IMPACT OF THE LAND RECORD MANAGEMENT INFORMATION SYSTEM (LRMIS) ON LAND RELATED CORRUPTION IN GOVERNMENT ADMINISTRATION AND MANAGEMENT DEPARTMENTS: A QUASI-NATURAL EXPERIMENT

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ABSTRACT

This research evaluates the impact of access to digitized land record information on land-related corruption within government administration and management departments and civil cases in Punjab, Pakistan. Utilizing the roll-out of the program, the study exploits the implementation Punjab Land Record Management Information System (LRMIS), a World Bank project, as a natural experiment. The analysis leverages novel data collected from the Anti-Corruption Establishment (ACE) of Punjab and Lahore High Court (LHC), encompassing land-related complaints, inquiries, and cases, which serve as indicators of corruption within the relevant departments. I provide both the intent to treat and local average treatment effect estimates. The findings reveal that the early implementation of LRMIS significantly increased the registration of complaints at ACE and civil case at LHC while there is decrease in frequency of inquiries and cases. These results provide suggestive evidence of the role of LRMIS in curbing corruption through enhanced transparency, as indicated by the increased public utilization of the system. The study underscores the effectiveness of digitization and e-governance systems in improving land administration, reducing information asymmetry, and mitigating corruption within land-related departments.

PREFACE

Developing countries face numerous challenges in the administration and accessibility of land. Until 2017, all provinces of Pakistan relied on cadastral maps and manual registers for maintaining land records and transactions, managed by local land staff known as "patwaris." However, in 2017, the Punjab province digitized its entire land record system and introduced the Land Record Management Information System. The digitization process began in 2013, initially implemented in half of Punjab's districts. Supported by RASTA-PIDE, the project titled "Impact of the Land Record Management Information System on Land-Related Corruption in Government Administration and Management Departments: A Quasi-Natural Experiment in Punjab, Pakistan," assessed the impact of LRMIS on corruption within land-related departments.

Using data on complaints, inquiries and cases from the Punjab Anti-Corruption Establishment and civil cases from Lahore High Court, this study employed a quasi-experimental design to examine the effects of LRMIS on corruption. The empirical findings provide suggestive evidence of spillover effects on the number of complaints, inquiries and cases. Results indicate that the early implementation of LRMIS led to an increase in registration of complaints which is the very first stage of reporting corruption incident at ACE and an increase of civil cases in high court. There is decrease in the number of enquiries and cases which are the later conditions of complaints. The results suggest that the LRMIS increased the availability of transparent information which led to an increase in complaints while the decrease in enquiries and cases suggest an early resolution of those complaints.

The report is structured as follows: the introduction provides an overview and program description, detailing the implementation of LRMIS. The subsequent sections include the literature review, methodology, findings, and conclusion.

I am grateful to the Agriculture Department of the Government of Punjab for their cooperation in providing valuable data, as well as to the Anti-Corruption Establishment Punjab for their assistance in the research process. I am also grateful to Muhammad Aman Ullah and Professor Murtaza Haider for their constructive feedback, valuable comments and mentoring throughout the project. This research would not have been possible without the hard work and dedication of the research team, whose collective efforts were instrumental in shaping the outcomes of this study. I would also like to extend my thanks to the KDI School of Public Policy and Management, South Korea, for their ongoing academic support and encouragement

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INTRODUCTION

1.1. Overview

Does the digitization of land records reduce corruption and civil cases in the land administration department and high court? This research aims to answer this critical question. The hypothesis is that access to transparent land record information can potentially decrease information asymmetry. With transparent information accessible to the complainant[1], defendant[2] and adjudicator[3], the Punjab LRMIS can effectively curb corruption. Hence, access to transparent information may lead to a reduction in corruption. I leverage the phased implementation of LRMIS by the Punjab government as a quasi-experiment. The primary outcome variables include the number of registered complaints against the land bureaucracy, their transition to inquiries and cases, and their disposal rate. The novel data used in this research is sourced from the ACE and LHC, Punjab, measured at the district level. This data represents the aggregated number of complaints, inquiries, and cases per district per year from 2014 to 2022. While the LHC data is structured at balanced panel of district and week starting from the year 2018. The research examines the implementation stages of LRMIS and its potential for evidence-based policymaking in developing countries, particularly other provinces within Pakistan. By estimating the causal effect of LRMIS on corruption levels, this study aims to provide suggestive evidence for government officials, policymakers, and researchers. The findings support e-governance initiatives to combat corruption and enhance transparency, accountability, and efficiency in land administration.

The implementation of the LRMIS is a costly intervention that encompasses infrastructural, social, and behavioral changes, requiring a substantial budget. The growing literature on this particular program presents mixed findings. For instance, Ullah & Hussain (2023) found that the implementation of LRMIS, coupled with Alternate Dispute Resolution (ADR) centers and utilizing generalized multi-level mixed effect and two-stage least square models, led to districts with early treatment experiencing an average increase of approximately 50 land-related dispute cases compared to those in districts with late treatment. Additionally, it increased successful mediation outcomes by 126 cases in the treatment region, with no effect on mediation failure cases. Another study by Aman-Rana & Minaudier (2024) on the phased implementation of the LRMIS in Punjab highlights unintended consequences related to capacity building. Their findings reveal a notable decrease in tax collection following digitization, attributed not to a shrinking tax base but rather to reduced bureaucratic efficacy in revenue collection. Abdullah et al., (2020) conducted a qualitative study indicating an improved perception of land tenure security among stakeholders. Despite this positive perception, there has been no corresponding increase in accessibility to bank loans using land as collateral. The study also suggests that land records became more reliable following the

[1] It refers to an individual or entity who submits a complaint regarding land-related corruption to the ACE of Punjab.

[2] It refers to the individual or entity against whom a complaint regarding land-related corruption is filed with the ACE of Punjab. These defendants are typically part of the government administration or management departments involved in land-related activities.

[3] Refers to the ACE of Punjab that is responsible for reviewing, investigating, and making decisions on the complaints regarding land-related corruption.

implementation of the LRMIS. However, concerns remain regarding the clarity and simplicity of the new system.

Research evaluating the spillover effects LRMIS remains limited. There is scant rigorous investigative research to precisely estimate the program's causal effects on various outcomes, such as corruption within land administration and farmers' access to agricultural credit. Addressing these gaps in the literature, my study aims to contribute by analyzing how the implementation of LRMIS influences corruption levels within land bureaucracy. This research endeavors to offer insights into the broader implications of digitization on enhancing administrative transparency and efficiency.

I estimate the impact of LRMIS on frequency of corruption incidents and their resolution coupled with civil cases in high court. To do so, I provide the intent-to-treat (ITT) estimates as main specification using the roll-out of program. In addition, to overcome the endogeneity issues I provide the local average treatment effect (LATE) estimates in appendix. The results are consistent and robust. Further, I provide the estimates from correlated random effect model in appendix which returns the same estimates as fixed effect regression while controlling for the potential time-invariant covariates. Again, the results are robust and consistent with main estimation.

I find that the LRMIS has increase the registration of civil cases and complaints using mechanism of availability of transparent information. I also find a decrease in frequency of enquiries and cases at ACE which suggests the early and effective resolution of complaints. While there is decrease in the resolution of investigative incidents due to complexity of managerial issues. This paper contributes to the literature related to state capacity building and its spillover effects.

1.2. Program Description

1.2.1. Historical Background

The history of land administration and revenue generation in the Indian Subcontinent dates back to the 13th and 14th centuries, with early efforts in land record registration and management initiated by Ala Uddin Khilji, the first Indian Sultan (Ali, 2013). This practice was continued by subsequent rulers, notably Sher Shah Suri in the 16th century, who introduced fixed crop rates to improve land measurement (Thakur et al., 2005). In the 17th century, Mughal Emperor Akbar implemented significant reforms by classifying lands into various categories and revenue estates (Ali, 2013). The British colonial period further advanced the land administration system to enhance land revenue collection (Marshall, 1975). Due to difficulties in uniformly applying laws across the subcontinent, the British introduced and adjusted state-specific regulations over nearly 90 years (Thakur et al., 2005). A notable intervention during this period was the "Punjab Land Alienation Act of 1900," which restricted land transfers from agricultural to non-agricultural classes (Cheema et al., 2006). Although some amendments were made over time, foundational land-related laws such as "The Transfer of Property Act of 1882" and "The Punjab Tenancy Act of 1887" remained in place after the independence of Pakistan and India in 1947. For example, "The Land Revenue Act of 1887" was revised as "The Punjab Land Revenue Act of 1967." Today, Pakistan's land administration system still operates under the framework established during the British era (Hussain, 2012).

