

# Analysis of the Pull Effect of Local Government Special-Purpose Bond Investment on Economic Growth Under the Input-Output Framework

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**Abstract** In this paper, we discuss the development process of local government special bonds, and the role channels of local government special debt investment in driving China's economic growth. Based on the specific decomposition of Xinjiang local government special bond investment, this paper uses the non-competitive input-output model for the first time to analyze the net pulling effect of Xinjiang local government special bond investment on Xinjiang's GDP and employment in 2020. Two measure calibers are set in this paper based on whether the financing costs are considered or not; in addition, we set up four scenarios based on two conditions: Whether to consider retained fun and whether to consider using special-purpose bond investment to leverage social capital. The results show that: 1) when financing costs are not considered, the RMB77.4 billion local government special-purpose bonds can push the GDP of Xinjiang to grow by RMB42.27 billion, RMB35.12 billion, RMB77.548 billion and RMB69.34 billion respectively under the four scenarios; 2) when financing costs are not considered, the number of jobs driven by the RMB77.4 billion local government special-purpose bonds was respectively 372,300, 324,500, 718,500 and 601,300 in the four scenarios; 3) when financing costs are considered, the RMB77.4 billion local government special-purpose bonds can push the GDP of Xinjiang to grow by RMB71.876 billion and RMB64.268 billion under scenario 3) and scenario 4).

**Keywords** local government special purpose bond investment; non-competitive input-output model; value-added

## 1 Introduction

The economic growth in China's provinces cannot be achieved without the support of government debt. Local government bonds include general bonds and special-purpose bonds. Special-purpose bonds, which were publicly issued nationwide in 2015 for the first time, are bonds issued by local governments for the construction of a specific project. They are mainly invested in projects with certain returns and repaid with the corresponding government fund or

project income as a guarantee. Local government special-purpose bonds, an important source of funds to support infrastructure to make up for shortcomings, have played an important role in stabilizing infrastructure investment and underpinning stable economic growth. Nationwide, special-purpose bonds are gradually becoming the main channel of investment and financing for local governments in the country, with the scale of issuance growing rapidly. From 2015 to 2020, the scale of new special-purpose bonds issued in each year stays respectively at RMB90.7 billion, RMB403.7 billion, RMB793.7 billion, RMB1352.7 billion, RMB2148.7 billion, and RMB3601.9 billion. Obviously, the growth rate is much higher than that of the national economy and fiscal revenue.

For local government special-purpose bonds, a series of policy interpretations and theoretical discussions have been conducted in the academic and policy circles. 1) Studies on the impact of local government special-purpose bonds on the risk of government debt. Local government special-purpose bonds were created to prevent and resolve systemic financial risks and curb illegal debt borrowing: After the financial crisis in 2008, local governments at all levels increased investment in infrastructure construction to stabilize economic growth, accumulating a large amount of local government hidden debt and heightening the risk of local government debt. In order to prevent and mitigate systemic financial risks, the Central Government decided to “open the front door and block the back door”, that is, supporting local governments to raise funds legally and compliantly within the statutory special debt limit while curbing illegal debt borrowing. Local government special-purpose bonds were created as a result<sup>[1]</sup>. Hidden debts are at the intersection of fiscal and financial risks in China<sup>[2]</sup>. Local government special-purpose bonds can make hidden debts visible, standardize and institutionalize debt management, and thus reduce the risk of default on local government debts. Moreover, local government special-purpose bonds can also lower local governments’ financing costs and optimize their debt structure in terms of interest rate and maturity, thereby reducing the short-term liquidity risk of local debts<sup>[3]</sup>. The quota management system for the issuance of local government special-purpose bonds can effectively regulate local governments’ borrowing behavior, control their debt scale and prevent the disorderly expansion of their debt scale<sup>[4]</sup>. Meanwhile, some scholars have also pointed out that special-purpose bonds are plagued by problems such as inefficient use of funds and specific default risks<sup>[5]</sup>. 2) Studies related to the issuance and circulation mechanism of special-purpose bonds. According to some scholars, there are non-market-oriented factors, including government administrative intervention, government guarantee expectations, and low credibility of bond credit ratings, in the process of local government special-purpose bonds, which make the issuance rate of special-purpose bonds unreasonable<sup>[6]</sup>. Besides, there is also the problem of poor liquidity in the secondary market for special-purpose bonds, which are concentrated in those large State-owned commercial banks in the country. The poor liquidity causes special-purpose bonds to transfer the fiscal risk of local governments into the financial risk of commercial banks. In this way, the resource allocation role of special-purpose bonds cannot be effectively played<sup>[7]</sup>. 3) Economic benefits of local government special-purpose bonds. On the one hand, local government special-purpose bonds can promote economic growth, directly and indirectly: Special-purpose bonds can drive local economic growth through direct investment<sup>[8]</sup>. Relevant calculations show that the multiplier of local government special-purpose bonds on

