A DYNAMIC CGE-SLUDGE FRAMEWORK FOR PAKISTAN

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INTRODUCTION

The concept of a sludge economy has garnered increasing attention in recent years as a framework for understanding the drag on economic productivity and individual welfare created by excessive administrative burdens. Sludge refers to the frictions and inefficiencies that make it unnecessarily difficult for individuals and businesses to complete basic tasks, comply with regulations, or access public services. Reducing sludge has become a priority for policymakers seeking to streamline bureaucracy, improve service delivery, and promote economic dynamism.

Overall cost of sludge is 49% of Pakistan's GDP, equivalent to over $132 billion in 2023, according to the PIDE Sludge Series (1-3) examining the burden of red tape in many industries while starting a business (such as agriculture, electricity, construction, etc.). In a partial equilibrium and close-economy setting, digitization can reduce time and monetary costs by over 40% and 34%, respectively. However, it is not as effective in reducing opportunity costs unless the government intervenes and eliminates the need for physical documents, which can reduce opportunity costs by over 60%.

Computable general equilibrium (CGE) models have become a cornerstone of economic policy analysis over the past few decades. They provide a powerful framework for assessing economy-wide impacts of policies, shocks, and structural changes across various sectors and regions. Though originally developed to analyze trade policies, CGE models have expanded to study various distortions and frictions that create welfare losses and deadweight costs. For example, recent applications have quantified economic impacts of informality, financial market imperfections, and governance quality. The unifying theme is using CGE models to measure direct and indirect effects of market imperfections and institutional failures.

Reducing sludge is an urgent priority for Pakistan's economic development. But the most effective policies require rigorous diagnosis of how sludge permeates the economy. This research will provide that diagnosis by leveraging a CGE model tailored to analyze sludge in Pakistan. Our model will quantify sludge impacts on sectoral outputs, household incomes, government revenue, international trade, and other core macroeconomic outcomes – capturing both direct effects and indirect spillovers.

RESEARCH METHODOLOGY: DYNAMIC CGE-SLUDGE FRAMEWORK

Our CGE-Sludge framework extends the usages of dynamic Global Trade Analysis Project (GTAP) model by incorporating sludge features through productivity channel that account for changes over time, particularly in GDP, investment and welfare level. This model is designed to analyze medium- and long-run policy impacts.

Simulation Design

Our dynamic CGE-Sludge framework is initially calibrated to a SAM that reflects Pakistan's current economy, including existing sludge. Baseline equilibrium inherently incorporates productivity losses and distortions caused by sludge across different sectors.

To simulate sludge removal, it adjusts sector-specific total factor productivity parameters based on empirical estimates from PIDE Sludge Audit Series. These adjustments represent productivity gains from removing administrative burdens. For example, the audit data suggests that sludge in construction due to "Obtaining permission for a high-rise building from CDA" causes cumulative productivity loss in Construction equivalent to 17.5% of GDP over four years. Our dynamic CGE-Sludge model increases (matches) TFP parameter for construction by corresponding for each year to reflect this effect in each of the four years. Other causes of sludge affecting construction are modeled similarly to obtain our initial sludge removal change in TFP for this sector. Similar adjustments are made across all sectors based on their specific sludge burdens. After implementing these changes, the CGE model solves for a new general equilibrium, allowing all markets to adjust. Economic impacts of sludge removal are then quantified by comparing key indicators (e.g. GDP, sectoral output, etc.) between no-sludge simulation counterfactual equilibrium and sludge-inclusive baseline.

Social Accounting Matrix (SAM)

