

Transparent budget: the idea of deep transparency

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Article**

JEL: H61, H83, H57, D73, D82

<https://doi.org/10.3326/pse.50.3.4>

* The authors would like to thank two anonymous referees for their comments and suggestions.

** Received: February 16, 2026

Accepted: May 13, 2026

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Abstract

Governments know exactly where public money goes. Citizens do not. This asymmetry is not a technical accident – it is a structural feature of how public financial management systems are designed. Existing transparency frameworks – the IMF Fiscal Transparency Code, the Open Budget Index, and the OECD Budget Transparency Toolkit – measure what governments choose to disclose. They do not make spending verifiable. This paper develops a model of deep transparency that closes this gap. By connecting budget allocations to real-time execution data through tamper-resistant technologies – write-once, read-many (WORM) storage and blockchain – the model enables citizens to trace every public outlay to its final private recipient. Deep transparency shifts fiscal accountability from publication to verification. It reduces the discretionary space through which patronage, corruption, and state capture operate. The model is normative and conceptual, but the problem it addresses is real and the tools required to solve it already exist.

Keywords: budget transparency, democratic accountability, public policy, digital governance, discretionary spending, WORM technology

1 INTRODUCTION

The idea that public budgets are inseparable from democratic accountability is not new. Aaron Wildavsky (1964: 1) famously described the budget as “the lifeblood of the government, the financial reflection of what the government intends to do” – the central arena where the political question of “who gets what and how” is answered. For Wildavsky, the budget was not a technical document but a political one, and the ability of citizens to scrutinize it was fundamental to holding governments accountable. That insight is now over six decades old. And yet, despite the internet, open data portals, and sophisticated public financial management systems, the promise it contained remains unfulfilled. Since the IMF introduced its Fiscal Transparency Code in 1998, governments have promised to disclose budget information. The promise has largely been kept – on paper. Budgets are published, procurement portals exist, and international organizations produce annual rankings of fiscal openness. Yet a critical gap persists: while governments maintain detailed records of every transaction internally, citizens lack the means to verify how public funds are actually spent. This asymmetry is not incidental. It is structural. And it undermines democratic accountability at its core.

The problem is most acute where it matters most. Research consistently finds that discretionary spending – including off-budget items, subsidies, and grants – generates systematic opportunities for abuse. Public procurement and public-private partnerships, now accounting for up to 33 percent of global GDP, are increasingly pre-rigged to favour politically connected firms (Fazekas et al., 2024), including in developed economies (Fazekas and Tóth, 2016; Dávid-Barrett and Fazekas, 2020; Curry, 2022). The result is corruption, state capture, party patronage, and rent-seeking that existing frameworks have failed to constrain (Rubin, 2020). They have failed not because the standards are wrong, but because they depend on the government’s willingness to disclose.

Deep transparency addresses this democratic deficit. It is not primarily a technical upgrade to existing public financial management systems – those systems already exist, and governments already possess complete transaction-level data. Rather, deep transparency is a policy innovation that makes this data continuously verifiable by the public through tamper-resistant technologies such as write-once, read-many storage (WORM). By converting the insider advantage into public visibility, deep transparency restores the democratic principle that citizens have a right to scrutinize how their tax money is spent.

Existing public financial management systems – Integrated Financial Management Information Systems (IFMIS), International Public Sector Accounting Standards (IPSAS), the IMF Fiscal Transparency Code (IMF, 2019), and the IMF Digital Solutions Guidelines (IMF, 2023) – are designed for insiders. Government officials have full visibility over budget execution; citizens do not. Data can be modified locally, reports are generated episodically, and disclosure depends entirely on the government’s choice. Why these systems fall short of democratic accountability and how deep transparency differs from them are developed in section 3.

This article is conceived as a normative, design-oriented framework rather than as an empirical case study or pilot evaluation. Its contribution lies in specifying the institutional logic, technical architecture, and implementation pathway through which deep transparency could be integrated into existing treasury and IFMIS-based public financial management systems.

The next sections proceed as follows. Section 2 develops the conceptual foundations of deep transparency. Section 3 situates the model within existing transparency practices and explains why current approaches remain insufficient. Section 4 presents the technical architecture that operationalizes the model in practice. Section 5 discusses the broader political economy implications of adopting deep transparency, and section 6 concludes.

2 DEEP TRANSPARENCY: THE MODEL

Our model presents a natural progression from previous models of transparency. We build on the arguments for openness, clarity in rules and decision-making, public scrutiny of government and business operations, and the application of transparency in budgetary and fiscal domains (Hood, 2006). According to Heald (2003), transparency entails that public expenditures are visible and understandable to designated user communities. This perspective underscores the inadequacy of simply generating and disseminating information; instead, transparency demands an audience capable of comprehending and effectively utilizing this information. It underlines the necessity of communicating public expenditure in a format intelligible to external stakeholders (referred to as “inward transparency”). This approach mirrors the accountability mechanisms expected of managers within publicly listed companies, where substantial resources are allocated to establishing accounting standards, financial reporting, and auditing conducted by accredited auditors (Heald, 2012).

It is important to note that deep transparency, as developed in this paper, is a normative and conceptual model. No government currently applies it in the form we describe, which is precisely why we wrote this paper.

The historical development of budget transparency can be divided into four stages, following the framework found in Khagram, Fung and de Renzio (2013):

- TS1 Absence of transparency (Weberian Model) – budgets not revealed to citizens.
- TS2 Paper transparency (new public management, NPM) – budgets revealed on paper, typically with lump sums (pre-digital era).
- TS3 Online transparency (new public governance, NPG) – data on public spending can easily be accessed online and are more detailed, categorized by economic classifications.
- TS4 Deep transparency – citizens can access the entire budget proposal process, adoption, execution, and associated discretionary spending, such as grants, subsidies, loans, and public contracts.

These four stages represent our analytical reading of how budget transparency has evolved historically, broadly corresponding to the trajectory documented in Khagram, Fung and de Renzio (2013). Deep transparency constitutes the fourth and most recent stage in this progression.

We define deep transparency as follows. It is a comprehensive model of budget oversight that enables real-time, detailed institutional tracking of public expenditures, linking each budgetary outlay to its final beneficiary, the recipient of the disbursed funds, including private agents in public-private partnerships. It employs write-once, read-many (WORM) storage and/or blockchain technology to ensure data integrity and prevent tampering, creating an immutable, publicly verifiable record of budget execution. It is essentially a part of financial technology, applying innovative technology-driven solutions to improve and automate the delivery of financial services. By making each stage of budget execution traceable and verifiable, the model significantly expands the scope and precision of fiscal disclosure.

