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Economic Policy Uncertainty and Financial Innovation: Evidence from Commercial Bank in China

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Abstract: The empirical results show that the rise of economic policy uncertainty (EPU) makes the level of financial innovation at banks significantly improve; that is, there is an incentive effect of EPU on financial innovation at banks. In addition, the degree of incentive-induced EPU for different types of banks is significantly different. Compared with listed banks, this incentive effect is more significant for non-listed banks; rural commercial banks are the most significant incentive, followed by urban commercial banks, and state-owned banks and joint-stock commercial banks are more robust. This shows that EPU has a "selective effect" on bank financial innovation. Moreover, the incentive effect of EPU on financial innovation activities is affected by the return on assets and the asset liquidity ratio of commercial banks, which further validates the "selective effect" of financial policy uncertainty on bank financial innovation.

Keywords: Economic Policy Uncertainty, Financial Innovation, Commercial Bank, Heterogeneity.

1. Introduction

Economic policy uncertainty (EPU) is defined as the inability of economic entities to accurately predict whether, when, and what kind of economic policy actions the government will take and what kind of economic policy actions (or not) will bring about in the future [1]. Economic policy is a significant measure for the government to implement macroeconomic regulation and ensure the healthy development of the economy. The visible hand of the government plays an essential role in the adjustment of economic policies. Studies by economists have shown that EPU has a significant negative effect on sustained macroeconomic growth [2]. Bloom found that EPU was a considerable driving force leading to economic recession [3]. After the global financial crisis in 2008, the world economic situation is complicated, and uncertain events are increasing. The European sovereign debt crisis, Brexit, Trump's election as US President, the China-US trade war, the Federal Reserve's interest rate hike, intensifying geopolitical conflicts, rising trade protectionism, and the trend of "anti-globalization" are heating up. The global economy is suffering from weak recovery and weak growth due to the "gray rhino" dilemma of debt and will also face the risk of "black swan" events in terms of economic policies. In the future, a series of uncertain events are likely to further ferment and evolve, leading to systemic financial risks and even a new round of economic crisis under the influence of the domino effect.

In order to resolve the negative impact brought by the 2008 financial crisis and prevent China's economy from accelerating its decline, China has launched an unprecedented "Ten Industry Revitalization Plan" and "government stimulus package." These policies have brought some problems to our country's economy while saving economic growth. In order to solve the problem of overcapacity caused by strong economic stimulus, China put forward the strategic policy of "supply-side structural reform" in 2015 to promote structural adjustment, correct the distortion of factor allocation, and expand effective supply. On the one hand, the implementation of a series of macroeconomic policies helps to alleviate China's economic growth's quandary; on the other hand, it increases the uncertainty of China's economic policy.

Innovation has become an important source of development and a new engine for sustained medium-high growth in the new economy. China is accelerating the building of an innovative country and will be among the top innovative countries in the future. As the core of modern economic life and an important lever of macroeconomic adjustment, the financial industry directly affects the process of national economic construction in our country. Actively promoting financial innovation is of great significance to the sustained and rapid development of China's economy.

The relationship between EPU and innovation has become a hot topic in current research. However, most of the existing researches focus on the effect of EPU on firms' technological innovation, and the relationship between the two is remains controversial. According to Schumpeter and the endogenous growth theory, EPU has a negative effect on firms' technological innovation. Kalamova et al. conducted an empirical evaluation of the economic data of 23 countries in the Organization for Economic Cooperation and Development by establishing a model. Its results show that a 10% increase in policy uncertainty leads to a 1.2%-2.8% decrease in innovation activity [4]. Bhattacharya et al. used data samples from 43 countries to conduct empirical research. Its results find that policy uncertainty can adversely affect innovation in a country, and this effect is more pronounced for patent citations and originality [5]. Other scholars analyzed the relationship between policy uncertainty and innovation from the perspective of real option theory. The results show that EPU has a significant inhibitory effect on corporate innovation [6, 7]. Some domestic researchers use the data of NASDAQ-listed companies to conduct empirical research. The results show that EPU significantly reduces the level of corporate innovation [8, 9]. From the perspective of official change, Wang pointed out that the uncertainty caused by the change of local officials would have a significant negative effect on firm innovation. The Knightian uncertainty party believes that EPU promotes enterprise technological innovation [10]. Marcus studied the impact of R&D policies, health and safety policies, and economic regulation policies on innovation and concluded that policy uncertainty and innovation are positively correlated [11]. Brower inserted Knightian uncertainty into Schumpeter's innovation model. He found that the increase in uncertainty increases the utilization rate of human capital and effectively promotes the innovation activities of enterprises [12]. Gu et al. used R&D investment and patent applications from publicly traded companies to examine the relationship between EPU and innovation. The results show that EPU has a significant incentive effect on corporate innovation [13].