the investment in infrastructure construction is 1.6~2.5 times, and infrastructure construction as a quasi-public good has a significant positive externality on economic growth<sup>[9]</sup>; on the other hand, there may also be some negative effects of local government special-purpose bonds on economic growth. For example, the multiplier of government spending is relatively low in the vast majority of cases, regardless of whether the external economic environment is favorable or not<sup>[10]</sup>. Smaller public deficits and lower public debts always generate higher growth rates when considering general debt policy<sup>[11]</sup>. Special-purpose bonds may increase the cost of financing for the real economy and bring about a crowding-out effect on investment by private enterprises<sup>[12]</sup>. The issuance costs and economic benefits of special-purpose bonds vary from one region to another, which may widen the gap in economic development between regions<sup>[13]</sup>.

To sum up, most of the existing studies on special-purpose bonds are qualitative analyses on the role of risk control, economic growth, circulation mechanism of special-purpose bond issuance, etc. There is no quantitative analysis of the economic returns on the investment in special-purpose bond investment. There are not many further studies on empirical data and calculation, either. In China, a country with a vast territory, the social and economic development is still uneven between the eastern and western regions because of various reasons. The financial self-sufficiency rate of the western regions is relatively low, which makes it difficult for them to accelerate the local development solely on their own revenue. Therefore, the demand for special-purpose bonds in the western regions is very urgent. As a strategic barrier in northwest China, Xinjiang is a key area to implement the strategy of large-scale development of western China, the core area of China's Silk Road Economic Belt, and an important national energy base and transportation corridor in the country, thus being of special strategic importance. As a representative of provinces in western China, local government special-purpose bonds have also developed rapidly in Xinjiang. From 2018 to 2020, the scale of new special-purpose bonds issued in Xinjiang every year stays respectively at RMB28.3 billion, RMB48.2 billion, and RMB77.4 billion, ranking steadily among the top five provinces and regions in western China. In view of this, this paper quantitatively measures the pull effect of special-purpose bond investment on economic growth based on the input-output model and data from the areas of Xinjiang, where special-purpose bonds were actually invested in 2020, with a view to providing a quantitative reference for relevant policy development.

This paper has the following possible innovations. First, this paper uses a non-competitive input-output model for the first time to measure the net driving effect of Xinjiang's special bond investment on the region's GDP. The results show that Xinjiang's 77.4 billion special bond investment in 2020 only drives Xinjiang's GDP growth by 42.3 billion, more than 45%  $((774 - 423)/774)$  spillover of the investment effect outside Xinjiang. Second, this article considers the positive role of special bond funds as capital to leverage social capital. After considering social capital, Xinjiang's special bond investment in 2020 can boost GDP growth by 77.548 billion yuan.

The remainder of this paper contains: Section 2 gives an introduction to the research methodology and data sources, mainly based on the input-output model and the establishment of an investment-pulling model, which can measure the value added to various sectors by the investment in special-purpose bonds; Section 3 the analysis of the calculation results; and

Section 4, the conclusion of the paper.

## 2 Data Sources and Research Methodology

### 2.1 Selection of Research Methodology

Measuring the effects of fiscal policy has been a major concern for the efforts in formulating the national policy, as well as an important research topic in academia. The traditional tool to measure the effects of fiscal policy is the fiscal policy multiplier, also known as the Keynesian multiplier<sup>[14–16]</sup>. Academics have estimated China's government spending multiplier mainly through two types of methods, such as Reduced-form empirical studies<sup>[17–19]</sup> and micro-based structural models such as DSGE<sup>[20–24]</sup>. However, both estimation methods have certain limitations. The empirical measures suffer from heavy reliance on the assumption of identifying conditions and from not allowing for diversity in fiscal policy choices while the main drawback of structural model estimation methods stems from nonconsensual calibration of parameters<sup>[21]</sup>.