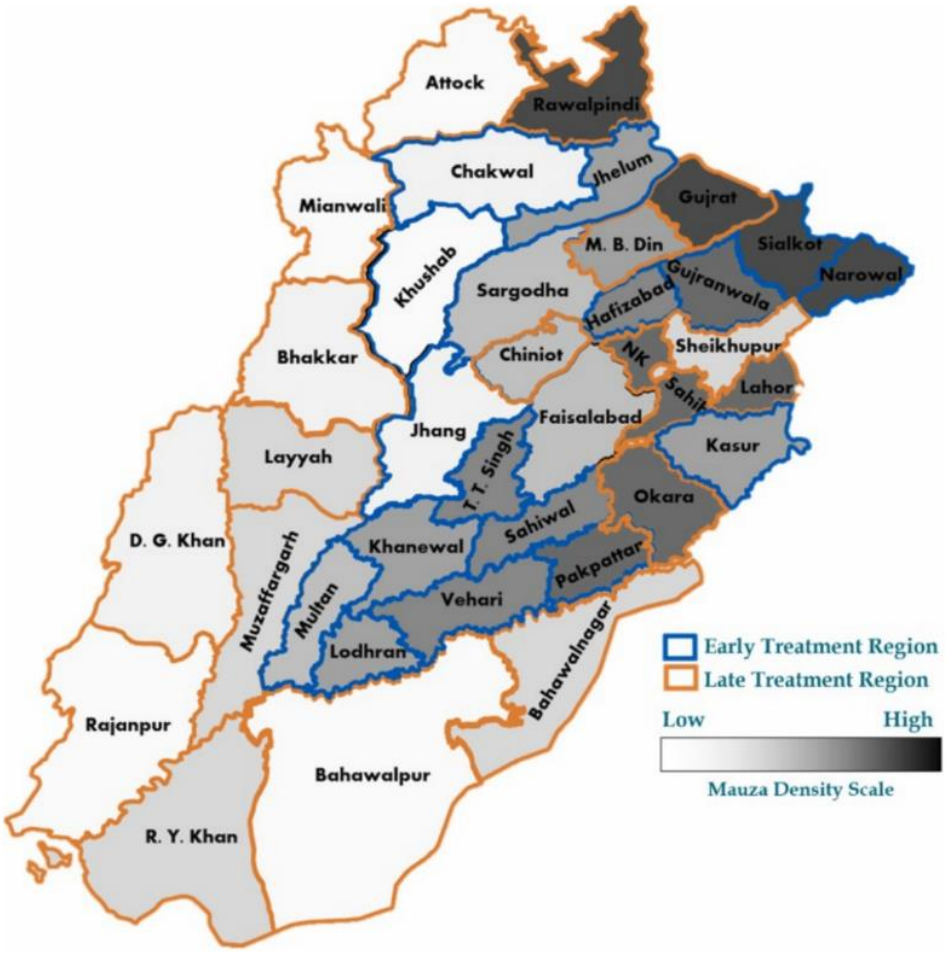
1.2.2. Punjab Land Record Management Information System

Punjab province, covering an area of 205,345 km^2, is Pakistan's most populous province, with over 120 million inhabitants, constituting 55% of the national population. The majority of Punjab's residents live in rural areas where agriculture is the predominant economic sector. Recognizing the need to enhance land administration, develop functional land markets, and integrate these improvements into broader governance frameworks, the Punjab provincial government, in collaboration with the World Bank (WB), launched the Punjab Land Record Management and Information System (PLRMIS) under the Punjab Land Record Authority (PLRA). This initiative aimed to improve public access to land information and enhance transparency in land records.

Initially implemented in eighteen districts (Early Treatment Group), the program expanded in its second phase to include the entire province (Late Treatment Group). Figure 1 illustrates the distribution of districts exposed to these implementation phases. Key features of the PLRMIS include:

- **Automated Issuance of Land Ownership Documents:** The system issues "Fard" in 23,183 out of 25,709 revenue estates (rural and semi-urban), covering 90% of Punjab's land. It has significantly improved service delivery, with "Fard" issued in 30 minutes and mutations processed in 50 minutes.
- **Establishment of Land Record Centers:** A total of 151 state-of-the-art Land Record Centers have been set up, integrated with 45 Sub-registrar offices across Punjab. This infrastructure has enhanced the authentication and reliability of land records, increasing the collateral value of land.
- **Online Access to Land Records:** The system provides 24/7 online access to land records through a dedicated website, streamlining the land registration process and improving accessibility.

Figure 1: Implementation of LRMIS



1.2.3. How Does It Works?

The PLRMIS Project was developed by the Project Management Unit, incorporating insights from pilot projects in districts such as Kasur, Lahore, Rahim-Yar Khan, and Gujrat, as well as experiences from other countries. Since its full implementation across all districts of Punjab in 2017, the system has facilitated a streamlined process for landholders to search for, obtain, and register their land.

Landholders can visit a service center where staff retrieve records using the landholder's name, father's or husband's name, or khewat number, and verify their identity with a Computerized National Identity Card (CNIC). After verification through biometric devices for thumb impression and photo, the landholder receives a copy of their record within 10-15 minutes, following the payment of the specified fee.

1.2.4. Theory of Change

The PLRMIS has exerted a notable influence on stakeholders through institutional, social, and behavioral mechanisms.

Institutional Changes: PLRMIS has transformed methods and procedures, notably through the development of web-based software, the establishment of Automated Record Centers (ARCs), and the re-engineering of the land record management system. These advancements include the creation of a standardized monitoring dashboard that allows top-level management to oversee activities and ensure adherence to standard operating procedures at all levels. ARCs, which expedite the issuance of "Fards" (essential land record documents), aim to enhance client satisfaction, reduce transaction times and costs, and improve land tenure security. The legal and policy framework of LRMIS supports these institutional improvements by ensuring smooth operation and aligning with project objectives, particularly in enhancing public service delivery. Importantly, LRMIS facilitates easier access to land records for women, thereby promoting their participation in land transactions.

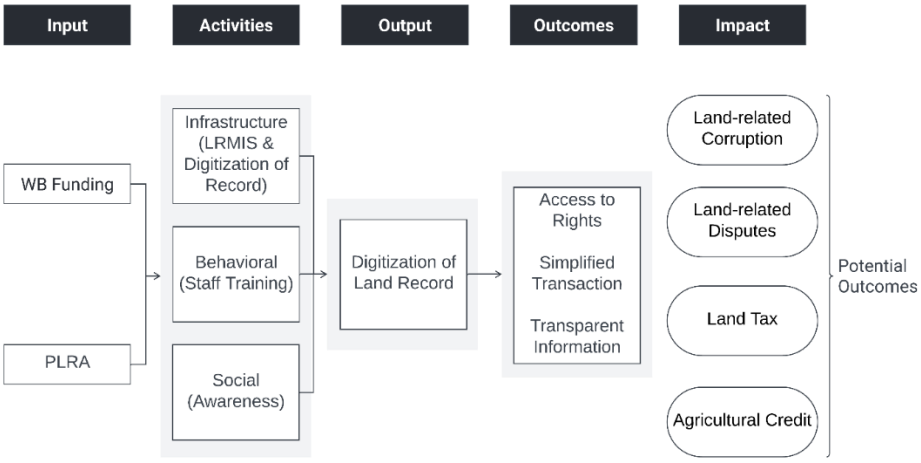
Behavioral Changes: LRMIS has implemented various training and capacity-building initiatives to foster positive attitudes among key stakeholders, particularly employees of the land department. These initiatives have addressed initial resistance from Tehsil-level land record staff ("Patwaris"), including strikes and work refusals. To overcome these challenges, the program introduced incentives and capacity-building measures, such as constructing new field offices with IT facilities, providing transportation allowances, and allocating 2% of land revenues to revenue officers. These efforts have helped to alleviate concerns about job security and clarify new roles under the system.

Social Awareness: Social awareness campaigns have played a crucial role in the project's success, especially in rural areas where public response can be slow. LRMIS has conducted multiple awareness initiatives to encourage active participation in the digitized record management system. Key efforts included 36 workshops from December 2011 to February 2014, engaging 5,663 internal stakeholders, such as district administration officers (District Collectors, Additional District Collectors, Assistant Commissioners) and revenue functionaries (Tehsildars, Girdawars/Qanungos, Patwaris). Additionally, consultations with 250 representatives from the Punjab Bar Association and Field Revenue Staff have further ensured effective program implementation.

1.2.5. Result Chain Analysis

Based on a detailed analysis of the LRMIS program and its implementation mechanisms, the hypothesis suggests that its effects are mediated through key components identified in the result chain depicted in Figure 2.

