Margin—The Journal of Applied Economic Research 13 : 1 (2019): 1–20
SAGE Publications Los Angeles/London/New Delhi/Singapore/Washington DC/Melbourne
DOI: 10.1177/0973801018800088

Risk-taking Channel of Monetary Policy: Evidence from Indian Banking

Sanjukta Sarkar
Rudra Sensarma

Some recent articles have studied the link between the central bank's monetary policy stance and the risk-taking behaviour of banks in the context of advanced economies. Loose monetary policy can encourage banks to reach for yield, which will increase their share of risky assets, and also induce them to use more short-term funding. We empirically examine the existence of this risk-taking channel of monetary policy transmission in India. We find that expansionary monetary policy may increase default risk particularly for foreign banks and new private sector banks. We also find that tightening of monetary policy leads to lower liquidity risk and market risk and the effects are stronger for foreign banks than for other bank groups. In terms of market risk, the effect on foreign banks is weaker in cases of monetary tightening compared to expansion.

Keywords: *Banks, Monetary Policy, Risk*
JEL Classification: *G21, G28, G32*

1. Introduction

Since the global financial crisis of 2007–2009, the question of whether low interest rates encourage bank risk-taking has been extensively debated, especially in the context of advanced economies (Altunbas, Gambacorta, & Marques-Ibanez, 2014; Delis, Hasan, & Mylonidis, 2012; Jiménez, Ongena, Peydró, & Saurina, 2014). One way in which the central bank's monetary policy stance affects bank risk-taking is when a prolonged period of low interest rates incentivises banks to 'reach for yield' (Rajan, 2005), leading to a rise in the

Sanjukta Sarkar is at the Indian Institute of Management, Bangalore, India.
Rudra Sensarma (**corresponding author**) is at the Indian Institute of Management, Kozhikode, India, email: rsensarma@iimk.ac.in

share of their risky assets. Moreover, low interest rates are likely to increase the valuation of banks' assets that could encourage them to take on more risks (Adrian & Shin, 2009). On the funding side, easy monetary policy increases incentives to use more short-term funding which exposes banks to greater risks (Adrian & Liang, 2014). These kinds of monetary policy effects have come to be known as the risk-taking channel of monetary policy transmission. This article empirically examines whether the risk-taking channel exists in the transmission of monetary policy in India.

The presence of the risk-taking channel in a banking system would suggest that monetary policy has important financial stability implications. The risk-taking channel has been previously used to explain how low interest rates caused the 2007 financial crisis (De Nicolò, Dell'Ariccia, Laeven, & Valencia, 2010). It is vital for the central bank to understand how different types of risks could emanate in different types of banks, in response to monetary policy actions. While the literature has studied how differences in ownership structures of banks affect the lending channel of monetary policy transmission (Andries & Billon, 2010; Bhaumik, Dang, & Kutan, 2011), the effect of ownership on the risk-taking channel is less explored. The role of ownership is particularly important for emerging economies that have banking systems characterised by mixed ownership. For instance, the players in India's highly competitive banking landscape range from government to private and foreign-owned banks. Such banks differ in their abilities to raise funds and have different incentive mechanisms. However, the differences in their risk behaviour in response to monetary policy have been hitherto unexplored.

In this article, we combine the two strands of the literature—on the risk-taking channel of monetary transmission and the role of ownership—to investigate how different bank characteristics, particularly their ownership structures, influence the risk-taking channel of monetary policy transmission in an emerging market. Our empirical analysis has three components. First, we test for the presence of the risk-taking channel in the Indian banking sector. Second, we investigate the effect of bank ownership on the risk-taking channel, and third, we take into account the interactions of various types of bank ownership with tight and easy monetary policy regimes. We use data for 86 Indian banks for the period 2000–2016. We employ panel data regression methodology to study the impact of ownership and monetary policy on four categories of bank risks, such as, default, liquidity, asset and market risk.

Our results suggest that an increase in policy rates can amplify default risk while a reduction can decrease the same, particularly for foreign banks and new private sector banks. However, the latter exhibit a stronger response in case of

monetary tightening rather than expansion. We also find that a tight monetary policy stance leads to lower liquidity risk and market risk, and the effects are stronger for foreign banks compared to other bank groups. However, with respect to market risk, the impact on foreign banks is weaker in the case of a monetary tightening than in the case of an expansion.

A survey of the extant literature indicates that there is a negative relationship between the central bank's policy rates and risk-taking by the banks. For the banking market in the USA, past studies suggest that prolonged periods of relatively low levels of interest rates lead to higher bank risk (Altunbas et al., 2014; Angeloni, Faia, & Duca, 2015; Delis et al., 2012). Monetary expansion increases bank leverage due to a fall in the cost of borrowed funds and thereby exacerbates risk exposure. It has been seen for European countries that the policy interest rate negatively affects liquidity retained by banks and the lending decision of a bank in the interbank market (Jiménez et al., 2014; Lucchetta, 2007). Lower overnight rates lead banks to lend more to borrowers with poor credit profiles and grant more loans to those with a higher default risk.

With respect to ownership effects in bank risk-taking and monetary transmission, the literature finds that stockholder-controlled banks in the USA and Europe exhibit significantly higher risk-taking behaviour than managerially controlled banks (Barry, Lepetit, & Tarazi, 2011; Saunders, Strock, & Travlos, 1990). With respect to bank characteristics, Delis and Kouretas (2011) for Euro area banks and Jiménez et al. (2014) for Spanish banks show that the risk-enhancing effect of lower overnight rates is particularly pronounced for less capitalised banks. On the other hand, De Nicolò et al. (2010) find that when the policy rate is low, well-capitalised banks rather than poorly capitalised banks increase risk-taking.