To understand what deep transparency adds to the existing infrastructure, it is necessary to be precise about what existing systems already do – and where they stop. Governments already record detailed transaction-level data internally through treasury and IFMIS systems. This information is, in principle, comprehensive. In practice, however, it is not made publicly accessible. The information released externally is aggregated – typically at the level of programs, sectors, or institutions – rather than individual transactions. Reporting is also periodic: monthly, quarterly, or annually, rather than continuous or in real time. As a result, traceability is incomplete. It is difficult to follow specific budget outlays to their final beneficiaries, especially in areas such as public procurement or public-private partnerships. Deep transparency builds directly on these existing systems. It does not replace them. It extends them by making their underlying transaction data publicly accessible, traceable, and verifiable in real time.

Our model develops the fourth stage of transparency by bringing the entire budget cycle into view and illuminating what we call the shadow budget. We define it as the broad domain of public spending that falls outside or at the margins of core budget documents and therefore escapes routine public scrutiny. It includes off-budget items such as contingency funds, special accounts, and quasi-fiscal activities of state-owned enterprises; tax expenditures such as exemptions and tax breaks that reduce revenues without appearing as direct outlays; debt obligations and guarantees; and discretionary transfers such as subsidies, grants, and loans to private and public entities (IBP, 2011). Public-private partnerships (PPPs) occupy a particularly opaque corner of the shadow budget: their costs are often spread over time or kept off the official balance sheet, concealing fiscal commitments that can rival conventional public debt in scale (IMF, 2019). Unlike the formal budget, where allocations are at least nominally visible, the shadow budget is fragmented – its components are scattered across separate platforms, agencies, and reporting frameworks, making it structurally difficult for non-insiders to follow. The shadow budget plays a significant role in generating corruption, state capture, rent-seeking, and party patronage, and in eroding public trust in political institutions (Bauhr et al., 2020).

Our model integrates subsidies, grants, loans, public procurement, PPPs, and other discretionary flows with the formal budget, exposing the areas most vulnerable to opacity and abuse. Every budget expenditure ultimately reaches a final recipient in the private sector, whether through a PPP contract, a subsidy, or any other budgetary channel. Our solution provides a straightforward way to identify where funds went, searchable by the final recipient, regardless of how many different budget items the outlay was recorded under. By linking these items to real-time execution data, the model enables observers to track actual outlays rather than merely the official presentation.

Tracking expenditures – including the full breakdown of allocations, final beneficiaries, and relevant execution details – is among the most prominent features of deep transparency. For instance, when a budget line item allocates public funds to a private entity for the provision of some public good (such as the construction of a new public hospital, road, school, stadium, sewage system, power grid, etc.), selecting the corresponding online entry would reveal a detailed breakdown of expenses for each component (e.g., construction costs, hospital furniture, medical equipment, interior fit-out, etc.). Our model could be applied with equal efficiency to off-budget items such as contingency funds, debt obligations, subsidies and grants, special accounts, tax breaks, and quasi-fiscal activities of state-owned enterprises (IBP, 2011).

To illustrate how this would work in practice, consider a hypothetical €10 million road construction contract awarded to a private firm. Under deep transparency, the budget system would record the commitment at contract signing, link it to the procurement record and the winning bid, trace each payment milestone to the contractor's bank details, and make the entire chain – from budget line to final recipient – permanently verifiable online in real time. No equivalent mechanism exists in current PFM or transparency frameworks.

The practical relevance of such traceability is evident in a recent Hungarian case. Early research (Fazekas, King and Tóth, 2013) revealed – that Hungarian public procurement exhibited systemic, politically driven patterns in which contract allocation depended more on connections than on competition, with outcomes shifting alongside changes in political power – was later quantified by the Financial Times, which found that 14% (€28 bn) of all funds awarded in state tenders under Viktor Orbán went to 13 of his associates, based on an analysis of nearly 350,000 contracts (Caruana Galizia, 2026). Under a deep transparency model, patterns of this kind would become publicly visible within a few clicks.

Our model also enables object-based outlay aggregation, providing a quick, efficient, and straightforward method to calculate public expenditures by summing costs across various administrative units – such as the executive, courts, and regulatory institutions – based on specific activity categories. To illustrate, consider the U.S. federal budget, where outlays are categorized using object classifications, a system defined by the Office of Management and Budget. This system groups spending by transaction type, regardless of the agency incurring the expense, ensuring consistency across federal agencies and facilitating cost comparison. For instance, one can simply refer to the relevant object class across all agencies and departments to determine total expenditures on specific activities, such as travel (object class 21) or grants (object class 41).

This information is essential not only for budget transparency but also for responsible public spending. It lets citizens see how much different administrative or economic activities cost the government. While many national budgets provide access to this data, calculating aggregate sums for specific activities often requires tedious manual work. Our online model automates this process, allowing users, particularly MPs, to obtain these aggregates with just a few clicks.

Deep transparency enables interested parties (who may have different authorisation levels) to verify that all changes in the budget are permanently recorded using WORM technology, similar to tracking changes in a word processor, history on Wikipedia, or blockchain transactions. This refers to comprehensive information regarding the annual budget, ongoing revisions, and amendments, encompassing all aspects of budget item execution and reallocations. When a payment is made from the budget, the system traces the action, recording who made the payment, when, and why. If the budget is rebalanced – as it often occurs in the second half of the year – the changes are visible, allowing the public to judge which items were decreased or increased. Most importantly, if someone makes unauthorised changes or pays out more than the budget item allows, the trace remains, enabling oversight institutions (such as the audit office) to identify and hold the responsible parties accountable.

The model enables governments to disclose summaries of PPP finances, covering rights, obligations, and anticipated financial transactions. PPPs have become essential to fiscal transparency, with the 2019 IMF Fiscal Transparency Code requiring disclosure of financial details by private agents to ensure transparency and accountability (IMF, 2019: 28). Under this framework, governments must

disclose PPP financial summaries, including rights, obligations, and expected financial transactions, highlighting the fiscal impact without revealing sensitive, proprietary, or operational contract details.

Unlike typical public expenditures (such as the cost of public administration), which appear as immediate costs in government budgets, PPPs often conceal their financial impact by spreading costs over time or keeping them off the official balance sheet. These deals often create off-the-books obligations, such as guarantees for future losses or required payments when the government is the only buyer. In the end, this “private” debt can be just as significant as traditional public debt. To ensure transparency, all documents related to these PPP obligations should be stored in a public archive, in the same way as regular budget data.

