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Fiscal policy volatility and capital misallocation: Evidence from China

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ABSTRACT

This paper investigates how domestic policy uncertainty stemming from discretionary fiscal policy disrupts efficient capital allocation across firms. While fiscal policy represents the government's reaction to economic conditions, its volatility presents firms with considerable uncertainty about conditions affecting their future profitability and consequently disrupts decisions about investment in the presence of capital adjustment costs. Using firm-level data from Chinese manufacturing industries spanning from 1998 to 2007, we find that reducing fiscal policy volatility leads to a decrease in the dispersion of the marginal revenue product of capital, accounting for 8.3 percent of the observed improvement in capital allocation during the sample period. In addition to various fiscal reforms to curb fiscal policy volatility directly, policies contributing to lower capital adjustment costs and lower reliance of firms on government expenditure can alleviate the adverse effects of fiscal policy volatility.

1. Introduction

Variation in marginal products across firms, even within narrowly defined industries, is widely regarded as evidence of frictions that hinder an efficient allocation of resources in the economy. Extensive research has underscored the qualitative significance and quantitative importance of resource misallocation in both developed and developing countries (e.g., Banerjee and Duflo, 2005; Hsieh and Klenow, 2009; Gopinath et al., 2017). Identifying the driving forces behind resource misallocation is of paramount importance if we are to reallocate resources to more productive uses and enhance aggregate efficiency and welfare within industries and countries as well as over time.

In this paper, our focus is on examining how fiscal policy volatility affects the dispersion of the marginal revenue product of capital (MRPK) among firms in the manufacturing sector. By investigating this relationship, we aim to contribute to the understanding of how fiscal policy volatility has an impact on resource allocation efficiency, shedding light on optimal fiscal policy management. As many countries have to grapple with considerable uncertainty or volatility in fiscal policy after expending substantial resources to mitigate the human and economic impact of the Covid-19 pandemic, understanding the effects of fiscal

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policy volatility on resource allocation is of utmost importance for policymakers navigating the challenges of recovery and promoting sustainable economic growth. This is especially true for many developing countries, which appear to have about one-third more macro uncertainty than developed ones (Bloom, 2014).

Through government purchases fiscal policy has a direct impact on the level of demand experienced by firms, as well as an indirect impact through the provision of basic infrastructure and other public goods and services that influence firms' production costs and sales.[1] While fiscal policy often reflects a government's response to economic conditions, its *volatility*, stemming from discretionary government expenditure, introduces significant uncertainty for firms regarding future profitability. That uncertainty, especially in the presence of capital adjustment costs, can disrupt firms' decision-making processes around capital allocation and investment. The increase in MRPK dispersion resulting from higher fiscal policy volatility induces capital allocative inefficiency. Conversely, the misallocation could be mitigated by reducing fiscal volatility for a given level of fiscal expenditure. Estimating the magnitude of this impact is crucial for understanding the potential for improvement in capital efficiency by designing less volatile fiscal policies and reducing the impact through changing industrial and economic characteristics.

China serves as an excellent case for this question due to its unique fiscal landscape. As one of the world's most fiscally decentralised countries, the local governments in China at province, prefecture, county, and township levels, have substantial expenditure responsibilities to provide public goods and services that have a direct impact on people's lives. However, not all expenditure assignments are adequately supported by revenue assignments or intergovernmental transfers (Lardy, 2014). Overall, discretionary government expenditure and fiscal volatility in China can be attributed to two main factors. First, a fiscal reform in 1994, by re-centralising the revenue collection but leaving expenditure assignments unchanged, has created a significant mismatch between expenditures and revenues of local governments. This mismatch increases the likelihood of procyclical discretionary government spending and fiscal volatility. Second, a lack of fiscal transparency and information provision by local governments further exacerbates fiscal policy volatility. According to the Penn World Table database, the degree of fiscal volatility is above the median for China. Sorting 135 developed and developing countries from the lowest to highest volatility during 1980–2013, China is ranked 80th. While the existing research on China's fiscal system focuses mainly on the effectiveness of fiscal reform or the growth impact of fiscal decentralisation (e.g., Lin and Liu, 2000; Wong and Bird, 2008), we explore the role of *volatility* of fiscal policy in driving resource allocation.

Resource misallocation results in substantial welfare losses. Hsieh and Klenow (2009) claim that China could benefit from huge aggregate productivity gains (up to 30%–50%) if manufacturing firms were able to achieve the same efficiency in allocating capital and labour across production units as the United States. While the literature on resource misallocation in China has been increasing, the focus has primarily been on specific policy distortions, such as ownership and financial frictions (e.g., Brandt et al., 2013; Wu, 2018). Our contribution lies in examining the role of second-order policy moments, the volatility induced by discretionary fiscal policy, as a novel driver of the observed dispersion of marginal revenue product of capital (MRPK).

Our analysis uses comprehensive panel data from the Annual Survey of Industrial Firms from the National Bureau of Statistics of China over the period 1998–2007. The firms in the data are located in all 31 Chinese provinces. We follow the literature (e.g., Fatás and Mihov, 2003; Woo, 2011; Fatás and Mihov, 2013) in defining fiscal policy volatility as the standard deviation of the residuals from province-specific regressions of government expenditure on output, using a panel of 31 provinces at yearly frequency drawn from various issues of the China Statistics Yearbook and the "China Compendium of Statistics 1949–2009". This regression-based measure of fiscal volatility captures the portion of discretionary fiscal policy that is not explained by the state of the business cycle. The MRPK is derived from Cobb–Douglas production functions by industry. In a static model without frictions, profit maximisation implies that MRPK should be equal to the user cost of capital. In the presence of capital adjustment costs, the dispersion of MRPK across firms rises with the uncertainty of future profitability. In our context, the volatility of fiscal policy contributes to such uncertainty and disrupts efficient capital allocation across firms and industries by influencing firms' future market conditions regarding their costs and demand.

The identification of the causal relationship between fiscal policy volatility and the dispersion of MRPK stems from the variation in fiscal disparities and fiscal transparency across regions and over time in China. China's fiscal system is characterised by significant regional disparities. Wealthier provinces in the East, situated along the coast, enjoy ample fiscal revenue, enabling them to provide robust public services and invest in local infrastructure whereas provinces in the Central and Western regions, which face serious fiscal challenges, are experiencing a deterioration in public services. Despite the implementation by the central government of the "Go West" development strategy in 1999, which aimed to redirect fiscal resources to poorer regions, the impact has been limited, as is reflected by persistently high fiscal volatility in inland provinces. Furthermore, fiscal transparency at the province level is generally low in China, with substantial variation in the amount of information disclosed by individual provinces from year to year (Deng et al., 2013). These disparities and variations generate significant differences in the volatility of fiscal policy across regions and over time, which provides us with a means of studying the relationship between that volatility and the dispersion of MRPK within a cross-province panel data framework.[2]

Our findings demonstrate that fiscal policy volatility has a substantial influence on the dispersion of MRPK. This relationship remains statistically significant even after accounting for a range of factors encompassing policy distortions (e.g., government size

[1] In China, the share of "Economic construction expenditure" in total government expenditure ranged from 38.7 percent to 26.6 percent during the period 1998–2006. This is the most important component of fiscal expenditure and directly relates to the manufacturing sector (see Online Appendix Figure OB.1).

[2] Regional differences may also come from variation in the composition of manufacturing industries across regions, which may be associated with different user costs of capital. This might naturally imply different levels (and consequently dispersion) of MRPK. In order to tease out the role of fiscal policy volatility, we adjust MRPK by taking away the industry- and year-level differences and focus on its within-province dispersion by year.

and subsidy), market frictions (e.g., financial development and inflation), and trade openness, all of which can potentially have an impact on MRPK dispersion. We find an elasticity of 0.022 between MRPK dispersion and fiscal policy volatility. This result has economic significance across three dimensions. First, the magnitude of fiscal policy volatility is large — the degree of uncertainty arising from fiscal policy encompasses around 14.5 percent of the overall uncertainty associated with total factor productivity. Second, the effect of fiscal policy uncertainty (as evidenced by the measured elasticity of 0.022) is comparable (about 59 percent) to the impact arising from the overall uncertainty of total factor productivity. Finally, considering the overall decrease in fiscal policy volatility in China during the period 1998–2007, the estimated impact indicates that this decrease contributed to 8.3 percent of the observed improvement in capital dispersion during this period. Overall, this result underscores the significance of policies aimed at directly reducing fiscal policy volatility, such as expenditure-side reforms to address the mismatch between local government revenue and expenditure, enhanced fiscal transparency, and efforts to alleviate regional fiscal disparities. By adopting such measures, policymakers can effectively enhance firms' capital allocative efficiency.

Since our fiscal volatility measure is induced by macroeconomic policy and regional disparities, it is likely to be exogenous. Nonetheless, we may be concerned with potential endogeneity due to reverse causality. For instance, provinces with a higher level of capital misallocation may be more inclined to utilise discretionary fiscal policy to support the least efficient firms. To address this concern, we employ several novel instruments, using the two-stage least squares (2SLS) approach as well as the System Generalised Method of Moments (GMM) estimator. First, we utilise an instrumental variable based on the historical and cultural distinctions between China's wheat and rice regions which have persisted for thousands of years. The idea is that societies with a history of rice farming exhibit greater interdependence due to the extensive cooperation required for water-intensive cultivation, while wheat farming fosters independence, as irrigation or labour do not necessitate interdependence (Talhelm et al., 2014). Since paddy rice cultivation increases the value of cooperation within societies, monitoring and control mechanisms are more likely to be established, potentially curbing the discretionary use of fiscal policy and reducing associated volatility in rice regions compared to wheat regions. Moreover, the historical wheat and rice division is unlikely to be influenced by MRPK dispersion, making it a valid instrumental variable. Second, we employ the income inequality of each province as an additional instrumental variable. According to Woo (2011), problems of income distribution in highly unequal societies can lead to discretionary spending decisions and more volatile fiscal outcomes. Therefore, provinces characterised by high initial income inequality may experience greater fiscal policy volatility, while the initial income inequality itself is unlikely to be influenced by the current MRPK dispersion. Our empirical findings support these hypotheses and affirm the role of fiscal volatility in the dispersion of MRPK.

We also conduct a large number of robustness tests to validate our causal results from other confounding factors. First, to circumvent the potential endogeneity bias caused by omitted variables and different sorts of uncertainty, in the regression analysis we include various factors such as output volatility, total factor productivity growth volatility, and political volatility. Second, we use alternative and flexible methods to construct the two key variables, fiscal policy volatility and the MRPK dispersion, in order to minimise the potential mismeasurement problem. Overall, the key result regarding the relationship between fiscal policy volatility and the dispersion of MRPK remains robust.

To explore the mechanisms underlying the fiscal volatility effect, we analyse how types of government expenditure, capital adjustment costs, and firms' reliance on government purchase shape the relationship. First, government investment in infrastructure is mainly included in budgetary expenditure, while extra-budgetary expenditure covers city maintenance and administrative costs. The former expenditure is more relevant in determining manufacturing firms' profitability and thus its volatility is more important in influencing capital allocation in the manufacturing sector. Consistent with this conjecture, we find that only the volatility of budgetary expenditure matters. This result also serves as a placebo test since the documented relationship is indeed driven by the volatility that directly affects firm profitability. Second, industries characterised by higher capital adjustment costs, as indicated by a higher level of sunk investment costs or greater external finance dependency, experience a more pronounced impact of fiscal policy volatility on capital misallocation. Third, the impact is more muted in industries where firms have a lower level of dependence on government purchase. Overall, these results suggest that policies contributing to lower capital adjustment costs and lower reliance of firms on government expenditure can alleviate the capital misallocation caused by fiscal policy volatility.