In the context of India, there are studies that explore the bank-lending channel of monetary transmission. Bhaumik et al. (2011) show that the bank-lending channel is much more effective in a tight monetary policy regime for state-owned banks, old private banks and foreign banks but not for new private banks. Other studies find that changes in monetary policy cause banks to adjust their credit portfolios, and the effects are pronounced for smaller and less liquid banks (Bhaduri & Goyal, 2015; Khundrakpam, 2011). However, the risk-taking channel of monetary transmission has not been studied for the Indian case.

The above review highlights the fact that there is a lacuna in the literature with respect to the role of ownership in influencing the risk-taking channel of monetary transmission, particularly for emerging economies such as India. Understanding how bank ownership plays a role in the risk-taking channel is significant for the Indian context which exhibits a wide ownership spectrum. In terms of size, public sector banks account for the largest share of the entire

banking system's assets and loans when compared to domestic private and foreign banks. Public sector banks dominate with 72.1 per cent market share while new private banks which started operations in the 1990s have a market share of 15.9 per cent (Gandhi, 2015). Foreign banks and old private banks have market shares of 7.2 per cent and 4.9 per cent, respectively. In this backdrop, we carry out an assessment of the risk-taking channel of monetary transmission in India. In particular, this article makes three contributions. First, in view of the absence of studies in an emerging market context, ours is the first study to examine the evidence for the risk-taking channel in the context of Indian banking. Second, we estimate the differential behaviour of banks across ownership groups, such as, public sector banks, old and new private sector banks as well as foreign banks. Third, we study banks' risk response in terms of a wide array of risks that is asset, liquidity, default and market risks in the face of easy and tight monetary stances adopted by the central bank.

The rest of the article proceeds as follows: Section 2 briefly highlights the evolution of monetary policy in India while Section 3 explains the data and methodology, as well as our empirical specifications. Section 4 discusses the regression results, and Section 5 concludes.

2. Development of Monetary Policy in India

The liberalisation of the Indian economy in the early 1990s necessitated an encompassing recast of monetary policy operating procedures. The central bank of the country, the Reserve Bank of India (RBI) shifted from direct to indirect instruments in sync with the increase in market orientation in the economy (Kanagasabapathy, 2001; Reddy, 2002). This needed the development of an array of policy measures which could efficiently modulate monetary situations in alignment with price discovery. Also, shifts in transmission mechanisms led to the policy impulses which further travelled through quantitative and rate channels. Finally, episodes of volatility in foreign exchange markets emphasised the need for quick policy reactions to balance domestic and external sources of monetisation to sustain financial markets in an orderly manner.

Even within the set of indirect instruments, authorities preferred market-based instruments such as open market operations (OMOs). Accordingly, the cash reserve ratio (CRR) was lowered from 15 per cent in the early 1990s to only 5 per cent by 2004, with some minor adjustments to deal with the evolving liquidity situation in the economy. With the introduction of the liquidity adjustment facility (LAF), in 2000, the RBI was also able to influence short-term interest rates by modulating liquidity in the system through repo

rate operations and also transmit interest rate signals to the market (Reserve Bank of India [RBI], 2000).

The current operating framework of monetary policy has the following distinguishing features. The repo rate is the single policy rate and operates in a corridor between the marginal standing facility (MSF) rate and the reverse repo rate. The MSF rate is 25 basis points above the repo rate, and the reverse repo rate is 25 basis points below the repo rate. The corridor of policy rates ensures that the operating target, namely, the overnight call rate, despite market-driven fluctuations, stays close to the repo rate. There were two reasons driving the change from the earlier regime based on reserve targeting (base money, borrowed reserves, non-borrowed reserves) to the current framework involving the short-term interest rate as the operating target (RBI, 2014). First, financial sector reforms enabled freeing up of interest rates from administrative control and helped improve the policy rate's efficacy in transmitting monetary policy. Second, there was an undermining in the relationship between money, output and prices due to an increase in financial innovations, technological advances and global integration.

While the use of monetary tools to achieve policy objectives is fairly common, central banks have recently also started using non-monetary instruments as part of their overall policy toolkit (RBI, 2014). These are engineered to handle different kinds of situations, such as, sudden huge increases in capital flows, allocation of credit, pro-cyclicality issues, interconnectedness in the economy and the lower limit of zero on the nominal interest rate. There are three sets of instruments used. The first set consists of those instruments which are mainly regulatory by nature such as credit control tools (setting up credit bureaus, credit registry, greater risk weight for sensitive sectors), supervisory measures (on-site and off-site inspection of banks) and moral suasion. These measures are aimed at improving the credit culture. The second set of measures is financial in nature and functions mostly in the foreign exchange market, namely, liberalising/restricting capital flows, sterilisation policies, reserve requirements on foreign currency and variants of the Tobin tax. The third set of instruments is macro-prudential in nature and aims at controlling the occurrence of systemic risks. The RBI employs all these instruments to varying degrees, but its key policy rate is set with the objective of keeping retail inflation at the mandated level.

3. Data and Methodology

We collect data for 86 Indian scheduled commercial banks of different ownership types that is public sector banks, old private banks, new private banks and

foreign banks. We employ bank-wise data (at the national level) at an annual frequency over the period from 1999–2000 to 2015–2016 leading to an unbalanced panel consisting of 816 observations. The data is obtained from various issues of *Statistical Tables Relating to Banks in India*, an annual publication of the RBI which provides audited data on the balance sheet and income statements of individual banks.

