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Research article

Statistical measurement of the impact of monetary policy on price levels

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Abstract: The channels of monetary policy transmission highly depend on industrial structure, and there are significant differences across industries. This paper studies the industrial effects of monetary policy in China using the Vector Autoregression (VAR) model. We explore the heterogeneity of the response three pillar industries and factor intensity industries to a monetary shock. In order to capture the transmission of monetary policy, decomposing monetary policy as anticipated and unanticipated is considered. Results show evidence of the industrial effects of aggregate monetary policy shock is almost not effective. And the effectiveness of monetary policy shocks is conducted in close association with expectations and factor intensity.

Keywords: industrial effects; anticipated; unanticipated; monetary policy

JEL Codes: E23, E52, O14

1. Introduction

The industrial structure is at the heart of sustainable development. The United Nations Environment Programme (UNEP) has stated that sustainable development is seen as a guiding principle for development that encompasses three aims: Environmental quality, economic prosperity and social equity. And economic activity in a sustainable way has been considered as the basis of their economic development. In its most basic form, sustainable development of the economy can be loosely defined as one which balances economic development with environmental and resource protection and in this form, it appears to be inseparable from the industrial structure (Huang et al., 2019; Li et al., 2019; Li et al., 2018b; Murray et al., 2015; Li et al., 2019). The sustained economic growth was largely

achieved at the cost of over-consumption of energy resources, especially the secondary industry driven by industrialization (Feng et al., 2012; Liu et al., 2015; Ren et al., 2014; Sarkodie and Strezov, 2018). The evidence suggests that a strong negative correlation between industrialization and energy consumption exists. Moreover, the structural change led to an unsustainable composition of output which can be followed by abrupt and sharp bursts with unpredictable consequences (Atoyan et al., 2013; Eichengreen, 2010; Turunen et al., 2011). However, structural change makes possible higher rates of economic growth along with a better income distribution (Cimoli et al., 2016; Kaplan et al., 2018; McKay et al., 2016). Thus, coordinating the relationship between industrial structure is an important task for the sustainable development of the economy.

The industrial structural change is primarily attributed to a better conduct of monetary policy. On the one hand, the transmission of monetary policy through capital flows whereby an expansionary shock to monetary policy leads to an increase in the cross-border capital flows in the banking sector (Bruno and Shin, 2015; Gerali et al., 2010; Yin et al., 2019). A low policy rate induces thinly capitalized banks to grant riskier lending (Jiménez et al., 2014; Maddaloni and Peydró, 2011). Bank as the intermediary sector takes up an important position in the transmission of monetary policy. They can choose a portfolio of loans between industries their preferences, which may be create spare capacity even more. On the other hand, monetary policy has continued to influence the output of industries, with Frankel (2006) arguing that the demand for and supply of various commodities and services are therefore likely to be heavily influenced by interest rates. Monetary expansion decreases real interest rates and results in significant increases in sectoral output (Obstfeld and Rogoff, 1995; Svensson and Wijnbergen, 1989; Vespignani and Ratti, 2016). Low-interest rates can clearly communicate a path to the industry whose development highly depends on interest rates, so that the monetary policy can influence industrial structure. Thence, the economic system became more stable and the sectoral output increased reasonably because of the effective monetary policy support.

Monetary policy is unlikely to have a uniform impact on the thrice industry. This makes the task of central banking difficult because the impetus for monetary policy intervention depends on the source of weakness or instability in macroeconomic. There are different views existing regarding the three pillar industrial effects of monetary policy nexus. The first view supports the view of significant impact of all industries, and the offer that output in the tertiary industry increase by more than the secondary industry, which in turn increase by more than the primary industry (Bouakez et al., 2009; Hausman et al., 2019). The second view supports that output responses to monetary policy shocks are large on the secondary industry (e.g. durable-goods producers) (Dedola and Lippi, 2005; Peersman and Smets, 2005). Another stresses that traditional monetary transmission in the tertiary industry is weak or nonexistent. Ghossoub and Reed (Ghossoub and Reed, 2015) explore the impact of monetary policy on the banking sector and stress that the efficacy of monetary policy on credit market activity is weaker. At the root of these industrial effects were large economic system differentials, which accumulated to substantial shifts in the effectiveness of monetary policy due to the economic environment and the distinctive of the instrument to adjust monetary policy. The effect of monetary policy may be related to the different industries in price rigidity and to industrial characteristics. It is a more major to understand the differential industry impacts of monetary policy than their aggregate counterpart.

