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Cross-border Capital Flows and Sudden Stops: Lessons from Emerging Market Economies

Sujata Kundu, Anshu Kumari and Deepika Rawat*

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The paper studies the evolving dynamics in cross-border capital flows, with an emphasis on the emerging market economies (EMEs) covering a timeline of three decades (Q1:1992-Q1:2022). In view of the persistent volatility in capital flows to EMEs, the paper examines major episodes of capital flow reversals, in particular sudden stops. The empirical analysis suggests that global factors – global growth, risk, liquidity, long-term interest rates, policy rate changes – along with domestic growth and nominal exchange rate dynamics are key drivers of capital flow reversal episodes in the EMEs. The appropriate utilisation of capital flow management measures (CFMs) and macroprudential policy measures (MPMs), along with a strengthening of domestic macroeconomic and financial fundamentals and adequate buffers in the form of foreign exchange reserves, can help the EMEs navigate the ebbs and surges in capital flows better, while preserving macroeconomic and financial stability.

JEL Classification: F3, F32, F320, F41

Keywords: Capital flows, capital flow reversal, cloglog model, foreign portfolio investment, gross capital inflows, monetary policy communication, net capital flows, sudden stop, taper tantrum.

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Introduction

International capital mobility has witnessed a significant surge since the early-1990s, led by both country-specific and global developments. While domestic pull factors, such as structural reforms, capital account liberalisation and stabilisation programmes in several emerging market economies (EMEs) improved creditworthiness, drove productivity gains and investors' confidence in macroeconomic management, global push forces, such as the decline in real interest rates in the advanced economies (AEs) in the early-1990s also attracted foreign investors towards EMEs. Further, global easing in communication costs and increased competition led firms in AEs to locate their production centres in EMEs to garner production efficiency and profits. Moreover, as EMEs gradually moved towards capital account liberalisation, institutional investors discovered wider opportunities in EMEs for risk diversification. Consequently, the volume of capital flowing into EMEs rose, simultaneously resulting in risks of sudden shifts and reversals in capital flows and increased financial market volatility.

From the standpoint of the EMEs, cross-border capital flows help in the mobilisation of external savings, which has been perhaps the strongest argument in favour of international capital mobility (Devlin *et al.*, 1994). While from a macroeconomic perspective, net inflows of external savings supplement domestic savings, from the financial stability angle, gross capital flows provide insights into the international exposure of an economy (Lane and Milesi-Ferretti, 2007; Tarashev *et al.,* 2016; OECD, 2018). Spillovers and contagions are often transmitted and amplified across economies *via* the channel of gross capital flows (BIS, 2021). Therefore, their impact is wide-ranging, affecting an array of macroeconomic parameters, including exchange rates, interest rates and foreign exchange reserves. Large capital inflows/reversals are often associated with macroeconomic and financial sector disruptions (Calvo *et al.,* 1993; Kamin and Wood, 1997; Lopez-Mejia, 1999; Kohli, 2001)[1].

[1] An unwarranted expansion in aggregate demand owing to excessive capital inflows (macroeconomic overheating) could be reflected in higher inflation, real exchange rate (RER) appreciation and higher current account deficit along with its sustainability issues. Moreover, the accumulation of international reserves by central banks, unless sterilised, could lead to more than desired increases in money supply, thus adversely impacting domestic price and financial sector stability. On the other hand, reversal episodes are often associated with macroeconomic and financial sector instability due to large exchange rate depreciation, high inflation, interest rate hikes and output losses, depletion of foreign exchange reserves, and stress in the corporate and banking sectors.

The period since the 1990s has been eventful, characterised by extraordinary movements in global capital flows, not only in terms of their levels but also volatility along with extreme movements or capital flow "waves"[2]. After surging through the mid-2000s, capital flows contracted during the Global Financial Crisis (GFC) of 2008-09. An array of global events including highly accommodative monetary policies by the major AEs with policy rates close to zero or even negative (both after the GFC and the COVID-19 pandemic), the taper tantrum of 2013-14, Chinese stock market sell-off, the devaluation of the Chinese renminbi, the outbreak of COVID-19 in 2020, monetary policy normalisation by major AE central banks beginning 2021 and the Russia-Ukraine war in 2022 have imparted sizeable volatility to capital flowing into EMEs. Surges in capital flows and sudden stops[3] have significant adverse effects on the EMEs. Capital flow reversals are generally sudden, large, disruptive and broad-based with a limited window for policy reactions. As capital flows often obey global factors and events, there is a need for policy preparedness and a careful monitoring of domestic and global macroeconomic conditions.

Set against this background, this paper has two objectives. First, it attempts to study the evolving dynamics in global capital flows during the post-GFC period, with a focus on the EMEs. The paper provides an account of the major episodes of sudden stops for a sample of major EMEs, covering a period of 30 years (Q1:1992 to Q1:2022). Secondly, it examines the key drivers of such reversal episodes. The paper is structured as follows: Section II presents a review of the literature on identifying episodes of sudden stops in EMEs. Section III provides the stylised facts on capital flow developments globally and in India since the 1990s. Section IV discusses the empirical findings related to the identification and drivers of major episodes of capital flow reversals, distinguishing them from sudden stops. Section V concludes the paper.

Section II
Literature Review

Following Calvo (1998), the balance of payments (BoP) accounting identity after subtracting errors and omissions rests on the following equation:

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[2] Comprising episodes of 'surges' or 'bonanzas', 'capital flight', 'retrenchment' and 'sudden stops' (Forbes and Warnock, 2012).

[3] These are episodes that witness sharp contractions in international capital flows as against capital flow surges.

$$KI = CAD + RA \quad (1)^4$$

where, KI, CAD and RA represent capital inflows, current account deficit and accumulation of international reserves, respectively. When a sudden stop occurs causing the financial account (FA) of the BoP to shift towards outflows, the current account (CA) balance has to improve (implying CAD in identity (1) must fall quickly and sizeably and transit towards a surplus), assuming central banks do not intervene through the sale of international reserves [RA in identity (1)]. The fall in CAD may happen either through a rise in domestic savings or a fall in investment[5]. Such adjustment usually accompanies a cyclical slowdown, or a recession, with a related significant decline in national income. BoP crises are usually characterised by such type of adjustments (Cecchetti and Schoenholtz, 2018).

A series of EME crises in the 1990s[6] increased the academic and policy interest in sudden stops, which were spelt out as a phase of an abrupt reversal in net flows. During such episodes, the associated adjustments in CA balance and RER depreciation often resulted in significant loss of output in the crisis economies (Calvo, 1998; Calvo *et al.*, 2004, 2008). In contrast to the 1990s, when net capital flows closely mimicked gross capital inflows, especially in the context of EMEs, gross inflows and outflows have surged since the early-2000s in terms of both level and volatility, weakening the relationship between gross and net inflows. Domestic and foreign investors often react differently to various shocks and policy measures/responses need to consider the sources of extreme movements in capital flows, *i.e.*, whether driven by foreign investors (surges or sudden stops) or domestic investors (capital flight or retrenchment). Therefore, the recent literature on sudden stops has taken into account gross inflows instead of net flows to identify and analyse such episodes (Cowan and De Gregorio, 2007; Agosin and Huaita, 2011; Forbes and Warnock, 2012; Eichengreen and Gupta, 2016; Forbes and Warnock, 2021).

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4 In a non-monetary economy, RA is absent.

5 $Y = C + I + G + NX$, where Y, C, I, G and NX (X-M) represent aggregate demand, consumption, investment, government expenditure and balance of goods and services in the BoP, respectively. Current account balance (CAB) = NX + net income from abroad (NY) + net current transfers (NCT). Gross national disposable income (GNDY) = $C + I + G + CAB$, or $GNDY - C - G = S = I + CAB$; or, $S - I = CAB$.

6 Including the Mexican crisis (1994), Argentinian crisis (1995), the Asian crisis (1997), the Russian crisis (1998) and the Brazilian crisis (1999).

Following the taper tantrum of 2013 and the accompanying significant capital flow reversals, more financially developed EMEs with more liquid capital markets and higher inflows recorded larger pressure on their exchange rates, foreign reserves, and equity prices (Aizenman, Binici and Hutchison, 2014; Eichengreen and Gupta, 2015). Annex Table A1 provides a broad summary of the available literature on sudden stop episodes, in both AEs and EMEs, including major studies that examined the impact of the taper tantrum on EMEs.

Section III
Salient Stylised Facts

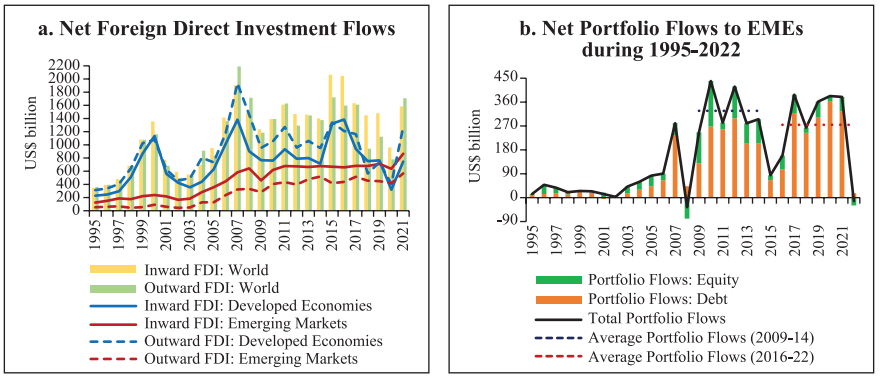
Following a surge through the mid-2000s, capital flows contracted during the GFC. In the post-GFC period, beginning around 2010, capital flows recovered, driven by highly accommodative monetary policies and large-scale asset purchases by the major AE central banks. Capital flows declined during 2013-15 on the back of the US Federal Reserve's (Fed's) announcement of its intention towards monetary policy normalisation and tapering its asset purchase programme. In particular, foreign portfolio investment (FPI) flows reversed from the EMEs. The Chinese stock market sell-off and the devaluation of Renminbi also contributed to the moderation in capital flows. In 2020, with the outbreak of the COVID-19 pandemic, capital flows again recorded exceptionally large swings, especially in the initial months. FPI flows to EMEs reversed with unparalleled speed and magnitude amidst extreme uncertainty and flight to safety. With central banks in the major AEs shifting to extremely accommodative monetary policies – including sharp cuts in policy rates and large asset purchases – capital flows to EMEs revived in late-2020 and 2021.

In 2021, inflation recorded decadal highs both in the AEs and EMEs owing to supply chain disruptions induced by the pandemic, heightened commodity price pressures due to geopolitical tensions, and strong demand recovery. With inflation well above target, major AE central banks were forced to pursue an aggressive synchronised monetary policy normalisation in 2022. As a result, during 2022, EMEs faced intense financial market volatility, short-term portfolio capital outflows, foreign exchange reserve losses and currency depreciation pressures.

III.1 Movements in Global Capital Flows

In the case of foreign direct investment (FDI) flows, EMEs showed some recovery in the post-GFC period and the trend remained largely stable till

Chart 1: Movements in Global Capital Flows during 1995-2021

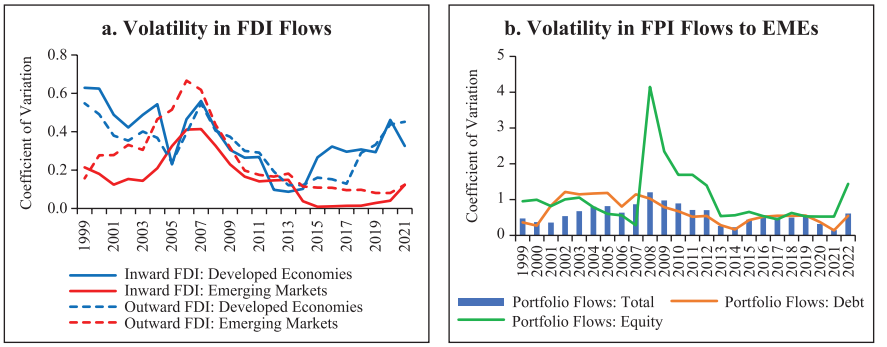


Source: UNCTAD; Institute of International Finance (IIF); and Koepke and Paetzold (2020).

the outbreak of the pandemic in 2020 (Chart 1a). There was a drop in net FPI flows in 2015 (Chart 1b). The volume to EMEs did not increase significantly during 2016-21; it remained slightly lower as compared to the six-year period from 2009-14 prior to the drop in 2015.

Volatility in both FDI and FPI flows to EMEs dropped in the post-GFC period (Charts 2a and 2b), with this period being characterised as "great moderation" in the volatility of capital flows, in particular to the EMEs (McQuade and Schmitz, 2017; Pagliari and Hannan, 2017). However, volatility in both net FDI and FPI flows has increased since 2020, particularly for the EMEs.

Chart 2: Volatility in Global Capital Flows during 1995-2021



Note: Volatility has been measured using rolling coefficient of variation with a 5-years rolling window.
Source: UNCTAD; IIF; and Authors' calculations.

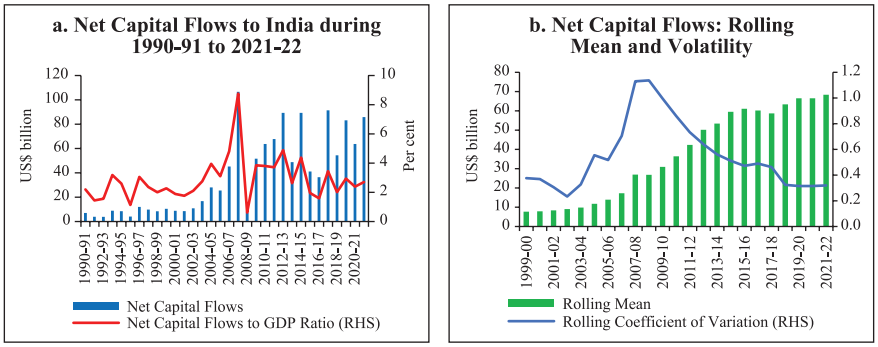
III.2 Trends in India

India, in line with the global trends, saw a steady increase in capital flows following the structural reforms, including capital account liberalisation, in the early-1990s (Chart 3a). Foreign investment responded favourably over the years with FDI and FPI flows emerging as the important sources of external finance and non-debt flows exceeding debt flows in the form of non-resident deposits, external commercial borrowings and external assistance. India witnessed an upsurge in net capital flows from 2003-04 until the GFC. In terms of annual averages, net capital flows were around US$ 31.3 billion during 2000-01 to 2007-08 as compared to US$ 7.7 billion during 1990-91 to 1999-2000.

A sudden stop in capital inflows occurred during the GFC[7], after which the inflows showed a recovery. The subsequent years recorded a substantial increase in net capital flows averaging around US$ 67.9 billion per annum during 2010-11 to 2021-22. The overall volatility in net capital flows to India declined in the post-GFC period (Chart 3b).

Capital flow liberalisation has led to a greater financial integration of India with the global economy. In tandem with the other EMEs, and as indicated in the literature, net capital flows to India have been procyclical *i.e.*, in times of higher economic growth, net capital flows have also generally remained higher and *vice versa* and have reflected in exchange rate

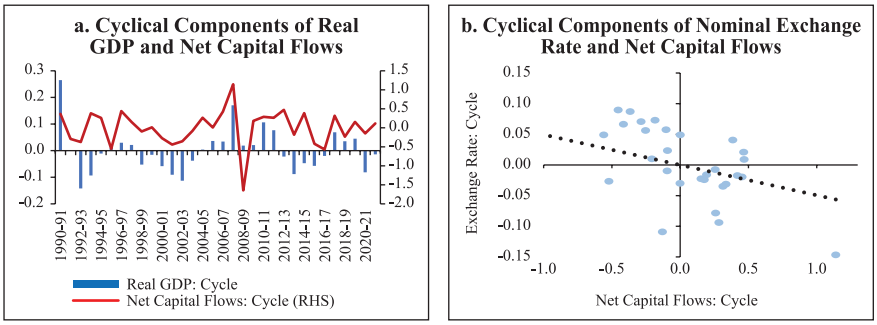
Chart 3: Net Capital Flows to India during 1990-91 to 2020-21



Note: Rolling mean and volatility are based on a 10-year rolling window.
Source: Handbook of Statistics on the Indian Economy, RBI; and Authors' calculations.

[7] Literature has identified the crisis year of 2008-09 as a year of sudden stop in capital inflows (Gupta, 2016).

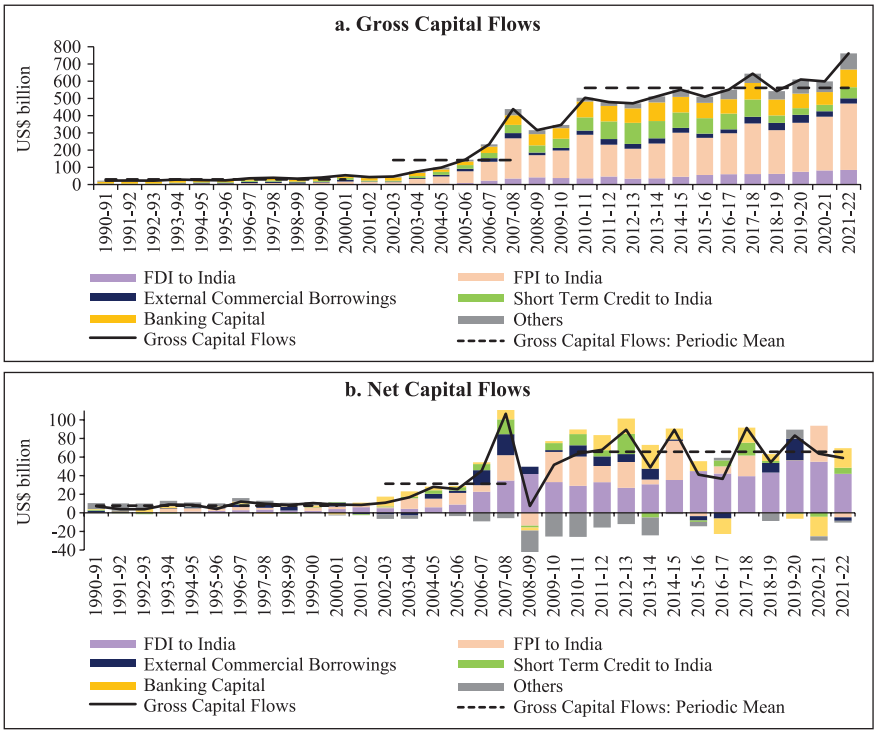
Chart 4: Net Capital Flows, GDP Growth and Exchange Rate



Note: The cyclical components are computed using Hodrick-Prescott (HP) filter. INR-USD exchange rate has been considered as the nominal exchange rate for Chart 4b.
Source: Handbook of Statistics on the Indian Economy, RBI; and Authors' calculations.

appreciation (depreciation) (Chart 4). Component-wise, while gross capital flows have been dominated by FPI, in net terms FDI to India has risen over the years (Chart 5).

Chart 5: Capital Flows to India



Source: Handbook of Statistics on the Indian Economy, RBI; and Authors' calculations.

Section IV
Capital Flows and Sudden Stops: An Empirical Analysis

As indicated earlier, capital flows to EMEs have generally been volatile, with various components exhibiting significant differences in the levels of volatility. For example, FPI flows have shown higher volatility as compared with FDI flows (Chart 6). Further, Chart 7 highlights the magnitude and intensity of reversals in net FPI flows from EMEs during the major shock episodes in the past two decades since the GFC. It indicates that the volatility experienced by EMEs in FPI flows since the COVID-19 outbreak has been significantly higher than the GFC as well as the 2013 taper episode.

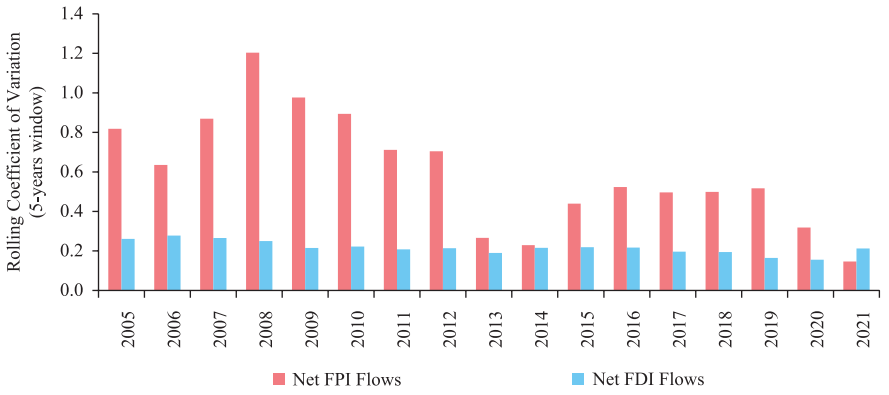
Against this background, this section provides an account of the sudden stop episodes in EMEs during the previous three decades. It considers a sample of 19 economies, including India, covering a span of about 30 years (Q1:1992 to Q1:2022). It then focuses on India and the set of EMEs to analyse the key driving factors behind the capital flow reversal episodes.

IV.1 Identifying Episodes of Capital Flow Reversals in EMEs

(a) Event Study Framework

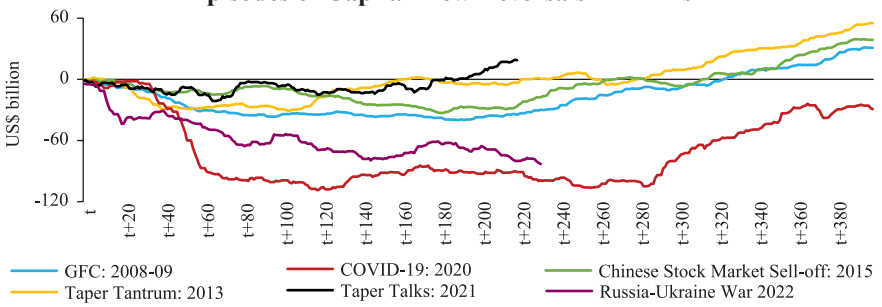
To begin with, the paper first considers the past two decades (2001-2022) marked by a major surge in EME capital inflows. As discussed earlier, the scale of the impact of the shocks on net FPI flows has varied widely, not only in terms of the level, but also with respect to the duration taken for the correction in flow reversals (Chart 7). Therefore, as a first step towards

Chart 6: Volatility in Net FDI *vis-à-vis* Net FPI Flows



Source: RBI; and Authors' calculations.

Chart 7: Daily Net FPI Flows (Cumulative Basis) across the Major Episodes of Capital Flow Reversals in EMEs



Note: In Chart 7, 't' for GFC is September 8, 2008; for taper tantrum, it is May 17, 2013; for the Chinese stock market sell-off, it is July 26, 2015; for COVID-19, it is January 21, 2020; for taper talk of 2021, it is June 16, 2021; and for the Russia-Ukraine war, it is February 24, 2022, which overlaps with the start of monetary policy normalisation by the AE central banks.
Source: IIF.

identifying the severity of these episodes in terms of their impact on net FPI flows[8], a panel data-based event study approach is adopted using the weekly FPI net flows data[9] for 10 major EMEs plus South Korea[10]. The period of analysis differs across the episodes[11]. The approach has gained popularity in recent years and has been used to analyse the impact of the pandemic on various macroeconomic parameters (Mishra *et al.,* 2014).

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[8] FPI constitutes only one component of the total capital flows in EMEs. Being short-term in nature and highly volatile, FPI flows are often considered to analyse capital flow reversals in EMEs. The literature suggests that median volatility is greater in the case of portfolio flows than other types of capital flows (Pagliari and Hannan, 2017). Moreover, the availability of high frequency net FPI flows data across EMEs makes it easier to use these data for an event study analysis.

[9] Sourced from the Institute of International Finance (IIF).

[10] The EMEs include India, Indonesia, Thailand, South Africa, Hungary, Türkiye, Mexico, Poland, Brazil, and Philippines. South Korea has also been included in the panel as it joined the ranks of a developed country only in 1996 following its membership in the OECD. As per the IMF's/World Bank's classifications, South Korea became an advanced economy/high-income country in 1997 and 2001, respectively. Moreover, South Korea is part of the MSCI Emerging Markets Index and the South Korean Won trades as a non-deliverable currency. Broner and Rigobón (2004) showed that EME capital flows have higher volatility as compared to that of AEs.

[11] The period of analysis for the different episodes is as follows: GFC - January 2007 to December 2009; taper tantrum 2013 - January 2012 to December 2013; Chinese stock market sell-off - January 2014 to December 2016; COVID-19 - January 2019 to December 2020; taper talks 2021 - January 2021 to January 2022; and Russia-Ukraine War - February 2022 to October 2022.

The following equation is used to examine the impact of the various episodes on the weekly net FPI flows in the EMEs:

$$Y_{it} = \sum_{t=i-n}^{i+m} \beta_{1t} * Time\ period_t + \alpha_i + \gamma_j + \varepsilon_{it} \quad (2)$$

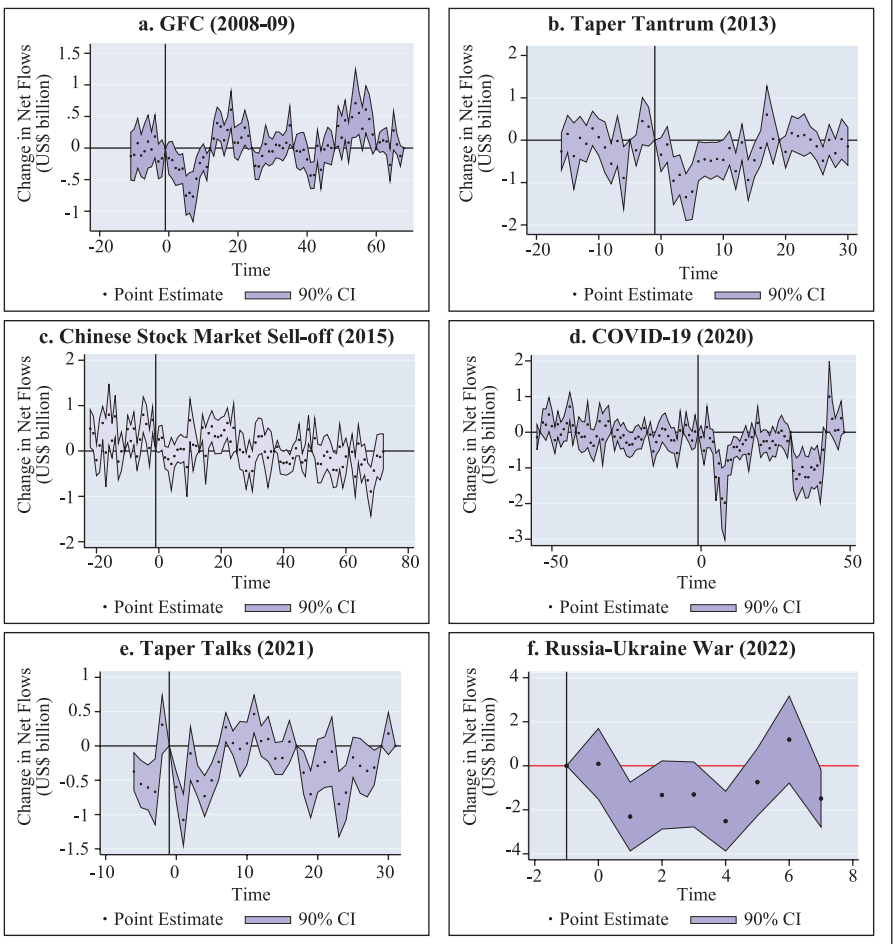
where, Y_{it} stands for the weekly net FPI flows recorded in an EME *i* at time *t*. $Timeperiod_t$ is a dummy variable associated with the week of the event. It takes the value 1 for each of the weeks after the event. The week containing the date of the occurrence of the event (as indicated in Chart 7) is taken as 0 and the week prior to that is taken as -1 and is the base period for the analysis. α_i is the country fixed effect, γ_j is the year fixed effect to control for the time-invariant characteristics and ε_{it} is the error term. The coefficient of the dummy variable $Time\ period_t$ captures the change in the net FPI flows in each week before and after the event relative to the base week in each event. If the event indeed led to a fall in the net FPI flows, one would expect to see negative and statistically significant coefficients for time periods starting from 0.

The results show that weekly net FPI flows to the EMEs were heavily impacted during the GFC, the taper tantrum episode of 2013, the COVID-19 pandemic, the Russia-Ukraine war and the synchronised aggressive monetary tightening by AEs in 2022 (Chart 8)[12]. The Chinese stock market sell-off event during 2016 did not produce any statistically significant decline in overall net FPI flows to the EMEs (Chart 8c). In terms of the statistical significance, the immediate impact of the pandemic and GFC were much stronger as indicated by the narrower confidence bands around the estimated coefficients (Charts 8a and 8d). Moreover, the impact of the pandemic persisted longer as compared with the other episodes. Further, the multiple waves of the pandemic also had an adverse effect.

In contrast to 2013, the taper talks of 2021 did not create any major impact on the net FPI flows to the EMEs. While net flows declined significantly in some weeks of 2021 as the taper talks began (with the actual tapering starting only in November 2021), the impact was broadly contained. The statistically significant dip in net FPI flows around t = 18 to 25 (Chart 8e) is the period around which the US Fed began its actual tapering of asset purchases during November 2021. The weak impact could perhaps be due to the fact that the

[12] As only a few data points are available for this plot, the time period is taken from January 2021 to September 2022 as per data availability.

Chart 8: Event Study Plots Showing Major Events of Net FPI Reversals in EMEs during 2001-2021[13]



Source: Authors' estimates.

US Fed was still making large asset purchases of US$ 105 billion per month in November 2021 as compared with US$ 120 billion in the previous month. Moreover, the macroeconomic fundamentals of the EMEs had strengthened sizeably relative to 2013.

While the event study framework provides a comparison of the severity of the episodes in terms of the magnitude and duration of the impact, not all of these episodes can qualify as sudden stops. Therefore, as a second step to

[13] Annex Table A3 provides the basic statistics with regard to the key macroeconomic indicators during these episodes.

the analysis, the definition provided by Calvo *et al.* (2004) has been followed to identify the sudden stop episodes.

(b) Calvo et al. (2004) Methodology for Identifying Sudden Stops

According to Calvo *et al.* (2004), a sudden stop is a phase that satisfies the following criteria: (i) it contains at least one observation where the year-on-year (y-o-y) decline in capital flows falls at least by two standard deviations below its sample mean; and (ii) the phase ends once the annual change in capital flows exceeds one standard deviation below its sample mean; and (iii) for symmetry, the start of a sudden stop phase is determined by the first time the annual change in capital flows falls one standard deviation below the mean. This implies that a sudden stop episode starts with a fall in capital flows exceeding one standard deviation below the mean, followed by a fall of two standard deviations and the process lasts until the change in capital flows moves above mean minus one standard deviation. Given this definition and the growing importance of gross capital flows in the post-GFC years as indicated in the previous sections, the sudden stops have been identified in this section on the basis of gross capital inflows using the methodology adopted by Forbes and Warnock (2012) [similar methodology is also given in Cavallo *et al.* (2015)].