In the existing literature, the research on the impact of EPU on commercial banks is mainly divided into two aspects: bank credit allocation and credit risk. Regarding the relationship of EPU and bank credit allocation, Talavera et al. explored the effect of uncertainty on bank credit through the dynamic model of bank profit maximization. Their study found that a rise in economic uncertainty reduces the share of loans made by banks [14]. Valencia found in his study on the credit data of commercial banks in the United States that EPU inhibits the credit supply of banks, and this inhibitory effect is more significant for banks with a low capital adequacy ratio [15]. Qiu and Liu and Xin et al. constructed the optimal asset portfolio allocation model and the dynamic optimization model of bank value maximization to study the impact of economic uncertainty on bank asset allocation. Its empirical results show that an increase in economic uncertainty significantly reduces the proportion of commercial

bank loans [16, 17]. Liu and Cao, Qian and Zhang, and Shen and Ma analyzed the relationship between EPU and bank credit from the perspectives of government intervention, accounting information quality, and bank heterogeneity, respectively. The results show that EPU reduces bank credit allocation efficiency and significantly inhibits bank credit supply [18, 19, 20]. As for the study on the impact of EPU on bank credit risk, Valencia found that when the uncertainty increased, the bank bankruptcy risk would be significantly increased. EPU has a negative effect on the stability of the banking system [15]. EPU has significantly increased the risk of banks [17, 21, 22].

The existing literature mainly studies the impact of EPU on corporate technological innovation and bank credit. However, the relationship between EPU and commercial banks' financial innovation, an important link, has been ignored by most scholars. Based on the data of commercial banks from 2007 to 2017, our study explores the relationship between EPU and financial innovation. The results of this paper show that EPU has a significant incentive effect on financial innovation, and the impact on different types of commercial banks is different. It is also related to banks' asset liquidity ratio and asset return rate. Compared with existing research at home and abroad, our research has made the following contributions:

(1) At present, there is still a lack of relevant research on the impact of EPU on financial innovation. This paper examines the influence mechanism of EPU on financial innovation from a theoretical standpoint and empirically investigates the incentive and selection effect of EPU on financial innovation.

(2) This paper uses return on assets and asset liquidity ratio as proxy variables of bank profitability and risk-taking, analyzes the difference in the incentive effect of EPU on banks with different characteristics in two dimensions, that is, the selection effect of EPU, and further verifies the influence mechanism of EPU on financial innovation.

(3) Based on the impact mechanism of EPU on financial innovation and the empirical research findings, our study makes reasonable recommendations for China's economic policy adjustment and financial supervision mechanism.

2. Theoretical Analysis and Research Hypotheses

This paper selects China's EPU, constructed by Baker et al., as the proxy variable to measure the changes in the macroeconomic environment and examines its relationship with banks' financial innovation [23]. So, how does the level of bank financial innovation respond to EPU? This paper examines the impact mechanism of EPU on financial innovation using real options theory and financial frictions theory.

First of all, the real options theory holds that in a market environment facing uncertainty, enterprises often choose the "wait and see" strategy. Business leaders hold off on investment and wait for more information before making a decision on investment [24]. Dixit and Pindyck considered that the real option theory made up for the deficiency of the net present value (NPV) theory in considering the irreversibility of corporate investment and the selectivity of investment timing [25]. When the uncertainty of the business environment rises, enterprises can implement "flexible" investment strategies to dynamically grasp the value and timing of investment. For commercial banks, lending can be viewed as holding a call option. The increase in economic uncertainty will increase the value of options, the return to waiting will increase, and the opportunity cost of lending today will also increase. Therefore, when EPU rises, banks will take the initiative to shrink the credit scale and reduce the credit supply to decrese the opportunity cost. The credit business is the major contributor to the income of commercial banks, and the reduction of the credit business will produce a "forced mechanism" for banks, which have to find new profit growth points through financial innovation. Therefore, facing the economic uncertainty, banks are more liable to improve their profitability through financial innovation so as to make up for the loss caused by the decline in credit scale.