Our empirical analysis has three components. First, we test for the presence of the risk-taking channel in the Indian banking sector. Second, we investigate the effect of bank ownership on the risk-taking channel, and third we take into account the interactions of various bank ownership forms with tight and easy monetary policy regimes. Based on the extant literature (Altunbas et al., 2012; Bonfim & Soares, 2014; Delis & Kouretas, 2011), we propose regression Equation (1) to test for the presence of the risk-taking channel in the Indian context. We follow Bhaumik et al. (2011) in setting up Equations (2) and (3) to test for ownership and regimes effects.

$$y_{it} = \alpha_i + \beta_1 \Delta MP_{it} + \beta_2 Z_{it} + \beta_3 \text{ Time Dummy} + \varepsilon_{it} \quad (1)$$

$$y_{it} = \alpha_i + \beta_1 \Delta MP_{it} * \text{Oship} + \beta_2 Z_{it} + \beta_3 \text{ Time Dummy} + \varepsilon_{it} \quad (2)$$

$$y_{it} = \sum_j \alpha_j (\Delta MP_{it} * \text{Oship}_{jit} * TMP_t) + \sum_j \beta_j (\Delta MP_{it} * \text{Oship}_{jit} * EMP_t) + \beta_3 Z_{it} + \beta_4 \text{ Time Dummy} + \varepsilon_{it} \quad (3)$$

where y_{it} = the risk level of a bank, i is bank and t is time, and ε_{it} is the independently and identically distributed (IID) error term. MP stands for monetary policy, and Oship refers to ownership type. We estimate these equations for an unbalanced panel data set of 86 Indian banks for the period from 1999–2000 to 2015–2016 giving us 816 unique observations. We employ panel data regression methodology, namely, fixed effects and random effects models, and the final choice of the appropriate model is based on the outcome of the Hausman test. Bank-specific fixed effects are incorporated by estimating the model in first differences (instead of at levels) as this transformation eliminates the time-invariant components (Cameron & Trivedi, 2010). Therefore, we do not explicitly include cross-section dummies in the final estimation but include time dummies to allow for year-specific effects.

We are not concerned about endogeneity or the reverse causality problem in our regressions because ever since the introduction of the LAF framework in 2000 (where our data set begins) the RBI has been setting the policy rate with a view to keeping the call rate within the corridor of policy rates. The corridor is set based on the mandate of the RBI which earlier covered a broad set of

macroeconomic parameters such as growth, inflation and exchange rate, and in more recent times has narrowed to a single target of retail inflation. Therefore, it is unlikely that the policy rate decisions would respond to banking risk alone. Secondly, the risk data we use is reported by banks at the end of the financial year whereas the monetary policy variable captures the change in the policy rate over the entire year. Hence any possibility of endogeneity is addressed to some extent through the temporal difference in measuring the dependent and independent variables.

Following Zhang, Jiang, Qu, and Wang (2013) and Altunbas, Carbo, Gardener, and Molyneux (2007), we define four types of risks, namely, default risk (gross non-performing assets [NPAs]/ gross advances), liquidity risk (liquid assets/ total assets), market risk (interbank borrowings/total borrowings) and asset risk (loan loss provisions to total assets). MP is the monetary policy variable proxied by the weighted average call rate. We rely on the call rate to proxy monetary policy because the RBI uses a variety of monetary policy tools such as the repo rate, reverse repo rate, marginal standing facility rate and the cash reserve ratio. Changes in all of these instruments have an impact on the short-term overnight rate in the interbank market which is the call rate. This variable has been previously used as the monetary policy indicator for India by Aleem (2010), Singh and Kalirajan (2007), Al-Mashat (2003), Kannan, Sanyal, and Bhoi (2006), Virmani (2004). The call rate is a very vital market-related variable in the carrying out of daily monetary operations. With respect to RBI's stance in the money market, the call rate is given preference over other short-term rates in understanding the central bank's stand on monetary policy (Aleem, 2010). Hence, we identify shocks (changes) in the call rate as unanticipated monetary policy shocks.

ΔMP is the change in the call rate calculated for each year as the difference between the rate in April of the previous year and March of the current year. We classify monetary policy regimes into tight monetary policy (TMP) and easy monetary policy (EMP) and define dummy variables accordingly in the regressions. Table 1 shows our classification of the monetary policy regime in each of the years based on whether the call rates increased or decreased in the month of March in any year compared with that in April in the previous year. For instance, for the year 1999–2000, we find that the call rate had gone up from 8.7 in April 1999 to 15.97 in March 2000. Hence, we classify this period as TMP (tight monetary policy). The remaining years have been classified in the same manner.

Based on the extant literature (Altunbas et al., 2012, 2014; Angeloni & Ehrmann, 2003; Barry et al., 2011; Bhaumik et al., 2011; Brissimis & Delis, 2010; Dell'Ariccia, Laeven, & Suarez, 2017; Farinha & Marques, 2001; Gambacorta, 2005;

Table 1 Monetary Policy Regimes in India

Year	*Previous Year's April Call Rate*	*Current Year's March Call rate*	*ΔMP (Change in Monetary Policy)*	*Monetary Policy Regime*
1999–2000	8.700	15.970	7.270	TMP
2000–2001	6.970	10.200	3.230	TMP
2001–2002	7.470	12.180	4.710	TMP
2002–2003	5.620	6.120	0.500	TMP
2003–2004	3.560	3.750	0.190	TMP
2004–2005	3.250	4.720	1.470	TMP
2005–2006	3.620	6.500	2.880	TMP
2006–2007	4.950	7.000	2.050	TMP
2007–2008	9.500	6.500	−3.000	EMP
2008–2009	4.750	3.620	−1.130	EMP
2009–2010	3.020	5.500	2.480	TMP
2010–2011	3.150	7.580	4.430	TMP
2011–2012	6.860	9.950	3.090	TMP
2012–2013	8.370	7.770	−0.600	EMP
2013–2014	7.570	8.590	1.020	TMP
2014–2015	8.460	7.480	−0.980	EMP
2015–2016	7.510	6.910	−0.600	EMP

Source: Reserve Bank of India website.
Note: Change in monetary policy is calculated as the difference between the call rate in April of the previous year and March of the current year; monetary policy regime is TMP (tight monetary policy) or EMP (easy monetary policy) depending on whether the change in monetary policy is positive or negative.