This paper delivers at least two contributions to the literature. First, we study fiscal policy volatility as a novel source of shocks leading to capital misallocation. While our work is rooted in the insights of Asker et al. (2014), who highlight the role of future profitability uncertainty in shaping the dispersion of MRPK, we diverge from the general profitability uncertainty that firms face. Instead, we focus on the uncertainty arising from a specific form of policy shock — the frequent and discretionary changes in fiscal policy that are not necessarily driven by economic conditions. Our analysis reveals that a substantial portion of the observed capital misallocation is attributable to policy volatility, offering a compelling argument for a government's policy toolbox to achieve more efficient resource allocation.

Second, we advance the understanding of the impact of policy uncertainty, with a specific focus on fiscal volatility, on industry performance. Previous research such as that of Bloom (2009) has shown that shocks to stock market volatility, often used as a proxy for uncertainty, can delay firm-level investment, employment, and productivity growth in the United States. Baker et al. (2016) have reaffirmed these findings by introducing a novel index of economic policy uncertainty based on newspaper coverage frequency. In the context of China, research on policy uncertainty has predominantly concentrated on trade policy uncertainty (e.g., Feng et al., 2017; Crowley et al., 2018). Our contribution to this literature is distinct, because we shift the spotlight to a significant policy uncertainty stemming from fiscal policy volatility and examine its impact on resource allocation in individual firms. In terms of fiscal volatility, despite ample cross-country evidence pointing to the negative impact of policy volatility on long-term economic growth (Fatás and Mihov, 2013), our study highlights capital misallocation as a pivotal transmission channel for fiscal volatility shocks. This complements the existing channels that encompass output volatility (Fatás and Mihov, 2003), firm investment (Fernández-Villaverde et al., 2015), and household saving incentives (Bachmann et al., 2020).

The structure of the paper is as follows. Section 2 discusses the relevant literature. Section 3 describes the background of China's fiscal system, with a focus on potential sources of fiscal volatility. Section 4 defines measures of fiscal policy volatility and MRPK dispersion and describes the empirical methodology. Section 5 presents the data and stylised facts regarding MRPK and fiscal policy volatility across regions and over time. Section 6 discusses the empirical results of both the baseline model and various tests addressing reverse causality, omitted variables and mismeasurement problems. Section 7 focuses on economic mechanisms that make fiscal policy volatility matter when capital misallocation is affected. We conclude in Section 8.

2. Related literature

2.1. Literature on resource misallocation

The extensive literature shows that misallocation of resources across firms/plants in an economy lowers aggregate total factor productivity (TFP).[3] That is, aggregate productivity may be low because inputs are misallocated across heterogeneous production units.[4] In the literature market imperfections, adjustment costs, and policy distortions are commonly identified as potential candidates for explaining the dispersion of TFP or marginal revenue products of inputs. Trade openness, on the other hand, is found to be conducive to the improvement of resource allocation.

Taking capital market imperfections as an example, using cross-country data Midrigan and Xu (2014) examine the role of financial frictions in driving the dispersion of returns to capital across individual producers and find that this misallocation channel accounts for a moderate degree of efficiency loss due to firms' ability to use internal funds to mitigate borrowing constraints. Based on a sample of manufacturing firms in the US and using the dispersion of firms' borrowing costs to measure resource misallocation caused by capital market imperfections, Gilchrist et al. (2013) reach a similar finding showing that the efficiency loss due to misallocation associated with financial market frictions is relatively small. Using a dataset for Indian manufacturing plants, Galle (2016) finds that in the presence of financial constraints, capital wedges of firms can be amplified by competition because reduced markups driven by competition lower the scope for internally-financed capital accumulation and impede the process of convergence to the firm's optimal capital level. Using a structural model with both policy distortions and financial frictions, Wu (2018) identifies a non-trivial role of financial frictions in explaining capital misallocation in China over the period of 1998–2007 (about 30%).

The misallocation literature acknowledges the role of factor adjustment costs in driving the dispersion of marginal revenue products. Asker et al. (2014) find that in a dynamic investment model adjustment costs of capital coupled with TFP shocks, lead to differences in MRPK among producers in a dynamic investment model. Their empirical evidence shows that variation in the volatility of productivity across industries and countries can explain 80%–90% of cross-industry and cross-country variation in the dispersion of the marginal revenue product of capital. Costly adjustment costs of capital are more pervasive in developing countries. Wu (2015) claims that if Chinese firms had faced a lower level of adjustment costs such as that in the US, China's aggregate output would be 25% higher.

Non-market distortions induced by government policies are argued to be another important contributing factor to the observed misallocation. Restuccia and Rogerson (2008) focus on the effect of firm-level variation in taxes and subsidies which create heterogeneity in the prices faced by individual producers. Hsieh and Klenow (2009) relate the TFP gaps between China/India and the US to policy distortions such as state ownership in China and licensing and size restrictions in India. In a model where plants face idiosyncratic shocks (Da Rocha and Pujolas, 2011) consider policy distortions (such as subsidising low-productivity plants or taxing high-productivity ones) and find that the cross-sectional dispersion of productivity increases as the time-series volatility of idiosyncratic shocks rises. Brandt et al. (2013) examine the effect of factor market distortions (such as barriers to factor mobility across regions and forms of ownership) in both manufacturing and services sectors in China between 1985 and 2007. They find that the misallocation of factors across provinces and sectors leads to an aggregate TFP loss in the non-agriculture economy of 20% and almost all the within-province distortions are due to misallocation of capital between state and non-state sectors induced by government policies. Based on a unified framework, David and Venkateswaran (2019) claim that the presence of substantial distortions of firm investment such as size-dependent policies accounts for a major component of observed capital misallocation in China, as measured by the dispersion of average revenue products of capital (ARPK).

The international trade literature has long recognised the role of trade openness in enhancing resource allocation and thus aggregate productivity. In the seminal work of Melitz (2003), trade liberalisation shapes sector dynamics by inducing reallocation of resources towards more efficient use, that is, exposure to trade induces more productive firms to enter the export market and forces the least productive ones to exit, so that the aggregate productivity increases due to selection and market share reallocation. A similar mechanism works for imports both in theory and in empirical evidence (Melitz and Ottaviano, 2008; Ding et al., 2016).

[3] Throughout this paper, for convenience we use TFP to refer to revenue-based total factor productivity.

[4] See, for instance, Banerjee and Duflo (2005), Foster et al. (2008), Restuccia and Rogerson (2008), Hsieh and Klenow (2009), Syverson (2011), Restuccia and Rogerson (2013), Asker et al. (2014) and Midrigan and Xu (2014).

2.2. Literature on (policy) volatility

The literature on (policy) volatility mainly relates to economic growth. In theory, the volatility-growth relationship is ambiguous. Endogenous growth can be negatively affected by volatility due to irreversibility or diminishing returns on investment; on the other hand, the effect can be positive in the presence of precautionary saving, innovative creative destruction, liquidity constraints, or if high returns technologies also entail high risks (Imbs, 2007). The negative link between volatility and growth is well established in the empirical literature. For instance, Ramey and Ramey (1995) show that aggregate volatility is low in fast-growing economies. Aghion et al. (2010) find that, by affecting the cyclical composition of investment, financial frictions play an important role in shaping the negative link between volatility and growth.

Turning to the growth impact of policy volatility, research based on macroeconomic data suggests that policy volatility has detrimental effects on economic growth. Using a cross-section of 91 countries, Fatás and Mihov (2003) find that the aggressive use of discretionary fiscal policy amplifies business cycle fluctuations, generates undesirable volatility, and leads to lower economic growth. In other words, they regard output volatility as a vital channel through which policy volatility affects economic growth. Using a similar dataset but a better technique to control for reverse causality, Fatás and Mihov (2013) discover a direct negative effect of volatility induced by fiscal policy changes on long-term growth rates. Institutional factors (such as the presence of political constraints on executives) are found to play an important role in shaping the relationship between policy-induced volatility and economic growth.

Based on a large sample of countries over the period of 1960–2000, Woo (2011) views fiscal policy volatility as a new mechanism for the negative link between income inequality and growth, that is, conflict over income distribution in highly unequal societies may lead to discretionary spending decisions by governments and volatile fiscal outcomes, which in turn reduces economic growth. Using cross-industry data, Aghion et al. (2014) find that a more counter-cyclical fiscal policy enhances value-added and productivity growth more in more financially constrained industries. Using the vector auto-regression (VAR) model and impulse response functions, Fernández-Villaverde et al. (2015) show that unexpected changes in fiscal volatility shocks have a sizable adverse effect on economic activity (such as output, consumption, investment, hours, and real wages) in the US, and that the main transmission mechanism is through a fall in investment triggered by higher uncertainty about future returns on capital.

Micro-economic evidence echoes the above findings. For instance, Chong and Gradstein (2009) examine the volatility-growth nexus using a large panel of firms in different countries and find that perceived policy volatility has an adverse impact on firms' sales growth, and that such effects can be amplified by various institutional obstacles. Kandilov and Leblebicioğlu (2011) discover a negative effect of exchange rate volatility on plant-level investment in the Colombian manufacturing sector, and find that both higher markup and export exposure can help mitigate such effects.

3. Background on China's fiscal system

The fiscal system in China has undergone dramatic changes since 1978, accompanied by significant volatility in fiscal policy over time and substantial variations across provinces. These dynamics provide the necessary foundation for investigating the relationship between fiscal policy volatility and the dispersion of MRPK. To better comprehend the factors driving discretionary government spending and fiscal volatility in China, it is essential to consider the background of China's fiscal reforms. Two key factors contribute to these phenomena: (i) the mismatch between local government expenditure and revenue resulting from the 1994 fiscal reform and (ii) low fiscal transparency.

3.1. Mismatch between local government expenditure and revenue

The original Chinese fiscal system was a highly centralised one, and the central government had absolute control over revenue collection and budget appropriation. The tax system rested on the local collection of revenues that were then remitted to the centre, where essentially all expenditures were determined. Earlier waves of fiscal reform in the 1980s (1980, 1985, and 1988) aimed at decentralising this unitary fiscal system by passing fiscal controls from central government to local governments in order to increase economic efficiency. For instance, in 1985 an income tax on SOEs was introduced to replace profit remittances and in 1988 a fiscal responsibility system was introduced which allows local governments to keep revenues once certain stipulated remittances have been made to the central government. Fiscal decentralisation is argued to be conducive to China's economic growth by boosting investment at the local level (Lin and Liu, 2000). However, one direct outcome is the dramatic decline of "two ratios". The ratio of fiscal revenue to GDP fell from 28.4% in 1978 to 12.6% in 1993, and the central government's share of total fiscal revenue dropped from 46.8% in 1978 to 31.6% in 1993, which implies the erosion of central government's allocative control.

Thus, a major fiscal reform started in 1994 to restrengthen the central government's role in the fiscal system through a tax-sharing system, where taxes were assigned to the central government, to local governments, or were shared. A national tax administration office was established to collect central and shared taxes, and a local tax administration was responsible for collecting local taxes. On the one hand, the 1994 reform has turned out to be effective in improving both ratios by providing fiscal incentives to all levels of governments; on the other hand, the fact that the reform recentralised revenues but left expenditure assignments unchanged has created a significant mismatch of expenditures and revenues between the levels of governments. This not only led to distortions that impair the role of central and local governments in providing public goods and services, but also generated discretionary government spending and unnecessary fiscal volatility.

