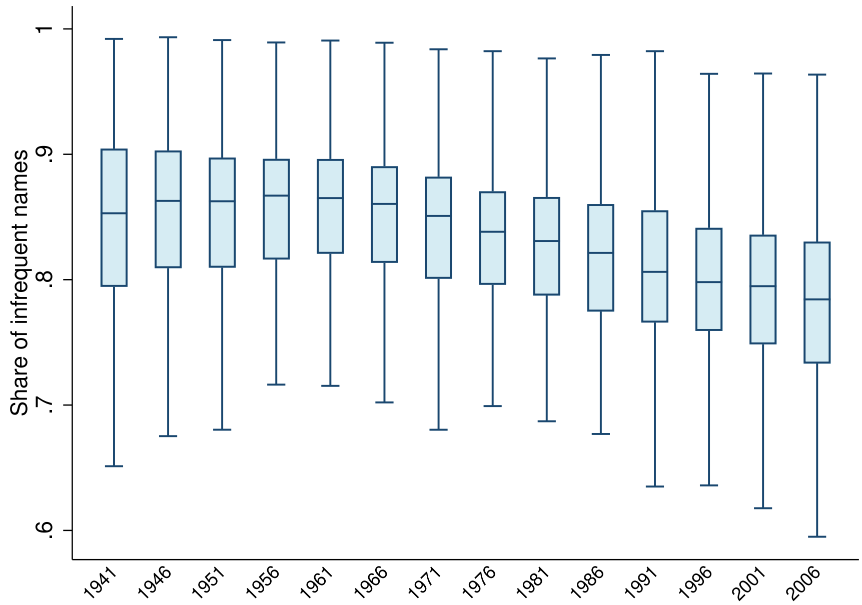


Fig. 3. Distribution of the share of infrequent names by cohort: 1941–2006.
Notes: The figure shows the distribution of the district-level share of infrequent (outside the top 25) names across birth cohorts from 1941 to 2006. Each boxplot displays the distribution across the 241 districts included in the baseline specification. The box represents the interquartile range, and the horizontal line within the box indicates the median.

frequent) names among individuals born in period t. We use 5-year intervals for time periods, with the individualism measure for period t calculated from individuals born in between year t and year $t + 4$. Given that the Green Revolution in Indonesia officially began in 1966, we use 1966 as our reference period.

$$\text{INDIV}_{it} = \alpha + \sum_t \beta_t \, \text{GR}_i + \delta_i + \delta_{pt} + \epsilon_{it} \tag{4}$$

Our primary explanatory variable, GR_i, denotes the change in rice acreage share between 1963 and 1983, which we interpret as capturing the intensity of Green Revolution policies and attendant disruptions of traditional communal practices.

Following the decomposition described in Section 3.1, we use residual rice growth as our preferred measure of district-level exposure to Green Revolution programs, and present regressions using potential rice growth for comparison. The associated time-varying coefficients, β_t, reflect the temporal relationship between the Green Revolution and individualistic culture. δ_i are district fixed effects that account for time-invariant district-specific characteristics, such as any initial differences in cultural traits or agroclimatic conditions. We also control for province-period fixed effects, δ_{pt}, which sweep out time-varying changes in province-specific characteristics. Thus, β_t is estimated conditional on both the temporal effects of province-level Green Revolution policies and province-level trends in individualism.[25] We cluster standard errors allowing for spatial autocorrelation of up to 200 km following Conley (1999). The results are not sensitive to different distance cutoffs (Appendix A.4).

4.2. Results

Baseline estimates. Fig. 4 displays the estimates from Eq. (4), with standardized coefficients shown for ease of interpretation. Our baseline results are shown in Fig. 4(a), which uses residual rice growth—the preferred measure of Green Revolution exposure—as the explanatory variable (see Table 3).

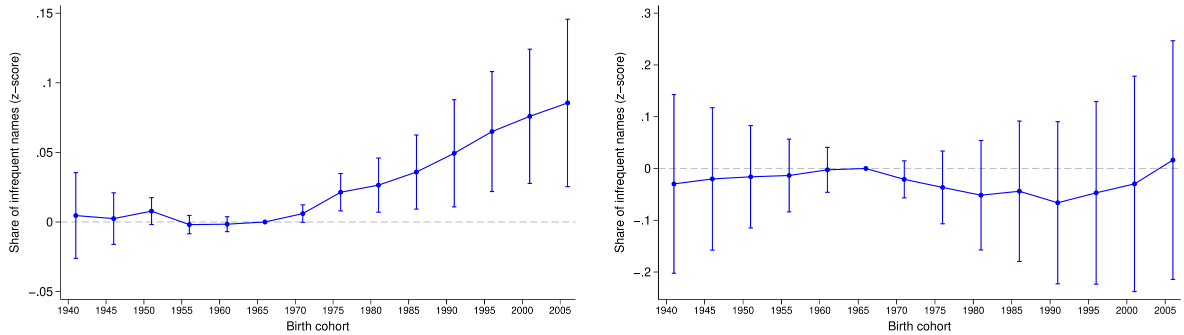
Our estimates show that individualism increased in districts with greater exposure to the Green Revolution, with no presence of pre-trends. Prior to the Green Revolution, we find no evidence of existing cultural trends that are correlated to residual rice growth; the estimated coefficients are small and statistically insignificant. This aligns with our discussion in Section 2.1, indicating that the Green Revolution programs were not systematically targeted towards districts that had initially exhibited increasing individualism.