Van den Heuvel, 2002, to name a few), our bank-specific control variables are profitability, denoted by the return on assets (ROA), size (proxied by the log of total assets) and capitalisation, measured as the ratio of equity/total assets. Oship is a dummy variable, and *j* is the index of different kinds of bank ownership. We divide banks into four groups—foreign, public, old domestic private and new domestic private. We consider public sector banks as the benchmark category. Table 2 provides greater details for these variables.

The descriptive statistics of the main variables are presented in Table 3. We observe that across all risk variables, foreign banks have the highest mean values. When it comes to the bank-specific control variables, predictably, public sector banks have the highest mean size while foreign banks have higher mean profitability and capital levels. Figure 1 exhibits the trend in the movement of the call rate from 2000 to 2016. From as high as 16 per cent in the year 2000, it dropped sharply to below 4 per cent in 2004. From there on, it keeps fluctuating in the range of 4–7 per cent but starts rising from 2010–2011 when the central

Table 2 Definitions of Variables

Variable	*Definition*
	Risk Variables
Default risk	*Default risk* is measured by the ratio of gross non-performing assets (NPAs) to gross advances. A high value of the ratio indicates a higher proportion of problem loans in a bank's overall portfolio and increased exposure to credit risk.
Liquidity risk	*Liquidity risk* is the risk that a bank faces from insufficient liquidity to meet its liabilities as and when they fall due. It is measured by the liquidity buffer or the ratio of liquid assets to total assets. The higher the ratio, the lower is the liquidity risk a bank faces.
Market risk	*Market risk* is measured by the ratio of interbank borrowings to total borrowings. A high value of this ratio for a bank indicates that it relies more on interbank borrowings and faces higher risk arising from movements in interest rates. Interbank markets are vital for banks' liquidity management when interbank markets function smoothly in normal time. However, in crisis periods, over-reliance on interbank borrowing can lead to liquidity problems.
Asset risk	*Asset risk* is measured by the ratio of loan loss provisions to total assets. While higher provisions help banks absorb losses in a smoother manner, making such banks less vulnerable to bankruptcy, in the case of India where provisioning is pro-cyclical, the ratio is a backward looking indicator of the quality of assets on a bank's balance sheet. Therefore a higher ratio indicates deterioration in asset quality, i.e., higher asset risk.
	Monetary Policy Variable
Weighted average call money rate	The call money rate is the interest rate on a type of short-term loan that banks give to brokers who in turn lend the money to investors to fund margin accounts. For both brokers and investors, this type of loan does not have a set repayment schedule and must be repaid on demand. Weighted average is an average in which each quantity to be averaged is assigned a weight. These weightings determine the relative importance of each quantity on the average. Weightings are the equivalent of having that many like items with the same value involved in the average. As defined by the RBI, weighted average call money rate is the volume-weighted average of daily call money rates for the week (Saturday to Friday). Data cover 90–95% of total transactions reported by participants.

(Table 2 continued)

(Table 2 continued)

Variable	*Definition*
	Monetary Policy Regime Variables
Tight monetary policy regime	It is a course of action undertaken by the central bank to constrict spending in an economy, i.e., seen to be growing too quickly or to curb inflation when it is rising too fast. The RBI aims to make money tight by raising short-term interest rates which increases the cost of borrowing and effectively reduces attractiveness.
Easy monetary policy regime	An easy monetary policy, indicating an accommodative monetary policy, is one that increases the money supply usually by lowering interest rates. It occurs when a country's central bank decides to allow new cash flows into the banking system.
	Bank-specific Control Variables
Return on assets	ROA reflects the ability of a bank's management to generate profits from its assets. It is calculated as ROA = Profit during the year/total assets.
Capitalisation	*Capitalisation* is measured by the capital buffer of banks given by the ratio of equity to total assets. It reflects to what extent a bank's total assets are funded by equity capital.
Size	Size is an important characteristic of a bank in trying to understand what scale of operations may help in managing day to day operations as well as risks better. It is measured by the log of total assets.

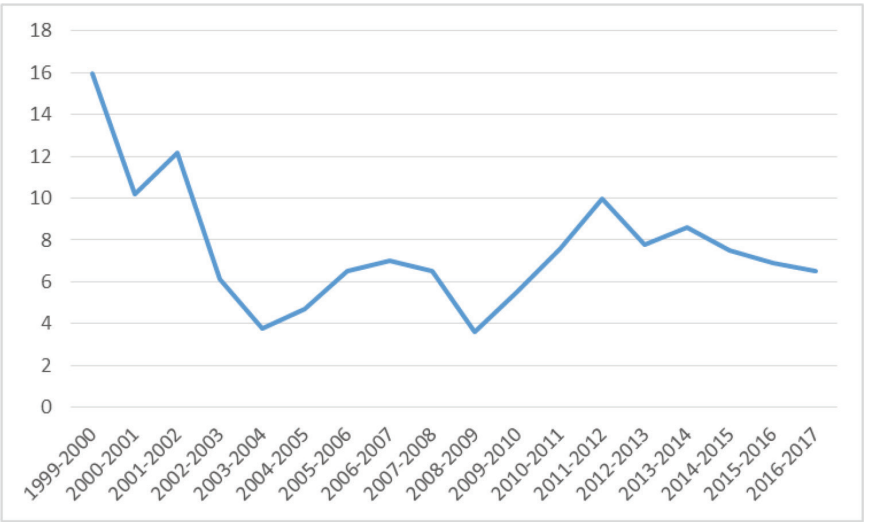
Source: Summarised from the literature.