Figure 2: Result Chain Analysis



LITERATURE REVIEW

The primary purpose of land reforms is to secure citizens' property rights (Conning & Deb, 2007). Various reforms have been implemented to achieve this goal, including land titling (Zhang et al., 2020), reforms in land administration processes (Gignoux et al., 2013; Enemark, 2009; Conning & Deb, 2007), redistributive reforms that incorporate information systems allowing citizens access to their land (Conning & Deb, 2007; Adams & Howell, 2001), market-driven reforms (Gauster & Isakson, 2007), and restitution (Conning & Deb, 2007; Gignoux et al., 2013). These reforms can have significant spillover effects on the state, though they may also result in unintended consequences (Besley, 1995; Deininger, 2003; Feder & Nishio, 1998). National and international bodies play a crucial role in land-related reforms. According to USAID (2010), the World Bank (2004), and Holstein (1996), the World Bank has undertaken several initiatives in land reform, investing billions of dollars across developing nations.

Core components of land-related reforms include sustainable development indicators, environmental conditions, geographical factors, political landscape, access to credit, and economic factors (Conning & Deb, 2007; De Soto, 2000; North, 1990). Failures in land reform can often be attributed to a lack of accountability, poor implementation, and unclear arrangements (Conning & Deb, 2007; Dupont et al., 2003; Scott, 1988; Lauria-Santiago, 1999). To mitigate unintended consequences and ensure successful implementation, a rigorous monitoring and accountability system is required, accounting for all implementation mechanisms, feasibility, and stakeholder inputs (World Bank, 2004; Conning & Deb, 2007). Additionally, a quick feedback mechanism is necessary for effective monitoring and evaluation, reducing the risk of failure. One approach is to leverage impact evaluation studies conducted by researchers.

The digitization of land records in the Punjab province of Pakistan provides a suitable environment to conduct a quasi-experimental study, estimating the causal effects on intended and unintended outcomes such as disputes, corruption, access to credit, and tax collection by the Board of Revenue. The LRMIS serves as a pivotal catalyst for land reforms. Recent initiatives toward digitization and e-governance have contributed to the transformation of governance through information and communication technology (ICT), coupled with models such as Government to Business (G2B), Government to Citizen (G2C), and Government to Government (G2G) to improve service delivery for all stakeholders (Arfeen & Khan, 2012). The introduction of LRMIS in Punjab exemplifies this model, transforming land governance in a modern way and positively impacting state capacity.

EXISTING EVIDENCE

Corruption in land administration presents significant challenges across different regions, undermining governance, economic growth, and social equity. Research studies have explored various strategies to combat these issues, including transparency, institutional reforms, and community engagement.

Adeyinka and Bewaji (2020) underscore the critical role of transparency in addressing corruption within Africa's land sector, specifically Nigeria. Corruption manifests in bribery, favoritism, falsification of records, and inefficient processes, creating barriers to equitable access and trust in land administration. Their study emphasizes the importance of transparent land title registration to mitigate these challenges. Transparency—defined as openness, accessibility, and accountability in procedures—has been identified as a key strategy. Data collected from Nigerian legal and estate surveying professionals, as well as land bureau staff, revealed systemic inefficiencies exacerbated by a lack of openness, which enables corruption to flourish unchecked. The authors advocate for reform measures such as secure land tenure and streamlined registration systems, supported by insights from the World Bank on their critical role in economic development.

Despite modernization efforts, corruption persists due to a weak regulatory framework and bureaucratic inefficiencies. Corruption's pervasive nature hinders the effectiveness of initiatives like the National Information System (NIS). Strengthening transparency is essential to enhance trust, secure tenure, and drive economic growth. Future research should focus on tailoring anti-corruption strategies to diverse African contexts.

In Bangladesh, Sakib, Islam, and Shishir (2022) examine the implementation of the National Integrity Strategy (NIS) as a means to combat corruption in land administration. The NIS includes measures such as digitization, training programs, and citizen charters to promote good governance. However, challenges such as local political interference, inadequate skilled manpower, and persistent rule-breaking undermine its effectiveness. Qualitative data from interviews and official documents highlight both the progress and limitations of NIS implementation.

The authors argue that a hybrid approach, combining systemic reforms with localized solutions, is necessary for sustainable improvements. While initiatives like e-Namji digitization have enhanced transparency, addressing social and political dynamics remains critical. Future efforts should integrate innovative, context-specific strategies to build dynamic, corruption-free land management systems.

Brankov and Tanjević (2013) provide a comprehensive analysis of corruption's impact on land administration. Their study identifies bribery and embezzlement as primary forms of corruption that erode public confidence and hinder economic development. Weak institutional frameworks, low public official salaries, and political interference are key contributors. Corruption exacerbates social injustice and inequality, particularly for marginalized groups seeking land rights. Additionally, corrupt officials often overlook environmentally detrimental land uses for personal gain.

The authors highlight successful anti-corruption initiatives in various countries, emphasizing the need for robust institutional checks, fair land distribution practices, and community involvement.

While the research provides a broad framework, its findings are applicable globally, offering practical insights for policymakers seeking to strengthen land administration systems.

Burns et al. (2007) explore the indicators of success and challenges in land administration reforms. Key success factors include security of tenure, efficient and accessible services, and transparent systems. Digital tools and robust spatial data infrastructures further enhance transparency and informed decision-making. However, reform efforts face challenges such as adapting to diverse legal and social contexts, ensuring stakeholder engagement, and maintaining sustainability through capacity building and funding.

The study underscores the importance of tailored reforms to address poverty, environmental protection, and gender equity. Although the research lacks specific variables, it offers a valuable framework for understanding land administration reform in developing countries, emphasizing the complexity of real-world conditions.

Mathiba (2021) investigates corruption's role in undermining land reform programs in South Africa's post-apartheid era. Despite efforts to redress historical injustices, corruption—manifested in bribery, nepotism, embezzlement, and illicit land deals—continues to impede equitable redistribution. These practices erode the credibility of land reform programs, sustaining inequality and public dissatisfaction.

The study highlights the need for robust anti-corruption mechanisms, community empowerment, and inclusive decision-making processes. Strengthening oversight institutions, fostering a culture of integrity, and involving affected communities are pivotal for achieving equitable land reform. Mathiba's findings provide critical insights for policymakers addressing the enduring legacy of apartheid and striving for transitional justice.

RESEARCH METHODOLOGY

4.1. Data

A balanced panel dataset on outcome variables from 2014 to 2022 has been collected from the Anti-Corruption Establishment (ACE) Punjab records and Lahore High Court (LHC). In Pakistan, the distribution of ACE Punjab offices mirrors the pattern of revenue estate districts, although data are typically compiled at the division level. Data on complaints, inquiries, and cases were gathered through a field survey, with observations recorded at the district and year levels. Consequently, I introduce year and district fixed effects (judge fixed effect in case of Lahore high court data) in the regression model to account for district or year-specific effects and provide robust estimates.

In addition to the ACE data, it is necessary to control for factors that might differentially affect the treatment or outcome variables. Data on the political landscape of the district, literacy rates, crimes, and disputes are currently being processed.

4.2. Summary Statistics

Table 1: Summary Statistics

Variable	N	Mean	Std. Dev.	Min	Max
	Panel A: Anti-Corruption Establishment				
Total Cases	351	11.9	11.8	0	97
Disposed-off Cases	351	11.1	10.8	0	89
Total Enquiries	351	54.8	66.4	0	830
Disposed-off Enquiries	351	53.4	65.6	0	828
	Panel B: Lahore High Court				
Civil Cases	2356	103.71	87.413	0	432
Criminal Cases	2394	100.877	107.423	0	954
Family Cases	2394	159.309	156.465	0	943
Guardian Cases	2394	9.64	12.465	0	56
Rent Cases	2394	2.153	4.181	0	24
Other Cases	2394	19.591	23.671	0	98

4.3. Definitions of Key Variables

Complaints: A complaint is a formal application in which an aggrieved individual levels allegation against a public servant and seeks justice for alleged misconduct or criminal behavior. It serves as the primary step to initiate action against such misconduct. Complaints can be lodged in various ways, including by the directly affected party to inquire about the matter, by the affected individual or reporter to request a trap raid, by formulating a source report, through directives, departmental references, or court references. Complaints are typically submitted to the offices of the Director General, Additional Director General, Regional Directors, or Deputy Directors, and are then forwarded to an Enquiry Officer who is responsible for recommending appropriate action, if necessary. However, the frequency of complaints excludes those which are irrelevant to corruption thus forwarded to relevant home department.

Enquiry: An enquiry is the initial action taken by an Anti-Corruption Enquiry Officer after a complaint is submitted by any person, which is deemed liable for investigation. This process is

governed by Rule 5 of the Punjab Anti-Corruption Establishment Rules, 2014. The primary objective of the enquiry is to verify the authenticity of the complaint, discourage habitual complainants, and ensure that no public servant or citizen is unnecessarily implicated based on a false or fraudulent complaint. The Anti-Corruption Establishment can also initiate an enquiry based on a source report, a directive, a National Accountability Bureau (NAB) reference, or in compliance with orders from the Federal or Provincial Ombudsman or Superior Courts.