GTAP provides a comprehensive framework for analyzing global economic issues, offering a wide range of CGEs models along with a vast database, enabling researchers to assess the economic implications of various policies and shocks. Construction of GTAP Data Base version 11 aims to harmonize global-scale data sources for analytical purposes, offering comprehensive time series data on value flows, volumes, and various tax measures. This extensive coverage of economic activities enhances its utility in conducting wide-ranging studies on global economic issues.
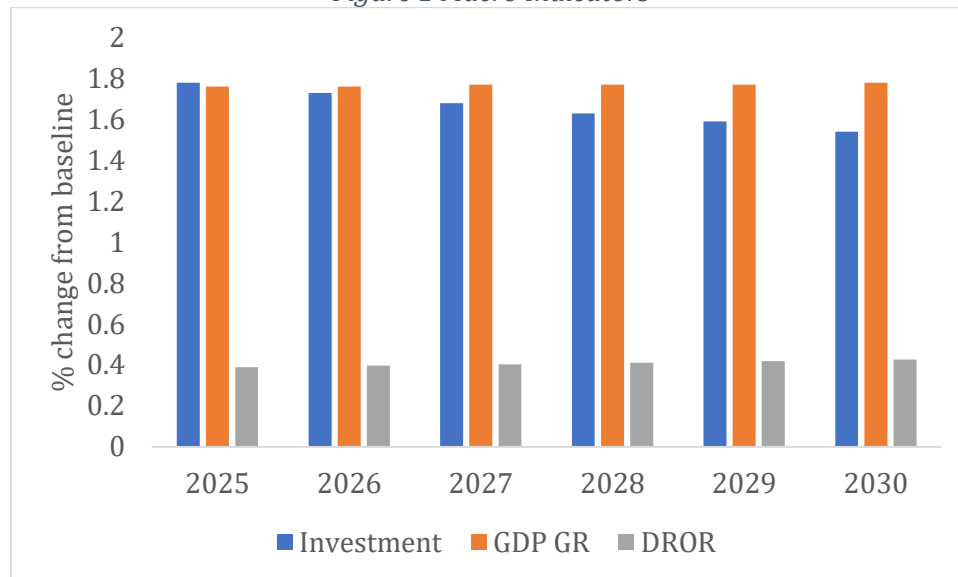
SIMULATION RESULTS[1]

Case Study: Sludge Removal in Electricity Sector

According to the PIDE Sludge Audit Vol 2, cost of sludge in the electricity sector for year 1 only is around 1.50 % of GDP. Compared to the baseline model, a 30.3% TFP productivity gain in the

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[1] We use the expected rate of return closure (RORE), where capital moves across regions and regions' trade balances change accordingly.

electricity sector would raise total GDP by this amount. Hence, this scenario increases the baseline productivity parameter by 30.3% in electricity sector. The simulation results of removing sludge in electricity sector reveal a picture of steady growth and positive trends across multiple sectors. Macroeconomic indicators show a slight decline in investment growth from 1.78% to 1.54%, yet GDP growth rate demonstrates a consistent upward trajectory from 1.76% to 1.78%. This suggests improving economic efficiency, generating higher output even with slower investment growth. DROR shows a steady increase from 0.389% to 0.426%, indicating improving profitability and efficiency in domestic investments.

Figure 1 Macro Indicators

Source: Own calculations.

### *Sludge Removal in All the Given Sectors*

The simulation results present the economic impact of sludge on investment, real GDP growth rate, domestic Rate of Return (DROR), and welfare levels. Results are presented on an annual basis for 2025 through 2030, which represents short-term and medium term, rather than long-term, outcomes.

Initial return of removal of sludge as estimated in partial equilibrium analysis of PIDE on investment is extraordinarily high at 314.6% compared to baseline in 2025 (Figure 2). In 2023, overall investment to GDP ratio was 12% in Pakistan; hence, removing sludge would increase overall investment more than three times in Pakistan i.e. 37.8% of GDP. PIDE Sludge Audit Vol 1 explains that obtaining permission for a high-rise building from CDA costs 10.9% of GDP in year 1, which is the primary cause of such huge investment loss in Pakistan; however, it reduces significantly in subsequent years.

The real GDP growth rate shows a consistent increase from 47% in 2025 to 57.9% by 2030. Hence, overall impact of removing sludge in the general equilibrium framework is higher after five years

(57.9% of GDP) than the combined (1-3) micro Sludge Audits (49% of GDP) due to inter-temporal effects and backward & forward linkages. Backward and forward linkages between different industries prorogates this impact, which is intensifies by dynamic interaction of sludges in the same sector and across different industry. Hence, domestic ROR increased around 68% in Pakistan, meaning for every dollar invested, we gain 68 cents return on these projects.