In addition, both of the above methods are aggregate estimates, which analyze investment and economic growth as a whole, implicitly assuming that the allocation of fiscal expenditure across sectors has no effect on the fiscal expenditure multiplier<sup>[25]</sup>. However, the recently emerging production network model has demonstrated the non-negligible amplifying role of production networks in the transmission of economic shocks<sup>[26–31]</sup>. Intuitively, the national economy is a complex and large mega-system. The financial expenditure invested in a particular sector not only directly affects the production of products in this sector, but also has an impact on other sectors through the input-output correlation between sectors. When measuring, if investment and value-added are analyzed as a whole, rather than by sector, the heterogeneity of the pull effect of fiscal policy on each sector will be overlooked, and the impact of fiscal policy on the structure of the economy will be ignored. Some scholars have pointed out that the irrational sectoral allocation of fiscal expenditure was one of the reasons for the distorted industrial structure in China<sup>[32, 33]</sup>. Therefore, when measuring the pull effect of fiscal policy on economic growth, it is necessary to consider the interdependence and mutual influence between the products of various sectors of the national economy and to examine the impact of the sectoral allocation of fiscal expenditure on the economy.

As a multi-sectoral model which has been widely used in macroeconomics<sup>[34–38]</sup>, an input-output model is actually a tool that describes the sources of intermediate inputs used in the production of each sector of the national economy and the destination of the products produced in a certain period of time and explains the interdependence and inter-constrained quantitative relationships among these sectors. The input-output model can effectively identify the structural effects of the sectoral allocation of fiscal expenditure. Some scholars have used input-output techniques to measure the economic effects of investment: By virtue of the input-output closed model, Guo, et al.<sup>[39]</sup> quantitatively measured the total pull effect of RMB4 trillion investment on China's GDP to be RMB6448.9 billion while discussing in detail the characteristics of the time lag effect of investment on China's GDP. After measuring three kinds of investment multipliers, including fixed asset investment multiplier, Keynesian investment multiplier, and input-output investment multiplier, Xu, et al.<sup>[40]</sup> insisted that China's investment multiplier has not experienced a substantial decline in recent years, playing a positive role in driving the

economic growth. Given the fact that the input-output technique can study the pulling effect of investment on the economy from a multi-sectoral perspective, this paper chooses to quantitatively measure the pulling effect of special-purpose bonds issued by the local government of Xinjiang in 2020 on the Chinese economy on the basis of the input-output table.

## 2.2 Measurement of the Pulling Effect of Investment

Input-output tables, also known as sectoral linkage equilibrium tables, actually constitute databases reflecting the interlinkages and equilibrium proportional relationships between sectors in a given period. The basic structure of a non-competitive input-output table is shown in Table 1, according to which, the Leontief model can be derived from its horizontal equilibrium relationship and the parameters of its vertical production results (intermediate coefficient).

**Table 1** Table of non-competitive inputs and outputs

Sector	Intermediate	End Use (product)				Total Output	
	Use (domestic)						
	$1, 2, \cdots, n$	Consumption	Capital Formation	Exports	Total		
Intermediate Input of Domestic Products	$1, 2, \cdots, n$	$X_{ij}^d$	$C_i^d$	$in_i^d$	$ex_i^d$	$Y_i^d$	$X_i$
Intermediate Input of Imported Products	$1, 2, \cdots, n$	$X_{ij}^m$	$C_i^m$	$in_i^m$		$Y_i^m$	$M_i$
Value Added	$V_j$						
Total Inputs	$X_j$						

As shown in Formula (1), the Leontief model, which reflects the driving relationship between final demand and aggregate output, is at the core of the input-output technique.  $(I - A)^{-1}$  is the Leontief inverse matrix, which provides a comprehensive picture of the intricate economic linkages between various sectors of the national economy. Based on the Leontief model, the pulling effect of final demand on GDP and employment can be further calculated, as shown in Formula (2) and Formula (3):

$$\Delta X = (I - A)^{-1} \Delta Y, \quad (1)$$

$$\Delta \text{GDP} = A_v (I - A)^{-1} \Delta Y, \quad (2)$$

$$\Delta L = A_L (I - A)^{-1} \Delta Y. \quad (3)$$

The competitive input-output model ( $X = (I - A)^{-1}$ ) includes the imported intermediate inputs matrix ( $A^M$ ), which overestimates the actual impact of investment on GDP and employment. To eliminate this overestimation, the non-competitive input-output model should be used.