The enquiry may be conducted by an individual officer or a team designated by the regional or central head of the establishment. During the enquiry, relevant parties are summoned and questioned about the complaint. After gathering the necessary information, the Enquiry Officer evaluates the available evidence and draws conclusions. If the allegations are found to be unsubstantiated, the enquiry may be dismissed or forwarded to the concerned department for appropriate action under efficiency and discipline rules. If the allegations are validated, the registration of a case may be recommended.

Case: If, after a detailed and comprehensive enquiry, there is sufficient evidence suggesting the commission of an offence, a criminal case is registered at the ACE Police Station by the order of the competent authority, as outlined in Rule 6 of the Punjab Anti-Corruption Establishment Rules, 2014. This marks the beginning of the legal process, and an investigation is conducted in accordance with the law.

Once the case is registered, the concerned department is informed about the development. If necessary, the arrest of the accused public servant may take place, but this requires permission from the competent authority. However, if the public servant is caught red-handed during a trap raid, no prior permission is needed for either the registration of the case or the arrest.

After the case registration and any necessary arrests, the next steps in the process are carried out. The investigation continues to gather further evidence, and if the findings support the allegations, the accused may be arrested. Once the investigation is complete, the challan, or formal charge sheet, is submitted to the court. Following this, the case proceeds to prosecution, where the evidence is presented for trial, and the legal process moves toward a resolution.

4.4. Empirical Strategy

Given the phased implementation of the Land Record Management Information System (LRMIS) across districts in Punjab, I leverage the presence of counterfactuals within the region. To implement this approach, I categorize districts into early treatment and late treatment groups. The first strategy involves comparing the mean difference before treatment, with the expectation that this pre-treatment mean difference will be negligible. The second approach establishes parallel trends between both groups, satisfying the basic assumption of the difference-in-differences methodology. Finally, using Equation 1, I present preliminary findings supported by an event study.

$$incident_{it} = \varphi location_i \times timing_t + \iota_i + \tau_t + \varepsilon_{it} \ (1)$$

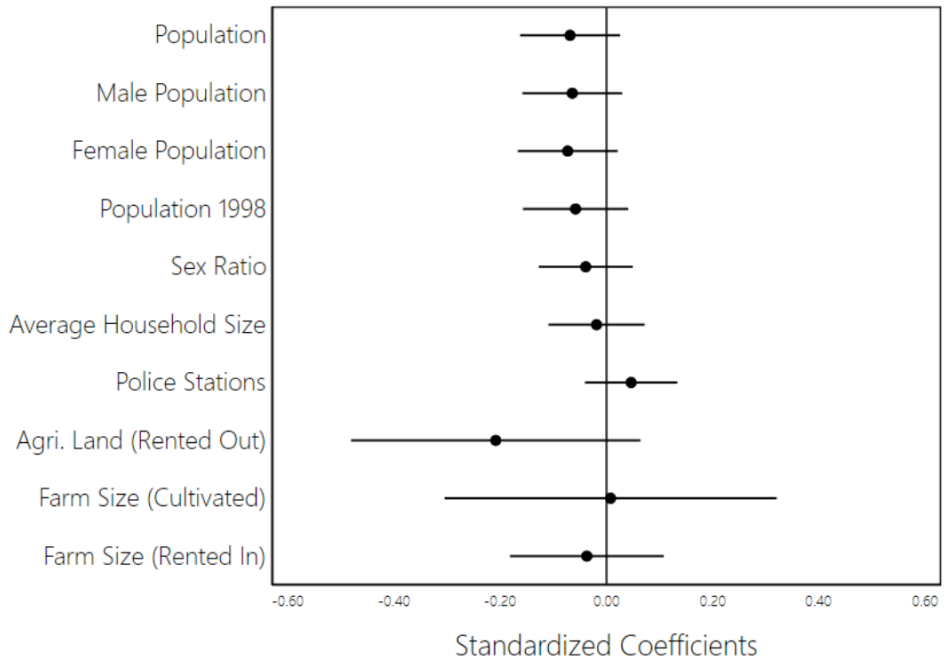
where $incident_{it}$ is the outcome variable i.e. total number of complaints, enquiries and cases and their disposal and pendency at district *i* and year (week in case of LHC data) *t*. This number will be divided by the total population, total area and total number of mauzas of the district for the purpose of normalization. $location_i$ is a binary variable as $location \begin{smallmatrix} =1 \ if \ district \ is \ early \ treated \\ =0 \ is \ district \ is \ late \ treated \end{smallmatrix}$. ι_i represents

the district fixed effect to partial out the unobserved factors of the district that may have an impact on the outcome variables. τ_t represents the calendar year fixed effect considering the observed level of outcome variable and counts for the unobserved heterogeneity caused by the time. Finally, ε_{it} is the error term.

One can concern about the omitted variables and confounding factors. For example, if there is factor that can affect both the implementation and outcome at the same time like income shock, the estimates from specification (1) could be biased. To address these issues, I provide balance test before the implementation of program in figure 2. This represents there is no statistically difference between early and late treated districts. This is also seconded by the World Bank implementation report that the selection of early and late treated district was independent of any district characteristics, however, the budget of program was a key factor.

In addition to baseline characteristics, I controlled for the potential covariates that could affect the outcome of interests. In doing so, I provide the estimates in Appendix using correlated-random effect model. The rationale behind moving from fixed effect to alternate approach is to control for the time invariant variables for instance number of mauzas in districts. However, the correlated-random effect returns the same estimates as fixed effect.

Figure 3: Baseline Characteristics



Notes: Standardized coefficients of baseline characteristics. Data on these characteristics is sourced from the Development Statistics of the Pakistan Bureau of Statistics and Demographic Health Surveys (1997–2010). The point estimates are obtained from a regression of the respective covariates on a staggered variable indicating the phase implementation. The reference category includes districts in Phase 3 of the reform. Hollow circles represent the point estimates, and horizontal lines indicate 95% confidence intervals.

Still there is worry of potential endogeneity of implementation of program, therefore, I leverage the planned roll out of program as instrumental variable to actual implementation. I provided the local

average treatment estimates in appendix. The results from alternate approaches are consistent with intent to treat analysis and robust.

FINDINGS AND DISCUSSION

5.1. Impact on Land-related Corruption Incidents

The primary indicator of corruption is the frequence of complaints, enquiries and cases initiated by the ACE Punjab against defendants. Since many complaints might be false, ACE investigates each complaint and converts it into an inquiry if warranted; otherwise, the complaint is disposed of. My first analysis estimates the effect of LRMIS on the number of complaints registered by the ACE Punjab. The second and these main variables are the frequence of enquiries and cases. To do this, I utilize data from ACE Punjab, comparing districts exposed to early LRMIS implementation (early treatment group) with those that experienced later implementation (late treatment group). The late treatment group serves as the control group.

Table 2 presents the effect of early LRMIS implementation on the total number of complaints, enquiries and cases. The results indicate that early LRMIS implementation increased the total complaints while decreased the total number of inquiries and cases. The complaints have been increased by 29.35, enquiries and cases decreased by 40.66 and 31.71 percent, respectively, relative to the mean of dependent variable. The mechanism behind increase in complaints is the availability of transparent information further detailed in appendix. The reduction in enquiries and cases represents the actual decrease in corruption incidents in early treated districts.

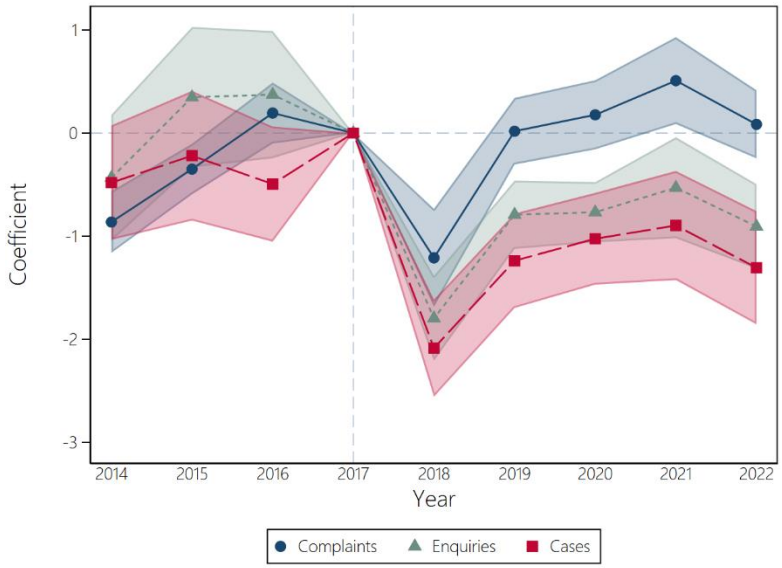
Figure 4 shows the event study analysis of the main three outcome variables. The time varying effect is consistent and statistically significant as in Table 2.