Many local governments face a fiscal gap, and rely heavily on extrabudgetary revenue and/or accumulate a large amount of government debt to cope with their increasing fiscal problems.[5] Neither way is without problems. Despite the fact that extra-budgetary funds (including both extra-budgetary revenue and expenditure) provide considerable autonomy to local governments, without an effective system of monitoring and control they are prone to abuse (Wong and Bird, 2008). Rising local government debt has also become a key source of concern in terms of fiscal sustainability in China (Huang, 2014).[6] Overall, the fiscal reform of 1994 led to a significant mismatch between local government expenditure and revenue and consequently induced discretionary government spending and significant volatility in regional fiscal policy.

3.2. Low fiscal transparency

Fiscal transparency comprises clarity of role and responsibility by different levels of governments, open budget processes, public availability of information, and assurances of integrity (Rehm and Parry, 2007). The International Budget Partnership (IBP) published an "Open Budget Index" in 2008, which is a cross-country comparative measure of budget transparency which evaluates the quantity and type of information available to the public regarding a country's budget documents (Carlitz et al., 2009). China ranks 63rd among 85 developed and developing countries, with a score of 14 out of 100, indicating that the Chinese government provides scant or no information to the public. Deng et al. (2013) find that fiscal transparency at the province level is low in China and there is significant volatility in the amount of information disclosed by individual provinces from year to year. Low fiscal transparency is likely to facilitate the aggressive use of discretionary fiscal policy and lead to excessive volatility. Indeed, using a fiscal transparency index from the Chinese government's performance evaluation website published by the Ministry of Commerce of China in 2005, we find a negative relationship between the fiscal transparency index and fiscal policy volatility across Chinese provinces.[7]

Thus, more recent fiscal reforms focus on improving fiscal transparency. Since 2000, China has legalised and publicised government expenditures through several reforms such as a centralised payment system, a government procurement system, and separate management of revenue and expenditure. Since January 2011, the discretionary use of extra-budgetary funds has been eliminated by merging them into budgetary management and therefore enhancing fiscal transparency. These reforms may have contributed to declining fiscal policy volatility since 2000, which is used as a source of identification of its relationship with the MRPK dispersion in the time dimension.

4. Empirical methodology

4.1. Measure of fiscal policy volatility

While fiscal policy may represent the government's reaction to economic conditions, its *volatility*, which may be caused by discretionary government expenditure due to the mismatch between revenue and expenditure of local governments and low fiscal transparency, presents firms with considerable uncertainty about conditions affecting their future profitability. Our objective is to explore how such uncertainty can disrupt firms' decisions regarding capital allocation and investment.

For this purpose, it is crucial to distinguish fiscal volatility from adaptability to sudden changes in economic conditions such as counter-cyclical fiscal responses to macroeconomic shocks, as the latter can mitigate allocative inefficiency over business cycles. Following the recent literature (Fatás and Mihov, 2003; Woo, 2011; Fatás and Mihov, 2013), we define fiscal policy volatility as the standard deviation of the residuals from province-specific regressions of government expenditure growth on output growth.

Specifically, we estimate the following regression for 31 provinces over the period of 1994–2013[8]:

$$\Delta \log G_{p,t} = \alpha_p + \beta_p \Delta \log Y_{p,t} + \gamma_p \Delta \log G_{p,t-1} + \varepsilon_{p,t}, \tag{1}$$

where Δ denotes the rate of growth from $t-1$ to t. $Y_{p,t}$ is the real GDP in province p in year t and $G_{p,t}$ is real government expenditure in province p in year t.[9] Finally, $\varepsilon_{p,t}$ is the residual term, reflecting policy decisions exogenous to the state of the economy.

This regression model is based on the evolution model of fiscal policy analysed in Fatás and Mihov (2003), who specify three components in the evolution process: (i) automatic stabilisers; (ii) fiscal policy that reacts to the state of the economy; and (iii) discretionary policy that is implemented for reasons other than smoothing out output fluctuations or responding to macroeconomic conditions. Because our focus is on the volatility of the last component and its relationship to the dispersion of MRPK, we adopt the regression-based measure of fiscal volatility to capture the portion of discretionary fiscal policy that is not explained by the state of the business cycle and contributes to the uncertain future profitability faced by firms.[10] This is the key difference between our

[5] According to Fan (2013), local governments providing public services at the local level finance half or more of their expenditures from extrabudgetary revenue.

[6] As recently as August 2016, China launched a new wave of major fiscal reform targeting better balancing of central and local governments' fiscal obligations by moving some public service duties to central government in order to relieve local governments' fiscal burden.

[7] The relationship is illustrated by Online Appendix Figure OB.2.

[8] We choose 1994 as the starting year because the 1994 fiscal reform can be viewed as a major structural break in the Chinese fiscal system and the tax-sharing system has remained in place until now.

[9] In this baseline model, government expenditure includes both budgetary and extra-budgetary expenditure. We examine different implications of the two types of expenditure volatility in Section 7.1.

[10] As a result, this definition helps to identify the role of the volatility of discretionary policy from large countercyclical fiscal policy changes aiming to mitigate allocative inefficiency over business cycles.

approach compared to the conventional models such as GARCH or Markov Regime Switching which are designed to gauge overall fiscal volatility.[11]

To be precise, our measure of fiscal policy volatility is the standard deviation of the residual, $\sigma(\varepsilon_{p,t})$. Given the short time span of our final sample (1998–2007), we use the 5-year moving window method to construct our fiscal policy volatility for province p in year t.[12]

Remark. In the fiscal policy volatility measure used in the baseline result in Section 6.1, we estimate (1) using Ordinary Least Squares without any further control variables (other than the provincial fixed effect included). Nonetheless, in Section 6.3.2, we conduct a wide range of robustness checks of different versions of the fiscal policy evolution process. First, we extend (1) to include CPI, time trend, and a further lagged dependent variable ($\Delta \log G_{p,t-2}$) as control variables. Second, we adopt a two-stage IV approach to estimate (1), where lagged provincial GDP growth ($\Delta \log Y_{p,t-1}$) is used to instrument current GDP growth. Third, we include the log difference of aggregate national government expenditure ($\Delta \log G_{t-1}$) as a control variable in (1) given that a shock in national government spending may introduce a common factor affecting all provincial spending. Fourth, we opt for non-parametric regression methods (locally weighted average estimator and local constant estimator) to compute fiscal policy volatility from (1). Fifth, we use different time intervals (such as from $t-5$ to $t-1$) to compute the observed volatility of the residual at time t based on past observations, compared to the standard two-sided 5-year moving window (from $t-2$ to $t+2$) which includes future observations at time t. Finally, to alleviate potential small sample bias, we extend the sample period to the pre-COVID period, that is from 1994 to 2019, in estimating (1) to compute the fiscal policy volatility in year t for our sample. Overall, we find that our results are robust to different specifications of the fiscal policy evolution process and different ways of constructing the fiscal policy volatility measure.

In addition, there are two reasons why we choose to use government expenditure in (1) to measure fiscal policy volatility. First, government expenditure is argued to be more exogenous than other fiscal policy variables such as fiscal balances, which are more likely to suffer a simultaneity problem in the determination of output and budget and to be affected by changes in macroeconomic conditions (Fatás and Mihov, 2003). Second, we prefer government expenditure to tax revenue because in China a large part of local government revenue comes from various administrative fees and land sales and therefore tax revenue does not represent an overall picture of fiscal revenue.

4.2. Measure of MRPK dispersion

In our context, the dispersion of MRPK is defined within provinces in a year. There are multiple industries in each province and the composition of industries can be different across provinces. To simplify the notation, we suppress the superscript of industry. We start from a Cobb–Douglas production function of a profit-maximising firm in a given industry:

$$Q_{it} = A_{it} K_{it}^{\alpha_K} L_{it}^{\alpha_L} M_{it}^{\alpha_M}, \tag{2}$$

where Q_{it} is quantity output of firm i in year t, and K_{it}, L_{it}, and M_{it} are the capital input, labour input and intermediate materials, respectively. A_{it} represents the firm's technical efficiency of production.

Assume the demand curve for a firm's product has constant elasticity: $Q_{it} = B_{it} P_{it}^{-\eta}$, where B_{it} is a demand shifter. The revenue-based production function can be written as:

$$S_{it} = \Omega_{it} K_{it}^{\beta_K} L_{it}^{\beta_L} M_{it}^{\beta_M}, \tag{3}$$

where S_{it} is total revenue of firm i in year t, $\beta_X = \alpha_X[1-(1-\eta)]$ for $X \in (K, L, M)$, and $\Omega_{it} = A_{it}^{1-(1/\eta)} B_{it}^{1/\eta}$ is revenue-based total factor productivity as usually defined in the related literature.[13]

Thus, the marginal revenue product of capital is written as:

$$\frac{\partial S_{it}}{\partial K_{it}} = \beta_K \frac{\Omega_{it} K_{it}^{\beta_K} L_{it}^{\beta_L} M_{it}^{\beta_M}}{K_{it}}. \tag{4}$$

With a slight abuse of notation, we define the marginal revenue product of capital (in natural logarithm) as:

$$MRPK_{it} = \log(\beta_K) + \log(S_{it}) - \log(K_{it}) = \log(\beta_K) + s_{it} - k_{it}, \tag{5}$$

where s_{it} is the natural logarithm of a firm's revenue and k_{it} is the natural logarithm of a firm's capital input, which is computed using the perpetual inventory method following Brandt et al. (2012).

Our focus is on MRPK dispersion at the *province-year* level and its relationship with fiscal policy volatility. Potentially, there are a few factors in addition to fiscal policy volatility that could drive MRPK dispersion. First, when there is capital misallocation (or friction) across *industries*, β_K (that is, the output elasticity of capital) appears as part of MRPK in (5) and varies across industries due

[11] While the models employed by Fernández-Villaverde et al. (2015) offer the advantage of capturing time-varying volatility, they are also tailored to assess the general volatility of government spending and tax rates rather than to isolate the aggressiveness of discretionary policy.

[12] That is the standard deviation over $\varepsilon_{p,t-2}, \varepsilon_{p,t-1}, \varepsilon_{p,t}, \varepsilon_{p,t+1}, \varepsilon_{p,t+2}$. Our full sample for (1) is 1994–2013, which is long enough for us to compute the corresponding figure for the final sample 1998–2007 used in the analysis. In Section 6.3.2, we show that our result is robust to different ways of computing volatility.

[13] Note that the production and demand functions are industry-specific. Nonetheless, we suppress the industry superscript because our focus is the dispersion of marginal revenue product of capital, which is adjusted by industry and time.

to differences in production technologies. Because the composition of industries differs across provinces, the dispersion of MRPK naturally varies accordingly. Second, a set of variables that influence MRPK, such as user costs of capital, technologies involved in installing capital, and industry policies, may also be industry-specific and vary over time.

In order to address the above issues, we adjust MRPK by industry and year.[14] That is, we isolate these industry- and time-specific components from the observed MRPK before computing its dispersion within a province in a year. Specifically, we regress the computed MRPK on the interaction between industry fixed effects (at 4-digit level, indexed by j) and year fixed effect (indexed by t):

$$MRPK_{it} = \sum_{t,j} \gamma_t^j * D_t^j + e_{it}, \tag{6}$$

where D_t^j is the industry-time specific dummy. The residual term, e_{it}, is our industry- and year-adjusted MRPK. We refer to it as the adjusted MRPK and denote it as $MRPK^A$. Then, our measure of within-province dispersion of marginal revenue product of capital is computed as the standard deviation of $MRPK^A$ of firms in province p in year t. We denote it as $\sigma(MRPK_{p,t}^A)$.

