SLUDGE ECONOMY OF PAKISTAN: A DYNAMIC CGE-SLUDGE FRAMEWORK

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Pakistan's economy is hindered by bureaucratic inefficiencies, or "sludge." The Pakistan Institute of Development Economics (PIDE) has undertaken various sludge audits (1-3) to examine this issue under the mentorship of Dr. Nadeem ul Haque. This study develops a Computable General Equilibrium (CGE) framework to account for the total economic cost of sludge across different sectors. Different sectors are impacted by sludge in varying degrees. The construction sector is hit hardest by permitting and red tape, while real estate might see growth by 2028 as construction-related sludge reduces. Household demand drops across the board, particularly in construction and pharmaceuticals. Increased demand for imported construction materials and drugs suggests weaknesses in domestic production. The study calls for reducing sludge by streamlining bureaucracy, boosting local production, and promoting R&D in pharmaceuticals.

INTRODUCTION

The sludge economy refers to the inefficiencies and administrative burdens that hinder economic productivity and individual welfare. Sludge makes basic tasks, regulatory compliance, and accessing services unnecessarily difficult for businesses and individuals. Reducing

these frictions has become a key goal for policymakers aiming to streamline bureaucracy and foster economic growth. In Pakistan, the cost of sludge is 39% of the GDP, equivalent to over $132 billion in 2023 (PIDE, 2022). Studies show that digitization can reduce time and monetary costs by over 40% and 34%, respectively (Faraz & Qasim, 2022), though opportunity costs can only be reduced significantly if physical documents are eliminated.

The Pakistan Institute of Development Economics (PIDE) has undertaken various sludge audits to examine this issue.[18] These audits meticulously assess and quantify the impact of regulatory and procedural bottlenecks on various sectors. By identifying areas where administrative processes create unnecessary delays or barriers, PIDE provides guidelines how to streamline procedures and reduce the economic drag associated with bureaucratic red tape. The insights gained from these audits are crucial for formulating targeted reforms that can enhance the efficiency of governance and facilitate a more conducive environment for business growth and investment in Pakistan.

While sludge creates significant costs across many sectors, no study has yet examined its full effects using a general equilibrium approach. An inter-sector analysis is crucial to understand how sludge in one industry impacts others, both domestically and internationally. This gap calls for applying a Computable General Equilibrium (CGE) model, which can assess the total economic cost of sludge across sectors.

CGE models use a Social Accounting Matrix (SAM) to simulate the relationships between different economic activities. They help estimate changes in macroeconomic variables like GDP, employment, and prices in response to specific shocks.[19]Though originally for trade policy, CGE models have evolved to analyze a wide range of economic distortions, including market imperfections and institutional failures. Sludge fits into this category of market imperfections, as it distorts prices and reduces productivity by imposing unnecessary burdens on firms and consumers. However, no dedicated CGE model has yet been used to analyze the effects of sludge in a developing economy like Pakistan.

Reducing sludge is essential for Pakistan's development, but effective policies require a detailed analysis of how sludge affects the economy. This research aims to fill that gap by using a CGE model to measure the impact of sludge on key economic outcomes, such as sectoral outputs, household incomes, and trade flows. This approach will also help identify the most impactful policies for reducing sludge, guiding reforms that could alleviate one of Pakistan's major growth constraints.

PIDE SLUDGE AUDITS (1-3)

The section outlines different types of sludge that the private sector faces while initiating and completing a project in Pakistan. These costs are represented in three categories: 1) In terms of GDP, 2) Stress level, and 3) Number of trips.[20]The first indicator (cost in % share of GDP) summarizes all the costs faced by the private sector, whereas the other two indicators are additional explanatory factors that represent additional dimensions of this cost.

[18]https://pide.org.pk/research-category/sludge-audits/
[19]Our simulation results are based on GTAP data base version 11, and author is the solo contributor of the Pakistan input – output table to the GTAP data base: https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5957
[20]https://pide.org.pk/research-category/sludge-audits/

For the sake of our analysis in the dynamic CGE framework, this study uses the first indicator because it sums up all types of costs in monetary terms.