Quarterly data on gross inflows and net flows for a sample of 19 EMEs (including South Korea)[14] over the period Q1:1992 to Q1:2022 as available in the Balance of Payments Statistics (BOPS) of the IMF have been used for the purpose. Given below is the detailed methodology used for the identification of sudden stops:

Let C_t be the four-quarter moving sum of gross capital inflows $(GrossInflow_t)$.

$$C_t = \sum_{i=0}^{3} GrossInflow_{t-i}, \quad t = 1,2,\dots,N \tag{3}$$

Given C_t, y-o-y changes are then computed as follows:

$$\Delta C_t = C_t - C_{t-4}, \quad t = 5,6,\dots,N \tag{4}$$

[14] The major EMEs that were considered for the sudden stop analysis were: Brazil, Russia, India, China, South Africa, Indonesia, Malaysia, Philippines, Thailand, Vietnam, Colombia, Mexico, Hungary, Poland, Türkiye, Ukraine, Pakistan, Sri Lanka, and South Korea. The EMEs were selected based on adequate time series data availability on capital flows in the BoP Statistics of IMF's International Financial Statistics (IFS).

Rolling means and standard deviations of ΔC_t over the previous five years are then computed. A sudden stop episode is then identified using a symmetric approach as defined in Calvo *et al.* (2004). Using a similar methodology, net capital flows and gross FPI inflows have also been considered to look at sudden stops.

The results indicate that, for the sample of all EMEs, GFC is the only sudden stop episode during Q1:1992 to Q1:2022 both in terms of gross capital inflows and net flows (Chart 9). However, in EMEs excluding China, the pandemic quarters of Q3 and Q4:2020 have also been identified as sudden stop phases, *albeit* on the basis of net capital flows only (Chart 9d).

A disaggregated country-level analysis reveals that sudden stops were recorded in some EMEs, such as Brazil, China, Colombia, India, Indonesia, South Korea, Mexico and Sri Lanka during H2:2015 and H1:2016. These were a result of the international financial market turmoil in August 2015 due to the Chinese stock market sell-off and the first hike in the US Federal Funds rate in December 2015 after a long pause (Annex Table A2). Interestingly, none of the taper talk episodes, either the taper tantrum phase of 2013 or the taper talks of 2021, were identified as sudden stops[15]. These findings are in line with the existing literature (Gupta, 2016; Eichengreen and Gupta, 2016; Forbes and Warnock, 2021)[16].

As FPI flows have higher volatility and are more often impacted by global shocks, the same analysis was repeated considering gross FPI inflows for the same set of EMEs and sample period. The results were unchanged at the aggregate level. At a disaggregated level, EMEs that witnessed sudden stops during the taper talks and/or the beginning of taper during 2013 and

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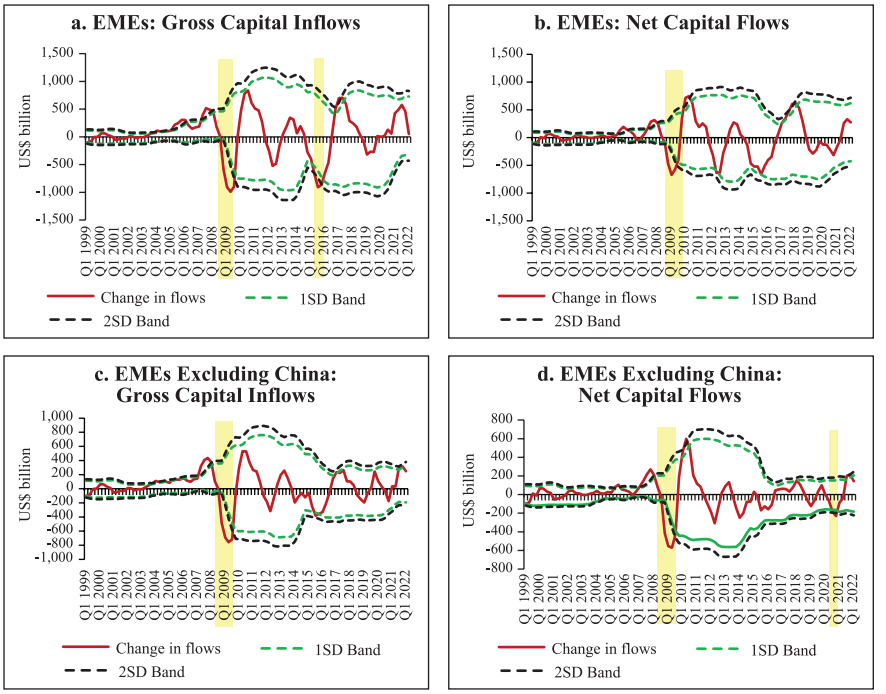
[15] Similar exercise was also repeated using a shorter period of 3 years for the computation of rolling mean and standard deviation of change in gross FPI inflows. The results remained unaltered.

[16] For instance, Eichengreen and Gupta (2016), while extending their analysis on sudden stop episodes in EMEs using data during 1991 to 2014, concluded that the frequency and duration of sudden stops remained largely unchanged since 2002. With regard to the taper tantrum episode of 2013, their study indicated that the period recorded smaller reversals in capital flows and had a milder impact on key macroeconomic indicators. The study referred to the episode as a '*sudden pause*' instead of a *sudden stop* in capital flows. In another study, Forbes and Warnock (2021) stated, "Since the GFC, capital flows have moved more in "ripples" rather than "waves"."

Chart 9: Sudden Stop Episodes in EMEs based on both Gross Capital Inflows and Net Capital Flows



Note: The shaded regions indicate the sudden stop episodes; SD: standard deviation.
Source: Authors' estimates.

2014 were Türkiye (Q4:2013 to Q2:2014), Mexico (Q4:2013), Thailand and Ukraine (Q1:2014)[17]. Both China and India recorded sudden stops during Q1:2022 with respect to gross FPI inflows.

[17] It is important to discuss the nature of the shock. For instance, the GFC in 2008-09 was an endogenous financial shock that affected the demand-side first and then led to the Great Recession of 2009 (Strauss-Kahn, 2020). The initial financial shock resulted in a burst of the housing bubble in the US and, hence, of demand *via* wealth effects. Both affected economic activity in the US and international financial markets, leading progressively to a global recession. Therefore, all actions were aimed at reviving the financial sector to lift up the economy. On the other hand, the pandemic was an exogenous shock (health emergency) and affected first the real sector and the supply-side dynamics followed by its impact on the financial sector and the demand-side. In 2008, insufficiently capitalised banks were a part of the problem. However, over the years, financial sector regulation has improved. Also, drawing insights from the previous crisis episodes, central banks were faster to react. During taper tantrum of 2013-14, central banks responded to the exchange market pressure by foreign exchange market interventions, allowing freer movement of exchange rates, changing domestic interest rates and imposing capital controls. Moreover, in the post-GFC period, countries had also built up their foreign exchange reserve buffers.

IV.2 Factors Driving Capital Flow Reversals

The literature provides an array of factors that drive global capital flow waves, mainly classified into "push" factors – forces driving capital flows external to the domestic economy and "pull" factors – forces relating to the domestic economy that help in attracting capital flows. Some of the seminal papers in this area of work, such as Calvo *et al.* (1993, 1996), Fernandez-Arias (1996), and Chuhan *et al.* (1998) find push factors to be more significant than pull factors in driving capital flows, although Calvo *et al.* (1996) highlight that better domestic policies and economic performance had initially contributed to the surge in capital inflows to EMEs. However, subsequently, global factors became more important, especially the movements in global interest rates.

In this paper, following Forbes and Warnock (2012, 2021), the major factors driving capital flow reversal episodes have been identified for the 19 EMEs (as defined in the previous sub-section) during Q1:1992 to Q1:2022. Annex Table A4 provides the details of the variables/ indicators that have been used for the empirical analysis. The variables have been identified based on the review of the extant literature. In order to examine the role played by these variables in the conditional probability of having an episode of capital flow reversal each quarter, the model estimated is as follows:

$$Prob(e_{it} = 1) = F(\emptyset_t^{Global}\beta_{Global} + \emptyset_t^{Domestic}\beta_{Domestic}) \qquad (5)$$

where, e_{it} is an episode dummy variable that takes the value 1 if a country is experiencing an episode of capital flow reversal defined as the y-o-y fall in gross capital inflows lying at least one standard deviation below its sample mean (as indicated in sub-section IV.1) in quarter 't'[18]. $\emptyset_t^{Global}$is the vector of global factors, while $\emptyset_t^{Domestic}$ is the vector of domestic factors. The methodology that has been found to be appropriate and thus, adopted in the literature in such type of analyses to estimate equation (5) is determined by the distribution of the cumulative distribution function F(·). Because capital flow reversal episodes occur irregularly and may be treated as a rare event (6 per cent probability in our sample period), F(·) is asymmetric. Therefore, equation (5) is estimated using the complementary logarithmic (cloglog) regression framework, which assumes that F(·) is the cumulative distribution function of the extreme value distribution. Or, in other words, this framework assumes that:

[18] For the purpose of the empirical analysis in this section, a weaker definition of sudden stops has been used.

$$F(z) = 1 - \exp\left[-\exp(z)\right] \quad (6)$$

The results presented in Table 1 for India indicate weak global economic growth, higher global interest rates and higher global risk as crucial factors associated with a fall in gross capital inflows. The y-o-y increases in long-term

Table 1: Results of the Cloglog Regression Model - India[19]

Explanatory Variable	Dependent Variable: *Dummy_Gcapital*					
	(1)	(2)	(3)	(4)	(5)	(6)
Global GDP Growth$_{t}$	-0.2** (0.1) [-2.3]	-0.2** (0.9) [-2.5]	-0.3*** (0.1) [-3.1]	-0.2** (0.1) [-2.2]	-0.5*** (0.1) [-3.9]	-0.5*** (0.2) [-3.0]
Global GDP Growth$_{t-1}$	-0.2* (0.1) [-1.7]	-0.1 (0.1) [-1.2]	-	-0.1 (0.1) [-1.3]	-0.2** (0.1) [-2.1]	0.2 (0.2) (0.8]
ΔGlobal Risk$_{t-4}$	-	0.01** (0.00) [2.3]	0.01*** (0.00) [2.8]	0.01*** (0.00) [2.9]	0.02*** (0.00) [4.6]	0.03*** (0.01) [3.4]
ΔGlobal Long Term Rate$_{t-3}$	-	-	-	1.5*** (0.5) [3.2]	2.6*** (0.6) [4.4]	3.2*** (0.9) [3.4]
ΔGlobal Oil Prices$_{t-4}$	-	-	-	-	-0.0 (0.02) [-0.1]	-
ΔUS Federal Funds Rate	-	-	-	-	0.4*** (0.1) [2.7]	0.3** (0.2) [2.0]
Domestic Headline Inflation$_{t-1}$	-	-	-	-	-	0.1 (0.3) (0.4)
ΔExchange rate of INR-USD$_{t-2}$ [App (+)/Dep (-)]	-	-	-	-	-	-0.2*** (0.1) [-3.1]
Constant	-2.7*** (0.5) [-5.7]	-3.0*** (0.5) [-5.8]	-3.0*** (0.5) [-6.2]	-3.4*** (0.8) [-4.5]	-3.4*** (0.8) [-4.1]	-5.5*** (1.5) [-3.7]
Observations	88	85	85	85	85	85
Zero outcomes	83	80	80	80	80	80
Non- zero outcomes	5	5	5	5	5	5
Wald chi2	12.3***	15.3***	16.2***	14.1***	48.6***	19.3***

Note: ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively. Robust standard errors indicated in ( ) and z-statistic indicated in [ ].
Source: Authors' estimates.

[19] Unit root test results are provided in Annex Table A5.1.

global interest rates as well as the US Federal Funds rate raise the likelihood of capital flow reversals, which is in sync with our expectations. Exchange rate depreciation also increases the probability of capital flow reversals. Domestic macroeconomic variables, such as GDP growth and inflation are not found to be statistically significant. In an extended analysis, global liquidity and domestic CAD also turn out to be significant drivers of gross capital flows, wherein a rise in global liquidity lowers the likelihood of a capital flow reversal episode, while a rise in the CAD raises its likelihood (Annex Table A5.3). Overall, the results point to the significant role played by global factors in capital flow reversal episodes in India, consistent with the extant cross-country literature (Albuquerque *et al.*, 2005; Bacchetta and van Wincoop, 2010; Gourio *et al.*, 2010; Forbes and Warnock 2012, 2021).

Moving on to the EME panel, the results suggest that, among the global factors, global risk, global liquidity, crude oil prices and policy rate differentials with the US Federal Funds Rate are statistically significant in predicting capital flow reversals. Amongst domestic factors, real GDP growth, exchange rate movements and domestic monetary policy rate are important drivers of sudden stops (Table 2). Sound macroeconomic fundamentals mitigate the probability of capital flow reversals to external shocks. For instance, during the taper talks of 2013, weak economic growth prospects coupled with high current account deficits and elevated inflation contributed towards adverse investor sentiments and EME portfolio outflows (Sahay *et al.*, 2014; Mishra *et al.*, 2014; Eichengreen *et al.*, 2022)[20].

Section V
Conclusion

Cross-border capital mobility has witnessed a significant surge since the early-2000s led by both country-specific and global developments. While large capital inflows can contribute to higher domestic investment and growth, they remain quite volatile. Sudden reversals in capital flows can lead to increased financial market and macroeconomic volatility. This paper identified the major episodes of capital flow reversals or sudden stops for a sample of major EMEs covering a span of three decades (1992-2022). It also analysed the major drivers of capital flow reversal episodes.

[20] Other variables, such as domestic CPI inflation, global long-term interest rate and US Federal Funds rate were also used in alternate model specifications. However, they did not turn out to be statistically significant.

Table 2: Results of the Cloglog Panel Regression Model - EMEs[21]

Explanatory Variable	Dependent Variable: *Dummy_Gcapital*			
	(1)	(2)	(3)	(4)
Domestic real GDP Growth	-0.1*** (0.02) [-2.5]	-0.1*** (0.03) [-3.3]	-0.1*** (0.02) [-2.5]	-0.1* (0.03) [-1.8]
App (+)/Dep (-) of Domestic Currency per USD	-0.1*** (0.01) [-3.3]	-0.1*** (0.01) [-3.5]	-0.1*** (0.02) [-3.4]	-0.1*** (0.02) [-3.5]
ΔMonetary Policy Rate	-0.1* (0.03) [-1.8]	-0.1** (0.03) [-2.4]	-0.1* (0.02) [-1.8]	-
Policy Rate Difference	-	-	-	0.03* (0.02) [1.7]
CAD to GDP Ratio$_{t-2}$	-	-	0.006 (0.03) [0.2]	-
Global GDP Growth$_{t-1}$	-	-	-	-0.1* (0.03) [-1.9]
ΔGlobal Risk	0.002** (0.001) [2.0]	0.004*** (0.001) [5.2]	0.002** (0.001) [2.0]	-
ΔGlobal Risk$_{t-4}$	-	-	-	0.01*** (0.001) [6.6]
ΔGlobal Oil Prices$_{t-4}$	0.004** (0.002) [2.1]	0.001 (0.002) [0.7]	0.004** (0.002) [2.1]	0.01*** (0.002) [3.3]
ΔGlobal Liquidity change	-	-0.4*** (0.1) [-2.7]	-	-
Constant	-2.6*** (0.2) [-10.9]	-2.5*** (0.3) [-10.8]	-2.6*** (0.2) [-10.9]	-2.5*** (0.2) [-12.7]
Observations	1,076	1,076	1,071	1,112
Groups	18	18	18	18
Wald chi2	48.2***	71.7***	48.5***	139.0***
AIC	624.8	609.8	625.9	625.6
BIC	659.7	649.6	665.7	665.8

Note: ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively. Robust standard errors indicated in ( ) and z-statistic indicated in [ ].
Source: Authors' estimates.

[21] Dummy for gross capital flow sudden stop has 1674 observations, out of which 154 are non-zero outcomes. Dummy for gross FPI-based sudden stop has 177 non-zero outcomes. Among the 19 economies for which sudden stops were calculated, 18 were selected for the panel regression. Pakistan was dropped due to data comparability issues. The panel clog-log model uses random effects. To test if the random effect is suitable for the data, Hausman test was carried out for model (1). The test suggested random effect with chi2(5) = 3.02 to be statistically not significant (p-value 0.70). Comparable results were found with pooled clog-log as well. Unit root test results are provided in Annex Table A5.2.

The analysis indicated that the volatility in capital flows moderated post-GFC, *albeit* with some increase after the outbreak of the pandemic in 2020. In terms of the statistical criteria following Calvo *et al*. (2004), the GFC was the only major sudden stop episode for EMEs both in terms of gross capital inflows and net capital flows. The pandemic quarters of Q3 and Q4:2020 were sudden stop phases in terms of net capital flows. Global factors (global growth, global risk, US Federal Funds rate and global liquidity) as well as domestic growth predicted capital flow reversal episodes for the sample EMEs.

Capital flow reversals are generally sudden, disruptive and broad-based with a limited window for policy reaction and can lead to large volatility in domestic financial market conditions and have an adverse impact on inflation and output. The appropriate utilisation of CFMs and MPMs, along with a strengthening of domestic macroeconomic and financial fundamentals and adequate buffers in the form of foreign exchange reserves, can help the EMEs better navigate the ebbs and surges in capital flows while preserving macroeconomic and financial stability.

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Annex

Annex Table A1: Summary of the Major Studies Identifying Sudden Stops and the Impact of Taper Tantrum in EMEs

A. Literature on Sudden Stops				
Author/s	**Objectives of the Study**	**Period of Analysis**	**Methodology**	**Key Findings**
Calvo *et al.* (2004)	Analyse the empirical characteristics of sudden stops	1990-2001 (AEs and EMEs)	Provide the criteria/ algorithm to identify sudden stops. Use panel probit model to estimate the probability of a sudden stop regime	EMEs, unlike AEs, face large RER fluctuations during sudden stops. Openness and domestic liability dollarisation are key determinants of sudden stop probability
Cowan and De Gregorio (2007)	Examine the resilience of the economy of Chile	1980-2003	Discuss and compare Chile's experience with international borrowing and capital flows during 1980-2003 with other Latin American economies	Banking regulations supporting a strong financial system and absence of currency risk guarantees to the private sector provided resilience to the Chilean economy in the 1990s
Joyce and Nabar (2009)	Study the impact of financial openness in the context of sudden stops	1976-2002 (EMEs)	Panel fixed effects and panel GMM regressions	Banking sector strength helps to withstand the fallout of capital flight in EMEs open to global capital flows
Agosin and Huaita (2011)	Use Kindleberger – Minsky model for capital account reversals	1976-2003 (EMEs)	A panel-probit model incorporating unobserved random country effects	Determinants include the preceding capital surges, share of non-FDI flows in GDP, CAD, contagion effect and external debt to exports ratio

Forbes and Warnock (2012)	Analyse global capital flow waves by identifying episodes of surges and stops using gross inflows and flight and retrenchment using gross outflows; Identify factors explaining such episodes	1980-2009 (AEs, EMEs and Low-income Economies)	Construct a new method to document extreme movements in capital flows after differentiating activity by foreigners and domestic residents. Further, the complementary logarithmic (cloglog) framework is used to estimate the significance of global, contagion, and domestic factors for different capital flow waves	Global factors are associated with extreme capital flow movements, whereas contagion *via* the channels of international trade, banking or geography is linked with stops and retrenchment. Domestic factors, including capital controls, are generally less important
Cavallo *et al*. (2015)	Develop a new taxonomy of sudden stops depending on the behaviour of gross and net capital flows. The new taxonomy is then explored to characterise different types of sudden stops	1980-2012 (AEs and EMEs)	Six categories of sudden stops are arrived at using the Calvo *et al.* (2004) algorithm. For each type of sudden stop, pre- and post-episode trends in real GDP and RER are compared using OLS fixed effects regressions	Both sudden reversals in net flows and swift reversals in gross flows may be disruptive and cause growth slowdown
Eichengreen and Gupta (2016)	Analyse sudden stops in capital flows since 1991	1991-2014 (EMEs)	Sudden stop classification is done using inflows. The probability of a sudden stop is determined using Probit / Logit/ Cloglog methods	Global factors appear to have become more important in influencing sudden stops as compared to country characteristics

Cavallo (2019)	Provides a survey of the empirical literature with an emphasis on definitions, turning points, causes and consequences of sudden stops	1983-2015 (AEs and Developing Economies)	Cavallo *et al.* (2015) algorithm is used to identify sudden stops	The paper reiterates the 6 different types of sudden stops given in Cavallo *et al.* (2015)
Forbes and Warnock (2021)	Analyse the phenomenon of extreme capital flow movements since GFC by including the COVID-19 period	1978-2020 (AEs and EMEs)	Methodology worked out in Forbes and Warnock (2012)	Extreme capital flow movements have not grown since the GFC, including the early phases of COVID (H1:2020). However, the drivers of such episodes are found to have changed since the GFC with global risk factors becoming less dominant and oil prices gaining significance. Moreover, large global "waves" in international capital flows have recently turned into more idiosyncratic "ripples"

B. Literature on Taper Tantrum Episode of 2013				
Author/s	**Objectives of the Study**	**Period of Analysis**	**Methodology**	**Key Findings**
Aizenman, Binici and Hutchison (2014)	Assess the impact of 2013 announcements on tapering of asset purchases by the US Fed on financial markets	November 27, 2012 -October 3, 2013 (EMEs)	A quasi-event study is used to trace the impact. Further, a panel fixed effect framework is used with daily data and various models to evaluate the impact of news on three prices (stock market, exchange rate and CDS spreads)	Financially developed economies were more impacted as they were more exposed. Exchange rates of EMEs with robust fundamentals were more adversely affected. However, differential responses between the fragile and the robust EMEs tend to dissipate over time
Mishra *et al*. (2014)	Analyse reaction of market towards the 2013–14 US Fed announcements on tapering of asset purchases, and their relationship with macroeconomic fundamentals/ country characteristics	January 1, 2013 - January 22, 2014 (EMEs)	An event study framework is used	Macroeconomic fundamentals, financial market depth, and macroprudential policy stance significantly affected behaviour of exchange rates and bond yields
Eichengreen and Gupta (2015)	Analyse the characteristics of economies hit by 2013 taper tantrum episode	Cross-sectional 2013 data (EMEs)	Linear regression models are used	Countries with larger and more liquid markets and larger capital inflows experienced more pressure on their exchange rates, foreign reserves, and equity prices

Eichengreen *et al*.(2022)	Evaluate the possibility of another taper tantrum episode for EMEs, particularly India, in 2021	1997-2020 (EMEs)	Debt dynamics explored for India using linear regression models	External vulnerabilities of EMEs have reduced with reduced CAD, dependence on portfolio capital inflows, external financing needs and real appreciation, but large public-sector debt poses risks

Source: Authors' compilation.

Annex Table A2: Sudden Stop Episodes in Major EMEs during Q1:1992-Q1:2022

EME	Gross Capital Inflows		Gross FPI Inflows		Net Capital Flows	
	Episodes	Number of Quarters	Episodes	Number of Quarters	Episodes	Number of Quarters
Brazil	Q1 1999 - Q2 1999	2	Q4 2008 - Q2 2009	3	Q1 1999 - Q2 1999	2
	Q4 2008 - Q1 2009	2	Q1 2016 - Q2 2016	2	Q4 2008 - Q2 2009	3
	Q3 2015 - Q1 2016	3	-	-	Q1 2016 - Q2 2016	2
China	Q4 2008 - Q3 2009	4	Q4 2007 - Q3 2008	4	Q1 2009	1
	Q2 2012 - Q3 2012	2	Q3 2015 - Q2 2016	4	Q1 2012 - Q4 2012	4
	Q1 2015 - Q4 2015	4	Q4 2021 - Q1 2022	2	Q4 2014 - Q2 2015	3
Colombia	Q3 2015 - Q1 2016	3	Q2 2002 - Q4 2002	3	Q3 2006	1
	-	-	Q2 2008 - Q4 2008	3	Q4 2015 - Q3 2016	4
	-	-	Q2 2015 - Q2 2016	5	-	-
Hungary	Q2 2002	1	Q2 2006 - Q3 2006	2	Q2 2002	1
	Q1 2009 - Q1 2010	5	Q4 2007 - Q1 2008	2	Q4 2009	1
	Q4 2017 - Q3 2018	4	Q3 2009	1	Q3 2012	1
	Q2 2021 - Q3 2021	2	-	-	-	-
India	Q4 2008 - Q2 2009	3	Q3 2006	1	Q3 2004	1
	Q1 2016 - Q2 2016	2	Q3 2008 - Q1 2009	3	Q3 2006	1
	-	-	Q1 2016	1	Q4 2008 - Q2 2009	3
	-	-	Q1 2022	1	Q1 2016 - Q2 2016	2

EME	Gross Capital Inflows		Gross FPI Inflows		Net Capital Flows	
	Episodes	Number of Quarters	Episodes	Number of Quarters	Episodes	Number of Quarters
Indonesia	Q1 2007	1	Q1 2007	1	Q4 2008	1
	Q2 2009	1	Q2 2008 - Q2 2009	5	Q2 2009 - Q3 2009	2
	Q2 2012	1	Q2 2018 - Q3 2018	2	Q4 2011 - Q2 2012	3
	Q3 2015 - Q1 2016	3	-	-	Q3 2015 - Q1 2016	3
South Korea	Q2 2008 - Q2 2009	5	Q1 2005 - Q2 2005	2	Q3 2007 - Q2 2008	4
	Q4 2015 - Q1 2016	2	Q4 2008 - Q1 2009	2	Q4 2008 - Q1 2009	2
	-	-	Q1 2016 - Q2 2016	2	Q2 2021	1
Malaysia	Q1 1999	1	Q1 1999	1	Q1 1999	1
	Q1 2001 - Q2 2001	2	Q4 1999	1	Q3 1999 - Q4 1999	2
	Q4 2005 - Q1 2006	2	Q2 2000 - Q3 2000	2	Q2 2000	1
	Q4 2008 - Q2 2009	3	Q1 2001	1	Q1 2001	1
	-	-	Q4 2005	1	Q4 2005 - Q3 2006	4
	-	-	Q2 2008 - Q1 2009	4	Q4 2008 - Q2 2009	3
Mexico	Q4 2006	1	Q2 2006 - Q3 2006	2	Q2 2004	1
	Q2 2007	1	Q1 2009 - Q2 2009	2	Q3 2009 - Q4 2009	2
	Q2 2009 - Q3 2009	2	Q4 2013	1	Q2 2012	1
	Q2 2015	1	Q2 2015 - Q4 2015	3	Q2 2015 - Q4 2015	3
	Q1 2021 - Q4 2021	4	Q4 2021	1	Q1 2021 - Q2 2021	2

EME	Gross Capital Inflows		Gross FPI Inflows		Net Capital Flows	
	Episodes	Number of Quarters	Episodes	Number of Quarters	Episodes	Number of Quarters
Pakistan	Q1 1999 - Q2 1999	2	Q2 2008 - Q1 2009	4	Q1 1999	1
	Q2 2008 - Q4 2008	3	Q4 2015 - Q1 2016	2	Q2 2008 - Q4 2008	3
	Q2 2019 - Q3 2019	2	-	-	Q3 2019	1
	Q1 2020 - Q2 2020	2	-	-	Q1 2020 - Q4 2020	4
	Q4 2020	1	-	-	-	-
Poland	Q4 2001 - Q2 2002	3	Q3 2001 - Q1 2002	3	Q4 2001 - Q2 2002	3
	Q4 2008 - Q3 2009	4	Q2 2006 - Q1 2007	4	Q1 2009- Q2 2009	2
	-	-	-	-	Q4 2017	1
Philippines	Q2 2008 - Q4 2008	3	Q4 2007 - Q3 2008	4	Q2 2009 - Q3 2009	2
	Q1 2020 - Q2 2020	2	Q1 2020 - Q3 2020	3	Q4 2011 - Q3 2012	4
	-	-	Q4 2021	1	Q1 2020 - Q3 2020	3
Russia	Q1 1999 - Q2 1999	2	Q1 1999 - Q3 1999	3	-	-
	Q4 2008 - Q3 2009	4	Q4 2008 - Q2 2009	3	Q3 2008 - Q3 2009	5
	Q3 2014 - Q4 2014	2	Q2 2020 - Q4 2020	3	-	-
	Q4 2020	1	-	-	-	-
Sri Lanka	Q3 2001 - Q4 2001	2	Q3 2003 - Q2 2004	4	Q2 2001 - Q3 2001	2
	Q1 2008 - Q2 2008	2	Q4 2005 - Q1 2006	2	Q4 2007 - Q2 2008	3
	Q4 2009	1	Q2 2007	1	-	-
	Q3 2010	1	Q2 2010 - Q4 2010	3	Q3 2009	1
	Q1 2015 - Q3 2015	3	Q1 2015 - Q3 2015	3	Q1 2015 - Q3 2015	3
	Q3 2020 - Q1 2021	3	Q3 2020 - Q4 2020	2	-	-

EME	Gross Capital Inflows		Gross FPI Inflows		Net Capital Flows	
	Episodes	Number of Quarters	Episodes	Number of Quarters	Episodes	Number of Quarters
South Africa	Q1 1999 - Q2 1999	2	Q1 1999 - Q2 1999	2	Q1 1999	1
	Q4 2000 - Q1 2001	2	Q3 2020 - Q2 2021	4	Q4 2008 - Q2 2009	3
	Q3 2008 - Q2 2009	4	Q4 2007 - Q4 2008	5	Q2 2019	1
	-	-	Q4 2018 - Q2 2018	3	Q3 2020 - Q2 2021	4
Thailand	Q1 2007	1	Q1 1999	1	Q1 2007 - Q2 2007	2
	Q2 2008 - Q1 2009	4	Q4 2006 - Q1 2007	2	Q1 2009	1
	Q4 2011 - Q1 2012	2	Q2 2008 - Q1 2009	4	Q4 2009	1
	-	-	Q1 2014	1	Q4 2011 - Q2 2012	3
Türkiye	Q2 2001 - Q4 2001	3	Q1 1999 - Q2 1999	2	Q1 1999 - Q2 1999	2
	Q4 2007 - Q1 2008	2	Q2 2001 - Q3 2001	2	Q2 2001 - Q4 2001	3
	Q4 2008 - Q3 2009	4	Q4 2007 - Q3 2008	4	Q1 2007 - Q2 2007	2
	Q4 2018	1	Q4 2013 - Q2 2014	3	Q4 2008 - Q3 2009	4
	-	-	-	-	Q4 2018 - Q1 2019	2
Ukraine	Q4 2008 - Q4 2009	5	Q1 1999	1	Q4 2004 - Q1 2005	2
	Q4 2014 - Q1 2015	2	Q2 2006	1	Q4 2008 - Q3 2009	4
	Q3 2020 - Q1 2021	3	Q2 2008 - Q1 2009	4	Q4 2014 - Q1 2015	2
	-	-	Q4 2014	1	Q3 2020 - Q4 2020	2
	-	-	Q3 2020 - Q1 2021	3	-	-

EME	Gross Capital Inflows		Gross FPI Inflows		Net Capital Flows	
	Episodes	Number of Quarters	Episodes	Number of Quarters	Episodes	Number of Quarters
Vietnam	Q4 2008 - Q2 2009	3	Q3 2008 - Q2 2009	4	Q4 2008 - Q1 2009	2
	Q42018 - Q2 2019	3	Q1 2020 - Q4 2020	4	Q3 2015	1
	-	-	-	-	Q4 2018 - Q1 2019	2

Source: Authors' estimates.