Overall, this adjustment allows us to isolate all industry-and time-specific factors (such as user costs of capital, production technology, and market competition) and potential measurement errors at the industry and year level when measuring the within-province dispersion of MRPK.[15]

4.3. Fiscal policy volatility and capital misallocation

In a static model without friction, a profit-maximising firm will equalise its marginal revenue product of input to its unit input cost. In the case of capital, MRPK should be equal to the user cost of capital, and uncertainty about future profitability does not affect the dispersion of MRPK. Nonetheless, as emphasised by Asker et al. (2014), in the presence of adjustment costs of capital, uncertainty about future profitability plays a role in shaping the dispersion of MRPK. This is because the capital stock determined in the previous period may no longer be optimal after a profitability shock. This consequently implies that MRPK dispersion rises with the degree of uncertainty.

The mechanism that shapes the relationship in our paper comes from this insight, but we explore further in the context where firms' future profitability is influenced by government policy distortion (that is, fiscal policy volatility).[16] The increase of MRPK dispersion due to higher fiscal policy volatility represents the size of capital allocative inefficiency that could be reduced by eliminating *volatility* but maintaining the *level* of fiscal expenditure. In this sense, the impact of fiscal policy volatility on MRPK dispersion represents capital misallocation.

Putting this in the context of Chinese manufacturing industries where firms face considerable adjustment costs of capital (Wu, 2015; Tang, 2022), fiscal policy significantly affects firm profitability, but is volatile. That volatility presents firms with uncertainty regarding their future profitability and thus affects the dispersion of MRPK. Our goal is to understand how much of the MRPK dispersion (capital misallocation) can be attributed to fiscal policy volatility and thus could be alleviated by government policies.

For this purpose, the variation of fiscal policy volatility due to fiscal transparency and fiscal disparities across provinces and over time as discussed above (in Sections 1 and 3) helps to identify the relationship between these factors. Specifically, using a fixed effect model we examine the relationship between fiscal policy volatility and capital misallocation by estimating the baseline equation:[17]

$$\log(\sigma(MRPK_{p,t}^A)) = \alpha + \beta \log(FisVol_{p,t}) + \gamma Z_{p,t} + \varsigma_p + \eta_t + \xi_{p,t}, \tag{7}$$

where $\sigma(MRPK_{p,t}^A)$ is dispersion of industry- and year-adjusted MRPK in province p and in year t, and $FisVol_{p,t}$ is fiscal policy volatility of province p in year t (that is, $\sigma(\varepsilon_{p,t})$ as defined in Section 4.1).

The error term in (7) comprises three components: (i) ς_p is the province-specific fixed effect, capturing geographic factors that influence capital misallocation; (ii) η_t is the year-specific fixed effect, accounting for possible business cycles and other macroeconomic shocks such as influences from monetary policies; and (iii) $\xi_{p,t}$ is an idiosyncratic error term.[18]

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[14] Of course, firm-level characteristics such as ownership type may also affect firm MRPK. In an unreported specification, we considered a version of (6) where extra firm characteristics (for instance, private or state ownership) are controlled for in computing adjusted MRPK. Our baseline results in Section 6.1 are quantitatively and qualitatively similar.

[15] In the rest of the paper, we always use the adjusted marginal revenue product of capital. We refer to it as MRPK when applicable in order to simplify notations. When the raw MRPK is used to compute the dispersion of MRPK, the output elasticity of capital, β_K, has to be estimated. This involves estimating the production functions by industry. In Section 6.3.2, we show that our baseline result is robust to the use of raw MRPK and different production function estimation approaches such as those of Olley and Pakes (1996), Levinsohn and Petrin (2003), Wooldridge (2009), and Ackerberg et al. (2015).

[16] In Online Appendix OD, we provide a stylised model similar to that in Asker et al. (2014) to describe the mechanism in detail.

[17] In Online Appendix OD, we examine the impact of fiscal policy volatility on the dispersion of the marginal products of other inputs (labour and intermediate materials). We find the results are similar to those for capital. If there exist adjustment costs for labour and intermediate materials, the mechanism that shapes the relationship is similar to that of capital. Even without these adjustment costs, we show in Online Appendix OD that fiscal policy volatility may still have an impact on the dispersion of the marginal products of labour and intermediate materials via the distorted choice of capital, if the quality of labour and intermediate materials are complementary to capital in promoting the quality of output (e.g., Kugler and Verhoogen, 2012; Grieco et al., 2022).

[18] In contrast to Fatás and Mihov (2003, 2013) who use cross-sectional regressions to focus on the long-run growth effect, we adopt the entire panel of annual data to examine the determinants of capital misallocation in order to capture time-varying effects and fully use the variation in the sample.

To take into account other factors that can potentially influence MRPK dispersion, we include several control variables as $Z_{p,t}$ in (7).[19] These variables consist of factors capturing policy distortions, capital market imperfections/frictions, and trade openness, as discussed in Section 2.1.[20] Although all of these variables may affect the dispersion of MRPK, their associations are not necessarily causal. Instead, our purpose is to control for these factors in the analysis in order to tease out the impact of fiscal policy volatility. We explain these variables as follows.

First, we use government size ($GovSize_{p,t}$) as a proxy for the extent of government intervention in the process of resource allocation. This variable is defined as the natural logarithm of total government expenditure as a share of GDP in province p in year t. There is no consensus on the impact of government size on resource allocation and economic growth. On the one hand, an oversized government can have negative spillover effects on the economy due to government inefficiencies, crowding-out effects, an excess burden of taxation, distortion of the incentives systems faced by firms and households as well as interventions in free markets (Barro, 1991). Self-interested politicians are also likely to utilise political power to exercise control over firms for their own political and social objectives (Shleifer and Vishny, 2002). On the other hand, a very small government size or government expenditure may indicate insufficient provision of public goods such as legal, administrative and economic infrastructure, which can hinder the efficient allocation of resources (Asimakopoulos and Karavias, 2016).

Second, government subsidy ($Subsidy_{p,t}$) is included as an additional measure of policy distortion. This variable is defined as the natural logarithm of total subsidised income divided by total sales income of all manufacturing firms in province p in year t. Subsidies (especially to inefficient firms) can generate significant distortions in factor prices and adversely affect resource allocation (Restuccia and Rogerson, 2008). In China, many SOEs receive substantial government subsidies and possess great advantages over private firms in terms of obtaining bank loans at subsidised rates, preferential tax treatment, market entry, and many other resources, which can be viewed as distortions introduced by governments to compensate inefficient SOEs for their cost disadvantages.

Third, we include a financial dependence variable ($FD_{p,t}$) as a proxy for capital market imperfections due to financial frictions in China. This variable is defined as the natural logarithm of total bank loans as a share of GDP in province p in year t. Financial markets are generally found to improve the allocation of capital by mitigating information asymmetry, exerting corporate governance, and thus channelling funds to the most productive uses (Wurgler, 2000; Levine, 2005). However, China's financial system is argued to be inefficient and "repressed", as the government has intervened, and continues to intervene in bank lending to favour the state sector in order to keep unprofitable SOEs afloat during the reform process (Riedel et al., 2007). By contrast, private firms, the driving force of the economy, are generally discriminated against by the formal financial system and have to rely on internal funds or other forms of informal finance for investment (Allen et al., 2005; Ding et al., 2013; Cull et al., 2015).

Fourth, inflation ($Inflation_{p,t}$) is included as a measure of the informational friction faced by producers and consumers, defined as the growth rate of the natural logarithm of the Consumer Price Index (CPI) in province p in year t. The traditional view is that low or stabilising inflation improves the informational content of the price system and favours a more efficient allocation of resources (Friedman, 1977), whereas high inflation and the inflation-induced variation in relative prices shorten agents' horizons, disrupt the organisation of markets and generate resource misallocation (Tommasi, 1999). Tobin (1972) however, proposes that inflation greases the wheels of the labour market by allowing real wages to fall, even when nominal wages are sticky downwards. Akerlof et al. (1996) support this view and claim that creeping inflation is associated with the dynamics of resource allocation and a moderate steady rate of inflation permits maximum employment and output.

Finally, we use the share of exports in provincial GDP in year t ($Export_{p,t}$) as a proxy for trade openness to examine whether the Melitz-type mechanism works in China. The benefits of exposure to foreign competition/markets enjoyed by the more productive domestic firms may drive the least efficient domestic producers out of business, thereby potentially reducing the dispersion of MRPK.

5. Data

5.1. Sample and data sources

For this research we use an integrated, rich sample drawn from several data sources. First, the computation of MRPK dispersion and some related variables (such as government subsidy and ownership) is based on a comprehensive firm-level data set drawn from the annual accounting reports filed with the National Bureau of Statistics (NBS) of China by industrial firms over the period of 1998–2007. This data set includes all SOEs and other types of enterprises with annual sales of five million yuan (about $600,000) or more. These firms operate in the manufacturing sectors and are located in all 31 Chinese provinces or province-equivalent municipal cities. Following the literature, standard cleaning rules are applied.[21]

Second, the data used to compute our fiscal policy volatility measure and other provincial-level control variables come from various issues of the China Statistics Yearbook and the "China Compendium of Statistics 1949–2009" compiled by the National Bureau of Statistics. The final sample consists of a panel of 31 provinces with annual data for the period 1998–2007. However,

[19] All these variables are in natural logarithm, unless otherwise stated. See Online Appendix OA for detailed definitions.

[20] These variables are in (logarithm) levels rather than volatility, with the purpose of capturing the frictions/imperfections examined in the literature (as discussed in Section 2.1). In Section 6.3.1, we show that our baseline result is robust even after other sorts of volatility are taken into account. Furthermore, in Section 7.2, we also consider the role of capital adjustment costs to show that it is not capital adjustment costs alone that drive the impact on MRPK dispersion.

[21] We drop observations with negative total assets minus total fixed assets, negative total assets minus liquid assets, and negative sales, as well as negative accumulated depreciation minus current depreciation. Firms with less than eight employees are also excluded as they fall under a different legal regime (Brandt et al., 2012). Finally, to isolate our results from potential outliers, we exclude observations in the one percent tails of each of the regression variables.

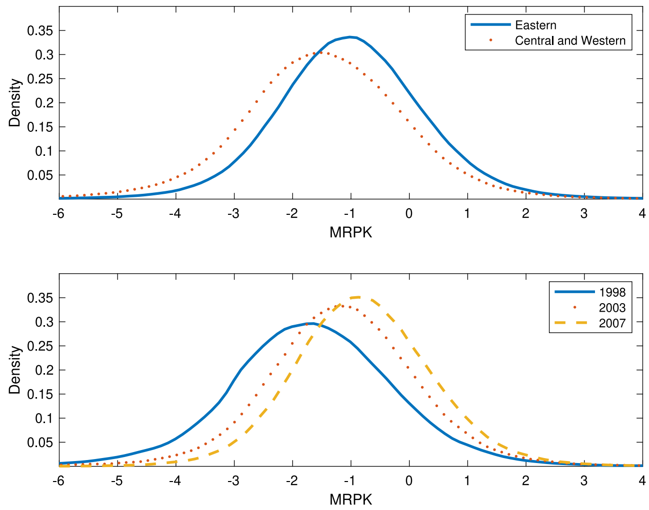

Fig. 1. MRPK distributions: by region and by year. [1] Top figure: The distributions are based on the raw MRPK of firms in different regions. The Eastern region includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Shandong, Guangdong, Fujian, and Hainan (11 provinces); the Central region includes Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, and Guangxi (10 provinces); and the Western region includes Sichuan, Chongqing, Guizhou, Tibet, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang (10 provinces). [2] Bottom figure: The distributions are based on the raw MRPK of firms in three different years.

due to the use of the moving window method for the construction of fiscal policy volatility, the full sample for this calculation is 1996–2009. All nominal variables are deflated using a provincial GDP deflator to convert to real values (at 1978 constant price).[22]

Finally, we draw information from a range of supplementary data sources for variables that are used for robustness checks. Specifically, historical and political datasets are used to construct instrumental variables (such as the wheat-rice ratio) and omitted variables (such as political volatility) to tackle the problem of endogeneity in Section 6.3. Industry-level data (such as industry-specific financial dependence and the capital resalability index) are obtained from the US Bureau of the Census and are merged into the Chinese data. Firm-level information from the World Bank Investment Climate dataset is used to calculate industry-specific reliance on government demand. The summary statistics of all variables and detailed variable definitions are provided in Online Appendix OA.