The industrial effects of monetary policy shocks also should be conducted in close association with factor intensity. With this body of literature, studies stress that substantial heterogeneity in sectoral output responses to monetary policy shocks (Barth III and Ramey, 2001; Givens and Reed, 2018; Hayo

and Uhlenbrock, 2000; Loo and Lastrapes, 1998; Tena and Tremayne, 2009). For instance, Kabundi et al. (Kabundi et al., 2015) and Poon (Poon, 2004) find that the information technology industrial effect of monetary policy is crucial. Carlino and Defina (Carlino and DeFina, 1998) find evidence of asymmetry in the monetary policy response patterns and trace this result to differences in certain industry characteristics across regions. However, the transmission of monetary policy to the different factor intensity industries is largely ignored. The effects of monetary policy shock at sectoral output variations are significantly related to factor intensity. For one thing, policy actions affect production costs and the responses of participants to demand shifts (Li et al., 2018a). Then the shock might be expected to be observed in capital- intensive industries, as they usually are sensitive to interest rates. For another, the role of market-orientated to explain technology-intensive industries. In this context, the loans would be provided by financial intermediaries to highly technological industries as they are more likely to achieve development opportunities (Mumbi, 2018).

There are pronounced differences in effectiveness between anticipated and unanticipated monetary policy. There is also a relatively adequate understanding of how monetary policy impacts structural change, or how this is related to industry characteristics. Whereas we purposefully focus on an increasingly important domain, industrial effects that are likely to be exposed to unanticipated monetary policy shocks. The question of monetary policy transmission has always been of key interest for monetary policy, but most of the research, by nature of the topic, has been concentrating on the aggregate level of monetary policy. Monetary transmission may be both weak and unreliable (Cebula and Boylan, 2019; Mishra et al., 2012). Anticipated and Unanticipated monetary policy are substantial channels to affect output. As market participants different expectations, monetary policy tends to be of the effect variety. on the premise of the efficient market, the monetary policy instrument can exert predictable effects on output, at least under normal conditions. The effectiveness of monetary policy depends on the expectation since heterogeneous expectations can alter the way in which monetary policy propagate shocks. It is, therefore, possible that the impact of the industrial output on the monetary policy response is related to market participants sentiment (Chen et al., 2019; Smales and Lucey, 2019; Li and Zhong, 2019; He et al., 2019).

This paper contributes to the literature by the industrial effects of monetary policy. First, we discuss central banks' actions affects conditions across industries, and reveal differences in the response to a monetary shock among three pillar industries. Further, based on the notion that monetary policy has a diverse impact on different industries, we explore the monetary policy shock by categorizing the industries in the secondary industry into their factor intensity. Last but not least, this paper focuses on disaggregate monetary policy transmission. In order to more comprehensive evaluating the monetary transmission mechanism, we provide a detailed analysis of the different monetary policy transmission in all industries, by decomposing monetary policy as anticipated and unanticipated.

The paper continues as follows. Section 2 details methodology and data, Section 3 discusses industrial effects of monetary policy shock. Section 4 provides industrial effects of anticipated vs unanticipated monetary policy shocks and Section 5 conclusions and policy implication.

2. Methodology and data

2.1. The Vector Autoregression (VAR) model

The VAR model is to examine the impact of monetary policy on the real output by analyzing the accumulated impulse responses of monetary policy shocks. Theoretical studies of the monetary transmission mechanism suggest the reason why a policy-induced rise in the interest rate should influential on industry activity. On the one hand, monetary policy impinges on sectorial output because it affects both the demand for the industrial commodities and the firms' decision problem. The monetary restriction, by raising the expected real interest rate, triggers a decrease in the expenditure for investment and durable consumption goods, which materializes in the lower output of the industries producing such commodities. In an open economy, an interest rate increase may also involve an exchange rate appreciation which causes an expenditure switching effect from domestic to foreign (traded) goods. Moreover, firms in sectors characterized by more capital-intensive production processes may display a higher sensitivity to interest rate changes. On the other hand, monetary transmission mechanism, by credit channel, matters under frictions in financial markets. This channel is rather thought of as an amplification. An interest rate rise has a negative impact on borrowers' net-worth and their borrowing capacity. The existing literature has focused mainly on the monetary transmission mechanism using the VAR model (Anagnostou and Papadamou, 2016; Chen and Groenewold, 2018; Georgiadis, 2015; Jawadi et al., 2017; Petersen et al., 2015). We are interested in characterizing the effects of exogenous monetary shocks on the variation among individual industrial output. The shocks are not constrained to be the same across the aggregate output since each industrial VAR model is used to identify its own aggregate shocks. In addition, the speed and degree of adjustment of the output due to a monetary policy shock are investigated in the accumulated impulse response. Therefore, we employ a VAR and identify monetary shocks.

