Quantity or quality? The impact of China's stimulus-driven credit expansion at the industry level

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Abstract

This paper studies the effects of China's economic stimulus of 2009-10 on industry investment performance and allocation trends within provinces. We identify industries with strong, weak and without government support by collecting keywords from official government documents, and estimate the differential impact by applying a difference-in-difference strategy. Quantitatively, industries with government back-up are encouraged to invest more after 2009. However, qualitatively, it results in a less efficient investment of industries with strong government intervention, which causes a poor post-stimulus allocation trend within provinces, particularly in state-dominant sectors and regions with high corruption levels or less-developed financial systems. We further confirm that this is related to the sharp increase in bank loans and severe over-investment after 2009. Overall, our findings support the view that the stimulus-driven

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credit expansion in China results in more resources being allocated to sectors with weaker growth prospects.

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1 Introduction

The global financial crisis of 2008 has cast its long shadow on the economic fortunes of many countries, resulting in what has often been called "the Great Recession". Following the Keynesian macroeconomic theory that the solution to a recession is expansionary economic policy, major countries around the world have introduced massive stimulus packages whose main purpose is to restore economic growth by encouraging investment.

Compared to mature markets in which stimulus packages are usually market-oriented, with well-designed mechanisms to guarantee their implementation, stimulus packages in emerging markets may be more government-oriented. This can be an important concern because government intervention generally causes potential unintended consequences in terms of allocation of capital and labour across sectors firms (Bai et al., 2016). However, there is very limited empirical evidence on the effects of these programs in emerging economies.

In this paper, we focus on the biggest emerging economy, China, where the government controls a large number of firms and the banking system. At the end of 2008, the Chinese government announced its stimulus package, involving pursuing not only fiscal stimulus in the form of large government spending, but also credit stimulus in the form of relaxing funding and lending constraints of traditional banks. Several studies have confirmed that this program and associated credit boom encourage aggregate investment and thereby stimulate real GDP in the short run (Bai

et al., 2016; Ouyang and Peng, 2015), but in the long run, it worsens the aggregate allocation trend and growth potential.

What is the mechanism behind this reversed effect of the stimulus program? Our paper aims to provide a novel view at the industry level, examine the impact of the Chinese credit stimulus plan on industry investment activity and its outcomes (measured by investment efficiency), and how the allocative efficiency of investment within provinces has evolved in China following the implementation of the credit expansion.

By applying a difference-in-difference strategy, we compare the differential effects on government-supported and non-supported industries during a time period encompassing the years both before and after the introduction of the stimulus plan. Our evidence is based on 2-digit industrial data in 31 Chinese provinces from 2000 to 2016, collected from the China Industrial Economic Statistical Yearbook.

The main identification challenge we face is how to measure the intensities of government support in each industry. It is widely believed that due to the imperfection in the Chinese capital market, credit resource does not allocate to each sector or firm fairly. And government intervention plays an important role in this process. However, the access to increased bank loans or the intensities of government support is hard to identify. To this end, by using keywords collected from official government documents, we divide our samples into three groups: strongly-supported, weakly-supported and non-supported industries. This is a key innovation of this paper.

Our results indicate a change in the allocation trend of investment across Chinese industries in correspondence with the introduction of the stimulus plan in 2009. Specifically, starting from the quantity effect perspective, We study the differential impact of a credit-supply increase under China's stimulus plan on industry investment activity. In contrast to the situation in the US where firms shrank their investments (Duchin et al., 2010), the effect of increases in credit supply on industry investment is found to be larger for those with government support post the stimulus

program. This implies that government support helps some industries enjoy easier access to financing after 2009.

Next, quality-wise, we are interested in whether the increased investments are efficient. The results show that government-intervened industries suffer lower investment efficiency than other industries, as measured by the investment-investment opportunity relationship. This is driven by two forces. Ex ante, industries supported by the government are likely to miss profitable investment opportunities to carry out the plans and policies of the government. Ex post, when projects fail to produce the expected results or when there are diminishing investment opportunities, those industries are likely to find it difficult to either terminate failed projects or reduce their investment due to potential conflicts with government agendas and policies.

Finally, we expand our picture to the quality effect at the province level, and investigate how the 2009 credit expansion affects province allocative efficiency, measured by the elasticity of investment growth to output growth. We find that after 2009, the efficiency of investment flows across industries is negatively associated with credit expansion.

In sum, stimulus-driven credit expansion plays an important role in the industry's investment decisions and outcomes. Industries with government back-up invest more, but in a less efficient way. This drives a worsening trend of allocation and a slowdown in allocative efficiency at the aggregate level.

A nature question following is what can explain this effect? In the last part of our paper, we discuss and test several main potential mechanisms that can rationalize our empirical findings. First, we document that the decline in investment efficiency is related to the access to external financing channels, but we also see that there is no correlation between the increase in investment activity and financing access. Second, the positive quantity and negative quality effects are significant in state-owned dominant industries. Third, these effects are also significant in regions with intensive government intervention and less developed financial systems.

Our paper contributes to several strands of the literature in macroeconomics

and finance. First, we add to the strand of literature by showing that government intervention plays an important role in driving and allocating industries' investment. Existing literature generally focuses on one aspect of investment decisions, investment efficiency or allocative efficiency. Both quantity and quality effects have been analyzed separately in cross-country data. Our paper investigates the quantity effects of the stimulus program, and doing so within the same empirical framework as the quality effects. This produces a more complete picture of the effects of the stimulus-driven credit expansion and government intervention, and enables us to evaluate its overall impact.

Second, this paper enriches the extant literature on investment efficiency. The majority of studies in this area are primarily based on information asymmetry and agency conflicts among shareholders, debtholders, and managers in mature markets (Stein, 2003). In a transitional economy, government ownership or political connections as another market friction has also been well documented in China studies (Chen, 2006). However, most of these studies are based on a normal period. It is much less clear how government intervention fares in financial crises period. In this paper, we add new evidence to this strand of literature by placing our research question under the background of the economic stimulus program, when the government has more power over the resource allocation, thereby helping us better observe the role of government and the consequences of such intervention.

Third, this paper is related to a new wave of research that studies the drivers and consequences of China's stimulus program, and in particular the unprecedented credit boom. Traditional literature pays more attention to the different responses of SOEs and non-SOEs after the financial crisis and stimulus program. The role of government ownership (Cong et al., 2019; Liu et al., 2018) and political connections (Bai et al., 2016) has been well documented. Specifically, government intervention in SOEs and non-SOEs with political connections help them receive more bank loans and increased investment after the stimulus program. However, this view is challenged by Lardy (2014) and Jiang et al. (2018) that the belief that Chinese banks

discriminate in their lending may be overstated. The preference of SOEs does not, or at least does not fully explain the whole story of the allocation trend in 2009-10. Our paper provides a novel view: Credit resource preference does not only exist between SOEs and non-SOEs within a sector, but also exists among sectors. To the best of our knowledge, our paper is one of the first studies to focus on the industry-level trend.

The remainder of the paper is organized as follows. Section 2 summarizes the effects of government intervention on investment, the definition of investment efficiency and allocative efficiency. Section 3 introduces the China's institutional background. Section 4 lays out the empirical methodology. Section 5 reports data and variables. Section 6 provides the main results and associated mechanism analysis, heterogeneous analysis and robustness check. Section 7 concludes.

2 Literature review

2.1 Quantity effects: Investment

2.1.1 Theoretical background

Tobin's Q and its extension The neoclassic Q theory states that what is relevant to a firm's investment decision is marginal Q – the ratio of the market value of a marginal unit of capital to its replacement cost (Tobin, 1969). The value indicates how an additional dollar of capital affects the present value of profit. This is the shadow value of an additional unit of capital and, under certain conditions, it is a sufficient statistic for investment (Hayashi, 1982), and all other determinants, including cash flow, are irrelevant. In other words, it is the 'fundamental' factor that determines investment policy of profit-maximizing firms in efficient markets.

However, marginal Q is unobservable, and hence many studies use average Q, the ratio of the total value of the firm to the replacement cost of its total capital, as a proxy for marginal Q (Blanchard et al., 1993; Brainard and Tobin, 1968). The empirical problem is that average Q is not necessarily sufficient to explain invest-

ment behaviour. Hayashi (1982) shows that average Q will differ from marginal Q whenever average profit differs from marginal profit. Therefore, using Q as a proxy for marginal Q assumes that average profit and marginal profit are highly correlated.

Additionally, Fazzari et al. (1988) finds that investment is positively sensitive to cash flow, even after controlling for Q, and interpreted this finding as evidence of financing frictions. Given that the current cash flow is likely to be positively correlated with future profitability, a link between cash flow and investment could reflect the link between expected profitability and investment rather than the sensitivity of firm investment to cash flow[1]. For this reason, Q is commonly used as a proxy for investment opportunities.

Let I and CF be the physical investment and cash flow, respectively, scaled by physical assets K, and Q be the market-to-book ratio. The investment–Q (β_1) and investment–cash flow (β_2) sensitivities are as follows (Fazzari et al., 1988):

$$\frac{I_{i,t}}{K_{i,t}} = \beta_0 + \beta_1 q_{i,t-1} + \beta_2 \frac{CF_{i,t}}{K_{i,t-1}} + \epsilon_{i,t} \tag{1}$$

2.1.2 Empirical evidence

The role of policies in driving investment is an important topic. Existing literature starts from different types of policies or government intervention, discusses their impact on the aggregate, industry or corporate investment, and explores the potential mechanism behide.

Guiso and Parigi (1999) investigates the effects of uncertainty on the investment decisions of a sample of Italian manufacturing firms. They test the response of investment to demand shocks, where sales growth is used as a proxy for investment opportunities from the demand side. The results support the view that uncertainty weakens the response of investment to demand thus slowing down capital accumulation. They further find that there is considerable heterogeneity in the effect

[1] For example, the current realization of cash flow would proxy for future investment opportunities if the productivity shocks were positively serially correlated.

of uncertainty on investment: it is stronger for firms that cannot easily reverse investment decisions and for those with substantial market power. They show that the negative effect of uncertainty on investment cannot be explained by uncertainty proxying to liquidity constraints.

Kang et al. (2014) examines the effect of economic policy uncertainty and its components on firm-level investment. It is found that economic policy uncertainty in interaction with firm-level uncertainty depresses firms' investment decisions. When firms are in doubt about costs of doing business due to possible changes in regulation, cost of health care and taxes, they become more guarded with investment plans. The effect of economic policy uncertainty on firm-level investment is greater for firms with higher firm-level uncertainty and during a recession. News-based policy shock has a significantly negative long-term effect on firms' investment. Policy uncertainty does not seem to influence the investment decisions of the very largest firms (about 20% of listed firms).

Using a news-based index of policy uncertainty, Gulen and Ion (2016) investigate the effect of policy-related uncertainty on corporate investments in the United States. They document a strong negative relationship between firm-level capital investment and the aggregate level of uncertainty associated with future policy and regulatory outcomes. To identify possible mechanisms through which policy uncertainty propagates in the economy, they further test whether the negative effect of policy uncertainty on capital investment exhibits heterogeneity in the cross-section. Evidence shows that the relation between policy uncertainty and capital investment is not uniform in the cross-section, being significantly stronger for firms with a higher degree of investment irreversibility and for firms that are more dependent on government spending. Their results lend empirical support to the notion that policy uncertainty can depress corporate investment by inducing precautionary delays due to investment irreversibility.

Additionally, the relationship between investment and fiscal policies, laws, or regulations are well documented.

McLean et al. (2012) study how investor protection affects firm-level resource allocations. They use average Q as a proxy for marginal Q, and test whether investment and external finance are more sensitive to Q in countries with stronger investor protection laws. Based on a sample of firms drawn from 44 countries during the period 1990 to 2007, they find that Q predicts investment, and that this relation is significantly stronger in countries with more investor protection. This is in part because, in these countries, high Q firms can more easily obtain external finance to fund their investments. Additionally, investment (positive) sensitivity to cash flow is lower in countries with strong investor protection because firms with good investment opportunities and limited internal financing raise capital and use the proceeds to invest.

Afonso and Jalles (2015) assess the relevance of fiscal components for private and public investment using data for a large panel of 95 countries for the period 1970–2008. By employing a cross-section time series analysis, they aim at assessing, which budgetary components drive (or determine) private and public investment. The results suggest a negative effect of government expenditure and of government consumption spending on private investment. Interest payments and subsidies have a negative effect on both types of investment (particularly in emerging economies). Social security spending has a negative effect on private investment for the full and OECD samples, whereas government health spending has a positive and significant impact on private investment. Moreover, stronger fiscal numerical rules decrease public investment.

Recently, a large amount of literature also pays attention to the impact of a certain event (such as the financial crisis, stimulus program etc.) on investment.

Lemmon and Roberts (2010) examine how shocks to the supply of credit impact corporate financing using the shock to the supply of below-investment-grade credit after 1989. Their sample begins with all nonfinancial firm-year observations in the annual Compustat dataset between 1986 and 1993. A DID strategy reveals that the contraction in the supply of credit to below-investment-grade firms significantly al-

tered their financing and investment behaviour. Net debt issuances are nearly halved relative to what they were prior to the supply shock. This contraction is accompanied by almost no substitution for alternative sources of finance, such as bank debt, equity, retained earnings, or trade credit. Consequently, net investment declines almost one for one with the decline in net debt issuances. The contemporaneous decline in debt and investment has offsetting effects on corporate leverage ratios, which are largely unaffected by the supply shock. Their results support the view that shifts in the supply of capital can have significant consequences on the financial and investment policies of firms.