5.2. Stylised facts

This subsection presents stylised facts regarding MRPK dispersion and fiscal policy volatility that motivate our research.

First, there is a significant dispersion of MRPK across firms within provinces, but the degree of the dispersion systematically varies by region. The mean of province-year level MRPK dispersion is 1.39.[23] This is significant and is close to the high end of the levels reported by Asker et al. (2014), who show that country-level MRPK dispersion ranges from 0.98 in the United States to 1.56 in Slovenia. Nonetheless, there exist regional disparities in the dispersion. As shown at the top of Fig. 1, firms in the Eastern (coastal) region have a lower degree of MRPK dispersion than firms in the Central and Western (inland) regions. This implies that capital allocation efficiency is higher in coastal provinces than in inner provinces. This is consistent with the literature which shows that firms in Central and Western regions face higher capital adjustment costs, more obstacles to factor mobility, and more financial frictions due to the lack of financial development (Wu, 2015; Tang, 2022).

Second, there is a decreasing trend of dispersion degree in MRPK distribution over time. Specifically, the bottom of Fig. 1 illustrates the time evolution of MRPK distributions over the sample period.[24] In particular, there is a truncation from the lower end of MRPK distribution as indicated by the thinner left tail of the MRPK distribution in 2007 than in 1998 and 2003. Despite the significant amount of welfare loss due to resource misallocation discovered in the literature (Hsieh and Klenow, 2009; Brandt et al., 2013; Wu, 2015), we observe a gradual improvement of capital allocation efficiency within China over the period of 1998–2007, as indicated by a decrease in MRPK dispersion.

Third, the significance of fiscal policy volatility is notable. Within the sample, the average volatility measures 0.062, indicating that a one-standard-deviation change in discretionary fiscal policy leads to a 6.2 percent shift in fiscal expenditure, according to

[22] As a robustness check provincial CPI is used as an alternative price deflator because there is concern that China's implicit GDP deflator based on the Material Product System approach has understated inflation and thus exaggerates the real GDP figure in China.

[23] Because the statistics of this variable reported in Online Appendix Table OA.2 is in natural logarithm, the (geometric) mean is computed as $\exp(0.326) = 1.39$.

[24] To demonstrate the evolution of MRPK dispersion over time, we use the raw MRPK rather than the industry- and year-adjusted MRPK.

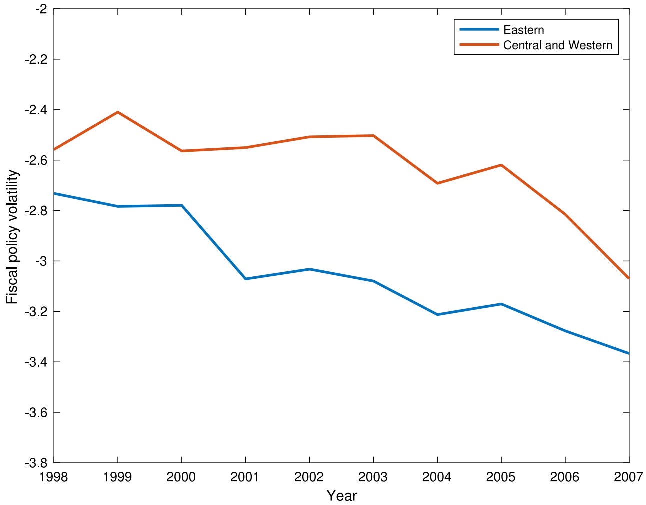

Fig. 2. Fiscal policy volatility evolution, by region. Note: Fiscal policy volatility is in natural logarithm; region classification is the same as in Fig. 1.

(1).[25] This magnitude aligns with findings reported by Fatás and Mihov (2003).[26] When compared with the volatility in total factor productivity growth, calculated in accordance with the approach outlined by Asker et al. (2014), the level of uncertainty stemming from fiscal policy amounts to approximately 14.5 percent of the overall uncertainty associated with total factor productivity.[27]

Fourth, there is a dramatic, decreasing trend of fiscal policy volatility over time. The magnitude reduces from 0.073 in 1998 to 0.042 in 2007 on average across all provinces. This reflects the positive outcome of the various fiscal reforms discussed in Section 3. Nonetheless, regional disparities are sizable and persistent. We compute the fiscal policy volatility of different regions (that is, Eastern and Central/Western) as the mean value of fiscal policy volatility of all provinces in each region in each year and present its evolution throughout 1998–2007 in Fig. 2.[28] The Eastern (coastal) region has lower volatility than the Central/Western (inland) region, although both of them declined significantly over time.

Finally, we observe a positive relationship between MRPK dispersion and fiscal policy volatility. Fig. 3 shows that the two variables are strongly and positively related (fitted slope: 0.061, significant at 1 percent level) using province-year level measures. Furthermore, this relationship holds, both in the time dimension and spatial dimension. Over the sample period, MRPK dispersion reduced by 14.4 percent, and the volatility of fiscal policy decreased by 55.5 percent.[29] At the same time, provinces with lower fiscal policy volatility turn out to have lower dispersion of MRPK. In the formal analysis in Section 6, we control for a range of covariates and account for endogeneity to examine how fiscal policy volatility influences the capital allocation efficiency of firms. Importantly, our formal analysis includes time dummies and province dummies to control for the fixed effects so that the documented impact is not confounded by unobservable year-level or province-level forces that drive both MRPK dispersion and fiscal policy volatility.

6. Empirical findings

6.1. Baseline results

In Table 1 we present the baseline results for different specifications of (7). We find that fiscal policy volatility has a significant effect on MRPK dispersion in all specifications. This indicates that shocks generated from distortionary government policies (that is, fiscal policy volatility) are one of the key drivers of resource misallocation across manufacturing firms within Chinese provinces. The marginal effect ranges from 0.022 to 0.024 over the 7 columns, implying that a 10 percent fall in fiscal policy volatility is associated with a drop of about 0.2 percent in MRPK dispersion.

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25 The level of mean volatility is calculated as $0.062 = e^{-2.78}$. We take exponentiation because the volatility in the figures and tables is presented in the natural logarithm.

26 For example, the fiscal policy volatility of Portugal and Spain are 3.9 percent and 2.6 percent, respectively, as reported by Fatás and Mihov (2003), who use data from 1960 to 2000 and estimate an equation similar to (1) to compute fiscal policy volatility.

27 The calculation is based on the summary statistics reported in Online Appendix Table OA.2: exp(−2.78)/exp(−0.85) = 14.5%.

28 It is important to highlight that the downward trend depicted in Fig. 2 is unlikely to be due to structural breaks in (1). Specifically, we conduct Chow tests to examine structural changes that could occur in each province and each year in (1). Over 90% of the test results (across all provinces and sample years) do not indicate structural breaks. As a supplementary check, we employ the Andrews–Ploberger and Andrews–Quandt structural break tests (i.e., Andrews, 1993; Andrews and Ploberger, 1994) to examine potential structural break over a longer period,1994–2019, in estimating (1) for each province. During our regression analysis sample period only one out of the 31 provinces indicated a structural break, which occurred in 1998.

29 Both of the changes are averaged over provinces.

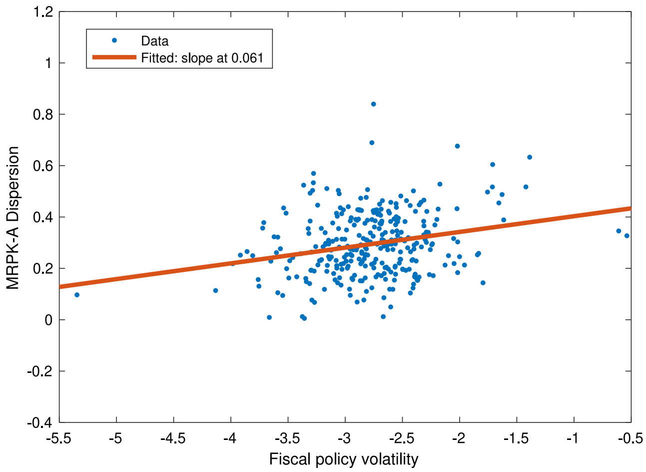

Fig. 3. Relationship between MRPK dispersion and fiscal policy volatility. Note: Both fiscal policy volatility and MRPK dispersion are in natural logarithm.

Table 1
The effect of fiscal policy volatility on the MRPK dispersion.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FisVol	0.024***	0.023***	0.024***	0.024***	0.024***	0.024***	0.022**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.009)
GovSize		−0.061					−0.070
		(0.060)					(0.065)
Subsidy			0.002				0.003
			(0.014)				(0.016)
FD				0.001			−0.005
				(0.032)			(0.033)
Inflation					−0.004*		−0.004*
					(0.002)		(0.002)
Export						−0.005	−0.010
						(0.018)	(0.020)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.448	0.451	0.449	0.448	0.451	0.449	0.445
Observation	310	310	310	310	310	310	310

Note: The dependent variable is $\log(\sigma(MRPK^A))$ at the province and year level; all independent regressors are in natural logarithm unless otherwise stated — see Online Appendix OA for detailed definitions of all variables; *** p < 0.01, ** p < 0.05, * p < 0.1.

Factors other than fiscal policy volatility also seem to influence MRPK dispersion, but most of them are statistically insignificant. One possible reason is that year fixed effects have absorbed the influence of these control variables. The only exception is inflation, which is found to have a negative and significant impact on MRPK dispersion in column (5), indicating that an increase in inflation from a low level could improve resource allocation in China as suggested by Tobin (1972) and Akerlof et al. (1996).[30] In addition, since inflation and real interest rates are always found to move in opposite directions (Mishkin, 1993), creeping inflation from a low level may reduce firms' borrowing costs and facilitate better allocation of capital across firms.

In the full-fledged specification, columns (7) of Table 1, we include all control variables in the regression and find that, of all the factors considered, fiscal policy volatility remains the most significant driving force of MRPK dispersion. After accounting for various factors that could influence MRPK dispersion, the elasticity between MRPK dispersion and fiscal policy volatility is 0.022. Considering that fiscal policy volatility in Chinese provinces decreased by half over the ten-year sample period, this result suggests that, on average, the implied reduction of MRPK dispersion due to fiscal policy volatility accounts for 8.3 percent of the observed improvement in capital allocation over the period 1998–2007.[31]

It is worth noting that the result is not driven by different provincial compositions of industries. Appendix Table A.2 presents the result of industry-specific analysis, where MRPK dispersion is computed for firms in each of 29 industries in each province. In

[30] The average inflation rate was only 1.2 percent per year over the sample period.

[31] The calculation is as follows. The change in fiscal policy volatility (in logarithm) from 1998 to 2007 is −0.556 (i.e., about half in level, exp(−0.556) = 0.574). Its implied effect on MRPK dispersion, according to the coefficient estimate of the last column of Table 1 is $0.022 \times (-0.556) \times 100\% = -1.2$ percentage points. Because the overall reduction of MRPK dispersion (i.e., $\sigma(MRPK^A)$) during the period is 14.4 percentage points, the implied reduction of MRPK dispersion due to fiscal policy volatility accounts for $(-1.2)/(-14.4) = 8.3$ percent of the overall MRPK dispersion change.

all 29 2-digit manufacturing industries, the impact of fiscal policy volatility is significant for 17 industries but insignificant for the other 12. The impact is positive in most industries (27 out of 29), ranging from 0.004 to 0.131.