$$\Delta X = (I - A^D)^{-1} \Delta Y^D, \quad (4)$$

$$\Delta \text{GDP} = A_v (I - A^D)^{-1} \Delta Y^D, \quad (5)$$

$$\Delta L = A_L (I - A^D)^{-1} \Delta Y^D. \quad (6)$$

Among them,  $\Delta Y^D$  is the domestic investment vector,  $A_v$  is the diagonal matrix of value-added coefficients, and the elements on the diagonal are the value-added coefficients for each sector.  $A_L$  is the diagonal matrix of employment coefficients, and  $A^D$  is the matrix of domestic input coefficients. Formula (5) and Formula (6) can be used to calculate the full contribution of increased investment in various sectors to GDP and domestic employment.

### 2.3 Source and Processing of Data

The allocation of special bonds across sectors is needed to measure the pulling effect of special-purpose bond investment on economic growth. In 2020, the special-purpose bonds issued by the local governments of Xinjiang went to a total of 11 sectors, which include RMB6.144 billion for transportation infrastructure, RMB2.16 billion for energy, RMB4.08 billion for agriculture, forestry, and water conservancy, RMB5.51 billion for ecology and environmental protection, RMB8.87 billion for healthcare, RMB3.41 billion for education, RMB5.976 billion for social undertakings, RMB2.81 billion for urban-rural cold chain logistics infrastructure, RMB27.75 billion for municipal and industrial park infrastructure, RMB1.39 billion for the renovation of old urban residential areas and RMB9.3 billion for the renovation of shanty areas, totaling RMB77.4 billion. Xinjiang boasts numerous advantageous industries, such as the cotton industry, animal husbandry, and photovoltaic industry. The investment of Xinjiang's special-purpose funds for cotton industry and animal husbandry industry is counted in the agriculture, forestry and water conservation section, and the investment for photovoltaic industry is counted in the energy section.

The destination of funds from special-purpose bonds does not correspond to the sectoral divisions of the national accounts. How to translate the new special bond investment projects into pure sector investments corresponding to the input-output table is the key to this paper. According to the allocation scheme, transportation infrastructure, energy, urban-rural cold chain logistics infrastructure, municipal and industrial park infrastructure, renovation of old urban residential areas and shantytown renovation are all infrastructure investments, which mainly correspond to sectors such as construction and equipment manufacturing; agriculture, forestry, water conservancy, and ecological and environmental protection mainly correspond to the sectors of water conservancy, environment and public facility management; education can completely correspond to the education sector; healthcare and social undertakings correspond to health, social security and social welfare undertakings. To improve the accuracy of the allocation, this paper draws on Guo's<sup>[27]</sup> allocation scheme, which investigated four infrastructure projects to determine the proportion of investment composition of different infrastructure projects when measuring the pull effect of RMB4 trillion investment on the Chinese economy. Therefore, this paper gives relevant sectors of Xinjiang's local government special-purpose bond investment projects corresponding to the input-output table, as detailed in Tables 2 and 3.

Table 2 shows the correspondence between the categories of special-purpose bond projects and the sectors of national accounts. Based on the allocation scheme of Guo<sup>[27]</sup>, this paper assumes that 57.5% of the investment in "transportation infrastructure" goes to the construction

sector, 15% to “general and special equipment manufacturing”, 15% to “electrical, mechanical and equipment manufacturing” and 12.5% to “integrated technical services”. The same allocation scheme is followed for energy, urban-rural cold chain logistics infrastructure, municipal and industrial park infrastructure, renovation of old urban residential areas, and shantytown renovation. Furthermore, this paper assumes that all special-purpose bond investments in agriculture, forestry and water conservation, ecological and environmental protection, and healthcare are allocated to the sectors of “water conservancy, environment, and public facilities management”; it assumes that education projects correspond to the “education” sector and that social undertakings projects correspond to the sectors of “health, social security, and social welfare”. Based on the project data and assumptions, this paper gives the relevant sectors of the special-purpose bond investment projects launched in Xinjiang in 2020 corresponding to the input-output table, where the amount of special-purpose bonds issued comes from the China electronic local government bond market access (CELMA) under the Ministry of Finance.