The openness envisioned by deep transparency does not extend to personal data such as salaries or private information about public officials, nor to financial details tied to national security or sensitive business information of private firms involved in PPP programs. It does not require ministries or agencies to disclose information that is not already legally public. It works by integrating existing budget, procurement, and PPP contract data that are currently scattered across separate platforms and documents, making it difficult for non-insiders to see how specific outlays correspond to individual contracts. By linking these already-public records, the model makes execution traceable without expanding disclosure obligations or violating privacy and security rules. In line with the IMF Fiscal Transparency Code (2019), the government is not required to disclose proprietary, commercially sensitive, or operational details embedded in full PPP contracts. Such undisclosed elements may include proprietary technologies or processes, detailed financial models, specific operational procedures, pricing strategies, or security measures essential to project integrity. These exclusions are intended to protect private partners’ competitive position, preserve intellectual property, and ensure the security and effectiveness of PPP arrangements.

That said, deep transparency requires governments to disclose information essential for public accountability without compromising commercial confidentiality. To ensure transparency when public funds are allocated to private agents for the provision of public goods, it is crucial to disclose the total contract value, the bids submitted by unsuccessful competitors, and lump-sum prices of key cost components. For example, if a private company is contracted to build a hospital, the budget should publicly list overall costs for major inputs such as construction work, labour, and core materials like concrete, bricks, or medical equipment. While individual salaries need not be published, aggregated input costs must be available so that concerned stakeholders can benchmark them against prevailing market prices.

Most importantly, deep transparency is crucial for identifying patterns in which a private firm repeatedly wins contracts, possibly due to political connections rather than competitive merit. This issue is especially notable in hybrid regimes and weak democracies, where firms often leverage political ties to secure contracts, but it is observable in developed Western democracies as well (Fazekas and Tóth, 2016).

3 POLICY INITIATIVES TOWARD TRANSPARENT BUDGETING

Over the past several decades, public financial management (PFM) frameworks have developed along two main lines. First, they establish standardised systems for governments to record, track, and manage public finances internally. These systems – such as treasury operations and accounting structures – are typically managed by Ministries of Finance and implemented through integrated platforms such as IFMIS, which connect budgeting, treasury, accounting, and reporting functions. They allow entrusted public officials to monitor budget execution across stages (commitment, accrual, payment) and ensure consistency, control, and auditability. International accounting standards such as IPSAS further underpin these systems by providing standardized frameworks for general-purpose financial reporting, improving the quality and comparability of public sector financial statements. However, this internal visibility is primarily designed for administrative and oversight purposes, not for direct public access. Only privileged public officials have the full picture of what was spent.

Second, these frameworks define what information should be disclosed externally. Governments are expected to publish structured reports, such as financial statements, budget execution reports, and fiscal summaries, that include data on revenues, expenditures, assets, liabilities, deficits, and fiscal risks. These practices are also reflected in IMF guidance on digital PFM systems, which emphasizes interoperability and standardised reporting across financial functions (IMF, 2019). Initiatives such as the Open Budget Index (OBI) and PEFA assessments build on these standards to evaluate the availability and quality of such disclosures. While these measures improve transparency, reporting remains aggregated, periodic, and institutionally mediated, without transaction-level traceability.

In practice, the implementation of these standards varies considerably across countries. Most advanced economies, particularly OECD countries, operate integrated PFM systems based on IFMIS platforms that generate detailed internal, transaction-level data and produce standardized fiscal reports for external use. However, even in these systems, public disclosure remains largely aggregated and periodic, with limited ability to trace specific expenditures to final beneficiaries. In many developing and transition economies – including the Western Balkans and Sub-Saharan Africa – PFM systems are not fully integrated, reporting practices are uneven, and transparency is often weaker or inconsistently applied. Despite these differences, a common feature across contexts is the gap between internally available financial data and publicly accessible data, particularly at the level of individual transactions.

Over the past two decades, a number of initiatives have sought to make public budgets easier for citizens to access and understand. National efforts such as Italy's Cohesion Policy portal, Barcelona's Budget Obert, and the USAspending.gov platform in the United States have made progress in publishing data on public expenditures. In Central and Eastern Europe, subnational budget watch initiatives

in countries such as Croatia, Macedonia, and Ukraine have similarly attempted to improve citizen access to local government finances, documenting persistent gaps between formal disclosure requirements and actual public access (Ott, 2006).

Among the most advanced PFM systems is Brazil's SIAFI (*Sistema Integrado de Administração Financeira*), an integrated treasury platform launched in 1987 that provides real-time tracking of federal budget execution across all ministries. SIAFI represents a significant achievement in internal fiscal control and is widely cited as a model for integrated financial management. Yet even SIAFI falls short of what deep transparency envisions: its transaction-level data serve internal government purposes and is not structured to allow citizens to independently verify payments to final beneficiaries. Like other advanced PFM systems, it improves the state's internal legibility of spending without creating public verifiability of execution. Yet across these efforts, the contribution remains largely limited to improving access. Real-time monitoring, systemic oversight, and accountability mechanisms often remain out of reach.

More systematic approaches have emerged from multilateral organizations and expert networks. Among these, the Open Budget Index (OBI), the International Monetary Fund's Fiscal Transparency Code, and the OECD's Budget Transparency Toolkit stand out. These initiatives have helped define fiscal transparency, but they also highlight persistent gaps in practice.

The OBI, developed by the International Budget Partnership, evaluates national budget transparency by assessing the availability and quality of eight core documents, ranging from pre-budget statements to audit reports. These evaluations follow a standardized methodology and include peer reviews, feedback loops with government authorities, and input from civil society researchers. The OBI's strength lies in its ability to normalize transparency as a measurable standard. Recent cross-country evidence using OBI data suggests that higher levels of budget transparency are positively associated with financial sustainability outcomes, including fiscal balance and debt performance. However, the model is largely document-based and episodic. Governments may receive high scores for publishing planned budgets, while withholding information on mid-year expenditures or execution reports. More than 40 percent of countries assessed by the OBI fail to release such updates.