We express the basic VAR model as follows:

$$\mathbf{y_t} = A + B_1\mathbf{y_{t-1}} + \cdots + B_p\mathbf{y_{t-p}} + \varepsilon_i \tag{1}$$

$$B_p = \begin{pmatrix} b_{11} & b_{12} & \cdots & b_{1p} \\ b_{21} & b_{22} & \cdots & b_{2p} \\ \vdots & \vdots & \ddots & \cdots \\ b_{n1} & b_{n2} & \cdots & b_{np} \end{pmatrix}$$

where $\mathbf{y_t}=\left(Y_i, MP\right)'$ is a column vector of endogenous variables under consideration industrial output and monetary policy, B_p is the matrix of coefficients that capture the relations among the variables, p is the optimal lag length, determined by the Akaike Information Criterion (AIC) and so on, two lags in this case, and ε_i is the vector of monetary policy shocks.

We employed the accumulated impulse response to test the validity of the monetary policy, thus, the nexus between monetary policy and industrial output.

$$I_n = \partial Y_i / \partial \varepsilon_{MP} \tag{2}$$

where I_n is the impulse response functions. We identify monetary policy effectiveness by imposing sign restrictions on the I_n. The validity of the monetary policy is estimated by the target of it which promotes stable economic growth, i.e. loose monetary policy increases industrial output. Hence, the effective monetary policy requires the value of accumulated impulse response to be negative.

2.2. The variables and data

2.2.1. Monetary policy measures

The aggregate of the monetary policy was obtained using the prediction of the econometric model. The monetary policy is purely a macroeconomic factor. The dominance of interest rates in monetary policy is due in large part to the fact that it allows for reflecting the effectiveness of monetary policy as well as the relative ease of adjustment in comparison to another instrument. Shanghai Interbank Offered Rate (SHIBOR) is regarded as the most actively traded instruments and represents market liquidity. Utilizing 1-week SHIBOR, is relatively strong sensitivity, allows us to isolate the White Noise interference of high-frequency data than 1-day SHIBOR. The 1-week SHIBOR is data from the People's Bank of China (PBC). As the known to us, the target of macro-economic policy promotes economic growth, price stability, full employment, balance of payments. Monetary policy carried out, so that achieve macroeconomic goals. Thus, the 1-week SHIBOR (L_t), growth rate of real Gross Domestic Product (GDP_t), inflation (π_t), money gap (SD_t) and international benchmark interest rate (SI_t) are predicted the real monetary policy ($\hat{L}_t$). We employ the consumer price index (CPI) as inflation. The money gap is defined as the rate of the spread between M2 and loan, premium, household consumption expenditure. The household consumption expenditure that weighting the per capita consumption with rural and urban at population. The GDP, CPI, M2, loan and household consumption expenditures were obtained from the National Bureau of Statistics (NBS). The premium comes from China Banking and Insurance Regulatory Commission. We also utilize the Federal Fund Rate measure to provide an indication of the international benchmark interest rate that was taken from the International Monetary Fund (IMF). The dataset covers quarterly data from 2005–2018. Specifically, we estimate the following regression model:

$$\hat{L}_t = \alpha + \beta_1 GDP_t + \beta_2 \pi_t + \beta_3 SD_t + \beta_4 SI_t + \mu_t \tag{3}$$

2.2.2. Other variables

Monetary policy shocks respond to other variables include different industries. On the one hand, we could characterize the effects of monetary shocks on the structural change. On the other hand, the industrial effect of monetary policy that is likely to be exposed to variations in factor intensity.

Table 1. The secondary industry classification.