Campello et al. (2010) survey 1,050 COFs in the U.S., Europe, and Asia to directly assess whether their firms are credit constrained during the global financial crisis of 2008. By studying whether corporate spending plans differ conditional on this survey-based measure of financial constraint. They find that: first, financially constrained firms plan to cut more investment, technology, marketing and employment relative to financially unconstrained firms during the crisis; secondly, constrained firms are forced to burn a sizeable portion of their cash savings during the crisis and to cut more deeply their planned dividend distributions. In contrast, unconstrained firms do not display this behavior; thirdly, constrained firms also display a much higher propensity to sell off assets in place as a way to generate funds during the crisis. Looking beyond the crisis, their paper provides new evidence that financial constraints hamper investment in valuable projects. Relaxing these constraints would produce additional long-term growth opportunities in the economy.

Duchin and Sosyura (2012) investigates the relation between corporate political connections and government investment. Using hand-collected data on firm applications for capital under the Troubled Asset Relief Program (TARP) after the 2008 financial crisis, they find that politically connected firms are more likely to be funded, controlling for other characteristics. Yet investments in politically connected firms underperform those in unconnected firms. Overall, they show that connections between firms and regulators are associated with distortions in investment efficiency.

Duchin et al. (2010) study the effect of the 2008 financial crisis on corporate investment. They employ a differences-in-differences approach in to compare the investment of firms before and after the onset of the crisis as a function of their internal financial resources (cash reserves and net debt), external financing constraints, and dependence on external finance, controlling for firm fixed effects and observable measures of investment opportunities, specifically Q and cash flow. Based on a sample consists of quarterly data on publicly traded firms during 2006-09, corporate investment is found to decline significantly following the onset of the crisis. Consistent with a causal effect of a supply shock, the decline is greatest for firms that have low cash reserves or high net short-term debt, are financially constrained, or operate in industries dependent on external finance. Additional analysis suggests an important precautionary savings motive for seemingly excess cash that is generally overlooked in the literature.

2.1.3 Evidence in China

Corporate finance literature on China focuses mainly on the effect of government policies or political connection on firms' investment (or growth) behaviour, after controlling for various proxies for investment opportunities.

Chow and Fung (1998) study the relationship between investment and cash flow using a panel of 5825 manufacturing firms operating in Shanghai over the period 1989–1992, with the objective of testing the financing constraints hypothesis. Current and lag changes in sales are used to represent the investment opportunities. They find that firms' investment is constrained by cash flow, and that the sensitivity of investment to cash flow is highest for private firms and lowest for foreign-owned firms. State-owned and collective firms also exhibit positive sensitivities, higher for the former.

Using the same dataset, Chow and Fung (2000) focus once again on investment equations, showing that small firms exhibit lower sensitivities of investment to cash

flow than large firms. They explain this finding considering that small firms are dominated by non-state, fast-growing enterprises, which may be using their working capital to smooth their fixed investment.

Using a panel of over 116,000 Chinese firms of different ownership types over the period 2000–07, Ding et al. (2013) analyze the extent to which firms owned by different agents are able to use working capital to mitigate the effects of financing constraints on their fixed capital investment. They use the time dummy interacted with the industry dummy to capture investment opportunities, as these dummies are believed to account for all time-varying demand shocks at the industry level. The results show that in the presence of fluctuations in cash flow, older, larger, and slow-growing firms typically adjust fixed capital investment, while smaller, younger, and fast-growing firms tend to adjust working capital instead. They conclude that active management of working capital may help firms to alleviate the effects of financing constraints on fixed investment.

Employing the World Bank's Enterprise Survey of manufacturing firms in 120 Chinese cities conducted in 2005, Cull et al. (2015) study whether and how firms with differential government connections are financially constrained in China and how that affects their investment patterns. In the empirical section, both firm-level sales growth and industry-level Tobin's Q are used to proxy growth opportunities. Their empirical findings suggest that investment in firms with strong government connections is less sensitive to internal cash flows, access to external finance, and to indicators of growth opportunities than investment in other firms. This result shows that the Chinese credit market is still strongly driven by political connections, and models that ignore firms' government connections are likely to yield imprecise or even misleading estimates of the effects of cash flows on Chinese investment patterns.

Ding et al. (2018b) apply a set of methods to calculate the sensitivity of investment to investment opportunities in Chinese manufacturing firms from 1998-2007. Specifically, they construct three groups of proxies for investment opportunities from the supply side, demand side and the forward-looking perspective, and examine their

impact on investment in both the static regression and dynamic impulse-response analyses. They find that private firms place greater value on all types of investment opportunities in China, which explains their high investment efficiency and rapid growth. Relatively, SOEs respond more to investment opportunities from the supply side, but much less so to demand shocks. Their results also call for further financial sector reforms in order to expand the benefit to SOEs and other ownership groups since financial market development only improves the investment efficiency of private firms at present.

Based on the quarterly data of China's listed firms from 2006 to 2010, Deng et al. (2020) examines how government intervention affects firms' investment and investment efficiency, focusing on the economic stimulus package during the 2008 global financial crisis period. By using propensity score matching to match government-intervened firms with their controls to reduce the endogeneity issue of government intervention. Their difference-in-differences analysis shows that government-intervened firms invest more than control firms. Further analysis shows that the source of funding for investment is mainly bank loans rather than internal cash flows.

To sum up, existing literature applies different proxies for investment opportunities, and tests the relationship between investment, a firm's political conditions (such as ownership, political connection), and institutional system (such as investor protection system, and financial development). The role of policies in determining investment behaviour has been well documented in developed economies. Less of them consider the role of certain types of government intervention in emerging economies.

2.2 Quality effects: Investment efficiency

2.2.1 Theoretical background

Definition of investment inefficiency Under the neoclassical theory, firms invest until the marginal benefit equals the marginal cost of this investment in order to maximize their values (Abel, 1983; Hayashi, 1982; Yoshikawa, 1980). However, in the Keynesian framework (Crotty, 1992; Gordon, 1992), where expected investment will be determined by the preference for growth or for financial security. Therefore, firms may deviate from their optimal investment levels and hence suffer from underinvestment (lower investment than expected) or overinvestment (greater investment than expected). This deviation is defined as "investment inefficiency". Relatively, investment at the optimal level is "efficient investment".

Measure of investment efficiency As discussed above, in a perfect capital market without frictions (Modigliani and Miller, 1958), a firm's investment should be solely determined by the profitability of its investment as measured by Tobin's Q (Tobin, 1969), given Q as a summary statistic for the market's information about investment opportunities.

Therefore, the majority of investment literature employs the sensitivity of investment expenditure to investment opportunities as the measure of investment efficiency as shown below:

$$\frac{I_{i,t}}{K_{i,t}} = \beta_0 + \beta_1 q_{i,t-1} + \epsilon_{i,t} \tag{2}$$

Two main measures of investment efficiency are both based on the above equation. First, the coefficient of β_1 is applied as the level of sensitivity of investment expenditure to investment opportunities (Lang et al., 1996; Stein, 2003). Second, some literature defines that investment efficiency exists when the residuals from the investment model are equal to zero, suggesting there is no deviation from the expected level of investment (Biddle et al., 2009). Positive deviations from the expected

level of investment imply that firms are overinvesting while negative deviations or residuals imply firms do not undertake all positive net present value projects.

Determinants of investment efficiency In perfect financial markets, all positive net present value (NPV) projects should be financed and carried out. Nevertheless, there is a significant body of literature that contradicts this assumption (for instance, Hubbard (1998); Stein (2003)). Market imperfections, as well as information asymmetries (Fazzari et al., 1988; Myers and Majluf, 1984) and agency costs (Jensen and Meckling, 1976; Lang et al., 1996), can lead to negative NPV projects being carried out (over-investment) and to the rejecting of positive NPV projects (under-investment).

According to agency theory, both overinvestment and underinvestment can be explained by the existence of asymmetric information among stakeholders. Jensen and Meckling (1976), Myers (1977), and Myers and Majluf (1984) develop a framework for the role of asymmetric information in investment efficiency through information problems, such as moral hazard and adverse selection.

With regard to the moral hazard model, which is more relevant to our study, over-investment comes from agency conflicts between managers and shareholders such as discrepancy of interests between shareholders and a lack of monitoring of managers. Since managers are assumed to maximize their own personal interests (rather than those of outside shareholders), they can have a preference for running large, instead of profitable, businesses in order to consume perquisites associated with size (Jensen and Meckling, 1976), leading to the establishment of managerial empire and overinvestment.

Under adverse selection, better-informed managers may overinvest if they sell overpriced securities and achieve excess funds. To avoid this, suppliers of capital can ration the capital or raise its cost, which will lead to the rejection of some profitable projects due to fund constraints (Biddle et al., 2009; Stiglitz and Weiss, 1981) with subsequent underinvestment.

2.2.2 Empirical evidence

Biddle et al. (2009) aims to answer the question of whether higher-quality financial reporting is associated with a reduction of over-investment or with a reduction of under-investment. They directly model the expected level of investment based on a firm's investment opportunities. Investment efficiency will exist when there is no deviation from the expected level of investment. Their study provides evidence of both in documenting a conditional negative (positive) association between financial reporting quality and investment for firms operating in settings more prone to over-investment (under-investment).

Following the same investment equation of Biddle et al. (2009), Gomariz and Ballesta (2014) conducted with a sample of Spanish listed companies during the period 1998–2008, examine the role of financial reporting quality and debt maturity in investment efficiency. The results show that financial reporting quality mitigates the overinvestment problem. Likewise, lower debt maturity can improve investment efficiency, reducing both overinvestment and underinvestment problems. They further find that financial reporting quality and debt maturity are mechanisms with some degree of substitution in enhancing investment efficiency: firms with lower (higher) use of short-term debt, exhibit higher (lower) financial reporting quality effects on investment efficiency.

Using the high-power setting of newly privatized firms from 64 countries, Chen et al. (2017) examine the relationship between ownership type and firm-level investment efficiency as captured by the sensitivity of investment expenditure to investment opportunities. Consistent with the theoretical prediction that government and foreign institutional owners are associated with different levels of information asymmetry and agency problems, they find strong and robust evidence that government (foreign) ownership weakens (strengthens) investment-Q sensitivity, thereby increasing investment inefficiency (efficiency). This finding highlights the important role of ownership type in determining firms' investment behaviour and efficiency.

2.2.3 Evidence in China

Chen et al. (2011) use the data of listed non-financial A-share Chinese firms from 2001 to 2006 to test the relationship between government intervention and investment performance. They define the sensitivity of investment expenditure to investment opportunities as investment efficiency, and compare the coefficients among different groups. The main findings are: first, the investment efficiency in SOEs is less than non-SOEs; Second, for SOEs, there exists a significantly negative impact of political connections on investment sensitivity; third, the negative effect of political connections manifests itself mainly in SOEs that are controlled by local governments. In summary, their results suggest that government intervention in SOEs through majority state ownership or the appointment of connected managers distorts investment behaviour and harms investment efficiency.

Deng et al. (2020) employ the investment-Tobin's Q sensitivity model to investigate whether government intervention affects investment efficiency. They find that the post-investment performance is poor: the investment efficiency of government-intervened firms decreases and government-intervened firms over-invest after the economic stimulus program. This result is robust to alternative model specifications and placebo tests. The findings suggest that government intervention can play a negative role in government-intervened firms.

In sum, many studies use the investment opportunity sensitivity as a proxy for investment efficiency, thus the estimated coefficient can only show us whether or not investment efficiency increased, without figuring out the mechanism or channels. Comparatively, the residual from the investment model is a better measure, and we will apply it to our methodology in this paper.

2.3 Quality effects: Allocative efficiency of resources

A large body of literature has examined the link between economic policies and the allocation of resources across countries. Reallocation of capital to more

productive uses has important implications for aggregate productivity and welfare, within industries, countries, and over time (Olley and Pakes, 1996; Guner et al., 2008; Hsieh and Klenow, 2009; Hopenhayn, 2011; Bartelsman et al., 2013). This section summarizes both theoretical and empirical literature on allocative efficiency and its relation to policy intervention.

2.3.1 Theoretical background

Alternative tests of the role of policy interventions in the improvement of allocative efficiency are based on the neoclassical argument that capital should be allocated such that its marginal product is equalized across projects. Theory suggests that more productive firms should be able to attract more resources (capital and labour) relative to less productive firms (Olley and Pakes, 1996; Restuccia and Rogerson, 2008). Distortions, however, prevent such flow of resources to productive firms. This would result in more productive firms growing below their optimal size while less productive firms grow above their optimal size, leading to a reduced efficient allocation of resources across firms. Consequently, aggregate output and TFP would be lower than they should otherwise be.

The seminal work by Restuccia and Rogerson (2008) incorporates policy distortions into a neoclassical growth model with heterogeneous firms. They illustrate how policy distortions generate resource misallocation and lead to sizeable decreases in output and productivity, which can well explain the cross-country differences in output per capita. The model shows that differences in the allocation of resources across establishments that differ in productivity may be an important factor in accounting for aggregate TFP losses. In the context of their model, all producers face the same prices in the competitive equilibrium without distortions. Policy distortions, although do not change aggregate prices and aggregate factor accumulation, create heterogeneity in the prices faced by individual producers. They underscore that productivity losses due to misallocation would be huge if distortions are positively

correlated with firm productivity. The implication is an aggregate shift of resources away from efficient firms towards less efficient firms, further reducing aggregate TFP.

Hsieh and Klenow (2009) show that the greater the variation in the distortions, the larger the aggregate TFP losses. They develop a method that identifies the extent of resource misallocation and the associated TFP losses based on the variation in marginal revenue products of inputs. In their monopolistic competition model, firms have different productivities and face different product and factor prices due to firm-level distortions. They argue that in perfectly competitive markets without distortions, and assuming Cobb-Douglas production functions, marginal revenue product (MRP) for capital and labour will be equalised across all firms, even if their productivity levels differ. A further implication of this is that Total Factor Revenue Products (TFRP) will also be equalised across firms. However, in the presence of distortions, there will be differences between the MRP of capital and labour across firms. Firms that face negative distortions (a lower output price or a higher factor price) will hire fewer resources than they would otherwise while firms with positive distortions would hire more. This misallocation of resources lowers aggregate TFP.

