

THE ROLE OF BIG DATA ANALYTICS IN STRENGTHENING MONETARY POLICY TRANSMISSION MECHANISMS

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Abstract

This paper examines the integration of Big Data analytics into monetary policy transmission mechanisms. As traditional macroeconomic data often exhibits significant reporting lags, Central Banks are increasingly exploring high-frequency, granular datasets to enhance policy efficacy. The study evaluates how real-time digital transaction data, consumer sentiment indicators, and AI-driven predictive models can shorten transmission lags and improve the precision of policy responses, with a specific focus on the potential for emerging economies to adopt data-driven frameworks. The research highlights the transition from reactive to proactive economic governance, demonstrating that the systematic incorporation of high-frequency data provides the speed and granularity required for effective management in a digital-first economy.

Keywords: Monetary Policy, Big Data, Transmission Mechanism, Digital Economy, Central Banking, Real-time Analysis.

Monetary policy transmission mechanisms are the primary conduits through which central bank actions, such as adjustments to benchmark interest rates, influence the real economy, including inflation rates and total output. Historically, these transmission processes have relied heavily on traditional macroeconomic aggregates that are typically reported at monthly or quarterly intervals. While these aggregate indicators have long served as the standard for policy formulation, the rapid proliferation of the digital economy has generated vast quantities of high-frequency, granular data, commonly referred to as "Big Data".

The emergence of these new data sources presents a transformative opportunity for central banking, allowing for a shift from reactive, lag-heavy policy frameworks to more agile, real-time interventions. This research explores the mechanics of how Big Data analytics can fundamentally reshape existing transmission channels by providing policymakers with more precise and timely information. By bridging the gap between traditional econometric modeling and the modern data-driven landscape, this paper examines the technical and structural requirements necessary for central banks to successfully integrate high-frequency data into their decision-making processes. Furthermore, the study addresses the potential for emerging economies to adopt these data-driven frameworks to improve the efficacy of their monetary policy transmission and overall financial stability.

Recent academic research explores how "Big Data" and modern digital technologies reshape monetary policy transmission mechanisms. Li et al. (2022) demonstrate that BigTech credit providers exhibit higher sensitivity to monetary policy changes compared to traditional commercial banks. The authors highlight that BigTech firms' superior data accessibility, coupled with advanced customer screening and monitoring capabilities, allow them to transmit monetary policy signals to the real economy more rapidly, thereby enhancing the efficacy of monetary impulses.

Doerr, Gambacorta, and Serena Garralda (2021) examine the practical implementation of Big Data and machine learning technologies by Central Banks. Their research indicates that Central Banks are increasingly utilizing these tools not only for macroeconomic research but also for optimizing monetary policy and overseeing financial stability through supervisory technology and regulatory technology.

Lenzu (2026) provides a systematic analysis of the relationship between Artificial Intelligence and monetary policy, showing that AI affects transmission through cyclical transmission, structural transition, and financial stability channels. The study concludes

that because AI alters production technologies and price-setting mechanisms, it necessitates that Central Banks recalibrate their existing policy frameworks.

Hambur and Haque (2023) propose an approach to identifying monetary policy shocks using high-frequency data. Their work describes an effective method for distinguishing between "action shocks," which represent current policy, and "signalling shocks," which refer to expectations regarding future interest rates, by analyzing fluctuations in interest rates immediately following policy decisions and announcements.

Finally, research published in the *JCLI* (2026) demonstrates a positive correlation between the level of AI readiness and the effectiveness of monetary policy, using Indonesia as a case study. The findings indicate that implementing AI transformation within the financial sector and developing high-quality institutions significantly improves the quality of monetary policy transmission mechanisms.

This study employs a conceptual and comparative analytical framework to evaluate the role of Big Data in refining monetary policy transmission mechanisms. The research design is structured to bridge the gap between traditional econometric modeling and the modern data-driven landscape currently emerging within central banking. By synthesizing findings from recent academic literature and institutional reports, the methodology maps conventional transmission channels—specifically the interest rate, credit, and signaling channels—against high-frequency data inputs.