PIDE Sludge Audit 1 mainly focuses on high-rise buildings, residential construction, sludge cost for obtaining permission from an environmental protection agency, acquiring a plot in a private housing society, setting up a pharmaceutical Unit, a private Hospital, a Diagnostic Center, a Pharmacy or Petrol Pump, and Pension kick-off process.

PIDE Sludge Audit 2 primarily focuses on different industries (such as restaurants, hotels, and cash & carry), services (such as private school, intercity public/private transport business, banking & loan services, electricity connections and IT business), and others (including registration of a new medicine, and intellectual property rights). Finally, the **PIDE Sludge Audit 3** basically focuses on Pakistan's judicial system such as criminal trials, civil trials, inland revenue court cases and various other categories.

DYNAMIC CGE-SLUDGE FRAMEWORK

The CGE-Sludge framework enhances the dynamic GTAP model by incorporating sludge features through productivity, accounting for changes over time in GDP, investment, and welfare (Ianchovichina and McDougall, 2012). It analyzes medium- and long-term policy impacts. Moreover, the micro foundations of this dynamic CGE-Sludge framework are based on PIDE Sludge Audits (1-3)[21].

One key feature of our model is treating time as a continuous variable, offering a more accurate portrayal of economic processes. Traditional models use time indices, but CGE-Sludge integrates time directly, enabling smoother simulations of economic dynamics.

Capital accumulation plays a central role, represented by an integral equation that tracks net investments and initial capital stock. This continuous approach captures real-world economic behavior better than discrete-time models. Investment decisions are based on adaptive expectations, where agents respond to past experiences and anticipated returns, ensuring capital stocks adjust gradually.

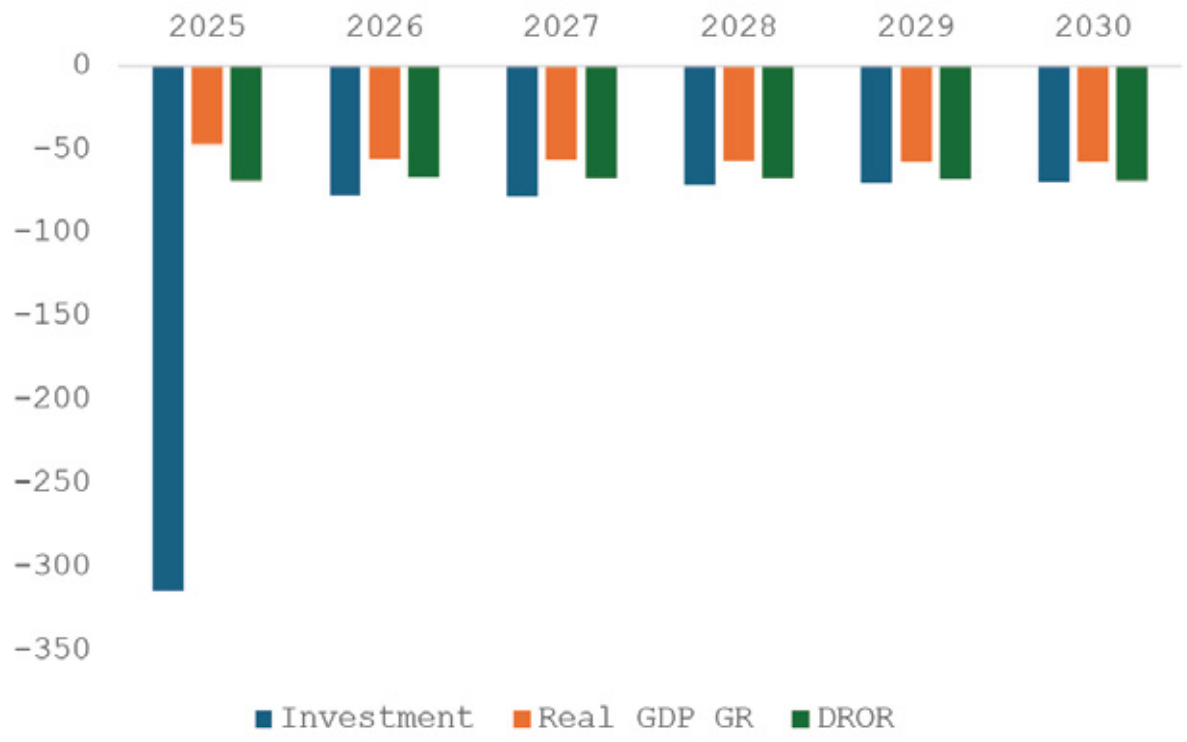
The model strikes a balance between complexity and computational efficiency, maintaining GTAP's sectoral detail while enabling dynamic analysis. It also faces challenges like ensuring accuracy over long periods. The CGE-Sludge framework advances economic modeling by incorporating dynamic elements that improve policy analysis. While it doesn't cover short-run dynamics, its focus on capital and wealth accumulation offers key insights for long-term policy impacts.