Industry Category	Sub-industry Description
Technology-intensive Industries (Y_{21})	Communication Equipment, Computers and Other Electronic Equipment
Medium Capital- and Technology-intensive Industries (Y_{22})	Tobacco; Raw Chemical Materials and Chemical Products; Chemical Fibers; Smelting and Pressing of Ferrous Metals
Medium Labor- and Technology-intensive Industries (Y_{23})	Medicines; Special Purpose Machinery; Railway, Shipping, Aerospace and Other Transport Equipment; Electrical Machinery and Equipment; Measuring Instruments; Metal Products, Machinery and Equipment
Capital-intensive Industries (Y_{24})	Processing of Petroleum, Coking and Processing of Nuclear Fuel; Production and Supply of Electric Power and Heat Power
Medium Capital-intensive Industries (Y_{25})	Wine, Beverages and Refined Tea; Paper and Paper Products; Smelting and Pressing of Non-Ferrous Metals; Production and Supply of Gas; Production and Supply of Water
Labor-intensive Industries (Y_{26})	Processing of Food from Agricultural Products; Foods; Textile; Textile Wearing Apparel and Clothing; Leather, Fur, Feather and Related Products; Processing of Timber, Wood, Bamboo, Rattan, Palm and Straw Products; Furniture; Articles for Culture, Education, Art, Sport and Entertainment Activities; Rubber and Plastics; Non-metallic Mineral Products; Metal Products
Mining and Quarrying Industries (Y_{27})	Mining and Washing of Coal; Extraction of Petroleum and Natural Gas; Mining and Processing of Ferrous Metal Ores; Mining and Processing of Non-Ferrous Metal Ores; Mining and Processing of Nonmetal Ores

In order to get a better overview of the effect of monetary policy shocks, we classified the industries along with two different classification schemes. The first distinguished between the thrice industrial. This distinction follows the classification of the industries according to the traditional economy's activity shifts. The economies are divided into three sectors of activity: extraction of raw materials (primary), manufacturing (secondary), and services (tertiary).

The second classification distinguishes factor intensity. We classification is based on Wang (Wang, 2002). The other aim of this paper is to examine the effectiveness of monetary policy to the industries by investigating the effects on different factor intensity industries. Hence, each industry is classified by seven different industry types: Technology-intensive Industries, Medium Capital- and Technology-intensive Industries, Medium Labor- and Technology-intensive Industries, Capital-intensive Industries, Medium Capital-intensive Industries, Labor-intensive Industries and Mining and Quarrying Industries. Each industry category of the secondary industry is illustrated in Table 1. The industry-level data used the quarterly time series data spanning from 2005 to 2018 for China from the CEInet Industry Database.

2.2.3. Data description

The divergence of each industrial output is considerable. For the thrice industrial, the mean for the secondary industry is 55524.63 while for the tertiary industry it is 61262.31 which is nearly 6x larger than in the primary industry. The characteristics of the primary industry are similar to volatility highest in the tertiary industry. In general, output and variation are all greater in the tertiary industry which is consistent with the industrial structural change. What's more, the industry-level of factor intensity varies widely. It is

easy to recognize that the mean of labor-intensive industries is much higher than other industries, indicating that labor-intensive industries are dominant industries. Comparatively, technology-intensive industries have the least means. The development of the secondary industry is mainly relying on labor input, whereas the scale of the technology industry will be a very low ratio of it. Both medium labor- and technology-intensive industries and labor-intensive industries were the more volatile, which could be attributed to monetary policy shocks. Summary statistics are provided in Table 2.

Table 2. Summary statistics.

Variable	Mean	Max.	Min.	Std.Dev	Coef.var
Y_1	11152.57	24934.20	2882.00	5633.44	0.51
Y_2	55524.63	104178.10	18159.50	22066.31	0.40
Y_3	61262.31	124486.40	18745.50	31062.94	0.51
Y_{21}	1567.05	4274.54	198.15	1127.32	0.72
Y_{22}	5454.31	20625.68	719.26	3886.47	0.71
Y_{23}	7746.95	24659.74	314.64	6667.22	0.86
Y_{24}	5711.52	14529.55	943.02	3609.62	0.63
Y_{25}	4250.37	11858.04	286.00	3302.34	0.78
Y_{26}	15429.75	48857.32	780.18	12806.37	0.83
Y_{27}	3228.31	8720.93	266.42	2194.37	0.68

3. Industrial effects of monetary policy shocks

Preprocessing is critical to the estimation in the VAR model. All the variables, with the 1-week SHIBOR, are in natural logarithms. Disaggregate seasonally-adjusted series of industries are used for the VAR model. And all variables are the first difference stationary according to Augmented Dickey-Fuller (ADF). It is, of course, necessary to choose the number of augmentation lags to account for monetary policy shocks and this is done using the AIC.