Table 2: Impact of LRMIS on Documenting Incidents

	Complaints (1)	Enquiries (2)	Cases (3)
Digitization	16.9441	-11.1059	-1.8219
	(3.7440)	(1.9357)	(0.3330)
	[0.0001]	[0.0000]	[0.0000]
Time Fixed Effects	Yes	Yes	Yes
Area Fixed Effects	Yes	Yes	Yes
R-Squared	0.0754	0.1907	0.1304
Observations	315	315	315
Dep. Var. Mean	57.7219	27.3127	5.7449
Dep. Var. SD	57.8850	20.6960	3.8905

Notes: This table presents the intent-to-treat estimates of the impact of digitization on corruption-related indicators. The variable "Digitization" represents the staggered rollout of the program. Columns (1) through (3) use the number of incidents per one million population in each district as the outcome variable. District-fixed effects control for unobserved, time-invariant characteristics specific to each district, while year-fixed effects account for time-related factors affecting all districts. Standard errors, clustered at the district level, are reported in parentheses, and p-values testing the null hypothesis of zero mean are shown in brackets.

Figure 4: Time-varying Effect of LRMIS on Documenting Incident, Event Study



Notes: Standardized coefficients of corruption incidents. The omitted year is the implementation of the program in the whole province. The point estimates are obtained from a regression of the respective covariates on a staggered variable indicating the phase implementation. The reference category includes districts in Phase 3 of the reform. Hollow circles represent the point estimates, and horizontal lines indicate 95% confidence intervals.

5.2. Impact on Disposal of Rates

Table 3 represent the disposal of each documented incidents i.e. complaint, enquiry and cases. The findings show a significant decrease in disposal rates. The overwhelming increase observed in Table 2, column 1, is the mechanism behind the decrease in resolution of complaints. Further, the decrease in the disposal of enquiries and cases channels the capacity of ACE handling such cases. In addition to that the decrease has been captured due to direct proportion of disposal and registration of incidents.

Table 3: Impact of LRMIS on Incidents Resolution

	Complaints (1)	Enquiries (2)	Cases (3)
Digitization	-0.3729	-2.5182	-4.5376
	(0.1199)	(0.4168)	(0.9620)
	[0.0038]	[0.0000]	[0.0000]
Time Fixed Effects	Yes	Yes	Yes
Area Fixed Effects	Yes	Yes	Yes
R-Squared	0.0333	0.0774	0.0715
Observations	298	312	303
Dep. Var. Mean	99.6643	97.6151	94.9219
Dep. Var. SD	1.4721	6.6139	12.7025

Notes: This table presents the intent-to-treat estimates of the impact of digitization on corruption-related indicators. The variable "Digitization" represents the staggered rollout of the program. Columns (1) through (3) use the disposal percentage in each district as the outcome variable. District-fixed effects control for unobserved, time-invariant characteristics specific to each district, while year-fixed effects account for time-related factors

affecting all districts. Standard errors, clustered at the district level, are reported in parentheses, and p-values testing the null hypothesis of zero mean are shown in brackets.

5.3. Impact on Conversion

The other key observable facto is the conversion of complaints to enquiries and further progression into cases. The findings reveal there is a significant decrease in complaints to enquiries and cases. This highlights the early resolution of complaints due to an increase information from land records department. When the information is available to all key players, they can predict the ultimate decision which translates into the early resolution/disposal of complaints therefore there is significant decrease in the conversion of complaints to enquiries and cases.

Table 4: Impact of LRMIS on Incidents Conversion

	Complaints to Enquiries (1)	Complaints to Cases (2)	Enquiries to Cases (3)
Digitization	-252.0869	-113.8122	-0.7026
	(55.0534)	(50.6382)	(3.4571)
	[0.0001]	[0.0312]	[0.8402]
Time Fixed Effects	Yes	Yes	Yes
Area Fixed Effects	Yes	Yes	Yes
R-Squared	0.1248	0.0560	0.0003
Observations	298	298	312
Dep. Var. Mean	216.8934	77.0714	30.0548
Dep. Var. SD	525.3363	342.8175	29.3864

Notes: This table presents the intent-to-treat estimates of the impact of digitization on corruption-related indicators. The variable "Digitization" represents the staggered rollout of the program. Columns (1) through (3) use the conversion rates of complaints and enquiries in each district as the outcome variable. District-fixed effects control for unobserved, time-invariant characteristics specific to each district, while year-fixed effects account for time-related factors affecting all districts. Standard errors, clustered at the district level, are reported in parentheses, and p-values testing the null hypothesis of zero mean are shown in brackets.

5.4. Impact on Civil Cases, Lahore High Court

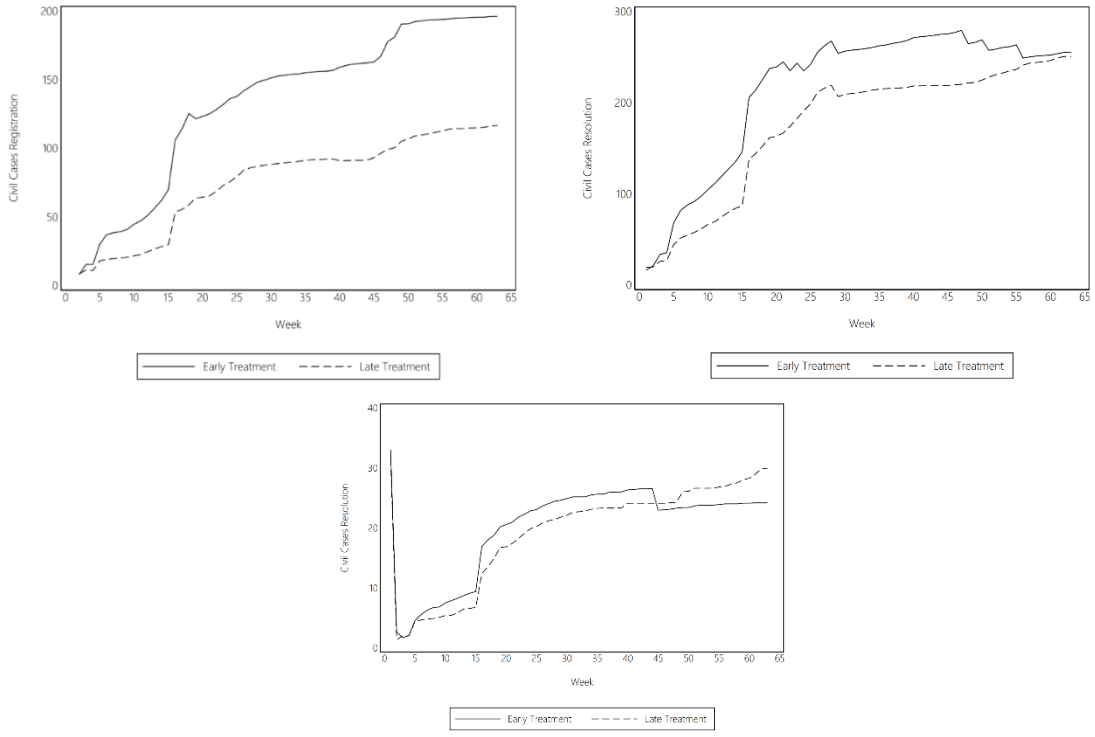
Table 5 presents the impact of the staggered rollout on the frequency of cases in the Lahore High Court across different types of cases: Civil, Criminal, Family, Guardian, Rent, and Other. The results show a significant positive impact of digitization on Civil cases (coefficient of 1.4414, p-value = 0.0191), suggesting an increase in Civil cases as a result of the LRMIS rollout. However, the effects on Criminal (coefficient of 0.2925, p-value = 0.6242), Family (coefficient of 1.0688, p-value = 0.3573), Guardian (coefficient of -0.0033, p-value = 0.9616), Rent (coefficient of 0.0298, p-value = 0.2539), and Other cases (coefficient of -0.0215, p-value = 0.9098) are not statistically significant, indicating no strong relationship between digitization and the frequency of these case types. The models control for time as week, area, and judge fixed effects, with high R-squared values indicating that the models explain a substantial amount of the variation in case frequencies. Overall, the findings suggest that digitization impacts Civil cases significantly but has little to no effect on other case types.