[21] https://pide.org.pk/research-category/sludge-audits/

SIMULATION RESULTS OF THE DYNAMIC CGE FRAMEWORK

Our simulation results highlight the economic and welfare impacts of sludge on investment in Pakistan, covering investment costs, real GDP growth, domestic Rate of Return (DROR), and welfare levels. The initial impact in 2025 is severe, with a -314.6% reduction in investment compared to the baseline, signalling a substantial early loss. However, this cost lessens over time, stabilizing around -70% by 2030, indicating a decreasing financial burden. Real GDP growth falls consistently from -47% in 2025 to -57.9% by 2030. The overall impact is higher (57.9% of GDP) than micro-Sludge Audits (49% of GDP) due to industry linkages and dynamic sludge interactions, though the negative impact stabilizes over time.

Figure 1 Macro indicators

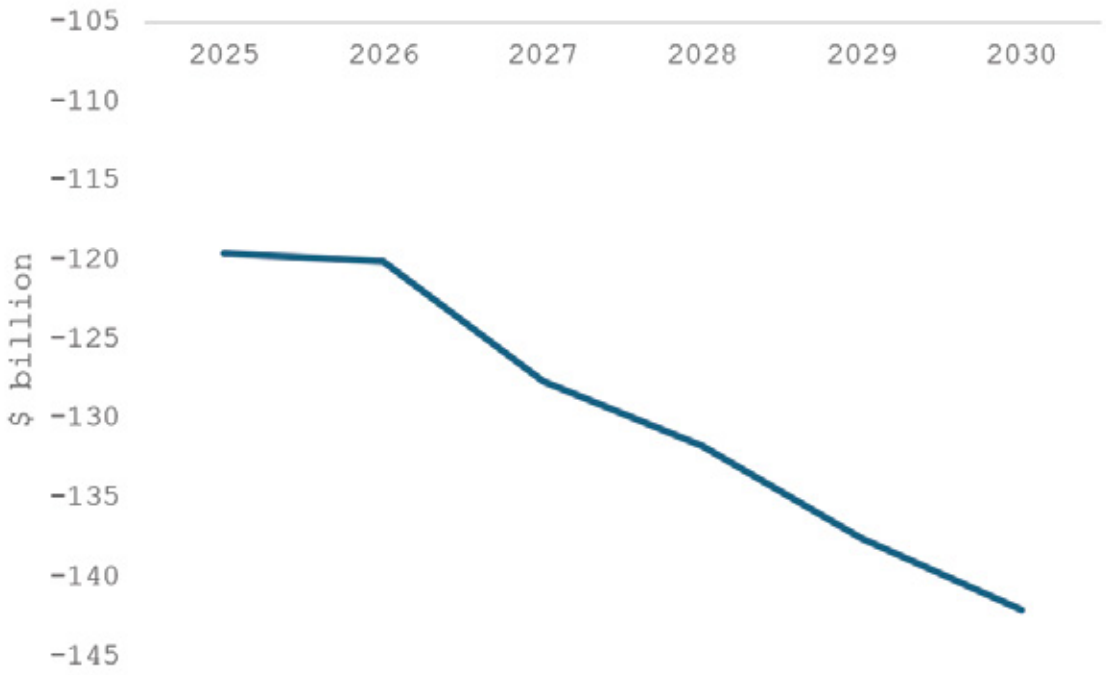


Source: Own calculations

The domestic rate of return stays consistently negative, around -68%. It starts at -68.6% in 2025, dips slightly in 2026, and rises to -68.9% by 2030. This indicates poor financial returns, suggesting these investments may not be viable unless supported by subsidies or non-financial benefits. Welfare costs linked to sludge begin at $119.55 billion in 2025, growing yearly to $142.045 billion by 2030. This increase highlights the escalating economic burden on Pakistan, straining public resources and impacting economic stability.