3.1. Response of the thrice industrial to monetary policy shocks

To achieve better comparability, the information pertaining to the relevant impulse response functions will be represented in tabulated form for all industries. Table 3 contains the accumulated impulse responses of the thrice industrial to monetary policy shocks and Table 4 the accumulated impulse responses of the seven factor intensity industries caused by monetary policy shocks. In columns two, information about the length of shocks is given. Table 3 and Table 4 the significant relative output responses of industries caused by monetary policy shocks in the short-term interest rate.

Reactions to monetary policy shock are observed positive in the thrice industry, but this is not effective. Changes in monetary policy are not rationally reflected in industrial output. Theoretically, a tight monetary policy increases opportunity cost via raise rates, and thus lower industrial output. Instead, we find a positive association between interest rates and output which, is indicative of complexity in the transmission of monetary policy. The inefficiency of monetary policy shocks to the thrice industry is a little difficult to interpret, which may be closely related to the phenomenon: the

industrial effects is heterogeneous among different monetary policy shocks or different factor intensity industries. Hence, both market participants' expectations and factor intensity appear to have a greater impact on the transmission of monetary policy.

Market participants' expectations should play a central role in macroeconomic dynamics and policymaking. Since expectation differs in influence with respect to the thrice industrial, it is interesting to know the expectation of market participants showed significant effects industries. Expectations on the transmission influence of monetary policy are insignificant in the efficient market. What's more, the information gathering capacity and sensitivity of market participants will affect the effectiveness of the monetary policy. However, the unanticipated monetary policy that is more notable than expected would drive interest rates lower (higher), and reduce (increase) costs that would manifest in higher (lower) industrial output. In other words, the unanticipated monetary policy will influence industrial output and improve policy effectiveness.

Table 3. The thrice industrial effects of monetary policy shocks.

Variance	LAG	L
Y_1	4	0.40
Y_2	6	0.34
Y_3	6	0.40

The effectiveness of monetary policy is related to factor intensity in different industries. While the difference in the factor intensity is greatest in the secondary industry, there is no significant difference in the primary industry and the tertiary industry. Due to the lack of diversity in the primary industry, the labor density to industrial output was likely the result of scale economies rather than monetary policy. As the same to the primary industry, the tertiary industry mainly based on services still rely on economic growth, and only more technology may be required to maintain and promote development. Therefore, the industrial effects of monetary policy shocks in the secondary industry were notable. Even though the effects on the secondary industry are not effective, the monetary policy shocks are heterogeneous over different factor intensity industries.

3.2. Response of the secondary industry to monetary policy shocks

There are heterogeneous effects on the secondary industries to monetary policy shocks. We find that in 4 cases out of 7 industries there is a relatively positive reaction in the accumulated impulse responses, for 2 industries there is a relatively negative and for medium capital-intensive industries there appears to be no clear visible difference. This leaves 4 industries with decreasing output effects and capital-intensive industries and mining and quarrying industries with increasing ones when interest rate decreases.

Firstly, the largest response from monetary policy shock is effective for capital-intensive industries. The output reaction of capital-intensity industries is correlated with monetary policy shocks. An expansionary monetary shock result in the output on capital-intensity industries becoming expand in response to interest rates decreasing. A plausible explanation may be that capital-intensive industries are dominated by interest rates that are often likely to be affected by monetary shocks (Dedola & Lippi, 2005; Kabundi et al., 2015). The fact that capital-intensive industries that are more likely to suffer financial constraints are more sensitive to monetary shocks compared to others. In

addition, banks are intermediaries whose financing costs are closely tied to the policy rate chosen by the central bank, so that monetary policy may act directly on the capital-intensive industries through the banking sector (Gerali et al., 2010; Givens & Reed, 2018). The increase in output of the capital-intensive industrial induced by lower industrial funding costs. Thus, the impact that remains significantly effective for capital-intensive industries.