**Table 2** Correspondence between investment projects transformed into pure sectors  
(100 million yuan)

Project Type	Identifier	Amount	Pure Sector
Transportation Infrastructure	A	61.44	57.5% for construction + 15% for general and special equipment manufacturing + 15% for electrical and mechanical equipment + 12.5% for integrated technical services
Energy	B	21.6	57.5% for construction + 15% for general and special equipment manufacturing + 15% for electrical and mechanical equipment + 12.5% for integrated technical services
Agriculture, Forestry and Water Conservancy	C	40.8	100% for water conservancy, environment and public facility management
Ecological and Environmental Protection	D	55.1	100% for water conservancy, environment and public facility management
Healthcare	E	88.7	100% for health, social security and social welfare
Education	F	34.1	100% for education
Social Undertakings	G	59.76	100% for health, social security and social welfare
Urban-rural Cold Chain Logistics Infrastructure	H	28.1	57.5% for construction + 15% for general and special equipment manufacturing + 15% for electrical and mechanical equipment + 12.5% for integrated technical services
Municipal and Industrial Park Infrastructure	I	277.5	57.5% for construction + 15% for general and special equipment manufacturing + 15% for electrical and mechanical equipment + 12.5% for integrated technical services
Renovation of Old Urban Residential Areas	G	13.9	57.5% for construction + 15% for general and special equipment manufacturing + 15% for electrical and mechanical equipment + 12.5% for integrated technical services
Shantytown Renovation	K	93	57.5% for construction + 15% for general and special equipment manufacturing + 15% for electrical and mechanical equipment + 12.5% for integrated technical services

Table 3 shows the amount of investment in relevant pure sectors, which correspond to the respective terms of the investment vector  $\Delta Y^D$ . The numerical value for the pull effect of

RMB77.4 billion of special-purpose bond investment on GDP and employment can be obtained when  $\Delta Y^D$  is put into Formula (5) and Formula (6). What's more, due to the characteristics of the input-output technique, the numerical value is meant to be the fully pull effect, i.e., it takes into account the sum of the direct and indirect stimulus effects of investment on production, exports and population in each sector.

**Table 3** Calculation of total investment by pure sector (100 million yuan)

Project Type	Amount	Pure Sector
Construction	284.94	57.5% (A+B+H+I+J+K)
General and Special Equipment Manufacturing	74.33	15% (A+B+H+I+J+K)
Electrical, Mechanical Equipment	74.33	15% (A+B+H+I+J+K)
Integrated Technical Services	61.94	12.5% (A+B+H+I+J+K)
Water Conservancy, Environment and Public Facility Management	95.9	100% (C+D)
Education	34.1	100% E
Health, Social Security and Social Welfare	148.46	100% (F+G)

The paper uses the 2017 Xinjiang input-output table for modeling and analysis, which is the latest available input-output table for Xinjiang.

### 3 Calculation Results and Analysis

#### 3.1 Scenarios Setting

Depending on whether or not to consider financing costs, two measure calibers are set in this paper. The issuance of local government bonds is a means of financing. Bonds issued need to be repaid upon maturity. The bonds issued by local governments bear simple interest and are usually issued for 5, 7, 10 or 20 years. Therefore, when considering their financing costs, there exist two calculation calibers. Caliber 1 considers the new government special-purpose bonds that correspond to specific projects and are repaid with specific revenues, most of which are debt service revenues from the transfer of State-owned land use rights, and which are not recorded in GDP accounting. So this approach does not take into account the financing costs of the new special-purpose bonds issued by local governments. Caliber 2 considers the time value of money, discounting the maturity value of the bonds (principle + interest) to 2020 at a discount rate of 10%, i.e., the current price of the bond (financing cost), subtracting the discounted value to the present from the pull effect.