Second, the theory of financial frictions argues that imperfections in the information structure of financial markets will lead to an increase in transaction costs. On the one hand, as the creditor bank, the increase in transaction costs will directly lead to a reduce in bank credit supply. On another, the increase in EPU will exacerbate information asymmetry in the financial market, reduce the accuracy of credit asset pricing, and increase the risk of bank credit business. In order to avoid losses caused by credit risks, commercial banks often adopt prudent business strategies to reduce the credit scale. Compared with the traditional credit business of banks, intermediary business has low risk and is a stable source of income for banks at a low cost. At the same time, intermediate business income is also an essential measure of financial innovation of commercial banks. Therefore, when facing the risk of market uncertainty, commercial banks are more likely to start from the perspective of financial innovation and expand the income channel of intermediate businesses so as to create the maximum profit at the lowest cost.

To sum up, the influence mechanism of EPU on financial innovation is shown in Figure 1.

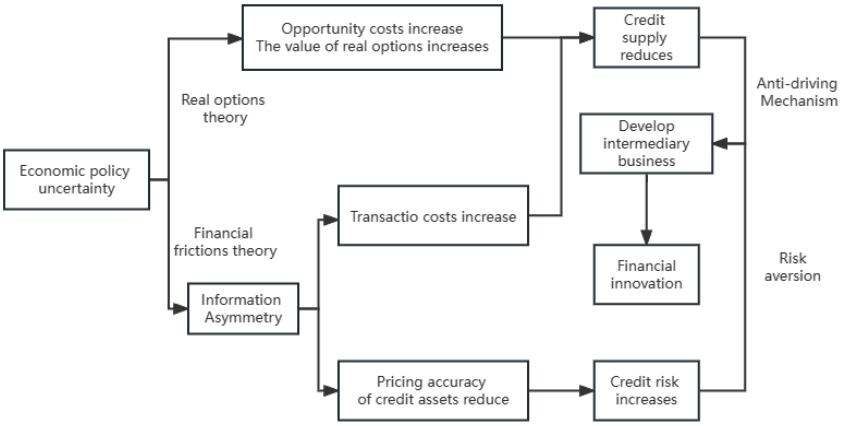

Figure 1: The mechanism of EPU influencing financial innovation.

Based on the above theoretical analysis, we propose:

H1: EPU positively affects the financial innovation activities of commercial banks; that is, EPU has an “incentive effect” on financial innovation.

Considering the heterogeneity of commercial banks, the incentive effect of EPU on financial innovation may be different for different banks. Listed banks have access to the capital markets, where they have less difficulty accessing capital than unlisted banks, which rely more on customer deposits. Therefore, when EPU increases, the desire of non-listed banks to obtain capital and profits through financial innovation becomes more urgent; that is, the incentive effect of EPU on non-listed banks may be greater than that of listed banks. Based on this, we propose:

H2.1: EPU has different impacts on listed banks and non-listed banks. It has a greater incentive effect on non-listed banks than on listed banks; that is, EPU has a “selection effect” on the two types of banks.

According to the property nature and regional division of Chinese commercial banks, they are mainly classified into state-owned banks, share-holding commercial banks, urban commercial banks and rural commercial banks. Banks with larger assets and a more stable income structure are less sensitive to the incentive effect of EPU. For urban and rural banks with smaller asset scales and a smaller user base, this incentive effect may be greater. Based on this, we propose:

H2.2: EPU has different degrees of influence on commercial banks with different natures; that is, EPU has a “selection effect” on banks with different natures.