Table 4. The second industrial effects of monetary policy shocks.

Variance	LAG	L
Y_{21}	5	2.94
Y_{22}	13	1.10
Y_{23}	3	0.80
Y_{24}	5	−1.12
Y_{25}	2	−0.01
Y_{26}	7	0.40
Y_{27}	4	−0.22

The mining and quarrying industrial effect of monetary policy shocks is effective. This may result from short-run, cost-push inflation brought on by an increase in interest rates. A tight monetary policy leads to declines in real wages and causes a fall in productivity. Monetary policy shocks affect industrial wages and costs to produce by interest rates and credit conditions, they can also be expected to alter the industrial short-run productivity to produce by investing in working capital. On the one hand, mining and quarrying industries must pay workers before selling goods, so firms must borrow cash from the bank in order to produce. The need to borrow introduces an additional component to the cost of labor. In this setting, monetary shocks have the greatest impact on the costs of hiring labor. On the other hand, it is useful for considering the direct effects on labor demand for a rise in the nominal interest rate. The drop-off in the mining and quarrying industrial internally generated funds as the opportunity cost rises may have to cut back dramatically on labor and production. As demand falls off, firms are faced with output and falling productivity. Hence, monetary shocks in the interest rate can have a significant impact on labor demand and output more generally.

4. Industrial effects of anticipated vs unanticipated monetary policy shocks

In the preceding section, we have shown that there are industries that show ineffective reactions after a monetary shock. Now we would like to explore the channel of monetary transmission. To explore the differences between monetary policy, we concentrate on the industrial effects of anticipated and unanticipated monetary policy shocks.

4.1. Decomposition monetary policy

In Section 2.2.1, we use macroeconomic variables to predict with aggregate monetary policy. They are also affected by uncertain factors. In these cases, part of monetary policy is not observable. The monetary policy model can be expressed as:

$$\hat{L}_t = C + \alpha * control_t + \mu_t, \tag{4}$$

Based on Equation (4), we decompose the monetary policy of the total economy into two effects: First, the contribution of changes in the respective macroeconomic variables, aggregated over monetary policy. Second, unobservable components are hard to identify but uncertainty measures represent one possible effect. Unanticipated monetary policy is represented for aggregate monetary policy minus anticipated monetary policy. The monetary policy decomposition can be summarized as:

$$L_t^u = \hat{L}_t - L_t^e, \tag{5}$$

where L_t^u expresses the unanticipated monetary policy at time t, $\hat{L}_t$ can be considered as aggregate monetary policy, which is estimated interest rates in the Equation (4), and L_t^e represents anticipated monetary policy that the carried out 1-week SHIBOR by central bank.

Table 5. Summary statistics of monetary policy.

Variable	Mean	Max.	Min.	Std.Dev	Coef.var
L_t^e	2.94	4.70	1.01	0.91	0.31
L_t^u	0.00	1.45	−2.04	0.68	-
L_t	2.94	4.56	1.10	0.76	0.26

There is a significantly difference between monetary policy. Table 5 reports the descriptive statistics of interest rates of the various monetary policy considered in the paper, which includes anticipated monetary policy, unanticipated monetary policy and aggregate monetary policy. The maximum of anticipated interest rates that are 1-week SHIBOR record higher than aggregate interest rates, even though the mean of them are the same. Among the three monetary policy rates, anticipated interest rates have the largest volatility. It's worth noting that the mean of unanticipated interest rates is 0.00. The negative interest rate can actually reflect the transmission of monetary policy in different industries. This is not surprising since unanticipated interest rates are more effective to represent the execution of monetary policy.

4.2. A comparison of anticipated and unanticipated monetary policy shocks

Industrial effects are distinguished between anticipated and unanticipated monetary policy shocks. Table 6 and Table 7, which follows the same structure as Table 3 and Table 4. Table 6 reports the accumulated impulse response of the thrice industrial to anticipated and unanticipated monetary policy shocks. And Table 7 shows the accumulated impulse response of the secondary industry to anticipated and unanticipated monetary policy shocks.

Table 6. The thrice industrial effects of anticipated and unanticipated monetary policy shocks.