When considering the time value of money, the principal and interest on the bond need to be discounted. Considering the local government special-purpose bonds issued with a face value of  $M$  units of  $t$  years and an annual interest rate of  $i$ , the purchase price is the face value (government bonds can be assumed to have no discount) and simple interest is charged. In this case, the maturity value of the bond, FV, can be obtained from Formula (7) and the bond interest can be obtained from Formula (8).

$$FV = M \times (1 + i \times t), \quad (7)$$

$$I = M \times i \times t. \quad (8)$$

There is heterogeneity in the way interest is repaid on local government special-purpose



bonds. For ease of calculation, assuming a lump-sum repayment of principal and interests at maturity, according to the discounted valuation model, the value of the bond is equal to the present value (PV) of the interest from the current to the maturity date of the bond, which, plus the present value of the bond's face value, is the bond's PV, as shown in Formula (9), where,  $r$  is the discount rate, which consists of the sum of the risk-free rate of return, risk-reward rate and the inflation rate. If the cost of financing is taken into account when calculating the pull effect of input and output, the present value of the bond needs to be deducted to obtain the final result.

$$PV = \frac{M + I}{(1 + r)^t}. \quad (9)$$

In addition, this paper sets up four scenarios based on two conditions: Whether to consider retained fund and whether to consider using special-purpose bond investment to leverage social capital. Scenario 1: Local government special-purpose bonds include new bonds, replacement bonds and refinancing bonds, among which, only the new bonds bring about actual investment. Scenario 1 measures the pull effect of such new special-purpose bond investment GDP. In 2020, the total amount of such special-purpose bonds issued by local governments in Xinjiang was RMB77.4 billion.

Scenario 2 excludes retained funds. Special-purpose bond funds can be used as project capital. According to the existing policies, the size of special-purpose bond funds used as project capital should not exceed 20% of the size of special-purpose bonds in each province. In addition, in accordance with relevant requirements, special-purpose bond funds used as project capital can only be used for major projects related to gas and power supply, railways and highways. Special-purpose bond fund as a percentage of the total amount of project capital is fairly flexible, staying between 4.7% and 63%.

Scenarios 3 and 4 take into account the pull effect of capital funds on social investment on top of the above two scenarios. In 2020, the total amount of investment in special-purpose bonds issued by local governments in Xinjiang was RMB77.4 billion, of which, if 20% or RMB15.48 billion is assumed to be used as project capital, the matching social capital will be RMB61.92 billion. Therefore, this paper measures the pull effect of social capital funds leveraged by special-purpose bond-turned project capital, thus obtaining the total effect with the consideration of social capital funds (Scenario 3) and the pull effect when considering the social capital funds but excluding the retained capital (Scenario 4).

### 3.2 Analysis of Calculation Results

The pull effect of the special-purpose bonds issued by local governments in Xinjiang is calculated separately under the four scenarios, as shown in Table 4. The RMB77.4 billion local government special-purpose bonds can push the GDP of Xinjiang to grow by RMB42.27 billion, RMB35.12 billion, RMB77.548 billion and RMB69.34 billion respectively under the four scenarios. In 2020, Xinjiang achieved a regional GDP of RMB1379.758 billion, an increase of 3.4% from the previous year at comparable prices. In the four scenarios, the values of GDP boosted by local government special-purpose bond investment as a percentage of the total value of Xinjiang's GDP are respectively 3.06%, 2.55%, 5.62% and 5.03%. The GDP growth brought by special bond investment is not uniform across all sectors. Among them, the construction sec-

tor has the highest GDP growth, which is RMB13.706 billion, RMB11.993 billion, RMB25.699 billion, and RMB23.129 billion under four different scenarios. Other sectors that have a significant increase in GDP include wholesale and retail, transportation, warehousing and postal services, information transmission, software and information technology services, and finance.

**Table 4** The pull effect of local special bond investment on GDP of various sectors under the first and fourth scenarios of caliber 1 and 4 (100 million yuan)