Disclosure of PPPs and off-budget liabilities is even more limited. As a result, the OBI reveals what governments are willing to disclose at selected points in time, but not how public funds are managed or disbursed throughout the fiscal year. Notably, the IBP's own companion guide explicitly identifies five domains as most vulnerable to opacity and abuse: extra-budgetary funds, tax expenditures, quasi-fiscal activities, contingent liabilities, and future liabilities (IBP, 2011). These are precisely the domains that constitute the shadow budget as defined in this paper. Deep transparency is designed to make these domains traceable and verifiable in real time – going beyond what the OBI framework can achieve through periodic document-based assessment alone.

The IMF's Fiscal Transparency Code, last revised in 2019, offers a broader framework organized around four pillars: fiscal reporting; forecasting and budgeting; risk analysis and management; and resource revenue oversight. It encourages the publication of aggregate fiscal data, including contingent liabilities such as those stemming from PPPs. Its emphasis is on macroeconomic stability and improved governance, achieved through timely and credible fiscal reporting. Yet the IMF Code remains centred on aggregate data and retrospective assessments. It does not require mechanisms that would allow transaction-level visibility or real-time oversight by the public or independent auditors. The primary objective is to make fiscal risks visible to markets and oversight institutions, rather than to enhance day-to-day accountability in public spending.

The OECD's Budget Transparency Toolkit (2017) takes a more operational approach. It emphasises not only openness but also integrity and accountability. The Toolkit recommends publishing detailed information on budgets, contracts, procurement procedures, and performance metrics. It also addresses the specific risks posed by opaque financial arrangements, especially those involving PPPs and similar off-budget commitments. Still, the Toolkit remains a set of best practices. Adoption is voluntary, enforcement mechanisms are absent, and data availability remains uneven and often delayed. Like the OBI and the IMF Code, it is anchored in what governments choose to disclose, not in mechanisms that ensure continuous and verifiable transparency.

These initiatives have succeeded in setting global standards and in defining fiscal transparency as a policy objective. Yet they share two critical shortcomings: they focus on selected publication rather than on implementation, and they depend on periodic reporting rather than on continuous observation. They describe what should be public but offer little insight into whether those principles are honoured in practice.

Deep transparency differs from all of these frameworks in a fundamental way. The OBI, IMF Code, OECD Toolkit, and PEFA assessments are, at their core, disclosure diagnostics: they measure and encourage what governments choose to publish, in the form of documents, reports, and aggregated data. They are institutionally mediated – citizens receive information filtered through government reporting choices, released periodically, and rarely traceable to individual transactions or final recipients. Public procurement and PPPs, which now account for up to 33 percent of global GDP (Fazekas et al., 2024), remain among the least transparent domains even under these frameworks. Deep transparency is something different. It is a democratic tool. It does not ask governments to improve reporting – it makes the underlying data directly and permanently verifiable by any citizen, civil society organization, or oversight body. Where existing frameworks produce document-level transparency, deep transparency produces execution-level traceability. Where existing frameworks rely on government willingness to disclose, deep transparency creates an architecture in which the link between each budgetary outlay and its final private recipient – the vendor, contractor, or beneficiary who ultimately receives public

funds – is online, immutable, and open to independent verification. This is the shift from publication to verification, from periodic reporting to continuous accountability, and from institutional mediation to direct democratic scrutiny.

Addressing these limitations requires a shift from standard-setting to infrastructure-building. A model that links budget allocations directly to public contracts and expenditures, stored in tamper-resistant systems such as WORM or sealed by blockchain technologies, allows for real-time, transaction-level traceability. This model does not replace the OBI, IMF Code, or OECD Toolkit. It puts their principles into practice by enabling real-time, traceable spending so that citizens can, on this basis, make informed political and policy decisions.

4 A TECHNICAL SOLUTION FOR DEEP BUDGET TRANSPARENCY

Multiple datasets define the budget and the recipients of its money. Some are linked to the government portal, while others are stored by various governmental agencies or local authorities. Gathering all corresponding budgeting data can ensure transparent and efficient access for all interested parties. The qualified majority of the parliamentary Security and Defence Committee should identify datasets that cannot be made public. Those data should be available to authorised persons, such as MPs, under appropriate procedures.

It bears repeating that the proposed architecture applies uniformly to all categories of discretionary and off-budget spending, not only to public procurement or PPP-related items. Any financial outlay – whether a subsidy, grant, transfer, routine operational payment, or contractual obligation – enters the system as a uniquely identified budget item with a timestamp and metadata. This guarantees that subsidies, special-purpose transfers, and administrative reallocations are captured by the same version-tracking logic as procurement transactions. Every modification, reallocation, or release of funds is recorded through the interoperability layer and written once to the WORM-secured Master node, ensuring a verifiable audit trail across the entire execution phase of the budget.

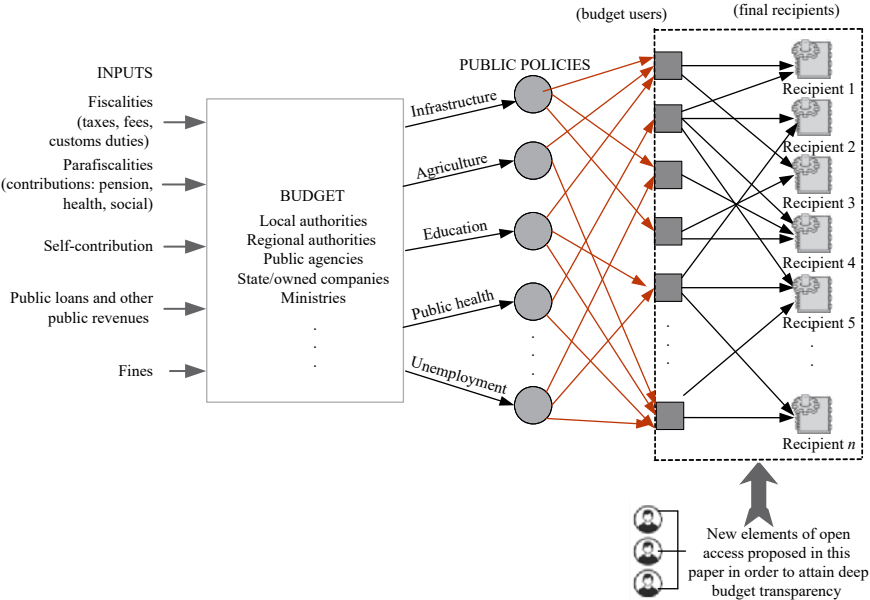
The new solution should enable monitoring of the complete budget cycle by implementing advanced search and data analytics. To accomplish this, we propose introducing an integration layer for existing datasets and services and suggest the application of several innovative technologies to improve problem-solving and resource utilisation. In addition, we intend to accelerate the digitisation process of public administration as a preferred means to hold the government accountable.