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3. Research Design

3.1. Sample Selection and Data Sources

This paper mainly studies the influence of EPU on the financial innovation of commercial banks. Considering the fact that the non-performing assets rate of state-owned commercial banks was relatively high before the shareholding reform and the completeness of the data, this paper selects the statistical data of China's banking industry from 2007 to 2017. The data mainly come from the Wind database. Excluding policy banks, postal savings banks, foreign banks, securities companies, trust companies, rural cooperative banks, rural credit cooperatives, and rural banks, the data of 306 commercial banks is finally formed. Among them, there are 5 state-owned commercial banks, 12 joint-stock commercial banks, 119 urban commercial banks, and 170 rural commercial banks. During the sample period, the ratio of the assets of the sample banks to the assets of the banking financial institutions has always remained above 70%, which has a high degree of representativeness. The M2 money supply data comes from the official website of the People's Bank of China. The variable of EPU comes from the EPU index, jointly published by Stanford University and the University of Chicago.

3.2. Research Model Setting

This paper mainly studies the impact of EPU on financial innovation ability, so the following basic regression model is set up:

$$innovation_{i,t} = \alpha_0 + \alpha_1 EPU_{i,t-1} + \alpha_2 Size_{i,t-1} + \alpha_3 CAR_{i,t-1} + \alpha_4 Leverage_{i,t-1} + \alpha_5 NPL_{i,t-1} + \alpha_6 LDR_{i,t-1} + \alpha_7 ROA_{i,t-1} + \alpha_8 M2_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

Where i represents the individual commercial bank, t represents the year, the explained variable is $Innovation_i$, and $_t$ represents the proportion of intermediate business income (financial innovation ability) of the commercial bank in year t of i. Considering that it takes a certain time for commercial banks to complete innovation activities, and to avoid endogeneity problems, we lag the explanatory variables and all control variables by one period. α_0 is the intercept term, and $\varepsilon_{i,t}$ is the regression residual. In addition, all variables except the adjustment variables were treated with 1% winsorize to reduce the effect of extreme values of variables on the regression results.

3.3. Variable Definition and Description

Explained Variable: Financial Innovation (Innovation). Throughout the existing research literature, the academic field has not reached a consensus on the measurement of banking and financial innovation. With respect to the revenue structure of commercial banks in China, the intermediate business income can reflect the innovation level of banks to a certain extent. First, in recent years, the innovative business of Chinese commercial banks has mainly focused on financing, investment banking, asset custody, guarantee business, and principal-agent service. And the operating income of these businesses will be included in the intermediate business income. Second, with the relaxation of financial regulation and the revolutionary progress of information technology, the phenomenon of financial disintermediation of commercial banks has accelerated significantly, and the income of traditional deposit and loan business has declined significantly. To ensure the status of the banking industry in economic development, banks successively expand the income channels of intermediary businesses and carry out financial innovation activities [26, 27]. Thirdly, from the perspective of supervision, intermediary business income is an important index used by the China Banking Regulatory Commission to measure the innovation ability of banks, and specific innovation development goals are proposed for different types of banks. Therefore, it is relevant to measure the innovation

level of banks with intermediate business income. In order to eliminate the interference caused by the scale effect on the empirical results of large banks, this paper believes that it is more reasonable to use relative indicators to measure Therefore, this paper selects the proportion of bank intermediary business income in operating income as the proxy variable for bank innovation ability.

Explanatory Variable: Chinese Economic Policy Uncertainty Index (EPU). This paper uses the Chinese EPU index constructed by Baker et al. to measure the uncertainty of China's economic policy [23]. The index is widely recognized by researchers at home and abroad and has been used in a large number of scientific research papers. The EPU index uses the South China Morning Post as the retrieval platform for news reports and constructs the uncertainty index of China's economic policy through text retrieval of keywords "uncertain/uncertainty", "policy", "spending", "economic/economy", "central bank", "tax", "regulation", "budget" and "deficit". In our study, by referring to the practice of Gu et al., the method of extracting the annual arithmetic average is used to transform the monthly EPU index into the annual index [13].

Control Variables. Following Hunter and Timme, De Young and Rice, Zou et al., Liu [28-31]. We include a series of control variables, Asset Size (Size), Capital Adequacy Ratio (CAR), Financial Leverage Ratio (Leverage), Non-Performing Loan Ratio (NPL), Loan-to-deposit Ratio (LDR), Asset Liquidity Ratio (ALR), Return on Assets (ROA), and General Money Growth Rate (M2).

Table 1: Variables and their definitions.