Sector	No consideration of driving social capital		Consideration of driving social capital	
	Total effect	Excluding retained funds	Total effect	Excluding retained funds
Agriculture, forestry and fishery products and services	10.225	6.956	17.726	14.457
Mining and washing of coal	7.456	6.221	13.725	12.490
Oil and gas extraction	3.827	3.156	7.027	6.356
Metal ore mining	4.150	3.395	7.828	7.073
Mining and dressing of non-metallic ores and other minerals	2.205	1.886	3.985	3.666
Food and tobacco	1.811	1.417	3.251	2.856
Textiles	0.513	0.416	0.943	0.832
Textiles, clothing, footwear, hats, as well as leather and down and their products	0.038	0.030	0.069	0.061
Woodwork and Furniture	1.383	1.201	2.548	2.366
Paper, printing and educational and sporting goods	6.945	5.586	12.280	10.921
Petroleum, coking products and processed nuclear fuel products	13.222	10.923	24.259	21.960
Chemical products	11.085	8.992	20.259	18.184
Non-metallic mineral products	13.160	11.354	23.792	21.986
Metal smelting and rolling processed products	14.285	11.691	27.021	24.427
metal products	3.263	2.704	6.371	5.812
General equipment	5.348	4.055	10.906	9.613
Special equipment	1.965	1.504	7.846	7.399
transportation equipment	3.303	1.992	5.426	4.115
Electrical machinery and equipment	4.876	3.927	10.524	9.575
Communication equipment, computers and other electronic equipment	0.505	0.365	1.255	1.116
Instrumentation	1.797	1.415	3.556	3.212
Other manufactured products and scrap	0.105	0.086	0.179	0.160
Metalwork, machinery and equipment repair services	0.042	0.034	0.079	0.071
Production and supply of electricity and heat	15.579	13.354	31.158	26.707
Production and supply of gas	0.067	0.055	0.124	0.112
Production and supply of water	0.121	0.097	0.226	0.202
Construction	137.059	119.926	256.986	231.287
Wholesale and retail	30.031	26.174	53.872	50.016
Transportation, storage and postal services	26.471	21.024	52.158	46.711

**Table 4** (Continued)

Sector	No consideration of driving social capital	Consideration of driving social capital	
	Total effect	Excluding retained funds	Excluding retained funds
Accommodation and catering	5.216	4.204	9.971
Information transmission, software and information technology services	27.668	22.348	49.103
Finance	27.509	21.943	40.874
Real estate	13.155	10.514	23.706
Leasing and business services	3.524	2.088	5.511
Research and experimental development	0.000	0.000	0.000
Integrated technical services	16.732	13.690	26.459
Water conservancy, environment and public facility management	0.151	0.117	0.268
Residential services, repairs and other services	5.211	4.207	9.386
Education	0.735	0.597	1.332
Health and social work	0.046	0.039	0.085
Culture, sports and recreation	1.522	1.204	2.725
Public administration, social security and social orga- nizations	0.400	0.314	0.686
Total	422.704	351.199	775.483

Correspondingly, the pull effect of special-purpose bond investment made by local governments in Xinjiang under the four scenarios on local employment by sector is shown in Table 5. Due to the RMB77.4 billion local government special-purpose bond investment, the number of new jobs thus created in Xinjiang was respectively 372,300, 324,500, 718,500 and 601,300 in the four scenarios. In 2020, the total number of people employed in Xinjiang amounted to 13.56 million, of which, the proportion of the number of people employed due to the local government special-purpose bond investment stood at 2.75%, 2.39%, 5.3% and 4.43% respectively in the four scenarios. The number of jobs driven by special bond investment is not uniform among different sectors. Among them, the employment growth in the construction sector is the highest, reaching 142,640, 137,530, 305,660, and 240,700 in the four scenarios. Other sectors with significant job growth include agriculture, forestry and fishery products and services, wholesale and retail, transportation, storage and postal services, integrated technical services, and information transmission, software and information technology services.

The financing cost is not considered in Caliber 1. Based on the above scenario, the financing cost is further considered in Caliber 2. The interest of the bond is calculated according to Formula (8). The sum of interest and principal is the bond value to maturity in Formula (7), which is discounted by Formula (9) into the present value of the bond, i.e. the financing cost. Among these, the discount rate is composed of the sum of the risk-free rate of return, risk-based

**Table 5** Pull effect of local special bond investment on employment in various sectors under caliber 1 and 4 scenarios (10,000 people)