Table 3 Descriptive Statistics

	Foreign Banks No. of Obs.: 251		*Old Private Sector Banks No. of Obs.: 152*		*New Private Sector Banks No. of Obs.:97*		*Public Sector Banks No. of Obs.: 316*	
Variable	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
				Risk Variables				
Default risk	0.114	0.238	0.069	0.081	0.065	0.197	0.079	0.087
Liquidity risk	0.775	2.515	0.316	1.185	0.298	1.210	0.163	0.871
Asset risk	0.154	0.592	0.056	0.349	0.017	0.056	0.016	0.060
Market risk	0.430	0.341	0.281	0.355	0.243	0.250	0.123	0.202
				Control Variables				
ROA	0.096	0.363	0.026	0.201	0.020	0.116	0.008	0.033
Capitalisation	1.023	3.997	0.014	0.033	0.008	0.007	0.012	0.037
Size	5.953	0.970	6.146	1.041	6.190	0.857	6.368	0.913

Source: Authors' calculations.

Figure 1 Weighted Average Call Rate from 2000 to 2016 (in %, as on end-March)



Source: Authors' calculations.

bank shifted its priority towards inflation control. In what follows we analyse the implications of these changes in the call rate for bank risk-taking.

4. Regression Results

This section presents the results of our empirical estimations. Table 4 illustrates the results of estimating Equation 1 which is carried out to test the presence of the risk-taking channel in the Indian banking sector. The panel data regression results indicate that the coefficient of the monetary policy variable is negative with respect to default risk and statistically significant at the 10 per cent level.[1] This implies that when the central bank tightens its policy rates, default risk on the balance sheets of banks comes down, and when policy rates are cut, default risk rises. The case of a policy rate cut can be interpreted as easy monetary conditions leading to a surplus liquidity situation and possibly reckless lending which engenders bad loans. The evidence for rising default risk in an

[1] Our inferences are based on unclustered standard errors. While it has become common practice to report clustered standard errors, we follow the advice of Angrist and Pischke (2009) and Cameron and Miller (2015) to avoid doing so as the number of clusters for our main regressor (monetary policy) is insufficient.

Table 4 Testing the Presence of the Risk-taking Channel

Particulars	*Default Risk (Gross NPAs/ Gross Advances)*	*Liquidity Risk (Liquid Assets/ Total Assets)*	*Asset Risk (Loan Loss Provisions/Total Assets)*	*Market Risk (Interbank Borrowings/Total Borrowings)*
		Monetary Policy Variable		
ΔMP	−0.029	−0.210	0.008	0.009
	(0.016)*	(0.188)	(0.018)	(0.025)
		Bank-Specific Controls		
ROA	−0.005	0.007	0.044	0.115
	(0.011)	(0.278)	(0.088)	(0.064)*
Capitalisation	0.001	−0.077	0.008	−0.006
	(0.001)	(0.035)**	(0.007)	(0.004)
Size	0.004	0.051	0.004	0.021
	(0.006)	(0.072)	(0.012)	(0.011)**
Time dummies	Yes	Yes	No	No
Intercept	0.164	0.816	0.004	0.099
	(0.052)	(0.616)	(0.089)	(0.106)
R^2 (within)	0.066	0.060	0.028	0.070
FE/RE	FE	FE	FE	FE
F-statistic	3.05***	1.14***	1.37	3.69***

Source: Authors' calculations.

Notes: This table reports estimates of the specification to test the presence of the risk-taking channel. The dependent variables are default risk, liquidity risk, asset risk and market risk; the monetary policy (MP) variable is change in the call rate, and the other independent variables are bank-specific controls, namely, return on assets (ROA), capitalisation and size (detailed explanations are given in Table 1). Using panel data regression, bank-specific fixed effects are shown as FE while random effects are shown as RE. The choice of FE/RE is based on the outcome of the Hausman test. For each variable the first row lists the coefficient, the second row lists standard errors in brackets, and the corresponding significance levels are adjacent to the latter. Note that *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

expansionary monetary policy regime is also in line with the 'search for yield' argument of Rajan (2005), as well as the possibility that the increased valuation of assets encourages banks to take more risks (Adrian & Shin, 2009).

However, if we consider the decline in default risk as a response to monetary tightening, this contradicts the findings of Jiménez et al. (2014) and Altunbas et al. (2014) who showed that tight monetary conditions are associated with higher loan default. It appears from our results that with the tightening of

monetary policy conditions, Indian banks are forced to become more stringent about borrowing checks and hence reduce the supply of loans which eventually reduces the level of bad loans as well. The coefficient of the monetary policy variable for the liquidity risk regression is also negative but significant only at the 10 per cent level. This suggests that tightening of monetary policy leads to a lower liquidity buffer with banks thereby increasing liquidity risk. On the other hand, lowering of policy rates eases liquidity conditions. Next, we observe that the monetary policy variable is statistically insignificant in the case of asset risk and market risk indicating that monetary transmission may not be happening through these two categories of risks.