Variables	Definitions
Innovation	The proportion of intermediate business net income in operating revenue
EPU	The arithmetic average of the monthly index of EPU
Size	The natural log of the bank's total assets at the end of the year
CAR	Net bank capital as a percentage of weighted risk
Leverage	The ratio of the bank's year-end net Tier 1 capital to its adjusted balance sheet assets
NPL	The ratio of non-performing assets to total loans at the end of the year under the standard of five-level loan classification
LDR	The ratio of bank loans to deposits at the end of the year
ALR	Ratio of bank's current assets balance to current liabilities balance at the end of the year
ROA	The ratio of a bank's net profit to its average assets at the end of the year
M2	The ratio of the difference between the money stock at the end of the year and the money stock at the end of the previous year
Nature	1 for state-owned commercial banks, 2 for joint-stock commercial banks, 3 for urban commercial banks, and 4 for rural commercial banks
List	0 for unlisted banks and 1 for listed banks

3.4. Descriptive Statistics

China's EPU Index. Figure 2 describes the index trend of China's EPU during the sample period. As shown in the figure, there are three peaks of EPU during the sample period. From 2008 to 2010, as the global financial crisis continued to spread, our economy was also affected to some extent. EPU has grown substantially since 2008. Between 2011 and 2013, the central government's economic stimulus plan not only boosted economic growth but also had some negative effects on the Chinese economy. At this time, our economy not only faces the dilemma of weak growth but also faces the problem of an excessively high inflation index. Therefore, since 2011, EPU has been rising sharply. Between 2016 and 2018, China began to carry out supply-side structural reform at the end of 2015 in

order to solve the problems of overcapacity and high debt brought about by the "4 trillion yuan" investment plan and improve the quality of economic growth. This has significantly increased the uncertainty of China's economic policy, which has risen sharply since 2016. With the steady implementation of "three removals, one reduction, and one supplement," the EPU index began to show a downward trend after 2017.

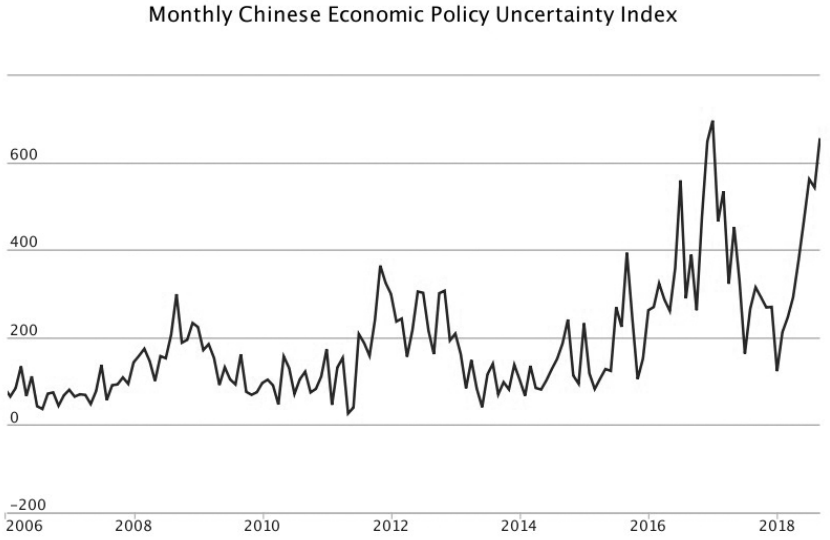

Figure 2: China's EPU index chart.

Descriptive Statistics of Major Variables. Table 2 gives descriptive statistics for the main variables. We can see that the difference between the maximum and the minimum value of the bank's innovation ability is relatively obvious, which may be due to the heterogeneity of the bank and the mode of operation. Other control variables also have some differences, but basically accord with our commercial bank conditions.

Table 2: Descriptive statistics of variables.