Figure 2 Macro Indicators
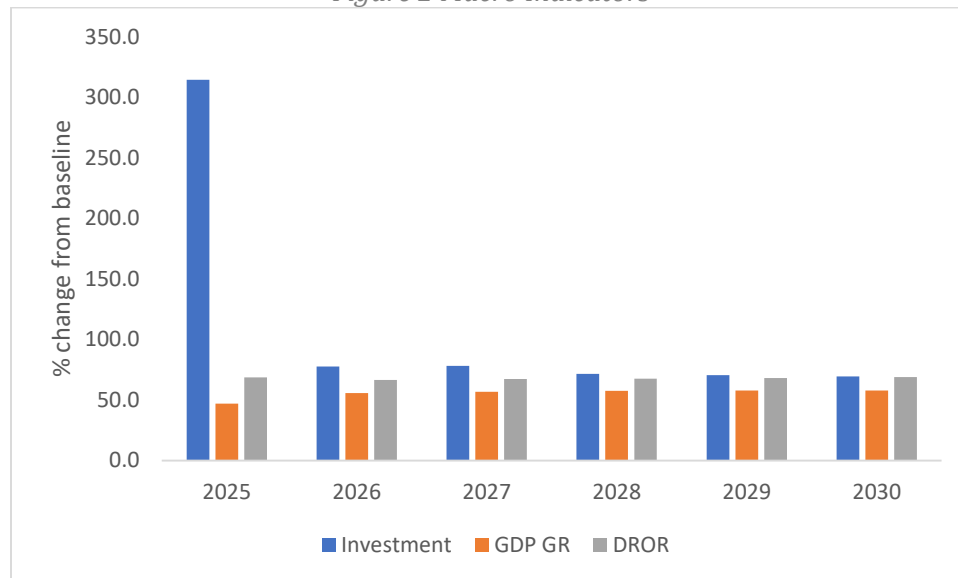
Source: Own calculations

Our simulation results indicate significant welfare gains from removing sludge in Pakistan, with these gains closely tied to increased household consumption. Welfare gains are expected to keep rising, reaching over $142 billion by 2030, (41% higher compared to the baseline). A persistent boost in private household demand for various commodities over time is a key driver of welfare gains. The increased household consumption across various sectors suggests a general improvement in living standards. The shift towards domestic production in key areas further amplifies these effects, details are provided in the next sub-section.

CONCLUSION AND DISCUSSION

Our simulation results highlight the profound economy-wide benefits of removing bureaucratic inefficiencies in Pakistan. Key findings include a significant boost to investment, potentially tripling Pakistan's investment-to-GDP ratio. This could transform economic development by accelerating industrialization, technological adoption, and productivity growth. Welfare gains could exceed $142 billion by 2030, driven by increased production activity by domestic firms, more household consumption particularly in construction and pharmaceuticals, signaling broad improvements in living standards and health outcomes.

Sectoral impacts reveal a boom in pharmaceuticals and construction, offset by a contraction in real estate as investments shift to other more productive sectors. Reduced reliance on imported

materials and pharmaceuticals highlights enhanced domestic industry competitiveness, promoting self-reliance and export growth. While the transition offers immense opportunities, challenges such as employment disruptions in certain sectors require careful policy management to ensure equitable benefits and minimize short-term impacts.

KEY POLICY RECOMMENDATONS

This section reinforces several key recommendations validated by our CGE analysis:

Prioritize High-Impact Sectors for Reform: Our CGE analysis reveals that certain sectors offer disproportionate economy-wide benefits when freed from sludge. The large potentials in the domestic activity of pharmaceuticals and construction sectors suggests prioritizing reforms in these sectors. Further, the magnitude of their effects, captured through our general equilibrium framework, is substantially larger than what partial equilibrium analysis alone would suggest due to inter-industry linkages.

Manage Structural Economic Transitions: The CGE results uniquely highlight the need for careful management of structural economic changes. Our analysis shows that removing sludge could cause a significant contraction in the real estate sector (-345.5%) while boosting other sectors. This insight, which emerges from the general equilibrium effects, suggests policymakers need to:

. Develop transition strategies for affected sectors

. Implement gradual reform timing to avoid market disruptions

Balance Import Substitution and Export Promotion: The economy-wide analysis reveals complex trade effects that were not visible in sector-specific studies. The projected 400% decrease in construction material imports alongside domestic sector growth suggests opportunities for import substitution. However, policymakers should:

. Target sectors showing strong domestic growth potential

. Support export capacity development in newly competitive sectors

. Maintain balanced trade policies during the transition