Following the introduction of the first national program in 1966, we find a relative increase in individualism in districts that were more intensely affected by the Green Revolution. Specifically, we observe a small positive coefficient in 1971, approximately 5–6 years after the program was introduced. The estimates then increase in magnitude and statistical significance over time. By 2006, the last period for which individualism can be measured using the 2010 census data, the estimated coefficients reach a peak.

The increasing effects over time suggest a pattern of cultural transmission that depends on temporal exposure to the Green Revolution. Importantly, given that the outcome variable is naming patterns of children, the cohort-by-cohort pattern should be interpreted as capturing parental experience with traditional versus modern rice farming due to the prevalence of Green Revolution programs in their localities. For example, the emergence of positive effects in 1971 suggests that exposure to the initial phase of these programs influenced the social norms and attitudes of prospective parents, with the small effect size being consistent with the relatively short duration of exposure. In contrast, parents of children born in 2006 to 2010—typically born in the late 1970s—are most likely to have the least experience with traditional rice agriculture compared to earlier cohorts in our sample, leading to stronger effects on their cultural attitudes.[26] As the share of individuals with lower exposure to traditional rice agriculture increases over time, individualistic culture spreads and is reflected in the growing share of infrequent names being given to children. Similar temporal transmission patterns have been documented by Bazzi et al. (2020a)

[25] The results are similar when controlling for period fixed effects instead of province–period fixed effects, suggesting that the cultural effects of the Green Revolution programs operated both within and across provinces.

[26] The median year of birth for parents of children in the 2006–2010 cohort is 1977 (1975 for males, 1979 for females).



(a) Residual rice growth. (b) Potential rice growth.

Fig. 4. The Green Revolution and rise in individualism.
Notes: The plots reports estimates of β_t from Eq. (4) for changes in residual rice growth and potential rice growth between 1963 and 1983, with 95% confidence intervals. Residual rice growth and potential rice growth correspond to the decomposition of observed changes in rice acreage shares presented in Section 3.1. Potential rice growth captures changes in the share of rice acreage between 1963 and 1983 that are attributable to agro-climatic crop suitability and non-local market conditions. Residual rice growth captures the remaining variation explained by district-specific factors. The outcome variable is the share of infrequent names, calculated as the share of names outside the top 25 most frequent names. All estimates control for district and province-period fixed effects. The sample consists of 241 districts for which rice acreage shares are observed in both the 1963 and 1983 Agricultural Censuses.

Table 3
Time-varying effects of the Green Revolution on individualism.

Dep. var.: share of infrequent names	Residual (1)	Potential (2)
Δ Rice acreage share × 1941	0.001	−0.004
	(0.002)	(0.013)
Δ Rice acreage share × 1946	0.000	−0.003
	(0.001)	(0.010)
Δ Rice acreage share × 1951	0.001	−0.002
	(0.001)	(0.007)
Δ Rice acreage share × 1956	−0.000	−0.002
	(0.000)	(0.005)
Δ Rice acreage share × 1961	−0.000	−0.000
	(0.000)	(0.003)
Δ Rice acreage share × 1971	0.001*	−0.003
	(0.000)	(0.003)
Δ Rice acreage share × 1976	0.003***	−0.005
	(0.001)	(0.005)
Δ Rice acreage share × 1981	0.004***	−0.008
	(0.001)	(0.008)
Δ Rice acreage share × 1986	0.005***	−0.006
	(0.002)	(0.010)
Δ Rice acreage share × 1991	0.007**	−0.010
	(0.003)	(0.012)
Δ Rice acreage share × 1996	0.010***	−0.007
	(0.003)	(0.013)
Δ Rice acreage share × 2001	0.011***	−0.004
	(0.004)	(0.016)
Δ Rice acreage share × 2006	0.013***	0.002
	(0.005)	(0.017)
Observations	4802	4802
R-squared	0.54	0.53
District fixed effects	Y	Y
Province-period fixed effects	Y	Y

Notes: The table reports estimates of β_t from Eq. (4) on measures of exposure to the Green Revolution. Columns 1 and 2 use the decomposition of rice acreage share into potential and residual rice growth, respectively, Corresponding to Section 3.1. Potential rice growth captures changes in the share of rice acreage between 1963 and 1983 that are attributable to agro-climatic crop suitability and non-local market conditions. Residual rice growth captures the remaining variation explained by district-specific factors. The outcome variable is the share of infrequent names, calculated as the share of names outside the top 25 most frequent names. The sample consists of 241 districts for which rice acreage shares are observed in both the 1963 and 1983 Agricultural Censuses. Standard errors are adjusted following the Conley (1999) method, with a distance cutoff of 200 km.

who find that individualism monotonically increases in relation to years of exposure to frontier conditions in the settlement of the United States.

In contrast, Fig. 4(b) shows that the estimates for potential rice growth are not statistically different from zero throughout the entire sample period. This confirms that the increase in individualism is not attributable to profitability-based responses to national market conditions by local populations. Taken together, our results provide novel evidence that short-term policy interventions can have substantial effects on the formation of culture, long after the end of the interventions. In all subsequent analyses, we use residual rice growth as our main regressor of interest.

Additional controls. Despite a rich set of fixed effects and the absence of pre-trends, concerns about selection in the rollout may still exist. In this regard, we examine the robustness of the baseline estimates to a battery of pre-Green Revolution local characteristics and their time-varying effects.