Annex Table A3: Key Macroeconomic Indicators during Major Capital Flow Reversal Episodes

	Episode	GFC (January 2007 to December 2009)	Taper Tantrum 2013 (January 2012 to December 2013)	Chinese Stock Market Sell Off (January 2014 to December 2016)	COVID-19 (January 2019 to December 2020)	Taper Talks 2021 (January 2021 to January 2022)*
Global	VIX	26.5	15.8	16.2	24.0	18.9
	Oil Price	80.2	109.4	64.3	52.3	73.7
	Global GDP Growth	-0.1	1.5	2.2	-1.4	5.8
	Global Inflation	6.7	4.8	3.6	3.5	5.1
	Global Liquidity	50.2	62.5	72.6	89.0	94.1
	Global Long-term Interest rate	3.5	2.0	1.5	0.6	0.6
	US Federal Funds rate	2.4	0.1	0.2	1.3	0.1
	DXY (‘+’ appreciation/ ‘-’depreciation)	-7.0	-0.2	27.7	-6.5	7.3
India	GDP Growth	14.0	7.0	7.8	-0.8	9.8
	Inflation	8.5	9.7	5.5	5.2	5.1
	CAD to GDP Ratio	-1.7	-3.8	-1.0	0.2	-1.0
	Exchange Rate Change (‘+’ appreciation/ ‘-’depreciation)	-5.3	-14	-8.9	-4.5	-2.6

* Figures reported relate to January 2021-December 2021 period (except for appreciation/ depreciation).

Source: Authors’ calculations.

Annex Table A4: Variable Description

Sl. No.	Variable	Indicator	Description / Data Source
1.	Risk_VIX	Global risk	VIX (CBOE Volatility Index) measures the 30-day expected volatility of the US stock market (y-o-y) / Bloomberg
2.	Liq_G	Global liquidity growth	Average of broad money (M3) indices for USA, Euro Area, UK, and Japan (y-o-y) / OECD
3.	LTR_G	Global long-term rate	Change in average market rates on government bonds maturing in ten years for USA, Euro Area, UK, and Japan over a year / OECD
4.	GDP_G	Global GDP growth rate	GDP growth rate (y-o-y) of OECD countries / OECD
5.	Oil_G	Global oil prices	Average crude oil prices (y-o-y) / World Bank
6.	US_FFR	US Federal Funds rate	Change in average US Federal Funds rate over a year / Federal Reserve Bank of St. Louis
7.	Exchrt_D	Exchange rate of domestic currency per USD	Appreciation (+)/Depreciation (-) of domestic currency per USD (y-o-y) / CEIC and RBI
8.	Repo	India's repo rate	Change in average India's Repo rate over a year / RBI
9.	Policy_D	Domestic monetary policy rate	Change in end-quarter policy rate over a year (y-o-y) / CEIC and RBI
10.	Policy_rate_diff	US Federal Fund rate – domestic policy rate	US Federal Fund rate – domestic policy rate/ Authors' calculation
11.	GDP_D	Domestic GDP growth	Domestic GDP growth rate/ CEIC and Ministry of Statistics and Programme Implementation (MoSPI), Government of India (GoI)
12.	CPI_Inflation_D	Domestic headline inflation	Domestic CPI inflation (y-o-y)/ CEIC and MoSPI, GoI
13.	CAD_ratio	CAD to GDP ratio	CAD to GDP ratio / CEIC and RBI
14.	Dummy_GFPI	Proxy for sudden stop using Gross FPI	The indicator describes the episodes when the fall in the Gross FPI is more than 1 SD / Calculated using BOPS, IMF
15.	Dummy_Gcapital	Proxy for sudden stop using gross capital flows	The indicator describes the episodes when the fall in the Gross Capital flows is more than 1 SD / Calculated using BOPS, IMF

Source: Authors' compilation.

Annex Table A5.1: Results of the Unit Root Tests for the India Model

Variables	Augmented Dickey Fuller (ADF) Test Statistic		Phillips–Perron Unit-Root Test Test Statistic Z(rho)	
	X	ΔX	X	ΔX
Risk_VIX	-3.5***	-	-6.7***	-
LTR_G	-3.2**	-	-3.7***	-
Liq_G	-2.0	-6.5***	-2.6*	
GDP_G	-2.8*	-	-4.8 ***	-
Oil_G	-4.6***	-	-3.9***	-
US_FFR	-2.7*	-	-3.0**	-
Repo	-3.0**			
Exchrt_D	-3.2**	-	-3.6***	-
CPI_D	-2.0	-4.2***	-2.1	-8.6***
CAD_ratio	-4.6***		-4.4***	

Note: ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively.
Source: Authors' estimates.

Annex Table A5.2: Results of the Unit Root Tests for the EME Panel

Variables	Im-Pesaran-Shin (Z_t tilde bar)		Fisher type Inverse χ^2	
	X	ΔX	X	ΔX
Risk_VIX	-20.4***		695.1***	
Liq_G	-2.7***		47.8*	680.1***
LTR_G	-11.2***		230.4***	
GDP_G	-14.2***		341.2***	
Oil_G	-14.6***		362.8***	
US_FFR	-2.5***		46.0	373.9***
Exchrt_D	-7.1***		127.7***	
Policy_D	-5.3***		126.3***	
Policy_rate_diff	-4.4**		126.4***	
GDP_D	-12.5***		309.2***	
CPI_D	-7.9***		221.4***	
CAD_ratio	-12.1***		306.1***	
Dummy_GFPI	-17.1***		519.6***	
Dummy_Gcapital	-17.2***		503.7***	

Note: ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively. As the panel data is not strongly balanced, Im-Pesaran-Shin test and several Fisher-type tests were conducted. Out of four statistics for Fisher-type tests, only Inverse chi-squared is reported. Z, L* and Pm statistics also gave similar results.
Source: Authors' estimates.

Annex Table A5.3: Results of the Cloglog Regression Model (Alternate Specifications) - India

Explanatory Variables	**Dependent Variable: *Dummy_Gcapital***			
	(1)	(2)	(3)	(4)
Global GDP Growth	-0.3***	-	-0.2**	-0.3***
	(0.1)		(0.1)	(0.1)
	[-2.6]		[-2.3]	[-2.4]
ΔGlobal Liquidity change $_{t-2}$	-	-	-0.8*	-1.5**
			(0.4)	(0.7)
			[-1.8]	[-2.2]
ΔGlobal Risk$_{t-3}$	-	0.01**	0.03**	0.04**
		(0.01)	(0.01)	(0.02)
		[1.9]	[2.3]	[2.2]
ΔGlobal Oil Prices$_{t-3}$	-	0.02*	0.01	-
		(0.01)	(0.01)	
		[1.9]	[1.1]	
ΔRepo rate	-	-0.9***	-	-
		(0.3)		
		[-2.9]		
CAD to GDP Ratio$_{t-5}$	0.5*	-	-	0.7*
	(0.3)			(0.4)
	[1.7]			[1.7]
ΔExchange rate of INR-USD$_{t-2}$ [App (+)/Dep (-)]	-0.2**	-	-	-
	(0.1)			
	[-2.1]			
Constant	-3.0***	-4.2***	-3.9***	-4.1***
	(0.7)	(0.9)	(1.0)	(1.3)
	[-4.5]	[-4.9]	[-4.0]	[-3.2]
Observations	86	85	85	85
Zero outcomes	81	80	80	80
Non- zero outcomes	5	5	5	5
Wald chi2	10.8***	12.9***	12.6***	15.2***

Note: ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively. Robust standard errors indicated in ( ) and z-statistic indicated in [ ].
Source: Authors' estimates.

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Procyclicality in Total Factor Productivity Measurement: An Analysis of the India KLEMS Data

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This paper examines procyclicality in the estimates of Total Factor Productivity (TFP) in the Indian economy from 1981-82 to 2019-2020 based on the India KLEMS 2022 database. A major driver of the procyclicality could be the varying factor utilisation rate over the business cycle. In this paper, new TFP indices have been constructed, adjusting for the variable capital utilisation rate and labour efforts using a partial equilibrium model. The procyclicality of the adjusted TFP series, as indicated by correlation of TFP growth with value added growth, reduces from 0.88 for the unadjusted series to 0.75 for the adjusted TFP series for the economy as a whole. The procyclicality is more in labour-intensive manufacturing sectors, such as textiles, and services sectors, such as construction, hotels, business services, education and health care.

JEL Classification: E32, D24

Keywords: Total factor productivity, business cycle, factor hoarding, production function estimation, constant returns to scale.

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Introduction

Capital investment, labour and productivity growth are the three main drivers of economic growth. Growth based on factor accumulation may not be sustainable due to potential limitations on the availability of the factors in future and diminishing returns to factors. As a result, the sustainability of growth depends heavily on productivity growth, which is output growth that is not accounted for by factor accumulation. For instance, it has been stated that decline in productivity, which resulted from ageing population, weakening of research and development activities and technological progress, was one of the primary causes of the Japanese economy's prolonged stagnation since 1990s, called as the "lost decade" (Yoshino and Taghizadeh-Hesary, 2015). Therefore, an on-going accurate measurement and assessment of productivity growth is critical for a robust understanding of economic growth, its drivers and appropriate policies.

A commonly used measure of productivity is the Total Factor Productivity (TFP), which is traditionally computed using the growth accounting methodology or Solow residual; this measure is also followed in the India KLEMS database. For unbiased estimates, the Solow approach requires preconditions of perfect competition, constant returns to scale (CRS) and full capacity utilisation. Any deviation from these assumptions and/or an error in the measurement of inputs or outputs can lead to biases in the measurement of the Solow residual. In the years of strong expansion, the residual could be usually large and in the years of recession, it could be low or even negative. The trends of TFP growth along with value added growth for the whole economy as well as for different sectors - agriculture, manufacturing and services – as depicted in Annex, Chart A1 through A4, respectively, suggest a strong tendency for the TFP growth and value added growth to co-move. A positive correlation of 0.88 is observed between the two series for the Indian economy as a whole and 0.95, 0.91 and 0.63 for agriculture, manufacturing and services sectors, respectively.

The literature has explored the sources of procyclicality in estimates of productivity, that is, rise of productivity in booms and fall in recessions. However, most of these studies have focused on labour productivity instead of TFP. Some of the early studies in this area, Gordon (1990), Burnside *et al*.

(1993) and Burnside and Eichenbaum (1996) argued that the procyclicality resulted from measurement errors in labour and capital due to factor hoarding, especially labour hoarding. Hall (1990), Basu and Fernald (1995), and Basu and Kimball (1997) presented a different perspective which suggested that fluctuations in inputs may cause procyclical fluctuations in productivity, when there are imperfect competition conditions and increasing returns to scales at the firm level. Basu (1996) examined the relative significance of cyclical fluctuations in labour and capital utilisation, increasing returns to scale and technology shocks as explanations for procyclical productivity, concluding that cyclical factor utilisation was the most important factor.

Cooley and Prescott (1995) suggested that productivity shocks, which are generated as Solow residuals are procyclical themselves and are the driving force for a business cycle, serving as the foundation for the real business cycle models. To explain cyclical movements in aggregate productivity, Basu and Fernald (2001) used a Dynamic General Equilibrium (DGE) model that took into account cyclical utilisation of factors of production, increasing returns to scale and reallocation of resources across sectors with different marginal products. Schmöller and Spitzer (2019) estimated a medium-scale Dynamic Stochastic General Equilibrium (DSGE) model in the Euro area and came to the conclusion that the major cause of the decline in productivity in the Euro area was the decline in the effectiveness of research and development (R&D) investment and non-adoption of new technologies.

To the best of my knowledge, not many studies have been undertaken on the measurement of procyclical biases in productivity in India, especially at the economy level. This paper attempts to fill this gap by constructing TFP indices adjusting for variable capital utilisation rate and labour efforts over the business cycle, using a partial equilibrium model. The model is tested on the India KLEMS database to address biases by adjusting for the variable factor utilisation.

The structure of the paper is as follows. Section II explains the various procyclical biases in the traditional TFP estimation. Section III describes the methodology and the data used. Section IV presents the empirical findings and their implications and Section V provides the concluding observations and direction for future research.

Section II
Biases in Traditional TFP Estimation

Solow (1957) developed the empirical method for measuring TFP growth by subtracting input growth of all factors of production from the output growth, which later came to be known as Solow residual. If Y be the output, K be the capital, L be the labour, A be the technology and α be the factor share earned by labour, then a CRS production function can be represented as below:

$$Y = AK^{1-\alpha}L^{\alpha} \tag{2.1}$$

Taking log and total differentiation,

$$\frac{dY}{Y} = \frac{dA}{A} + (1-\alpha)\frac{dK}{K} + \alpha\frac{dL}{L} \tag{2.2}$$

dA/A is the measure of TFP growth or Solow residual which can be written as below for discrete time series data:

$$\Delta A_t = \Delta y_t - (1-\alpha_t)\Delta k_t - \alpha_t \Delta l_t \tag{2.3}$$

where ΔA_t is the TFP growth in year *t*; Δy_t is output growth; Δl_t is growth of labour; Δk_t is growth of capital and α_t is the factor share earned by labour or the share of labour cost in revenue (wL/pY). Here, the time subscript has been used for parameter α too, to emphasise that it can change over time.

Under the assumptions of perfect competition, CRS and full capacity utilisation, the Solow residual should measure the exogenous technology shock. However, any deviation from these assumptions may lead to biases in the measurement of TFP. In this section, the potential biases in Solow residual due to deviations from these assumptions are discussed.

II.1 Presence of Market Power

The CRS production function assumes perfect competition and that all firms are price takers. However, in the economy, some of the firms or sectors could engage in monopolistic and oligopolistic price setting practices when determining prices.

Let μ be the mark up ratio or price to marginal cost, $\mu = p/c$. Then, the elasticity of the production function with respect to labour input is μα and the rate of growth of output can be decomposed as:

$$\Delta y_t = (1-\alpha_t\mu_t)\Delta k_t + \alpha_t\mu_t\Delta l_t + \Delta A_t \tag{2.4}$$

Under perfect competition, μ is equal to one.

From (2.4), standard Solow residual under market power can be derived as:

$$\Delta y_t - \alpha_t \Delta l_t - (1-\alpha_t)\Delta k_t = (\mu_t - 1)\alpha_t(\Delta l_t - \Delta k_t) + \Delta A_t \quad (2.5)$$

From equation (2.5), it may be observed that the Solow residual is equal to $(\mu_t - 1)\alpha_t(\Delta l_t - \Delta k_t) + \Delta A_t$ and no longer represents true TFP growth in the presence of market power (when μ is not equal to 1).

II.2 Increasing Returns to Scale

CRS is another assumption used in the estimation of the Solow residual. A company can also possess market power in order to operate at a point of increasing returns to scale. Let γ be the returns to scale index, that is, the elasticity of output with respect to both the inputs, then under the assumption of constant returns, γ =1.

$$\gamma = \frac{K}{Y}\frac{\partial Y}{\partial K} + \frac{L}{Y}\frac{\partial Y}{\partial L} \quad (2.6)$$

Under increasing returns to scale (γ>1), the standard Solow residual has an extra term as below:

$$\Delta y_t - \alpha_t \Delta l_t - (1-\alpha_t)\Delta k_t = (\mu_t - 1)\alpha_t(\Delta l_t - \Delta k_t) + (\gamma_t - 1)\Delta k_t + \Delta A_t \quad (2.7)$$

Hence, Solow residual no longer produces an unbiased estimate of TFP growth in the presence of increasing returns to scale, because of both market power as well as increasing returns to scale (when γ is not equal to 1).

II.3 Unmeasured Fluctuations in Capital Utilisation

One of the key assumptions in computation of Solow TFP estimate is that all the capital available for the firms is used for production. But in downturns, firms are not able to disinvest capital and the available capital may not get fully utilised leading to under-utilisation. In upturns, on the contrary, there could be over-utilisation of capital stocks due to extended production hours or minimising maintenance schedules. Further, if there is user cost of capital *i.e.*, if capital depreciation is on the basis of the usage of capital, then the capital depreciation rate will also vary depending on the utilisation rate and will not be constant over time. Due to both variable capital depreciation rate and variable capital utilisation, the capital stock would be over-estimated in downturns and under-estimated during upturns.

Suppose K is the usual measured capital stock and $\widetilde{K}$ is the effective capital stock used for production and ν be the measurement error of capital stock *i.e.,* $K = \widetilde{K} + \nu$, then the Solow residual, calculated with measured capital stock rather than actual effective capital stock will have extra term as below:

$$\Delta y_t - \alpha_t \Delta l_t - (1 - \alpha_t)\Delta k_t = -(1 - \alpha_t)\Delta v_t + \Delta A_t \quad (2.8)$$

Capital measurement error ν is likely to be negatively correlated with output changes (*i.e.,* in upturn, capital utilisation is higher than usual measure and the error is negative and *vice-versa*), which will create procyclical biases. Additionally, with prolonged excess capacity of capital, the firm's capital costs would be higher than normal, such that the cost share of labour (α) would understate the true elasticity of output with respect to labour input.

II.4 Unmeasured Fluctuations in Labour Effort

Similar to capital stock, in computation of the Solow estimate, it is assumed that all the labour is fully utilised for production. However, it may be difficult for firms to lay off workers in downturns. Similarly, it may be costly and time-consuming to train new employees, and hence, firms may use the existing employees more intensively during upturns. If cyclical fluctuations in labour efforts are ignored in the computation of TFP, it becomes procyclical, implying fluctuations in technology.

Let L be the usual measure of labour and $\tilde{L}$ be the effective labour used for production which is labour hour L multiplied by labour effort or $\tilde{L}$ = e*L, where 'e' is labour efforts and L is measured labour input. After taking log, we get, $\tilde{l}$ = e + l. Then, the Solow residual based on measured labour input rather than effective labour input (labour input multiplied by labour effort) can be written as under:

$$\Delta y_t - \alpha_t \Delta l_t - (1 - \alpha_t)\Delta k_t = \alpha_t \Delta e_t + \Delta A_t \quad (2.9)$$

Now, Δe_t is likely to be positively correlated with output changes *i.e.,* in upturns, labour efforts are higher giving rise to procyclical biases.

Section III
Data and Methodology

III.1 Data

This paper is based on the India KLEMS 2022 database, sourced from the Reserve Bank of India (RBI) for the period 1980-81 to 2019-20. The data

consist of value added, labour input, capital input, energy input, material input and TFP, among others, for 27 industries as well as for the three broad sectors - agriculture, manufacturing and services and for the whole economy.

III.2 Methodology

In this paper, productivity under variable factor utilisation is modelled under a partial equilibrium framework assuming Cobb-Douglas production function (Das, 2009).

III.2.1 Modelling of Productivity Under Variable Factor Utilisation

We assume the following two-factor Cobb-Douglas production function along the lines of Solow (1957):

$$Y_t = \tilde{A}_t(u_t K_t)^{1-\alpha}(e_t N_t)^{\alpha} \tag{3.1}$$

where Y_t is output produced, K_t is the capital stock, N_t is the employment, u_t is the capital utilisation rate, e_t is the labour effort and $\tilde{A}_t$ is the TFP adjusted for input utilisation rate over business cycle. Here, it is assumed that the cost of capital utilisation is not constant, and it causes a faster rate of depreciation. Following Burnside and Eichenbaum (1996), it is assumed that the rate δ_t at which capital depreciates is a convex function of capital utilisation rate and $\delta_t = \delta\, u_t^{\varphi}$, where $\varphi > 1$. We also assume that $E(u_t^{\varphi}) = 1$ or $E(\delta_t) = \delta$. Further, we assume that wage is linear in labour efforts or $w(e_t) = ce_t$ *i.e.,* if efforts are doubled, it is compensated by doubling the wages.

Additionally, it is assumed that (a) the cost of capital or the rate at which firms rent capital is equal to the interest rate r_t plus the depreciation rate δ_t induced by its use; and (b) the rental cost of capital is not fixed and depends on depreciation which is a function of the utilisation rate. δ_t is a function of the utilisation rate u_t, which is observable by the capital owner. It is also assumed that changing employment (in a short time) would be infinitely expensive and hence, employment is pre-set one period ahead. Firms can only adjust the effort of labour instantaneously by offering them higher wages proportional to their efforts. Firms choose utilisation rate u_t, capital stock K_t and labour effort e_t in a given period. Employment N_t is fixed for the period, and thus, the firm's optimisation problem can be written as:

$$\max_{u_t, K_t, e_t} \tilde{A}_t(u_t K_t)^{1-\alpha}(e_t N_t)^{\alpha} - w(e_t)N_t - (r_t + \delta_t)K_t$$

where, $w(e_t)$ is the wage which is a function of the labour effort.

The first order conditions are the following,

$$\frac{(1-\alpha)Y_t}{u_t} = K_t \delta\varphi \, u_t^{\varphi-1} \tag{3.2}$$

$$\frac{(1-\alpha)Y_t}{K_t} = r_t + \delta_t \tag{3.3}$$

$$\frac{\alpha Y_t}{e_t} = w'(e_t)N_t \tag{3.4}$$

From equation (3.2) substituting δ_t for δu_t^{φ} in the R. H. S. we get,

$$\frac{(1-\alpha)Y_t}{K_t} = \varphi\delta_t \tag{3.5}$$

Taking expectations on both sides of equation (3.5) we get,

$$(1-\alpha)E\left[\frac{Y_t}{K_t}\right] = \varphi E(\delta_t) \tag{3.6}$$

or,

$$(1-\alpha) = \frac{\varphi E(\delta_t)}{E\left[\frac{Y_t}{K_t}\right]} \tag{3.7}$$

Substituting the value of (1-α) in equation (3.5) we get,

$$\delta_t = E(\delta_t)\frac{\frac{Y_t}{K_t}}{E\left[\frac{Y_t}{K_t}\right]} \tag{3.8}$$

Comparing (3.3) with (3.5) we get,

$$\varphi\delta_t = r_t + \delta_t \tag{3.9}$$

Taking expectation on both sides of the equation (3.9) and solving for φ we get,

$$\varphi = \frac{E(r_t)+E(\delta_t)}{E(\delta_t)} \tag{3.10}$$

Substituting the value of φ in the equation for u_t we get,

$$u_t = \left[\frac{\frac{Y_t}{K_t}}{E\left[\frac{Y_t}{K_t}\right]}\right]^{E(\delta_t)/(E(r_t)+E(\delta_t)} \tag{3.11}$$

Thus, capital utilisation rate is high, when capital productivity is higher than its average.

To estimate labour efforts e_t assuming functional form of $w(e_t)$, from equation (3.4) we get,

$$\frac{\alpha Y_t}{N_t} = ce_t \tag{3.12}$$

Taking expectation on both sides of equation (3.12), we get,

$$\alpha\, E\left[\frac{Y_t}{N_t}\right] = cE(e_t) \tag{3.13}$$

Substituting the value of α in equation (3.12) we get

$$e_t = E(e_t)\ \frac{\frac{Y_t}{N_t}}{E\left[\frac{Y_t}{N_t}\right]} \tag{3.14}$$

Thus, labour effort is high, when labour productivity at t is higher than its average value. The trend values (HP filter) of Y_t/N_t and Y_t/K_t are used for their expected values and applied to the denominator of the equations (3.11) and (3.14).

III.2.2 Computation of New Capital Stocks Series and Effective Labour

The steps involved in the computation of the new capital stocks series are the following. First, from the standard capital stock series, the variable depriciation rate δ_t at time period *t*, is computed using equation (3.8), where $E(\delta_t)$ is δ, which is the average depreciation rate of capital based on capital asset classification (*i.e.*, building and construction, transport equipment or machinery) at industry level as used in KLEMS database. Following KLEMS database, we assume lifetime of 80 years for buildings, 20 years for transport equipment and 25 years for machinery and equipment. In other words, average depreciation rates of building and construction, transport equipment and machinery are considered to be 2.5 per cent, 10 per cent and 8 per cent, respectively. The variable depreciation rate δ_t is applied to compute new capital stock series K_t^N iteratively as follows:

$$K_{t+1}^N = K_t^N(1-\delta_t) + I_{t+1} \tag{3.15}$$

Further, capital utilisation rates are computed using equation (3.11). And finally, the effective capital stock series $\widetilde{\mathrm{K}}_\mathrm{t}$ is obtained by multiplying capital utilisation rate 'u_t' with new capital stock series K_t^N.

Similarly, for computing the new employment series, first, the variable labour effort at time period *t*, e_t is estimated using equation (3.14) with employment data from the India KLEMS database. Then the effective labour is computed by multiplying labour effort with employment as $\tilde{\mathrm{L}}_\mathrm{t}$ =e*L.

III.2.3 Computation of Adjusted TFP

In this paper, we have followed the KLEMS growth accounting methodology for the measurement of TFP and considered real value added as output; and employment, labour quality index, capital stock, and capital composition index as inputs. Based on a partial equilibrium model, new capital input series, utilisation rate of capital, labour efforts are estimated and effective capital stock and effective labour 'e*N' are computed. Labour quality index and capital composition index are taken directly from the KLEMS database for the computation of new TFP series.

First, TFP indices are computed at each industry level. Then, the sector-level aggregates are obtained using Tornqvist aggregate of growth rates of GVA, capital input and labour input (following the same methodology used in the India KLEMS database) to compute TFP at broad sectoral level – agriculture, industry and services, and at the economy-wide level.

Section IV
Empirical Findings

IV.1 Sector-wise Results

Sector-wise summary results are presented in Tables A1 and A2 and detailed industry-level results are given in Table A4 in the Annex. Table A1 presents biases in the traditional Solow TFP estimates for the last four decades, due to measurement errors in capital and labour. It is observed that during 1980s, the standard TFP growth rates were higher than the adjusted TFP growth rates and the biases were positive for all the sectors. However, in 1990s, these biases were negative. In upturn, the standard TFP growth is usually higher than the adjusted TFP growth, and therefore, the TFP growth is overestimated, and *vice-versa*. During the 1990s, the Indian economy witnessed episodes of economic downturn due to the balance of payment (BoP) crisis and the Asian financial crisis, which could have pulled down the capacity utilisation as well as production. However, since the available capital and labour, instead of the utilised capital and labour, were considered for the standard TFP computation, the traditional Solow TFP estimate was low as well as negative for many years.

At the economy-wide level, out of 39 years of TFP growth estimation available in the India KLEMS 2022 database, for 15 years, the traditional TFP growth estimates were near zero or negative. In the case of adjusted

TFP, the number of years of negative TFP growth was 12 and also the TFP numbers, although negative, were not as low. For example, during 2019-20, the unadjusted TFP growth was -2.1 per cent for the overall economy; it was -3.4 per cent, -8.1 per cent and 0.6 per cent for agriculture, manufacturing and services sectors, respectively. In comparison, the adjusted TFP growth for the same period for the whole economy was -0.6 per cent and for agriculture, manufacturing and services sectors, it was 0.8 per cent, -3.4 per cent, and 0.3 per cent, respectively.

The estimates of adjusted and conventional TFP measurements for major sectors - agriculture, manufacturing and services during 1981-1982 to 2019-2020 are presented in Table A2. The following points emerge from Table A2. First, the manufacturing industry as a whole had the lowest TFP growth and the mean TFP growth for the entire period was negative. Further, the average deviation of the standard Solow residual from the adjusted TFP residual was marginally positive for manufacturing, indicating a modest overestimation of the TFP growth. Second, productivity growth in agricultural sector was moderate (and higher than the manufacturing sector). Third, the services sector's TFP growth was the highest among all the sectors and, on an average, the TFP estimates of both the approaches were close.

In the last decade *i.e.,* during 2011-2019, the average adjusted TFP growth estimates were more than the standard TFP growth estimates. Due to this, the adjusted TFP's contribution to GVA growth increased to 14 per cent from 10 per cent in the case of the standard TFP. Further, the contribution to employment growth declined from 18 per cent to 13 per cent (Table A3).

IV.2 Procyclicality of Measured TFP

The standard computation of the Solow residual, as discussed earlier, fails to filter out the cyclical variation in input utilisation rates, assigning these to the fluctuations in technology. Therefore, as expected, the modified TFP series was found to be less volatile than the conventional TFP growth series, as evident from their standard deviations (Table A2). The degree of procyclical adjustment in TFP varied across sectors (as seen by the correlation with value added growth), with the labour-intensive manufacturing and services sectors seeing the most procyclical adjustment. In agriculture, high procyclicality was observed which could be attributed to changes in labour utilisation in high /

low productive years on account of weather shocks. Among the manufacturing sectors, textile and wood products reported the highest procyclical adjustment. Among the services sectors, construction, hotels, business services, education and health care sectors witnessed more TFP adjustments. For the economy as a whole, the procyclicality of the adjusted TFP was lower, with the correlation of the adjusted TFP growth with value added growth reducing from 0.88 to 0.75. Sector-wise, the correlation of the adjusted TFP growth with the respective value added growth rate reduced from 0.95 to 0.91 for agriculture, from 0.91 to 0.85 for manufacturing and from 0.63 to 0.50 for the services sector. Although the new adjusted TFP indices reduced procyclicality, they could not fully eliminate it due to other factors, such as imperfect competition, scale economies or procyclical TFP shocks.

IV.3 Implications

IV.3.1 GVA Growth - Major Factors

In recent years, India's growth is mainly driven by factor accumulation. Capital accumulation has played a significant role in driving GVA growth and it is estimated to have contributed between 44 per cent and 64 per cent, while employment growth has contributed only about 20 per cent of GVA growth during the last four decades (Table A3). Further, it may be observed that the contribution of employment growth is declining, and that of capital accumulation is rising over time. The contribution of TFP growth to GVA growth declined in the 2000s, with some recovery in the 2010s. On average, the TFP contributed around 8 to 9 per cent (standard / adjusted TFP growth) to growth during 2001-2019.

IV.3.2 Policy Measures to Increase TFP Growth

The TFP growth could be enhanced by reducing the dependency ratio - the ratio of the number of people from the non-working age to the number of working age population. According to Roy (2022), the reduction in the dependency ratio by one percentage point could increase TFP in the range of 0.33 per cent to 0.40 per cent. Measures to reduce the fertility rate by improving the access and quality of family planning services, and promoting female education can also help in enhancing TFP growth. The labour force participation rates need to be increased by enhancing the skills and employability, especially among youth and women.

Furthermore, financial development can support domestic investment (Malik *et al*., 2021). Sector-specific policies aimed at agriculture and food processing, manufacturing, retail trade and healthcare can also be instrumental in stepping up TFP growth (Sankhe *et al*., 2020). Some of the possible measures suggested by Sankhe *et al.* (2020) relate to development of manufacturing clusters near ports, free-trade warehousing zones, enhanced investment in e-commerce and trade sectors, improving medical tourism, among others.

A business-friendly environment can support a shift of labour from agriculture to industrial and services sectors (Kotera and Xu, 2023). Finally, investment in long-term infrastructural development, such as highways, ports and dedicated freight corridors can also help in a sustained increase in TFP growth.

Section V
Summary and Way Forward

An economy may be hit with TFP shocks due to various factors, including technological innovations, changes in the quality of inputs (embodied technological progress), variations in technical efficiency and allocative efficiency, economies of scale, weather shocks and changes in the policy framework. Ideally, the growth accounting technique should yield an estimate of TFP growth that is exogenous to the rate of output growth. However, due to deviations from the assumptions of perfect competition, constant return to scale and full capacity utilisation, the traditional measures of productivity may be procyclical.

This paper attempted to generate TFP estimates, while controlling for the variations in capacity utilisation rates of key factors (capital and labour) over the business cycle, using a partial equilibrium model allowing for factor hoarding. The model was tested on India KLEMS 2022 database for the period 1981-82 to 2019-20. The measured TFP growth was found to be less procyclical and the correlation between TFP growth and value added growth for the economy reduced from 0.88 to 0.75.

The TFP deviations were more in labour-intensive sectors. Capital accumulation has been the major driver of India's economic growth and its role has been increasing. The contribution of TFP growth, which fell during the 2000s, has shown signs of improvement during the 2010s. A further sustained increase in productivity growth would be necessary to boost India's potential growth and medium-term growth prospects.