Sector	No consideration of driving social capital	Consideration of driving social capital	
	Total effect	Excluding retained funds	Excluding retained funds
Agriculture, forestry and fishery products and services	3.572	2.441	6.220
Mining and washing of coal	0.269	0.226	0.499
Oil and gas extraction	0.048	0.048	0.107
Metal ore mining	0.041	0.029	0.067
Mining and dressing of non-metallic ores and other minerals	0.139	0.121	0.256
Food and tobacco	0.064	0.046	0.106
Textiles	0.092	0.069	0.156
Textiles, clothing, footwear, hats, as well as leather and down and their products	0.007	0.005	0.012
Woodwork and Furniture	0.051	0.044	0.093
Paper, printing and educational and sporting goods	0.456	0.386	0.849
Petroleum, coking products and processed nuclear fuel products	0.186	0.124	0.275
Chemical products	0.390	0.312	0.703
Non-metallic mineral products	0.638	0.551	1.155
Metal smelting and rolling processed products	1.055	0.937	2.166
metal products	0.161	0.131	0.309
General equipment	0.296	0.228	0.613
Special equipment	0.075	0.056	0.292
transportation equipment	0.377	0.228	0.621
Electrical machinery and equipment	0.104	0.087	0.233
Communication equipment, computers and other electronic equipment	0.010	0.007	0.024
Instrumentation	0.163	0.122	0.307
Other manufactured products and scrap	0.003	0.002	0.004
Metalwork, machinery and equipment repair services	0.002	0.002	0.005
Production and supply of electricity and heat	0.401	0.401	0.936
Production and supply of gas	0.002	0.002	0.005
Production and supply of water	0.009	0.009	0.021
Construction	14.264	13.753	30.566
Wholesale and retail	2.843	2.479	5.102
Transportation, storage and postal services	2.213	1.763	4.374
Accommodation and catering	1.229	1.008	2.391
Information transmission, software and information technology services	1.759	1.407	3.091
Finance	1.346	1.065	1.984

**Table 5** (Continued)

Sector	No consideration of driving social capital	Consideration of driving social capital	
	Total effect	Excluding retained funds	Excluding retained funds
Real estate	0.877	0.686	1.547
Leasing and business services	0.756	0.447	1.180
Research and experimental development	0.000	0.000	0.000
Integrated technical services	1.958	1.585	3.063
Water conservancy, environment and public facility management	0.022	0.017	0.039
Residential services, repairs and other services	0.816	0.700	1.562
Education	0.169	0.113	0.252
Health and social work	0.007	0.007	0.015
Culture, sports and recreation	0.266	0.199	0.450
Public administration, social security and social orga- nizations	0.094	0.094	0.205
Total	37.230	32.448	71.853

rate of return and the inflation rate. The coupon rate of government bonds is used to replace the risk-free rate of return. The five-year coupon rate in 2020 is 3.97%. The risk-reward rate is taken as the average interest rate of 3.42% for government special-purpose bonds. In 2020, the International Monetary Fund forecasts that China's inflation rate stays at 2.5%. The discount rate is thus taken as 9.89%. The financing costs under Scenarios 3 and 4 are calculated to be RMB5.672 billion and RMB5.072 billion respectively. According to Caliber 2, the pull effects on GDP after deducting the corresponding financing costs for the three scenarios are RMB71.876 billion and RMB64.268 billion respectively. The pull effect of local government special-purpose bond investment on GDP for two scenarios under two calibers is shown in Table 6.

**Table 6** Pulling effect of local special bond investment on GDP under four scenarios under different calibers (100 million yuan)

	Scenario 3	Scenario 4
Caliber 1	775.483	693.400
Financing cost	56.724	50.718
Caliber 2	718.759	642.682

## 4 Conclusion

Based on the input-output technique, this paper constructs a method for measuring the contribution of local government special-purpose bond investment to GDP and employment and measures the contribution of local government special-purpose bond investment to GDP and employment in Xinjiang in 2020 respectively under two calibers and four scenarios on

the basis of a specific breakdown of the sectors that local government special-purpose bond investment goes to. The results show that in 2020, the RMB77.4 billion special-purpose bond investment made by local government in Xinjiang can help increase GDP by RMB42.27 billion and the total employment by 372,300; when further consideration is given to the role of special-purpose bond capital in leveraging social capital, it can boost GDP by RMB77.548 billion and total employment by 718,500.

It's necessary to note that this paper assumes that all of the RMB77.4 billion special-purpose bond investment made by local governments in Xinjiang was turned into capital in the same year. Given the complexity of the capital formation process, heterogeneity of different projects, and the need to obtain data on the timing of capital formation and the rate of capital formation, this paper does not consider the time lag of investment in its calculations, i.e., it is assumed that the investment is fully capitalized in the same year. However, in practice, projects such as infrastructure construction feature long construction periods. The RMB77.4 billion of local government special-purpose bond investment cannot all be converted into capital in the same year, so its pulling effect on our economy will continue to be felt for years to come.

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