We estimate Eq. (5) that now includes $X_{i,1963}$, a vector of pre-Green Revolution district characteristics. These controls are measured around our reference period (1966) from the 1963 Census and are allowed to have time-varying coefficients to capture their temporal effects on individualism. As in the baseline specification, we control for district (δ_i) and province-period (δ_{pt}) fixed effects.

$$\text{INDIV}_{it} = \alpha + \sum_t \beta_t \,\text{GR}_i + \sum_t X'_{i,1963}\gamma_t + \delta_i + \delta_{pt} + \epsilon_{it} \tag{5}$$

$X_{i,1963}$ includes five additional district characteristics that may potentially be associated with the cultural traits and agricultural practices of the locality. Given the possibility that initial agricultural prevalence or productivity influenced the adoption of Green Revolution policies (Evenson and Gollin, 2003), we control for the proportion of farmland in the district area and the average farm size. Land inequality among farms is also included, as disparities in landholdings may have influenced the adoption of advanced production technologies (Binswanger et al., 1993; Foster and Rosenzweig, 2010), while economic inequality could also be correlated with individualistic tendencies (Kraus and Keltner, 2009; Piff et al., 2010). Green Revolution policies could also have been targeted towards districts based on pre-existing levels of local economic development. If pre-existing economic development correlates with changes in individualism, it could bias our estimates. To mitigate this concern, we control for initial population density, a commonly used proxy for local development status in the absence of more detailed data. Lastly, the pre-Green Revolution sex ratio is included to account for possible gender differences in individualism, as well as gender-specific shifts in agricultural labor intensity over time in Indonesia (White, 1985), which may lead to differential effects on culture.

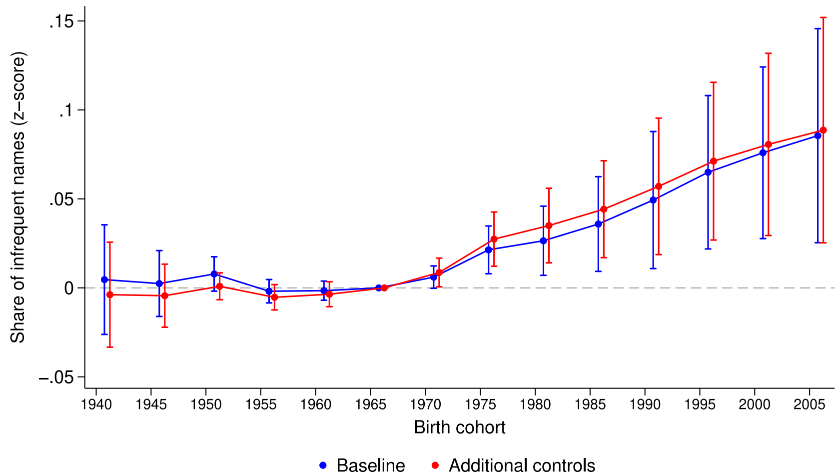


Fig. 5. Robustness to additional controls with time-varying effects.
Notes: The plot reports estimates of β_t from Eq. (4) for changes in residual rice growth between 1963 and 1983, with 95% confidence intervals. For details on the calculation of residual rice growth, see Section 3.1. The outcome variable is the share of infrequent names, calculated as the share of names outside the top 25 most frequent names. Estimates in blue control for district and province-period fixed effects. Estimates in red additionally control for pre-treatment (1963) levels of land inequality, female ratio, population density, average farm size, and the share of farmland, all of which are allowed to have time-varying effects. The sample consists 241 districts for which rice acreage shares are observed in both the 1963 and 1983 Agricultural Censuses. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Fig. 5 presents the baseline estimates (in blue) and the estimates with additional controls (in red), using residual rice growth as the explanatory variable. The results show a consistent pattern: even after accounting for initial local characteristics and their time-varying effects, rice expansion during the Green Revolution exhibits a positive impact on individualism in the subsequent periods, with pre-trends close to zero and statistically insignificant. This suggests that our results are unlikely to be confounded by pre-existing socioeconomic conditions.

Additional robustness checks. Beyond the robustness to initial local characteristics, we conduct a range of additional robustness checks in the appendix. One potential concern is that the rise in infrequent names may reflect the concurrent spread of Islam under Suharto's New Order regime rather than an increase in individualism. To address this, Appendix A.1 replicates the estimation using the share of infrequent names recalculated after excluding all individuals with names of Arabic origin. The results remain largely unchanged.

We also examine whether the results vary by gender. Given female-specific naming conventions that emphasize familial or religious conformity in Indonesia, the name-based measure might be a less reliable proxy for cultural values in the case of female names. To this end, Appendix A.2 shows the estimates using the gender-specific share of infrequent names. The results indicate positive and statistically significant responses to Green Revolution exposure for both groups.

On the estimation side, Appendix A.3 shows that the findings are not driven by outlier districts. By re-estimating the baseline specification after excluding districts in the top five percent of changes in rice acreage shares, we find no meaningful shift in the results. Appendix A.4 tests robustness to different distance cutoffs for the Conley standard errors, where the results are stable across all cutoffs.

Appendix A.5 examines robustness to the alternative definitions of the name-based measure of individualism. We first show that the results are not sensitive to the choice of thresholds used to define infrequent names (top 10 versus top 50 most common names). Next, we confirm that calculating name frequency at a broader island level, rather than the province level, does not significantly alter the findings. Lastly, we show that the results are robust using the individualism measure based on ethnicity-level name frequency, indicating that variation in naming practices across ethnic identities does not confound the observed effects on individualism.