In summary, the concept behind misallocation, as hypothesised by Hsieh and Klenow (2009), is that in competitive markets with no frictions, firms will pay common factor prices, and consequently the marginal revenue product (MRP) of factor inputs will be equal across firms with similar production functions. Should MRP for a particular factor differ across firms, then the higher MRP firms will bid for these factors, leading to a reallocation from low to high marginal revenue production firms. A further consequence is that in efficient markets, firms within the same industry should have the equivalent total factor productivity revenue (TFPR).

2.3.2 Evidence at the industry level

Simply put, the criterion of allocative efficiency used at the industry level is the usual one in microeconomics, namely, that if the marginal rate of return on capital

invested in various sectors becomes more equal than before, then, we can conclude that there exists a better allocation of capital. While theoretically, the approach seems to be simple, its implementation in practice is difficult, both because of data limitations and measurement problems at the industry level.

The studies on South Korea by Cho (1988) use the marginal cost of the optimizing condition claiming that the data required to estimate the marginal rates of return are simply not available. Further, he approximates the marginal cost with the average cost because of the data limitations. As an index of comparison, he uses the variance of borrowing costs for the 68 manufacturing industries, stating that a reduction in the variance of average cost across the sectors signifies an improvement in the efficiency of credit allocation. According to the result of the comparison between the variance before and after a financial deregulation event, he finds that the liberalisation encourages flows of capital to equate marginal returns across sectors.

However, this inference has been criticized by Gupta and Lensink (1996) on the grounds that a reduction in the variance does not necessarily indicate improved efficiency of allocation because such a reduction can be easily induced by state intervention, requiring lending institutions to allocate credit to favoured sectors at uniform rates.

Wurgler (2000) directly examines the relationship between the characteristics of a country's financial development and the efficiency with which capital is allocated to investment projects. By applying the elasticity of industry investment to value-added as the proxy of allocation efficiency in 28 industries across 33 years, he finds that generally countries with developed financial sectors increase investment more in their growing industries, and decrease investment more in their declining industries, than those with undeveloped financial sectors. The efficiency of capital allocation is improved with stock markets efficiently impounding more firm-specific information into individual stock prices, with less state ownership and strong minority investor rights.

Based on a panel of 42 countries and 36 industries, Beck and Levine (2002)

examine the impact of financial structure on industry growth, new establishment formation, and efficient capital allocation. First, they find industries that depend heavily on external finance grow faster in economies with higher levels of overall financial development. Second, by using Wurgler (2000)'s measure of the efficiency of investment flows, they explore the importance of financial structure for the efficient allocation of capital. Results show that the overall financial development boosts efficient capital allocation. Their results are robust to a battery of sensitivity checks.

Fisman and Love (2004) use a new methodology based on industry co-movement to examine the role of financial market development in inter-sectoral allocation. Based on assumptions that there exist common global shocks to growth opportunities, they hypothesize that country pairs should have correlated patterns of sectoral growth if they are able to respond to these shocks. Consistent with financial markets promoting responsiveness to shocks, countries have more highly correlated growth rates across sectors when both countries have well-developed financial markets. This effect is stronger eh country pairs at similar levels of economic development, which are more likely to experience similar growth shocks.

Bena and Ondko (2012) examine whether financial markets development facilitates the efficient allocation of resources. Using European micro-level data for 1996–2005, they show that firms in industries with growth opportunities use more external finance in financially more developed countries. This result is obtained using two alternative proxies for the global component of industry growth opportunities: (i) industry value-added growth in the U.S. and (ii) the change in the global industry price-to-earnings (PE) ratio. Both proxies rely on the assumption that there exists a global component in the industry specific growth opportunities caused by demand and productivity shifts.

In essence, the basic idea is that resources should be allocated to industries/sectors with high (marginal) returns. At the aggregate level, we could either look at the marginal rate of return or the marginal cost across industries/sectors and use some index to compare the allocative efficiency. The definition of allocative efficiency in

this paper is shown in the following section.

2.3.3 Evidence in China

It is widely believed that China experiences severe resource misallocation across sectors and firms (Hsieh and Klenow, 2009). We start from aggregate- and sector-level literature, and then move to the discussion at the firm level.

At an aggregate level, Bai et al. (2006) estimate the return to capital in China, calculated using data on the share of capital in total income, the capital-output ratio (where both capital and output are measured at market prices), the depreciation rate, and the growth rate of output prices relative to capital prices. They find that the aggregate annual return to capital averages 25 percent during 1978-93, falls during 1993-98, and has remained roughly stable at around 20 percent since 1998. These rates of return are above rates of return for most advanced economies calculated on a similar basis. Thus there is no evidence to believe that China invests too much at the aggregate level (sectors, regions, and types of ownership) They also find that the dispersion in the return to capital across Chinese provinces has fallen since 1978.

Sector-wise, Brandt et al. (2013) study the effect of factor market distortions (forms of ownership and barriers to factor mobility) on TFP losses associated with capital and labour misallocation in China's non-agriculture sectors across provinces and examine their evolution between 1985 and 2007. They decompose the overall loss into factor market distortions within provinces (between state and non-state sectors) and distortions between provinces (within sectors). Results show that the misallocation of factors across provinces and sectors leads to an aggregate TFP loss in the manufacturing and service economy of 20%, with within distortions accounting for more than half of the total loss. Comparatively, TFP losses from between-province distortions are relatively constant over the entire time. Specifically, the measure of within-province distortions declines sharply between 1985 and 1997, contributing to 0.52% non-agricultural TFP growth per year, but then increases significantly in the

last ten years, reducing the non-agricultural TFP growth rate by 0.5% a year. They further argue that all the within-province distortions are due to the misallocation of capital between the state and non-state sectors induced by government policy.

In recent years, studies on China pay more attention to how specific factor drives misallocation and lowers aggregate productivity efficiency. Policy distortions are commonly identified as the potential candidates for explaining the dispersion of TFP or of marginal revenue products of inputs in the literature (Ding et al., 2018a; Wu, 2018).

Based on a survey covering a stratified random sample of 12400 firms in 120 cities in China with firm-level accounting information for 2002-2004, Dollar and Wei (2007) examine the presence of systematic distortions in capital allocation that result in uneven marginal returns to capital across firm ownership, regions, and sectors. It provides a systematic comparison of investment efficiency of state-owned, foreign-owned and domestic privately owned firms, conditioning on their sector, location, and size characteristics. It finds that even after a quarter-of-century of reforms, state-owned firms still have significantly lower returns to capital, on average, than domestic private or foreign-owned firms. Similarly, certain regions and sectors have consistently lower returns to capital than other regions and sectors. By their calculation, if China succeeds in allocating its capital more efficiently, it could reduce its capital stock by 8 percent without sacrificing its economic growth.

Ding et al. (2018a) study the effect of fiscal policy volatility on the capital misallocation within Chinese provinces, measured as the dispersion of marginal revenue product of capital. In their study, fiscal policy volatility is defined as the standard deviation of unforeseeable changes in government expenditure. And a risk-adjustment MRPK dispersion is applied to represent a new measure of capital misallocation. Based on cross-province data, they find that fiscal policy volatility has a significant positive impact on the risk-adjusted MRPK dispersion, and the changes in fiscal policy volatility account for 8.9% to 27.4% of the observed reduction in capital misallocation during 1998-2007. Factors relating to capital adjustments, financial

frictions and policy distortions are found to play an important role in shaping the nexus between fiscal policy volatility and the static measure of capital misallocation.

Cong et al. (2019) study the allocation of bank credit across firms in China, and how it has changed following the introduction of a major credit expansion program in 2009. Based on a novel data set covering information on both banking relationships and firm real outcomes, as well as firm ownership information, they study credit allocation across firms with different initial characteristics such as productivity and state-ownership over the period of 2006-2013. The result shows that during the stimulus period, new credit is allocated relatively more toward state-owned or state-controlled firms and firms with lower initial marginal productivity of capital. Importantly, they document that this is a reversal of the previous trend of factor reallocation from low-productivity state-owned firms to high-productivity private firms that contributed to China's growth up to 2008.

Wu (2018) find that the vast majority of capital misallocation in China is due to policy distortions instead of financial frictions. She designs an identification strategy to separate the effects of financial frictions and policy distortions on average MRPK dispersion across firm ownership. The strategy identifies how the variance of the distortions and the covariance between distortions and firm characteristics can attenuate or exacerbate capital misallocation. She uses firm ownership as the proxy of policy distortions. and firm size and age as financial friction. Results show that financial frictions are estimated to cause an aggregate TFP loss of 8.3% on the intensive margin, which accounts for 30% of observed capital misallocation observed in China. Compared with other strategies such as Hsieh and Klenow (2009), this method takes into account heterogeneities in production functions and market power. What is interesting about Wu (2018)'s study is that she is able to determine the contribution of financial access distortions to the aggregate TFP by using propensity score matching (PSM), a semi-parametric technique. The advantage of the PSM method is that it solves some econometric issues (such as selection bias and misspecification) that are associated with the regression approach.

A common element of the emerging literature outlined above is that heterogeneity (ownership, regions) in productivity performance on a firm level may suggest resource misallocation across firms with adverse impacts at the aggregated level. It pays more attention to allocation between or within state-owned and non-state-owned enterprises in the same sector and normally ignores the allocation between industries. Therefore, in this chapter, we plan to start from the industrial perspective, which could be furthered to identify more fruitful connections to the mechanism of resource allocation. Furthermore, it will reveal inherent relationships between resource allocation, industrial structure and credit expansion, as well as the role of government intervention.

3 Background

3.1 China's government intervention at the industry level

It is widely believed that government intervention plays an important role in China's remarkable growth in recent decades. While China has been gradually moving to a development model that increasingly stresses market mechanisms over central planning, the state still intervenes in the economy in several ways, dominating the allocation of factor resources. At the industry level, it is mainly manifested in the implementation of administrative-led "selective industrial intervention".

Specifically, the State Council, the political authority and primary body that oversees the actual formulation of national policies in China, plans and arranges major national construction projects, productivity distribution, and proportions of the national economy, and then formulates development and structural adjustment goals for different industries.

Under the guidance of the central government, local governments and functional departments will promulgate various measures including direct intervention and indirect guidance accordingly. The direct intervention includes the approval of

market access and investment projects by the government, which will affect the thresholds for firms to enter and exit, change the level of market competition in the industry, and then affect the innovation input and incentives of firms through market competition mechanisms. In addition, the approval of resources such as credit and land in the direct intervention will also affect the role of fiscal and financial policies.

Regarding to the indirect guidance, fiscal and financial measures are widely applied to ensure the implementation of industrial intervention. For instance, the fiscal policies include: (1) the accelerated depreciation of fixed assets, additional deductions for RD expenses, and other tax means which will affect firms' innovation activities directly; and (2) tax incentives, subsidies and industrial parks which will affect the financial constraints of firms and change the economic environment. And the financial development policies implemented at the industry level mainly reflect bank credit policies and so on.

"The Top Ten Industrial Revitalization Plan" is an example of the industry-level government intervention in recent years.

3.2 China's economic stimulus program at the industry level

The economic stimulus package is composed with an investment plan, exploding credit expansion and a series of industrial policies (Naughton, 2009). Under the economic stimulus program, China's government initiated an accommodative monetary policy regime. The central bank reduced the interest rate five times to encourage firms to borrow money from banks. Meanwhile, the state council office issued a call to banks and aimed to increase total lending by four trillion RMB in 2008.

In order to stimulate the economy and adjust industry structure, on 26, November 2008, Jiabao Wen, the then Prime Minister of the State Council, put forward policies that strongly support the development of key industries, which cover manufacturing industries (automobile industry, equipment industry, shipbuilding manufacturing industry, non-ferrous metal industry, steel industry, textile industry, petrochemical

industry, and light industry), electronic information industry and logistics industry. In early 2009, the National Development and Reform Commission (NDRC) publishes a series of industrial policies for those ten sectors, labelled "the Top Ten Industrial Revitalization Plan", and designed to cover a three-year period, from 2009 through 2011.

These policy documents clearly propose an increased injection of government resources into many of these sectors. For instance, the electronic information plan designs an investment of 600 billion RMB in the build-out and integration of the "three networks": next-generation Internet, third-generation wireless, and digital television. While most of this investment comes from government-run corporations rather than from the government itself, there has been clearly expected an increase in the flow of credit resources into these sectors.

Table 1 presents the specific release time and related financing and credit measures of each industry, which are collected from the government documents of China's State Council. Although related financing and credit measures are issued in all sectors, the biased attitude of the government is clearly identified by different expressions. For instance, the steel industry, one of China's traditional government-support industries, has not received obvious credit policy support. "Financing with retention" seems to simply provide loan discount support to prevent the risk of chain disconnection of funds for large backbone enterprises, while "financing with pressure" means implementing measures such as financing restrictions for projects that violate laws and regulations, and projects that are approved beyond their authority, as well as enterprises with backward production capacity.

In sum, the revitalization plan issues more than 160 implementing regulations related to investment activities, which may have generated changes in industry investment decisions.

Table 1: Related measures of the Top Ten Industrial Revitalization Plan

Sector	Release time	Financing and credit measures
Logistics	13 Mar, 2009	N.A.
Steel	20 Mar, 2009	"Continue to implement the policy of financing with retention and pressure."
Automobile	20 Mar, 2009	"Promote and regulate auto consumption credit."
Electronic information	15 Apr, 2009	"Improve investment and financing environment."
Textile	24 Apr, 2009	"Increase financial support for textile enterprises."
Non-ferrous metal	11 May, 2009	"Promote and regulate auto consumption credit."
Equipment manufacturing	12 May, 2009	N.A.
Petrochemical	18 May, 2009	"Strengthening credit policy support."
Light	18 May, 2009	" Increase financial support."
Shipbuilding	9 Jun, 2009	" Increase credit financing support for production and operation."

Source: The official website of the Central People's Government of the People's Republic of China.