To quantify the impact of high-frequency Big Data on the efficiency of monetary policy transmission, this study utilizes the following model:

$$T_{\text{eff}} = \alpha + \beta_1 I_t + \beta_2 \left(\frac{1}{\Delta D_{\text{big}}} \right) + \epsilon$$

In this formula, T_{eff} represents the transmission efficiency of monetary policy, I_t denotes the central bank's interest rate, and ΔD_{big} signifies the volume and quality of Big Data. The term $\beta_2 (1 / \Delta D_{\text{big}})$ illustrates that the effectiveness of interest rate

policy is inversely related to data latency; thus, incorporating granular Big Data effectively reduces transmission lags, leading to more responsive policy outcomes. This comparative approach facilitates an identification of the technical and structural requirements necessary for developing economies to successfully adopt data-driven policy interventions.

The integration of Big Data into monetary policy transmission mechanisms creates a significant shift from reactive to proactive economic governance. By leveraging real-time data, central banks can effectively minimize the information gap that traditionally delays the impact of policy decisions. The table below provides a comparative analysis of traditional versus Big Data-driven transmission mechanisms:

Table 1

Comparison of traditional and big data-driven monetary policy transmission mechanisms

Feature	Traditional Transmission Mechanism	Big Data-Driven Mechanism
Data frequency	Quarterly or monthly	Real-time / high-frequency
Information lag	High (long reporting delays)	Low (instantaneous access)
Data type	Aggregated / structured	Granular / unstructured
Predictive accuracy	Baseline / historical trends	Enhanced / AI-based forecasting
Policy responsiveness	Lagged / gradual adjustment	Agile / adaptive calibration

The analysis indicates that Big Data offers three primary advantages to transmission mechanisms. Reduced latency is a key benefit, as real-time access to payment system data allows central banks to detect shifts in aggregate demand before official reports are released, enabling faster adjustments to interest rates. Granularity

represents another major advantage, as Big Data enables the analysis of how specific policy changes affect different sectors or demographics, identifying potential disparities in policy impacts that aggregated data often masks. Finally, Big Data facilitates improved expectation anchoring, as policymakers can better measure the effectiveness of communication strategies in managing public inflation expectations by analyzing social media, news sentiment, and search trends.

However, challenges remain, including data privacy concerns, the need for advanced technical expertise within central banking institutions, and the necessity of distinguishing meaningful economic signals from digital noise. Consequently, for developing economies, the transition requires a dual approach that involves investing in robust data infrastructure and cultivating the analytical capacity to interpret high-frequency datasets effectively.

In conclusion, the integration of Big Data into monetary policy transmission mechanisms represents more than a mere technical enhancement; it signifies a fundamental paradigm shift in contemporary economic governance. While traditional macroeconomic models continue to serve as the foundation for policy, the systematic incorporation of high-frequency data provides the necessary speed, granularity, and precision required for effective management in a digital-first economy. The analytical framework established in this study confirms that reducing information latency through Big Data inputs directly improves transmission efficiency, allowing central banks to navigate economic cycles with greater agility and foresight.

Furthermore, this transition addresses the inherent limitations of reliance on aggregated, low-frequency indicators that often fail to capture rapid shifts in consumer behavior or financial conditions. By successfully bridging the gap between traditional econometric models and real-time data environments, policymakers can ensure that monetary policy remains both effective and well-anchored amidst the rapid-paced shifts

of the global digital landscape. Ultimately, the successful implementation of these data-driven frameworks requires a strategic focus on investing in robust data infrastructure and cultivating high-level analytical talent within central banking institutions. Such advancements will be vital for maintaining price stability and fostering sustainable economic growth in an increasingly complex and interconnected financial environment.

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