As the first task, we ensure interoperability between different participants in the budget creation process. Therefore, our solution (figure 1), based on Interconnected government services (Bojović et al., 2023), incorporates three core principles:

- Using the available computing infrastructure without investing in new storage capacity (data remain in their current locations, entirely functional and self-sustaining) or spending time on data preparation.

- Decoupling data processing from data storage. This enables an application to communicate with a single instance despite multiple databases (assigned to different budget entities such as local, state, public agencies, and others) reading the data. Each user represents a single instance that can access the same application using their identification parameters.
- Dynamic Budget Reporting: This approach facilitates the retrospective review of all current public budget execution versions, providing insight into historical modifications. It enables authorities within the budget’s jurisdiction to decide on project financing. The analysis evaluates whether contract prices align with market rates, aiming to prevent inflated costs and ensure compliance with legal requirements.

FIGURE 1
Public budget allocation process with the final beneficiaries



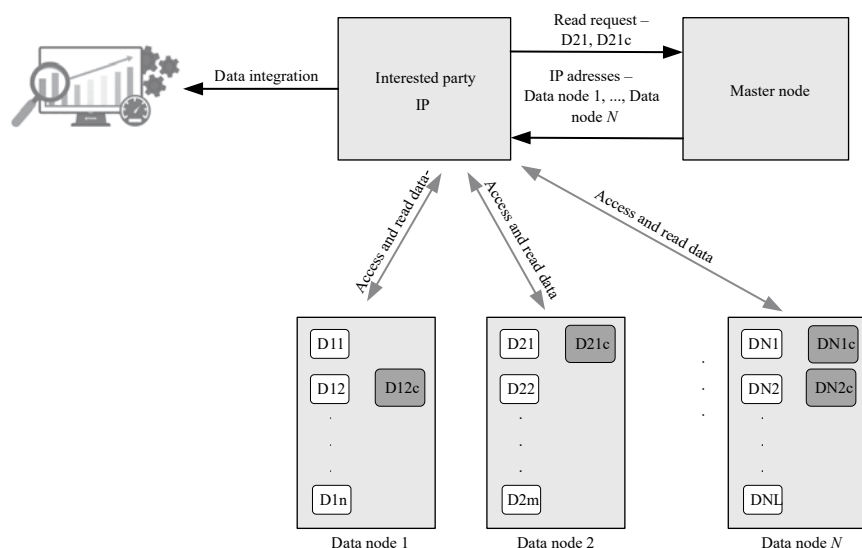
Source: Authors.

As a common access point, we offer an open data portal containing information on the annual budget, current changes, and amendments (all execution versions of budget items and positions that initiate redistribution or engagement of new funds). Experience has shown frequent changes in the government’s priorities during the mandate. These changes usually result in new policies for allocating and spending budget funds (e.g., additional funds for social assistance, unemployment, eliminating the consequences of a catastrophic event, and spending on pension or defence). For this reason, we propose integrating the solution shown in figure 1 into the e-government system. By digitising budgetary procedures, we can realise the critical objectives of good governance.

As depicted in figure 2, our solution implies building a distributed file system with a Master/Slave architecture comprising a single Master node and several Slaves (so-called Data nodes). As a multifunctional and highly available server, the Master node is responsible for maintaining and managing data on the Data nodes. Access to data is possible only after obtaining permission from the Master node. It contains the Namespace entity, which acts as a container, with file name grouping, metadata, and information such as file owners, access permissions, data locations, and data size. We must emphasise that the actual budget data resides on Data nodes, while a separate block called budgeting – historical data stores previous execution versions and budgeting rules.

FIGURE 2

A technical solution for deep budget transparency



Source: Authors.

The state budget allocates funds to budget users (BU1, BU2, etc.) (see figure 1). These budget users, in turn, distribute the allocated funds to specific entities responsible for implementing policy programs (D11, D12, ..., DNL). The Master node, a hardware system designed to log every transaction, records all financial transactions, even those that might be altered or erased locally. When introducing a new version of a budgetary item, such as D12, following a public procurement process, it requires reporting to the Namespace Data Management unit (NDM). This report includes essential data such as the amount paid and the recipient, along with relevant metadata: the initiator of the transaction, the precise transaction time, and any restrictions on data access (these restrictions are essential for state security reasons and must be pre-approved). NDM then registers this data and metadata into the Master node. The newly corrected version, D12c, replaces the original D12 locally, but the Master node permanently stores both versions.

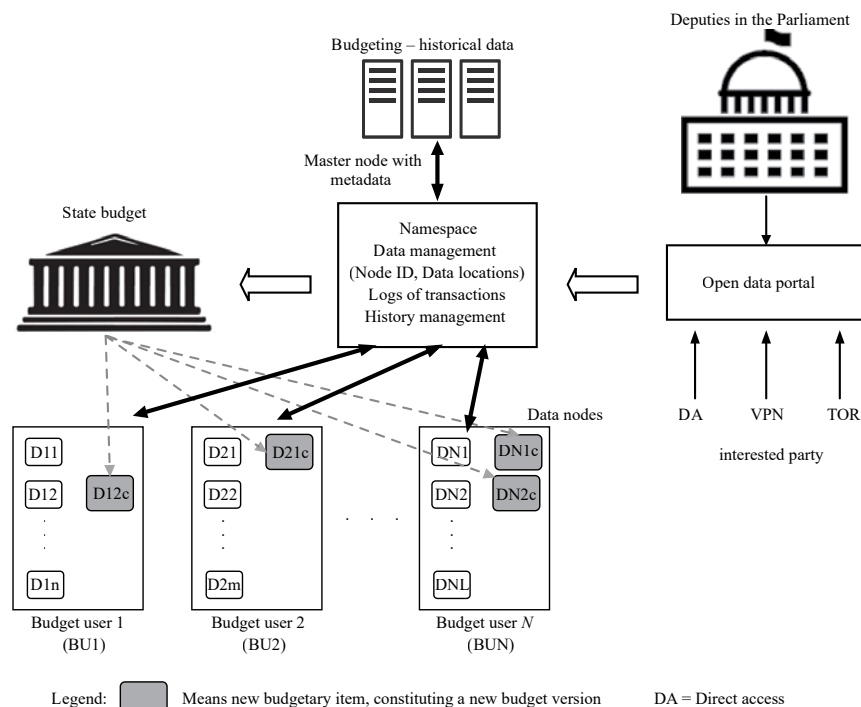
Our solution centres on maintaining data integrity in the Master node using WORM technology. This technology involves writing data to a storage medium only once. Once in the WORM database, the data becomes immutable and permanent, preventing any possibility of erasure, modification, substitution, or re-encryption. The previous and current data remain recorded in the local database, while the Master node documents every change to the metadata files. The primary goal of this proposed solution is to ensure that any alteration, at any level, remains permanently visible, thereby guaranteeing full transparency in the use of budget funds and enhancing accountability for government institutions. Furthermore, data integrity can be further secured, through the optional use of blockchain technology, which can also be used as an alternative to WORM storage. Though in the implementation of the Deep Transparency model one can opt for either WORM or blockchain, it would be beneficial if they could be used together, given that the passage of time always brings new possibilities of cyber attack, and that redundancy in security costs little to implement and could save a lot in the unforeseen future.