Variables	N	Mean	s.d.	Min	Max
Innovation	2,026	3.71	4.05	0.004	19.60
EPU	2,023	202.72	98.90	82.25	364.83
Size	2,023	24.95	1.66	22.15	30.27
CAR	1,863	13.51	2.76	8.49	25.88
Leverage	2,023	14.77	4.29	6.69	30.32
NPL	1,887	1.57	0.97	0.04	6.06
LDR	2,009	63.69	10.21	31.25	85.53
ALR	1,623	53.86	17.05	28.68	126.48
ROA	2,023	1.04	0.40	0.13	2.18
M2	2,026	14.02	4.32	8.20	27.70
List	2,026	0.20	0.40	0	1
Nature	2,026	3.31	0.71	1	4

4. Empirical Analysis and Results

4.1. The Incentive Effect of EPU

The full-sample regression in Table 3 describes the relationship between EPU and the financial innovation ability of commercial banks from 2007 to 2017. The regression results show that EPU has a

significant positive correlation with the financial innovation of commercial banks; that is, EPU has an incentive effect on the innovation behavior of commercial banks. For commercial banks, the uncertainty of economic policy is both a risk and an opportunity. Banks seize the opportunity to carry out financial innovation activities so as to obtain higher market share and profits. Therefore, this regression result supports hypothesis 1.

4.2. The Selection Effect of EPU

According to the listing situation of commercial banks, we carry out subsample regression, respectively. Table 3 Neutron sample regression results show that for non-listed banks, EPU has a significant incentive effect on the financial innovation ability of banks. For listed banks, EPU has no significant incentive effect on the financial innovation ability of banks. This indicates that EPU has a selective effect on listed and unlisted banks, and this regression result supports H2.1.

Table 3: Incentive and selection effects of EPU: listing situation.

Variable names	Full sample	Unlisted bank	Listed bank
L. EPU	0.0033***	0.0030***	0.0015
	(3.52)	(2.90)	(0.79)
L. Size	1.6364***	1.2924***	2.7164***
	(10.09)	(7.00)	(8.74)
L. CAR	-0.0680*	-0.0269	-0.2698***
	(-1.75)	(-0.64)	(-2.94)
L. Leverage	-0.1005***	-0.0224	-0.3882***
	(-3.38)	(-0.68)	(-6.08)
L. NPL	0.1651	0.1530	0.5288***
	(1.60)	(1.30)	(2.73)
L. LDR	-0.0163	-0.0187	0.0586**
	(-1.35)	(-1.43)	(2.05)
L. LAR	0.0141**	0.0109*	0.0384**
	(2.36)	(1.75)	(2.41)
L. ROA	0.6319**	0.6385**	-0.0075
	(2.27)	(2.17)	(-0.01)
L. M2	0.0789***	0.0869***	0.0688*
	(3.68)	(3.42)	(1.91)
Constant	-36.8062***	-29.8816***	-63.7390***
	(-7.65)	(-5.65)	(-6.11)
Sample size	1385	1101	248
R^2	0.1754	0.0988	0.5255

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Next, sub-sample regression is carried out according to different properties of commercial banks. The regression results show that for state-owned banks and joint-stock banks, EPU has no significant incentive effect on the financial innovation ability of banks but has a certain incentive effect on urban commercial banks and rural commercial banks. The difference is that EPU has more significant impact on the innovation behavior of rural commercial banks, which reflects a certain heterogeneity of commercial banks. In general, EPU has certain selection effects on banks of different natures, and this regression result supports H2.2.

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Table 4: The selection effect of EPU: banking nature.

Variable names	Nationalized bank	Joint-stock bank	City commercial bank	Rural commercial bank
L. EPU	0.0017	0.0051	0.0026**	0.0030***
	(0.45)	(1.16)	(2.00)	(2.75)
L. Size	2.0932	4.7681***	1.1274***	1.3449***
	(1.07)	(9.32)	(5.77)	(3.71)
L. CAR	0.6227	-0.3419*	-0.0171	-0.0940*
	(1.33)	(-1.67)	(-0.35)	(-1.75)
L. Leverage	-0.1853	-0.3492***	0.0029	-0.0801*
	(-0.90)	(-3.63)	(0.08)	(-1.65)
L. NPL	0.5511	0.0620	0.1134	0.0276
	(0.06)	(0.19)	(0.87)	(0.17)
L. LDR	0.0342	0.1068	-0.0132	-0.0344
	(0.44)	(1.61)	(-0.94)	(-1.60)
L. LAR	0.1174*	0.0531*	0.0155*	0.0023
	(1.87)	(2.09)	(1.95)	(0.33)
L. ROA	3.5789	-2.0536	0.1737	0.7174*
	(0.85)	(-1.23)	(0.50)	(1.77)
L. M2	0.3975***	-0.0484	0.0726***	0.1117***
	(4.21)	(-0.76)	(2.73)	(2.59)
Constant	-71.8481***	-119.0144***	-26.1231***	-28.8506***
	(-1.18)	(-6.34)	(-4.49)	(-2.99)
Sample size	46	93	772	576
R^2	0.5239	0.8304	0.1033	0.0869