The simulation results reveal significant economic challenges. High initial investment costs, falling GDP growth, negative returns, and rising welfare costs indicate substantial hurdles. The upfront capital needs remain a financial burden, and the negative impact on GDP growth signals harm to economic expansion. Meanwhile, increasing welfare costs suggest an escalating strain on the country's economy.

Figure 2 Welfare level



Source: Own calculations

The construction sector sees a sharp decline in 2025, with a -301.5% drop in domestic activities. Though it stabilizes slightly, it remains heavily negative, indicating long-term challenges. In contrast, real estate shows negative growth from 2025 to 2027 but experiences a surge in 2028, peaking at 345.5%, suggesting a major recovery in the sector.

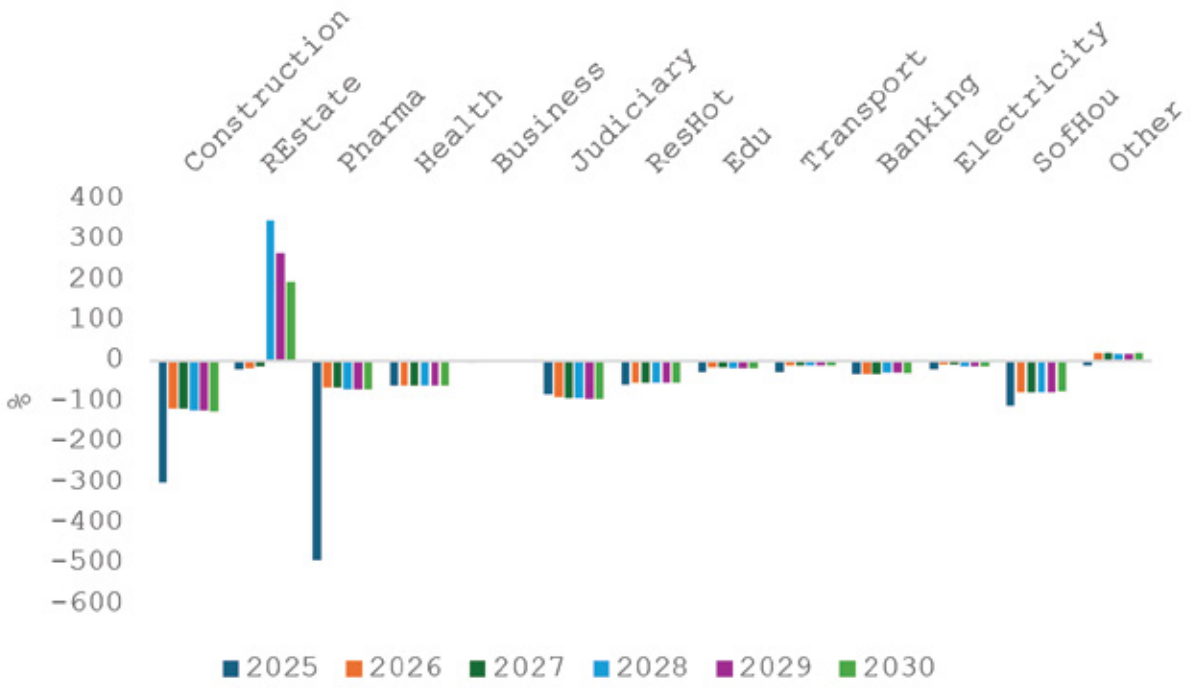
The pharmaceutical sector faces a steep drop of -491.7% in 2025, followed by smaller but consistent reductions, signaling persistent issues. The health sector remains negative, hovering around -61.5%, indicating continued underinvestment or inefficiencies.