The parliament icon in the upper-right corner of figure 2 signifies that data is transparent to MPs through the secure parliamentary portal. It is also accessible to any interested party (IP) based on their access rights (similar to a Role-Based Access Control system), which may be more restricted than those of MPs for national security reasons. IPs can access the Open Data Portal directly or, if they prefer anonymity, through a Virtual Private Network (VPN) from any public space, such as a café, or even via TOR (The Onion Router) for complete anonymity and security. Implementing a VPN before accessing TOR is also advisable in such cases because a VPN prioritises data security and cannot fully anonymise IP identity. Using VPN over TOR makes it extremely difficult to trace the origin of the request and the data back to the user (the original IP address remains hidden).

Figure 3, which presents a more technically demanding aspect, indicates that our search engine should be capable of providing this functionality according to the specified procedure:

- the MP or any authorised person (IP, who, in most cases, can be anyone) can access Master node, asking for the metadata related to the desired data
- the Master node will return the lists of data nodes with the data locations
- after that, IP connects to data nodes, where the data are stored
- the IP can start reading data in parallel from all corresponding data nodes
- once the IP gets all the required data, it can combine them into a report.

FIGURE 3
Data search engine



Source: Authors.

The first step in this procedure is essential for full transparency of the proposed solution. It implies clearly defined data access rights within the system. Next, IP and budget creators must undergo authentication (the process of verifying a user's identity) and authorisation (a process giving official permission). Finally, the system grants specific permissions based on data ownership, group membership, or to anyone for data designated as fully open (the majority of data should fall in the latter category).

Use case 1: Budget creators at different levels (ministries, local authorities, state-owned companies, and public agencies) own their data. They enter data into the appropriate database without deleting or modifying it, in accordance with the principles of WORM technology. The Data node will record every change as a new execution version. The Master node database will also automatically record metadata that more precisely identifies the change (what, when, and who made it). Every outlay from the budget needs to be associated with a budget item. If none exists, the database operator can create one, with a remark explaining who, why, when, and according to which document authorised it.

Use case 2: IPs can access data after the authentication and authorisation procedure. They can read data according to the IP's permission level and search according to criteria. The proposed solution enables defining rights at both individual and group levels – group permissions are used for confidential data.

It is necessary to emphasise that the Master node plays a crucial role in our solution. It contains a daemon (a software component that runs processes in the background of the Master node) responsible for maintaining and managing the data nodes and metadata stored in the Master node files (such as the location of data, size of data, permissions, and hierarchy). Two files are associated with the metadata:

- File system state: contains the entire state of the Namespace (from the creation of the Master node onward), with clearly indicated checkpoints where data changes occurred.
- Edit Logs: records each change to the metadata (checkpoints), e.g., a deletion of an item in the file system. The Master node will immediately record this in the Edit Logs.

To improve the database's resistance to unauthorised changes, we propose introducing a blockchain that protects the data hash and metadata of all previously introduced records so that anyone who reads the data can verify the consistency of all previous data.

We differentiate among at least five authorisation levels in the Namespace directory:

- 1) Read – citizens,
- 2) Read – authorised persons (for restricted data, such as military spending, recipients of social subsidies, and similar),
- 3) Read and comment (MPs; authorized civil society agents),
- 4) Read, comment, and challenge (official oversight institutions; public prosecution),
- 5) Read, comment, and write (budget officials, policymakers, top public servants).

Each authorisation level is a file containing the list of users with applied rights and passwords for some budgetary items.

From an implementation perspective, deep transparency relies on three interconnected cost components: infrastructure, data integration, and institutional adaptation. A fundamental requirement is establishing data integrity and immutability layer, centred on hardware-level WORM storage, with optional blockchain-type distributed ledgers (€100,000 to €200,000). The initial investment for this component typically ranges from €150,000 to €350,000, laying a technical foundation for public trust. Upgrades to legacy IFMIS platforms are essential to enable real-time, API-based interoperability. The costs associated with these upgrades, including data warehousing and portal development, are estimated to be between €1.2 million and €2 million. An additional €500,000 to €800,000 will be required for data cleaning and alignment with international standards, such as the Open Fiscal Data Package (OFDP). Institutionally, the Ministry of Finance must serve as the central anchor, playing a crucial role in enforcing data-sharing mandates and ensuring inter-agency coordination. Thus, capacity building and change management are critical non-technical cost drivers, estimated at €400,000 to €700,000.

Annual operating costs, covering cybersecurity and continuous data validation, range between €300,000 and €500,000. To mitigate implementation risks, we recommend a phased pilot program in high-expenditure sectors, such as health or infrastructure. Even under worst-case assumptions, total lifecycle costs over five years are projected to remain below €5 million – typically lower than the fiscal losses resulting from a single large-scale corrupt procurement.

5 POLITICAL CONSEQUENCES OF DEEP TRANSPARENCY

Implementing deep transparency changes the political economy of the shadow budget and discretionary spending. By recording each outlay as it occurs, the model reduces the discretionary space through which political actors distribute favours, reward loyalty, or hide losses. Informational power shifts: what was previously known only within patronage networks becomes visible to oversight bodies and, in filtered form, to the public. These shifts impose political costs on actors who rely on opacity, and raise the stakes for institutions expected to enforce disclosure. Since reducing transparency, clientelism, and discretionary abuse presupposes that budget data become accessible to far more actors – including ordinary citizens – we first address a preliminary question: whether such expanded visibility risks overwhelming users through technical complexity and information overload.