Table 5: Impact of LRMIS on LHC Cases

	Main	Falsification				
	Civil (1)	Criminal (2)	Family (3)	Guardian (4)	Rent (5)	Other (6)
Digitization	1.4414	0.2925	1.0688	-0.0033	0.0298	-0.0215
	(0.5881)	(0.5920)	(1.1465)	(0.0690)	(0.0257)	(0.1882)
	[0.0191]	[0.6242]	[0.3573]	[0.9616]	[0.2539]	[0.9098]
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Area Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Judge Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.8992	0.8655	0.8666	0.9049	0.8717	0.8687
Observations	2,356	2,394	2,394	2,394	2,394	2,394
Dep. Var. Mean	103.7101	100.8772	159.3091	9.6395	2.1533	19.5911
Dep. Var. SD	87.4130	107.4227	156.4654	12.4653	4.1815	23.6708

Notes: This table presents the intent-to-treat estimates of the impact of digitization on the frequency of Lahore High Court cases. The variable "Digitization" represents the staggered rollout of the program. Columns (1) through (6) use the number of cases as the outcome variable. District-fixed effects control for unobserved, time-invariant characteristics specific to each district, year-fixed effects account for time-related factors affecting all districts, and judge-fixed effects account for unobserved heterogeneity caused by judge characteristics. Standard errors, clustered at the district level, are reported in parentheses, and p-values testing the null hypothesis of zero mean are shown in brackets.

Figure 5: Time-varying Impact of LRMIS on High Court Cases



Note: This figure represents the time varying trend of Lahore High Court cases. The top two figures represent the registration of civil cases and their resolution while the lower figure represent the impact on other cases as

falsification test. The y-axis of the figures shows the number of cases while the x-axis represents the week number starting from the full implementation of LRMIS in Punjab.

CONCLUSION

This research evaluates the impact of digitized land record information on land-related corruption within government administration and management departments in Punjab, Pakistan and civil cases from Lahore High Court. Utilizing a quasi-experimental design, the study exploits the LRMIS as a natural experiment. The analysis draws on novel data from the Anti-Corruption Establishment of Punjab, encompassing land-related complaints, inquiries, and cases, which serve as indicators of corruption within the relevant departments.

The findings reveal that the early implementation of LRMIS led to a significant decrease in the number of inquiries and cases. Specifically, the number of corruption inquiries decreased by 40.66 percent and the number of cases decreased by 31.71 percent.

These results provide suggestive evidence of the pivotal role of LRMIS in curbing corruption through enhanced transparency. The increased public utilization of the system highlights its effectiveness in improving land administration, reducing information asymmetry, and mitigating corruption within land-related departments. The study underscores the value of digitization and e-governance systems in modernizing governance and enhancing state capacity.

RECOMMENDATIONS / POLICY IMPLICATIONS

LRMIS was implemented in Punjab and this research estimate the effect on the corruption within Punjab province. Considering the similar socioeconomics characteristics of Punjab with other provinces, this research provides significant policy implications for the structural transformation of Pakistan and low-income countries as well. It highlights the importance of land record digitization in reducing corruption and improving governance, contributing to e-governance and digital transformation efforts. The findings of this research could be used as an instrument for developing the digitized land record systems in other provinces and other developing nations. By promoting anti-corruption measures, enhancing digital capabilities, and fostering collaboration, the project aims to support the integration of digitization initiatives, leading to transparent and efficient land administration systems and overall structural transformation in the region.

In the context of this research, the digitization of land records represents a fundamental shift in the way land-related transactions and information are managed. By replacing traditional paper-based systems with digital platforms, the aim is to improve transparency, efficiency, and accountability in the land administration process. This transformation can have wide-ranging effects on various aspects of the economy. Firstly, digitization can enhance the governance and transparency of land-related transactions, reducing corruption and rent-seeking behaviors. By improving access to accurate and up-to-date land records, the project seeks to minimize the opportunities for fraudulent activities and illegal practices. This, in turn, can lead to a more level playing field for businesses, encouraging investment and entrepreneurship, and promoting economic growth. Secondly, the project's focus on corruption and its impact on land-related matters aligns with the broader objective of structural transformation and state capacity building. Corruption is often seen as a significant barrier to economic development and inclusive growth. By addressing corruption in the land sector through digitization, the project aims to create an enabling environment for productive activities, such as agriculture, real estate, and infrastructure development. This can contribute to the diversification and modernization of the economy, leading to structural transformation.

Since this research follow an appropriate measurement tool, operationalizing variables, and employing statistical techniques for data analysis, the study contributes to the conceptual framing of the relationship between digitization, corruption, and governance reforms in the land sector. By reducing corruption and improving transparency, the digitization of land records can reduce frictions and enhance the business environment. It also aligns with industrial policies aimed at promoting efficiency, competitiveness, and investment in sectors dependent on land resources.

Last but not least, the research is related to the Political Economy and Public Investment in terms of addressing the political economy aspects related to corruption in the land sector. It investigates the effectiveness of a government initiative LRMIS in curbing corruption and bringing governance reforms. The findings inform public investment decisions and policy-making processes by providing evidence on the impact of digitization on corruption and the potential for improving governance and transparency in the land sector.

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APPENDICES

Appendix A: Alternate Approach

Considering the phase-in implementation of the program in the study area, the fact that my potential covariates are time-invariant variables, the “size of district”, "number of police stations" "urbanization", standard fixed-effect models cannot be utilized to control for unobserved heterogeneity.

In the existence of a potential control time-invariant variable that could be correlated with the outcome of interest and can introduce a bias, the standard fixed-effect models or first-difference estimators cannot be utilized.

Therefore, I adopt a hybrid model as an alternative to fixed effect (FE) models in the linear case.

It demeans the explanatory and outcome variables (subtracting the mean value from each observation), I address the issue of omitted coefficients of level-two variables.

$$\overline{y_\iota} = \beta\overline{x_\iota} + \gamma d_i + u_i + \overline{\epsilon_\iota} \quad (2)$$

where $\overline{y_\iota}$ is the mean of level-one outcome variable by district, $\overline{x_\iota}$ is the mean of level-one explanatory variable by district *i*, d_i is the level-two control variables that only varies between clusters, u_i is the level-two error term, $\overline{\epsilon_\iota}$ is the mean of level-one error term.

The standard random effect model is given by:

$$y_{it} = \beta x_{it} + \gamma d_i + u_i + \epsilon_{it} \quad (3)$$

where subscript *i* and *t* represent the level-two-unit district and level-one-unit time respectively. Subtracting equation (2) from equation (3) leads to the "within transformation" that averages out all time-invariant elements including the level-two error term due to the fact that ($\overline{d_\iota} = d_i$) and ($\overline{u_\iota} = u_i$).

This within-transformed model is given as:

$$(y_{it} - \overline{y_\iota}) = \beta_{FE}(x_{it} - \overline{x_\iota}) + (\epsilon_{it} - \overline{\epsilon_\iota}) \quad (4)$$

My interest is not to examine what happens within each district or tehsil itself, rather I treat them as a random sample from a larger population and following Ruppert et al. (2003) and Diggle et al. (2002), I model the between-districts variation as a random effect at the district level.

I thus adopt a hybrid model that separates within- and between-district effects (Neuhaus and McCulloch, 2006; Schunck, 2013; Allison, 2009) and the correlated random-effects model (Cameron and Trivedi, 2005; Wooldridge, 2010) as below:

$$g(\mu_{it}) = \beta_W(x_{it} - \overline{x_\iota}) + \beta_B X_i + \gamma d_i + \alpha_i + u_i \quad (5)$$

This specification includes both the deviation from the district-specific means $(x_{it} - \overline{x_\iota})$ and the district-specific mean x_i among other covariates in the model. γ is the coefficient of time-constant variables that include the size of the district, number of police stations, population density, literacy rate, and mauza density.

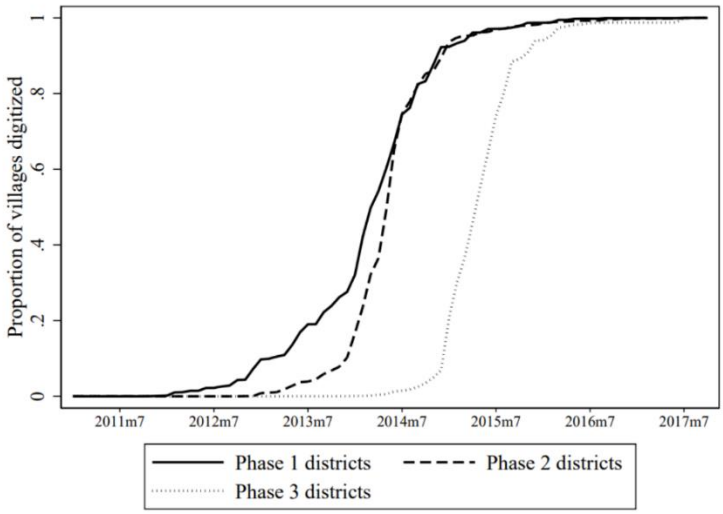
To address reverse causality, I estimate the effect[4] of bordering districts dummy on the standard DDR dummy variable and obtaining the predicted values of the treatment.