The business sector improves from a slight decline in 2025 to positive growth by 2027, reflecting resilience. The restaurant & hoteling sector shows consistent negative growth of around -55%, possibly due to changing consumer behavior. The banking sector also shows ongoing but manageable decline.

The education sector experiences a significant drop in 2025, with a slower decline afterward. Similarly, the software and transport sectors show steep declines in 2025, followed by gradual easing but remaining under pressure. The electricity sector drops in 2025 but stabilizes with partial recovery. Meanwhile, the judiciary sees increasing declines, reaching -93.4% by 2030, indicating systemic issues.

Finally, the 'Other' category rebounds strongly post-2025, showing recovery and growth. This analysis highlights severe downturns in key sectors like construction and pharmaceuticals, while sectors like real estate and 'Other' recover, offering opportunities for policy interventions and investment strategies.

Figure 3 Domestic sales



Source: Own calculations

The simulation results show a persistent drop in private household demand for various commodities in Pakistan from 2025 to 2030. The construction sector suffers a drastic decline of -131% in 2025, improving slightly but still stabilizing at -125.7%. This reflects a sharp reduction in household investment in construction, likely due to economic downturns or lower disposable income. Real estate demand also drops initially, fluctuating before stabilizing, but remains negative, indicating ongoing but manageable cuts in household investments.

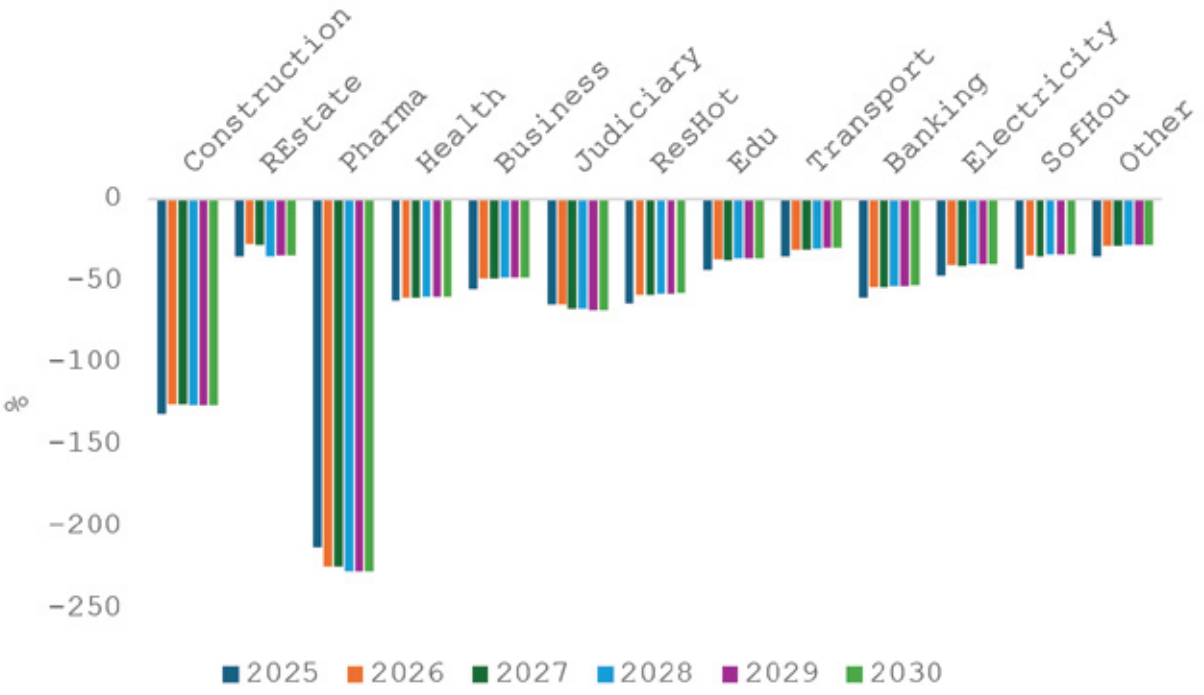
The pharmaceutical sector experiences a severe drop, from -212.6% in 2025 to -227.3% by 2028, where it stabilizes. This may indicate affordability challenges or a shift in spending priorities. Similarly, the health sector sees a steady decline, stabilizing around -59.8%, signaling reduced household health expenditures, likely due to economic pressure.

