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HOW LARGE WILL BE THE EFFECT OF CHINA'S FISCAL- STIMULUS PACKAGE ON OUTPUT AND EMPLOYMENT?

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Abstract

This paper studies the effects of the fiscal-stimulus package in Mainland China on its output and employment. Using the input-output table as the analytical framework, we argue that the aggregate effect on output and employment of a given amount of fiscal spending depends on the distribution of such spending across different economic sectors. We estimate that the announced fiscal spending of RMB2 trillion yuan in 2009 could lead to a direct increase in output of RMB1.7 trillion yuan, implying a fiscal multiplier of around 0.84 in the short-run, and could potentially generate 18 million to 20 million new jobs in non-farming sectors. We further argue that the size of the fiscal multiplier also depends on the cyclical conditions of the economy and the policy environment, which we simulate using a dynamic structural model. Model results show that the fiscal multiplier in the medium run is around 1.1 as government fiscal spending leads to higher household consumption and corporate investment, which will take time to fully materialise.

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Executive Summary:

- *As the global financial crisis worsens, fears over a sharp economic downturn in Mainland China have heightened. The authorities have rolled out a series of measures to mitigate the adverse impacts of the financial crisis. On the fiscal policy front, the central government announced in November 2008 that a stimulus package of RMB4 trillion yuan would be launched during 2009-2010, with most of the funds targeted at infrastructure. The economic outlook for the Mainland economy hinges critically on the effectiveness of this package, since it is unlikely that the external environment will provide much stimulus in the coming year.*

- *This paper evaluates the potential impact of the fiscal-stimulus package on output and employment on the Mainland. We utilise two approaches to gauge the effects of the package. First, we employ the input-output (IO) table which allows us to track the impact of fiscal spending at sector level through upstream and downstream linkages. Since the fiscal package is heavily concentrated in several sectors, an accurate estimate of its impact requires precise identification of the sector level linkages, which is the strength of the IO table.*

- *The IO-table approach has its limitations because it is a static analysis and does not consider second-round effects on components of final demand. To complement the IO table analysis, the second approach employs a dynamic stochastic general equilibrium model to explore the transmission mechanisms of the fiscal package. The model provides a platform to simulate the cyclical conditions under which the fiscal-stimulus package is launched, and the endogenous response of prices and other macroeconomic variables to increased fiscal spending.*

- *Analysis using the IO-table shows that the fiscal stimulus of RMB2 trillion yuan in 2009 could lead to a direct increase of close to RMB1.7 trillion yuan of output, implying a fiscal multiplier of around 0.84. Further analysis of the labour income generated by such an increase in output shows that the fiscal package could potentially generate 18 million to 20 million new jobs in non-farming sectors, depending on how the fiscal spending is allocated across sectors. The impact seems large, but displaced workers might incur costs in moving into sectors that require new skills. Policy measures that facilitate such transition would help to make the fiscal policy more effective in job creation.*

- *The effectiveness of the fiscal stimulus hinges not only upon the production and employment structure of an economy, but also upon its cyclical conditions, the exchange rate regime, its openness and other factors. Our simulations using the IMF Global Integrated Monetary and Fiscal model, which has been calibrated by us for the Asia-Pacific region, show that while the fiscal multiplier on output ranges between 0.80 and 0.84 in the short run, it is about 1.1 in the medium run under the current cyclical background of a significant global economic downturn. The distinction between the short term and medium term effects is important for the discussion of the economic outlook in 2009.*

I. INTRODUCTION

As the global financial crisis worsens, fears over a sharp economic downturn in Mainland China have heightened. A survey conducted by the Ministry of Agriculture[1] reveals that about 20 million workers have returned from urban areas to their hometowns in rural areas in recent months due to job losses. Reports from other sources confirm the economic slowdown has led to sizeable job loss.[2] The Mainland authorities have rolled out a series of measures to mitigate the adverse impacts of the financial crisis. On the fiscal policy front, the central government announced in November 2008 that a stimulus package of RMB4 trillion yuan would be launched during 2009-2010, with most of the funds targeted at infrastructure. The economic outlook for the Mainland economy hinges critically on the effectiveness of this package, since it is unlikely that the external environment will provide much stimulus in the coming year.