First Stage:

$$g(ET_{it}) = \beta_0 + \beta_1 D_i + \delta X_{it} + U_{it} (6)$$

where ET_{it} is a (probit) function of binary dependent variable "treatment" dummy, D_i represents the binary for the district at planned i. My interest in the first stage is in the statistical strength of β_1.

Figure 6: Roll-out of LRMIS



I then ran second stage regression of corruption outcome on the predicted values of treatment conditional on district, and time fixed effects as follows:

Second Stage:

$$Y_{it} = \theta_0 + \widehat{\theta_1} ET_{it} + \theta_2 X_{it} + \epsilon_{it} (7)$$

where:

θ_1 is the parameter of interest indicating the effect of program on the outcome of corruption Y in district i in year t.

[4] If I consider that district selection into the treatment was based on its status of bordering districts, then the best option is to use the binary variable for bordering district or distance from border to centroid of the district for precise estimation. At this stage, I utilize the binary for border districts. The IV is still a time-invariant variable.

Appendix B: Brief Explanation of Results

The digitization of land records has proven to be a transformative intervention aimed at improving transparency, reducing corruption, and streamlining administrative processes. In districts where this initiative has been implemented, a significant shift in citizen engagement has been observed. Initially, one might expect that making land records more accessible and transparent would result in fewer complaints, enquiries, and cases, but the data suggests a different story: while complaints have increased, enquiries and cases have decreased.

The rise in complaints can be seen as a positive development, reflecting increased public engagement and trust in the system through a potential mechanism of availability of transparent information. Availability of this information can increase the predictability of ultimate decision for all the key players[5] i.e. complainant, defendant and adjudicator. This predictability results into the filing complaints and their early resolution while reducing the intense enquiries and cases. The digitization has made land records more accessible and easier for citizens to review. This enhanced transparency has led many to notice discrepancies or issues they might not have seen before. Moreover, the process of filing complaints has been simplified, allowing citizens to more easily express their concerns. This newfound awareness and streamlined pathway to report grievances seem to have empowered the public, leading to an uptick in complaints.

At the same time, the reduction in the number of enquiries and cases could indicate a significant reduction in corruption. The digitized systems have limited human discretion in handling land records, which in turn has reduced opportunities for manipulation or corrupt practices. As these opportunities for corruption diminish, fewer complaints are being escalated into serious offences that require legal investigations or criminal cases. This suggests that the digitization effort is effectively addressing the issue of corruption in land administration, allowing for a more transparent and fair system.

Additionally, the digitization of land records has led to a quicker resolution of many issues. In the past, a complaint might have led to a prolonged investigation or legal case. Now, with the digitized system, administrative clarifications or corrections can often resolve issues swiftly, preventing the need for formal enquiries or legal action. This has resulted in a reduction in the number of cases and enquiries, showing that disputes are being handled more efficiently.

However, there is another side to the increase in complaints. With easier access to complaint mechanisms, some non-substantive complaints—such as habitual or trivial grievances—may have surged. These complaints are often screened out during the initial enquiry stage due to their lack of evidence or relevance. This phenomenon further explains the simultaneous increase in complaints

[5] In legal and administrative contexts of Punjab and this research, the complainant is the individual or group who registers a grievance or complaint, typically seeking resolution or justice. In my case, the complainant is mostly a member of the general public who files concerns regarding land record issues. The defendant is the individual or entity against whom the complaint is filed, often accused of wrongdoing or failure in their duties. In this context, the defendant is an official of the land department who may be responsible for issues raised in the complaint. The adjudicator is the party that responds to the complaint, typically tasked with addressing or resolving the matter. In my case, the adjudicator could be the Anti-Corruption Establishment Punjab or the Lahore High Court, which oversees and resolves such grievances.

and decrease in enquiries and cases. While many of these issues are filtered out early in the process, it is important to understand whether the complaints are genuinely problematic or merely frivolous.

The trends observed in the treatment areas demonstrate the powerful impact of digitizing land records. The increase in complaints signifies greater public awareness and engagement, while the decrease in enquiries and cases reflects improved efficiency and a reduction in corruption. These results suggest that digitization has the potential to bring about systemic change, although continuous monitoring and targeted interventions are essential to fully realize its benefits.

Appendix C

Table 6: Impact of LRMIS on Corruption, Robustness

	Complaints		Enquiries		Cases		Conversion		
	Incidents (1)	Disposal (2)	Incidents (3)	Disposal (4)	Incidents (5)	Disposal (6)	Complaints to Enquiries (7)	Complaints to Cases (8)	Enquiries to Cases (9)
Digitization	16.6284	-0.3750	-11.0164	-2.4944	-1.8199	-4.5020	-257.9812	-116.8656	-1.0081
	(3.8488)	(0.1243)	(1.9762)	(0.4266)	(0.3454)	(0.9970)	(57.0831)	(52.4398)	(3.5418)
	[0.0000]	[0.0025]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0258]	[0.7759]
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	297	281	297	294	297	286	281	281	294
Dep. Var. Mean	56.8553	99.6550	27.2859	97.6068	5.7353	94.8464	227.6300	81.1630	29.8002
Dep. Var. SD	58.7356	1.5101	20.7695	6.6480	3.9125	12.9114	539.1300	352.6474	28.3132

Notes: This table presents the intent-to-treat estimates of the impact of digitization on corruption-related indicators. The variable Digitization represents the staggered rollout of the digitization program. District-fixed effects control for unobserved, time-invariant characteristics specific to each district, while year-fixed effects account for time-related factors affecting all districts. Control variables include population, urbanization, literacy rates, and the number of police stations in each district. Standard errors, clustered at the district level, are reported in parentheses, and p-values testing the null hypothesis of zero mean are shown in brackets.

Table 7: Impact of LRMIS on Corruption, IV

	Complaints		Enquiries		Cases		Conversion		
	Incidents (1)	Disposal (2)	Incidents (3)	Disposal (4)	Incidents (5)	Disposal (6)	Complaints to Enquiries (7)	Complaints to Cases (8)	Enquiries to Cases (9)
					Panel A: Instrumental Variable Estimation				
Digitization	34.5708	-1.0859	-13.2127	-6.0382	-2.3817	-9.2207	-389.0354	-103.8908	5.3109
	(6.5265)	(0.4226)	(2.1424)	(1.4237)	(0.6211)	(2.1752)	(110.2812)	(36.3204)	(3.4823)
	[0.0000]	[0.0147]	[0.0000]	[0.0002]	[0.0005]	[0.0002]	[0.0012]	[0.0072]	[0.1365]
Dep. Var. Mean	57.7219	99.6643	27.3127	97.6151	5.7449	94.9219	216.8934	77.0714	30.0548
Dep. Var. SD	57.8850	1.4721	20.6960	6.6139	3.8905	12.7025	525.3363	342.8175	29.3864
					Panel B: First Stage Estimation				
Planned	0.2100	0.2100	0.2100	0.2100	0.2100	0.2100	0.2100	0.2100	0.2100
	(0.0167)	(0.0167)	(0.0167)	(0.0167)	(0.0167)	(0.0167)	(0.0167)	(0.0167)	(0.0167)
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Time F**E**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area F**E**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	351	351	351	351	351	351	351	351	351
F-Statistic	135.4562	133.2223	135.4562	135.4520	135.4562	135.4390	133.2223	133.2223	135.4520