Overall, our result suggests that measures to reduce fiscal policy volatility, for instance, by implementing expenditure-side reform to mitigate the mismatch between local government revenue and expenditure, enhancing fiscal transparency, and alleviating regional fiscal disparities, are important for improving firms' capital allocative efficiency.

6.2. Addressing the reverse causality problem

Despite the largely exogenous nature of the fiscal volatility measure induced by macroeconomic policy, it is possible that provinces with higher levels of MRPK dispersion are more likely to use discretionary fiscal policy to support the least efficient firms. To tackle this potential endogeneity bias induced by reverse causality, we adopt the two-stage least squares (2SLS) approach and the System GMM estimation method.

Three sets of instrumental variables are used in the 2SLS approach. Several diagnostic tests are conducted to verify the quality of the three sets of instruments. Specifically, as the first check, we adopt the traditional approach of using the lagged value of fiscal policy volatility ($L.FisVol_{p,t}$) as an instrumental variable. We lag this variable by three years to avoid potential reverse causality.[32]

Second, we introduce a novel instrumental variable derived from the historical and cultural distinctions between China's wheat and rice regions. This instrumental variable is defined as the natural logarithm of the ratio between wheat output and rice output in province p in year t ($WheatRice_{p,t}$). China's wheat-growing north and rice-growing south have been geographically separated by the Yangtze River for thousands of years. According to Talhelm et al. (2014), a history of rice farming fosters a more interdependent culture, as the cultivation of rice necessitates significant water resources, requiring intensive cooperation during planting and harvesting. Rice farmers must collaborate to develop and maintain the necessary infrastructure, fostering an interdependent culture in the southern region. In contrast, wheat farming fosters a more independent culture, as wheat can be grown on dry land without requiring irrigation or extensive cooperation. Consequently, individualism is more prevalent in northern Chinese culture, as wheat farmers rely on themselves and their crop is irrigated by the rain. These cultural legacies, shaped by generations of farming practices, result in distinct psychological cultures in northern and southern China, which continue to influence the behaviour of individuals in modern society. For example, the economic incentives to cooperate embedded in rice culture may motivate interdependent individuals to monitor government behaviour, thereby restraining potential discretionary use of fiscal policy and reducing associated volatility in the rice region. Conversely, monitoring and control mechanisms are less prevalent in the wheat region, where individualism dominates, leading to higher fiscal volatility. Indeed, we find a robust positive correlation between the wheat-rice ratio and fiscal policy volatility across the 31 provinces.[33] Importantly, the historical division between wheat and rice regions is unlikely to be influenced by the current dispersion of MRPK, making the wheat-rice ratio a suitable instrumental variable for our analysis.

Third, we use the income inequality of each province as another instrumental variable ($Gini_{pt}$). This variable is defined as the overall Gini coefficient of province p in the year t. Following Thomas et al. (2001) and Sundrum (2003), we compute the overall Gini index as a weighted average of the Gini indices of population subgroups (i.e. rural people and urban people) and a covariance term between rural and urban people in each province.[34] According to Woo (2011), problems with income distribution in highly unequal societies can lead to discretionary spending decisions and more volatile fiscal outcomes. Thus, provinces with high income inequality may suffer greater fiscal policy volatility, whereas the income inequality is unlikely to be affected by the MRPK dispersion.[35] As expected, we find a significant and positive relationship between income inequality and fiscal policy volatility.[36]

In addition to the IV approach, we adopt the System GMM estimator (Blundell and Bond, 1998) to estimate (7). In addition to the external instruments described above, the level of fiscal policy volatility lagged three times is used as an IV in the first-differenced equations and the first-differenced fiscal policy volatility lagged twice is used as an additional IV in the level equations. The Hansen J test of over-identifying restrictions is adopted to evaluate the overall validity of the set of instruments. In assessing whether our models are correctly specified and consistent, we also check for the presence of second-order autocorrelation in the differenced residuals in all estimations.

Table 2 reports the results. The first-stage IV results show that all three sets of instruments have a significantly positive effect on fiscal policy volatility. The second-stage results confirm the exogenous role of fiscal policy volatility in raising MRPK dispersion within provinces. To verify the quality of the instruments, we first use the under-identification test based on Kleibergen–Paap rk LM statistics to check whether the excluded instruments are correlated with the endogenous regressors. As shown in Table 2, the null hypothesis that the model is under-identified is rejected at the 1 percent significance level in columns (1) and (3) and at the 10

[32] In summary statistics, the sample of this instrument ($L.FisVol$) is 279 (31 provinces*9 years) because our sample is from 1994, so given the 5-year moving window method the earliest volatility measure we can get is for 1996. Then the 1996 value is used to instrument the value of 1999 and so on. Thus we have the missing year of 1998 where no instrument is available.

[33] We present the cross-sectional relationship between the wheat-rice ratio and fiscal policy volatility (in 2003) in Online Appendix Figure OB.3.

[34] The income and population data are from the Provincial Statistical Yearbook published by National Bureau of Statistics of China. Due to the missing data of four provinces (Tibet, Shandong, Tianjin, Hunan, Yunnan, Hainan, and Jilin), we compute the Gini coefficient for 24 provinces.

[35] Higher inequality may also imply that starting entrepreneurs face more significant financial constraints, which results in a higher degree of capital misallocation (e.g., Midrigan and Xu, 2014). Nonetheless, our sample data only include established firms with annual sales of five million yuan (about $600,000) and State-Owned Enterprises, and we use the Gini index in the analysis. Thus, our result is unlikely to be driven by capital misallocation directly resulting from higher inequality.

[36] We show the relationship between income inequality and fiscal policy volatility in Online Appendix Figure OB.4.

Table 2
Addressing the reverse causality problem.

	Two-stage least square regression			System GMM estimator	
	(1)	(2)	(3)	(4)	(5)
FisVol	0.070***	0.240*	0.040***	0.120***	0.089***
	(0.019)	(0.125)	(0.016)	(0.022)	(0.025)
Control variables	Yes	Yes	Yes	No	Yes
Under-identification test	27.193***	3.285*	18.151***	–	–
Weak-identification test	15.48***	13.22***	5.59**	–	–
AR(2) test	–	–	–	0.338	0.076
Hansen J test	–	–	–	30.72	28.61
Observations	279	310	240	310	310
First stage					
L.FisVol	0.584***				
	(0.093)				
WheatRice		0.099*			
		(0.051)			
Gini			4.123***		
			(0.742)		

Note: The dependent variable is $\log(\sigma(MRPK^A))$ at the province and year level; the control variables include: government size, subsidy, financial dependence, inflation, and export; all independent regressors are in natural logarithm unless otherwise stated — see Online Appendix OA for all variable definitions; the under-identification test is based on the Kleibergen–Paap rk LM statistic, with a null hypothesis that the model is under-identified; the weak-identification test is based on the Anderson–Rubin Wald F statistic, with a null hypothesis that the first stage regression is weakly identified; the AR(2) test is to check for the presence of second-order autocorrelation in the differenced residuals; the Hansen J test of over-identifying restrictions is to evaluate the overall validity of the set of instruments. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

percent significance level in columns (2). Second, the weak-identification test based on Anderson–Rubin Wald F statistics provides strong evidence for rejecting the null hypothesis that first-stage regression is weakly identified at the 1 percent significance level in columns (1) and (3) and at the 10 percent significance level in column (2). In addition, the System GMM results in columns (4) and (5) also confirm that the positive impact of fiscal policy volatility on MRPK dispersion is not driven by reverse causality.[37]

6.3. Further robustness checks

In the baseline model, we have already controlled for a set of factors (related to policy distortions, frictions or market imperfections, and trade openness) that affect MRPK dispersion in addition to fiscal policy volatility. In this subsection, we further conduct a number of robustness checks to secure our results from potential identification bias originating from omitted variable and mismeasurement problems.

6.3.1. Omitted variable problems

Essentially, fiscal policy volatility represents a sort of uncertainty about conditions affecting firms' future profitability. A natural concern could be that the volatility of fiscal policy may be confounded with other sorts of uncertainty that also affect firms' future profitability. To address this concern, in the regression model we consider a set of different uncertainty measures such as output volatility, volatility of total factor productivity growth, and institutional and political volatility. The results are presented in Table 3. Overall, the results suggest that the documented relationship is not driven by other sorts of uncertainty or omitted variables.

First, according to Fatás and Mihov (2013), any misspecification of first-stage regression computing fiscal policy volatility in (1) may make a component of output fluctuations enter the residuals. Thus, there is concern that the positive relationship between fiscal policy volatility and MRPK dispersion might be driven by the effect of output volatility on MRPK dispersion. In column (1) of Table 3, we include output volatility ($GDPGVol_{p,t}$) as a control variable, which is defined as the standard deviation of real provincial GDP growth, after detrending using first-difference filtering (in natural logarithm).[38] The positive effect of fiscal policy volatility on capital misallocation remains intact when output volatility is included, suggesting that fiscal policy volatility is not simply a proxy for output volatility.

Second, Asker et al. (2014) find that in the presence of capital adjustment costs, higher productivity volatility (that is, revenue-based total factor productivity shock) leads to higher cross-sectional MRPK dispersion. We therefore include the volatility of total factor productivity growth ($TFPGVol_{p,t}$) as a control variable in column (2) of Table 3, which is defined as the natural logarithm of volatility of TFP growth of all manufacturing firms in province p in year t.[39] This variable represents the overall volatility of firm profitability in addition to fiscal policy volatility. We find that the volatility of TFP growth does indeed have a significant

[37] There is no evidence of second-order serial correlation in the first-differenced residuals, and the Hansen test does not reject the validity of the instruments.

[38] More specifically, $GDPGVol_{p,t}$ is computed as follows. First, we calculate the annual provincial growth rate of GDP in province p and year t, $\Delta \log GDP_{p,t}$. Then, we apply a filtering method similar to (1) to the annual provincial growth rate of GDP. The standard deviation of the difference of the filtered growth rate and the actual growth rate, in a 5-year rolling window, is defined as $GDPGVol_{p,t}$.

[39] We first compute the TFP of each firm by estimating industrial production functions using the Olley and Pakes (1996) approach, then TFP growth is the log difference of TFP of firm i in province p in the year t, i.e. $TFPG_{i,p,t}$. The volatility of TFP growth is the standard deviation of $TFPG_{i,p,t}$.

Table 3
Robustness check: the omitted variable problem.

	(1)	(2)	(3)	(4)	(5)	(6)
FisVol	0.022**	0.016*	0.022**	0.022**	0.023**	0.023**
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)
GDPGVol	0.004					
	(0.008)					
TFPGVol		0.027*				
		(0.014)				
SOE			−0.014			
			(0.017)			
FOR			−0.035***			
			(0.006)			
PolVol1				0.001		0.001
				(0.002)		(0.002)
PolVol2					0.002	0.002
					(0.002)	(0.002)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.456	0.448	0.490	0.456	0.459	0.459
Observations	310	279	310	310	310	310

Note: The dependent variable is $\log(\sigma(MRPK^A))$ at the province and year level; the control variables include: government size, subsidy, financial dependence, inflation, and export; all independent regressors are in natural logarithm unless otherwise stated — see Online Appendix OA for all variable definitions. *** p < 0.01, ** p < 0.05, * p < 0.1.

and positive impact on MRPK dispersion, and more importantly, the effect of fiscal policy volatility on MRPK dispersion remains robust. Notably, by comparing the estimated coefficients in this column, the elasticity of MRPK dispersion in relation to fiscal policy volatility is approximately 59% (= 0.016/0.027) of that observed in relation to total factor productivity volatility, which is computed using the approach outlined by Asker et al. (2014). This suggests that the impact of uncertainty from fiscal policy is comparable to the impact of overall uncertainty from total factor productivity.