Future research can be aimed at improving upon the TFP measures developed in this paper. In particular, an attempt can be made to further reduce the possible biases resulting from the presence of imperfect competition and scale economies, which may require consistent and reliable estimates of the mark-up and the returns to scale parameter.

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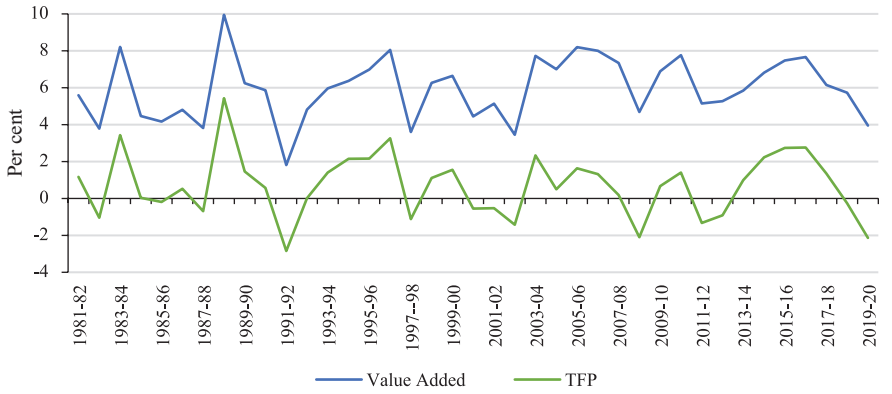
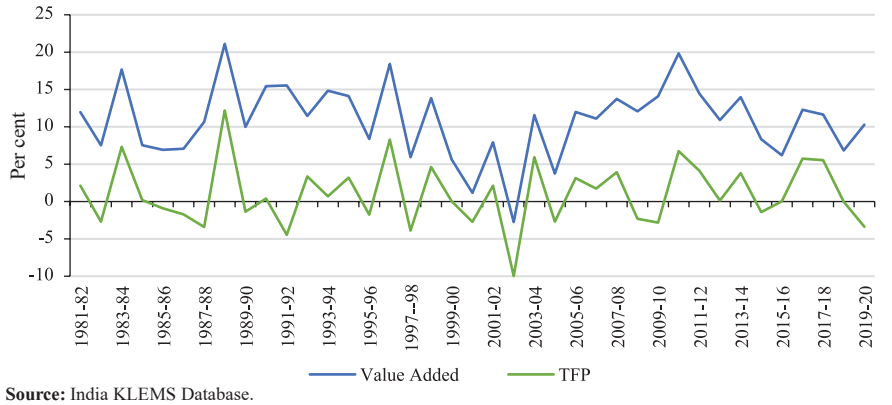
Annex

Chart A1. Growth Rates of Value Added and TFP: Whole Economy



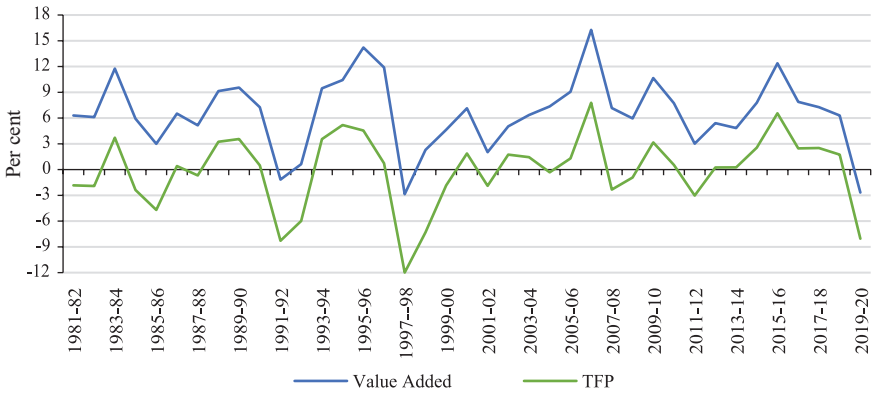
Source: India KLEMS Database.

Chart A2. Growth Rates of Value Added and TFP: Agriculture and Allied Activities



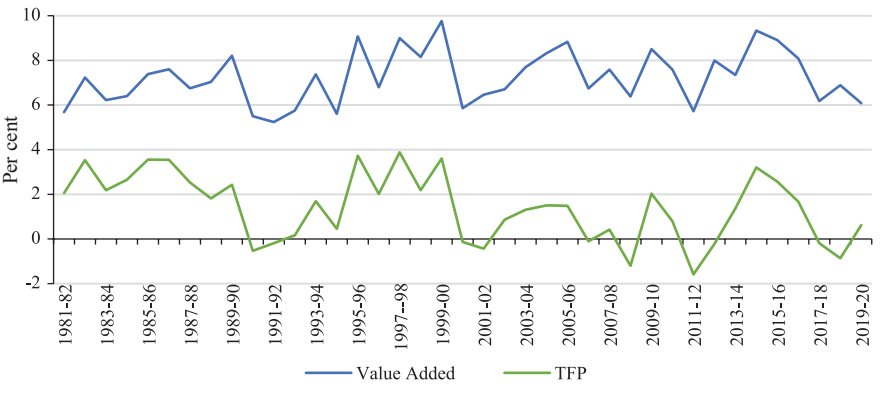
Source: India KLEMS Database.

Chart A3. Growth Rates of Value Added and TFP: Manufacturing



Source: India KLEMS Database.

Chart A4. Growth Rates of Value Added and TFP: Services



Source: India KLEMS Database.

Table A1. Differences in TFP Measurement for Major Sectors During the Last Four Decades *(Contd.)*

Year	Agriculture			Manufacturing		
	Standard TFPG	Adjusted TFPG	Diff (1)-(2)	Standard TFPG	Adjusted TFPG	Diff (4)-(5)
	(1)	(2)	(3)	(4)	(5)	(6)
1981-1990	1. 20	1. 10	0. 10	0. 00	-0. 60	0. 60
1991-2000	0. 70	0. 80	-0. 10	-2. 00	-1. 50	-0. 50
2001-2010	0. 60	0. 30	0. 30	1. 10	0. 30	0. 80
2011-2019	1. 60	2. 20	-0. 60	0. 60	0. 80	-0. 20

Table A1. Differences in TFP Measurement for Major Sectors During the Last Four Decades *(Concld.)*

Year	Services			Economy		
	Standard TFPG	Adjusted TFPG	Diff (7)-(8)	Standard TFPG	Adjusted TFPG	Diff (10)-(11)
	(7)	(8)	(9)	(10)	(11)	(12)
1981-1990	2. 40	2. 00	0. 40	1. 10	0. 70	0. 40
1991-2000	1. 70	1. 60	0. 10	0. 70	0. 80	-0. 10
2001-2010	0. 70	0. 70	0. 00	0. 40	0. 30	0. 10
2011-2019	0. 70	1. 00	-0. 30	0. 60	0. 80	-0. 20

Source: Standard TFP growth from the India KLEMS database and Adjusted TFPG from author's computation.

Table A2. Differences in Adjusted TFP Growth for Major Sectors During 1981-82 to 2019-20 *(Contd.)*

Year	Agriculture				Manufacturing			
	VA_g	TFPG	Adj_ TFPG	Diff (2)-(3)	VA_g	TFPG	Adj_ TFPG	Diff (6)-(7)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1981-82	4.50	2.12	1.17	0.95	6.30	-1.84	-2.45	0.62
1982-83	-0.28	-2.70	-1.50	-1.19	6.11	-1.92	-1.99	0.08
1983-84	9.64	7.32	4.69	2.62	11.76	3.71	4.50	-0.79
1984-85	1.57	0.19	0.35	-0.17	5.92	-2.37	-3.42	1.04
1985-86	0.31	-0.91	0.33	-1.24	3.00	-4.70	-3.99	-0.71
1986-87	-0.41	-1.72	-1.12	-0.60	6.51	0.40	0.35	0.05
1987-88	-1.60	-3.41	-2.26	-1.14	5.15	-0.68	-1.25	0.57
1988-89	14.53	12.19	6.66	5.54	9.14	3.24	0.73	2.51
1989-90	1.18	-1.36	0.28	-1.64	9.55	3.56	0.76	2.80
1990-91	3.94	0.40	2.08	-1.69	7.26	0.49	0.77	-0.28
1991-92	-1.97	-4.45	-2.75	-1.71	-1.17	-8.29	-5.41	-2.88
1992-93	6.44	3.35	1.81	1.55	0.62	-5.99	-4.65	-1.34
1993-94	3.27	0.70	0.17	0.53	9.46	3.55	1.86	1.69
1994-95	4.61	3.20	2.16	1.03	10.43	5.19	3.29	1.91
1995-96	-0.70	-1.76	-0.70	-1.06	14.25	4.58	4.51	0.07
1996-97	9.46	8.29	5.58	2.71	11.89	0.73	1.63	-0.90
1997-98	-2.59	-3.90	-1.74	-2.16	-2.89	-12.02	-9.49	-2.53
1998-99	6.13	4.62	3.37	1.25	2.28	-7.33	-3.68	-3.64
1999-00	2.63	0.03	-0.35	0.37	4.63	-1.86	-4.31	2.45
2000-01	-0.01	-2.72	0.25	-2.97	7.15	1.88	1.73	0.15
2001-02	5.83	2.12	0.28	1.83	2.03	-1.89	-1.31	-0.58
2002-03	-6.83	-9.97	-5.09	-4.87	5.04	1.74	0.58	1.16
2003-04	8.66	5.93	3.48	2.45	6.36	1.44	-0.53	1.97
2004-05	0.18	-2.69	-3.29	0.60	7.36	-0.31	-1.04	0.73
2005-06	4.70	3.14	1.62	1.52	9.07	1.30	2.03	-0.73
2006-07	2.90	1.73	1.00	0.73	16.28	7.79	4.27	3.52
2007-08	5.36	3.93	3.32	0.60	7.17	-2.33	0.53	-2.86
2008-09	-0.24	-2.31	-0.27	-2.05	5.96	-0.93	-1.82	0.89
2009-10	-0.88	-2.82	-1.20	-1.62	10.66	3.17	2.65	0.52
2010-11	8.43	6.75	3.37	3.38	7.73	0.55	-1.87	2.42
2011-12	6.20	4.12	3.46	0.66	2.99	-3.05	-4.50	1.45
2012-13	1.48	0.13	1.94	-1.82	5.40	0.23	2.42	-2.19
2013-14	5.42	3.80	3.04	0.76	4.83	0.24	-0.24	0.49
2014-15	-0.22	-1.42	-0.10	-1.31	7.78	2.56	2.49	0.07
2015-16	0.65	0.03	0.60	-0.57	12.40	6.58	7.42	-0.84
2016-17	6.58	5.74	3.10	2.64	7.88	2.47	3.04	-0.57
2017-18	6.40	5.55	4.79	0.76	7.27	2.51	1.88	0.64
2018-19	2.07	-0.03	1.92	-1.95	6.30	1.74	-2.04	3.78
2019-20	5.37	-3.37	0.80	-4.17	-2.68	-8.05	-3.41	-4.64
Mean	**3.15**	**1.02**	**1.06**	**-0.04**	**6.59**	**-0.10**	**-0.26**	**0.16**
Std Dev	**4.15**	**4.26**	**2.50**	**2.11**	**4.17**	**4.20**	**3.36**	**1.90**
Corr: VA_g and TFPG		**0.95**	**0.91**			**0.91**	**0.85**	

Table A2. Differences in Adjusted TFP Growth for Major Sectors During 1981-82 to 2019-20 *(Concld.)*

Year	Services				Economy			
	VA_g	TFPG	Adj_ TFPG	Diff (10)-(11)	VA_g	TFPG	Adj_ TFPG	Diff (14)-(15)
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1981-82	5.68	2.06	0.86	1.20	5.59	1.17	0.30	0.86
1982-83	7.23	3.53	1.49	2.04	3.79	-1.04	-1.21	0.16
1983-84	6.22	2.18	2.03	0.16	8.21	3.43	2.54	0.89
1984-85	6.40	2.65	2.55	0.10	4.46	0.03	0.08	-0.05
1985-86	7.39	3.55	2.83	0.72	4.17	-0.19	0.10	-0.29
1986-87	7.60	3.54	3.03	0.51	4.80	0.53	0.25	0.28
1987-88	6.75	2.53	2.68	-0.15	3.82	-0.69	-0.33	-0.36
1988-89	7.03	1.82	2.30	-0.48	9.95	5.43	3.16	2.27
1989-90	8.21	2.43	2.19	0.24	6.25	1.46	1.15	0.31
1990-91	5.50	-0.53	0.45	-0.98	5.86	0.57	1.14	-0.56
1991-92	5.24	-0.19	0.52	-0.71	1.81	-2.84	-0.84	-2.00
1992-93	5.75	0.16	0.06	0.11	4.81	0.01	-0.55	0.56
1993-94	7.37	1.69	0.93	0.76	5.96	1.40	0.73	0.67
1994-95	5.61	0.45	0.56	-0.10	6.37	2.15	1.50	0.65
1995-96	9.08	3.73	2.25	1.48	6.99	2.16	1.52	0.63
1996-97	6.79	2.02	2.17	-0.15	8.05	3.26	2.97	0.29
1997-98	9.00	3.88	3.21	0.67	3.60	-1.12	-0.44	-0.68
1998-99	8.15	2.19	2.18	0.01	6.26	1.11	1.24	-0.13
1999-00	9.76	3.60	2.97	0.63	6.65	1.56	0.59	0.96
2000-01	5.86	-0.13	1.39	-1.52	4.44	-0.55	1.34	-1.89
2001-02	6.46	-0.43	0.30	-0.73	5.13	-0.53	-0.74	0.21
2002-03	6.71	0.86	0.64	0.23	3.45	-1.42	-0.30	-1.12
2003-04	7.69	1.31	0.88	0.43	7.73	2.33	1.32	1.01
2004-05	8.32	1.50	0.95	0.56	7.00	0.50	-0.54	1.04
2005-06	8.83	1.49	1.22	0.27	8.20	1.63	1.45	0.18
2006-07	6.74	-0.10	0.67	-0.78	8.00	1.32	1.18	0.14
2007-08	7.58	0.42	0.65	-0.23	7.34	0.19	0.76	-0.57
2008-09	6.38	-1.20	-0.68	-0.52	4.69	-2.10	-1.29	-0.81
2009-10	8.51	2.03	1.33	0.70	6.89	0.67	0.82	-0.15
2010-11	7.58	0.79	0.94	-0.15	7.77	1.40	0.22	1.19
2011-12	5.72	-1.58	-0.71	-0.87	5.15	-1.32	-1.39	0.07
2012-13	7.99	-0.21	0.46	-0.68	5.27	-0.91	0.29	-1.20
2013-14	7.34	1.37	1.22	0.15	5.85	1.00	0.52	0.47
2014-15	9.33	3.21	1.54	1.67	6.82	2.23	1.26	0.97
2015-16	8.91	2.57	2.45	0.13	7.48	2.74	2.99	-0.25
2016-17	8.08	1.68	1.89	-0.21	7.66	2.77	2.32	0.45
2017-18	6.18	-0.18	2.28	-2.46	6.15	1.36	2.46	-1.10
2018-19	6.89	-0.86	-0.35	-0.51	5.73	-0.26	-0.21	-0.04
2019-20	6.08	0.62	0.26	0.36	3.95	-2.13	-0.60	-1.53
Mean	**7.23**	**1.40**	**1.35**	**0.05**	**5.95**	**0.70**	**0.66**	**0.04**
Std Dev	**1.19**	**1.51**	**1.05**	**0.85**	**1.69**	**1.72**	**1.22**	**0.89**
Corr: VA_g and TFPG		**0.63**	**0.50**			**0.88**	**0.75**	

Source: Growth rate of real value added (VA_g) and standard TFP growth (TFPG) from the India KLEMS database and Adjusted TFPG (Adj_TFPG) from author's computation.

Table A3. Growth Accounting of GVA Growth - Last Four Decades

Year	India KLEMS Database				Adjusted TFP			
	1981-1990	1991-2000	2001-2010	2011-2019	1981-1990	1991-2000	2001-2010	2011-2019
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Contribution to Employment Growth	29	23	21	18	32	22	22	13
Contribution to Labour Quality Growth	6	4	5	3	6	4	5	3
Contribution to Capital Accumulation Growth	44	56	65	63	48	56	65	64
Contribution to Capital Composition	2	3	4	6	2	3	4	6
Contribution to TFP Growth	19	13	6	10	13	15	4	14
	100	100	100	100	100	100	100	100

Source: Author's computation based on the India KLEMS database.

Table A4. Differences in Adjusted TFP Growth for Various Industries in India - 1981-82 to 2019-20 *(Contd.)*

Year	Agriculture				Mining and Quarrying				Food Products, Beverages & Tobacco			
	VA_g	TFPG	Adj_ TFPG	Diff (2) - (3)	VA_g	TFPG	Adj_ TFPG	Diff (6) - (7)	VA_g	TFPG	Adj_ TFPG	Diff (10)-(11)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1981-82	4.5	2.1	1.2	0.9	12.8	1.4	0.1	1.3	16.7	11.0	5.0	6.0
1982-83	-0.3	-2.7	-1.5	-1.2	11.2	-9.8	-7.6	-2.2	15.1	10.7	3.4	7.4
1983-84	9.6	7.3	4.7	2.6	2.9	-11.5	-9.3	-2.2	19.7	15.0	20.9	-5.9
1984-85	1.6	0.2	0.4	-0.2	1.2	-9.7	-9.2	-0.5	-3.2	-7.9	-4.2	-3.7
1985-86	0.3	-0.9	0.3	-1.2	5.3	-5.5	-3.8	-1.7	0.0	-4.7	-2.4	-2.2
1986-87	-0.4	-1.7	-1.1	-0.6	11.6	2.2	1.4	0.9	4.0	-0.5	-0.3	-0.2
1987-88	-1.6	-3.4	-2.3	-1.1	3.7	-4.1	-3.5	-0.6	4.4	1.1	-3.0	4.1
1988-89	14.5	12.2	6.7	5.5	15.0	9.2	8.8	0.4	25.3	18.6	13.0	5.6
1989-90	1.2	-1.4	0.3	-1.6	7.3	-0.5	-0.2	-0.3	7.6	-0.3	1.6	-1.9
1990-91	3.9	0.4	2.1	-1.7	10.0	3.6	3.6	0.0	-7.3	-13.1	-6.1	-7.0
1991-92	-2.0	-4.5	-2.7	-1.7	3.3	-0.7	-0.9	0.2	0.5	-4.7	-4.3	-0.4
1992-93	6.4	3.4	1.8	1.5	0.9	-1.9	-0.9	-0.9	1.6	-3.8	-8.2	4.4
1993-94	3.3	0.7	0.2	0.5	1.4	-2.0	-2.0	-0.1	15.4	10.9	8.3	2.6
1994-95	4.6	3.2	2.2	1.0	8.9	-4.4	-4.6	0.2	13.7	8.6	8.3	0.3
1995-96	-0.7	-1.8	-0.7	-1.1	5.7	3.6	2.3	1.3	0.4	-7.4	-6.1	-1.3
1996-97	9.5	8.3	5.6	2.7	0.6	2.3	4.0	-1.7	3.7	-2.1	-2.8	0.7
1997-98	-2.6	-3.9	-1.7	-2.2	9.4	10.3	9.2	1.0	13.0	7.5	7.7	-0.2
1998-99	6.1	4.6	3.4	1.3	2.8	3.8	4.9	-1.1	1.6	-1.5	-0.4	-1.1
1999-00	2.6	0.0	-0.3	0.4	4.1	2.7	1.9	0.8	3.4	-4.5	-4.0	-0.5
2000-01	0.0	-2.7	0.2	-3.0	2.3	2.6	2.5	0.1	7.9	3.1	1.1	2.0
2001-02	5.8	2.1	0.3	1.8	1.8	1.9	2.8	-0.9	-0.3	-1.6	-1.0	-0.6
2002-03	-6.8	-10.0	-5.1	-4.9	8.1	7.5	5.5	2.0	12.6	9.3	4.1	5.1
2003-04	8.7	5.9	3.5	2.5	2.7	3.2	3.1	0.0	3.3	-0.9	-0.5	-0.4
2004-05	0.2	-2.7	-3.3	0.6	7.6	-2.3	-1.2	-1.1	3.0	-3.3	-1.4	-2.0
2005-06	4.7	3.1	1.6	1.5	5.9	-4.4	-3.2	-1.2	11.2	7.2	7.2	0.0
2006-07	2.9	1.7	1.0	0.7	4.6	-7.8	-7.3	-0.4	27.6	18.9	9.6	9.3
2007-08	5.4	3.9	3.3	0.6	4.5	-7.6	-8.0	0.4	3.2	-5.1	-0.2	-4.8
2008-09	-0.2	-2.3	-0.3	-2.0	-2.5	-12.2	-9.9	-2.4	3.7	-0.2	2.3	-2.5
2009-10	-0.9	-2.8	-1.2	-1.6	5.8	-1.8	0.5	-2.3	4.4	-1.0	-2.0	1.0
2010-11	8.4	6.8	3.4	3.4	12.6	3.6	0.4	3.2	-11.5	-18.1	-11.1	-7.0
2011-12	6.2	4.1	3.5	0.7	-19.3	-27.0	-21.2	-5.9	15.7	9.9	4.4	5.5
2012-13	1.5	0.1	1.9	-1.8	0.6	-5.7	-6.9	1.2	-8.1	-11.4	-5.9	-5.5
2013-14	5.4	3.8	3.0	0.8	0.2	-12.5	-14.9	2.4	-0.6	-2.6	-7.1	4.6
2014-15	-0.2	-1.4	-0.1	-1.3	9.3	8.4	7.3	1.1	2.6	-0.4	-2.8	2.4
2015-16	0.6	0.0	0.6	-0.6	9.7	11.0	9.6	1.4	15.0	12.3	15.1	-2.8
2016-17	6.6	5.7	3.1	2.6	9.4	9.1	5.4	3.7	10.3	8.0	5.8	2.3
2017-18	6.4	5.5	4.8	0.8	-5.8	-7.5	0.7	-8.2	5.5	1.9	2.6	-0.7
2018-19	2.1	0.0	1.9	-2.0	-0.9	-4.8	-2.1	-2.8	18.8	14.9	10.3	4.6
2019-20	5.4	-3.4	0.8	-4.2	-1.6	1.4	-5.0	6.4	-4.2	-8.3	-2.5	-5.8
Mean	**3.1**	**1.0**	**1.1**	**-0.0**	**4.4**	**-1.4**	**-1.2**	**-0.2**	**6.5**	**1.7**	**1.4**	**0.3**
Std Dev	**4.1**	**4.3**	**2.5**	**2.1**	**6.1**	**7.7**	**6.6**		**8.9**	**8.8**	**6.8**	
Corr: VA_g and TFPG		**0.95**	**0.91**			**0.69**	**0.61**			**0.98**	**0.88**	

Table A4. Differences in Adjusted TFP Growth for Various Industries in India - 1981-82 to 2019-20 *(Contd.)*

Year	Textiles & Leather				Wood & Wood Products				Paper & Paper Products			
	VA_g	TFPG	Adj_ TFPG	Diff (14)-(15)	VA_g	TFPG	Adj_ TFPG	Diff (18)-(19)	VA_g	TFPG	Adj_ TFPG	Diff (22)-(23)
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1981-82	-2.6	-8.8	-7.1	-1.7	1.5	-9.7	-8.8	-1.0	8.2	-1.5	0.7	-2.2
1982-83	-0.5	-8.4	-7.4	-1.1	-12.0	-18.8	-14.1	-4.8	-7.7	-14.7	-9.5	-5.2
1983-84	10.1	3.5	2.3	1.2	7.1	-2.9	-7.1	4.2	14.4	7.2	7.6	-0.3
1984-85	2.1	-3.9	-3.9	-0.0	-14.1	-18.9	-16.6	-2.3	15.9	5.9	5.2	0.7
1985-86	7.3	1.9	-3.1	4.9	3.3	-1.0	1.1	-2.1	-2.9	-12.1	-9.1	-3.1
1986-87	7.1	3.0	4.3	-1.3	-2.8	-5.4	-5.5	0.1	17.9	9.6	8.4	1.2
1987-88	-4.0	-8.4	-5.2	-3.3	1.5	0.1	-3.0	3.1	-0.9	-6.3	-1.0	-5.3
1988-89	1.3	-1.1	-3.4	2.3	-11.9	-16.9	-15.6	-1.2	10.4	3.7	0.6	3.1
1989-90	16.8	13.4	5.0	8.3	5.0	0.2	-4.2	4.4	18.8	11.9	8.3	3.7
1990-91	8.2	3.3	5.6	-2.3	0.3	-2.5	-7.3	4.9	6.6	1.7	2.6	-0.9
1991-92	-2.9	-7.4	-1.2	-6.2	-6.1	-7.4	-6.3	-1.1	4.6	2.5	2.6	-0.1
1992-93	0.8	-3.8	-4.0	0.2	-11.1	-13.1	-7.2	-5.9	-23.8	-26.1	-13.4	-12.7
1993-94	23.9	18.3	11.6	6.7	2.7	-0.6	-6.7	6.1	16.6	14.1	5.8	8.3
1994-95	5.3	-1.8	0.1	-1.9	-0.5	-5.0	-7.4	2.5	10.1	3.8	-1.5	5.3
1995-96	-8.4	-18.1	-8.0	-10.2	18.0	6.7	4.1	2.6	5.3	0.9	4.2	-3.3
1996-97	20.1	11.5	6.0	5.6	11.7	2.2	-1.0	3.2	1.8	-2.4	-2.4	0.0
1997-98	5.2	-4.5	-6.1	1.6	-12.9	-22.0	-12.4	-9.6	-13.1	-17.9	-13.8	-4.0
1998-99	-6.8	-11.6	-3.5	-8.1	-1.1	-12.0	-12.4	0.4	4.6	0.7	0.3	0.4
1999-00	5.7	-1.1	-4.0	2.9	-14.8	-24.3	-21.3	-3.0	-1.8	-4.8	-4.7	-0.2
2000-01	9.1	4.1	2.7	1.4	6.2	-4.3	-4.6	0.3	-8.4	-12.3	-8.0	-4.3
2001-02	-2.1	-4.5	-2.3	-2.2	-14.3	-18.4	-17.0	-1.4	3.8	-1.7	-7.0	5.3
2002-03	6.5	0.9	0.4	0.6	-16.7	-22.9	-17.5	-5.5	7.1	1.6	-1.8	3.4
2003-04	-1.7	-8.3	-6.1	-2.1	3.8	-2.9	-8.3	5.4	14.7	10.3	2.7	7.6
2004-05	10.8	1.0	-1.7	2.7	-9.2	-16.3	-14.7	-1.5	9.6	4.0	1.3	2.7
2005-06	15.2	9.5	3.0	6.5	21.6	21.0	7.1	14.0	16.4	13.5	12.2	1.3
2006-07	17.7	8.5	3.9	4.6	8.5	5.4	4.1	1.3	13.6	9.7	6.2	3.5
2007-08	-3.0	-10.1	0.4	-10.5	-11.1	-14.1	-2.4	-11.7	15.9	11.8	8.9	2.9
2008-09	12.3	10.9	5.8	5.1	9.5	9.7	2.5	7.2	-5.8	-7.7	-3.8	-4.0
2009-10	13.0	9.8	6.4	3.4	7.3	4.8	2.9	1.9	4.8	2.8	3.4	-0.6
2010-11	6.4	1.2	0.8	0.4	8.9	5.0	1.9	3.1	26.3	24.8	16.5	8.3
2011-12	1.3	-0.7	0.2	-0.9	10.9	10.3	12.0	-1.6	-4.8	-5.4	-4.5	-0.9
2012-13	14.6	12.1	12.7	-0.5	-2.1	-1.7	2.2	-3.8	-11.5	-13.3	-5.0	-8.3
2013-14	19.9	17.9	7.6	10.3	-14.8	-13.4	-6.1	-7.3	-1.4	-2.8	-1.8	-1.0
2014-15	0.0	0.1	5.7	-5.7	29.3	30.1	20.1	10.0	14.3	12.5	4.3	8.2
2015-16	17.9	15.2	13.9	1.3	9.7	9.4	10.5	-1.0	11.8	10.6	14.4	-3.9
2016-17	0.8	-1.3	0.7	-2.0	9.8	9.5	9.4	0.2	5.2	4.9	4.1	0.8
2017-18	7.3	4.5	4.4	0.1	-2.2	-3.9	2.2	-6.0	12.7	10.5	8.6	1.9
2018-19	6.6	8.8	4.8	4.0	15.5	15.7	9.0	6.7	9.2	6.0	2.1	3.9
2019-20	-2.1	-2.3	0.9	-3.1	7.0	3.9	6.3	-2.5	-3.2	-2.4	0.1	-2.5
Mean	**6.1**	**1.4**	**1.1**	**0.3**	**1.1**	**-3.2**	**-3.4**	**0.2**	**5.5**	**1.4**	**1.1**	**0.3**
Std Dev	**8.1**	**8.6**	**5.5**		**11.2**	**12.4**	**9.4**		**10.4**	**10.2**	**7.0**	
Corr: VA_g and TFPG		**0.94**	**0.77**			**0.95**	**0.84**			**0.97**	**0.88**	

Table A4. Differences in Adjusted TFP Growth for Various Industries in India - 1981-82 to 2019-20 *(Contd.)*