Table 5 shows the results of estimating our regression specification 2 in order to understand the effect of ownership differences along with changes in monetary policy on the risk-taking channel. We begin with the default risk regression. Here we find that the coefficient of the interaction term of ownership with the monetary policy variable is negative and significant at the 5 per cent level for foreign banks and at the 1 per cent level for new private banks. It suggests that the positive effect of monetary tightening on bad loans that we saw earlier (in Table 4) is stronger in the case of foreign banks and new private banks compared with the other ownership groups. This can be explained by the more efficient risk management practices that foreign banks and new private banks employ which enable them to be more prompt in tightening their lending practices in response to higher policy rates. On the other hand, these two types of banks are also swifter in increasing lending when policy rates come down thereby leading to higher bad loans.

In the case of liquidity risk, we find that the interaction term is negative and significant at the 1 per cent level for foreign banks and at the 10 per cent level for old private banks. Therefore, we can say that the liquidity effects of monetary policy observed earlier (in Table 4) are stronger in the case of foreign banks as compared with other bank groups. In other words, higher policy rates have a stronger effect on the liquidity conditions of foreign banks as compared with other bank groups. Old private banks also seem to respond in terms of liquidity risk, but the coefficient of the interaction term is only significant at the 10 per cent level. Finally, in the case of market risk, we find that the interaction term is negative and significant at the 1 per cent level that is an increase in the policy rates lead to lower market risk of foreign banks compared with the other bank groups. This implies that foreign banks reduce their interbank borrowings to a greater extent than other bank groups in the face of tighter monetary conditions. Our main finding, therefore, is that foreign banks are the quickest to transmit monetary policy signals through the risk-taking channel in Indian banking.

Table 5 Effect of Ownership and Monetary Policy Changes on the Risk-taking Channel

Particulars	*Default Risk (Gross NPAs/ Gross Advances)*	*Liquidity Risk (Liquid Assets/ Total Assets)*	*Asset Risk (Loan Loss Provisions/Total Assets)*	*Market Risk (Interbank Borrowings/Total Borrowings)*
Interaction Between Monetary Policy and Ownership				
Δ*MP**FB	−0.028	−0.344	−0.025	−0.070
	(0.014)	(0.073)	(0.016)	(0.028)**
Δ*MP**OPR	0.008	−0.252	−0.004	−0.031
	(0.005)	(0.025)	(0.005)	(0.022)
Δ*MP**NPR	−0.063	0.048	0.006	−0.028
	(0.012)**	(0.301)	(0.085)	(0.100)*
Bank-specific Controls				
ROA	−0.003	0.020	0.045	0.119
	(0.010)	(0.286)	(0.088)	(0.064)*
Capitalisation	0.001	−0.075	0.007	−0.007
	(0.001)	(0.035)**	(0.007)	(0.004)
Size	0.004	0.047	0.003	0.020
	(0.006)	(0.073)	(0.012)	(0.010)**
Time dummies	Yes	Yes	No	Yes
Intercept	0.151	0.822	0.049	0.204
	(0.051)	(0.645)	(0.087)	(0.104)
R^2 (within)	0.058	0.056	0.030	0.092
FE/RE	FE	FE	FE	FE
F-statistic	3.56***	0.98	1.34	3.34***

Source: Authors' calculations.

Notes: This table reports estimates of the specification to test the impact of bank ownership and monetary policy on the risk-taking channel. The dependent variables are default risk, liquidity risk, asset risk and market risk; the monetary policy (MP) variable is change in the call rate, and the other independent variables are bank specific controls, namely, return on assets (ROA), capitalisation and size. Foreign banks are termed FB, old private sector banks as OPR and new private sector banks as NPR (detailed explanations are given in Table 1). Using panel data regression, bank specific fixed effects are shown as FE while random effects are shown as RE. The choice of FE/RE is based on the outcome of the Hausman test. For each variable the first row lists the coefficient, the second row lists standard errors in brackets, and the corresponding significance levels are adjacent to the latter. Note that *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

In Table 6, we present the results of estimating Equation 3 that tells us the effects of ownership and the type of monetary policy regime on the risk-taking channel of monetary transmission. In the case of default risk, we find there is no difference in the response of foreign banks across monetary policy regimes. However, new private sector banks seem to respond more strongly to tight monetary policy as shown by the negative coefficient of the interaction term that is also significant at the 1 per cent level. This signifies that banks in this group are more likely to change their lending practices when policy rates rise rather than fall. Therefore, there is an asymmetry in the risk-taking channel whereby new private banks exhibit lower default risk when monetary conditions tighten but do not show a commensurate increase in default risk when policy rates are cut by the central bank. Next, in the case of liquidity risk, we find the interaction term is negative and significant at the 1 per cent level in both monetary policy regimes. This suggests that the liquidity levels of foreign banks change in response to both tight as well as easy monetary policy, and therefore there is no asymmetric response.

Finally, in the market risk regression, we find that the interaction term is positive and significant at the 1 per cent level for foreign banks in the case of a tight monetary policy but is not significant for an easy monetary policy.

Table 6 Effect of Ownership, Monetary Policy Changes and Policy Regime Changes on the Risk-taking Channel

Particulars	*Default Risk (Gross NPAs/ Gross Advances)*	*Liquidity Risk (Liquid Assets/ Total Assets)*	*Asset Risk (Loan Loss Provisions/Total Assets)*	*Market Risk (Interbank Borrowings/ Total Borrowings)*
Interaction between Monetary Policy and Ownership				
Δ*MP**FB*TMP	−0.016	−0.684	−0.001	0.059
	(0.018)	(0.647)	(0.009)	(0.013)***
Δ*MP**OPR*TMP	0.001	−0.055	−0.003	0.034
	(0.012)	(0.098)	(0.006)	(0.015)**
Δ*MP**NPR*TMP	−0.060	0.012	−0.010	−0.003
	(0.006)***	(0.062)	(0.008)	(0.009)
Δ*MP**FB*EMP	−0.015	−0.706	−0.004	−0.004
	(0.018)	(0.648)	(0.005)	(0.011)
Δ*MP**OPR*EMP	0.009	0.313	−0.013	0.042
	(0.014)	(0.206)	(0.006)**	(0.030)
Δ*MP**NPR*EMP	−0.032	0.169	0.007	0.021
	(0.019)*	(0.219)	(0.007)	(0.029)