4 Empirical methodology

The classification approach is conceptually simple: If certain policy-relevant terms appear in central government documents, such as providing credit or financial support to one industry, we infer that the industry is supported by the 2009 credit expansion, and define it as the treatment group, otherwise as the control group.

This paper examines the quantity and quality effect of China's stimulus-driven credit expansion using an industry-level panel data set. The empirical analysis is structured in the following three ways. First, we estimate the impact of the 2009 credit expansion on the investment rate at the industry level. Second, we directly model the expected/optimal level of investment based on each industry's financial factor (cash flow) and the fundamental factor (investment opportunities), then test the association between the 2009 credit expansion and deviations from this expected/optimal level (our proxy for investment efficiency). Third, we calculate the

elasticity of investment to output (our proxy for allocative efficiency) among supported and non-supported industry groups of each province, and examine whether the 2009 credit expansion significantly influence the allocative efficiency among industries.

4.1 Identification strategy

The main challenge we face is which industries have received more support from the credit expansion in 2009 cannot be confirmed at the data level. We hereby use a series of government documents issued by the State Council and the NDRC from the end of 2008 to 2009 to identify the industry preference for the credit stimulus program.

Financial support: {financial support, financing support, expand corporate financing channels}

Credit support: {credit support, credit policy support}

We list industries in the treatment group and associated policy plans/rules in Table 2. As shown in the table, some documents contain terms in more than one category for certain industries, we, therefore, divide the treatment group into Treatment group A (strongly supported by the government), and Treatment group B (less strongly supported by the government). Specifically,

Treatment group A: {credit support and financial support}

Treatment group B: {credit support only}

The list of treatment and control groups in this study is shown in Table 3.

Table 2: Industries directly benefit from the 2009 credit expansion

Sector and 2-digit classification code	Policy measures and terms in government documents
Panel A: Treatment group 1 (Strongly)	
13 Agricultural and sideline food processing 14 Food Manufacturing 15 Beverage manufacturing 16 Tobacco products 22 Paper and paper products 27 Pharmaceutical manufacturing	VI. Increase **financial support**. "Encourage financial institutions to increase credit support for textile industrial enterprises... Expand corporate financing channels" (Light Industry Revitalization Plan, February 2009)
17 Textiles 18 Textile clothing shoes and hats	VI. Increase **financial support** for textile enterprises Same as above. (Textile Industry Revitalization Plan, February 2009)
37 Transportation equipment	I. Increase **credit financing support** for production and operation. (Shipbuilding manufacturing Industry Revitalization Plan, February 2009)
Panel B: Treatment group 2 (Weakly)	
39 Communication equipment and computer	IV. Improve the investment and financing environment. Implement relevant policies and measures for promoting economic development through finance, and increase **credit support** for the electronic information industry. (Electronic information industry Revitalization Plan, February 2009)
7 Oil and gas extraction 25 Petroleum and coking processing 26 Chemical raw materials and chemical products	III. Strengthening **credit policy** support. Encourage financial institutions to provide credit support to petrochemical enterprises with good fundamentals,good credit records, law-abiding operations,competitiveness, and market, but temporarily experiencing operational or financial difficulties. (Petrochemical Industry Revitalization Plan, February 2009)

Source: The official website of the Central People's Government of the People's Republic of China.

Table 3: List of treated and control industry groups

Treatment group ($N = 13$)	Control group ($N = 14$)
A. Treated (strongly support) ($N = 9$)	
13 Agricultural and sideline food processing	6 Coal mining
14 Food Manufacturing	8 Ferrous metal mining
15 Beverage manufacturing	9 Non-ferrous metal mining
16 Tobacco products	10 Non-metallic mining
17 Textiles	28 Chemical fibers
18 Textile clothing shoes and hats	30 Non-metallic mineral products
22 Paper and paper products	31 Ferrous metal smelting
27 Pharmaceutical manufacturing	32 Non-ferrous metal smelting
37 Transportation equipment	33 Metal Products
B. Treated (weakly support) ($N = 4$)	34 General equipment
7 Oil and gas extraction	35 Special equipment
25 Petroleum and coking processing	38 Electrical machineries
26 Chemical raw materials and chemical products	40 Instrumentation
39 Communication equipment and computer	44 Electricity and heat

4.2 Our measure of investment efficiency

In terms of the measure of investment efficiency, we start by constructing a model that predicts the level of investment based on the fundamental factor (investment opportunities) (Biddle et al., 2009; Gomariz and Ballesta, 2014) and the financial factor (cash flow) (Firth et al., 2008; Ding et al., 2018b). Next, we apply the negative of absolute value of the deviation/error term from the investment model to represent investment efficiency.

The optimal investment regression is in the following static form:

$$\frac{I_{i,t}}{GDP_{i,t}} = \alpha_0 + \alpha_1 q_{i,t-1} + \alpha_2 \frac{CF_{i,t-1}}{K_{i,t-1}} + \epsilon_{i,t} \tag{3}$$

where I/GDP is the investment rate of industry i at time t, defined as the ratio of

fixed investment to GDP in the province. CF/K is the ratio of cash flow to total assets, in which cash flow is calculated as the sum of net profit and accumulative depreciation of fixed assets. According to Firth et al. (2008), investment cash flow sensitivity is a reasonable indicator of financial constraints in the Chinese institutional context.

q is investment opportunities, which are represented by different proxies including (1) sales growth, (2) excess sales growth, and (3) inventory growth.

First, sales growth is widely used in corporate finance literature as the proxy of investment opportunities (Firth et al., 2008; Biddle et al., 2009; Cull et al., 2015; Ding et al., 2018b).

Second, consider that sales growth is empirically nosier in measuring investment opportunities (Chen et al., 2011) because it reflects pass sales growth, which includes some transitory component such as relative market share. To control for these effects, following Ding et al. (2018b), we construct a variable of excess sales growth, defined as sales growth minus mean value of industry-level sales growth in each province.

Third, due to the same reason above, we also use the growth rate of inventory as an inverse proxy for the demand shock (Ding et al., 2018b), which is defined as the first difference of inventory stock to fixed assets.

We then estimate the investment model within provinces. Ideally, investment efficiency will exist when there is no deviation from the expected level of investment. And the residuals from the regression Model 3 reflect the deviation from the expected investment level, and we use these residuals as an industry-specific proxy for investment inefficiency. Specifically, a positive residual/deviation means that the industry is making investments at a higher rate than expected, so it will overinvest. In contrast, a negative residual/deviation assumes that real investment is less than that expected, representing an underinvestment scenario.

Our dependent variable will be the absolute value of the residuals multiplied by -1, so a higher value means higher efficiency (IE).

4.3 Our measure of allocative efficiency

The main difference with existing studies on quality effects has been their definition of allocative efficiency. Existing literature generally calculate aggregate allocative efficiency based on firm-level or industry-level data and compare its changes during the pre-and post-policy period.

Efficient capital allocation is supposed to invest capital in the sectors that are expected to have high returns and withdraw from sectors with poor prospects (Wurgler, 2000). Following this fundamental principle, we assume that the optimal investment implies increasing investment in industries that are "growing" and decreasing investment in industries that are "declining" in the economy, and estimate the following simple specification:

$$ln\frac{I_{ipt}}{I_{ipt-1}} = \alpha_0 + \alpha_1 ln\frac{Y_{ipt}}{Y_{ipt-1}} + \epsilon_{ipt} \tag{4}$$

where I is fixed investment, Y is output, i indexes industry, p indexes province, and t indexes year. The slope estimate in Model 4 is an elasticity. It measures the extent to which the economy increases investment in its growing industries and decreases investment in its declining industries at time t [2].

We apply our province-level data to Model 4 and estimate the allocative efficiency among industries supported and non-supported by the policies before and after the credit expansion of each province. We run these regressions using ordinary least squares (OLS) due to the low number of observations.

[2] A major concern with this specification is reverse causality; instead of value added growth causing investment, it could be investment causing the contemporaneous change in value added. However, Wurgler (2000) argues, based on prior literature, that fixed capital takes some time to become productive. Because of this lag, the more plausible proposition is that contemporaneous value added growth causes changes in investment.

4.4 Model specification

To estimate the industry-level effect of the economic stimulus package on investment outcomes, we use a difference-in-differences model.

$$y_{i,p,t} = \alpha + \beta Treat_i * After_t + \gamma X_{i,p,t} + \delta Z_{p,t} + Year_t + Industry_i + Province_p + \epsilon_{i,p,t} \quad (5)$$

Here and throughout the paper, y indicates a set of variables of industry performance, including investment rate, investment efficiency, and allocative efficiency. i indexes industries, p indexes provinces, and t time periods. $Treat_i$ indicates whether industry i is supported by the credit expansion policy, i.e., $Treat_i = 1$ if the industry i belongs to treatment group, and $Treat_i = 0$ otherwise. $After_t$ indicates the post-treatment period, taking the value of 0 before 2009, and 1 after. $X_{i,c,t}$ is a set of control variables at the industry level. $Z_{c,t}$ is a set of control variables at the province level. $Year_t$ is year-specific fixed effects, accounting for possible business cycles and macroeconomic shocks, $Industry_i$ is industry fixed effects, reflecting time-invariant industrial features affecting industrial performance, and $\epsilon_{i,c,t}$ is the error term, controlling for other unobserved factors.

The coefficient we are interested in is β, which measures the average treatment effect of the economic stimulus package on industries. If β is significantly negative, it indicates that after the stimulus period, industries supported by credit expansion policies perform worse.

Following the the literature (Lang et al., 1996), we include a vector of controls X. the industry size ($size$), financial leverage ($leverage$), investment opportunities (q^D), and the tangibility ($tangibility$) are applied to control for the characteristics of industries. Specifically, leverage ($leverage$) is calculated as the ratio of total liabilities to total assets (Chen et al., 2011; Firth et al., 2008; Liu et al., 2018). A positive coefficient implies that highly indebted firms are active in investment.

Industry size ($size$) is defined as the natural logarithm of the industry's real total assets. While larger industries are more likely to enjoy larger market size, and have

more resources for investment, resulting in a positive coefficient for *size* (Myers, 1977), a negative relation is also possible if smaller industries tend to be in their expansion stage (Levchenko et al., 2009; Rajan and Zingales, 1998).

Tangibility (*tangibility*) is defined as the ratio of fixed assets to total assets in the industry. The positive coefficient implies that there is a positive sensitivity of investment to asset tangibility, as has been extensively documented (Boasiako et al., 2022; Chaney et al., 2012; Liu et al., 2018). And the negative coefficient also makes sense explaining that industries with a higher asset tangibility are more likely to operate in less dynamic environment with lower growth potential (Ding et al., 2018b; Hovakimian, 2009)

To isolate changes in investment that are driven solely by credit supply forces instead of credit demand or investment opportunities (q^D), we include sales growth to measure investment opportunities from the demand side (Biddle et al., 2009; Cleary et al., 2007; Cull et al., 2015; Ding et al., 2018b; Firth et al., 2008). As firms with better investment opportunities are likely to receive more bank loans, we expect a positive coefficient for q^D.

At the province level, the level of financial development is controlled as well. We apply the Financial Marketization index (FM) developed by China's National Economic Research Institute (NERI) [3]. A larger value of this indicator implies a higher degree of financial market development.

We also consider China-specific factors that may affect industry-level investment and performance: the role of state-owned enterprises (SOE), which is defined as the share of state-owned assets in total assets in the province.

Detailed definitions of variables are presented in Table 4.

[3]Fore detailed information, please see Fan et al. (2003)

Table 4: Definition of variables

Variable	Definition
Dependent variable	
Investment rate (%)	Ratio of fixed investment to GDP
Investment efficiency	Absolute value of residuals of the investment model multiplied by -1
Allocative efficiency	Elasticity of the industry's investment to output
Control variable	
Leverage (%)	Ratio of total liabilities to total assets
Cash flow	The sum of the industry's net profit and the accumulative depreciation of fixed assets
Sales growth (%)	Log difference of sales from time $t-1$ to time t
Industry size	Nature logarithm of the real total assets
Tangibility (%)	Ratio of fixed assets to total assets.
Inventory growth (%)	Ratio of the first difference of inventory stock to fixed assets
External finance (%)	Ratio of interest expense to sales
Labour productivity	Ratio of real output to the number of employees
SOE (%)	Share of state-owned asset in total asset in the province
Financial marketization	Financial Marketization Index

5 Data and variable

5.1 Data source

5.1.1 Provincial 2-digit industry statistics

Province-level 2-digit industry statistics come from the *China Industrial Economic Statistical Yearbook*. It reports capital formation, sales and other information for up to 27 2-digit ICS industries, in 31 provinces in mainland China over the period 2000 to 2016. We use data reported in current RMB, and convert them into constant using PPI. The sample size is expected to be 14 229 (with $T = 17$, from 2000 to 2016, $N = 27$ in 31 provinces).

5.1.2 Other province-level statistics

Most of the province-level control variables come from *China Macroeconomic Database (Annual)*. All nominal variables are deflated to the base time (2000) according to the province-level producer price index (PPI). Additionaly, the Financial Marketization Index is obtained from *China Market Index Database*, which provides indices of marketalization for 31 provinces in mainland China.

5.2 Descriptive statistic

Table 5 reports the summary statistics of key variables. We first focus on the average and corresponding standard deviations.

The investment rate (I/GDP) on average is 0.006, 0.004 and 0.007 for the full group, treatment group, and control group, respectively. The standard deviation of the investment rate is 0.042, 0.056 and 0.023 correspondingly for the three groups. Meanwhile, the variation range of investment rates is wide for each group. The collective evidence seems to suggest that industries make very different investment decisions during our sample period even if they are in the same group.

Investment efficiency (IE) using different measures shows a similar average value in our sample for all measures: -0.012 for the treatment group and -0.013 for the control group.

The average of allocative efficiency ($Elasticity$) ranges from 0.861 in the treatment group and 0.984 in the control group.