Year	Petroleum Products				Chemicals & Chemical Products				Rubber & Plastic Products			
	VA_g	TFPG	Adj_ TFPG	Diff (26)-(27)	VA_g	TFPG	Adj_ TFPG	Diff (30)-(31)	VA_g	TFPG	Adj_ TFPG	Diff (34)-(35)
	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
1981-82	-3.2	-50.8	-36.4	-14.3	16.9	15.9	6.9	9.0	-10.6	-25.1	-15.0	-10.1
1982-83	43.0	14.4	11.0	3.4	3.4	2.2	2.9	-0.7	24.9	8.7	5.3	3.4
1983-84	7.0	-17.5	-10.7	-6.9	20.8	17.0	14.9	2.1	0.6	-23.8	-22.4	-1.4
1984-85	16.3	-4.6	-2.8	-1.9	4.0	0.4	-3.1	3.5	4.0	-14.6	-11.0	-3.6
1985-86	2.7	-9.1	-8.8	-0.3	4.1	0.5	0.3	0.1	-4.8	-17.6	-9.1	-8.5
1986-87	32.4	23.7	20.4	3.4	1.7	-4.3	-4.3	-0.1	51.5	40.6	31.7	8.9
1987-88	16.7	12.2	8.8	3.4	9.4	4.5	5.4	-0.9	-0.9	-11.8	-13.1	1.3
1988-89	12.1	4.6	-2.0	6.6	13.2	8.5	5.4	3.1	28.9	19.3	14.3	5.0
1989-90	11.6	5.5	3.4	2.1	16.9	10.8	6.8	4.0	-5.6	-14.2	-15.4	1.2
1990-91	11.6	0.3	-7.4	7.7	10.0	4.4	4.5	-0.1	30.7	17.9	13.7	4.2
1991-92	-3.2	-15.7	-10.5	-5.2	2.5	-3.1	-0.4	-2.7	6.0	-13.0	-13.5	0.5
1992-93	4.1	-5.0	5.5	-10.5	16.3	11.3	11.1	0.2	7.0	-5.3	1.8	-7.1
1993-94	11.2	3.4	-1.8	5.2	7.2	1.8	2.9	-1.2	11.7	-3.4	-3.4	-0.0
1994-95	5.8	4.4	-0.4	4.8	4.0	0.9	0.8	0.1	-2.9	-9.8	-8.9	-0.9
1995-96	15.9	11.9	4.4	7.5	24.1	11.5	10.0	1.5	3.7	-15.1	-8.1	-7.0
1996-97	23.4	7.3	8.8	-1.5	10.5	1.9	0.8	1.0	41.4	3.0	-0.6	3.7
1997-98	-17.2	-27.2	-20.6	-6.6	-4.8	-19.0	-15.1	-3.9	-1.2	-8.5	-8.0	-0.5
1998-99	-2.1	-48.8	-36.1	-12.7	17.3	11.7	13.5	-1.8	5.5	2.9	-0.2	3.1
1999-00	-8.2	-27.6	-28.8	1.2	1.2	-4.5	-4.7	0.2	5.8	1.8	-0.1	1.8
2000-01	3.9	-10.4	-13.4	3.1	8.1	4.5	3.4	1.0	38.5	36.4	33.5	3.0
2001-02	12.1	-23.2	-16.1	-7.1	5.5	5.6	4.9	0.7	9.5	10.8	8.5	2.2
2002-03	18.7	14.3	13.3	1.0	4.1	3.2	2.6	0.6	-38.0	-38.7	-28.9	-9.8
2003-04	6.3	2.4	-1.0	3.5	7.7	6.9	4.1	2.8	-5.8	-10.2	-11.6	1.4
2004-05	1.0	-0.5	-4.0	3.6	13.8	10.6	6.4	4.2	7.4	-3.8	-6.4	2.6
2005-06	-10.0	-25.2	-12.4	-12.7	5.3	-1.2	0.8	-2.0	-26.8	-31.2	-16.3	-14.9
2006-07	11.8	9.3	1.3	8.0	11.2	3.4	3.0	0.4	9.1	1.3	-3.0	4.3
2007-08	25.2	22.6	8.1	14.5	7.6	0.5	2.1	-1.5	28.2	18.7	9.8	8.8
2008-09	-10.3	-14.5	-11.9	-2.6	-8.5	-16.3	-8.8	-7.5	28.5	21.2	17.3	3.9
2009-10	8.3	-9.1	-14.9	5.8	5.9	2.9	7.2	-4.3	28.7	19.8	9.8	10.0
2010-11	8.4	4.0	-0.9	4.9	5.1	0.8	-6.1	6.8	23.4	13.7	12.8	0.8
2011-12	-33.4	-42.9	-48.1	5.2	11.4	6.2	3.3	2.9	-21.9	-29.8	-27.2	-2.5
2012-13	55.0	53.1	50.6	2.5	-6.7	-13.5	-9.5	-4.0	-6.5	-9.4	-8.8	-0.7
2013-14	4.8	-11.1	-4.1	-7.0	3.2	-1.7	-1.6	-0.1	26.2	23.8	22.9	0.9
2014-15	37.8	17.3	25.0	-7.7	4.1	-1.3	-2.8	1.5	4.7	1.5	-2.8	4.2
2015-16	15.2	-4.4	9.3	-13.7	7.7	-0.7	-1.2	0.5	24.9	20.1	19.3	0.8
2016-17	-8.8	-24.7	-20.8	-3.8	10.5	0.0	4.8	-4.8	14.0	8.2	8.3	-0.1
2017-18	0.7	-8.5	-9.0	0.6	3.5	-2.9	-2.9	-0.0	-0.5	-7.1	-4.0	-3.1
2018-19	-38.3	-44.5	-50.2	5.7	13.4	6.6	0.4	6.2	10.6	0.6	-2.1	2.8
2019-20	-18.0	-26.7	-24.2	-2.6	1.9	-6.2	-0.4	-5.9	-2.4	-9.9	-4.5	-5.4
Mean	**6.9**	**-6.2**	**-5.8**	**-0.3**	**7.5**	**2.0**	**1.8**	**0.3**	**8.9**	**-0.8**	**-0.9**	**0.1**
Std Dev	**18.3**	**21.6**	**19.3**		**6.9**	**7.7**	**6.1**		**18.6**	**18.2**	**14.6**	
Corr: VA_g and TFPG		**0.85**	**0.90**			**0.92**	**0.86**			**0.92**	**0.88**	

Table A4. Differences in Adjusted TFP Growth for Various Industries in India - 1981-82 to 2019-20 *(Contd.)*

Year	Other Non-Metallic Mineral Products				Basic Metals & Metal Products				Machinery, nec.			
	VA_g	TFPG	Adj_ TFPG	Diff (38)-(39)	VA_g	TFPG	Adj_ TFPG	Diff (42)-(43)	VA_g	TFPG	Adj_ TFPG	Diff (46)-(47)
	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)	(46)	(47)	(48)
1981-82	7.6	-2.7	-4.1	1.3	7.4	0.4	-0.7	1.1	5.3	-3.6	-3.3	-0.3
1982-83	18.8	6.9	3.8	3.1	0.3	-7.3	-6.9	-0.4	4.0	-6.8	-4.7	-2.0
1983-84	11.7	-1.9	-1.4	-0.5	7.4	2.1	5.7	-3.5	15.3	5.9	4.6	1.2
1984-85	19.7	7.6	2.1	5.5	1.6	-6.4	-10.9	4.5	17.9	9.1	5.1	4.0
1985-86	5.3	-8.4	-5.7	-2.7	5.1	-1.9	-0.6	-1.4	5.7	-4.7	-4.0	-0.7
1986-87	-3.0	-15.7	-11.4	-4.3	-6.4	-10.9	-11.2	0.3	0.3	-3.9	-3.5	-0.4
1987-88	11.7	-0.5	-1.3	0.9	11.1	3.7	2.1	1.7	9.6	6.6	5.1	1.6
1988-89	9.0	-0.2	-2.7	2.4	17.6	13.5	10.3	3.3	-4.2	-10.9	-7.1	-3.8
1989-90	17.0	10.6	7.3	3.3	-4.4	-9.1	-9.7	0.6	15.0	5.4	2.4	3.0
1990-91	11.2	6.6	6.0	0.6	12.8	4.7	4.7	-0.0	-1.7	-11.0	-10.4	-0.6
1991-92	5.1	1.5	0.8	0.8	3.4	-7.5	-6.7	-0.9	-9.1	-17.0	-13.8	-3.3
1992-93	-15.3	-22.1	-17.3	-4.9	-5.3	-13.1	-11.0	-2.1	9.6	-0.5	-2.3	1.8
1993-94	-1.8	-8.0	-5.7	-2.3	3.0	-2.5	1.1	-3.7	-3.4	-8.4	-6.3	-2.1
1994-95	10.7	4.9	1.9	3.0	18.1	11.6	8.3	3.2	8.0	3.1	-1.0	4.1
1995-96	22.3	10.4	9.5	0.9	18.4	10.4	7.3	3.1	31.5	20.7	13.9	6.7
1996-97	27.9	14.3	11.5	2.8	7.3	0.8	3.9	-3.1	8.5	-1.8	1.2	-2.9
1997-98	-16.6	-30.0	-21.2	-8.8	-3.7	-13.0	-12.9	-0.1	-16.4	-24.9	-15.6	-9.3
1998-99	-10.1	-20.4	-12.9	-7.5	4.2	-8.5	-3.0	-5.4	12.3	-0.0	-4.4	4.4
1999-00	32.5	25.0	12.0	13.0	4.3	5.1	-0.0	5.1	0.2	-6.3	-4.7	-1.7
2000-01	0.1	-9.5	-3.9	-5.6	5.0	3.7	2.2	1.5	3.6	-1.7	0.1	-1.8
2001-02	1.9	-6.8	-2.8	-4.0	1.3	2.0	0.9	1.1	-10.2	-11.1	-8.7	-2.4
2002-03	5.5	0.0	0.4	-0.4	11.0	11.1	5.4	5.7	6.9	2.4	-2.0	4.4
2003-04	3.5	-2.1	-2.6	0.5	7.3	1.2	0.0	1.2	8.4	2.4	1.5	0.9
2004-05	1.4	-7.5	-5.6	-1.9	5.1	-3.6	-1.6	-2.0	14.3	2.5	2.6	-0.0
2005-06	14.2	10.0	2.3	7.7	4.3	-5.8	-6.6	0.8	18.5	8.6	3.8	4.8
2006-07	11.0	3.3	0.6	2.7	22.2	11.1	8.1	2.9	12.2	0.9	5.1	-4.2
2007-08	-3.0	-14.2	-8.1	-6.1	8.9	-4.2	0.4	-4.5	7.2	-4.6	-1.4	-3.2
2008-09	12.6	2.7	2.3	0.4	-3.5	-14.4	-11.3	-3.1	40.3	33.1	13.6	19.5
2009-10	3.8	-2.4	-1.7	-0.7	12.3	1.1	4.3	-3.2	-5.1	-12.0	1.0	-13.0
2010-11	11.4	6.0	-6.5	12.4	10.9	-1.0	-3.9	2.9	9.5	-1.0	-6.2	5.2
2011-12	13.0	7.5	3.6	3.9	-3.5	-10.7	-10.8	0.2	16.4	9.5	6.7	2.8
2012-13	1.2	-2.6	-3.7	1.0	3.8	-2.2	-0.2	-2.0	-3.0	-9.6	-4.6	-5.1
2013-14	-7.4	-8.9	-5.6	-3.4	15.1	9.8	8.7	1.0	-14.5	-19.3	-13.0	-6.3
2014-15	12.0	8.7	0.9	7.9	-6.0	-9.9	-8.8	-1.1	9.8	3.0	-1.6	4.7
2015-16	8.0	5.8	6.4	-0.6	-14.8	-18.4	-19.1	0.7	7.2	0.5	-0.5	1.0
2016-17	19.8	18.3	13.0	5.3	23.5	23.1	22.2	0.9	19.0	11.1	6.6	4.5
2017-18	-0.8	-3.6	-3.8	0.2	11.5	11.6	5.6	6.0	14.5	3.8	5.1	-1.3
2018-19	7.1	3.2	-1.4	4.6	2.0	1.1	-3.6	4.7	2.3	-9.7	-9.5	-0.2
2019-20	4.5	0.3	4.9	-4.6	-0.9	-1.2	-1.3	0.1	-7.0	-17.9	-12.6	-5.2
Mean	**7.3**	**-0.4**	**-1.0**	**0.7**	**5.6**	**-0.6**	**-1.0**	**0.4**	**6.6**	**-1.5**	**-1.6**	**0.1**
Std Dev	**10.5**	**11.0**	**7.4**		**8.4**	**9.0**	**8.1**		**11.4**	**10.9**	**6.9**	
Corr: VA_g and TFPG		**0.94**	**0.89**			**0.90**	**0.91**			**0.97**	**0.90**	

Note: 'Machinery nec.' includes machinery not elsewhere classified.

Table A4. Differences in Adjusted TFP Growth for Various Industries in India - 1981-82 to 2019-20 *(Contd.)*

Year	Electrical Equipments				Transport Equipments				Manufacturing, nec.			
	VA_g	TFPG	Adj_ TFPG	Diff (50)-(51)	VA_g	TFPG	Adj_ TFPG	Diff (54)-(55)	VA_g	TFPG	Adj_ TFPG	Diff (58)-(59)
	(49)	(50)	(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	(60)
1981-82	7.4	4.2	9.0	-4.8	12.1	8.5	3.4	5.2	14.4	2.0	-0.3	2.3
1982-83	23.3	18.6	17.8	0.8	11.6	4.2	2.4	1.9	-5.7	-9.3	-3.9	-5.4
1983-84	9.2	4.6	11.2	-6.6	8.9	2.7	3.6	-0.9	18.8	14.2	5.0	9.2
1984-85	22.3	16.3	14.6	1.7	9.9	-2.0	-3.0	1.0	-1.3	-8.8	-6.4	-2.4
1985-86	-12.6	-18.8	-14.1	-4.6	-11.5	-21.8	-16.8	-5.0	31.3	22.2	15.0	7.3
1986-87	20.0	13.3	13.1	0.2	17.1	8.5	2.8	5.6	-16.1	-23.7	-11.2	-12.5
1987-88	16.5	7.4	3.9	3.4	-6.4	-14.5	-12.4	-2.1	2.1	-2.7	-3.9	1.2
1988-89	-2.5	-12.8	-12.0	-0.8	7.2	1.6	-3.1	4.7	-10.2	-17.8	-18.1	0.3
1989-90	19.1	13.0	13.3	-0.3	9.9	5.3	1.2	4.1	3.5	0.0	-4.2	4.2
1990-91	2.6	-4.6	-7.6	3.0	9.5	4.5	5.6	-1.2	2.3	-0.9	-4.8	3.9
1991-92	-17.2	-23.2	-11.5	-11.7	-1.4	-6.3	-3.3	-3.0	-11.4	-14.2	-7.9	-6.3
1992-93	3.0	-3.2	-2.4	-0.8	-6.5	-12.6	-10.7	-1.9	35.1	31.4	11.9	19.5
1993-94	4.1	-2.3	-7.4	5.1	9.2	3.0	-0.3	3.3	16.2	11.1	9.8	1.3
1994-95	38.5	32.4	22.5	9.9	18.4	16.0	8.1	7.9	-7.8	-12.9	1.8	-14.7
1995-96	1.8	-5.1	-0.9	-4.2	43.5	31.9	25.3	6.7	14.9	7.4	6.7	0.7
1996-97	1.7	-4.8	0.0	-4.8	-3.9	-24.3	-10.0	-14.4	5.6	0.9	-0.5	1.4
1997-98	8.5	1.8	-2.0	3.8	-4.2	-12.2	-7.4	-4.8	23.4	18.2	10.2	8.0
1998-99	13.4	8.8	12.1	-3.3	-17.3	-25.7	-17.6	-8.1	15.5	10.7	9.5	1.2
1999-00	-8.4	-16.8	-13.5	-3.3	24.0	12.9	1.9	11.1	5.3	0.1	0.2	-0.1
2000-01	20.1	13.4	7.8	5.6	-0.8	-6.5	-3.4	-3.1	-6.3	-13.3	-0.8	-12.5
2001-02	9.9	6.9	7.2	-0.3	7.5	7.1	5.1	2.0	-3.1	-8.2	-10.0	1.8
2002-03	-7.5	-13.7	1.3	-15.0	14.1	10.7	4.8	5.9	-10.4	-18.2	-17.4	-0.8
2003-04	18.6	12.4	4.8	7.7	15.6	10.1	5.5	4.6	9.6	0.9	-7.3	8.2
2004-05	22.4	15.7	5.8	10.0	3.9	-8.5	-3.4	-5.2	6.2	-4.0	-7.7	3.7
2005-06	37.4	27.7	21.2	6.5	13.8	5.8	18.0	-12.1	17.5	11.9	8.7	3.2
2006-07	11.5	1.9	2.1	-0.2	11.6	1.0	-3.6	4.6	22.0	15.8	15.9	-0.1
2007-08	6.7	-4.6	1.7	-6.3	3.4	-15.1	-9.6	-5.5	-7.4	-13.8	3.8	-17.6
2008-09	25.8	17.8	12.6	5.2	0.0	-11.9	-14.6	2.7	11.7	8.2	3.9	4.4
2009-10	14.5	6.6	4.7	1.9	31.9	24.2	17.0	7.1	29.4	24.4	-1.3	25.7
2010-11	11.2	2.8	-1.1	3.8	10.4	3.5	-0.7	4.2	7.8	1.8	27.2	-25.4
2011-12	2.5	-5.2	-1.3	-3.9	11.2	2.3	0.9	1.5	1.8	-1.8	2.3	-4.1
2012-13	3.6	0.1	1.4	-1.3	8.0	-5.8	0.3	-6.1	21.3	20.9	3.0	17.9
2013-14	9.5	7.0	-0.9	8.0	-8.8	-14.0	-8.2	-5.8	4.1	5.4	5.3	0.0
2014-15	-10.8	-13.3	-7.7	-5.7	21.3	15.9	9.3	6.6	7.0	7.5	11.0	-3.5
2015-16	15.0	11.8	9.1	2.7	26.4	21.1	17.6	3.4	51.9	52.6	49.5	3.0
2016-17	5.0	1.1	-4.7	5.8	7.0	-0.8	1.1	-1.9	-30.4	-29.9	-20.3	-9.6
2017-18	23.5	18.2	18.1	0.1	3.9	-3.4	-3.6	0.2	21.5	21.8	17.7	4.1
2018-19	4.0	-2.0	-1.8	-0.2	14.9	7.8	5.5	2.3	9.6	3.4	3.4	0.0
2019-20	-2.5	-11.3	-3.6	-7.7	-4.3	-14.9	-6.9	-8.0	-8.2	-11.7	-4.8	-6.9
Mean	**9.5**	**3.1**	**3.1**	**-0.0**	**8.2**	**0.2**	**0.0**	**0.2**	**7.5**	**2.6**	**2.3**	**0.3**
Std Dev	**12.6**	**12.6**	**9.6**		**12.0**	**13.1**	**9.5**		**15.8**	**16.3**	**12.7**	
Corr: VA_g and TFPG		**0.99**	**0.89**			**0.95**	**0.90**			**0.98**	**0.78**	

Note: 'Manufacturing nec.' includes manufacturing not elsewhere classified.

Table A4. Differences in Adjusted TFP Growth for Various Industries in India - 1981-82 to 2019-20 *(Contd.)*

Year	Electricity, Gas & Water Supply				Construction				Trade			
	VA_g	TFPG	Adj_ TFPG	Diff (62)-(63)	VA_g	TFPG	Adj_ TFPG	Diff (66)-(67)	VA_g	TFPG	Adj_ TFPG	Diff (70)-(71)
	(61)	(62)	(63)	(64)	(65)	(66)	(67)	(68)	(69)	(70)	(71)	(72)
1981-82	9.1	1.5	-2.4	3.9	5.3	-1.7	0.8	-2.5	6.1	2.4	2.0	0.4
1982-83	6.4	-2.0	-4.5	2.5	-7.3	-14.5	-10.8	-3.6	5.1	1.5	1.4	0.1
1983-84	6.7	-0.7	-2.0	1.3	5.3	-2.9	-5.2	2.3	5.4	1.3	1.1	0.2
1984-85	10.3	3.4	1.5	1.8	3.4	-7.2	-2.7	-4.5	4.2	0.5	0.1	0.4
1985-86	7.6	0.3	0.1	0.3	5.5	-5.2	-5.1	-0.1	8.1	3.7	1.9	1.8
1986-87	9.8	1.0	0.1	0.9	2.4	-9.0	-12.5	3.4	5.6	1.4	1.4	0.1
1987-88	7.5	-1.0	-0.8	-0.2	5.6	-7.2	-6.7	-0.5	4.2	-0.3	0.6	-0.9
1988-89	9.3	3.2	1.4	1.8	6.8	1.3	-3.4	4.8	6.4	-0.1	-0.4	0.3
1989-90	9.3	3.9	1.9	2.0	6.8	2.8	0.1	2.8	7.3	0.9	0.2	0.7
1990-91	6.5	1.0	1.9	-0.9	11.1	7.3	0.7	6.5	4.9	-2.3	-0.9	-1.4
1991-92	9.3	3.9	3.3	0.7	2.0	-0.9	10.7	-11.5	0.5	-4.1	-1.6	-2.5
1992-93	6.7	2.5	2.3	0.2	3.4	-0.4	-5.5	5.2	5.8	1.1	0.0	1.1
1993-94	7.2	3.1	2.5	0.5	0.6	-2.8	-0.9	-1.8	6.7	3.1	1.5	1.6
1994-95	9.0	4.9	3.3	1.6	5.2	1.0	1.2	-0.2	10.3	4.8	3.2	1.6
1995-96	6.6	3.5	2.8	0.7	5.8	0.3	-4.0	4.3	13.1	6.1	4.2	1.9
1996-97	5.3	1.6	1.6	0.0	1.9	-1.7	1.3	-3.0	7.4	2.8	4.0	-1.2
1997-98	7.4	4.0	2.8	1.2	10.0	3.5	2.8	0.8	7.4	1.1	2.1	-1.0
1998-99	6.8	2.5	2.1	0.4	6.1	0.7	-2.3	3.0	7.0	-1.1	-0.6	-0.5
1999-00	5.2	2.1	0.9	1.1	8.1	1.7	0.0	1.7	6.8	0.7	0.3	0.4
2000-01	2.2	-0.6	-0.1	-0.6	6.0	-2.7	4.2	-6.9	4.9	-0.1	0.2	-0.4
2001-02	1.8	-1.1	-0.6	-0.5	3.9	-7.6	-11.4	3.8	9.4	3.4	2.0	1.4
2002-03	4.6	2.8	-0.2	3.0	8.0	-2.6	4.3	-6.8	6.7	2.7	1.6	1.0
2003-04	4.5	-0.3	-0.9	0.6	11.7	1.4	2.4	-1.1	9.7	2.0	1.7	0.4
2004-05	7.6	4.0	7.1	-3.1	15.1	4.1	-3.8	7.9	7.0	-0.6	0.2	-0.8
2005-06	6.1	1.5	4.7	-3.2	12.1	2.0	2.0	0.0	9.5	-0.1	-0.5	0.5
2006-07	7.7	1.8	3.5	-1.7	10.1	-1.6	0.6	-2.2	9.5	1.4	0.9	0.6
2007-08	8.0	1.9	3.3	-1.3	11.1	-1.0	-0.8	-0.2	5.6	-1.7	0.1	-1.8
2008-09	4.8	-2.8	-3.8	1.0	5.4	-4.9	-1.8	-3.0	1.7	-6.8	-4.7	-2.0
2009-10	5.8	-2.1	-2.9	0.8	6.6	-3.1	-0.5	-2.6	3.4	-4.8	-4.5	-0.2
2010-11	6.9	-2.3	-2.3	0.0	5.9	-4.1	-5.2	1.1	14.3	3.4	-0.8	4.2
2011-12	8.2	-0.6	-1.2	0.6	12.3	1.7	-1.5	3.2	5.6	-6.9	-4.7	-2.2
2012-13	2.6	-5.1	-2.0	-3.0	0.3	-6.1	-4.8	-1.3	11.3	-8.5	-5.2	-3.3
2013-14	4.1	-2.9	-2.2	-0.7	2.6	0.1	-1.3	1.4	5.8	-2.7	-1.0	-1.6
2014-15	7.0	1.1	0.1	1.0	4.2	1.9	-1.4	3.3	9.7	-0.6	-1.2	0.7
2015-16	4.6	-1.8	-0.9	-1.0	3.5	0.8	1.8	-1.0	10.3	0.4	0.7	-0.2
2016-17	9.5	3.9	3.2	0.8	5.7	1.6	0.7	1.0	9.8	-0.6	-0.3	-0.3
2017-18	10.1	6.1	5.1	1.0	5.1	0.4	-0.9	1.3	12.4	1.9	1.0	0.9
2018-19	7.6	5.8	2.9	2.9	6.3	-1.7	-0.8	-0.8	8.5	-2.3	-0.6	-1.7
2019-20	2.2	-4.9	-0.3	-4.6	1.2	-6.7	-3.2	-3.5	6.9	-5.9	-2.2	-3.8
Mean	**6.7**	**1.1**	**0.8**	**0.3**	**5.8**	**-1.6**	**-1.6**	**0.0**	**7.3**	**-0.1**	**0.1**	**-0.1**
Std Dev	**2.2**	**2.8**	**2.6**		**4.1**	**4.2**	**4.4**		**2.9**	**3.3**	**2.2**	
Corr: VA_g and TFPG		**0.69**	**0.43**			**0.69**	**0.34**			**0.43**	**0.31**	

Table A4. Differences in Adjusted TFP Growth for Various Industries in India - 1981-82 to 2019-20 *(Contd.)*

Year	Hotels & Restaurants				Transport & Storage				Post & Telecommunication			
	VA_g	TFPG	Adj_ TFPG	Diff (74)-(75)	VA_g	TFPG	Adj_ TFPG	Diff (78)-(79)	VA_g	TFPG	Adj_ TFPG	Diff (82)-(83)
	(73)	(74)	(75)	(76)	(77)	(78)	(79)	(80)	(81)	(82)	(83)	(84)
1981-82	-2.8	-10.7	-7.8	-2.9	6.6	0.1	-1.0	1.1	7.5	-2.0	-1.0	-0.9
1982-83	17.0	10.3	3.2	7.1	4.2	-2.6	-2.5	-0.1	4.6	-4.7	-2.4	-2.3
1983-84	0.9	-5.3	-2.5	-2.8	5.0	-0.6	-2.0	1.4	5.5	-3.3	-3.4	0.1
1984-85	5.5	0.7	3.8	-3.1	5.4	1.6	0.4	1.2	7.8	3.9	-0.7	4.6
1985-86	4.6	-0.6	0.0	-0.6	7.7	4.7	2.7	2.0	1.6	-1.9	-0.7	-1.2
1986-87	4.7	0.0	0.4	-0.4	6.3	1.2	1.1	0.1	6.1	2.6	2.3	0.2
1987-88	5.9	0.2	0.0	0.2	7.0	4.0	3.4	0.6	5.7	0.3	0.2	0.2
1988-89	6.4	1.3	0.5	0.8	4.5	1.2	1.8	-0.7	4.5	-4.3	-1.6	-2.7
1989-90	11.7	7.0	4.0	2.9	6.1	2.1	1.5	0.5	6.8	-2.3	-1.5	-0.8
1990-91	7.3	3.0	2.7	0.3	4.6	1.1	-1.4	2.5	6.4	-2.1	-1.2	-0.9
1991-92	0.8	-4.2	-0.6	-3.6	5.9	2.1	-0.1	2.1	7.1	-1.3	-0.9	-0.4
1992-93	6.2	1.8	0.9	0.9	3.7	0.1	-0.1	0.2	12.0	2.0	0.7	1.3
1993-94	8.0	5.4	3.1	2.3	5.7	0.4	-0.7	1.0	12.5	2.1	1.3	0.8
1994-95	4.0	-1.4	0.0	-1.4	8.0	3.4	3.4	0.1	14.3	3.1	2.1	1.0
1995-96	22.7	16.3	8.8	7.6	8.9	4.8	4.1	0.7	15.2	4.8	3.7	1.2
1996-97	12.1	6.8	6.7	0.1	7.4	3.1	3.0	0.1	10.2	2.2	2.5	-0.3
1997-98	7.7	2.5	5.6	-3.1	4.9	1.7	2.4	-0.7	18.3	10.2	6.9	3.4
1998-99	13.1	7.1	5.3	1.8	4.9	1.2	1.3	-0.1	17.8	10.2	7.3	2.8
1999-00	9.3	4.6	5.2	-0.6	6.9	2.8	1.1	1.8	20.0	9.8	6.6	3.3
2000-01	6.7	0.3	3.0	-2.7	6.8	2.6	1.4	1.1	22.3	10.2	7.6	2.5
2001-02	7.6	1.1	1.9	-0.8	4.4	0.7	1.3	-0.6	17.7	8.0	7.1	0.8
2002-03	5.6	1.3	1.0	0.4	8.8	3.4	1.5	1.9	20.9	14.0	9.4	4.5
2003-04	8.3	2.0	1.7	0.3	10.3	4.8	2.8	2.0	23.0	19.6	13.3	6.3
2004-05	10.8	2.9	1.5	1.4	10.8	5.2	5.4	-0.2	19.0	11.9	10.9	1.0
2005-06	13.4	3.7	2.0	1.7	9.2	2.9	3.7	-0.8	2.9	-3.2	2.1	-5.3
2006-07	11.3	1.7	2.0	-0.3	9.2	3.8	4.0	-0.2	1.9	-2.2	0.9	-3.1
2007-08	9.6	-0.2	1.2	-1.4	8.7	0.7	2.0	-1.3	7.8	2.8	2.6	0.2
2008-09	-4.4	-13.1	-0.6	-12.5	5.3	-2.0	1.3	-3.3	3.1	-10.2	-4.6	-5.6
2009-10	-0.3	-8.5	-3.2	-5.3	8.2	1.9	2.4	-0.5	18.7	8.3	4.7	3.6
2010-11	15.3	5.8	-1.5	7.3	7.5	1.7	2.1	-0.4	0.6	-5.5	0.4	-5.9
2011-12	6.3	-3.7	-2.2	-1.5	7.5	0.1	1.3	-1.3	5.4	-1.2	1.3	-2.5
2012-13	3.3	-3.5	-3.9	0.5	7.5	1.1	2.5	-1.4	6.6	-0.8	0.2	-1.0
2013-14	-0.4	-3.2	-3.8	0.6	5.9	3.4	2.7	0.7	14.8	-9.0	-2.0	-7.0
2014-15	5.9	0.2	-1.4	1.5	7.2	3.5	2.1	1.3	12.1	9.4	5.3	4.1
2015-16	12.5	4.1	0.9	3.3	6.7	2.0	1.5	0.6	13.4	2.3	6.6	-4.3
2016-17	8.4	2.1	2.3	-0.2	4.2	-1.8	-0.2	-1.6	1.3	-5.5	-2.9	-2.6
2017-18	8.8	3.0	3.2	-0.2	8.4	1.5	1.2	0.2	-2.8	-17.9	-14.8	-3.2
2018-19	8.9	2.6	1.3	1.3	5.2	-2.7	-0.8	-1.9	-0.6	-11.7	-8.1	-3.6
2019-20	6.5	-1.6	-1.2	-0.4	1.3	-5.4	-1.1	-4.3	10.6	9.2	8.2	1.0
Mean	**7.4**	**1.1**	**1.1**	**-0.0**	**6.6**	**1.5**	**1.4**	**0.1**	**9.8**	**1.5**	**1.8**	**-0.3**
Std Dev	**5.3**	**5.4**	**3.2**		**2.0**	**2.3**	**1.8**		**7.0**	**7.6**	**5.3**	
Corr: VA_g and TFPG		**0.94**	**0.71**			**0.76**	**0.73**			**0.86**	**0.83**	

Table A4. Differences in Adjusted TFP Growth for Various Industries in India - 1981-82 to 2019-20 *(Contd.)*