(Table 6 continued)

(Table 6 continued)

Particulars	*Default Risk (Gross NPAs/ Gross Advances)*	*Liquidity Risk (Liquid Assets/ Total Assets)*	*Asset Risk (Loan Loss Provisions/Total Assets)*	*Market Risk (Interbank Borrowings/ Total Borrowings)*
		Bank-Specific Controls		
ROA	−0.006	−0.028	0.051	0.117
	(0.011)	(0.266)	(0.084)	(0.061)**
Capitalisation	0.001	−0.088	0.009	−0.005
	(0.001)	(0.039)**	(0.008)	(0.004)
Size	0.003	0.032	−0.010	0.016
	(0.006)	(0.070)	(0.014)	(0.010)
Time dummies	Yes	Yes	No	Yes
Intercept	0.134	1.150	0.121	0.145
	(0.057)	(0.764)	(0.112)	(0.092)
R^2 (within)	0.086	0.084	0.024	0.125
FE/RE	FE	FE	RE	RE
F-statistic	2.64***	2.57***		
Wald χ^2			33.97*	115.58***

Source: Authors' calculations.

Notes: This table reports estimates of the specification to test the effect of ownership type, change in the policy variable, as well as regime stance on the risk-taking channel. The dependent variables are default risk, liquidity risk, asset risk and market risk; the monetary policy (MP) variable is the change in the call rate, and the other independent variables are bank specific controls, namely, return on assets (ROA), capitalisation and size. Foreign banks are termed FB, old private sector banks as OPR and new private sector banks as NPR. Further, a tight policy regime is denoted by TMP while an easy one is denoted by EMP (detailed explanations are given in Table 1). Using panel data regression, bank specific fixed effects are shown as FE while random effects are shown as RE. The choice of FE/RE is based on the outcome of the Hausman test. For each variable the first row lists the coefficient, the second row lists the standard errors in brackets, and the corresponding significance levels are adjacent to the latter. Note that *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

This result contradicts the previous finding (in Table 5) that foreign banks reduce their interbank borrowing or market risk in response to monetary tightening. However, we reconcile this finding by referring to the asymmetry in the response of foreign banks that is the negative response of market risk to monetary policy tightening is weaker (since the coefficient of the relevant interaction term is positive) than in the case when policy rates are cut by the central bank. For old

private banks, during both contractionary and expansionary policy regimes, we find that the interaction coefficient is positive and significant at the 5 per cent level that is their market risk rises when monetary policy is tightened and declines when it is expansionary.

5. Conclusions and Policy Recommendations

This article has attempted for the first time an empirical investigation into the risk-taking channel of monetary transmission in India. We find that an expansionary monetary policy may increase default risk while a tight monetary policy may reduce default risk particularly for foreign banks and new private banks. In the case of new private banks, the response is stronger for monetary tightening than for an expansion. We also find that tightening of monetary policy leads to lower liquidity risk and market risk and the effects are stronger for foreign banks than for other bank groups. In terms of market risk, the effect on foreign banks is weaker during a monetary tightening than during an expansion.

The evidence in this article suggests that there is a role for conventional monetary policy, albeit to a limited extent, when it comes to financial stability. The monetary policy authority should, therefore, take cognisance of the effects of changes in their policy stance on risk-taking by different bank groups. Certainly, the RBI still has to use other tools such as macro-prudential measures when it comes to attaining overall financial stability. However, the central bank needs to be cautious about rising default risk during monetary expansion and rising liquidity risk during monetary easing, particularly in the case of foreign and new private banks. Recognising these unintended effects of monetary policy changes would improve the quality of decision-making in the central bank.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

References

Adrian, T., & Liang, N. (2014). Monetary policy, financial conditions, and financial stability (Federal Reserve Bank of New York Staff Report No. 690). New York, NY: Federal Reserve Bank of New York.

Adrian, T., & Shin, H. S. (2009). Financial intermediaries and monetary economics (Federal Reserve Bank of New York Staff Report No. 398). New York, NY: Federal Reserve Bank of New York.

Al-Mashat, R. (2003). Monetary policy transmission in India: Selected issues and statistical appendix (Country Report No. 03/261). Washington, DC: International Monetary Fund.

Aleem, A. (2010). Transmission mechanism of monetary policy in India. *Journal of Asian Economics*, *21*(2), 186–197.

Altunbas, Y., Carbo, S., Gardener, E. P., & Molyneux, P. (2007). Examining the relationships between capital, risk and efficiency in European banking. *European Financial Management*, *13*(1), 49–70.

Altunbas, Y., Gambacorta, L., & Marques-Ibanez, D. (2012). Do bank characteristics influence the effect of monetary policy on bank risk? *Economics Letters*, *117*(1), 220–222.

———. (2014). Does monetary policy affect bank risk-taking? *International Journal of Central Banking, 10*(1), 95–135.

Andries, N., & Billon, S. (2010). The effect of bank ownership and deposit insurance on monetary policy transmission. *Journal of Banking & Finance*, *34*(12), 3050–3054.

Angeloni, I., & Ehrmann, M. (2003). Monetary policy transmission in the Euro area: Any changes after EMU? (ECB Working Paper Series No. 240). Frankfurt am Main: European Central Bank.