For the controls, the mean of leverage ranges from 0.593 for the control group to 0.597 for the treatment group, indicating on average, the debt of the industry accounts for more than half of total assets. The treatment group has larger average industry assets ($size$) of 4.834 than the control group (4.761). The mean of sales growth ($sales\_growth$) ranges from 0.145 in the treatment group to 0.153 in the control group. Tangibility ($tangibility$) is on average 42.3% of total assets for all groups, with the treatment group enjoying a larger share of fixed assets (0.461).

Table 5: Summary statistics

Variable	Full	Treat=1	Treat=0	Observation	Difference
I/GDP	.006	.004	.007	11,588	-.002***
	(.042)	(.056)	(.023)		
Investment_efficiency					
q: sales growth	-.012	-.012	-.013	8,277	.001
	(.03)	(.025)	(.034)		
q: inventory growth	-.012	-.012	-.013	7,599	.002***
	(.027)	(.025)	(.028)		
q: excess sales growth	-.012	-.012	-.013	8,277	.001
	(.029)	(.024)	(.034)		
q: productivity growth	-.013	-.012	-.013	6,734	.001
	(.029)	(.025)	(.032)		
elasticity	.923	.861	.984	124	.123
	(1.467)	(1.545)	(1.394)		
leverage	.595	.597	.593	13,338	.004
	(1.518)	(2.185)	(.185)		
size	4.796	4.834	4.761	13,356	.004***
	(.044)	(.033)	(.052)		
sales_growth	.149	.145	.153	11,636	-.009
	(.325)	(.314)	(.335)		
tangibility	.423	.461	.387	12,549	.074
	(2.568)	(3.189)	(.194)		

Notes: This table reports sample means and standard deviations (in brackets). The column 'Difference' reports a difference in means of corresponding variables between treatment group and control group associated with the results of t-test on the equality of means. *** indicates significance at the 1% level.

We then turn this discussion to the comparison of industry characteristics potentially related to investment performance. T-tests of means for corresponding variables reveal no statistical differences between the treatment and control group along the following dimensions: leverage, sales growth, inventory growth, tangibility, and cash flow. The only dimension that significantly differs between supported and non-supported industries is industry size: 4.834 and 4.761, respectively. We interpret these results as evidence that the 2009 credit expansion is randomly assigned across industry characteristics.

5.3 Parallel trend test

A parallel trend, the same tendency in investment activity in the absence of the stimulus-driven credit expansion, is an important premise for assessing the policy effect by using the difference-in-differences approach. The parallel trend requires that, if there were no impact of the 2009 credit expansion, the development trend between the treatment and control groups should be parallel. If systematic differences exist in the trend of investment activity, the results will not be robust.

Figure 1 and 2 shows the parallel trend test. The impact of the revitalization plan on investment efficiency is represented by connected circles, and the dashed lines represent 95% confidence intervals. This figure demonstrates that changes in investment activity do not precede the credit expansion and the influence turns up immediately. Thus, the key identifying assumption for the DID method holds.

Figure 1: Parallel trend test of investment rate (treatment v.s control)

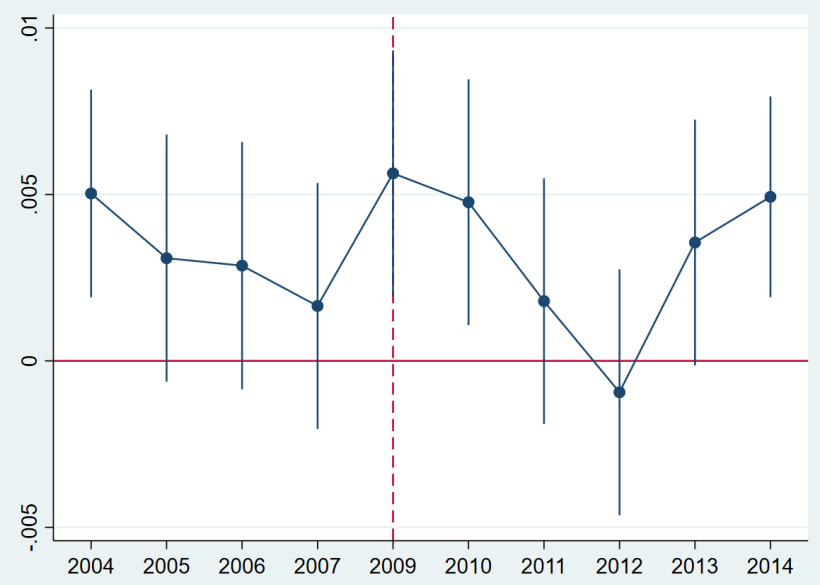

Figure 2: Parallel trend test of investment rate (strongly v.s. non-support)

5.4 Stylized facts

5.4.1 China's financial development and allocative efficiency

Table 6 shows the elasticity in each province during the sample period. The average province elasticity is 1.048 and the cross-province standard deviation is 0.616. The highest elasticity estimate is Shandong's at 2.478. The next highest estimates are Hunan, Sichuan, and Shanxi.

In general, consistent with Wurgler (2000)'s paper, provinces with high elasticity estimates have better fits. For instance, the relationship fits Neimenggu best with an R-square of 0.141. The elasticity is 1.504 (higher than the average value of 1.048). In some provinces, the elasticity estimate is not significantly positive, with an R-square close to zero. In these provinces, investment is not ramped up in growing industries and is not slowed down in declining industries; factors unrelated to current growth prospects must play a large role.

Figure 3 plots the relation between the financial development level and elasticity estimates from Table 6. Although there are some provinces that do not fit the pattern, the figure reveals a positive association between the province elasticity and

Table 6: Estimates of the elasticity of industry investment to output (full sample)

Province	Elasticity	Standard error	R-square
Beijing	.675	.432	.017
Tianjin	1.117	.368	.027
Hebei	.714	.418	.008
Shanxi	1.890	.386	.120
Neimenggu	1.504	.268	.141
Liaoning	1.043	.476	.012
Jilin	1.273	.350	.058
Heilongjiang	.027	.565	.002
Shanghai	1.169	.661	.025
Jiangsu	1.444	.466	.033
Zhejiang	.942	.344	.030
Anhui	1.128	.360	.038
Fujian	.936	.469	.008
Jiangxi	.358	.340	.004
Shandong	2.478	.391	.137
Henan	.396	.290	.004
Hubei	.265	.573	.001
Hunan	2.220	.467	.095
Guangdong	1.513	.492	.052
Guangxi	.756	.326	.016
Hainan	1.664	.4	.078
Chongqing	.163	.282	.006
Sichuan	1.901	.441	.108
Guizhou	.812	.372	.011
Yunnan	.647	.326	.014
Tibet	1.21	1.078	.012
Shaanxi	.221	.46	.001
Gansu	.678	.282	.048
Qinghai	.428	.388	.003
Ningxia	1.519	.528	.049
Xinjiang	1.408	.318	.067
Mean	1.048		.039
SD	.616		.042

the average level of financial development. The correlation between the province elasticity and the level of financial development is 0.19. This indicates that the financial market variable explains some of the cross-province variations in this measure of the elasticity of investment allocation.

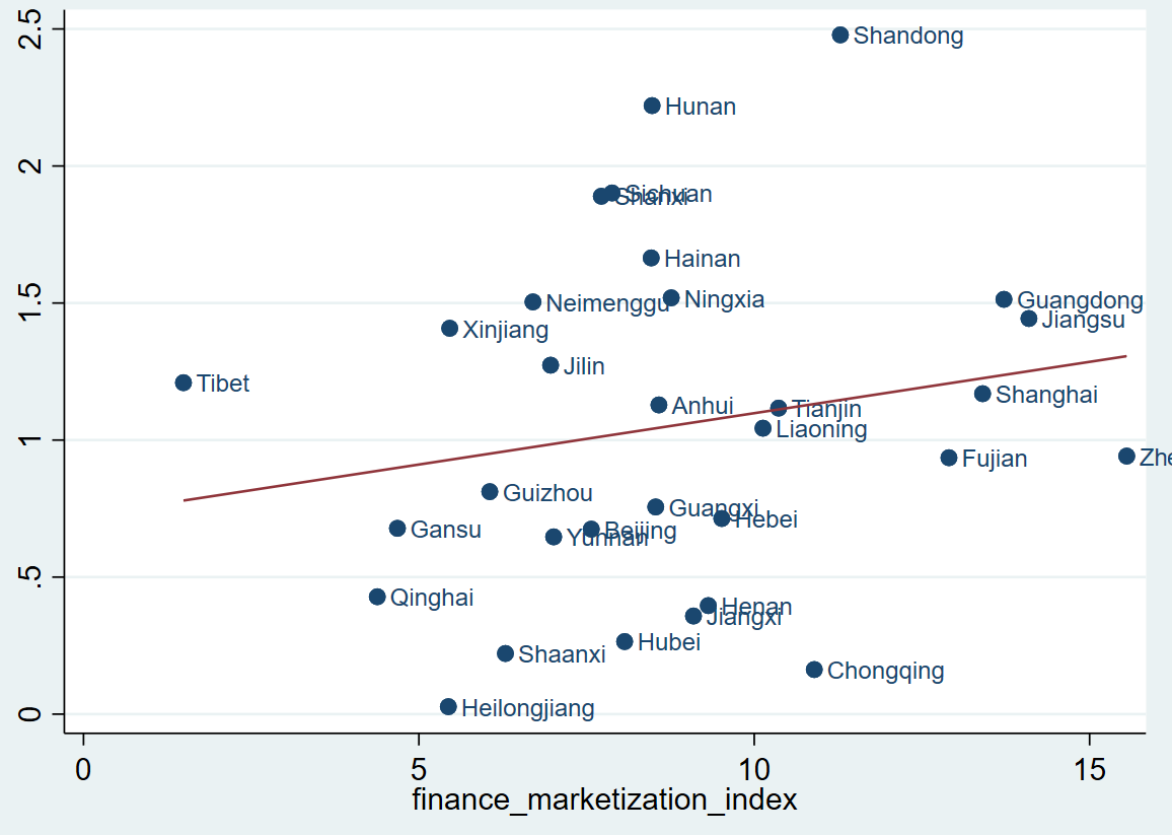

Figure 3: Allocative efficiency of industry investment versus financial development (2000-2016)

We then split our sample into two groups: before and after the 2009 credit expansion. According to Table 7, the average value of elasticity before 2009 is 1.264 with a standard deviation of 0.696. After 2009, the average value decreases to 0.640 with a standard deviation of 0.909. This indicates that in the post-stimulus period, the allocative efficiency becomes worsen and variates more widely. Consider a shock that causes output growth of 10%. The average estimates imply that investment will increase by more than 12.6% before 2009, but by only 6.4% after 2009.

Also, the average value of the R-square before 2009 is 0.073, while after 2009, it decreases to 0.025. Growth prospects become less able to explain efficiency the allocative efficiency after the stimulus program, implying the deeper influence of more unobserved factors (we suppose it is the government intervention) on the economy.

In addition, all province elasticises except Heilongjiang (with an R-square of 0) are positive before the stimulus period. However, six province elasticity become negative (insignificant) after the stimulus program, and more elasticises are insignificant. The allocation of investment is more driven by unobserved factors rather than growth opportunities in the post-stimulus period. This also confirms that the investment environment becomes worsened after 2009.

Figure 4 and 5 provide more information about the relationship between allocative efficiency and financial development level. The correlations between financial development level and elasticity are insignificantly negative in both sample periods.

We regress the province elasticity on a time dummy (equals 1 after 2008, and 0, otherwise) and the financial marketization index. The result shows that the province elasticity is strongly negatively associated with the 2009 stimulus program (t-statistic = 2.99), with an R-square of 0.288. This confirms that at the aggregate level, after the stimulus package program, China experiences a worsening allocation trend.

Table 7: Estimates of the elasticity of industry investment to output (before and after 2009)

Province	Elasticity	Std. error	R-square	Elasticity	Std. error	R-square
Beijing	1.418	.684	.033	-.017	.598	0
Tianjin	1.562	.433	.109	-.086	.688	.006
Hebei	1.022	.667	.007	.537	.57	.007
Shanxi	2.36	.571	.167	1.713	.558	.082
Neimenggu	2.189	.31	.325	.683	.478	.032
Liaoning	1.736	.539	.028	-.37	.956	.014
Jilin	1.565	.49	.112	.998	.533	.023
Heilongjiang	-.038	.815	0	-.012	.804	.004
Shanghai	.572	.891	.016	.774	1.204	.008
Jiangsu	.979	.637	.034	1.47	.787	.021
Zhejiang	1.555	.407	.093	.256	.62	.026
Anhui	2.398	.804	.091	.694	.368	.022
Fujian	1.888	.534	.107	-.371	.857	.004
Jiangxi	.017	.567	.003	.099	.411	.001
Shandong	1.705	.584	.01	3.342	.614	.184
Henan	1.245	.549	.024	.042	.385	0
Hubei	.352	.772	0	.205	.82	0
Hunan	1.741	.584	.088	2.426	.754	.043
Guangdong	1.518	.58	.08	.965	1.079	.028
Guangxi	1.144	.589	.033	.594	.405	.003
Hainan	2.193	.606	.059	.706	.495	.016
Chongqing	.29	.427	.013	-.154	.384	0
Sichuan	1.88	.535	.139	1.24	.866	.023
Guizhou	1.269	.473	.015	-.13	.62	.002
Yunnan	.998	.38	.042	.311	.577	.002
Tibet	.989	1.315	.019	-1.065	2.239	.071
Shaanxi	.407	.673	.034	.852	.882	.008
Gansu	.306	.318	.167	2.325	.642	.118
Qinghai	.467	.574	0	.754	.515	.002
Ningxia	1.732	.695	.097	.886	.767	.005
Xinjiang	1.737	.287	.242	.158	.817	.007
Mean	1.264		.073	.64		.025
SD	.696			.909		