Variance	LAG	EMP	UMP
Y_1	8	0.42	−0.28
Y_2	12	0.55	−1.54
Y_3	9	0.00	−0.30

There are significant differences in the thrice industrial to anticipated and unanticipated monetary policy shocks. The thrice industrial effects of anticipated monetary policy shock are ineffective. With respect to the primary industry, the farm relies on the environment, climate, disasters, etc. Further, due to the limited capacity of farmers to understand and analyze monetary policy, they update their information sets infrequently (Coibion et al., 2018). Farmers will be unaware that monetary policy shock has occurred and will not change their forecast at all. It can be concluded that farmers could not accurately predict industries to changes output when faced with monetary policy shocks. Consequently, we see that the primary industry does not suffer from anticipated monetary policy shocks. Regarding the tertiary industry, concentrating abundant talents who are more rational and sensitive to policy, monetary policy shocks are difficult to effectively restraint in the face of homoeconomicus. In the presence of rational individuals, the majority of participants' expectations do respond to monetary policy in the direction intended. If market participants are not surprised, monetary expansion may have no real effects. However, not only the expectation but also the disaggregated industry helps to explain the different reactions of industries to monetary policy shocks. The industrial effects of monetary policy could be conducted in close association with factor intensity. Therefore, the secondary industry should be further subdivided.

The effectiveness of monetary policy is primarily attributed to changes in unanticipated monetary policy. The magnitude of unanticipated monetary policy shocks does appear to vary in the thrice industry, obviously been of a greater shock in the secondary industry. However, the mechanisms by which these responses take place are different. The main reason for the discrepancy in the thrice industry lies in the demand for various commodities and services and changes in price. The unanticipated monetary policy creates an initial shock that is transmitted through price sticky and affects the demand in the thrice industry. As known to us, there is heterogeneity in price rigidity across the thrice industry. Sticky-price is by far the largest in the agriculture and service. The primary industry mainly based on agriculture is highly protected by the subsidy policy in China. Moreover, the evidence indicates that price stickiness and less-frequent price adjustments for services, which is consistent with Bils and Klenow (2004). Monetary policy is not the main reason to affect industrial output. Although prices in the primary industry and tertiary industry are sticky, their output increases because they produce material inputs employed by the secondary industries. Output responses to monetary policy shocks are significantly effective across the secondary industry. In contrast, the output effects of monetary policy shock in the primary industry and tertiary industry less than the second industry. However, prices in the secondary industry are flexible. The response of the secondary industry reflects the accommodation of a demand increase by the competitive producer of a flexible-price good. Market participants did not anticipate the changes brought by the monetary policy shocks. When interest rates decrease, the demand for goods will be immediately expanded. The response of the secondary industry is due to the increase in demand for investment goods by other sectors or products by consumers. The increase in output in the secondary industry reflects the usual mechanism whereby the competitive producer of a flexible-price good partially accommodates an increase in demand by raising its output. An expansionary monetary policy resulting in that firms in other sectors increase their current output and also their demand for investment goods in order to build up their capital stock and meet future produce. Because the production of investment goods is concentrated in the secondary industry, the output increase is relatively large.

Table 7. The second industrial effects of anticipated and unanticipated monetary policy shocks.

Variance	LAG	EMP	UMP
Y_{21}	13	2.14	−3.39
Y_{22}	12	0.51	−1.26
Y_{23}	12	1.82	−1.25
Y_{24}	11	−1.37	0.93
Y_{25}	2	−0.02	0.00
Y_{26}	15	2.75	−0.92
Y_{27}	5	0.54	2.13

Different industries based on the factor intensity perform differently at anticipated and unanticipated monetary policy shocks. Since anticipated monetary policy shocks differ in efficiency with respect to industrial output, it is interesting to know the importance of intensity factors related to industrial effects. As can be seen from Table 7, five industries show effects very similar to the second industry aggregate, which is not effective. The effective shocks with the anticipated monetary policy are industries experiencing negative industrial output movements accompanied. Anticipated monetary policy shocks are only significantly effective in capital-intensive industries. Large differences in market participants' expectations of monetary policy across different factor intensity industries are striking. Firms in industrial characterized by more capital-intensive production processes may display a higher sensitivity to interest rates changes. An anticipated tighten monetary policy, with raising the expected interest rates, triggers a decrease in the expenditure for investment and consumption goods, which materializes in the lower output of the capital-intensive industries producing such commodities.