Year	Financial Services				Business Services				Public Administration & Defence			
	VA_g	TFPG	Adj_ TFPG	Diff (86)-(87)	VA_g	TFPG	Adj_ TFPG	Diff (90)-(91)	VA_g	TFPG	Adj_ TFPG	Diff (94)-(95)
	(85)	(86)	(87)	(88)	(89)	(90)	(91)	(92)	(93)	(94)	(95)	(96)
1981-82	7.0	-1.4	-0.8	-0.5	9.7	4.3	1.7	2.5	2.2	-0.2	-0.8	0.5
1982-83	12.8	3.9	1.7	2.1	6.8	1.4	0.1	1.3	9.5	6.9	2.2	4.7
1983-84	9.0	0.3	0.4	-0.2	23.8	16.5	10.2	6.4	3.4	-0.4	2.0	-2.4
1984-85	7.4	0.3	0.6	-0.3	9.5	3.7	5.0	-1.4	9.0	2.7	3.2	-0.5
1985-86	12.9	5.9	3.2	2.7	8.9	2.8	4.7	-1.9	7.1	0.9	1.3	-0.4
1986-87	13.0	6.0	4.5	1.5	9.8	3.9	3.9	0.1	8.8	2.3	1.9	0.4
1987-88	6.1	-0.6	2.2	-2.8	0.4	-7.6	-3.7	-3.9	9.3	3.3	2.5	0.8
1988-89	10.6	3.3	3.0	0.3	6.1	-1.3	-1.0	-0.4	6.0	2.7	2.6	0.1
1989-90	20.3	12.3	7.1	5.2	6.9	-2.3	-2.6	0.3	7.7	5.6	4.0	1.6
1990-91	1.9	-5.4	0.6	-6.0	11.7	0.9	-0.3	1.2	1.3	-0.7	2.2	-2.8
1991-92	14.7	6.1	4.7	1.3	5.1	-3.1	-1.3	-1.8	2.1	0.2	1.6	-1.4
1992-93	2.6	-4.5	-1.8	-2.6	6.8	-2.9	-2.0	-0.9	4.9	3.2	1.6	1.7
1993-94	13.3	4.2	2.6	1.6	8.6	-0.7	-1.3	0.6	2.5	0.9	1.5	-0.6
1994-95	4.6	-4.9	-4.2	-0.7	11.6	1.3	0.7	0.6	1.3	0.0	1.5	-1.5
1995-96	10.8	0.2	-0.8	1.0	17.1	5.1	3.0	2.1	6.5	5.6	3.2	2.4
1996-97	8.1	-0.2	0.6	-0.8	11.8	-1.7	-0.6	-1.1	4.0	3.1	3.0	0.1
1997-98	17.2	11.4	7.4	4.0	20.2	4.0	1.7	2.2	13.3	12.2	7.7	4.6
1998-99	8.8	3.6	4.2	-0.6	17.9	-0.1	-2.4	2.3	10.0	8.6	7.8	0.8
1999-00	12.3	5.0	4.5	0.5	20.9	1.2	3.4	-2.3	12.6	11.2	10.4	0.8
2000-01	-2.4	-10.0	-4.2	-5.8	22.2	3.6	2.6	1.0	1.8	2.4	6.6	-4.2
2001-02	7.7	-0.6	-0.2	-0.4	12.0	-9.3	-6.1	-3.2	2.8	3.7	4.0	-0.4
2002-03	10.6	6.2	3.5	2.7	10.7	-7.4	-4.7	-2.7	1.5	2.3	3.9	-1.6
2003-04	2.6	-3.4	-1.3	-2.1	16.5	0.2	-1.4	1.6	2.3	3.5	4.1	-0.6
2004-05	7.8	3.1	2.6	0.5	16.2	-0.1	-0.6	0.4	6.4	6.9	2.5	4.4
2005-06	11.2	5.3	3.1	2.2	15.6	1.7	1.3	0.4	4.4	3.3	4.7	-1.4
2006-07	12.0	4.5	3.3	1.1	8.7	-4.3	-2.3	-2.0	2.1	0.4	2.9	-2.5
2007-08	9.3	1.5	2.8	-1.4	10.5	-2.1	-1.6	-0.5	7.4	5.5	2.8	2.8
2008-09	5.0	0.4	0.3	0.1	8.3	-7.3	-5.8	-1.6	17.3	15.8	12.4	3.5
2009-10	6.9	2.6	0.8	1.9	5.2	-6.8	-4.6	-2.2	15.6	14.3	13.5	0.8
2010-11	6.5	-1.1	-0.6	-0.5	3.9	-5.9	-4.5	-1.4	-0.1	-1.4	5.3	-6.7
2011-12	3.4	-0.7	-0.8	0.0	5.5	-7.2	-6.7	-0.5	4.2	3.1	2.7	0.4
2012-13	9.8	6.2	2.0	4.1	11.9	0.7	-2.3	3.0	2.1	1.5	4.3	-2.8
2013-14	8.7	4.7	5.3	-0.6	16.5	5.6	-0.7	6.3	1.7	1.2	1.8	-0.6
2014-15	8.2	4.8	3.4	1.3	17.1	4.6	2.3	2.3	6.4	5.9	1.6	4.3
2015-16	7.0	2.4	2.1	0.3	18.9	8.6	7.5	1.0	3.8	3.2	2.8	0.4
2016-17	3.4	0.1	-0.4	0.5	15.9	5.2	4.7	0.5	8.3	7.6	8.0	-0.5
2017-18	4.6	2.4	2.4	0.0	0.7	-8.3	3.5	-11.8	9.7	8.9	8.9	0.1
2018-19	4.0	-2.6	-0.1	-2.5	11.1	4.2	-2.6	6.8	6.6	2.7	5.6	-2.9
2019-20	3.4	0.4	0.3	0.1	10.9	4.9	0.3	4.7	5.0	2.1	3.7	-1.6
Mean	**8.3**	**1.8**	**1.6**	**0.2**	**11.6**	**0.2**	**-0.1**	**0.2**	**5.9**	**4.1**	**4.1**	**-0.0**
Std Dev	**4.5**	**4.4**	**2.6**		**5.7**	**5.4**	**3.7**		**4.2**	**4.1**	**3.1**	
Corr: VA_g and TFPG		**0.89**	**0.81**			**0.70**	**0.52**			**0.89**	**0.68**	

Table A4. Differences in Adjusted TFP Growth for Various Industries in India - 1981-82 to 2019-20 *(Concld.)*

Year	Education				Health & Social Services				Other services			
	VA_g	TFPG	Adj_ TFPG	Diff (98)-(99)	VA_g	TFPG	Adj_ TFPG	Diff (102)-(103)	VA_g	TFPG	Adj_ TFPG	Diff (106)-(107)
	(97)	(98)	(99)	(100)	(101)	(102)	(103)	(104)	(105)	(106)	(107)	(108)
1981-82	4.0	1.3	1.0	0.3	4.5	0.8	1.9	-1.1	6.5	4.8	2.1	2.7
1982-83	9.6	6.7	3.2	3.4	7.6	3.9	3.2	0.8	6.5	4.8	2.2	2.6
1983-84	3.1	0.1	2.4	-2.3	10.3	6.0	4.3	1.7	6.6	4.5	3.7	0.8
1984-85	4.7	2.0	2.8	-0.8	9.2	4.8	4.4	0.4	6.3	4.5	4.4	0.1
1985-86	8.6	5.7	3.0	2.6	4.5	-0.1	2.6	-2.7	6.1	4.3	4.1	0.1
1986-87	7.1	4.1	3.9	0.2	3.5	-1.3	0.8	-2.1	7.7	6.0	4.9	1.1
1987-88	4.1	0.9	3.2	-2.3	9.5	4.3	1.6	2.7	8.2	5.6	4.9	0.7
1988-89	7.1	2.0	2.5	-0.6	9.1	3.9	2.8	1.1	8.1	3.1	4.4	-1.4
1989-90	12.0	5.9	3.4	2.5	8.4	3.0	3.6	-0.6	6.1	-0.5	1.9	-2.4
1990-91	8.1	1.9	2.1	-0.1	10.0	4.5	3.7	0.8	7.4	0.2	0.6	-0.4
1991-92	3.0	-2.7	0.8	-3.6	1.8	-2.9	1.1	-4.0	7.3	0.7	0.5	0.2
1992-93	3.7	-2.3	-1.1	-1.2	6.2	1.1	1.0	0.1	7.4	0.1	0.3	-0.2
1993-94	4.7	-1.0	-1.7	0.7	6.7	1.9	0.5	1.4	8.6	1.5	1.1	0.4
1994-95	5.7	-0.0	-0.9	0.9	5.0	-1.6	0.6	-2.2	1.9	-1.7	-1.0	-0.6
1995-96	10.0	4.5	1.8	2.7	7.9	1.2	1.2	0.1	3.3	0.8	0.2	0.7
1996-97	9.1	3.5	2.7	0.8	8.0	1.4	0.6	0.8	4.2	1.4	0.8	0.6
1997-98	10.4	3.7	3.2	0.5	7.5	-0.5	-0.3	-0.2	1.5	-1.6	-0.1	-1.5
1998-99	10.8	2.1	1.9	0.2	9.1	-1.4	-1.6	0.2	3.2	-0.3	0.9	-1.2
1999-00	13.4	6.3	5.1	1.1	13.4	4.8	2.2	2.6	3.2	-0.9	-1.3	0.4
2000-01	6.3	-1.2	2.5	-3.8	10.9	2.6	2.6	0.0	2.8	-1.7	-0.7	-1.0
2001-02	3.6	-5.5	-1.5	-4.0	7.3	-3.1	-0.6	-2.5	2.8	-3.1	-2.1	-1.0
2002-03	5.9	-3.1	-3.1	-0.1	7.5	-2.5	-0.9	-1.7	2.4	-3.1	-2.4	-0.7
2003-04	7.5	-1.4	-2.5	1.1	10.4	0.4	-0.9	1.3	2.7	-2.3	-2.0	-0.4
2004-05	6.5	-3.6	-3.2	-0.4	10.6	-1.3	-3.4	2.0	2.7	-2.5	-2.3	-0.2
2005-06	10.9	2.3	-0.6	2.9	10.6	0.0	-1.5	1.5	5.0	-0.5	-1.2	0.7
2006-07	-5.3	-12.7	-5.8	-6.9	15.8	6.7	3.1	3.6	3.6	-1.4	-1.3	-0.1
2007-08	9.5	2.1	-1.3	3.4	5.8	-3.4	-0.2	-3.1	5.4	-0.0	-0.6	0.6
2008-09	14.1	8.1	0.5	7.6	8.8	1.8	2.6	-0.7	4.1	-2.4	-3.0	0.6
2009-10	13.8	8.3	6.0	2.3	16.5	10.2	5.1	5.1	7.8	2.1	0.1	2.0
2010-11	18.8	13.1	9.6	3.5	10.8	4.4	4.3	0.1	5.3	0.4	0.2	0.2
2011-12	13.4	7.8	8.4	-0.6	-0.1	-6.4	-0.0	-6.4	5.7	0.3	0.2	0.1
2012-13	5.3	-0.9	5.3	-6.2	7.8	1.6	-0.2	1.8	6.7	2.8	2.6	0.1
2013-14	5.9	-0.6	2.5	-3.2	4.0	-2.7	-4.8	2.1	7.0	3.6	2.8	0.8
2014-15	6.9	0.6	0.5	0.1	13.0	6.4	3.1	3.2	7.3	3.3	2.2	1.0
2015-16	8.1	0.8	-0.5	1.4	8.1	0.3	0.2	0.1	4.4	1.3	1.9	-0.6
2016-17	9.5	2.2	1.5	0.7	8.8	0.9	-0.1	1.0	4.9	1.6	2.0	-0.3
2017-18	11.0	3.6	2.8	0.8	6.0	-1.7	0.7	-2.4	0.4	-2.4	1.9	-4.3
2018-19	10.1	2.4	2.7	-0.3	7.5	0.2	-0.3	0.5	3.4	-4.2	-2.4	-1.9
2019-20	6.9	2.3	4.7	-2.3	6.0	2.2	-4.6	6.8	4.2	4.9	-0.8	5.7
Mean	**7.9**	**1.8**	**1.7**	**0.0**	**8.2**	**1.3**	**1.0**	**0.3**	**5.1**	**0.9**	**0.8**	**0.1**
Std Dev	**4.2**	**4.4**	**3.1**		**3.4**	**3.3**	**2.3**		**2.1**	**2.8**	**2.2**	
Corr: VA_g and TFPG		**0.90**	**0.63**			**0.79**	**0.40**			**0.72**	**0.63**	

Source: Growth rate of real value added (VA_g) and standard TFP growth (TFPG) from the India KLEMS database and Adjusted TFPG (Adj_TFPG) from author's computation.

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Macroprudential Policy and Tail Effects on Growth in India

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This paper analyses the effects of macroprudential policy actions on credit and output by looking at their tail effects in a growth-at-risk framework. The findings suggest that macroprudential policy measures moderate high credit growth, thereby preserving financial stability. These policy measures improve output over the medium term when the actual output is below its potential level; however, the effect of macroprudential policy on output is statistically insignificant when the output is well above its potential. The macroprudential policy is effective with the costs of policy implementation being not very significant.

JEL Classification: C54, E32, E58, G21, G28

Keywords: Growth-at-risk, macroprudential policy, local projection, quantile regression

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Introduction

Macroprudential policy became an integral part of the central banks' policy arsenal in the aftermath of the Global Financial Crisis (GFC), although some economies, including India, had made an active use of such policies prior to the crisis. During the GFC, there was a severe global economic downturn, primarily caused by problems in the financial sector, including the collapse of major financial institutions, a housing market crash, and a credit crunch. This crisis had far-reaching and long-lasting consequences, including the loss of jobs, housing foreclosures, and a significant impact on global financial markets. As a result of this crisis, there was heightened awareness about the need to monitor and maintain financial stability against system-wide risks, underscoring the need for macroprudential policy.

The risks to financial stability are generally tail events, *i.e.,* rare events with a low probability of occurrence but which have a material adverse impact on the real sector. While macroprudential policy measures offer long-term growth and financial stability benefits, there can be short-term costs associated with their implementation. These costs may affect the real economy mainly through financial channels (Carrasquilla *et al.*, 2000). As the tail events are rare in nature, the cost-benefit analysis of macroprudential policy occupies centrestage in policy debate.

Among macroprudential policy measures, capital buffer and loan-to-value (LTV) ratio are aimed at addressing the build-up of risks in banks' loan portfolio. The requirement to hold more capital by banks may reduce their ability to lend if banks are unable to raise the additional capital and borrowers find it harder to access credit, which can lead to a temporary slowdown in investment and consumption demands, and hence, economic activity. Also, tighter macroprudential policy may increase borrowing costs for households and businesses. This can be especially challenging for borrowers relying on bank-based financing. Macroprudential policy measures, such as liquidity requirements, can reduce market liquidity in the short term. They can also lead to credit market disruptions and increased volatility in the short run. Apart from these, the implementation of macroprudential policy entails a transitional period during which financial institutions adjust to the new requirements. This can lead to short-term compliance costs and operational challenges (IMF, 2013). However, the benefits of the availability of higher capital

outweigh the short-term costs. Higher capital improves the loss absorbing capacity of banks, leading to an improved flow of credit to borrowers, and thereby facilitating better deployment of credit.

The effects of macroprudential policy can be asymmetric across the distribution of credit supply and economic growth. A comparison of the macroeconomic outcomes over different time horizons can provide estimates of the causal effects. However, the effects can often get entangled with the other effects. In this context, quantile regression provides a better approach for evaluating the causality between macroprudential policy, credit supply and economic activities across the distribution of economic output. Quantile regression has been used in the literature to analyse the macroprudential policy effects over different parts of the distribution (Adrian *et al.,* 2019; Aikman *et al*., 2019; Adrian *et al*., 2022; and Lloyd *et al*., 2024).

In India, macroprudential policy has been in use in the form of counter-cyclical provisioning and risk weights for certain sectors since 2004 to foster financial stability (Chakrabarty, 2014). These sectors include residential housing, commercial real estate, capital market, other retail sectors and systematically important non-deposit-taking non-banking financial companies (NBFCs). The risk weights on commercial real estate (CRE) – residential housing category were reduced in 2015 to facilitate credit supply to this sector. In 2017, the risk weights for the housing sector were reduced. The risk weights for loans to NBFCs were aligned with their credit rating in 2019. More recently in 2023, the risk weights of the consumer credit exposures of commercial banks and credit exposure to NBFCs were increased amidst excessive credit growth in these segments.

Against this backdrop, this paper analyses the effects of macroprudential policy measures on credit growth and output at both tails (*i.e*., left or lower tail and right or upper tail) of the distribution. The left or lower tail of credit/output growth is defined as the lower level of growth which is in the 10^{th} percentile of their distribution. Similarly, the right or upper tail is defined as the higher level of growth which is in the 90^{th} percentile of their distribution. Furthermore, the left or lower tail of output gap corresponds to highly negative output gap belonging in the 10^{th} or 30^{th} percentiles of distribution of the output gap, whereas, the right or upper tail of output gap indicates highly positive output gap belonging in the range of 90^{th} or 70^{th} percentiles of its distribution. We analyse the effect of macroprudential policy using growth-

at-risk framework. We have drawn the macroprudential policy stances from the Integrated Macroprudential Policy (iMaPP) database maintained by the International Monetary Fund (IMF). iMaPP is a comprehensive database covering major macroprudential policy actions taken by 185 countries over time. The policy stances from the iMaPP database are extensively used for analysing the policy effects. The shock variable is drawn from the iMaPP database.

To evaluate the transmission channel, the paper analyses the tail effects of the macroprudential policy measures first on credit growth and then on output gap. The empirical findings suggest that restrictive macroprudential policy dampens credit supply during high credit growth periods. Further, it is also observed that over the medium term (*i.e.,* over 3-4 years horizon), restrictive macroprudential policy improves output when the output gap is highly negative. The marginal and positive effect of credit growth appears to be more pronounced on economic growth during low credit growth phases compared to high credit growth periods which suggests causality between macroprudential policy and economic growth through the credit channel.

The paper is organised as follows. Section II presents the review of literature. Section III provides a motivation for the paper using stylised facts. The empirical framework is described in Section IV, the empirical findings in Section V along with the robustness checks. The summary of observations is provided in Section VI.

Section II
Literature Review

The paper contributes to three strands of literature. First, it analyses the suitability of the various macroprudential policy measures. As noted earlier, macroprudential policy has been widely adopted and studied in both advanced and emerging economies (Cerutti, 2015). The primary objective of this policy is to maintain financial stability, which involves ensuring the resilience of the financial system and responding to unsustainable credit expansions (Milne, 2009). To enhance the effectiveness of these policies, a structured policy process is recommended, involving clear objectives, appropriate indicators, and robust evaluation mechanisms (Buch, 2018).

The Reserve Bank of India (RBI) has used macroprudential policy measures to address both time and cross-sectional dimensions of systemic risk (Sinha, 2011 and Chakrabarty, 2014). These policies have helped in moderating excessive credit growth in the short run (Verma, 2018). However, these policy measures have exerted limited effects on improving credit growth during the business cycle downturn. Saraf and Chavan (2023) observe that macroprudential policy measures, more specifically Loan to Value (LTV) policies, were effective in NBFC, CRE and retail housing sectors. They also note an asymmetric effect of these policies. Kumar *et al.* (2022) use structural VAR models to evaluate the effectiveness of macroprudential policy on asset prices and credit. They observe that the tighter policies reduce credit supply and moderate house prices. Accommodative policies, on the other hand, improve credit supply. Richter *et al.* (2019) use narrative identification of LTV policies in a panel study of countries and show that LTV policies reduce credit growth. Belkhir *et al.* (2020) observe a similar effect of macroprudential policy on credit growth of a panel of 100 countries including India. Apart from India, many emerging economies, including China and South Korea have frequently used macroprudential policy tools with a focus on tightening actions during credit expansions (Kim, 2019).

Secondly, the paper analyses the macroeconomic effects of macroprudential policy measures. As per the literature, these measures are seen to exert a positive effect on GDP growth, particularly in reducing downside risk to growth (Galán, 2020). This is achieved using various instruments, such as credit growth tools and exposure limits, which decrease individual bank's risk (Meulman & Vander Vennet, 2020). However, the effectiveness of these policies can vary depending on the position in the financial cycle, the type of instrument used, and the time elapsed since its implementation (Galán, 2020). Despite the potential benefits, the use of macroprudential tools can also have a detrimental effect on growth, particularly when used non-systematically (Boar *et al.*, 2017). Therefore, the design and implementation of these policies are crucial to achieve their intended goals.

In the literature, Lim *et al.* (2010) observe that macroprudential policy measures restrict credit growth and moderate asset prices. Similar findings are given in Cerutti *et al.* (2015), Vandenbussche *et al.* (2015) and Kuttner and Shim (2016). Kuttner and Shim (2016) underline the differential effect

of macroprudential policies across different phases of the business cycle. They observe less than expected effect of the easing macroprudential policies during the business cycle downturn due to the dominance of negative sentiments. On the asset price effect, Reinhart and Rogoff (2009) observe prolonged effects of macroprudential policies on the asset price cycle. Unsal (2013), and Zhang and Tressel (2017) observe that the transmission of macroprudential policy and monetary policy happens through asset price and credit channels. Claessens (2015) observes that the interaction of monetary and macroprudential policies dampens the transmission effect in some cases. Existing literature also highlights mixed net effect of macroprudential policy measures on the real economy. Galati and Moessner (2013, 2018) justify the mixed effects of macroprudential policies due to the lack of maturity of policy instruments.

Peydró (2016) and Cartapanis (2011) both highlight the importance of macroprudential policy measures in mitigating the negative effects of credit cycles and financial crises. Collin *et al.* (2014) further emphasise the need for a macroprudential framework for the banking sector, with the former discussing the specific instruments and the latter providing a comprehensive literature review on the topic. These studies collectively underscore the crucial role of macroprudential policy in preventing and managing financial crises.

Lastly, the paper evaluates the importance of credit channel for economic growth. The relationship between credit and economic growth is complex and context-dependent. Hung *et al.* (2002) and Sassi (2014) both highlight the interdependence of credit market and their impact on growth, with Sassi (2014) specifically noting the negative effect of consumer credit market development and the positive effect of investment credit market development. Singh *et al.* (2018) provide empirical evidence of a strong relationship between credit expansion and economic growth in India, while Banu (2013) underscores the crucial role of credit in economic development, particularly in the context of the GFC.

The research on macroprudential policy also suggests a risk-taking channel through which monetary policy can influence bank behaviour. Angeloni (2013) and Abbate and Thaler (2019) both find that monetary policy expansions can lead to increased risk-taking by banks, with the latter

suggesting that the monetary authority should stabilise the real interest rate to mitigate this effect. Dell'Ariccia *et al.* (2013) further supports this by showing that the *ex-ante* risk-taking by banks is negatively associated with increase in short-term policy interest rates. These findings once again underline the importance of macroprudential policy in regulating bank risk-taking and preserving financial stability.

The cross-country studies observe heterogeneous effects of financial conditions on different parts of the growth distribution. Akinci and Olmstead-Rumsey (2018) use a sample of 57 advanced economies to analyse the effectiveness of macroprudential policies. They observe that tighter policies reduce the probability of asset price bubbles by moderating credit growth. Adrian *et al*. (2019) observe a downside risk of strict financial conditions on the US growth at a 4-quarter ahead horizon. In a multi-country setup, Adrian *et al.* (2017) observe growth-at-risk in shorter horizon using a panel of 11 advanced and 11 emerging market economies; they observe the effect to be opposite when the initial financial conditions are loose. They also observe that the moderation of credit growth happens with a lag leading to a moderation of growth at lower quantiles.

Adrian *et al.* (2022) highlight the importance of financial conditions on growth-at-risk using 11 advanced economies. Aikman *et al.* (2019) analyse the effect of asset price booms on growth. Using a sample of 14 advanced economies, they observe that the macroprudential vulnerabilities lead to moderation of growth over a three-five year horizon. Using a sample of 12 advanced economies, Fernandez-Gallardo (2023) corroborate the growth-supporting role of tighter macroprudential policies on the lower tail of growth and no significant effect on the middle of the distribution. Franta and Gambarcorta (2020) undertake similar analysis with a panel of 56 countries and focus on LTV ratio and loan provisioning changes on a five-point scale. They observe that tighter macroprudential policies reduce risks of deep recession and improve growth at the lower tail. Galan (2020) also observes similar positive net effects of tighter macroprudential policies using 28 European countries over 1970-2018. Ma (2020), using a small open economy model, observes a positive and significant effect of macroprudential policies on growth and consumption.

Section III
Data-related Discussion and Stylised Facts

In this paper, the shock variable is macroprudential policy stances drawn from the iMaPP database for India, as noted earlier. The macroprudential policy actions are coded on a 3-point scale – (+1) for restrictive policies, 0 for neutral stance and (-1) for accommodative policies. While the data in the iMaPP database are available at a monthly frequency from 1990 up to Q3: 2021-22, we have extended the data till Q3: 2023-24 using macroprudential policy announcements by the RBI[1]. The macroprudential policy shock is identified by aggregating the number of instances of changes in countercyclical capital buffers, capital conservation buffers for banks, capital requirements for banks, leverage limits, loan loss provision requirements, limits on growth or the volume of aggregate credit, limits on LTV ratio, limits to the debt service-to-income ratio and loan-to-income ratio, measures of systemic liquidity and funding risks, loan-to-deposit ratio, reserve requirements and measures relating to systemically important financial institutions[2]. Following Alam *et al.* (2019), the macroprudential stance measure at a monthly frequency is derived by summing these policy stances. The quarterly shock variable is derived as sum of the monthly policy stances.

Among the target variables, real GDP, real private final consumption expenditure (PFCE) and real gross fixed capital formation (GFCF) are sourced from the Ministry of Statistics and Programme Implementation (MoSPI), Government of India. The macroprudential policy stances do not change frequently and hence, the shock variable does not show sufficient variations to estimate the medium-term policy effects. For that, we extract a longer time series of the target variables[3]. The real credit growth is derived by deflating

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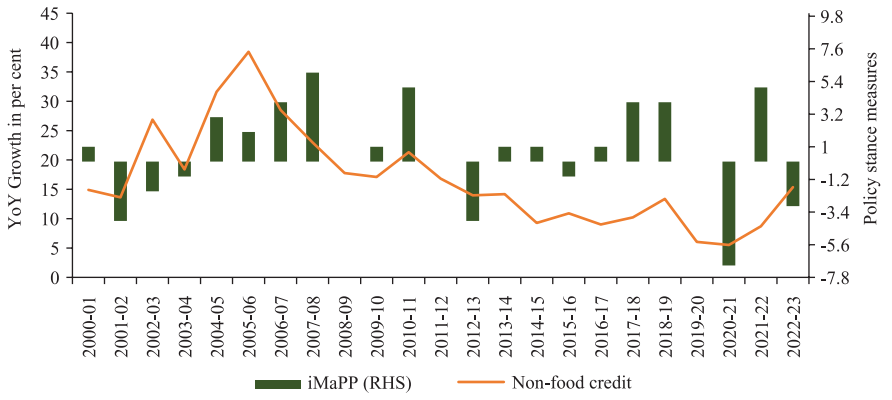
1 The policy stances were classified on a three-point scale to synergise with the iMaPP data compiled by IMF.

2 These policy actions are considered in the iMaPP database, though some of these were not applied in India.

3 The new base for the GDP series starts from 2011 onwards at a quarterly frequency. The older data are available at an annual frequency. The quarterly back series is constructed by applying quarterly shares from previous base estimates (2004-05) on the annual back series published by MoSPI. The bank credit data and non-food credit data are sourced from RBI.

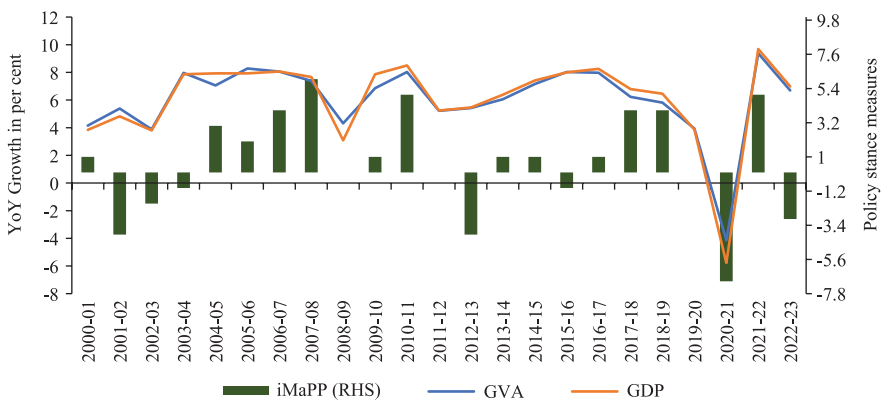
Chart 1: Macroprudential Policy Stance and Credit Growth in India



Source: RBI, iMaPP and Authors' calculations.

the nominal values by GVA financial sector deflator[4]. All variables are transformed into quarterly frequency. The macroprudential policy stances are summed over the quarter whereas the credit data are taken as the quarter-end values. The output gap estimates are the cyclical component estimated using the Hodrick-Prescott (HP) filter at a quarterly frequency on de-seasonalised data. The macroprudential policy stance is plotted against bank credit (Chart 1) and quarterly GDP and GVA growth rates from 2000-01 onwards (Chart 2).

Chart 2: Macroprudential Policy Stance and Growth in India



Source: MoSPI, RBI, iMaPP and Authors' calculations.

[4] For robustness, the WPI headline index is also used as a deflator. The results are found to be similar.

Section IV
Empirical Framework

As discussed earlier, the empirical framework uses the growth-at-risk approach. First, the effect of policy stance is analysed on the tails of non-food credit growth distribution. Next, a similar analysis is used for output gap to evaluate the policy effects on the tails of the output gap distribution. Lastly, credit growth is linked to the output gap distribution by looking at the average effects during high and low credit growth phases. The causality between macroprudential policy with output is evaluated at the tails by linking the credit effect with the tail effects on output gap.

To estimate the tail effects of macroprudential policies on credit growth and output gap, quantile regression approach is adopted. Since the macroprudential policies work with lags, the policy effect has been estimated using local projection approach, as suggested by Jorda (2005).

$$Q_{g^{y}_{t+h}}(\tau|\Delta MP_t, x_t) = \alpha_0 + \beta_1 MP_{t-1} + \gamma x_t + \epsilon_t \quad (1)$$

where the left-hand side variable $Q_{g^{y}_{t+h}}(\tau|\Delta MP_t, x_t)$ is the τ-th quantile of average output gap[5] at h-quarter (ahead) horizon, MP_{t-1} represents the number of changes in macroprudential policy stance at (t-1) and x_t are the controls of GDP growth. The quantile regression is estimated for 10^{th} – 90^{th} percentiles and over a 20-quarter horizon. The standard errors are estimated using bootstrapping. The regression is estimated using quarterly data from Q1: 2000-01 till Q3: 2023-24. The other controls of growth include interest rate (proxied by weighted average call money rate), inflation (proxied by inflation from GDP deflator and quarterly estimates backfilled by WPI inflation prior to 2011) and global GDP growth (sourced from Organisation for Economic Cooperation and Development (OECD)).

The quantile regression for credit growth is written as

$$Q_{g^{cr}_{t+h}}(\tau|\Delta MP_t, x_t) = \alpha_0 + \beta_1 MP_{t-1} + \gamma x^1_t + \epsilon_t \quad (2)$$

where $Q_{g^{cr}_{t+h}}(\tau|\Delta MP_t, x_t)$ is the τ-th quantile of average real credit growth at h-period ahead. The controls for credit growth (x^1_t) are taken as interest rate, lagged GDP growth and lagged inflation. The lagged value of GDP growth is used to control for macroeconomic demand. The effect of credit growth on output gap is estimated using a similar framework with threshold effects of credit growth included in the quantile regression.

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[5] Output gap is measured as deviation from the potential output using the HP filter.

