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Today, the Reserve Bank of India releases Volume 43, No.1, 2022 of its Occasional Papers, a research journal containing contributions from its staff. This issue contains four articles and three book reviews.

Articles:

1. Carbon Dioxide Emissions from India's Manufacturing Sector: A Decomposition Analysis

In this paper, Shashi Kant, Madhuresh Kumar, Shahbaaz Khan and Somnath Sharma decompose the increase in annual carbon dioxide (CO_2) emissions from the registered manufacturing sector in India during the period 2009-10 to 2017-18 into contributions from output growth, structural changes, energy intensity changes and fuel mix changes. The paper finds that carbon intensity, measured in terms of how much CO_2 is emitted when one rupee of Gross Value Added (GVA) is generated by the manufacturing sector, has reduced from 46g CO_2 per rupee GVA in 2009-10 to 36g CO_2 per rupee GVA in 2017-18 at 2011-12 constant prices. It also finds a mild structural shift in the manufacturing sector, with cleaner industries contributing a greater share of the aggregate GVA and the share of carbon-intensive industries posting a fall. It shows that the change in the fuel mix has increased CO_2 emissions as the share of coal and electricity in the total fuel inputs in the manufacturing sector has increased, while the share of natural gas has reduced. It is also observed that electricity is a major contributor to CO_2 emissions. Hence, electricity generation through renewable sources can aid in faster green transition of the economy.

2. Sensitivity of Pension Liabilities of Banks to Various Actuarial Assumptions

R. K. Sinha assesses the sensitivity involved in the valuation of future pension liabilities of organisations, particularly Indian banks in this paper. A reliable assessment of future pension liabilities is necessary for prudent and timely provisioning by banks. Such an assessment is also important for the overall enterprise risk management in banks. Adding to limited research on this subject, this paper constructs salary indices by taking a representative sample of banks in India for the period 1987 to 2022, and generates longer-term projections of the indices under different key assumptions enabling to estimate the future pension liabilities of banks in India. The sensitivity of the estimates to various assumptions underlying the valuation of the pension liabilities – salary scale, decrement rates (mortality and attrition) and interest rate – is presented to aid in assessing the extent of likely under/over-provisioning by banks. A comparison of pension burden between defined benefit (DB) and defined contribution (DC) plan indicates that the cost of the DB pension plan could be 3 to 5 times higher than that of the DC pension plan under different assumptions. The pension outgo was found to be sensitive to the assumptions of interest rate. A 50-basis points decrease in interest rate may lead to an upward shift in the pension liability of DB plan by around 12 per cent.

3. Do Bank Mergers Improve Efficiency? The Indian Experience

In this paper, Snehal S. Herwadkar, Shubham Gupta and Vaishnavi Chavan evaluate bank mergers in India since 1997 to gauge their impact on acquirers' efficiency. The findings of the paper suggest that mergers have been beneficial to the banking sector as the financial performance and efficiency of acquirers improved post-merger. Findings of data envelopment analysis (DEA) for the period 1997-2017 suggest that the mean technical efficiency of acquirers increased from 90.88 in the pre-merger period to 93.80 three years post-merger, and 94.24 five years post-merger. The results are valid for both public and private sector banks, even after controlling for industry-wide impact. Relatively low managerial and organisational competencies in acquiree banks were not a hindrance for preserving efficiency of the merged entity and the benefits to acquirers from mergers on account of increased scale of productive capacity were statistically significant. A deep dive into factors that may have led to efficiency gains identifies post-merger geographical diversification and increased reliance on interest income as the significant contributors to the improvement. DEA and financial ratio analysis confirm that even the recent mergers during 2019-20 led to improvement in acquirers' efficiency. The event study analysis on these mergers indicates an increase in acquiree banks' shareholder wealth.

4. Behaviour of Credit, Investment and Business Cycles: The Indian Experience

In this paper, Sujeesh Kumar, Pawan Kumar, and Anand Prakash examine the behaviour of credit, investment and business cycles in India during the period 1950-51 to 2020-21, employing the National Bureau of Economic Research (NBER) dating procedure. The study finds that the average duration of the business cycle and the investment cycle in India is eight years, while that of the credit cycle is seven years in case of short cycles. The average duration of the medium credit cycle in India (17 years) is higher than that of the investment cycle and business cycle, with the contractionary phases of the credit cycle found to be more prolonged than the expansionary phases. The duration of the credit cycle has become longer since the initiation of financial sector reforms in the early-1990s. The paper finds bi-directional causality between credit cycle, investment cycle and business cycle, in the post-reforms period. The concordance index constructed in the paper shows that while phase synchronisation between investment cycle and the business cycle is 68 per cent, the synchronisation between the credit cycle and the investment cycle is 65 per cent. The results indicate an increase in synchronisation of the credit cycle in India with those of the emerging market economies as well as advanced economies after the global financial crisis.

Book Reviews:

This issue of the RBI Occasional Papers also contains three book reviews:

1. Akash Kovuri reviews the book "In Defense of Public Debt" written by Barry Eichengreen, Asmaa El-Ganainy, Rui Esteves, and Kris James Mitchener. The book offers a historical account of the evolution of public debt, narrating the episodes of debt crisis and debt consolidation from the Medieval Europe (14^{th} century) to the present-day world battered by the pandemic. While defending the utility of public debt as a prime

instrument of policy during crises, the book argues that debt consolidation is equally important, and adopting short cuts that involve fiscal dominance can become costly.

2. Rashika Arora reviews the book "Geopolitics, Supply Chains, and International Relations in East Asia" edited by Etel Solingen. This edited volume brings together the interdisciplinary work by different scholars to analyse global supply chains (GSCs) in various east-Asian countries in the context of the political and economic systems of these countries and experience with international cooperation and conflicts. The volume presents GSCs as a unique but complex mechanism of interdependence among countries and brings out the implications of geopolitical tensions for GSCs.

3. Anshu Kumari reviews the book "Chain Reaction: How Blockchain Will Transform the Developing World" written by Paul Domjan, Gavin Serkin, Brandon Thomas and John Toshack. The book proposes that problems in developing countries linked to trust, verification and value transfers can be solved using the distributed ledger technology (DLT). The book explains the technical aspects of DLT and explores its diverse applications for property registrations, money transfers, foreign aid, counterfeit drugs, and many others, using active case studies from developing countries.

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