This paper evaluates the potential impact of the fiscal-stimulus package on output and employment in Mainland China. We utilise two approaches to gauge the effects of the package. First, we employ the input-output (IO) table which allows us to track the impact of fiscal spending at sector level through upstream and downstream linkages. For instance, the IO table shows, for a given amount of money spent in the construction sector, how much output and employment will be generated in the construction sector as well as in other sectors which supply intermediate inputs to construction. Since the fiscal package is heavily concentrated in several sectors, an accurate estimate of its impact requires precise identification of the sector level linkages, which is the strength of the IO table. The IO-table approach has its limitations since it is a static analysis and does not consider second-round effects on components of final demand. To complement the IO table analysis, the second approach employs a dynamic stochastic general equilibrium model to explore the transmission mechanisms of the fiscal package. The model does not capture the sector level linkages, but provides a platform to simulate the cyclical conditions under which the fiscal-stimulus package is launched, and the endogenous response of prices and other macro variables to increased fiscal spending. The pros and cons of the two approaches will be further discussed in later sections.

This paper distinguishes the short-run and medium-run effects of the fiscal package. To illustrate the difference between the two effects, consider the construction of a road which is financed by fiscal spending. The construction would lead to demand for labour and output in the construction sector and other sectors through the linkages identified in the IO table. Therefore, the short-run

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[1] The statistics was quoted in a speech given by a senior government official, Xiwen Chen (2009). The speech is is available on http://www.sgdaily.org.cn/news/2009-02/03/content_97223.htm.

[2] It was reported in an earlier issue of the Caijing Magazine (2009) that more than 10 million workers have returned home several weeks ahead of the 2009 Chinese New Year for holidays (much earlier than that observed in previous years), with a notable proportion having lost their jobs. Wang and Hu (2009) also estimate that job losses may amount to 15-18 million in the first half of 2009.

effect of this project on employment and output from each sector can be pinned down using the IO table and is relevant for the discussion on how the fiscal spending could affect GDP and employment in 2009. The medium-term effect of the project refers to the consumption and investment this project eventually leads to, i.e., workers and firms who derive income from this project would increase their spending. We argue that such an effect is likely to take longer time to fully materialise.

Analysis using the IO-table shows that the fiscal stimulus of RMB2 trillion yuan in 2009 could lead to a direct increase of close to RMB1.7 trillion yuan of output, implying a fiscal multiplier of around 0.84. This is consistent with Hemming, Mahfouz, and Schimmelpfennig (2002), who study fiscal policies in 43 countries and suggest that the fiscal multiplier is likely to be less than one. Further analysis of the labour income generated by such an increase in output shows that the fiscal package could potentially generate 18 million to 20 million new jobs in non-farming sectors,[3] depending on how the fiscal spending is allocated across sectors. The estimated impact on employment is consistent with the findings in Feenstra and Hong (2007) who study the effect of export growth on employment in China. We find that the majority of the jobs created by the fiscal stimulus are not in agriculture and manufacturing industries, which implies that workers who have lost their jobs in the manufacturing industries need to pick up new skills in order to take up jobs created by the fiscal stimulus.

Simulations using a dynamic structural model confirm our findings on the effect of fiscal policy on output. A fiscal shock of one-percent of GDP is estimated to increase GDP growth by 0.8 percentage points in the first year. The effect dissipates rapidly after the first year, and leads to a total cumulative increase of GDP by 1.1 percentage points over a period of two years.

As far as we know, this paper is the first in the literature that studies the effect of fiscal policy on output and employment in China using an analytical framework that takes into account both industrial linkages and cyclical conditions of the economy. Most existing studies derive a single fiscal multiplier in a Keynesian framework by making assumptions of or estimating the marginal propensities to consume, to invest, and to import. The multiplier falls within a range of 1 to 1.5 in Peng and Zheng (2008), and Wang et al. (2008), while it has a range of 2.53 to 5.36 in Liu and Tsang (2009). There are several reasons why our estimate is smaller than their assumptions. First, estimates in these studies include both the short- and medium-run effects, while our estimates explicitly separate out these two effects. We argue that the short-run effect is more relevant in analysing the implications for growth in 2009. Second, their studies are based on analysis at the aggregate level, while our approach is "bottom-up" and takes into account the fact that the short-run multiplier may take a range of values rather than a single value,

[3] We focus on the jobs created in the non-farming sectors. The labour statistics in the agriculture sector is less accurate than those in non-farming sectors, which makes the inference of jobs in the agriculture sector difficult. This issue is further discussed in section III.

depending on the specific allocation of fiscal spending across different sectors. The fact that fiscal spending is heavily concentrated in several sectors indicates that a sector-based approach might provide a more accurate estimate of the effectiveness of fiscal packages.