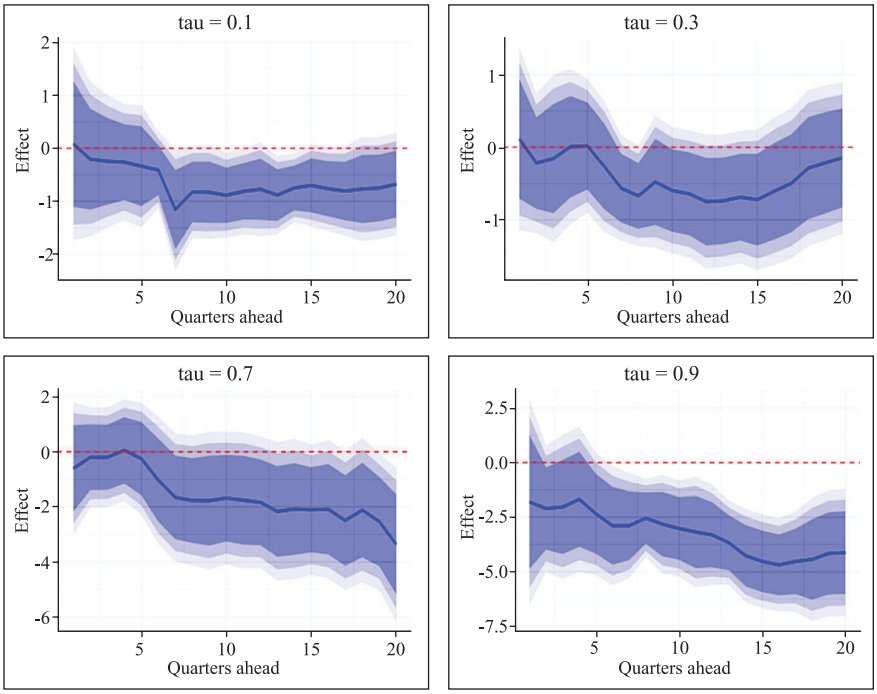
$$Q_{g^{y}_{t+h}}(\tau|\Delta MP_t, x_t) = \alpha_0 + \beta_1 \Delta NFC_t + \beta_2 \Delta NFC_t \times I_t^{Boom} + \gamma x_t^2 + \epsilon_t \quad (3)$$

where ΔNFC_t is the real growth rate of non-food credit and I_t^{Boom} is dummy variable which takes the value of 1 if real credit growth exceeds the median credit growth, otherwise zero. The parameters of interest are β_1 and $(\beta_1 + \beta_2)$ for low and high credit growth periods, respectively.

Section V
Empirical Findings

In the first leg, the effect of macroprudential policy on credit growth is evaluated across quantiles. These effects are presented along with their confidence bands, derived using the bootstrapped standard errors. When credit growth is very high *i.e.,* the credit growth is at 90th percentile, tighter macroprudential policy reduces the credit growth over the medium horizon. On the other hand, the effect is not highly significant when credit growth is low (Chart 3)[6].

Chart 3: Tail Effects of Macroprudential Policy on Credit Supply

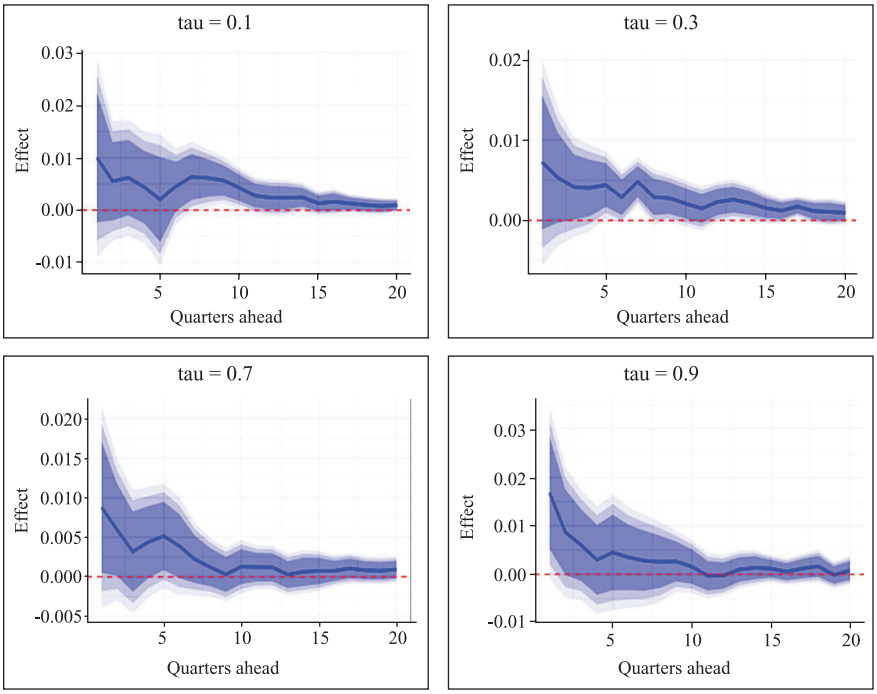


Source: Authors' calculations.

[6] The shaded regions in Charts 3 to 10 represent confidence band at 90 per cent (dark blue), 95 per cent (lighter blue) and 99 per cent (lightest blue).

The policy effect is then evaluated on the distribution of the output gap over different time horizons. Tight macroprudential policy supports output when the output gap is highly negative[7], whereas when the output gap is highly positive, it turns out to be insignificant. When the output gap is highly negative, the macroprudential policy helps in narrowing the negative output gap. The effect is significant at the 10th and 30th percentiles. On the other hand, macroprudential policy does not significantly impact output at the upper tails. This implies that the cost of implementing a tight macroprudential policy is outweighed by its benefits when the output gap is positive *i.e.*, the economy is operating above its potential level (Chart 4). Similar findings are obtained using GDP growth rates (see Chart A1.2 in Annex 1 and Chart A3.2 in Annex 3). When the economy is in slack, the relaxation in macroprudential policy helps in improving output growth by facilitating better credit supply. This aligns with the countercyclical nature of the macroprudential policies.

Chart 4: Tail Effects of Macroprudential Policies on GDP Output Gap



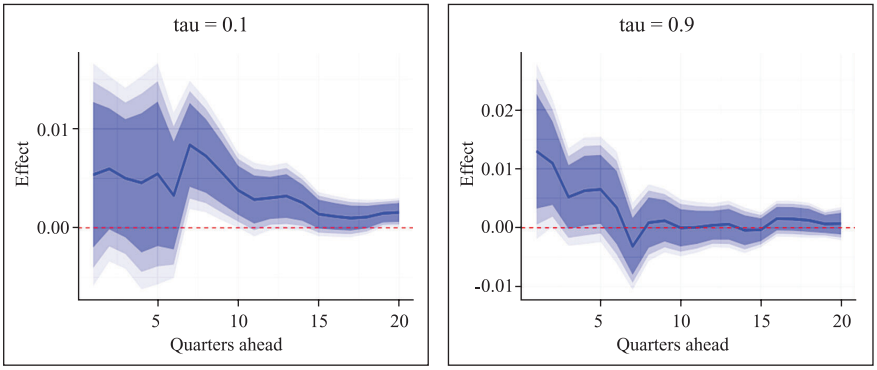
Source: Authors' calculations.

7 The lower quantiles of output gap correspond to large negative output gap.

The macroprudential policy is generally addressed to reduce systemic risks and these measures reduce default risks and strengthen banks' asset quality and health ensuring adequate credit supply across economic cycles (coefficient estimates provided in Annex 2).

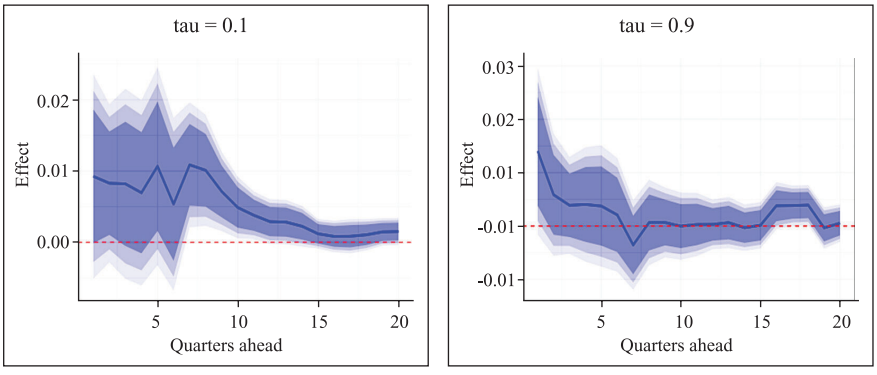
A similar effect is visible on the output gap measured using GVA. The lower tail effect of a tighter policy is even more prominently visible in this case. Further, the effect remains statistically significant over a 3-4 year horizon. Here too, the upper tail effect remains insignificant. The findings are similar in case of output gap measured using non-agriculture GVA (NAGVA) (Charts 5 and 6).

Chart 5: Tail Effects of Macroprudential Policies on GVA Output Gap



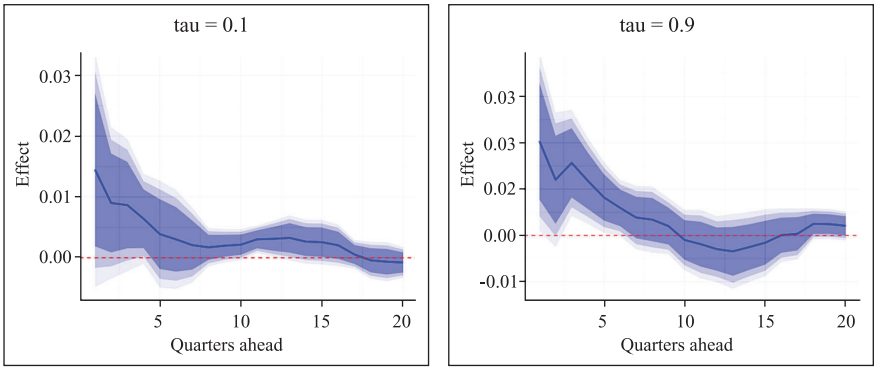
Source: Authors' calculations.

Chart 6: Tail Effects of Macroprudential Policies On NAGVA Output Gap



Source: Authors' calculations.

Chart 7: Tail Effects of Macroprudential Policies on Output Gap of Industry

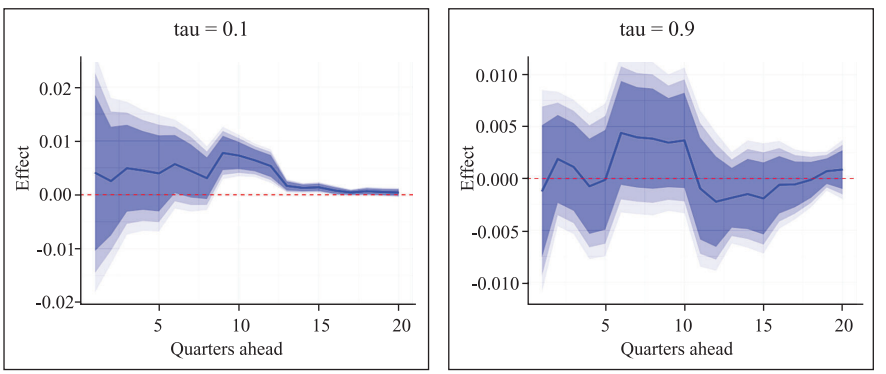


Source: Authors' calculations.

Further, the positive effect of the macroprudential policy on NAGVA is drilled down to check the tail effects on industry and services[8]. Using the same empirical framework on the output gap of industry and services, the findings highlight a positive effect of the macroprudential policy on the average output gap of industry and services at the lower tail. The effect is more prominent for services than industries (Charts 7 and 8).

Next, the tail effects of macroprudential policies are checked on PFCE and investment cycles. Like GDP growth and output gap, the tighter policy effects are visible in consumption cycles when the consumption is growing at a slower pace (*i.e.*, when the consumer growth is in the 10th percentile of its distribution). The upper tail (*i.e.*, when the consumer growth is in the 90th percentile of its distribution) effects are statistically insignificant (Chart 9).

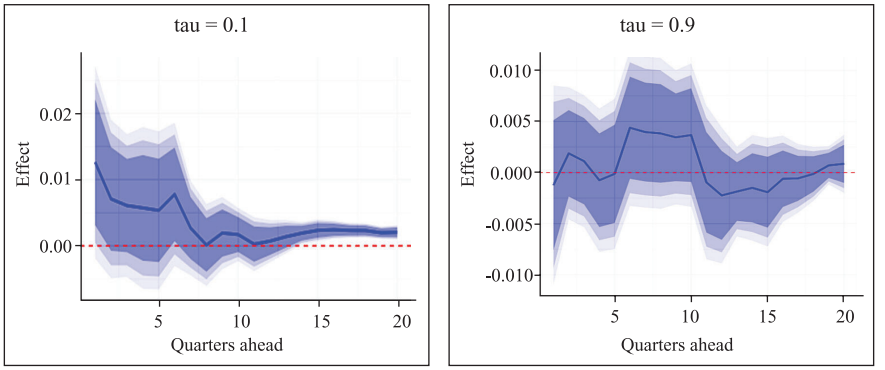
Chart 8: Tail Effects of Macroprudential Policies on Output Gap of Services



Source: Authors' calculations.

[8] The tail effect on agriculture is not considered in this analysis. This is because agricultural activities in India are primarily driven by rainfall and weather conditions.

Chart 9: Tail Effects of Macroprudential Policy on the Consumption Cycle

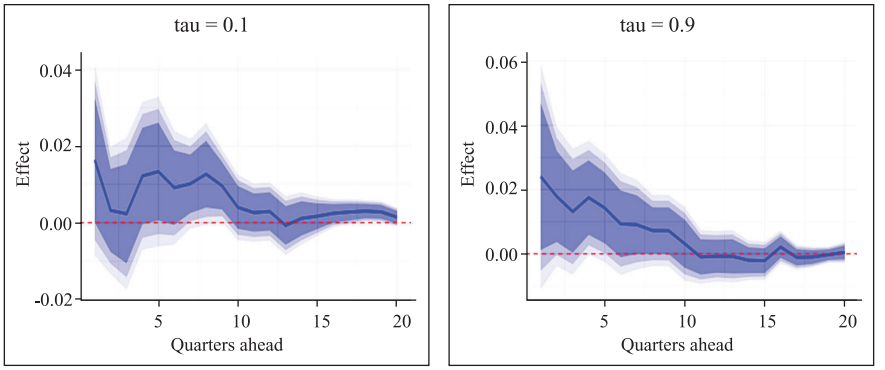


Source: Authors' calculations.

The lower tail effect of tighter policies improves investment over the medium term, but the effect is weakly significant. The upper tail effect is statistically insignificant (Chart 10).

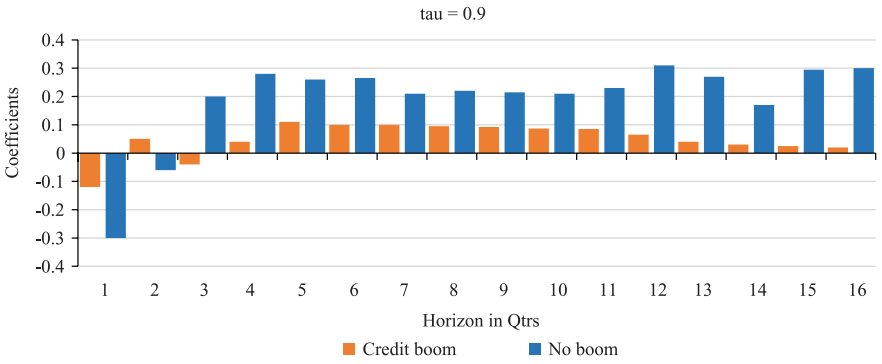
The analysis suggests that credit growth moderates in response to a restrictive macroprudential policy shock when it is already high. On the other hand, the effects of the macroprudential policy on the lower tail of the output gap *i.e.,* when the output gap is highly negative, highlight benefits which outweigh the short-term costs of implementing these policies. In the last leg of empirical validations, the effect of credit growth on output gap is evaluated over the distribution of the output gap.

Chart 10: Tail Effects of Macroprudential Policy on the Investment Cycle



Source: Authors' calculations.

Chart 11: Effect of Credit Growth on GDP Growth on Tails



Source: Authors' calculations.

When the output gap is highly negative, credit supply facilitates economic growth over the short and medium-term horizons *i.e.*, higher credit growth facilitates faster recovery when the economic activity is below its potential. The marginal effects are more pronounced when credit growth is low. On the upper tail, *i.e.*, when the output gap is already at a higher level, the additional credit supply improves output only marginally. The effect is higher if the existing credit growth is low. Higher credit growth in such circumstances facilitates greater investments and fuels economic growth. However, if the credit growth is already at a high level, then the additional credit does not translate into higher growth (Chart 11).

We employ a number of robustness checks. As the study period covers the COVID-19 pandemic, which may contaminate the results, we attempt an estimation excluding the pandemic period. The estimates show similar effects (Charts A1.1 and A1.2 for the tail effects on credit growth and output gap, respectively, in Annex 1). Further, the estimation is carried out using year-on-year (YoY) growth rates of credit, GDP, PFCE and GFCF for full sample as well as for pre-COVID-19 period. The results are again on similar lines (Annex 3).

Section VI
Conclusion

The macroprudential policy measures play an important role in fostering financial stability. However, the short-term cost of implementing these policies often leads to debates about their net benefits. In this context, this

paper assessed the effects of macroprudential policies on the distribution of credit and output over different horizons using a quantile regression approach in a local projection framework.

The empirical analysis suggests that tighter macroprudential policies help in containing credit growth when the credit growth is already high; the effect persists in the medium to long term. The normalisation of macroprudential policies from their earlier restrictive state improves output by narrowing the negative output gap at the time of economic slackness. However, the effect is statistically insignificant when output growth is highly positive. Using different measures of the output gap, we observe similar effects. We observe statistically significant favorable effects of normalisation of macroprudential policies especially on the services sector when it is performing below its potential. A tighter policy stance ensures financial stability by moderating credit growth, facilitating higher output over the medium term. Overall, the benefits of the macroprudential policy outweigh its costs.

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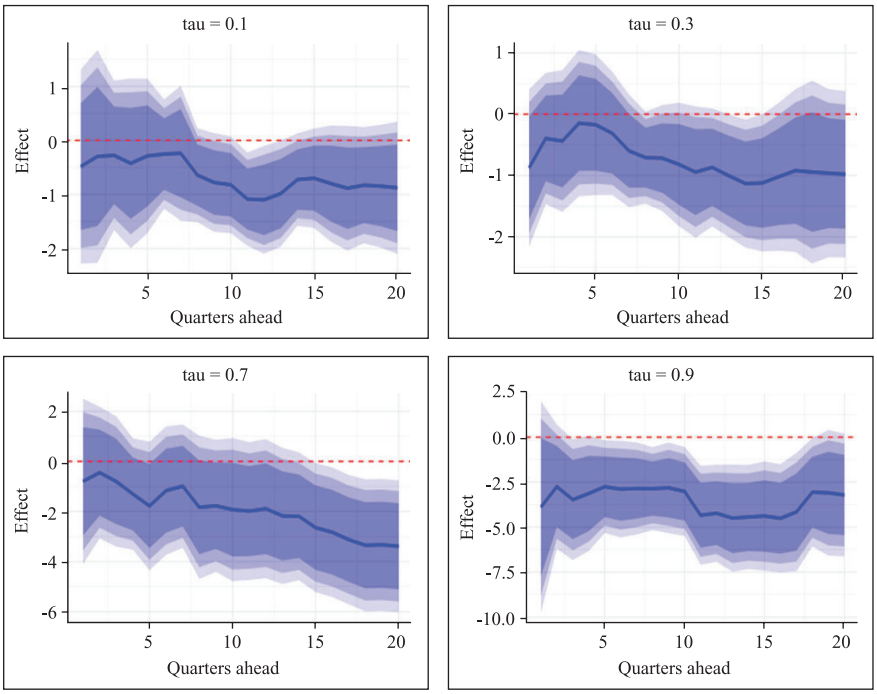
Annex 1: Pre-COVID-19 Period Estimates

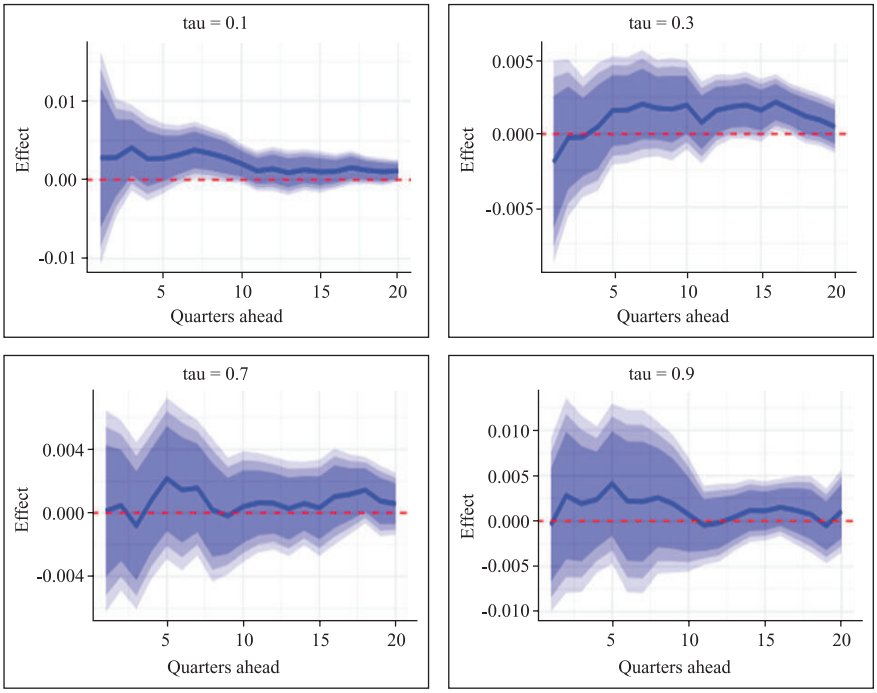
Chart A1.1: Tail Effects of Macroprudential Policy on Credit Supply[9]



Source: Authors' calculations.

[9] The shaded regions in Charts A1.1 to A1. 2 and in Annex 3 represent confidence band at 90 per cent (dark blue), 95 per cent (lighter blue) and 99 per cent (lightest blue).

Chart A1.2: Tail Effects of Macroprudential Policies on GDP Growth



Source: Authors' calculations.

Annex 2: Quantile Regression Coefficient Estimates

	h = 1	h = 2	h = 3	h = 4	h = 5	h = 6	h = 7	h = 8	h = 9	h = 10
yl	1.414	0.797	0.498	0.443	0.252	0.062	-0.031	0.039	-0.112	-0.037
	(0.816)	(0.521)	(0.844)	(1.052)	(0.787)	(0.651)	(0.646)	(0.574)	(0.224)	(0.491)
MaPPC	-0.004	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.004	0.004
	(0.015)	(0.007)	(0.011)	(0.010)	(0.007)	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)
BC_L	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.000	-0.000
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
WGDPC	0.033	0.016	0.010	0.010	0.005	0.000	-0.002	0.000	-0.004	-0.002
	(0.055)	(0.030)	(0.059)*	(0.005)	(0.010)	(0.007)	(0.009)	(0.010)	(0.006)	(0.007)
WPIL	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002
	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.001)	(0.004)	(0.003)	(0.002)	(0.002)
Num. obs.	93	92	91	90	89	88	87	86	85	84
Percentile	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100

	h = 11	h = 12	h = 13	h = 14	h = 15	h = 16	h = 17	h = 18	h = 19	h = 20
yl	-0.141	-0.130	-0.104	-0.257**	-0.216***	-0.159*	-0.134*	-0.125*	-0.061	-0.039
	(0.186)	(0.210)	(0.181)	(0.078)	(0.061)	(0.078)	(0.053)	(0.051)	(0.059)	(0.057)
MaPPC	0.006*	0.005	0.004	0.003	0.003*	0.002	0.002*	0.001	0.001	0.001
	(0.003)	(0.004)	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
BC_L	-0.001	-0.001	-0.001	-0.001**	-0.001***	-0.000*	-0.000*	-0.000*	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
WGDPC	0.000	0.002	0.002	0.001	0.001	-0.003	-0.003	-0.002	-0.002	-0.002
	(0.002)	(0.010)	(0.009)	(0.004)	(0.001)	(0.004)	(0.002)	(0.003)	(0.003)	(0.001)
WPIL	-0.001	-0.000	-0.000	0.000	0.000	-0.000	-0.000	-0.000	-0.000	-0.001
	(0.002)	(0.002)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Num. obs.	83	82	81	80	79	78	77	76	75	74
Percentile	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100

	h = 1	h = 2	h = 3	h = 4	h = 5	h = 6	h = 7	h = 8	h = 9	h = 10
yl	1.480***	0.889***	0.556***	0.506***	0.398	0.182	0.148	0.014	-0.011	0.041
	(0.179)	(0.127)	(0.120)	(0.135)	(0.302)	(0.249)	(0.192)	(0.090)	(0.063)	(0.109)
MaPPC	-0.000	0.000	0.001	0.001	0.001	0.003	0.003	0.004***	0.003**	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.003)	(0.002)	(0.001)	(0.001)	(0.002)
BC_L	-0.001**	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
WGDPC	0.034***	0.017**	0.011	0.010	0.008	0.003	0.002	-0.000	-0.002	0.002
	(0.001)	(0.005)	(0.006)	(0.007)	(0.022)	(0.020)	(0.006)	(0.003)	(0.002)	(0.006)
WPIL	-0.001**	-0.001	-0.001**	-0.001**	-0.001***	-0.001	-0.001**	-0.001***	-0.002**	-0.002**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Num. obs.	93	92	91	90	89	88	87	86	85	84
Percentile	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300

	h = 11	h = 12	h = 13	h = 14	h = 15	h = 16	h = 17	h = 18	h = 19	h = 20
yl	0.010	-0.040	-0.066	-0.217***	-0.219***	-0.210***	-0.173***	-0.147***	-0.100*	-0.087***
	(0.078)	(0.083)	(0.090)	(0.053)	(0.047)	(0.046)	(0.031)	(0.025)	(0.038)	(0.018)
MaPPC	0.003*	0.003*	0.003	0.003**	0.003***	0.003**	0.002**	0.001***	0.001*	0.001
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
BC_L	0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
WGDPC	0.003	0.003	0.002	0.001	0.001	-0.002	-0.001	-0.001	-0.001	0.000
	(0.003)	(0.006)	(0.006)	(0.003)	(0.001)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
WPIL	-0.002**	-0.002*	-0.001*	-0.001**	-0.001*	-0.001*	-0.001***	-0.001***	-0.001***	-0.001**
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Num. obs.	83	82	81	80	79	78	77	76	75	74
Percentile	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300

	h = 1	h = 2	h = 3	h = 4	h = 5	h = 6	h = 7	h = 8	h = 9	h = 10
yl	1.457***	0.671***	0.555**	0.508***	0.386***	0.331**	0.145***	0.075	0.017	0.014
	(0.087)	(0.132)	(0.167)	(0.119)	(0.105)	(0.102)	(0.040)	(0.080)	(0.043)	(0.073)
MaPPC	0.001	0.004	0.003	0.002	0.003	0.003	0.005***	0.003	0.002	0.002
	(0.001)	(0.002)	(0.004)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
BC_L	0.000	-0.000	0.000	0.000	0.000	0.000	0.000*	0.000	0.000***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
WGDPC	0.034***	0.017*	0.011	0.011	0.009	0.007	0.006***	0.005	0.003	-0.000
	(0.002)	(0.007)	(0.011)	(0.008)	(0.004)	(0.004)	(0.001)	(0.005)	(0.003)	(0.004)
WPIL	-0.000	0.001	0.000	0.000	0.000	-0.001**	-0.001**	-0.002*	-0.002***	-0.002***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Num. obs.	93	92	91	90	89	88	87	86	85	84
Percentile	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700

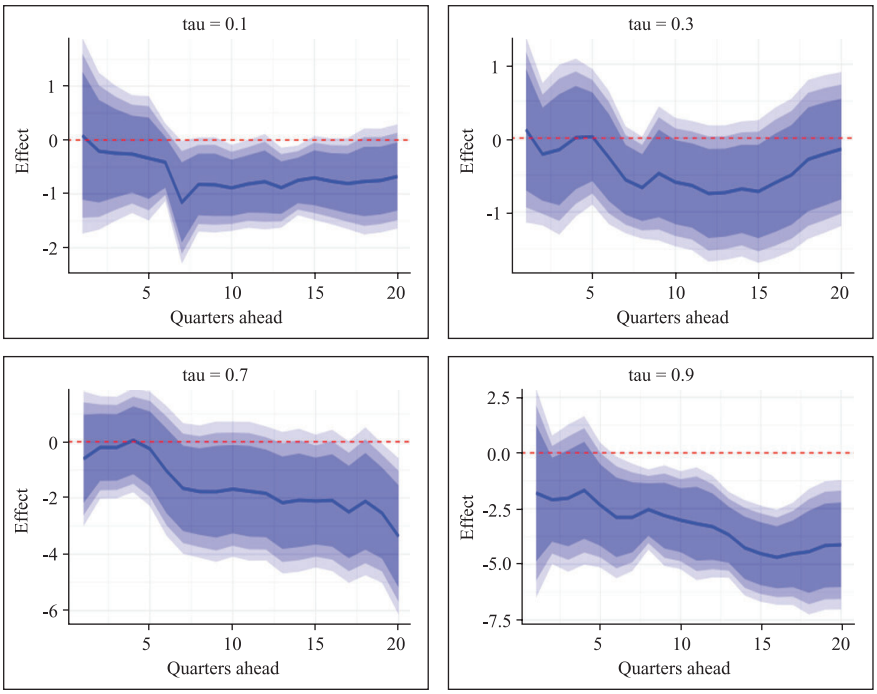
	h = 11	h = 12	h = 13	h = 14	h = 15	h = 16	h = 17	h = 18	h = 19	h = 20
yl	-0.032	-0.026	-0.044	-0.193***	-0.226***	-0.227***	-0.158***	-0.199***	-0.146***	-0.132***
	(0.064)	(0.096)	(0.113)	(0.051)	(0.031)	(0.044)	(0.040)	(0.032)	(0.022)	(0.029)
MaPPC	0.001	0.002	0.001	0.001	0.002**	0.001	0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
BC_L	0.001***	0.001***	0.001***	0.001***	0.001**	0.001***	0.000**	0.000*	0.000**	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
WGDPC	-0.001	0.001	0.002	0.002	0.003*	0.002	0.002	0.002	0.001	0.002*
	(0.003)	(0.002)	(0.002)	(0.005)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
WPIL	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.001***	-0.001*	-0.001**	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Num. obs.	83	82	81	80	79	78	77	76	75	74
Percentile	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700

	h = 1	h = 2	h = 3	h = 4	h = 5	h = 6	h = 7	h = 8	h = 9	h = 10
yl	1.269***	0.712*	0.556	0.522	0.344	0.240	0.227	0.058	-0.067	0.185
	(0.368)	(0.338)	(0.337)	(0.365)	(0.308)	(0.371)	(0.362)	(0.384)	(0.489)	(0.362)
MaPPC	0.001	0.004	0.006	0.004	0.004	0.006	0.005	0.002	0.000	0.001
	(0.006)	(0.005)	(0.006)	(0.005)	(0.007)	(0.005)	(0.005)	(0.011)	(0.010)	(0.007)
BC_L	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
WGDPC	0.033	0.017	0.012	0.011	0.009	0.007	0.007	0.005	0.004	0.003
	(0.019)	(0.012)	(0.011)	(0.012)	(0.025)	(0.011)	(0.021)	(0.036)	(0.035)	(0.011)
WPIL	0.000	-0.000	0.001	0.001	0.001	0.001	0.000	-0.000	-0.001	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Num. obs.	93	92	91	90	89	88	87	86	85	84
Percentile	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900

	h = 11	h = 12	h = 13	h = 14	h = 15	h = 16	h = 17	h = 18	h = 19	h = 20
yl	0.129	0.089	0.126	-0.050	-0.276*	-0.238***	-0.302***	-0.295**	-0.250*	-0.234
	(0.379)	(0.381)	(0.280)	(0.159)	(0.125)	(0.059)	(0.085)	(0.106)	(0.103)	(0.199)
MaPPC	0.001	0.000	0.000	-0.000	0.001	0.001	0.001	0.001	0.001	0.000
	(0.005)	(0.008)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
BC_L	0.001	0.001	0.001*	0.001***	0.001**	0.001***	0.001***	0.001**	0.001*	0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
WGDPC	0.002	0.001	0.002	0.002	0.003	0.004	0.004	0.004	0.004	0.004
	(0.011)	(0.018)	(0.012)	(0.004)	(0.005)	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)
WPIL	-0.002	-0.002	-0.002*	-0.002***	-0.002**	-0.002**	-0.002**	-0.001	-0.001	-0.000
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Num. obs.	83	82	81	80	79	78	77	76	75	74
Percentile	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900