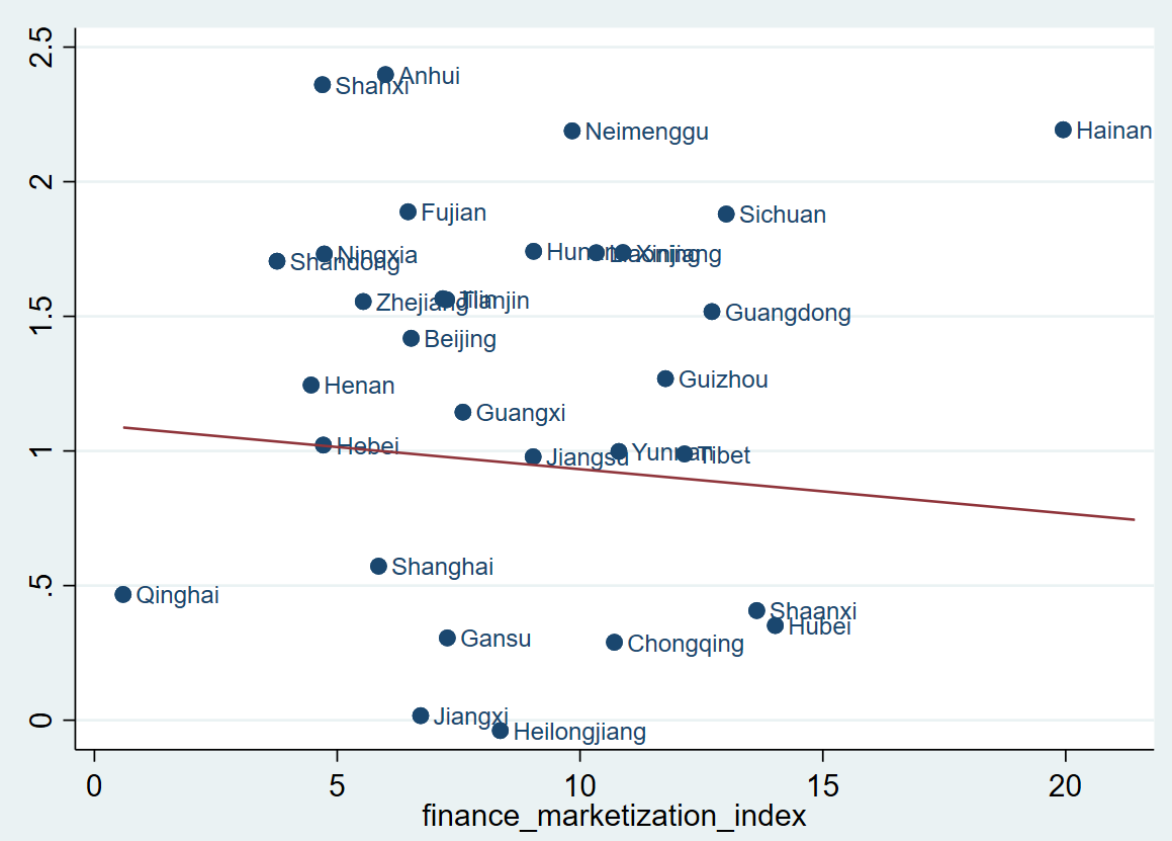

Figure 4: Allocative efficiency of industry investment versus financial development (2000-08)

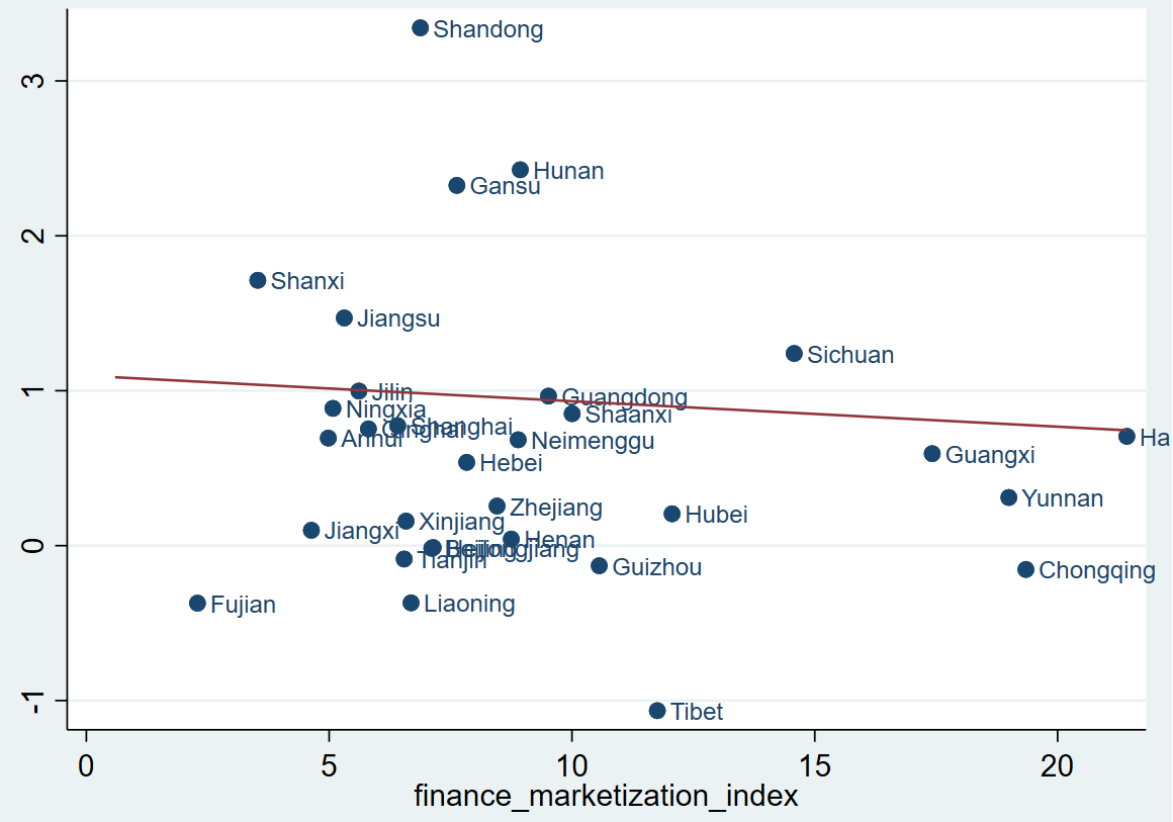

Figure 5: Allocative efficiency of industry investment versus financial development (2009-16)

6 Empirical result

6.1 Baseline result

6.1.1 Investment rate

Our first research question is how the 2009 credit expansion affects industry investments during the stimulus period.

Table 8 provides the baseline fixed effect regression of Equation 5 with the investment rate as the dependent variable. Columns (1) uses the full treatment and control groups, while columns (2) only uses the strongly supported treatment group and control group, excluding the weakly supported treatment group. In addition to the industry-and province-level controls, time-fixed effects, industry-fixed effects and province-fixed effects are included to control the time-invariant and time-variant unobservable factors that may affect the results.

The coefficients of $Treat * After$ in column (1) is significantly positive, suggesting the robust impact of the credit expansion on industries supported by the policy compared to those excluded from the policy. It implies that the 2009 credit expansion is associated with a rise in the sectoral investment rate of 0.2-0.3 percentage points. When excluding the weak treatment group, columns (2) provides a robust positive result with magnitudes of 0.2 percentage points. This confirms that industries with more government support invest more after the stimulus period.

In addition, industry characteristics also affect investment. Larger industries with better investment prospects and higher debt invest more during the sample period, as well documented in the literature (Ding et al., 2013). However, the effect of tangibility ($tangibility$) is mixed.

Regarding the province characteristics, a larger share of state-owned assets in the province will inhibit investment. And the coefficients of proxies for financial development: the financial marketization index ($Financial\_index$) is negatively associated with the investment rate at a 10% significance level, and credit share ($credit\_GDP$)

Table 8: The impact of the credit expansion on investment

Dep. Var.: Investment rate	(1)	(2)
*treat * time*	.0023**	.0015**
	(.0012)	(.0007)
leverage	.0049***	.0179***
	(.001)	(.0007)
size	.0028***	.003***
	(.0007)	(.0004)
sales_growth	.0063***	.0057***
	(.001)	(/0006)
tangibility	.0077***	-.0095***
	(.0006)	(.0008)
SOE	-.0064	-.0077**
	.0058	.0033
Fin_index	-.0002*	-.0002*
	(.0001)	(.0001)
Constant	-.0096***	-.0109***
	(.0054)	(.0031)
Industry FE	Yes	Yes
Year FE	Yes	Yes
Province FE	Yes	Yes
Treatment group	full	strongly
No. of obs.	11,577	9,919
group	818	703
R-squared	.454	.138

Notes: *, **, *** indicate significant at 10%, 5%, and 1%, respectively. Values in parentheses are standard error.

does not appear to be robustly significant.

6.1.2 Investment efficiency

Tables 9 demonstrates the results of estimating Equation 5, with different proxies of investment efficiency as the dependent variable. Unless otherwise indicated, we

use the same specifications, controls, and fixed effects as identically to the estimates of the investment rate effect in Table 8, throughout for maximum comparability.

Table 9: The impact of the credit expansion on investment efficiency

Dep. Var.: Investment efficiency						
q^D measure	sales growth		inventory growth		excess sales growth	
	(1)	(2)	(3)	(4)	(5)	(6)
treat∗*time*	.0005	-.0024***	-.0003	-.0037***	.0007	-.0025***
	(.0011)	(.0008)	(.001)	(.0009)	(.0011)	(.0008)
leverage	-.0125***	-.0157***	-.0123***	-.0161***	-.0126***	-.0157***
	(.0011)	(.0008)	(.0009)	(.0009)	(.0011)	(.0009)
size	-.0041***	-.0031***	-.0041***	-.0031***	-.0041***	-.0029***
	(.0007)	(.0005)	(.0007)	(.0006)	(.0007)	(.0005)
tangibility	.0057***	.0087***	.0056***	.0091***	.0058***	.0087***
	(.0007)	(.0008)	(.0007)	(.0009)	(.0008)	(.0008)
SOE	-.0094	-.0011	-.0056	-.0017	-.0104	-.0015
	(.0074)	(.0052)	(.007)	(.0059)	(.0073)	(.0052)
Fin_index	.0002	.0002**	.0001	.0002**	.0002	.0002**
	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)
Constant	.0189***	.0109**	.0135**	.0107**	.0196***	.01***
	(.0061)	(.0043)	(.0057)	(.0048)	(.006)	(.0044)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Treatment	full	strongly	full	strongly	full	strongly
group	799	686	796	685	799	686
No. of obs.	8,277	7,124	7,599	6,556	8,277	7,124
R-squared	.041	.105	.054	.109	.042	.103

Notes: *, **, *** indicate significant at 10%, 5%, and 1%, respectively. Values in parentheses are standard error.

Columns (1), (3) and (5) of Table 9 show it does not to be the case that the credit

expansion influences the investment efficiency of supported industries. However, when excluding the weakly support industries, in Columns (2), (4) and (6), we find a significant differential efficiency effect for strongly-supported industries compared to non-supported industries: The credit expansion reduces the investment efficiency of strongly supported industries. Specifically, compared to non-supported industries, the investment efficiency of strongly supported industries declines by 0.002-0.004 in the post-stimulus period.

Most controls are significantly correlated with investment efficiency. At the industry level, tangibility (*tangibility*) is positively and significantly associated with investment efficiency in all configurations. In the contrast to the estimates in Table 8, the coefficients of industry size (*size*) and leverage (*leverage*) are negative, indicating that smaller industries with lower leverage have a better investment performance.

6.1.3 Allocative efficiency

Table 10 provides the results of the credit expansion on the allocative efficiency (elasticity), considering the province fixed effects and time fixed effects. The elasticity is calculated based on Equation 4.

The results show that the 2009 credit expansion is strongly negatively associated with the province elasticity. It implies that after the stimulus program, compared to industries without any government support, among industries with government support, provinces either "underinvest" in growing industries or "overinvest" in declining industries or both. According to the stylized facts section, we can confirm that most industries with government support exist an overinvestment problem, which causes the worsening of allocative efficiency.

Additionally, financial sector development measure does not have a significant effect on elasticity in our sample.

Taken together, our above empirical results confirm that during the implementation of the stimulus package, credit expansion has a strong influence on capital

Table 10: The impact of the credit expansion on allocative efficiency

Dep. Var.: Allocative efficiency	(1)	(2)
$treat * time$	-1.547***	-.970*
	(.516)	(.565)
Fin_index	-.013	-.099
	(.081)	(.088)
SOE	-1.116	-.723
	(3.365)	(3.69)
$constant$	1.99	2.333
	(2.223)	(2.437)
Year FE	Yes	Yes
Province FE	Yes	Yes
Treatment group	full	strongly
No. of obs.	124	124
R-squared	.191	.084

Notes: *, **, *** indicate significant at 10%, 5%, and 1%, respectively. Values in parentheses are standard error.

allocation at the industry level through government support. Specifically, industries with government intervention invest more than control industries. However, these investments do not achieve higher investment efficiency, and cause an aggregate-level worsen resource allocation trend.

6.2 Channel and mechanism

6.2.1 Funding source for investment: external formal finance

We have already shown that industries with government support invest more than controls. A natural question is where the money for investment comes from. In this section, we further test the financing sources for investment.

Financing resources of a firm are either internal cash flow or external funding.