Angeloni, I., Faia, E., & Duca, M. L. (2015). Monetary policy and risk-taking. *Journal of Economic Dynamics and Control*, *52*(C), 285–307.

Angrist, J. D., & Pischke, J. (2009). *Mostly harmless econometrics: An empiricist's companion*. Princeton, NJ: Princeton University Press.

Barry, T. A., Lepetit, L., & Tarazi, A. (2011). Ownership structure and risk in publicly held and privately owned banks. *Journal of Banking & Finance*, *35*(5), 1327–1340.

Bhaduri, S., & Goyal, T. (2015). The bank lending channel of monetary policy transmission: Evidence from an emerging market, India. *International Journal of Banking, Accounting and Finance*, *6*(1), 1–20.

Bhaumik, S. K., Dang, V., & Kutan, A. M. (2011). Implications of bank ownership for the credit channel of monetary policy transmission: Evidence from India. *Journal of Banking & Finance*, *35*(9), 2418–2428.

Bonfim, D., & Soares, C. (2014). The risk-taking channel of monetary policy–exploring all avenues (Banco de Portugal Working Paper 2). Lisbon, Portugal: Economics and Research Department.

Brissimis, S. N., & Delis, M. D. (2010). Bank heterogeneity and monetary policy transmission (ECB Working Paper Series, No. 1233). Frankfurt, Germany: European Central Bank.

Cameron, C., & Miller, D. L. (2015). A practitioner's guide to cluster-robust inference. *Journal of Human Resources*, *50*(2), 317–373.

Cameron, A. C., & Trivedi, P. K. (2010). *Microeconometrics using stata* (Vol. 2). College Station, TX: Stata Press.

De Nicolò, G., Dell'Ariccia, G., Laeven, L., & Valencia, F. (2010). Monetary policy and bank risk-taking (IMF Staff Position Note, SPN/10/09). Washington D.C., USA: International Monetary Fund.

Delis, M. D., & Kouretas, G. P. (2011). Interest rates and bank risk-taking. *Journal of Banking & Finance*, *35*(4), 840–855.

Delis, M. D., Hasan, I., & Mylonidis, N. (2012). The risk-taking channel of monetary policy in the USA: Evidence from micro-level data (MPRA Paper No. 34084). Munich, Germany: University Library of Munich.

Dell'Ariccia, G., Laeven, L., & Suarez, G. A. (2017). Bank leverage and monetary policy's risk-taking channel: Evidence from the United States. *The Journal of Finance*, *72*(2), 613–654.

Farinha, L., & Marques, C. R. (2001). The bank lending channel of monetary policy: Identification and estimation using Portugese micro bank data (ECB Working Paper Series No. 102). Frankfurt, Germany: European Central Bank.

Gambacorta, L. (2005). Inside the bank lending channel. *European Economic Review*, *49*(7), 1737–1759.

Gandhi. (2015). Speech delivered at the 'Indian PSU banking industry: Road ahead'. Kolkata: Bengal Chamber of Commerce and Industry. Retrieved from https://www.rbi.org.in/scripts/BS_SpeechesView.aspx?Id=932

Jiménez, G., Ongena, S., Peydró, J. L., & Saurina, J. (2014). Hazardous times for monetary policy: What do twenty–three million bank loans say about the effects of monetary policy on credit risk-taking? *Econometrica*, *82*(2), 463–505.

Kanagasabapathy, K. (2001). Monetary policy underpinnings: A Perspective. *Economic and Political Weekly*, *36*(4), 303–310.

Kannan, R., Sanyal, S., & Bhoi, B. (2006). Monetary conditions index for India (Reserve Bank of India Occasional Papers 27, No. 3). Mumbai, India: Reserve Bank of India.

Khundrakpam, J. K. (2011). Credit channel of monetary transmission in India–how effective and long is the lag? (RBI Working Paper Series, WPS (DEPR):20/2011). Mumbai, India: Reserve Bank of India.

Lucchetta, M. (2007). What do data say about monetary policy, bank liquidity and bank risk-taking? *Economic Notes*, *36*(2), 189–203.

Rajan, G. R. (2005). Has financial development made the world riskier? (NBER Working Paper series, Working Paper 11728). Cambridge, MA: National Bureau of Economic Research.

Reddy, Y. V. (2002, January 15). Parameters of monetary policy in India. Lecture delivered at the 88th Annual Conference of Indian Econometric Society at Madras School of Economics, Chennai.

Reserve Bank of India (RBI). (2000). Report on currency and finance, 1999–2000. Mumbai, India: Reserve Bank of India.

———. (2014). Report of the expert committee to revise and strengthen the monetary policy framework. Mumbai, India: Reserve Bank of India.

Saunders, A., Strock, E., & Travlos, N. G. (1990). Ownership structure, deregulation, and bank risk-taking. *Journal of Finance*, *45*(2), 643–654.

Singh, K., & Kalirajan, K. (2007). Monetary transmission in post-reform India: An evaluation. *Journal of Asia Pacific Economy*, *12*(2), 158–187.

Van den Heuvel, S. J. (2002). Does bank capital matter for monetary transmission? *FRBNY Economic Policy Review, 8*(1).

Virmani, V. (2004). Operationalizing Taylor-type rules for the Indian economy: Issues and some results (1992Q–2001Q1) (IIMA Working Paper No. 2004-07-04). Ahmedabad, India: Indian Institute of Management Ahmedabad.

Zhang, J., Jiang, C., Qu, B., & Wang, P. (2013). Market concentration, risk-taking, and bank performance: Evidence from emerging economies. *International Review of Financial Analysis*, *30*(C), 149–157.