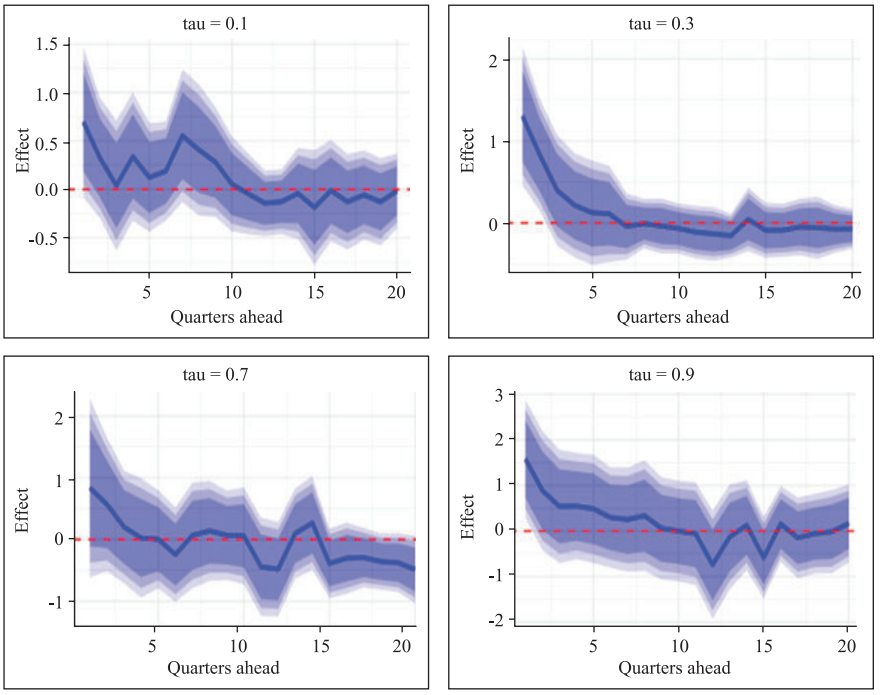
Annex 3: Tail Effects of Macroprudential Policies on YoY Growth Rates (Full Sample)

Chart A3.1: Effect on Credit Growth Rate (Full Sample)



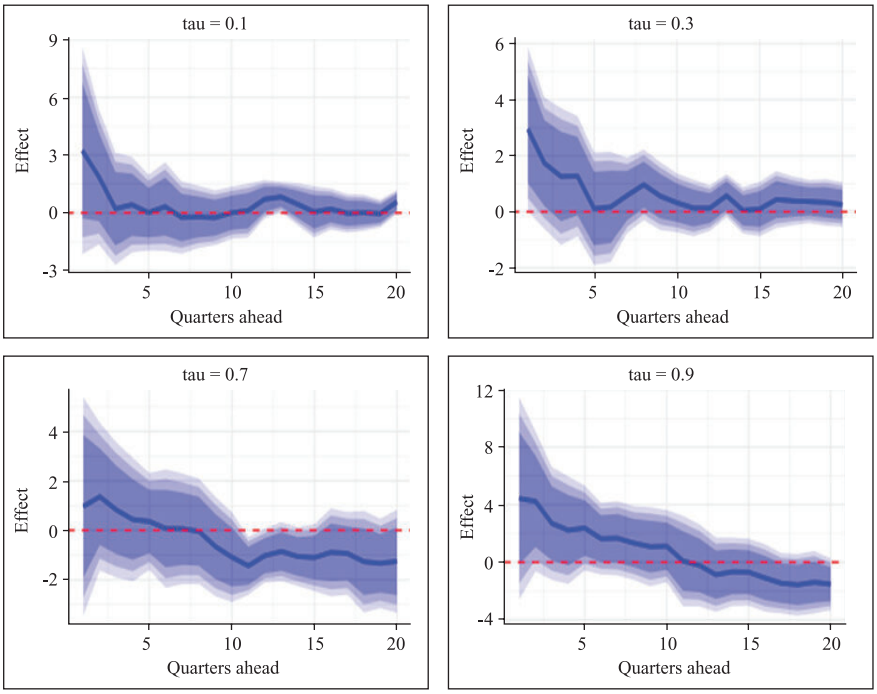
Source: Authors' calculations.

Chart A3.2: Effect on GDP Growth Rate (Full Sample)



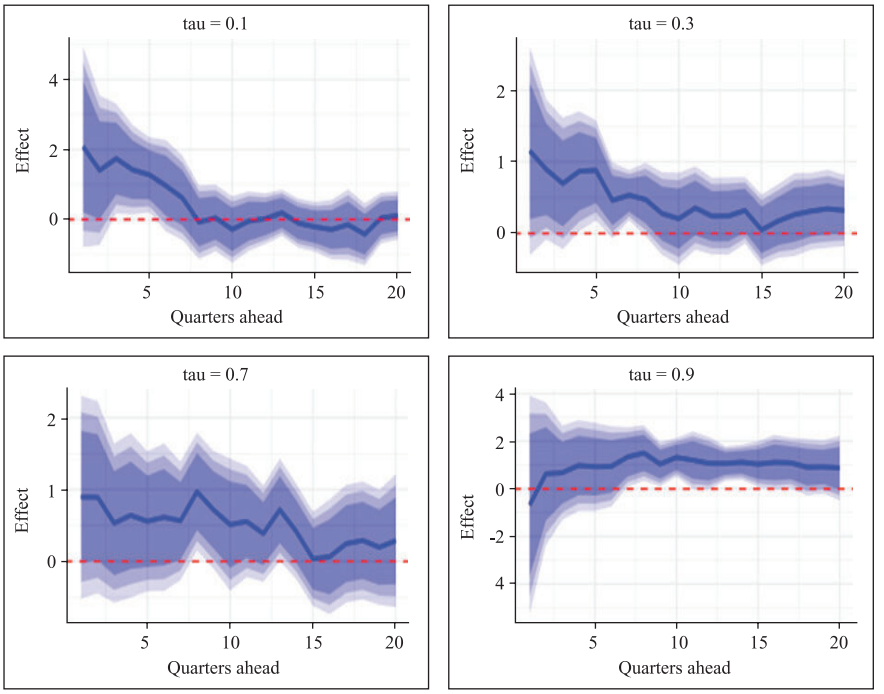
Source: Authors' calculations.

Chart A3.3: Effect on Investment (Full Sample)



Source: Authors' calculations.

Chart A3.4: Effect on Private Consumption



Source: Authors' calculations.

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How Economics Can Save the World: Simple Ideas to Solve Our Biggest Problems by Erik Angner, 288 pp, Penguin Business Press (2023), ₹799

Thomas Carlyle, a 19th century British historian, referred to economics as a dismal science. In "How Economics Can Save the World", Erik Angner aims to defend the discipline by offering real, actionable, and evidence-based solutions to the biggest problems that confront humankind. As a Professor of Practical Philosophy at Stockholm University and the author of "Hayek and Natural Law" (2007) and "A Course in Behavioral Economics", Angner brings to the table a wealth of expertise to support his compelling arguments in favour of the transformative power of economics in shaping a more equitable and sustainable world.

In the ten chapters of the book, Angner addresses issues that are not conspicuously related to economics, while focusing on the economic tools available to both individuals and policymakers to navigate these issues. Angner's approach is refreshingly accessible, devoid of technical jargon and favours simple and easy-to-understand economic theories. The book draws from psychology, neuroscience, literature and theology to tackle questions that range from how to solve the climate crisis, to how to be good parents, as well as how to be happy.

The book starts with an introduction that provides a historical perspective on the evolution of economics, highlighting what economics was, should have been, should be and now is. Angner emphasises that economics is not solely, or even primarily, about making predictions. It is a moral and social science that encompasses a broader understanding of all aspects of human desires, behaviours, and activities. He illustrates the multifaceted nature of the economic inquiry, utilising tools as diverse as laboratory experiments, field studies, field experiments, surveys, economic theories and econometric models while underlining the "economic way of thinking".

Angner initially dives into the monumental question of how to eliminate poverty. The economic approach assumes that the only factor distinguishing the poor from the non-poor is money, and nothing else. Behavioural economists Sendhil Mullainathan and Eldar Shafir claim that the problem is exacerbated

by the feeling of scarcity rather than scarcity itself, as it reduces people's bandwidth to notice, focus, deliberate, choose and make wise economic decisions. As such, giving poor people money, resources, opportunity, and making their lives easier to alleviate the feeling of scarcity will solve the problem of poverty, even if it involves taking from the rich. This perspective is shared by economists like Abhijit V. Banerjee and Esther Duflo, who support unconditional cash transfers as they are cheap, easy to manage, fair, and respect people's autonomy and dignity. Despite concerns about the misuse of funds or disincentivising work, empirical evidence in the form of randomised control trials by Johannes Haushofer and Jeremy Shapiro in rural Kenya suggests that such fears are unfounded.

While analytical egalitarianism dictates that the poor cannot be blamed for their poverty, in the chapter "How to get rich", Angner states that empowering individuals to make better financial choices does not contradict efforts to address systemic poverty, as the former involves thinking on the margin. The author advocates saving whenever you can and investing in index funds over individual assets due to their cost-effectiveness and diversification benefits, underpinned by the belief that markets are largely efficient. Borrowing judiciously is encouraged for consumption smoothing, but the importance of skill development to enhance earning potential is also emphasised. By adhering to these principles, individuals can better navigate the complexities of personal finance and pursue long-term prosperity.

Angner invokes the diminishing marginal happiness of money and the Easterlin paradox[1] to highlight an advantage of redistribution of wealth - maximising total happiness in a society. Economist Tibor Scitovsky suggests sacrificing comfort and spending money on things and activities that provide pleasure for sustained happiness, as the temporary boost in happiness subsides after people get used to the comforts. The economics of happiness also suggest that people can control their happiness levels by regulating aspirations and avoiding comparisons.

In addressing the challenge of "changing bad behaviour", the book explores the groundbreaking work of game theorist Cristina Bicchieri, who

[1] Easterlin paradox (after Richard A. Easterlin) states that while happiness varies directly with income, it does not trend upward in correspondence with income growth over time.

focused on reshaping social norms. Angner elucidates the concept of social norms – how they are formed, how they sustain despite their harmful effects, and strategies for altering them. Bicchieri's work emphasised that merely providing resources and information is insufficient for tackling deep-rooted issues like child marriage, female genital mutilation, or open defecation, as these behaviours are often upheld by entrenched social norms and can override individuals' beliefs about right and wrong. However, research indicates that if a critical mass of individuals, around one-quarter according to some of the studies, deviate from the norm, it can trigger a cascading effect leading to the establishment of new norms. Thus, rapid social change is possible. The key lies in altering expectations, even when it is not preceded by a shift in the underlying values.

The author takes the idea of reshaping social norms further in the chapter titled "How to build community" by invoking the work of economist Elinor Ostrom, who championed the cause for economics by bringing out the best in people and fostering positive societal outcomes. She envisioned a polycentric society, rejecting the dichotomy between society and the state, and proposed that economists act as facilitators of self-governance. Game theory problems like the tragedy of the commons and prisoners' dilemma in real-life situations illustrate that individual rationality may not align with societal well-being. However, individuals have agency in choosing the "game" they play and altering its rules by setting boundaries and building institutions that can prevent unfavourable outcomes. Such institutions should be locally-driven, appropriately scaled, reflect community values, and incorporate monitoring and sanctions to deter free-riding. These institutions should blur the lines between individual and collective interests, operate with the consent of the governed, and feature conflict-resolution mechanisms, while also gaining recognition from governmental authorities. Through these principles, Ostrom offered a framework for addressing complex social dilemmas and fostering cooperative solutions.

In addition to fostering communities and driving social change, economics also offers valuable insights for personal growth and humility. Angner believes that overconfidence permeates various aspects of human decision-making, proving out to be both pervasive and costly, contributing

to financial crises, accidents, and even wars. It acts as a force multiplier and gives an extra bite to other cognitive biases. Calibration, the alignment between subjective beliefs and objective reality, is therefore crucial; when subjective probabilities exceed actual frequencies, overconfidence ensues. Selection bias, hindsight bias, and a lack of feedback further perpetuate it. The author recommends strategies to mitigate overconfidence based on half a century of data, including considering alternative perspectives, seeking constructive feedback, and recognising one's 'circle of competence'. In doing so, individuals can make more informed decisions, grounded in empirical evidence and self-awareness.

The book also addresses the seemingly unrelated question of raising happy children while maintaining parental sanity and offers a rational and evidence-based approach amidst a flood of often contradictory and unsupported parenting advice. Building on the perspectives of economist Bryan Caplan, who views parenting as a significant upfront investment of time, attention, and financial resources, Angner underscores the economic nature of parental choices, which entail an opportunity cost and consequences for both parents and children. He highlights the insights of Emily Oster, who applied economic principles of rational choice to parenting decisions. While data analysis and randomised control trials can provide practical default options and advice on practices such as co-sleeping and sleep training, Oster emphasises the importance of considering individual circumstances, preferences, and uncertainties in such decisions.

Angner also believes that unregulated free markets may not always deliver the best results, and government intervention can sometimes improve what the markets deliver. In this vein, in the chapter titled "How to fix climate change", the author advocates the implementation of Pigouvian taxes on polluters, as also endorsed in "The Economists' Statement on Carbon Dividend". Such taxes can aid in internalising the negative externality of carbon emissions and align marginal social costs to the marginal benefits, leading to efficient production. Angner asserts that carbon taxes, irrespective of the level of taxation, along with import duties on goods from non-compliant countries, can drive innovation and encourage the transition to more sustainable production methods. Economist Julius J. Anderson's study in Sweden has shown that such taxes effectively cut emissions. When combined with measures like energy

efficiency standards, they can drive substantial progress in fighting climate change without causing any harm.

The chapter titled "How to give people what they need" explores other areas where traditional markets may not provide the best outcomes. Here, Angner highlights the innovative approach of economist Alvin E. Roth[2], wherein rather than starting with a pre-existing market structure, he advocates beginning with the desired outcome and designing a market to facilitate it. One of his notable successes is in addressing the matching problem in kidney donation through market creation and centralised clearing houses. By developing trading cycles or chains, Roth argues that all participants in the kidney exchange reached a Pareto-optimal outcome, revolutionising the transplantation practices in the US. Angner underlines the importance of well-functioning markets, characterised by traits such as thickness, lack of congestion, safety, and simplicity in delivering positive outcomes. Moreover, market designers must be attuned to the values of the communities they serve and strive to make the world a better place through their designs.

In conclusion, Angner's book underscores the importance of acknowledging the relevance of economics in areas where it may not be immediately apparent. It emphasises that the discipline does not exist in isolation and the values and ideologies of a society play a critical role in shaping economic theories. While Angner tends to go overboard in defending the discipline at times, he also draws attention to the need for economists to be more inclusive, transparent, and open to interdisciplinary dialogue. Ultimately, the book is a call to leverage the insights of social sciences in general, and economics in particular, to address contemporary challenges more effectively.

Sambhavi Dhingra*

[2] Roth built an entire sub-discipline of economics called market design or mechanism design.

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Money in One Lesson: How it Works and Why by Gavin Jackson, 400 pp, Macmillan (2022), ₹666

The impact of money is overarching owing to its ubiquitous role in our day-to-day lives. This book is one of the many recent attempts to deconstruct the mystique of money with sincerity to equip readers to make sense of the daily news and developments that take place in the field of finance. The author, with extensive experience as a correspondent with *The Economist* and *Financial Times*, channelises his professional learnings to deliver this information-intense book. A brief introduction of the book by the author is followed by 12 chapters, each of which deals with different dimensions revolving around the idea of money.

The first chapter of the book sheds light on the basics of what constitutes money through the example of events in Ireland in 1970. During this period, there was a half-year long strike by six of Ireland's largest banks that resulted in a complete shutdown of the banking system. In the absence of clearing and settlement mechanisms provided by banks, the mantle was taken up by the country's numerous pubs, which acted as exchange houses for carrying out day-to-day banking-related activities by its citizens, based on the public trust and reputation. The author then touches upon the important functions of money, *viz.,* medium of exchange, store of value and unit of account, and uses various historical insights to explain each function. The author concludes the chapter by delineating as to what constitutes modern money, including the notion of a 'fiat currency', the critical role of reserves and the importance of modern-day central banks.

In the second chapter titled "How do banks work?", the author delves into the mechanism of how modern banks work. He argues that elements like trust, management skills and liquidity underpin the transactions *via* banks. He touches upon the anatomy of a bank's balance sheet, and how it has led to the evolution of fractional reserve banking. The idea of "maturity transformation", wherein banks tend to undertake short-term borrowings in order to provide long-term loans is also explored, followed by a story of one of the earliest recorded bank run and bank bailout that took place in Sweden in

1664. The importance of holding a large amount of capital as a proportion of a bank's total assets is highlighted. The criticality of leverage is explained by the author using an interesting reel-life (as displayed in the 2019 Hollywood movie Uncut Gems) example along with a real-life (as witnessed during the Global Financial Crisis (GFC) of 2008) one. The chapter ends with the evolution of central banks and the monumental role played by them in keeping the financial system resilient and stable.

The third chapter titled "Why do we pay interest?" focuses on the historical and theoretical origins of the idea of interest. A brief introduction to the concept of interest and capital as espoused by theorists such as Wicksell, Böhm-Bawerk, Marx and Keynes has been provided, along with a case-in-point example of the lending mechanisms involved in the loans provided to the Parmesan cheese manufacturing farmers of Italy by the regional banks. The impact of negative interest rates, an unconventional monetary policy tool, that was intended to increase spending in the economy but had an adverse effect on pension funds and insurance companies, is analysed by the author.

The concept of inflation is dealt with in the fourth chapter titled "Where does inflation come from?" through the example of the demand and supply of cowrie shells in West Africa during the medieval era, where these were used as currency. It discusses the issues relating to velocity of money, while also providing insights into the contribution of Fischer, Phillips and Friedman to the major theories revolving around inflation. Lessons for monetary policymakers from Paul Volcker's experiment administering interest rate shocks to the US markets to tackle double-digit inflation has been discussed in this chapter. Volcker's interventions largely succeeded in draining excess liquidity out of the US economy to significantly bring down inflation and established a template for central bankers facing similar situations in future.

Chapter five of the book begins with the story of the evolution of London as a financial metropolis and emergence of the US dollar as the dominant global currency. The proceedings that took place at the Bretton Woods conference in 1944 led to the formation of the World Bank and the International Monetary Fund (IMF) as well as the introduction of the gold standard (which lasted till 1971) showcased the commanding role played by the US in the global economy. The IMF has emerged as a global creditor and has been providing conditional finance to troubled economies ever since. The

author has presented the case study of Argentina, which received multiple rounds of bailouts from IMF. The chapter concludes with a description of the steps taken in Europe to rebuild its economy after the end of the Second World War that led to the genesis of the Euro and the pivotal role played by Germany in it. The author feels that Euro has not been able to match the popularity of the US dollar in the global market, as it lacks the depth and liquidity of the US financial markets and due to lingering trust issues between various countries in the Euro bloc.

Chapter six titled "Why don't governments just print money?" provides a primer on the power of central banks to act as the sole agencies for printing money and the associated mechanisms, including quantitative easing which was used extensively by the Fed after the GFC. However, rampant flooding of the economy with newly printed money can also lead to hyperinflation as was observed in Weimar-era Germany and Zimbabwe. Debt management is also a tricky job for the governments and central banks around the world, with the possibility of default, such as the one faced by Greece during the tumultuous years of the GFC. Japan, which has the highest public debt-to-GDP ratio in the world, has been facing a persistently low growth and low inflation since the early-1990s. The dynamic relationship between governments and central banks floats on thin ice; the author discusses this relationship as part of the recent ideas of Modern Monetary Theory.

The seventh chapter of the book titled "Why do countries use different money?" provides an insight into the origins of various modern-day currencies around the world and the Asian Financial Crisis of 1997, which was primarily caused by liberal capital flow policies and build-up of credit bubbles in East Asian nations that eventually led to collapse of currency exchange rates and economic downturn. The economies that suffered the crisis subsequently undertook capital control measures to prevent the repeat of such instances in the future. The chapter provides an analysis of the current global norms pertaining to cross-border capital flows.

Chapter eight titled "Can more money make us rich?" begins with the various theoretical ideas propagated by Adam Smith and explores the trade-related power dynamics that existed during the era of imperialism and Industrial Revolution, while also venturing into a debate on the importance of productivity in an economy. The chapter then veers into the ideas of Friedrich

Hayek on neutrality of money, and the merits of a free market economy. The author argues that understanding the causes of the Great Depression of 1929 and the implications of the mitigative actions taken by the US Fed served as important lessons in managing the GFC.

Chapter nine titled "How do we save money?" discusses the different methods of savings by the public, including the Chilean pension system and chit funds in India. It is then followed by a discussion on the importance of concepts such as risk, statistical modelling and diversification in matters of decision-making pertaining to everyday finance. The author also looks into the complexities surrounding modern-day hedge funds.

Chapter ten begins with the demonetisation of ₹1000 and ₹500 notes in India in November 2016 and the mushrooming of a robust digital payment infrastructure in India. The author then highlights the global rise of cryptocurrencies, such as Bitcoins, which were designed as a decentralised tool of finance, serving as an alternate currency system based on libertarian ideals. The author opines that cryptocurrencies have not been very successful in fulfilling the three traditional functions of money due to high price volatility, being an inadequate store of value and acting as unreliable means of exchange, clubbed with a negative image of being used for illegal activities. The case study of Facebook's push for Libra (now known as Diem) as a widely accepted stablecoin (with its value pegged to a basket of currencies) and the reasons for its downfall have also been discussed in this chapter. Stablecoins are prone to extreme redemption pressures, and have also witnessed periodic collapses, thereby, adding to financial stability concerns[1]. Central Bank Digital Currencies (CBDCs) are currently an area of intense scrutiny for most central banks around the world, and hold promise of being an important stage in the evolution of money.

The eleventh chapter titled "Can money save the world?" talks about the issues of climate change, global warming, the resulting potential risks faced by the global financial system and the role of central banks in tackling these challenges. These developments have led to the adoption of new mechanisms like green finance; Environmental, Social and Governance (ESG) investing; and carbon trading, while raising concerns about greenwashing.

[1] Financial Stability Report, June 2023, Reserve Bank of India.

The final chapter of the book titled "Has money made us unequal?" reflects on the observable trend of the rising global inequality. The author also discusses the social welfare models followed by Sweden, which ensure publicly-funded healthcare and education for all its citizens through high taxation, and the US, which has lower tax rates and pursues less egalitarian policies towards its citizens. According to the author, although statistically, inequality is higher in Sweden than in the US, the poor in Sweden are in a less precarious situation due to better access to government-funded initiatives. The author also provides an enquiry into the intersection of money and gender in the modern world and suggests that the world of money is more resistant to the idea of gender equality. This is reflected in the poor representation of women in various academic disciplines on money and finance. It sums up how money dictates every activity of human life and will continue to do so in the foreseeable future.

In sum, the author covers most of the contemporary topics pertaining to money using a balanced approach. The vivid usage of relatable examples as well as comprehensive referencing makes the book a lucid read, demystifying money and its associated concepts, while also touching upon various topics pertaining to macroeconomics.

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Handbook of Real Estate and Macroeconomics by Charles Ka Yui Leung (*ed.*), 480 pp, Edward Elgar Publishing Ltd (2022), £203

The real estate sector plays a vital function in an economy as a store of wealth. However, standard macroeconomics textbooks only loosely allude to the importance of the real sector by discussing the fluctuation in housing prices leading to a wealth effect, and thereby affecting consumption and gross domestic product (GDP). It is against this backdrop that the book "Handbook of Real Estate and Macroeconomics" edited by Charles Ka Yui Leung presents a set of academic papers to give a deeper exposure to the interactions between real estate and macroeconomics and their effects on economic conditions from various countries across the world.

The book is divided into four parts with separate themes. The first part is titled as "Real estate-related wealth and macroeconomics", which deals with the real estate-related wealth effects and related questions. The chapter "Real estate market and consumption: Macro and micro evidence of Japan" by Kazuo Ogawa discusses the interaction between the real estate market and consumption in Japan. The real estate market can affect consumption through two channels: one is the wealth effect channel on the lines of the life cycle permanent income hypothesis of consumption (LCY-PIH), wherein consumption is determined by total wealth, including tangible wealth. The second is the collateral channel, where consumption depends on net worth, which gets affected by the changes in the balance sheet due to changes in the valuation of real estate. This can affect the ability to raise external finance. Using a Vector Autoregression (VAR) model on the quarterly time series data from 1980 to 2018, the author finds the collateral channel to dominate in propagating the shocks in land prices to consumption through consumer borrowing. Another interesting finding of this paper is the significant positive impact of housing wealth on consumption in case of younger households (whose heads were aged below 50 years) and not for the older households.

In the chapter "The Bank of Japan as a real estate tycoon: Large-scale REIT purchases", Bank of Japan's (BOJ) real estate investment trusts (REIT) share purchase programme is studied in detail by Takahiro Hattori and Jiro

Yoshida; it highlights the discretionary purchases by BOJ of REIT shares, which effectively aimed at reducing the risk premiums.

In the chapter, "Land and macroeconomics" using a quasi-experimental setup with a flexible event-study design and the difference-in-differences technique to identify the causal effect of land reforms on urbanisation, Prasad Sankar Bhattacharya highlights land reform implementation across the world. Land reforms involving the transfer of end-user rights to beneficiaries led to an increased urbanisation over time as compared to land reforms without the provision of transfer of end-user rights.

Another essential issue connecting real estate and macroeconomics is housing affordability, which is dealt with in the second part of the book titled "Housing price dynamics and affordability". The chapter "Affordable housing conundrum in India" highlights that inadequate housing should not be simply seen as the need to build more houses. It is necessary to work on upgradation, extension, and rebuilding of the existing houses before building new houses. The authors, namely Piyush Tiwari and Jyoti Shukla, argue that policies that encourage the development of smaller houses with the possibility of extension in future would improve affordability of housing for low- and middle-income households in India.

The chapter "The effect of macroeconomic uncertainty on housing returns and volatility: Evidence from US state-level data" by Reneé van Eyden, Rangan Gupta, Christophe André and Xin Sheng estimates a dynamic factor model with time-varying loadings and stochastic volatility (DFM-TV-SV) using Bayesian methods to dissect national and local factors affecting housing returns and volatility in the 50 US states and the district of Columbia. They then employ panel data methods with heterogenous coefficients to relate the first and second order moments with corresponding state-level uncertainty. They find that almost all states have a positive and significant relationship between macroeconomic uncertainty and the stochastic volatility measure. However, only 12 to 14 states show a significant negative relationship between uncertainty and housing returns.

Another interesting area of study is the structural change in housing market following a major event. A natural candidate in the recent past for this is the Global Financial Crisis (GFC), which is the theme of the third part of the

book titled "Financial crisis and structural change". The chapter "Is housing still the business cycle?" revisits residential investment's impressive ability to predict US GDP in the years before the GFC. The author (Richard K. Green) conducts Granger causality tests with the new data available after GFC and finds no evidence of residential investments causing GDP once data from 2008 onward is considered. On whether housing has ceased to be an instrument of monetary policy, the chapter argues that the Federal funds rate no longer influences new constructions. Quantitative easing as a new policy lever after GFC allowed the Federal Reserve to influence mortgage rates and other long-term rates leading to attenuation of the influence of short-term rates. However, even though long-term rates continued to influence new construction, the levels of new construction relative to GDP remained quite low by historical standards. As has been reported in the literature[1], the regulatory constraints against housing are responsible for undermining the efficacy of this channel.

In the chapter "International macroeconomic aspect of housing", the author (Joe Cho Yiu Ng) investigates the relationship among the business cycle components of housing prices and macroeconomic variables in 22 Organisation for Economic Cooperation and Development (OECD) countries. The idea is to examine whether the correlations have changed since the GFC among the real housing prices and other macroeconomic variables such as real GDP, unemployment rate, current account balance, real short-term interest rate, real credit to households, real consumption, and consumer price index (CPI). The author concludes that the strength of the linear association between housing prices and many macroeconomic variables has changed since the GFC. For instance, the correlation between housing prices and GDP has weakened in real terms in many countries, whereas the correlation between housing prices and unemployment rate has strengthened in countries like France and Italy.

The issues related to non-residential estate are dealt in the fourth part of the book titled as "Non-residential real estate". The chapter "From the regional economy to the macroeconomy" discusses the importance of the spatial distribution of economic activity for its fluctuations and aggregate outcomes. The authors, Santiago M. Pinto and Pierre-Daniel G. Sarte, build

[1] See Hsieh, Chang-Tai, and Enrico Moretti. (2019). Housing constraints and spatial misallocation. *American Economic Journal: Macroeconomics,* 11(2):1-39.

their analytical model on the framework provided by Roback (1982), where spatial equilibrium is a state with no incentive to move to any other region, *i.e.*, profits for firms and utilities for households are equal across space. It shows that to the extent that factors of production are spatially mobile, land rent and wages will reflect the region's attributes in equilibrium. Moving from the regional level to the aggregate level, the transportation system is found to be a key determinant in the economic performance of regions, as it improves spatial access to jobs and increases connectivity between high-unemployment neighbourhoods and locations with an abundance of jobs.

The chapter "Pension funds and private equity real estate" traces the long-term relationship between private equity real estate and pension funds, as the latter hold major investments in the former. According to the author Timothy J. Riddiough, pension funds pose risks to economic and financial stability due to concentrated levels of pension fund ownership in commercial real estate (CRE). These risks include sponsor concentration risks, and geographical concentration risks with high ownership of CRE assets by pension funds in the largest cities in the US and other countries.

The chapter "A mayor's perspective on tackling air pollution" by Shihe Fu and V. Brian Viard describes the sources, social costs and mitigation policies relating to air pollution. Air pollution imposes costs on cities *via* its impact on health, mortality, psychological well-being, labour productivity, labour mobility, and out-migration. The chapter has outlined multiple policies that are effective in reducing air pollution, ranging from some forms of driving restrictions, appropriately set congestion tolls, targeted public transit infrastructure, and incentive-aligned emissions standards. The other set of policies could be to encourage active commuting (walking or biking to work), subsidised green vehicles, increased percentage of prefabricated materials in construction, and use of water-canon trucks to suppress road dust.

In conclusion, the book presents interesting insights from real-life cases across countries on the interaction of real estate and macroeconomics, having implications for households, producers, and policymakers. It could also perhaps pave the way for a deeper incorporation of real estate dynamics in the standard macroeconomics texts. The book holds useful policy implications arising from the application of real estate in areas encompassing consumption,

investment, affordability of houses, and other externalities. These policy prescriptions backed by the rigorous empirical work can help address a variety of emerging concerns ranging from macroeconomic management at the national level to air pollution at the city level.

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