The remainder of this paper is organised as follows. The second section introduces briefly the methodology using the IO table. The third section estimates the employment and value added inducement coefficients across sectors. Section IV describes the fiscal package in detail and estimates its effect on employment and output. Section V discusses effects of government spending using a dynamic structural model. Section VI concludes.

II. METHODOLOGY

The IO table makes it possible to analyse sectoral linkages within the economy in a particular period and allows us to have a clear understanding of the relationship between final demand, output, and income. As we aim at studying the effects of government spending on China's employment and domestic value added, it is necessary to distinguish domestic intermediate inputs from imported intermediate inputs. The reason that we need to split domestic intermediate inputs and imported intermediate inputs is that the latter are produced abroad and do not generate any domestic value added. This is particularly relevant for China since intermediate imports have accounted for a majority of its total imports in the past years. Therefore we employ an IO table with non-competitive imports, which is also the approach taken by He and Zhang (2008).

The structure of the IO table is illustrated as follows. Given the IO table with non-competitive imports as illustrated in Table A1 of the Appendix, the following two equations hold:

$$\begin{aligned} A^D X + F^D &= X \\ A^M X + F^M &= M \end{aligned} \tag{1}$$

where A^D denotes the matrix of direct input coefficients of domestic products, X the total output column vector, M the total imports vector, A^M the matrix of direct input coefficients of imported products, F^D the column vector of final demand for domestic products, and F^M the column vector of final demand for imports. In particular, $A^D = \left[\frac{X_{ij}^D}{X_j} \right]$, $A^M = \left[\frac{X_{ij}^M}{X_j} \right]$. As a result, $X = (I - A^D)^{-1} F^D$, with the inverse matrix $(I - A^D)^{-1}$ referred to as the output multiplier of final demand. Denoting the sectoral fiscal stimulus with the column vector *F*, and the vector of value added induced by the fiscal-stimulus package

with V_F, we know that

$$V_F = A_v(I - A^D)^{-1}F \tag{2}$$

with A_v being a diagonal matrix whose *i*th element on the diagonal is the ratio of sector *i*'s value added to its total inputs (or gross output). The term $A_v(I - A^D)^{-1}$ is then referred to as the value-added multiplier of final demand. The *i*th element of the V_F vector is the *direct* value-added, and the sum of all elements of the V_F vector is the *total* value-added, induced by final demand for the output of the sector. Denoting A_v^L as the diagonal matrix whose *i*th element on the diagonal is the ratio of sector *i*'s labour income to its gross output, we can calculate the labour income induced by the fiscal stimulus with the formula

$$V_F^L = A_v^L(I - A^D)^{-1}F \tag{3}$$

with V_F^L being the vector of labour income induced by the government expenditure. The *i*th element of the V_F^L sector is the *direct* labour income, and the sum of all elements of the V_F^L sector is the *total* labour income, induced by government spending on the output of the sector.

The official IO tables of China do not separate domestic intermediate inputs from imported intermediate inputs. Employing a quadratic dynamic programming algorithm, Koopman et al. (2008) separate intermediate imports from final imports at sectoral levels in the 1997 and 2002 IO tables for China. Assuming that the ratios of intermediate imports to final imports in all sectors in 2005 remained unchanged from those in 2002, we have reconstructed the 2005 IO table separating out non-competitive imports.

III. EMPLOYMENT COEFFICIENTS AND VALUE-ADDED INDUCEMENT COEFFICIENTS

Dividing the whole economy into 17 sectors, we calculate the employment coefficients, defined as the numbers of vacancies generated by an increase of RMB10,000 yuan in each sector's final demand. We first calculate labour income across sectors induced by the RMB10,000 yuan increase in the final demand of each sector independently, and then use the annual sectoral wages to calculate the employment generated accordingly.[4] The estimates are presented in Table 1. While the "*Direct*" column presents only the number of vacancies

[4] We first estimate annual sectoral wages using data from CEIC for 2008, and by assuming nominal wages to increase by 5% in 2009 from those of the previous year, we then estimate the 2009 sectoral wages. In the past 15 years wages in all 17 sectors have seen significant increases, with the lowest rate being around 7%. Thus, assuming a 5% growth seems to be reasonable given the gloomy economic outlook.

created in a sector which sees an increase of RMB10,000 yuan in the final demand for its output, the "*Total*" column also includes vacancies generated in other sectors by the increased final demand in this sector.