Here, we use the following equation to investigate if the investment is supported by external funding after the stimulus program. Variable *Loan* and its triple interaction term with $Treat * Time$ to Equation 5. :

$$y_{i,c,t} = \alpha + \beta_1 Loan_{ict} * Treat_i * After_t + \beta_2 Treat_i * After_t + \beta_3 Loan_{ict} + \gamma X_{i,c,t} + \delta Z_{c,t} + Year_t + Industry_i + Province_c + \epsilon_{i,c,t} \tag{6}$$

where $Loan_{ict}$ is excess interest expense, defined as divided the ratio of interest expense to sales minus the mean value of the industry-level interest expense ratio in each province. This is due to the following reason:

In the Chinese case, because of China's relatively underdeveloped capital market (Gordon and Li, 2003), the key source of external funding is loans from banks or other formal financial intermediaries such as trust companies and credit cooperatives. However, the information on the quantity of loans that the industry receives is missing. Following Cull et al. (2009), we use a proxy for the use/access to loans from formal financial intermediaries, mostly banks, equal to interest expense divided by sales.

Considering that there is potential multicollinearity between the ratio of interest expense to sales and leverage, we apply two measures to partially address this concern. First, we construct the excess interest expense ratio, which is defined as the ratio of interest expense to sales minus the mean value of the industry-level interest expense ratio in each province. Second, we drop the variable *leverage* in regressions and check whether it makes any differences in the result [4].

In the first two columns of Table 11, the coefficients of the triple interaction ($Loan * Treat * After$) are insignificant, indicating that the use of external funds does not influence industry investment activity with the introduction of the stimulus program.

The last two columns show a more robust result of the effect on investment

[4]The results remain quantitatively similar.

Table 11: Mechanism analysis: Source of funds and investment

Dep. Var.	Investment Rate		Investment Efficiency	
	(1)	(2)	(3)	(4)
$loan*treat*time$	-.0045	.0035	0	-.0249*
	(.0054)	(.0098)	(.0065)	(.0135)
$treat*time$	.0012	.0016**	.0005	-.0026***
	(.0009)	(.0007)	(.0009)	(.0008)
$loan$	.0035*	.0027*	-.0022	-.0028
	(.0019)	(.0014)	(.0046)	(.0037)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Treatment group	full	strongly	full	strongly
group	806	692	795	684
No. of obs.	11,242	9,638	8,113	6,982
R-squared	.542	.147	.055	.11

Notes: *, **, *** indicate significant at 10%, 5%, and 1%, respectively. Values in parentheses are standard error.

efficiency, calculated by sales growth[5]. The coefficients of the triple interaction ($Loan*Treat*After$) are significantly negative in regressions with strongly-supported industries as the treatment group. This implies that the easier access to external funds worsens the investment efficiency of industries with strong government back-up.

According to the theory of moral hazard, bank loans derived from the stimulus package are considered to be 'free' resources. This relatively easy access to bank loans encourages firms to engage in sub-optimal investments and invest more, no matter whether their investment opportunities are promising or not. Therefore, industry investment expenditure will be less responsive to its investment opportunities after the introduction of the stimulus program, thereby declining the efficiency of

[5]The results remain quantitatively similar to other proxies of investment opportunities.

investment.

Furthermore, industries with government back-up receive most of the "free" credit resources and are more likely to be influenced by the government to make investments for government objectives rather than maximizing their own value. First, ex ante, industries supported by the government are likely to miss profitable investment opportunities in order to carry out the objectives of the government; Second, ex post, when projects fail to produce the expected results or when there are diminishing investment opportunities, they are likely to find it difficult to either terminate failed projects or reduce their investment due to potential conflicts with government agendas and policies.

6.2.2 Over- or under-investment?

Table 12: Mechanism analysis: Over- and under-investment groups

Dep. Var.:	*Over_I*	*Over_I*	*Under_I*	*Under_I*
	(1)	(2)	(3)	(4)
treat ∗ *time*	.0005	.0029***	.0025	-.0004
	(.001)	(.0008)	(.0068)	(.0032)
group	792	680	402	342
No. of obs.	7,237	6,216	1,040	908
R-squared	.078	.163	.019	.041
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Treatment	full	strongly	full	strongly

Notes: This table reports the results of Equation **??** for over- and under-investment groups. Column (1) and (2) present regressions for the over-investment group. Column (3) and (4) present regressions for the under-investment group, defined by the residual of Equation 3 with sales growth as the measure of investment opportunities. Control variables are defined as in previous tables. *, **, *** indicate significant at 10%, 5%, and 1%, respectively. Values in parentheses are standard error.

Specifically, we define a positive residual in Equation 3 as a proxy for over-investment ($Over\_I$), otherwise as under-investment ($Under\_I$).

In the first two columns of Table 12, we report the regressions of the over-investment group. The coefficient of $treat * time$ is positive and significant at the 1% level in Column (2), indicating that the credit expansion has boosted over-investment.

The last two columns of Table 12 provides the regressions for the under-investment group. Although the coefficients of $treat * time$ are negative, there is no significant correlation between the credit expansion and under-investment.

In sum, the 2009 credit expansion reduces the industry investment efficiency by boosting over-investment while having little influence on under-investment.

6.3 Heterogeneous analysis

Analysis so far has shown that the stimulus package affects the investment and allocation performance of industries with government support. In this section, we move further to explore cross-sectional variations of the effect of the 2009 credit expansion.

6.3.1 Ownership

The financial system in China is mostly controlled by the government. Relative to non-SOEs, SOEs are more bank-dependent, and thus will be affected more profoundly by changes in bank loan supply (Bai et al., 2016; Cong et al., 2019; Liu et al., 2018). Following an expansion of bank loan supply, access to bank loans for SOEs will increase significantly relative to non-SOEs, regardless of their profitability or creditworthiness. Once SOEs receive more bank loans, which is related to the stimulus package, they invest more, under the pressure of political objectives, irrespective of whether they have profitable investment opportunities or not.

To test whether ownership plays a role at the industry level, we divide these industries into two groups with different levels of state-owned capital share, namely

Table 13: Heterogeneous analysis: Ownership

Dep. Var.	Investment rate		Investment efficiency		Allocative efficiency	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: State-owned dominant industries					
$treat * time$	.0049**	.0022	.0011	-.0031*	-2.0643**	-1.5405
	(.0023)	(.0015)	(.0021)	(.0017)	(.8363)	(1.6824)
group	409	332	392	317	62	62
No. of obs.	5,731	4,643	3,943	3,198	124	121
R-squared	.488	.082	.032	.08	.215	.151
	Panel B: Non-state-owned dominant industries					
$treat * time$	-.0001	.0004	.0011	-.001	-.1143	-.4562
	(.0009)	(.0015)	(.0009)	(.0017)	(.6428)	(.6896)
group	409	371	407	369	62	62
No. of obs.	5,846	5,276	4,334	3,926	124	124
R-squared	.169	.373	.15	.343	.052	.062
Industry FE	Yes	Yes	Yes	Yes	/	/
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Treatment	full	strongly	full	strongly	full	strongly

Notes: This table reports the results of Equation **??** for state-dominant and non-state-dominant industries. Column (1) and (2) present regressions for investment rate. Column (3) and (4) present regressions for investment efficiency, calculalted by Equation 4 with sales growth as the measure of investment opportunities. Column (5) and (6) present regressions for allocative efficiency, calculalted by Equation 5. Control variables are defined as in previous tables. *, **, *** indicate significant at 10%, 5%, and 1%, respectively. Values in parentheses are standard error.

more or less state-dominate industries. Empirically, we re-estimate our main regressions for both industry groups, and the results are reported in Tables 13. Panels A and B present the results of regressions for more and less state-dominant industry groups.

Overall, we report the estimation of regressions for investment activity. We observe that our previous findings hold for more state-dominant industries only,

while they do not differ significantly for less state-dominant industry groups.

6.3.2 Corruption level

According to Chen et al. (2016), in countries with high corruption, government bank leading is less efficient which can decline bank performance during the financial crisis. Motivated by their findings, we exploit the variations in the level of regional corruption in China to test whether, and to what extent, regional corruption levels have an impact on industry investment performance and associated efficiencies.

In regions with high corruption, local government officials are likely to provide guarantees to sectors and firms, which leads to the pursuit of empire-building and higher agency costs (Firth et al., 2008). Thus, it is expected that the influence of the stimulus package on industry investment activity and performance will be more significant for industries located in regions with high corruption.

To conduct the regression analysis, we first define the corruption index as the average ratio of the number of duty crime cases to the total number of government officials for each province during the sample years. All data comes from the *China Procuratorial Yearbook*. Then, we assign provinces in our sample to the high corruption group if their corruption index is above the average level of the corruption index in all provinces, and otherwise to the low corruption group.

Table 14 reports the results of regressions for high and low corruption level groups, and our interest is in the interaction terms ($treat * time$). Consistent with our predictions, we observe that the coefficients of these interaction terms are more significant and have a greater magnitude for regressions located in the regions of high corruption. This finding is consistent with the argument of Chen et al. (2016) that government bank lending is less efficient in areas of high corruption. However, at the province level, the credit expansion has a significant effect on the allocative efficiency in regions with a low corruption level only.

Table 14: Heterogeneous analysis: Corruption level

Dep. Var.	Investment rate		Investment efficiency		Allocative efficiency	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: high corruption level						
$treat * time$	.0041*	.0027***	.0002	-.0039***	.78	-.6082
	(.0021)	(.001)	(.0018)	(.0011)	(.5627)	(.5713)
group	400	344	395	341	30	30
No. of obs.	5,718	4,918	4,133	3,571	60	60
R-squared	.513	.16	.018	.192	.312	.291
Panel B: low corruption level						
$treat * time$	.0004	.0013	.001	-.0015	-2.2472**	-1.3082
	(.0011)	(.0009)	(.0012)	(.001)	(.851)	(.9344)
group	418	359	404	345	32	32
No. of obs.	5,859	5,001	4,144	3,553	64	64
R-squared	.135	.245	.104	.196	.212	.127
Industry FE	Yes	Yes	Yes	Yes	/	/
Year FE	Yes	Yes	Yes	Yes	YES	YES
Province FE	Yes	Yes	Yes	Yes	YES	YES
Treatment	full	strongly	full	strongly	full	strongly

Notes: This table reports the results of Equation **??** for state-dominant and non-state-dominant industries. Column (1) and (2) present regressions for investment rate. Column (3) and (4) present regressions for investment efficiency, calculalted by Equation 4 with sales growth as the measure of investment opportunities. Column (5) and (6) present regressions for allocative efficiency, calculalted by Equation 5. Control variables are defined as in previous tables. *, **, *** indicate significant at 10%, 5%, and 1%, respectively. Values in parentheses are standard error.

6.3.3 Financial development stage

Many studies highlight that financial development could impact investment in various ways (Love and Zicchino, 2006; Naeem and Li, 2019; Wurgler, 2000). Therefore, we divide our sample into two groups by the Financial Marketization Index. Specially, provinces with an index above the median value are classified as "high level" and others are classified as "low level". The estimation results for both

Table 15: Heterogeneous analysis: Financial development level

Dep. Var.	Investment rate		Investment efficiency		Allocative efficiency	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: high financial development					
$treat * time$	.0029	.0008	-.0006	-.0017*	-.8166	-.5473
	(.0018)	(.0008)	(.0014)	(.0009)	(.6597)	(.694)
group	424	365	419	361	32	32
No. of obs.	6,058	5,204	4,388	3,785	64	64
R-squared	.573	.114	.022	.103	.111	.073
	Panel B: low financial development					
$treat * time$	.0016	.0029**	.0019	-.0035***	-2.326***	-1.42
	(.0016)	(.0012)	(.0017)	(.0009)	(.8076)	(.8955)
group	394	338	380	325	30	30
No. of obs.	5,519	4,715	3,889	3,339	60	60
R-squared	.081	.191	.059	.15	.316	.208
Industry FE	Yes	Yes	Yes	Yes	/	/
Year FE	Yes	Yes	Yes	Yes	YES	YES
Province FE	Yes	Yes	Yes	Yes	YES	YES
Treatment	full	strongly	full	strongly	full	strongly

Notes: This table reports the results of Equation **??** for state-dominant and non-state-dominant industries. Column (1) and (2) present regressions for investment rate. Column (3) and (4) present regressions for investment efficiency, calculalted by Equation 4 with sales growth as the measure of investment opportunities. Column (5) and (6) present regressions for allocative efficiency, calculalted by Equation 5. Control variables are defined as in previous tables. *, **, *** indicate significant at 10%, 5%, and 1%, respectively. Values in parentheses are standard error.

groups are shown in Table 15.

Our result suggests that industries located in regions with a less developed financial market have a higher tendency to invest more and deviate from their optimal investment, thereby reducing the overall allocative efficiency.

Overall, all of these results based on industrial and regional heterogeneities

are consistent with our main results that the supply side forces, namely the bank loan supply shock, shape bank lending behaviour and firm investment policies. Moreover, these effects are significant for state-dominated industries and industries from regions with high corruption levels, and less developed financial systems.

6.4 Robustness check

Following the extant literature, we also try alternative measurements for some key variables to test the robustness of our findings.

6.4.1 Alternative measure of investment opportunities

Table 16: Robustness check: Alternative measure of investment opportunities (labour productivity growth)

Dep. Var.: Investment efficiency	(1)	(2)
$treat * time$	.0009	-.0025***
	(.0011)	(.0009)
Industry FE	Yes	Yes
Year FE	Yes	Yes
Province FE	Yes	Yes
Treatment	full	strongly
group	798	686
No. of obs.	6,731	5,806
R-squared	.056	.11

Notes: *, **, *** indicate significant at 10%, 5%, and 1%, respectively. Values in parentheses are standard error.

In the baseline results, we apply a set of proxies of investment opportunities from the demand side: sales growth, excess sales growth, and inventory growth. However, according to Foster et al. (2008) and Ding et al. (2018b), the fundamental factor can be broken down into supply- and demand-side. Therefore, we re-estimate our investment efficiency equation (Equation 3) by applying an alternative measure of

investment opportunity from the supply side: Labour productivity growth, defined as the log difference of labor productivity.

Table 16 shows that the results remain quantitatively similar to the main results reported in previous tables, which confirms that our main findings are robust for alternative measurements.