4.3. Robustness to alternative channels

Competing channels. As discussed in Section 2.3, the Green Revolution may have affected individualism through channels beyond the disruption of communal agricultural practices. To address this concern, we estimate Eq. (6) controlling for a vector of *changes* in local socioeconomic characteristics, X_i, which might have been correlated with the rollout of the Green Revolution programs. The additional controls are primarily drawn from the 1971 and 1985 Intercensal Population Surveys (Ruggles et al., 2024), the closest years available to the start and end of the Green Revolution period.[27]

$$\text{INDIV}_{it} = \alpha + \sum_t \beta_t \ \text{GR}_i + \sum_t X_i' \gamma_t + \delta_i + \delta_{pt} + \epsilon_{it} \tag{6}$$

X_i consists of twelve variables that proxy for the competing channels. To capture the role of structural transformation, we control for changes in the share of employment in agriculture. To proxy for market integration, we include changes in the share of employment in the wholesale and retail trade sector. We account for broader modernization using four proxies for local economic development: population density, the urban population share, the share of the population with access to electricity, and the share of the population with access to piped water. For human capital, we control for changes in two measures of educational attainment: the adult literacy rate and the share of the adult population that completed primary schooling.[28] To capture demographic changes, we include changes in fertility rates and family size. Lastly, to account for shifting migration patterns, we control for two proxies of migration flows. The first is the population share of migrants, defined as individuals who have ever lived in a different

[27] Importantly, for many of these variables, data is not available at a sufficient number of time points for us to test for them explicitly as outcome variables in Eq. (4). We therefore assess their role by including them as additional controls.

[28] In the 1985 survey, 62.2% of adults aged 25 and over did not complete primary schooling, while only 8.9% completed secondary schooling. Given this distribution, we use completion of primary schooling as the threshold for educational attainment.

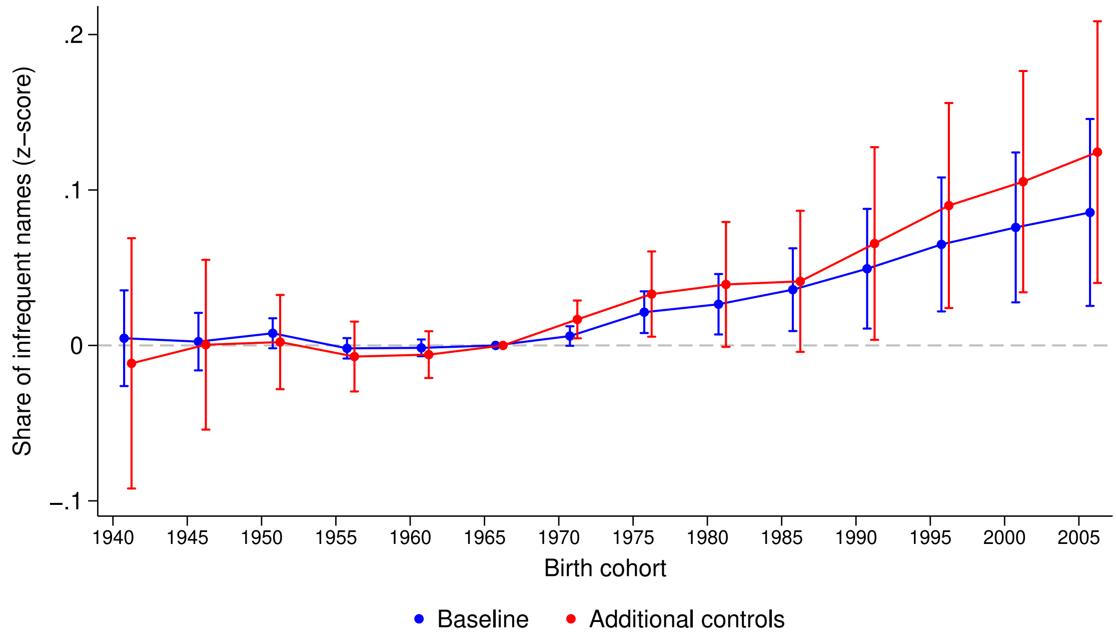


Fig. 6. Robustness to alternative mechanisms.
Notes: The outcome variable is the share of infrequent names, calculated as the share of names outside the top 25 most frequent names. All estimates control for district and province-period fixed effects. Estimates in red additionally control for variables that proxy for alternative possible mechanisms. These include changes between 1971 and 1985 in population density; the share of employment in agriculture; the share of employment in the wholesale and retail trade sector; the urban population share; the share of adults who completed primary school; the share of the population with access to electricity; the share of the population with access to piped water; adult literacy rate; average family size; fertility rate; share of migrants; and ethnic fractionalization. All variables up to the share of migrants are calculated from the 1971 and 1985 Intercensal Population Surveys, available at IPUMS International through Statistics Indonesia (Ruggles et al., 2024). The share of migrants and ethnic fractionalization are calculated from the complete-count 2010 Indonesian Population Census. The sample consists of 241 districts for which rice acreage shares are observed in both the 1963 and 1983 Agricultural Censuses. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

province.[29] The second is changes in the ethnic fractionalization index, based on the intuition that if the Green Revolution fostered migration inflows, the traditional ethnic composition in affected areas would likely have become more diverse.[30] Since the Intercensal Population Surveys do not report detailed information on ethnicity, we calculate the ethnic fractionalization index among individuals born in 1966 and 1986 using the 2010 census data, assuming that the ethnic distribution of newborns mirrors that of the overall district population. In the proceeding section, we discuss and test for the implications of selective migration in more detail by looking at household-level migration.