Third, policy distortions originating from institutions can lead to resource misallocation. Using the same dataset as ours, Hsieh and Klenow (2009) claim that SOEs account for 39% of China's TFPR dispersion. We thus include two ownership variables, $SOE_{p,t}$ and $FOR_{p,t}$, defined as the natural logarithm of SOE and foreign-owned shares of total value added in manufacturing industries in province p in the year t, respectively. The result is presented in column (3) of Table 3. Foreign ownership has a significantly negative effect on MRPK dispersion, whereas the impact of state ownership is insignificant. Presumably, this is because private firms face fewer policy distortions and are less reliant on government expenditure. Importantly, the impact of fiscal policy volatility is not affected by the inclusion of such ownership variables.

Finally, it is argued that political uncertainty affects capital allocation and economic performance in China. Li and Zhou (2005) find that the probability of promotion (or termination) of provincial leaders increases (or decreases) with their economic performance. An et al. (2016) claim that political turnover leads to lower corporate investment and higher volatility of corporate investment. Based on information about the tenure of provincial leaders, we construct two political uncertainty measures. $PolVol1_{p,t}$ is the length of service of the governor of province p in year t and $PolVol2_{p,t}$ is the length of service of the party secretary of province p in year t. In columns (4)–(6) of Table 3, political uncertainty does not have a significant impact on MRPK dispersion, whereas our result concerning the relationship between fiscal policy volatility and MRPK dispersion remains robust.

6.3.2. Mismeasurement problems

We conduct various robustness checks on the potential mismeasurement problems of our two key variables: fiscal policy volatility and MRPK dispersion. Table 4 reports the effect of fiscal policy volatility on MRPK dispersion when alternative methods are used to construct the fiscal policy volatility measure. A detailed description is given in Section 4.1 as well as in the notes below the results table.

In Table 5, we also examine the result using the raw (un-adjusted) MRPK (that is, from (5) as opposed to the counterpart of the residual of (6) which is used in the baseline result) to compute MRPK dispersion. In this check, we adopt four alternative approaches to estimate the firm-level revenue production function and compute the output elasticity of capital as a component of (5), including the Levinsohn and Petrin (2003) approach, the Wooldridge (2009) approach, the system GMM estimator, and the Ackerberg et al. (2015) approach.

Overall, we find that the impact of fiscal policy volatility on the static measure of capital misallocation remains robust despite the use of alternative measures of fiscal policy volatility and the dispersion of MRPK.

7. Mechanisms that make fiscal policy volatility matter

After establishing the relationship between fiscal policy volatility and capital misallocation, a natural question is what makes fiscal policy volatility matter. Answering this question is meaningful in providing government policymakers with alternative policy

Table 4
Robustness check: the mismeasurement problem of fiscal policy volatility.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
FisVol	0.018*	0.018*	0.021***	0.019**	0.024**	0.021**	0.019**	0.022**	0.020*
	(0.010)	(0.010)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.011)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.451	0.451	0.456	0.454	0.460	0.455	0.453	0.455	0.453
Observations	310	310	310	310	310	310	310	310	310

Note: The dependent variable is $\log(\sigma(MRPK^A))$ at the province and year level; the control variables include: government size, subsidy, financial dependence, inflation, and export; all independent regressors are in natural logarithm unless otherwise stated — see Online Appendix OA for variable definitions. The independent variables are the same across different specifications and the difference is how they are computed. Specifically, column (1) includes CPI as a control variable in (1); column (2) includes both CPI and time trend as control variables in (1); column (3) includes CPI, time trend and a further lagged dependent variable ($\Delta \log G_{p,t-2}$) in (1); column (4) adopts the IV method, where lagged provincial GDP growth ($\Delta \log Y_{p,t-1}$) is used to instrument current GDP growth; column (5) includes the log difference of aggregate national government expenditure, $\Delta \log G_{t-1}$, as a control variable in (1); column (6) uses a non-parametric regression method, locally weighted average estimator, to estimate (1) and compute fiscal policy volatility accordingly; column (7) uses another non-parametric regression method, local constant estimator, to estimate (1) and compute fiscal policy volatility accordingly; column (8) uses the residuals of (1) during the time interval of $t-5$ to $t-1$ to compute fiscal policy volatility in year t; column (9) uses a longer time series (i.e., from 1994 to 2019) in estimating (1) and computes the fiscal policy volatility during the sample period (i.e., from 1998 to 2007) accordingly. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5
Robustness check: the mismeasurement problem of MRPK dispersion.

	Levinsohn and Petrin (1)	Wooldridge (2)	System GMM (3)	Ackerberg et al. (4)
FisVol	0.022**	0.024**	0.022**	0.021*
	(0.009)	(0.009)	(0.009)	(0.011)
Control variables	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.438	0.443	0.444	0.337
Obs	310	310	310	310

Note: The dependent variable is $\log(\sigma(MRPK))$, which is the MRPK dispersion in logarithm computed from raw (un-adjusted) MRPK in defined (5) as opposed to the adjusted counterpart in (6), at the province and year level; the control variables include: government size, subsidy, financial dependence, inflation, and export; all independent regressors are in natural logarithm unless otherwise stated — see Online Appendix OA for variable definitions. The dependent and independent variables are the same across different specifications and the difference is how the dependent variable is computed. Specifically, we adopt four alternative approaches to estimate the firm-level revenue production function and compute the output elasticity of capital as a component of (5), including the Levinsohn and Petrin (2003) approach, the Wooldridge (2009) approach, the System GMM estimator, and the Ackerberg et al. (2015) approach. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

tools to reduce the impact on the allocative efficiency of capital even when the volatility of fiscal policy could not be lowered. For this purpose, we analyse how types of government expenditure, capital adjustment costs, and government dependence shape the relationship between fiscal policy volatility and the dispersion of marginal revenue product of capital.

7.1. Budgetary versus extra-budgetary expenditure

We start by investigating how the relationship is driven by the nature of fiscal policy. To this end, we distinguish two types of (provincial) government expenditure: budgetary and extra-budgetary expenditure. Government investment in infrastructure is mainly included in budgetary expenditure, while extra-budgetary expenditure covers city maintenance and administrative costs. The former type of expenditure is more relevant in determining manufacturing firms' profitability and thus its volatility is more important in influencing capital allocation in the manufacturing sector. In terms of the approval procedure, budgetary expenditure is proposed by the administrative branch of the government and approved by the National People's Congress, whereas extra-budgetary expenditure is directly controlled by local governments, government agencies, and government institutions.

Despite the difference, both types of expenditure suffer from discretionary usage, due to a mismatch between expenditures and revenues as well as low fiscal transparency, and over several years result in significant volatility. In particular, the negative correlation between fiscal transparency and fiscal volatility as illustrated in the Online Appendix Figure OB.2 is more significant for fiscal volatility resulting from budgetary expenditure (−0.33) than that resulting from extra-budgetary expenditure (−0.02). Using the method of variance decomposition, we decompose overall fiscal policy volatility into three different components: volatility due to budgetary expenditure ($FisVolB$), volatility due to extra-budgetary expenditure ($FisVolEB$), and a covariance term between budgetary and extra-budgetary expenditure ($FisVolCov$). Noticeably, both budgetary and extra-budgetary expenditures are volatile in Chinese provinces. They contribute about 60% and 52% respectively to overall fiscal policy volatility. The contribution of the covariance term is −12%, indicating the overall substitution between the two types of government expenditure.[40]

[40] We present these patterns in Appendix Table A.1.

Table 6
Role of volatility: budgetary versus extra-budgetary expenditure.

	(1)	(2)	(3)	(4)	(5)	(6)
FisVolB	0.042***	0.029***			0.042***	0.027**
	(0.006)	(0.010)			(0.007)	(0.010)
FisVolEB			0.002	0.022	−0.003	0.015
			(0.018)	(0.016)	(0.018)	(0.016)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes	No	Yes
R^2	0.331	0.466	0.282	0.449	0.331	0.468
Observations	310	310	310	310	310	310

Note: The dependent variable is $\log(\sigma(MRPK^A))$ at the province and year level; the control variables include: government size, subsidy, financial dependence, inflation, and export; all independent regressors are in natural logarithm unless otherwise stated — see Online Appendix OA for all variable definitions. *** p < 0.01, ** p < 0.05, * p < 0.1.

Interestingly, despite sizable volatility in both types of expenditure, fiscal policy volatility resulting from budgetary expenditure is the main driver of the documented capital misallocation. In contrast, volatility from extra-budgetary expenditure turns out to have an insignificant impact. The results are reported in Table 6. They are consistent with the nature of the two different types of government expenditure. Budgetary expenditure involves infrastructure development and fixed asset investment and has a direct impact on the market conditions faced by manufacturing firms. As a result, if it is volatile there is a more prominent impact on MRPK dispersion than when extra-budgetary expenditure, which is mainly used for maintenance, administration, and operative services, is volatile. This exercise can serve as a placebo test showing that the documented impact on MRPK dispersion is indeed driven by fiscal policy volatility that directly affects firms' profitability rather than by other factors that are confounded with fiscal policy. This novel finding also generates important policy implications, since it indicates that the elimination of extra-budgetary government expenditure alone may not be sufficient to curb the influence of fiscal policy volatility, which arises from budgetary government expenditure. Our results call for further policy reforms to reduce the discretionary use of budgetary funds.

7.2. Capital adjustment costs and government dependence

In theory, firms face adjustment costs that are inherent in changing the amount of input used, and their response to shocks is not instantaneous. Specifically, altering the level of capital services, whether it be the capital stock or its rate of utilisation, incurs net adjustment costs as it disrupts the routine of an unchanged workforce, leading to reassignment and restructuring of tasks (Hamermesh and Pfann, 1996). For instance, gross costs arise when the delivery of new equipment takes time, constraining production as the new equipment may divert other inputs away from production. Dixit and Pindyck (1994) highlight that uncertainty about future shocks makes firms hesitant to invest in new capital, resulting in substantial adjustment costs associated with changing the stock due to the irreversibility of many investment projects. Furthermore, Hamermesh and Pfann (1996) suggest that adjustment costs can arise from the direct or indirect effects of government policies.

The existing literature has emphasised the role of capital adjustment costs in shaping the relationship between profitability volatility and MRPK dispersion, that is, without adjustment costs, volatility would not affect MRPK dispersion (Asker et al., 2014). Nonetheless, in our context of fiscal policy volatility, even in the presence of capital adjustment costs, the impact of volatility would in all likelihood be muted if firms' performance were less dependent on government expenditure and intervention. Therefore, in this subsection, we empirically explore how adjustment costs and government dependency affect the impact of fiscal policy volatility on MRPK dispersion.

First, we use a proxy of sunk costs of investment as a measure of industry-specific capital adjustment costs. Specifically, we adopt the capital resalability index ($CapRes$) used by Balasubramanian and Sivadasan (2009). This measure is defined as the share of used capital investment in total capital investment in each 4-digit US industry.[41] We convert the US SIC industry codes to the Chinese industry code when merging them into the Chinese data set. This measure captures the recoverability of investments, which is an inverse proxy for the extent of the sunkenness of capital investments. We hypothesise that industries with higher sunkenness of capital investment are subject to higher capital adjustment costs as the more capital is invested, the longer it takes to change the amount of input used and the more costly it is to do so. For robustness purposes, three indices are used: $CapRes1$ refers to the capital resalability index in 1987, $CapRes2$ refers to the capital resalability index in 1992, and $CapRes3$ is the mean average of the capital resalability index in 1987 and 1992. In columns (1)–(3) of Table 7, the coefficients of the interaction terms between fiscal policy volatility and all three capital resalability indices are negative and significant. This implies that MRPK dispersion of industrial sectors with higher sunkenness of capital investment and capital adjustment costs, indicated by lower capital resalability, is more likely to be affected by fiscal policy volatility. This result further suggests that it is not the differential capital adjustment costs alone that drive the documented impact in the baseline regression in Section 6, because if that were the case the coefficients of the interaction terms would be insignificant.