6.4.2 Alternative measure of financial development

In the baseline regressions, we use the Financial Marketization Index to represent the development of financial system. In this section, we check robustness of our results by investigating the effect of other dimensions of financial development at the industry level.

Table 17: Robustness check: Alternative measure of financial development (share of credit to GDP)

Dep. Var.	Investment Rate		Investment Efficiency		Allocative Efficiency	
	(1)	(2)	(3)	(4)	(5)	(6)
$treat * time$	.0028**	.0017**	.0005	-.0024***	-1.560***	-.97
	(.0013)	(.0008)	(.0011)	(.0008)	(.51)	(.569)
Industry FE	Yes	Yes	Yes	Yes	/	/
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Treatment	full	strongly	full	strongly	full	strongly
group	816	701	799	686	62	62
No. of obs.	10,870	9,320	8,277	7,124	124	124
R-squared	.456	.14	.041	.104	.197	.071

Notes: *, **, *** indicate significant at 10%, 5%, and 1%, respectively. Values in parentheses are standard error.

The size of a province's RMB loan balance relative to its GDP (CM) is applied as a proxy for the general level of financial development[6].

[6]According to Rajan and Zingales (1998) and Wurgler (2000), the ideal measure of the credit market would be the value of private domestic credit. We use the RMB loan balance instead due to

Table 17 shows that the results remain quantitatively similar to the main results reported in previous tables, which confirms that our main findings are robust for alternative measurements.

7 Conclusion

This paper provides evidence on whether and how government intervention plays a role in determining industry investment performances and province allocative efficiency during the economic stimulus package led by the Chinese government. Based on data for 2000-16 for China's 2-digit industries in 31 provinces, we empirically examine the causal effect of the credit expansion on industries within a difference-in-differences framework and find that:

Quantitatively, we find that the stimulus-driven credit expansion after the financial tsunami encourages industries with government back-up to make more investments. However, qualitatively, it results in a less efficient investment of industries with strong government intervention, which causes a poor post-stimulus allocative trend within provinces.

Mechanism analysis empirically confirms that the decline in investment efficiency is more driven by over- rather than under-investment. Furthermore, these effects are more significant in state-dominant industries from regions with high corruption levels and less developed financial systems.

Overall, our paper illustrates how credit expansion leads to potentially unintended consequences when interacting with government interventions, which can be applied to the case of the stimulus packages in emerging markets in response to the Great Recessions.

data limitations at the province level in China.

References

Abel, A. B. (1983). Optimal investment under uncertainty. *American Economic Review*, 73(1):228–233.

Afonso, A. and Jalles, J. T. (2015). How does fiscal policy affect investment? Evidence from a large panel. *International Journal of Finance and Economics*, 20(4):310–327.

Bai, C. E., Hsieh, C. T., and Song, Z. M. (2016). The long shadow of China's fiscal expansion. *Brookings Papers on Economic Activity*, 2016(2):129–181.

Bai, C. E., Lu, J., and Tao, Z. (2006). The multitask theory of state enterprise reform: empirical evidence from China. *American Economic Review*, 96(2):353–357.

Bartelsman, E., Haltiwanger, J., and Scarpetta, S. (2013). Cross-country differences in productivity: The role of allocation and selection. *American Economic Review*, 103(1):305–334.

Beck, T. and Levine, R. (2002). Industry growth and capital allocation: does having a market- or bank-based system matter? *Journal of Financial Economics*, 64(2):147–180.

Bena, J. and Ondko, P. (2012). Financial development and the allocation of external finance. *Journal of Empirical Finance*, 19(1):1–25.

Biddle, G. C., Hilary, G., and Verdi, R. S. (2009). How does financial reporting quality relate to investment efficiency? *Journal of Accounting and Economics*, 48((2-3)):112–131.

Blanchard, O., Rhee, C., and Summers, L. (1993). The stock market, profit, and investment. *Quarterly Journal of Economics*, 108(1):115–136.

Boasiako, K. A., Adasi Manu, S., and Antwi-Darko, N. Y. (2022). Does financing influence the sensitivity of cash and investment to asset tangibility? *International Review of Financial Analysis*, 80:102055.

Brainard, W. C. and Tobin, J. (1968). Pitfalls in financial model building. *The American Economic Review*, 58(2):99–122.

Brandt, L., Tombe, T., and Zhu, X. (2013). Factor market distortions across time, space and sectors in China. *Review of Economic Dynamics*, 16(1):39–58.

Campello, M., Graham, J. R., and Harvey, C. R. (2010). The real effects of financial constraints: Evidence from a financial crisis. *Journal of Financial Economics*, 97(3):470–487.

Chaney, T., Sraer, D., and Thesmar, D. (2012). The collateral channel: How real estate shocks affect corporate investment.

Chen, H. (2006). Development of financial intermediation and economic growth: The Chinese experience. *China Economic Review*, 17(4):347–362.

Chen, R., El Ghoul, S., Guedhami, O., and Wang, H. (2017). Do state and foreign ownership affect investment efficiency? Evidence from privatizations. *Journal of Corporate Finance*, 42:408–421.

Chen, S., Sun, Z., Tang, S., and Wu, D. (2011). Government intervention and investment efficiency: Evidence from China. *Journal of Corporate Finance*, 17(2):259–271.

Chen, Y. S., Chen, Y., Lin, C. Y., and Sharma, Z. (2016). Is there a bright side to government banks? Evidence from the global financial crisis. *Journal of Financial Stability*, 26:128–143.

Cho, Y. J. (1988). The effect of financial liberalization on the efficiency of credit allocation: Some evidence from Korea. *Journal of Development Economics*, 29(1):101–110.

Chow, C. K. W. and Fung, M. K. Y. (1998). Ownership Structure, Lending Bias, and Liquidity Constraints: Evidence from Shanghai's Manufacturing Sector. *Journal of Comparative Economics*, 26(2):301–316.

Chow, C. K. W. and Fung, M. K. Y. (2000). Small businesses and liquidity constraints in financing business investment: Evidence from shanghai's manufacturing sector. *Journal of Business Venturing*, 15(4):363–383.

Cleary, S., Povel, P., and Raith, M. (2007). The u-shaped investment curve: Theory and evidence. *Journal of Financial and Quantitative Analysis*, 42(1):1–39.

Cong, L. W., Gao, H., Ponticelli, J., and Yang, X. (2019). Credit allocation under economic stimulus: Evidence from China. *The Review of Financial Studies*, 32(9):3412–3460.

Crotty, J. R. (1992). Neoclassical and Keynesian approaches to the theory of investment. *Journal of Post Keynesian Economics*, 14(4):483–496.

Cull, R., Li, W., Sun, B., and Xu, L. C. (2015). Government connections and financial constraints: Evidence from a large representative sample of Chinese firms. *Journal of Corporate Finance*, 32:271–294.

Cull, R., Xu, L. C., and Zhu, T. (2009). Formal finance and trade credit during China's transition. *Journal of Financial Intermediation*, 18(2):173–192.

Deng, L., Jiang, P., Li, S., and Liao, M. (2020). Government intervention and firm investment. *Journal of Corporate Finance*, 63:101–231.

Ding, S., Guariglia, A., and Knight, J. (2013). Investment and financing constraints in China: Does working capital management make a difference? *Journal of Banking and Finance*, 37(5):1490–1507.

Ding, S., Jiang, W., Li, S., and Wei, S. (2018a). Fiscal policy volatility and capital misallocation: Evidence from China.

Ding, S., Kim, M., and Zhang, X. (2018b). Do firms care about investment opportunities? Evidence from China. *Journal of Corporate Finance*, 52:214–237.

Dollar, D. and Wei, S.-j. (2007). Das (Wasted) Kapital: Firm Ownership and Investment Efficiency in China. *IMF working paper*.

Duchin, R., Ozbas, O., and Sensoy, B. A. (2010). Costly external finance, corporate investment, and the subprime mortgage credit crisis. *Journal of Financial Economics*, 97(3):418–435.

Duchin, R. and Sosyura, D. (2012). The politics of government investment. *Journal of Financial Economics*, 106(1):24–48.

Fan, S., Zhang, X., and Robinson, S. (2003). Structural change and economic growth in China. *Review of Development Economics*, 7(3):360–377.

Fazzari, S. M., Hubbard, R. G., Petersen, B. C., Blinder, A. S., and Poterba, J. M. (1988). Financing constraints and corporate investment. *Brookings Papers on Economic Activity*, 1988(1):141–195.

Firth, M., Lin, C., and Wong, S. M. (2008). Leverage and investment under a state-owned bank lending environment: Evidence from China. *Journal of Corporate Finance*, 14(5):642–653.

Fisman, R. and Love, I. (2004). Financial development and intersectoral allocation: A new approach.

Foster, L., Haltiwanger, J., and Syverson, C. (2008). Reallocation, firm turnover, and efficiency: Selection on productivity or profitability? *American Economic Review*, 98(1):394–425.

Gomariz, M. F. C. and Ballesta, J. P. S. (2014). Financial reporting quality, debt maturity and investment efficiency. *Journal of Banking and Finance*, 40(1):494–506.

Gordon, M. J. (1992). The Neoclassical and a post Keynesian theory of investment. *Journal of Post Keynesian Economics*, 14(4):425–443.

Gordon, R. H. and Li, W. (2003). Government as a discriminating monopolist in the financial market: The case of China. *Journal of Public Economics*, 87(2):283–312.

Guiso, L. and Parigi, G. (1999). Investment and demand uncertainty. *Quarterly Journal of Economics*, 114(1):185–227.

Gulen, H. and Ion, M. (2016). Policy uncertainty and corporate investment.

Guner, N., Ventura, G., and Xu, Y. (2008). Macroeconomic implications of size-dependent policies. *Review of Economic Dynamics*, 11(4):721–744.

Gupta, K. and Lensink, R. (1996). *Financial Liberalization and Investment*. Routledge.

Hayashi, F. (1982). Tobin's marginal q and average q: A neoclassical interpretation. *Econometrica*, 50(1):213–224.

Hopenhayn, H. A. (2011). Firm microstructure and aggregate productivity. *Journal of Money, Credit and Banking*, 43(1):111–145.

Hovakimian, G. (2009). Determinants of investment cash flow sensitivity. *Financial Management*, 38(1):161–183.

Hsieh, C. T. and Klenow, P. J. (2009). Misallocation and manufacturing TFP in China and India. *Quarterly Journal of Economics*, 124(4):1403–1448.

Hubbard, R. G. (1998). Capital-market imperfections and investment. *Journal of Economic Literature*, 36(1):193–225.

Jensen, M. C. and Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3(4):305–360.

Jiang, F., Cai, W., Wang, X., and Zhu, B. (2018). Multiple large shareholders and corporate investment: Evidence from China. *Journal of Corporate Finance*, 50:66–83.

Kang, W., Lee, K., and Ratti, R. A. (2014). Economic policy uncertainty and firm-level investment. *Journal of Macroeconomics*, 39(PA):42–53.

Lang, L., Ofek, E., and Stulz, R. M. (1996). Leverage, investment, and firm growth. *Journal of Financial Economics*, 40(1):3–29.

Lardy, N. R. (2014). *Markets over Mao: The rise of private business in China*. Columbia University Press.

Lemmon, M. and Roberts, M. R. (2010). The response of corporate financing and investment to changes in the supply of credit. *Journal of Financial and Quantitative Analysis*, 45(3):555–587.

Levchenko, A. A., Rancière, R., and Thoenig, M. (2009). Growth and risk at the industry level: The real effects of financial liberalization. *Journal of Development Economics*, 89(2):210–222.

Liu, Q., Pan, X., and Tian, G. G. (2018). To what extent did the economic stimulus package influence bank lending and corporate investment decisions? Evidence from China. *Journal of Banking and Finance*, 86:177–193.

Love, I. and Zicchino, L. (2006). Financial development and dynamic investment behavior: Evidence from panel VAR. *Quarterly Review of Economics and Finance*, 46(2):190–210.

McLean, R. D., Zhang, T., and Zhao, M. (2012). Why does the law matter? Investor protection and its effects on investment, finance, and growth. *Journal of Finance*, 67(1):313–350.

Modigliani, F. and Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *American Economic Review*, 48(3):261–297.

Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics*, 5(2):147–175.

Myers, S. C. and Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, 13(2):187–221.

Naeem, K. and Li, M. C. (2019). Corporate investment efficiency: The role of financial development in firms with financing constraints and agency issues in OECD non-financial firms. *International Review of Financial Analysis*, 62:53–68.

Naughton, B. (2009). Understanding the Chinese Stimulus Package. *China Leadership Monitor*, (28).

Olley, G. S. and Pakes, A. (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica*, 64(6):1263–1297.

Ouyang, M. and Peng, Y. (2015). The treatment-effect estimation: A case study of the 2008 economic stimulus package of China. *Journal of Econometrics*, 188(2):545–557.

Rajan, R. G. and Zingales, L. (1998). Financial dependence and growth. *American Economic Review*, 88(3):559–586.

Restuccia, D. and Rogerson, R. (2008). Policy distortions and aggregate productivity with heterogeneous establishments. *Review of Economic Dynamics*, 11(4):707–720.

Stein, J. C. (2003). Agency, information and corporate investment. In *Handbook of the Economics of Finance*, volume 1, pages 111–165.

Stiglitz, J. E. and Weiss, A. (1981). Credit Rationing in Markets with Rationing Credit Information Imperfect. *The American Economic Review*, 71(3):393–410.

Tobin, J. (1969). A general equilibrium approach to monetary theory. *Journal of Money, Credit and Banking*, 1(1):15–29.

Wu, G. L. (2018). Capital misallocation in China: Financial frictions or policy distortions? *Journal of Development Economics*, 130:203–223.

Wurgler, J. (2000). Financial markets and the allocation of capital. *Journal of Financial Economics*, 58(1-2):187–214.

Yoshikawa, H. (1980). On the" q" theory of investment. *The American Economic Review*, 70(4):739–743.