Fig. 6 summarizes the results. The estimates remain robust to the inclusion of these additional controls, suggesting that the alternative mechanisms considered above are unlikely to fully account for our findings. However, we interpret this evidence with caution. The robustness checks aim to assess whether our findings are driven by concurrent socioeconomic changes, not to identify the contribution of each channel. Moreover, some of these channels could have been downstream consequences of the disruption of communal practices rather than independent confounders. For example, the collapse of traditional collective arrangements may have encouraged trade and market interaction, which in turn could have affected individualism. To the extent that such channels operate downstream of the disruption, controlling for them would absorb part of the effect of interest rather than isolate a competing explanation. In this view, we interpret the robustness of our estimates as evidence that these channels alone do not drive our results, while acknowledging that the cultural change we document likely reflects the joint operation of the disruption of communal practices and the broader transformations it set in motion. These results also strengthen the validity of our decomposition approach. While we use residual rice growth as a proxy for local exposure to Green Revolution programs, variation in rice expansion driven by other concurrent factors could raise concerns about measurement error. The robustness to a wide range of concurrent factors suggests that variation in residual rice growth is primarily driven by program rollout.

Selective migration. It is possible that the diminishing collectivist culture in districts heavily exposed to the Green Revolution attracted individualistic households. Likewise, households who preferred a collectivist way of life may have left districts heavily exposed to the Green Revolution. To investigate the possibility of selective migration *towards* Green Revolution exposure, we compare households who migrated to districts more heavily exposed to the Green Revolution, to households who stayed in districts less exposed. To investigate selective migration *away from* Green Revolution exposure, we consider the reverse: households who migrated towards districts less exposed compared to households who stayed in districts heavily exposed.[31]

We identify households in the complete-count 2010 census that migrated based on the reported birth districts of children. A household

[29] Information on cross-district migration is not available prior to 1985. Therefore, changes in the share of migrants are measured solely based on cross-province migration. To further address concerns about selective migration, the following subsection replicates the baseline estimates using non-migrants only, where migration status is defined at the district level by comparing an individual's district of birth with their parents' districts of birth.

[30] The fractionalization index for district d during birth cohort t is defined as $F_{dt} = 1 - \sum_{e=1}^{E} s_{edt}^2$ where E indexes ethnic groups and s_{edt} is the population share of ethnic group e in district d and birth cohort t. The index measures the probability that two randomly selected individuals from district d born in birth cohort t belong to different ethnic groups.

[31] Our approach follows Bazzi et al. (2020a) who show that households with individualistic traits migrated towards the frontier, an area in the US that historically fostered "rugged individualism".

Table 4
Green Revolution exposure and selective migration.

	Dep. var.: child has an infrequent name (Children named prior to moving)			
Omitted reference group:	Stayers in low GR exposure dist.		Stayers in high GR exposure dist.	
	(1)	(2)	(3)	(4)
Migration from low to high GR exposure dist.	0.010*** (0.003)	0.010*** (0.003)		
Migration from high to low GR exposure dist.			0.008** (0.004)	0.008** (0.004)
Observations	32,615,464	32,615,394	34,160,955	34,160,873
R-squared	0.08	0.09	0.06	0.06
Mean of dep. var. of stayers	0.76	0.76	0.78	0.78
Origin district fixed effects	Y		Y	
Origin district × birth year fixed effects		Y		Y

Notes: This table estimates Eq. (7) in columns 1–2 and an analogous specification for movers from high to low Green Revolution exposure districts in columns 3–4. All columns include fixed effects for birth year by gender as well as birth order. Columns 1 and 3 include origin district fixed effects and columns 2 and 4 include origin district by birth year fixed effects. The dependent variable is an indicator equal to one if a child has a non-top-25 name in the province and decade in which they were born. In columns 1–2, the sample includes all children living in districts with low Green Revolution exposure, as well as children who were born in low exposure districts and have a younger sibling born in a high exposure district. In columns 3–4, the sample includes all children currently living in districts with high Green Revolution exposure, as well as all children who were born in high exposure districts and have a younger sibling born in a low exposure district. A district is defined as low exposure if the residual rice growth is below the median level, and is defined as high exposure if above the median level. Standard errors are clustered by origin district.

is classified as having migrated if it has at least two children born in different birth districts. We label the birth district of the older child as the origin district, and the birth district of the younger child as the destination district.[32]

Next, we define migration *towards* Green Revolution exposure as a household whose origin district is below the median of residual rice growth, and whose destination district is above the median of residual rice growth. Migration *away from* Green Revolution exposure is defined as the reverse. The estimating equation is

$$\mathrm{IFN}_{idt} = \alpha_d + \beta \mathrm{M}_i + \Gamma X_i + \delta_{it} + \epsilon_{idt}, \tag{7}$$

where IFN_{idt} is an indicator equal to one if child i born in district d with birth year t has a name outside of the top 25 most common names in their birth cohort and province. M_i is an indicator equal to one if the child is born in a below-median residual rice growth district, and their household eventually migrates to an above-median residual rice growth district *after* child i's birth. M_i is equal to zero if a child is born in a below-median residual rice growth district, and does not move during the time in which we observe their household in the census. We include birth year fixed effects interacted with gender (δ_{it}), birth order fixed effects (ΓX_i), and district of origin fixed effects (α_d).