These concerns are substantial. Technical complexity (Heald, 2015) and information overload (Heald, 2006) pose real obstacles to expanding public access to budget data. Deep transparency overcomes these challenges by filtering information for different audiences and clarifying budget details. This is crucial, as excessive or unstructured citizen participation – when paired with unfiltered transparency – can undermine fiscal performance and lead to short-term populist pressures (Jung and Kim, 2025). Yet at the opposite end of the spectrum, the absence of citizen involvement can be equally harmful. The COVID-19 pandemic revealed how emergency spending can bypass conventional transparency mechanisms, leading to large off-budget expenditures, minimal legislative or audit oversight, and almost no public participation in fiscal decisions – despite the unprecedented scale and urgency.

Deep transparency is designed to avoid both of these pitfalls. It emphasises institutional design – clarifying, structuring, and tailoring data to ensure that transparency serves accountability without descending into either technocratic opacity or populist distortion. We avoid the transparency illusion trap (Heald, 2003), in which increased transparency is only effective with proper data interpretation and dissemination mechanisms. Our model enhances external accountability by releasing data in a reusable format, allowing citizens, NGOs, and vulnerable groups to engage with budgeting and public policy (Anessi-Pessina et al., 2016). Knowledgeable citizens and organizations act as “information brokers,” simplifying and communicating complex information. Additionally, recent AI developments enable summarisation of budget items by filtered parameters, assisting users in understanding detailed information. In short, technological advancements allow our transparency model to help citizens better understand budgets.

The greatest gains from deep transparency arise where discretion is broad and oversight weak: in the political economy of off-budget spending and inside public administration. Once every budgetary move becomes visible and traceable, incentives shift, professional integrity matters more, and the patterns of patronage that thrive in the dark begin to lose ground.

Some empirical research has already demonstrated that civil service personnel's professional integrity substantially impacts budget allocation and wasteful spending. A study by Bostashvili and Ujhelyi (2019) found that in electoral years, high party patronage (indicative of unprofessional civil servants) led to a 12 per cent increase in wasteful spending in the electoral year, while in the pre-election years, the increase was 9 per cent. Conversely, public officials who demonstrate professionalism (low party patronage) are less likely to prioritize political interests by manipulating government spending to align with electoral needs and vested interests. In this context, deep transparency empowers these public officials to avoid the misuse of public funds, as the cost of such misconduct increases exponentially. When public officials are equipped with a deep transparency budget tool that entails tracking all budget changes (section 4), their ability to serve political interests plummets.

Besides reducing budgetary spending to enhance the incumbent government's chances in the impending elections, we expect deep transparency to function not only as a constraint on corruption but also as a barrier to entry for those inclined toward it. By rendering abuse traceable, costly, and institutionally unforgiving, it alters the calculus of opportunists. The logic is simple: when the space for discretion shrinks and the likelihood of exposure rises, those who rely on opacity will seek other avenues (UNODC, 2020). Recent political economy research suggests that institutional environments characterized by widespread corruption tend to attract individuals with a higher propensity for dishonest and self-serving behaviour.

Experimental studies from India reveal that students aspiring to civil service positions – operating within a high-corruption context – exhibit lower levels of altruism and a greater willingness to cheat or engage in bribery, consistent with a self-enrichment motive (Banerjee, Baul and Rosenblat, 2015; Hanna and Wang, 2017). Moreover, a corruptive environment can change behaviour even among individuals who enter public administration without corruptive preferences. This is documented by Gans-Morse et al. (2020), who show that corruption in Russia arises not from who enters public service, but from how institutions transform individuals once they are inside.

A similar claim – that a non-corruptive environment will make political parties look for people who have non-corruptive preferences – applies to political parties. Office-seeking parties, which aim to win elections and implement policies, tend to attract highly educated, experienced, and ideologically oriented activists who play influential roles in the party (Scarrow, 2015). In contrast, parties operating under a corrupt system do not actively seek out such members. Research indicates that

high levels of clientelism can significantly impact party organisation, including its membership structure, leadership, and inner-party democracy (Chiru, 2024). In extreme cases, these parties may collaborate with actors who provide violent services, such as criminal groups, assassins, enforcers, private security companies, thugs, political protesters, football hooligans, and paramilitaries (Pavlović, 2022; Tomić and Pavlović, 2023).

While deep transparency as a full system has not yet been empirically tested – which is precisely why this paper is written – evidence from adjacent domains offers useful proxies for the plausibility of these effects. A first proxy comes from research on self-selection into public institutions: studies conducted in Denmark show that students aspiring to public-sector employment demonstrate greater honesty and pro-social preferences in low-corruption environments, suggesting that clean institutions select for clean agents (Barfort et al., 2019). This supports the expectation that reducing discretionary space through deep transparency may, over time, alter who is attracted to public office.

A second proxy comes from the domain of party finance transparency. Casal Bértoa, Heapy-Silander and Lynge (2025) show that financial disclosure requirements, combined with independent oversight, reduce political corruption and increase party institutionalisation – as evidenced by the Latvian case, where the establishment of the Corruption Prevention and Combating Bureau (KNAB) as an independent oversight body, combined with mandatory party finance disclosure requirements, produced a measurable reduction in political corruption and a sustained increase in party institutionalisation over two decades. If transparency in party finances alone can alter party behaviour and incentive structures, the more comprehensive and tamper-resistant architecture of deep transparency may plausibly be expected to produce analogous effects at the level of budget execution. Taken together, these proxies are indicative rather than definitive. They suggest that deep transparency is expected to reduce discretionary space, which in turn may shift incentives, contributing to lower corruption and improved democratic outcomes. Deep transparency can therefore plausibly change politicians' motives, transforming them into more responsible officials. By offering a tracing mechanism for executing each budget item, including details on contracting out public services by linking budget items to public contracts, deep transparency can alter the incentives for politicians to engage in corruption and state capture.

We now turn to the question of our model's applicability. Is deep transparency more suitable for developed economies and democratic political systems, or for undeveloped and non-democratic systems where the cost of office abuse is low? Previous research (Khagram, Fung and de Renzio, 2013) shows that greater fiscal transparency does not result solely from institutional design. It is typically precipitated by political ruptures – transitions from authoritarian rule, fiscal and economic crises, corruption scandals, or international pressures that empower domestic reformers. These events alter the distribution of power, creating openings for actors who

demand access to budgetary information. The historical record supports this pattern. The post-communist transitions in Central and Eastern Europe after 1989 produced sweeping budget transparency reforms alongside new constitutions and freedom-of-information laws. The IMF Fiscal Transparency Code itself – introduced in 1998 – was a direct response to the Asian financial crisis of 1997, which exposed the dangers of opaque public finances and created international pressure for disclosure norms. Brazil’s SIAFI system, one of the most advanced integrated budget execution platforms in the world, was introduced in 1987 as part of the democratic transition following military rule. In each case, rupture preceded reform. We expect the same logic to apply to deep transparency: it is most likely to emerge not through gradual institutional evolution but in the wake of fiscal crises, anti-corruption breakthroughs, or democratic transitions that shift the balance of power decisively toward reformers demanding verifiable public accounts.