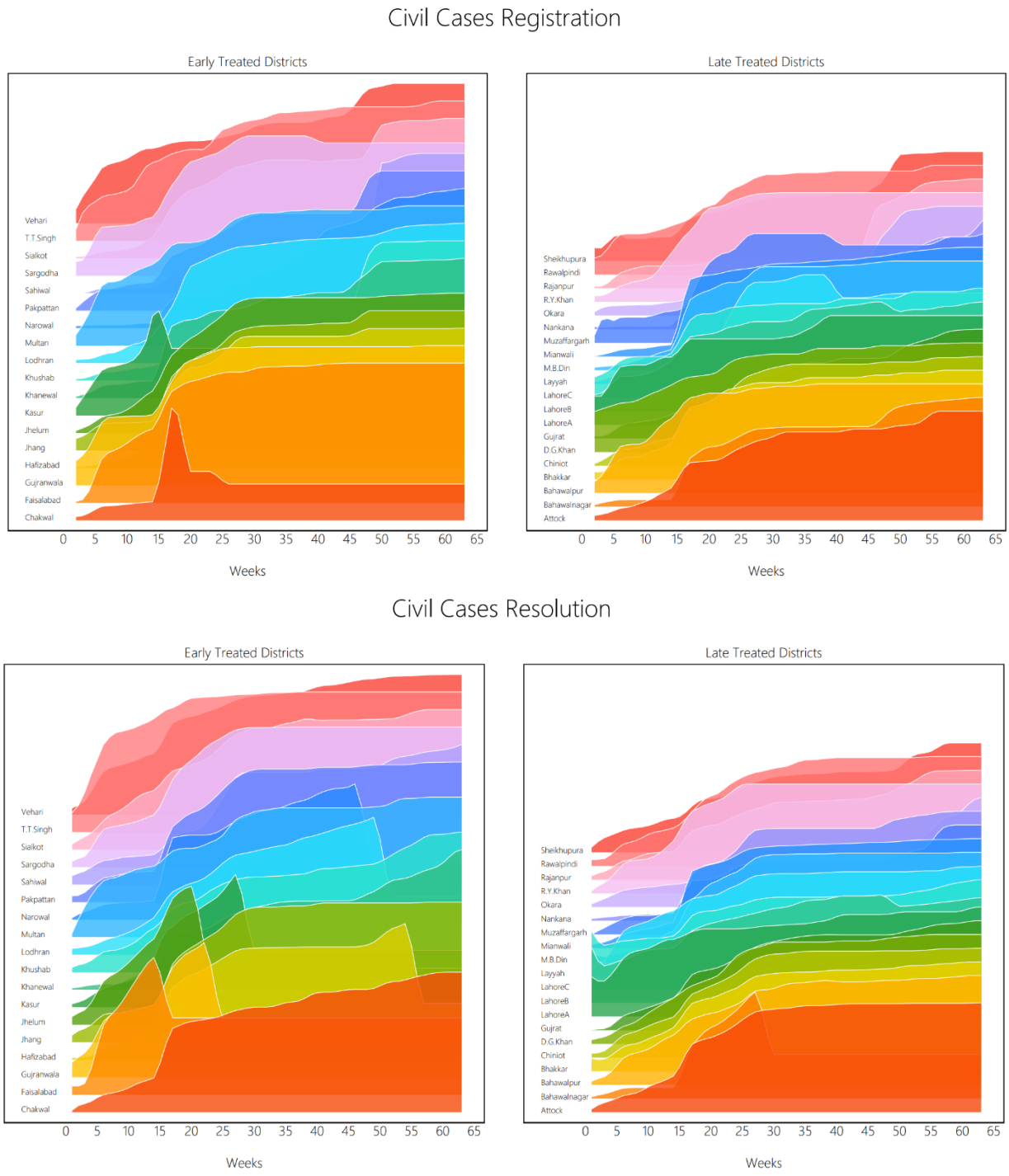
Notes: This table presents the local average treatment estimates of the impact of digitization on corruption-related indicators. The variable Digitization represents the staggered rollout of the digitization program. District-fixed effects control for unobserved, time-invariant characteristics specific to each district, while year-fixed effects account for time-related factors affecting all districts. Standard errors, clustered at the district level, are reported in parentheses, and p-values testing the null hypothesis of zero mean are shown in brackets.

Table 8: Exclusion Restriction

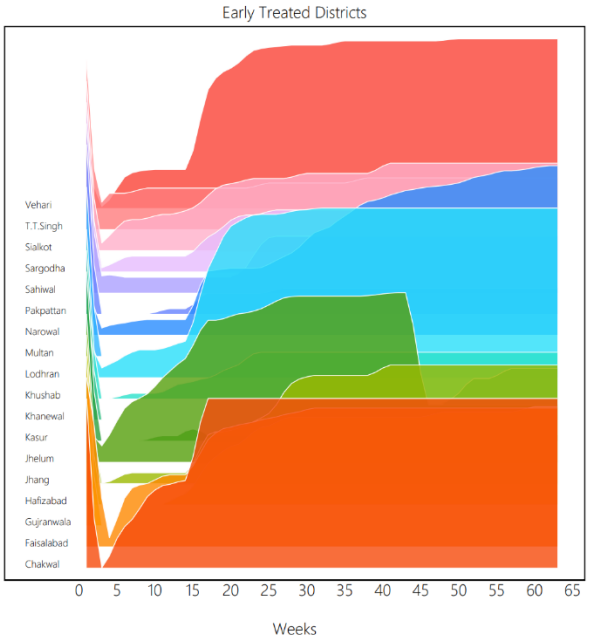
	Complaints		Enquiries		Cases		Conversion		
	Incidents (1)	Disposal (2)	Incidents (3)	Disposal (4)	Incidents (5)	Disposal (6)	Complaints to Enquiries (7)	Complaints to Cases (8)	Enquiries to Cases (9)
Planned	-1.0478	-0.0829	-1.0459	-0.1320	0.0192	0.2156	-14.5649	15.4040	3.5297
	(2.3327)	(0.1054)	(0.7272)	(0.4045)	(0.1637)	(0.6842)	(29.7072)	(17.6178)	(1.3960)
	[0.6562]	[0.4371]	[0.1595]	[0.7461]	[0.9075]	[0.7546]	[0.6271]	[0.3881]	[0.0163]
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.7404	0.3573	0.6472	0.5278	0.5875	0.4170	0.3613	0.1900	0.2175
Observations	315	298	315	312	315	303	298	298	312
Dep. Var. Mean	57.7219	99.6643	27.3127	97.6151	5.7449	94.9219	216.8934	77.0714	30.0548
Dep. Var. SD	57.8850	1.4721	20.6960	6.6139	3.8905	12.7025	525.3363	342.8175	29.3864

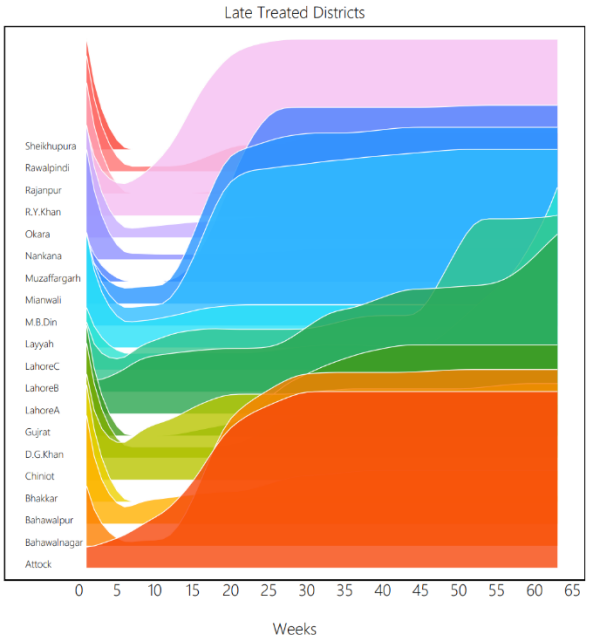
Notes: This table presents the estimates of the impact of the planned rollout on corruption-related indicators. The variable 'Planned' represents the staggered rollout of the program. District-fixed effects control for unobserved, time-invariant characteristics specific to each district, while year-fixed effects account for time-related factors affecting all districts. Standard errors, clustered at the district level, are reported in parentheses, and p-values testing the null hypothesis of zero mean are shown in brackets.

Appendix D


Civil Cases Registration
Early Treated Districts
Late Treated Districts
Vehari
T.T.Singh
Sialkot
Sargodha
Sahiwal
Pakpattan
Narowal
Multan
Lodhran
Khushab
Khanewal
Kasur
Jhelum
Jhang
Hafizabad
Gujranwala
Faisalabad
Chakwal
Sheikhupura
Rawalpindi
Rajanpur
R.Y.Khan
Okara
Nankana
Muzaffargarh
Mianwali
M.B.Din
Layyah
LahoreC
LahoreB
LahoreA
Gujrat
D.G.Khan
Chiniot
Bhakkar
Bahawalpur
Bahawalnagar
Attock
0 5 10 15 20 25 30 35 40 45 50 55 60 65
Weeks
Civil Cases Resolution
Early Treated Districts
Late Treated Districts
Weeks

Other Cases


Early Treated Districts
Vehari
T.T.Singh
Sialkot
Sargodha
Sahiwal
Pakpattan
Narowal
Multan
Lodhran
Khushab
Khanewal
Kasur
Jhelum
Jhang
Hafizabad
Gujranwala
Faisalabad
Chakwal
0 5 10 15 20 25 30 35 40 45 50 55 60 65
Weeks


Late Treated Districts
Sheikhupura
Rawalpindi
Rajanpur
R.Y.Khan
Okara
Nankana
Muzaffargarh
Mianwali
M.B.Din
Layyah
LahoreC
LahoreB
LahoreA
Gujrat
D.G.Khan
Chiniot
Bhakkar
Bahawalpur
Bahawalnagar
Attock
0 5 10 15 20 25 30 35 40 45 50 55 60 65
Weeks