We present the results in Table 4 with district of origin fixed effects interacted with birth year fixed effects in even-numbered columns. Columns 1 and 2 show the results for households who migrated towards Green Revolution exposure compared to households who remain in low exposure districts. We find that children in households migrating towards Green Revolution exposure are 1 percentage point more likely to have infrequent names, relative to children from families who remain in low exposure districts. Although the coefficient is statistically significant, the effect size is not large enough to explain our findings, given that the mean of the infrequent names share is 0.76. Furthermore, when looking at migration in the opposite direction (away from Green Revolution exposure) in Columns 3 and 4, we also find a positive effect of 0.8 percentage points, which almost entirely offsets the selective migration effects estimated in Columns 1 and 2.[33]

To complement these findings, we also investigate whether our baseline results remain robust to the exclusion of migrants by recalculating the share of infrequent names using only children from *non-migrant* families. Non-migrant families are defined as families in which children share the same birth district as their parents or the eldest sibling.[34] This restricted measure of infrequent names captures the extent to which parents born in a district, who subsequently have a child in the same district, choose a name for their child that is either common or unique relative to the pool of names in the province at the time. By construction, the number of observations classified as a non-migrant family decreases for earlier birth cohorts, as the likelihood of children living with their parents declines over time. The earliest birth cohort we can identify with non-migrant families is 1951–1955. For children less than 25 years old (born after 1985), the share coming from non-migrant families remains stable at approximately 62%, and thus we pay most attention to the estimates from these birth cohorts.

Fig. 7 replicates the baseline estimates using the individualism measure calculated exclusively for non-migrant families. Given the imprecise classification of non-migrant families for earlier birth cohorts, our primary focus is on the coefficients from 1986 onward, where the share of children from non-migrant families stabilizes. Despite the limitations of the measure, the results are analogous to the previous findings. Before the Green Revolution, the coefficients are not statistically different from zero but turn positive in the subsequent periods. Notably, the estimates for periods after the 1981–1985 birth cohort exhibit minimal differences from the baseline estimates in both magnitude and statistical significance, suggesting that selective migration does not drive our results for latter periods, where the effects of the Green Revolution are largest.

32 We restrict our sample to households that have moved at most once (at most two children born in different birth districts), which constitutes 94% of all moving households. By construction, this approach excludes individuals who moved without children, such as young adults and single workers, from the migrant classification. Because these migrants may have been among the more mobile and culturally influential individuals, our results should be interpreted with caution. We note, however, that our proxy for individualism is measured using the names of children, so migrants who had not yet had children in their destination district would not directly affect the individualism measure in that district.

33 In addition, the magnitudes we estimate are small relative to other selective migration effects documented in the literature (Bazzi et al., 2020a; Raz, 2025).

34 We restrict our analysis to households with only one household head and one spouse, ensuring a direct attribution of the names of children to each parent. This definition does not account for temporary migration of parents prior to the birth of children.

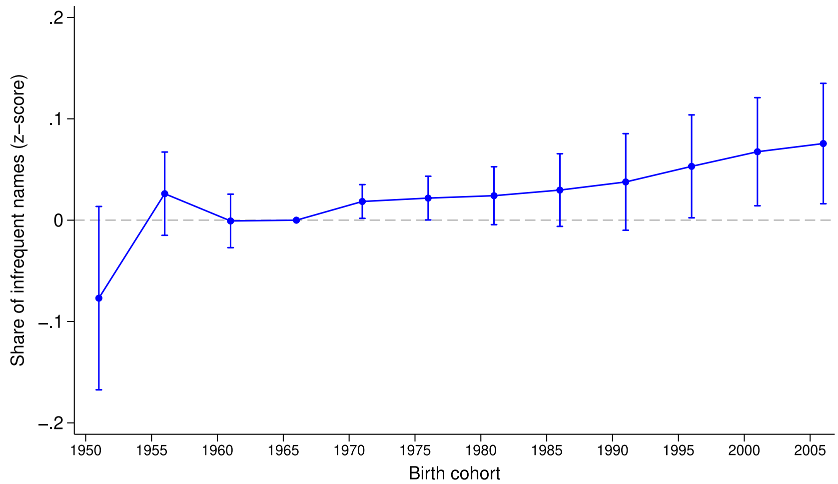


Fig. 7. Estimates based on non-migrants.
Notes: The plots reports estimates of β_t from Eq. (4) for changes in residual rice growth between 1963 and 1983, with 95% confidence intervals. The outcome variable is the share of infrequent names, calculated as the share of names outside the top 25 most frequent names, exclusively for individuals born to non-migrant parents. Individuals born to non-migrant parents are only identifiable up to the 1951–1955 birth cohort. For details on the calculation, see Section 4.3. All estimates control for district and province-period fixed effects. The sample consists of 241 districts for which rice acreage shares are observed in both the 1963 and 1983 Agricultural Censuses.

Taken together, the evidence suggests that selective migration is unlikely to account for the observed cultural effects of the Green Revolution. Nevertheless, we interpret this evidence with caution, as the results do not rule out a role for selective migration. Table 4 still points to a sorting of individualistic households into districts with greater Green Revolution exposure, but the robustness of our estimates to the exclusion of migrants indicates that such sorting is unlikely to fully explain the cultural effects of the Green Revolution.