Having considered where deep transparency may be most feasible – though politically obstructed – we now turn to a different question: do more developed democracies, where implementation faces fewer barriers, also have a pressing need for it? Our model is much easier to implement in developed economies and democratic systems. Although they are generally more open and less corrupt, they could still benefit from deep transparency. Incumbent governments use public funds for overt or covert campaign spending in election years everywhere. Developed economies often exhibit subtler forms of corruption, embedded within formal institutional frameworks rather than through overt violations of law. Two prominent mechanisms are regulatory capture and revolving door employment (Tomić, 2023; Ang, 2024). The former enables industries to shape regulations to their advantage, while the latter involves public officials moving between government and private sector roles, using privileged access to favour connected firms. These practices significantly affect budgetary decisions – particularly in areas like public procurement and PPPs – leading to inefficiencies and misallocation of public funds. Moreover, recent empirical evidence supports this claim: the new state capture index (Kaufmann, 2024) shows that abuse of public resources is rising even in advanced democracies and developed market economies. While state capture was once considered a post-communist phenomenon (World Bank, 2002), current data suggest it has become a global trend, indicating that all systems – regardless of income level or regime type – stand to gain from adopting deep transparency practices.

6 CONCLUSIONS AND FUTURE RESEARCH

This article has argued that the weakness of contemporary budget transparency is not only that governments disclose too little, but also that what they disclose is typically aggregated, delayed, and difficult to verify. Our contribution is to propose a model of deep transparency that addresses both problems. It makes public spending more visible by linking budget allocations to final recipients, including private actors, and it makes budget execution traceable in real time through tamper-resistant digital infrastructure. It also makes independent scrutiny possible: citizens no longer need to wait for governments, auditors, or intermediaries to tell them how public money was spent. They can examine the record themselves and draw their own conclusions.

In the concluding remarks, we address several remaining issues for future research, the most important of which are transparency on the revenue side and the appropriate extent and type of budgetary details that should be disclosed.

Deep transparency focuses exclusively on the expenditure side of the budget, leaving the revenue side outside its current scope. In line with the IMF Fiscal Transparency Code (2019), which calls for timely and detailed disclosure of revenue sources, tax expenditures, and natural resource income, we acknowledge that transparency in revenue collection is equally essential for fiscal accountability. Future research should extend this framework to include mechanisms for tracking tax policy impacts, public reporting of tax breaks, and the governance of non-tax revenues – especially those most vulnerable to misuse, such as off-budget and natural resource revenues.

As mentioned, recent policy and academic research trends in budget transparency indicate a movement towards more open budgets, with increasing details disclosed to the electorate and interested parties. Despite substantial efforts to implement these concepts, achieving a satisfactory level of transparency in budgeting, including online transparency, remains challenging (Rubin, 2020). Deep transparency implies a significant level of detail regarding PPPs and budgetary changes that can be monitored in real time. Is this level of detail too much?

The usual argument is that excessive budget openness can present significant challenges and be counterproductive (Rubin, 2020). Overloading the public with disaggregated data can obscure rather than clarify fiscal information, making it difficult to interpret. Too much information can result in public and interest-group demands that hinder effective decision-making, such as reducing spending or eliminating tax breaks. Additionally, open processes can prolong decision-making and increase contention, raising unrealistic public expectations and causing widespread frustration. Therefore, balancing transparency with practicality is essential to maintain effective governance and public trust.

We argued that rapid technological advancement would enable our deep transparency model to filter and summarise the significance of each disclosed item. For example, with one click, it would be possible to obtain information on how much public money a specific private entity received in a particular year, or how much was spent overall on asphalt, concrete, disinfectants, or printer paper.

However, we did not address which items should fall under the principle of openness. Every treasury contains many off-budget items, such as tax breaks and state-owned enterprises (SOE) spending (IBP, 2011). Tax breaks are among the most effective off-budget means of preferential treatment for social, economic, and political interests, as well as of budgetary abuse. Because they are less visible than direct spending, they can obscure the actual financial state of a budget. Similarly, in countries where SOEs provide many public services, including their spending in budget transparency is essential.

Deep transparency enables access to this information, but the format of such a budget must be conceptualised from the start. Our model can link existing budgetary items with off-budget items. For example, if a government takes a loan from an international financial institution to cover an SOE's losses, the loan will be linked to the SOE's financial statement in which the loss appears. It is difficult to say more than this at present.

Finally, will deep transparency, even if implemented, necessarily lead to more accountability? The evidence from previous advancement in budget transparency exists but remains limited (Khagram, Fung and de Renzio, 2013). Isolated successes – such as Uganda's reduction in school grant leakages or Brazil's electoral penalties for corrupt officials – are exceptions rather than the rule. For transparency to have real impact, a full action cycle must be in place: data must be accessible and intelligible; actors must have incentives to respond; and other institutions must be capable of acting on their demands. Without this alignment, deep transparency becomes an empty gesture – form without consequence. Effective anti-corruption measures require more than simply making information available; they depend on robust conditions for publicity and accountability, such as education, media circulation, and free elections (Lindstedt and Naurin, 2010). Addressing these issues in the context of budget transparency requires a separate paper.

The shift from publication to verification is not a technical refinement – it is a democratic one. Governments already hold the data. The infrastructure to make it permanently and publicly verifiable exists. What has been missing is the institutional commitment to deploy it. That commitment matters now more than ever: state capture is rising across regime types, discretionary spending remains the principal vehicle for political abuse, and existing transparency frameworks have reached the limits of what disclosure alone can achieve. Deep transparency does not guarantee accountability. But it removes the condition on which unaccountability depends – the asymmetry between what governments know and what citizens can see.

Disclosure statement

The authors have no conflicts of interest to declare.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this manuscript, the authors used ChatGPT and Grammarly to assist with copy-editing. The authors reviewed and edited any AI-generated content as needed and take full responsibility for the final manuscript.

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