The business sector shows gradual recovery, improving from -54.8% in 2025 to -47.8% by 2030, though demand remains negative. The restaurant and hoteling sector also improves but stays negative, hinting at lower discretionary spending. This could be linked to the banking sector slump, which suggests limited household banking activity due to economic instability or alternative financial solutions.

The education sector stabilizes at -36.6%, reflecting reduced spending, possibly due to economic constraints or more affordable options. Transportation sees a similar pattern, with gradual improvement but staying negative, indicating reduced spending, likely driven by economic factors. The software sector also shows a drop, likely due to spending cuts or the use of free alternatives.

The electricity sector follows a similar trend, with reduced spending, possibly due to energy-saving measures. The judiciary sector worsens, reaching -68.5% by 2030, indicating minimal household engagement. Finally, the 'Other' category stabilizes at -27.8%, reflecting broader economic difficulties and reduced household spending across the board. Overall, the results suggest a pervasive decline in household demand across all sectors from 2025 to 2030, with most sectors showing negative growth.

Figure 4 Overall private HH demand for commodity



Source: Own calculations

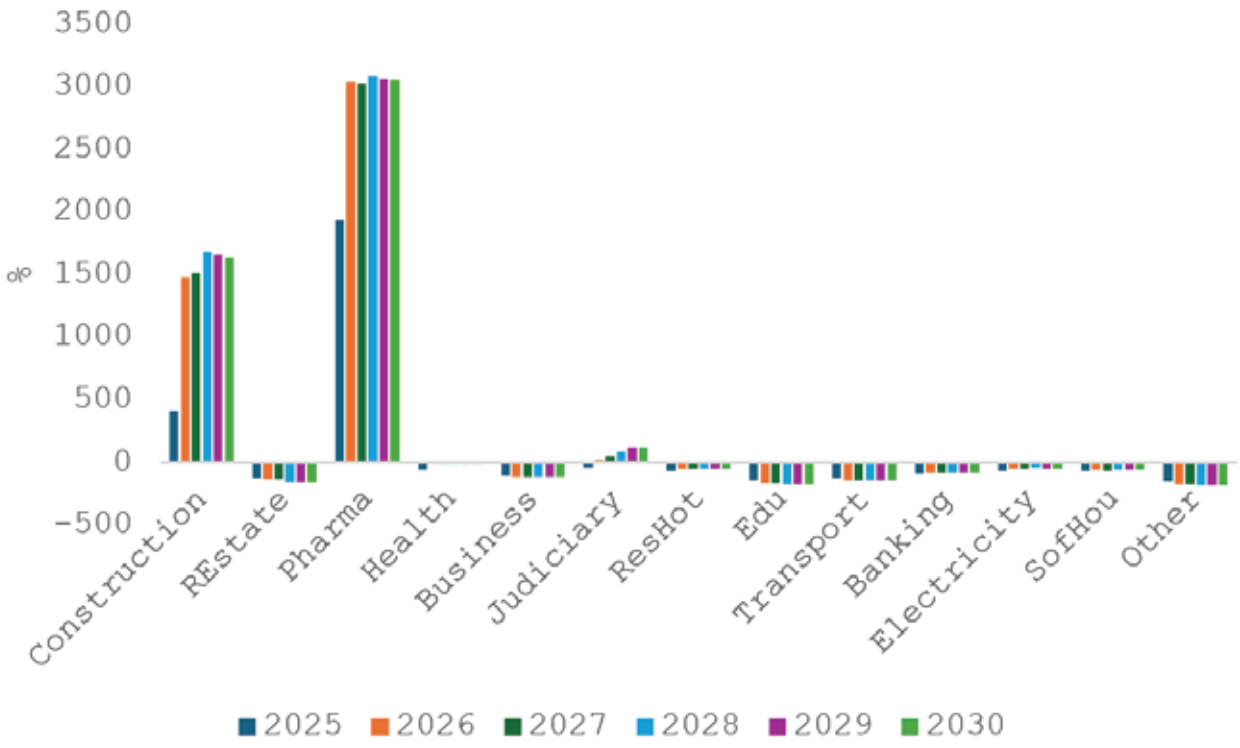
The simulation results highlight notable shifts in household demand for imported commodities in Pakistan from 2025 to 2030. The construction sector shows a sharp rise, with demand spiking from 417.9% in 2025 to 1677.8% in 2028, then slightly dropping to 1642.3% by 2030. This surge suggests a reliance on imported materials, likely due to domestic shortages or superior quality of foreign goods. In contrast, real estate experiences a declining trend, reflecting a shift towards local materials, potentially driven by domestic production or policy shifts favoring local goods.