5. Community-based cooperation & collective action

This section explores the link between residual rice growth, our baseline measure of Green Revolution exposure, and measures of community-level collective action. Results thus far suggest that greater exposure to the Green Revolution led to a rise in individualistic naming practices, which we interpret as a key measure of individualism. Here, we bolster this interpretation by examining effects on changes in within-village measures of collective action and communal efforts.

Community-based cooperative efforts are proxied using the prevalence of bottom-up community funds from the Indonesian Village Censuses. Bottom-up community funding is an important source for the co-production of public goods and development projects across many societies (Olken and Singhal, 2011). This is particularly evident in Indonesia, where studies have documented the significant role of such funds in local economic development (Martinez-Bravo, 2014, 2017; Lim, 2022).[35] If the Green Revolution fostered individualism by disrupting communal norms, it would be reasonable to expect that areas more exposed to the Green Revolution might exhibit a decline in community funds.

We consider two measures of bottom-up community funds from 1993 and 2003. Comparable measures do not exist in the pre-Green Revolution period. First, using 1993 Village Census data (PODES), we calculate the share of community funds that were used for non-INPRES development projects. INPRES (Presidential Instruction) programs were a series of physical infrastructure programs initiated and largely funded by Central Government block grants during the Suharto period. Its expressed purpose was to provide local government agencies with direct access to public funds, bypassing established bureaucratic channels and financial procedures (MacAndrews, 1986).[36] In contrast, non-INPRES programs were largely initiated, funded, and managed by village governments in collaboration with the local community. Qualitative studies further suggest that community-funded projects tended to be more numerous and successful in terms of being in continued operation (Evers, 2000; Martinez-Bravo, 2017).[37] Hence, a smaller share of community funds used for non-INPRES projects could reflect a weakening of collectivist values and beliefs.

Second, we calculate the share of the village budget derived from villager contributions using data from the 2003 Village Census.[38] The 2003 round does not stipulate whether villager contributions were used specifically for development projects versus other village expenses.[39] Nonetheless, it is conceivable that the share of village funds obtained from villager contributions reflects the strength of collectivist culture. For example, a higher share of villager contributions might suggest a stronger communal willingness to mobilize resources for the provision of local public goods.

We analyze the cross-sectional relationship between Green Revolution exposure and bottom-up community funds by estimating Eq. (2). In all specifications, we use residual rice growth as our main explanatory variable, while controlling for potential rice growth. Given the limitations of the cross-sectional specification for causal interpretation, we

35 As a share of public goods funding, Lim (2022) finds that community funds comprised nearly 50% of development funds for village public goods during the 1980s to 2000s. Similarly, as a share of household income, Olken and Singhal (2011) find that informal taxes form approximately 17% of total taxes paid by villagers in Indonesia.

36 INPRES programs have funded a broad range of public goods in Indonesia, including one of the largest primary school construction projects in the developing world (Duflo, 2001). Even though school construction largely ended by the early 1980s, INPRES funding for other public goods continued until as late as the 1996/1997 fiscal year (Evers, 2000).

37 The amount of funds successfully raised for non-INPRES projects can also be interpreted as a measure of trust that villagers have in their village government (Evers, 2000).

38 Specifically, this refers to informal tax and community contributions from villagers comprising of contributions from collections (*pungutan*), and mutual help funds (*gotong royong* and *swadaya masyarakat*). See Olken and Singhal (2011) for an overview.

39 Other village-level expenses typically include employee; good; maintenance; social; and transportation expenses.

Table 5
Green Revolution exposure and use of community funds.

Dep. var.: share of	Community funds for Non-INPRES 1993		Community-funded budget 2003	
	(1)	(2)	(3)	(4)
Residual rice growth	−0.093***	−0.096***	−0.081**	−0.109**
	(0.025)	(0.037)	(0.033)	(0.044)
R-squared	0.11	0.11	0.13	0.13
Observations	222	222	221	221
Oster's δ	−2.32	−3.20	7.12	−69.60
Potential rice growth	N	Y	N	Y
Geoclimatic controls	Y	Y	Y	Y
Initial socioeconomic controls	Y	Y	Y	Y
Province fixed effects	Y	Y	Y	Y

Notes: This table reports standardized coefficients estimated from Eq. (2). The outcome variable is the share of community funds used for non-INPRES purposes in 1993 (Columns 1 and 2) and the share of local budget sourced from community funds in 2003 (Columns 3 and 4). Standard errors are adjusted following the Conley (1999) method, with a distance cutoff of 200 km. Oster's δ is calculated using $R_{max} = 1$ as the upper bound for the R-squared.

report the values of Oster's δ, which quantify the degree of selection on unobservables required for them to fully account for the estimated results.

Table 5 presents the results. For ease of comparison, we display standardized coefficients. Columns 1 and 2 show that Green Revolution exposure is negatively correlated with the share of community funds used for non-INPRES projects. A one standard deviation increase in residual rice growth corresponds to a 0.1 standard deviation decline in the share of community funds allocated to non-INPRES projects (in 1993). Similarly, Columns 3 and 4 corroborate this pattern. A one standard deviation increase in residual rice growth is associated with a 0.08–0.11 standard deviation decrease in the share of village budget obtained from community funds (in 2003). The absolute values of Oster's δ suggest that unobserved district characteristics need to be 2.3 to 69.6 times as influential as the observed controls to explain away our findings. Considering that Oster's δ is calculated under the most conservative assumption using $R_{max} = 1$, the results mitigates concerns about omitted variables bias.