The industrial effects of unanticipated monetary policy shock significantly differently affected by disaggregated secondary industries. As for effective unanticipated monetary policy shock, output in technology-intensive industries increases by more than medium capital- and technology-intensive industries and medium labor- and technology-intensive industries, which in turn increase by more than the labor-intensive industries. Unanticipated monetary policy shocks are mainly driven by credit channel and firms' decisions in different industries. On the one hand, unanticipated changes in interest rates can affect corporate production. The cost has been the primary determinant for production in firms' decisions. Labor is more flexible than other investment goods when production costs are limited. It is in the responses of productivity and real wages that the unanticipated monetary policy shock really appears in the cost shock. Interest rates shock leads the labor cost, and further cause a fall in productivity. Monetary shock leads to declines in real wages and is relatively persistent. The responses of labor-intensive industries to unanticipated monetary policy shock affected by corporate decisions. Considering the cost, firm production possibilities lead to a decline in labor demand.

On the other hand, the credit channel as an amplification mechanism of interest rates. Financial debt becomes relatively easier under a monetary expanding, that amplifies the industrial effects of unanticipated monetary policy shocks. Further, there is the increasing effect of an interest rate decrease on enterprise borrowing capacity. By contrary, an unanticipated tight monetary policy shock should result in a more acute effect of monetary policy on firms impaired by more difficult access to financial markets, by smaller collateral, and in general whose credit-worthiness is more susceptible to changes in interest rates. This implies that industries characterized by relatively high technology intensity and subsidies fare better than the other industries after a monetary shock.

What's more, the imperfection of the financial market prevents the effective functioning of the credit channel. The relationship between monetary policy and industrial output from the characteristics of the functioning of the credit market. For one thing, this leads to limitations of capital flows over diverse factor intensity industries. For another, to a rise in the cost of credit, which is paid by enterprises in the real sector in addition to the initial interest rate. The government influences not only interest rates but also the volume and cost of the loan. The influence is exercised through a change in the preference of financial intermediate, which acts as loan support. The higher the support of the policy, the more development they are, that is, the lower the unanticipated interest rates for them and the higher the possibility of new borrowings. The policy encouragement has considerable Influence on determining the viability of different factor intensity industries, which makes it possible to apply it in the analysis of the effective influence of monetary policy on individual industry. Therefore, the loans would be provided by financial intermediaries to highly technological industries as they are more likely to achieve development opportunities due to policy encouragement to technology-intensive industries, and that also includes medium capital- and technology-intensive industries and medium labor- and technology-intensive industries.

5. Conclusions and policy implications

First, the industrial effects of aggregate monetary policy shock are ineffective. There is a positive association between monetary policy and industrial output. The validity of the monetary policy is estimated by the target of it which promotes stable economic growth. Thence, the response of industries to monetary policy shocks is indicative of complexity in the transmission of monetary policy.

Second, the industrial effects of monetary policy are primarily attributed to differences in the unanticipated monetary policy. In other words, the effectiveness performs differently between anticipated and unanticipated monetary policy. The anticipated monetary policy shock similar to the aggregate monetary policy, which is almost not effective. The unanticipated monetary policy is unlikely to have a uniform impact on the thrice industry. Output in the secondary industry increases by more than the primary industry and the tertiary industry under effective unanticipated monetary policy shock.

Third, the effectiveness of monetary policy shocks is also conducted in close association with factor intensity. Industrial effects of unanticipated monetary policy shock significantly differently affected by factor intensity industries. The unanticipated monetary policy shocks obviously been of a greater shock in the technology-intensive industries. And then there are also effective in the medium capital- and technology-intensive industries and medium labor- and technology-intensive industries more than the labor-intensive industries.

The results suggest, at least, two important implications for policymakers. The first one relates to obtaining a better knowledge of the transmission of monetary policy to different industries. In particular, exploring the transmission of aggregate monetary policy, anticipated and unanticipated could be masked. The second implication regards the transmission in which the industrial structure affected by the effectiveness of the monetary policy. The results of this paper suggest that different industries react diversely to monetary shocks. This implies the need for consideration of the heterogeneity of industries to inform policy decisions.

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Conflict of interest

The authors declare no conflict of interest.

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