There is considerable variation across sectors in terms of how many jobs a given amount of demand can generate. The agricultural sector has the highest employment coefficients, with the direct and the total employment coefficients being 0.488 and 0.508, respectively. This can partly be attributed to the facts that the agricultural sector has the lowest labour productivity and that it does not use much of imported intermediates. In fact, the annual wages in the agricultural sector is estimated to be around RMB13,000 yuan in 2009, less than half of the average sectoral wage in the same year. In addition, the direct input coefficients of imported intermediates in the agricultural sector have been lower than the sectoral average values.

Table 1: Employment and value-added (VA) inducement coefficients across sectors

Sector	Employment Coefficient (Persons/RMB10K)		VA Inducement Coefficient	
	Direct	Total	Direct	Total
Agriculture	0.488	0.508	0.710	0.921
Mining and quarrying	0.035	0.077	0.523	0.862
Foodstuff	0.035	0.261	0.347	0.883
Textile, sewing, leather and furs products	0.074	0.191	0.334	0.771
Other manufacturing	0.038	0.115	0.375	0.765
Production and supply of electric power, heat power and water	0.022	0.071	0.402	0.855
Coking, gas and petroleum refining	0.011	0.053	0.211	0.638
Chemical industry	0.040	0.107	0.331	0.740
Building materials and non-metal mineral products	0.053	0.111	0.311	0.832
Metal products	0.038	0.087	0.330	0.774
Machinery and equipment	0.036	0.081	0.278	0.654
Construction	0.059	0.154	0.258	0.821
Transportation, postal and telecommunication services	0.037	0.079	0.521	0.840
Wholesale and retail trades, hotels and catering services	0.060	0.137	0.534	0.894
Real estate, leasing and business services	0.027	0.067	0.583	0.882
Banking and insurance	0.045	0.075	0.663	0.915
Other services	0.098	0.151	0.501	0.870

Source: authors' estimates.

The *other services* sector has the second highest direct employment coefficient of 0.098, consistent with the fact that service sectors are relatively labour intensive. The textile sector also features a similarly large direct employment coefficient of 0.074, followed by the wholesale (retail) trades and catering services. The total employment coefficients, however, may show a somewhat different picture. Although the agricultural sector still has the highest employment coefficient, the foodstuff sector, whose direct employment coefficient is only 0.035, takes the second place with the total employment coefficient recording 0.261. The main reason is that the foodstuff sector uses a large quantity of inputs from agriculture and leads to an impressive amount of employment in the primary industry. The textile industry ranks the third with regard to total employment coefficient. The machinery and equipment sector has a direct coefficient of 0.036 and total coefficient of 0.081, lower than most sectors. This is not surprising given that this sector uses more imported intermediates as inputs. Indeed, the direct input coefficient of imported intermediates in this sector is 0.15, which is remarkably higher than other industries, partly reflecting that this sector accounts for a large portion of processing exports.

Dividing the sum of the third column (total employment coefficient) by 17, we obtain a rough estimate of the aggregate employment coefficient of 0.137.[5] That is, an increase of RMB10,000 yuan in final demand may raise the employment by 0.137 person per year. Using the 2002 IO table, Lau et al. (2006) find that an increase of US$1,000 in China's domestic demand may lead to an increase in employment of 0.440 person. Feenstra and Hong (2007), however, claim that Lau et al. (2006) have overestimated the employment coefficient. Employing certain refined methodologies and using the 2000 IO table, they argue that China's employment coefficient ranges between 0.11 to 0.13 per US$1,000 (or between 0.133 to 0.157 per RMB10,000 yuan), rather close to our estimate of 0.137. Because labour statistics in the agricultural sector is typically considered less reliable than in the other sectors, we focus our discussion on the employment coefficient in the non-farming sectors, which has an aggregate employment coefficient of 0.107, significantly lower than 0.137 for the economy as a whole.