When interpreting these results, we consider the possibility that lower bottom-up community funds may simply reflect broader changes in village-level fiscal capacity unrelated to declining collectivist culture. Given the heavy involvement of supra-village government officials in the rollout of the Green Revolution programs, greater exposure to these programs might have directly affected the relationships between: (i) local villagers and village governments and (ii) village governments and supra-village government, resulting in persistent differences in village-level fiscal capacity.

We test this alternative explanation by investigating the relationship between Green Revolution exposure and two measures of *total* community funds. Our first measure is the log of per capita total community funds for development projects in 1993, calculated as the sum of community funds for both INPRES and non-INPRES development projects. Our second measure is the log of per capita village budgets in 2003, that comprises of revenue from village land, market levies, supra-village government assistance, and villager contributions. Table 6 present the estimation results using these two variables. Across all columns, we find no statistically significant effects of Green Revolution exposure on village-level fiscal capacity, suggesting that lower levels of bottom-up community funds shown in Table 5 are not driven by declining village-level fiscal capacity.

The persistent negative effects of the Green Revolution on community funding provides novel evidence that individualism, though largely positive for long-run economic development, could have negative effects in developing economies due to a mismatch between rapidly changing cultural values and the existing production function for public goods for which communal practices remain a key component. These results, however, should be interpreted with caution as our cross-sectional regressions are more susceptible to omitted variable bias.

Table 6
Green Revolution exposure and overall village-level fiscal capacity.

Dep. var.: log of per capita	Community funds 1993		Budget 2003	
	(1)	(2)	(3)	(4)
Residual rice growth	0.018	−0.009	0.046	0.038
	(0.049)	(0.066)	(0.031)	(0.038)
R-squared	0.11	0.13	0.14	0.14
Observations	222	222	221	221
Oster's δ	0.37	−0.11	2.08	0.67
Potential rice growth	N	Y	N	Y
Geoclimatic controls	Y	Y	Y	Y
Initial socioeconomic controls	Y	Y	Y	Y
Province fixed effects	Y	Y	Y	Y

Notes: This table reports standardized coefficients estimated from Eq. (2). The outcome variable is the log of per capita community funds in 1993, used for both non-INPRES and INPRES projects (Columns 1 and 2), and the log of per capita local budget in 2003 (Columns 3 and 4). Standard errors are adjusted following the Conley (1999) method, with a distance cutoff of 200 km. Oster's δ is calculated using $R_{max} = 1$ as the upper bound for the R-squared.

For example, areas with relatively weaker or declining cooperative norms may have been disproportionately exposed to or targeted by Green Revolution interventions. Although historical accounts suggest that the bureaucratic rollout of the Green Revolution—primarily driven by central planning—was unlikely to have targeted districts at such a granular level (Rieffel, 1969; Hansen, 1972; Timmer, 1975; Santoso et al., 1986; Manning, 1987), we are unable to formally test this assumption by examining pre-trends in bottom-up community funds. Nonetheless, if such pre-trends existed, where areas with initially lower prevalence of collectivist culture saw increased exposure to the Green Revolution, our estimates would represent an upper bound of the true negative effect. Also, as discussed above, high values of Oster's δ partly alleviate concerns about omitted variables.

6. Conclusion

This paper investigates the cultural impact of the Green Revolution, one of the most profound instances of technical change across the developing world. Leveraging 246 million first names from the complete-count 2010 Indonesian Population Census, we provide the first systematic evidence that these disruptions had a lasting cultural legacy. Districts with greater exposure to the Green Revolution experienced a marked increase in individualism, with effects persisting decades after the program ended. Importantly, we show that these changes are not attributable to differences in pre-existing cultural trends.

Our results shed light on an understudied consequence of development policy: cultural change. While the link between culture and economic development is well-established, less attention has been given to the effects of (one-off) development policies on culture. A failure to understand the cultural implications of these policies may result in a "development mismatch" (McGuirk and Nunn, 2024), where contemporary development initiatives clash with traditional economic practices, resulting in unintended consequences for institutions that rely on cooperative behavior.

To that end, we present evidence that these changes were accompanied by lower levels of bottom-up community funds—an important source of funding for the co-production of public goods in developing countries (Ostrom, 1996). However, this does not preclude the possibility that the increases in individualism led to positive long-run effects on development (such as innovation and institutional quality). The cultural implications of rapid policy interventions like the Green Revolution, and their downstream economic consequences, are a fruitful avenue for future research that would broaden our understanding of the interactions between culture, policy, and economic development.

Our findings come with an important caveat regarding mechanisms. While our estimates capture the cultural legacy of the Green Revolution, the data do not allow us to identify the specific channel through which this relationship operated. While we suggest the decline of traditional collective practices as our preferred interpretation, it may have been accompanied by a number of interrelated channels. As communal agricultural arrangements gave way to more individually managed and market-oriented cultivation, the accompanying expansion of trade and market interaction could itself have fostered more individualistic values. The relevant mechanism may also extend beyond farming technology: any intervention that reduces households' reliance on communal risk-sharing, such as the provision of crop insurance, might plausibly have generated similar cultural shifts. As these socioeconomic changes evolved together, we cannot separately identify their marginal contributions. We therefore interpret our findings as capturing the combined cultural consequences of the Green Revolution rather than the effect of any single mechanism.

CRediT authorship contribution statement

Yeonha Jung: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Uyseok Lee:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Gedeon Lim:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work the author(s) used ChatGPT and Claude (Code) in order to check for grammatical errors and create references. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jdeveco.2026.103877.

Data availability

The data that has been used is confidential.

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