The pharmaceutical sector sees a significant rise, with demand growing from 1931.9% in 2025 to 3083.3% in 2028, indicating a heavy dependency on imports, possibly due to limited local production. The health sector, however, shows a decreasing trend in imports, which may point to improving domestic production or services.

Several sectors, including business, restaurants, banking, education, software, and transport, exhibit a steady decline in demand for imported goods, suggesting increased local production and changing consumer preferences. The judiciary sector, however, transitions from declining to rising demand, indicating possible changes in infrastructure or operations.

Overall, the results reflect contrasting trends: a growing dependency on imports in construction and pharmaceuticals, while other sectors move towards self-sufficiency. This reliance on imports, particularly in construction and pharmaceuticals, could strain foreign reserves and highlight gaps in local production capabilities. Investing in local manufacturing, fostering innovation, and building resilient supply chains are essential to reduce import dependency and support sustainable growth.

Figure 5 Private HH demand for imported commodity



Source: Own calculations

CONCLUSION AND DISCUSSION

Pakistan's economy holds great potential, but bureaucratic inefficiencies, or "sludge," act as a major hindrance. This research develops a dynamic CGE-Sludge framework to illustrate the severe economic drag caused by these inefficiencies. Investment takes the hardest hit, with a projected -314.6% drop in 2025 compared to the baseline. This discourages businesses from investing, stifling innovation and job creation, which hurts long-term economic growth. Similar to Faraz & Qasim's (2022) findings, this bureaucratic maze forces investors to either abandon projects or look for easier markets.

The CGE-Sludge model also reveals a steady decline in Pakistan's real GDP growth, plummeting to -57.9% by 2030. Sludge in one sector ripples throughout the economy, disrupting industries and reducing output. The construction sector, for instance, faces decreased demand for steel, cement, and related industries, sparking a broader economic slowdown.

The study also highlights a negative domestic return on investment, around -68%, signalling

poor financial gains and further discouraging private sector involvement. This places a greater burden on the public sector to fuel growth, limiting resources for vital investments in infrastructure and education.

Sludge impacts households too, with welfare costs projected to soar to $142 billion by 2030. Higher costs for goods and services, paired with job losses, mean lower living standards and increased poverty.

Sector-specific findings are telling construction activities decline due to red tape, while real estate grows starting in 2028, possibly benefiting from improved efficiency in housing construction. The pharmaceutical sector, however, sees a massive -491.7% decline by 2025, likely due to stringent regulations and supply chain inefficiencies, limiting access to essential medicines.

While some sectors struggle, others show resilience. Business activities improve by 2027, showing adaptability. However, the restaurant and hotel sector remains particularly vulnerable due to time-sensitive permits.

The decline in household demand, particularly in construction and pharmaceuticals, signals reduced spending power. Reliance on imported construction materials highlights the need to boost local production for long-term economic sustainability. Similarly, rising demand for imported pharmaceuticals reflects the challenges faced by domestic producers. Addressing these issues requires fostering innovation in the pharmaceutical sector and streamlining regulations to boost local production of essential medicines.

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