As a further check in this vein, and as an alternative approximation of how capital adjustment costs vary at the industry level, we measure how industries rely on external finance. The view that the costs of external finance generate additional adjustment costs

[41] The used capital expenditure data comes from the US Bureau of the Census.

Table 7
Capital adjustment costs and government dependence (industry level evidence).

	Capital adjustment costs				Government dependence		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
*FisVol*CapRes*	−0.038***	−0.102***	−0.071***				
	(0.011)	(0.018)	(0.017)				
*FisVol*IFD*				0.002***			
				(0.000)			
*FisVol*GovDem*					0.162***	0.071***	0.066***
					(0.030)	(0.006)	(0.005)
Province × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.040	0.040	0.040	0.039	0.038	0.040	0.040
Observations	63,142	58,092	57,148	74,738	75,174	75,174	75,174

Note: The dependent variable is $\sigma(MRPK^A)$ for each 4-digit industry at the province and year level; only interaction terms are reported because individual terms are absorbed by the industry-year level or province-year level fixed effects; columns (2)-(4) report the results of $CapRes1$, $CapRes2$, and $CapRes3$, respectively; columns (5)-(7) report the results of $GovDem1$, $GovDem2$, and $GovDem3$, respectively; see Online Appendix OA for all variable definition. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

on the stock of capital is widely accepted in the corporate finance literature (Chirinko, 1993; Casalin and Dia, 2014). Compared with internal funds, external funds are much more expensive and are more irreversible once invested to install capital. As a result, industries that are heavily dependent on external finance may face higher capital adjustment costs than those that rely more on internal finance. For this purpose, we adopt Rajan and Zingales (1998)'s measure of an industry's dependence on external finance as Industrial Financial Dependence (IFD). This measure is constructed as the sum of firms' use of external finance divided by the sum of capital expenditure throughout the 1980s for 425 4-digit US manufacturing industries. We convert the US SIC industry codes into the corresponding Chinese industry codes and merge them into the Chinese data set. We use the Difference-in-Difference (DID) method and include both industry-year effects and province-year effects to control for capital misallocation caused directly by external finance reliance.[42] We find that the coefficient of the interaction term between industry-level dependence on external finance and fiscal policy volatility is significantly positive in column (4) of Table 7. This suggests that the capital allocation efficiency of industrial sectors that are relatively more dependent on external finance suffers more from capital adjustment costs and consequently those sectors are more likely to be adversely influenced by fiscal policy volatility.

Second, to approximate industry-specific reliance on government expenditure, we compute the degree of dependence on government demand ($GovDem$) for every 2-digit industrial sector in China using the 2005 World Bank Investment Climate database of more than 12,000 Chinese manufacturing firms. For the sake of robustness, three measures are used: $GovDem1$ is the share of government purchase in total sales in each 2-digit industry in 2004; $GovDem2$ is the share of SOE purchase in total sales in each 2-digit industry in 2004; and $GovDem3$ is the share of both government and SOE purchase in total sales in each 2-digit industry in 2004.[43] In columns (5)–(7) of Table 7, we find a significant and positive interaction term between fiscal policy volatility and government demand. This suggests that industries that are more reliant on government and SOE purchases are more likely to be influenced by fiscal policy volatility.

While the above analysis is conducted by exploring the variations of capital adjustment costs and government dependence across industries, the result of analysis using the regional and provincial variations, as shown in Online Appendix OC is also in line with the industrial-level findings. Overall, these results suggest that policies contributing to lower capital adjustment costs and lower reliance of firms on government expenditure can alleviate the capital misallocation caused by fiscal policy volatility.

8. Conclusion

Firms face considerable uncertainty about future conditions affecting their costs, demand, and profitability, which affects their decisions regarding capital allocation and investment in the presence of capital adjustment costs. We focus on the uncertainty arising from a particular form of policy shock, that is the excessive discretionary changes in fiscal policy that do not represent a reaction to economic conditions. After controlling for a wide set of driving forces of capital misallocation we explore whether and how the dispersion of marginal revenue product of capital is influenced by fiscal policy volatility. Estimating the magnitude of the influence is crucial to understanding the extent to which capital efficiency can be improved by designing less volatile fiscal policy and how the influence is mediated by industrial features.

Using several disaggregate data sources, we document that the aggressiveness of the use of fiscal discretionary policy leads to capital misallocation (as proxied by the dispersion of industry- and year-adjusted MRPK) in manufacturing firms in China. The identification of the effect comes from the variation of fiscal transparency and fiscal disparities across regions and over time. After accounting for various factors that can influence MRPK dispersion, we document an elasticity of 0.022 between MRPK dispersion and changes in fiscal policy volatility. This result is robust to a wide range of robustness tests. Considering the overall decrease in fiscal policy volatility in China during the period 1998–2007, our estimate indicates that this decrease contributed to 8.3 percent of the observed improvement in capital dispersion during this period.

42 For example, firms relying more on external finance suffer more from collateral constraint and may have a higher level of capital misallocation (e.g., Moll, 2014).

43 The original questions in the 2005 World Bank survey are "Regarding your products sold in 2004: what percent of your products are sold to the government and what percent of your products are sold to SOEs?".

Our results have important policy implications. More expenditure-side fiscal reforms aiming at a better match between local government revenue and expenditure, measures to improve fiscal transparency, and policies to reduce regional fiscal disparities are crucial for curbing fiscal policy discretion and volatility, which are conducive to the overall enhancement of capital allocative efficiency among manufacturing firms. When the reduction of fiscal policy volatility is difficult to achieve, policies leading to lower capital adjustment costs and lower reliance of firms on government expenditure are important to alleviate the capital misallocation caused by fiscal policy volatility. Our paper has wider global policy implications given that the Covid-19 pandemic has caused a significant deterioration in public finances and fiscal resources, especially in many developing countries.

Data availability

The data that has been used is confidential.

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Appendix A. Appendix tables

See Tables A.1 and A.2.

Table A.1
Variance decomposition of government expenditure (percentage).

Province	BudgetExp share(1998) (1)	BudgetExp share (2007) (2)	BudgetExp share change (3)	FisVolB share (4)	FisVolEB share (5)	FisVolCov share (6)
Beijing	71.63	92.87	21.24	45.33	24.48	30.19
Tianjin	80.02	92.01	11.99	26.65	119.35	−46.01
Hebei	75.53	87.86	12.33	33.8	58.48	7.72
Shanxi	68.95	88.85	19.9	65.5	19.13	15.38
Inner Mongolia	87.09	92.9	5.81	90.2	94.64	−84.85
Liaoning	78.63	88.59	9.96	15.15	128.81	−43.96
Jilin	80.07	91.63	11.56	43.91	84.78	−28.69
Heilongjiang	79.39	90.16	10.77	92.47	77.27	−69.74
Shanghai	79.48	90.11	10.63	50.54	74.62	−25.17
Jiangsu	61.81	79.92	18.11	8.91	80.06	11.02
Zhejiang	58.88	74.93	16.05	51.27	41.58	7.15
Anhui	71.85	91.3	19.45	59.6	41.51	−1.11
Fujian	65.14	80.04	14.9	7.74	111.96	−19.7
Jiangxi	71.15	85.86	14.71	56.53	24.26	19.21
Shandong	68.54	85.82	17.28	65.04	95.73	−60.77
Henan	69.68	87.48	17.8	52.17	39.26	8.58
Hubei	75.5	87.51	12.01	87.06	27.78	−14.83
Hunan	64.83	85.9	21.07	56.6	43.13	0.26
Guangdong	82.08	83.92	1.84	110.42	58.1	−68.52
Guangxi	68.14	84.14	16	88.34	18.77	−7.11
Hainan	78.03	94.19	16.16	68.6	66.36	−34.96
Sichuan	42.81	77.42	34.61	11.75	103.38	−15.14
Chongqing	67.87	88.92	21.05	67.54	21.29	11.17
Guizhou	79.8	91.59	11.79	89.51	18.13	−7.64
Yunnan	84.39	94.17	9.78	42.76	26.98	30.26
Tibet	97.88	99.08	1.2	97.06	1.58	1.36
Shaanxi	79.62	86.14	6.52	46.18	45.87	7.96
Gansu	82.06	90.21	8.15	46.62	27.16	26.22
Qinghai	91.11	96.19	5.08	92.33	19.77	−12.1
Ningxia	85.94	90.83	4.89	106.59	17.53	−24.11
Xinjiang	77.92	91.72	13.8	85.35	5.77	8.88
Average	75.03	88.46	13.43	60.05	52.18	−12.23

Note: Column (1) is the share of budgetary expenditure in total government expenditure in 1998; column (2) is the share of budgetary expenditure in total government expenditure in 2007; column (3) is the change in budgetary expenditure share between 2007 and 1998, i.e. column (2)-column (1); column (4) is the share of budgetary expenditure volatility in total fiscal policy volatility; column (5) is the share of extra-budgetary expenditure volatility in total fiscal policy volatility; column (6) is the share of covariance between budgetary and extra-budgetary expenditure volatility in total fiscal policy volatility.

Table A.2
Industry heterogeneity effects.

Industry code	Industry name	FisVol	S.E.	Observations
All	All manufacturing sectors	0.059***	0.008	8578
13	Food processing industry	0.115***	0.022	310
14	Food manufacturing industry	0.126***	0.026	310
15	Beverage manufacturing industry	0.091***	0.025	310
16	Tobacco processing industry	0.037	0.064	259
17	Textile industry	0.074***	0.018	306
18	Clothing and other fibre products manufacturing	0.034	0.048	304
19	Leather, fur, down and down products industry	0.079*	0.041	285
20	Timber processing, bamboo, cane, calm fibre and straw products industry	0.131***	0.03	288
21	Furniture manufacturing industry	0.098*	0.05	298
22	Papermaking and paper products industry	0.004	0.036	299
23	Printing and record medium reproduction industry	0.043	0.027	310
24	Educational and sports goods industry	0.105	0.067	240
25	Petroleum processing and coking industry	0.058*	0.034	289
26	Chemical materials and chemical products manufacturing industry	0.057***	0.019	310
27	Pharmaceutical manufacturing industry	0.018	0.018	310
28	Chemical fibres manufacturing industry	0.068	0.076	259
29	Rubber product industry	0.035	0.054	289
30	Plastic products industry	0.034	0.035	305
31	Non-metallic mineral products industry	0.058***	0.017	310
32	Ferrous metal smelting and rolling processing industry	0.062***	0.022	300
33	Non-ferrous metal smelting and rolling processing industry	−0.042	0.026	300
34	Fabricated Metal Products industry	0.118***	0.025	306
35	General machinery manufacturing industry	0.045*	0.026	302
36	Special equipment manufacturing industry	0.051	0.046	307
37	Transportation equipment manufacturing industry	0.097***	0.018	310
39	Electrical machinery and equipment manufacturing	0.037*	0.019	300
40	Communication equipment, computer and other electronic equipment manufacturing industry	0.067**	0.027	283
41	Instrumental, cultural, and office machinery manufacturing industry	0.071***	0.026	278
42	Artwork and other manufacturing industry	−0.042	0.039	298

Note: The dependent variable is $\sigma(MRPK^A)$ for each 2-digit industry in province p at year t; *** p < 0.01, ** p < 0.05, * p < 0.1.

Appendix B. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.euroecorev.2024.104797.

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