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

5. Robustness Test

5.1. Discussion of Endogeneity

The EPU index used in our study belongs to the national macro-level indicators. It is difficult for individual banks' micro-behaviors to have an impact on national macroeconomic policies, so the reverse causal relationship between EPU and commercial banks' innovative behaviors can be ignored. In addition, all variables except the explained and moderated variables are delayed by one period, which can avoid the endogeneity problems caused by reverse causality to a large extent.

In addition, instrument can solve the endogeneity problems caused by missing variables and reverse causality to some extent. In order to further verify the robustness of the empirical results, this paper uses the global EPU index as an instrument to re-verify the results, as shown in Model 2 in Table 6. The empirical results show that the influence of global EPU on the innovation ability of banks is still significant.

5.2. Recalculation of Economic Uncertainty Indicators

The EPU index constructed by Baker et al. is a monthly index, which is inconsistent with the annual data of the financial innovation ability of commercial banks, the explained variable used in this paper [23]. Therefore, we need to convert the monthly index of EPU into annual data. In addition to the arithmetic mean value algorithm of the monthly index used above, this paper also tries to use the geometric mean value and median value algorithms of the monthly index to measure EPU, as shown in Model 3 in Table 6. There is no significant difference in the regression results obtained.

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5.3. Re-Selection of Regression Models

Random effects The GLS regression model can deal with heteroscedasticity and sequence correlation of random terms in linear models. In addition to the fixed effects regression model selected above, this paper also attempts to use the random effects GLS regression model to estimate the explained variables. Explanatory variables remain unchanged with all control variables, and the original data are recalculated by regression, as shown in Model 4 in Table 6. The results showed that the regression coefficients are basically consistent with our baseline regression.

Table 5: Robustness test results.

Variable names	Model 1 Basic model	Model 2 Instrumental variable	Model 3 Variable substitution	Model 4 Stochastic GLS
L. EPU	0.0033***	0.0028***	0.0034***	0.0033***
	(3.52)	(2.63)	(3.52)	(3.52)
L. Size	1.6364***	1.7315***	1.7042***	1.6364***
	(10.09)	(10.38)	(10.33)	(10.09)
L. CAR	-0.0680*	-0.0622	-0.0653*	-0.0680*
	(-1.75)	(-1.57)	(-1.66)	(-1.75)
L. Leverage	-0.1005***	-0.1039***	-0.1058***	-0.1005***
	(-3.38)	(-3.43)	(-3.51)	(-3.38)
L. NPL	0.1651	0.2006*	0.1841*	0.1652
	(1.60)	(1.89)	(1.75)	(1.60)
L. LDR	-0.0163	-0.0183	-0.0183	-0.0163
	(-1.35)	(-1.49)	(-1.49)	(-1.35)
L. ALR	0.0141**	0.0127**	0.0127**	0.0141**
	(2.36)	(2.10)	(2.10)	(2.36)
L. ROA	0.6319**	0.6353**	0.6492**	0.6319**
	(2.27)	(2.24)	(2.30)	(2.27)
L. M2	0.0789***	0.0798***	0.0803***	0.0789***
	(3.68)	(3.67)	(3.73)	(3.68)
Constant	-36.8062***	-38.9740***	-38.2922***	-36.8062***
	(-7.65)	(-7.90)	(-7.82)	(-7.65)
Sample size	1385	1354	1357	1385
R^2	0.1754	0.1808	0.1812	-

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

6. Further Expansion

According to the above research, EPU has an incentive effect on the financial innovation of commercial banks, and the incentive effect on non-listed banks is greater than that on listed banks. In addition, different types of commercial banks' responses to economic policy uncertainties have obvious differences: state-owned banks and joint-stock commercial banks have more stable performance, followed by urban commercial banks, while rural commercial banks are the most sensitive. On this basis, we carry out further analysis. Banks with strong profitability may choose to "wait" or "wait and see" in the face of EPU. However, when the banks with weak profitability are hit by the uncertainty of economic policies, they may have no choice and are more likely to escape the crisis through financial innovation activities. Consequently, we propose the following hypothesis:

H3: The incentive effect of EPU on the financial innovation of commercial banks gradually decreases with the increase of bank asset returns.

As mentioned above, when the uncertainty of macroeconomic policies increases, commercial banks will also face certain external environmental risks. In order to alleviate the negative effects of

such risks on banks, banks often develop lower-risk intermediary businesses through financial innovation. Banks with strong solvency have sufficient ability to meet customers' demand for cash withdrawals. Therefore, the incentive effect of EPU on their financial innovation ability may be low. Conversely, for banks with weak solvency, the incentive effect of EPU is likely to be stronger. Consequently, we propose the following hypothesis:

H4: The incentive effect of EPU on the financial innovation of commercial banks gradually decreases with the increase of the bank liquidity ratio.

To verify the selection effect of EPU on banks with different profitability and solvency, we draw on the research method of Rajan and Zingales and introduces the interaction terms of asset return rate, asset liquidity, and the EPU index into the basic regression model [32]. The specific empirical model is shown as follows:

$$innovation_{i,t} = \beta_0 + \beta_1 EPU_{i,t-1} + \beta_2 EPU_{i,t-1} \times ROA_{i,t-1} + Controls_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

$$innovation_{i,t} = \gamma_0 + \gamma_1 EPU_{i,t-1} + \gamma_2 EPU_{i,t-1} \times ALR_{i,t-1} + Controls_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

If hypotheses 3 and 4 are valid, then the coefficients of the interaction term of asset return, asset liquidity, and the EPU index should be significantly negative. The results in Table 6 show that the coefficients of the interaction terms of return on assets, liquidity of assets, and the EPU index is significantly negative at 5%. This indicates that banks with a higher return on assets and a higher ratio of asset liquidity can better reflect the incentive effect of EPU; that is, the incentive effect of EPU on financial innovation at commercial banks gradually decreases with the increase in bank return on assets and asset liquidity. This result supports the assertions of hypothesis 3 and hypothesis 4.

Table 6: The regression results of bank asset returns and asset liquidity.

Variable names	Return on assets	Asset liquidity
L. EPU	0.0086***	0.0101***
	(3.27)	(3.49)
L. EPU×X	-0.0053**	-0.0001**
	(-2.13)	(-2.47)
L. Size	1.6464***	1.7175***
	(9.86)	(10.41)
L. CAR	-0.0702*	-0.0674*
	(-1.78)	(-1.71)
L. Leverage	-0.1087***	-0.1028***
	(-3.60)	(-3.41)
L. NPL	0.2007*	0.2062*
	(1.90)	(1.95)
L. LDR	-0.0215*	-0.0209*
	(-1.75)	(-1.70)
L. ALR	0.0129**	0.0349***
	(2.13)	(3.21)
L. ROA	1.5927**	0.6726**
	(3.05)	(2.38)
L. M2	0.0820***	0.0832***
	(3.79)	(3.85)
Constant	-37.5669***	-39.7749***
	(-7.66)	(-8.07)
Sample size	1354	1354
R^2	0.1845	0.1857

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

7. Conclusion

We investigate the effect of EPU on financial innovation from the micro-perspective of commercial banks. The findings demonstrate that the enhance of EPU will leads to incentive and selection effects on bank' financial innovation. This incentive effect is more pronounced for non-listed banks than listed banks. Different types of commercial banks' responses to EPU have obvious differences: state-owned banks and joint-equity banks have more stable performance, followed by urban commercial banks, while rural commercial banks are the most sensitive. In addition, the incentive effect of EPU on financial innovation activities is affected by ROA and the ratio of asset liquidity. The higher ROA and the higher liquidity of assets, the weaker the incentive effect of the EPU; that is, the better the profitability of the bank, the smaller the liquidity risk of the bank is affected by the uncertainty of economic policy. This finding coincides with the study of the influence channel in the previous theoretical analysis section.

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