The sectors also vary substantially in terms of the amount of output a given amount of final demand could lead to. The fourth and fifth columns of Table 1 show the direct and total valued-added-inducement coefficients, defined as the ratios of induced direct value-added to the increase in final demand, and induced total value-added to the increase in final demand, respectively. While the agricultural sector also features the highest direct and total VA inducement coefficients, the banking and insurance sector takes the second place despite its relatively low employment coefficients. In contrast, the cooking, gas and petroleum refining sector has the lowest value added inducement coefficient. Similarly, manufacturing is not in the top sectors of value added inducement coefficients. In addition, although the construction sector has the lowest direct

[5] If we assume annual wages remain the same as in 2008, the aggregate employment coefficient is then about 0.144.

value added inducement coefficient, it has a significant total value added inducement coefficient of 0.82, implying that it has non-negligible linkages with other industries in the production chain. Dividing the sum of the last column by 17, we obtain a rough estimate of the multiplier of final demand of 0.82. That is, as final demand increases by RMB1 yuan, domestic value added may increase by about RMB0.82 yuan under the assumption that the increase in final demand is equally distributed across sectors. As discussed in the following section, the fact that the multiplier is smaller than one is due to leakages through imports of intermediate inputs. These estimates indicate that the effect of a fiscal-stimulus package could vary sizeably depending on how the spending is allocated across sectors.

IV. EFFECTS OF THE FISCAL-STIMULUS PACKAGE ON DOMESTIC EMPLOYMENT AND VALUE ADDED

Based on the empirical results of the previous section, the 2005 IO table is used in this section to evaluate the effects of the announced fiscal-stimulus package on China's employment, output and imports at both sectoral levels and aggregate level. According to the available public documents, the fiscal-stimulus package can bebroken down into items listed in Table 2, showing that most of the funding is targeted at construction and infrastructure.

Table 2: Components of the fiscal-stimulus package

Item	Amount (RMB, bn)	Share (%)
Transportation and power grids	1,800	45.0
Post-earthquake reconstruction	1,000	25.0
Rural infrastructure	370	9.25
Environment projects	350	8.75
Public housing	280	7.0
R&D	160	4.0
Healthcare and education	40	1.0
Sum	4,000	100

Source: Press conference speech by Mr Ping Zhang, the head of National Development and Reform Commission, 27 November 2008.

Because value added inducement and employment coefficients differ significantly across sectors, the effects of any fiscal stimulus hinge upon the specific allocation of the funds. Therefore, different ways to match the seven items in Table 2 with the 17 sectors in the IO table would lead to different results. Since there is considerable uncertainty as to how the government plans to allocate spending across sectors, we consider three scenarios (Table 3) which differ mainly in the patterns of allocation of funding for "transportation and power grids" and funding for "public housing". In scenario A we allocate two-thirds of the transportation and power grids funds to the transportation sector and the remaining 1/3 into power production. Moreover, we allocate all public housing funds to the

real estate sector in the IO table. In scenario B we allocate half of the transportation and power grids funds to transportation and the other half into power production. All public housing funds are put into the construction sector. In scenario C we distribute the transportation and power grids funds equally to the three sectors of construction, transportation and power production in the IO table. Two-thirds of the public housing funds are allocated to construction, with the remaining one-third to the real estate sector.

Table 3: Scenarios of funds allocation

Item	Scenario A	Scenario B	Scenario C
Transportation and power grids	2/3 to transportation, 1/3 to power production	Half to transportation, half to power production	1/3 to transportation, 1/3 to construction, 1/3 to power production
Post-earthquake reconstruction	All to construction	All to construction	All to construction
Rural infrastructure	Half to construction, half to transportation	All to construction	All to construction
Environment projects	Half to construction, half to other services	Half to construction, half to other services	Half to construction, half to other services
Public housing	All to real estate	All to construction	2/3 into construction, 1/3 to real estate
R&D	All to other services	All to other services	All to other services
Healthcare and education	All to other services	All to other services	All to other services

The results of the above three scenarios are presented in Table 4 below, and Table A2 and Table A3 in the Appendix respectively. Table 4 indicates that total value added may increase by RMB1,683 billion yuan, suggesting a multiplier of around 0.84. This is slightly higher than the previous estimate of 0.82 obtained by equal allocations of final demand across sectors. A closer look at the third column shows that the transportation sector, which receives the largest proportion of the package, sees a rise in the value added of around RMB439 billion yuan. In contrast, the construction sector, which is allocated the second largest proportion of the package (marginally lower than that to the transportation sector), sees a modest increase in value added of RMB183 billion yuan. This is because the direct VA inducement coefficient of the transportation sector is double that of the construction sector. Nevertheless, the total value added induced by the construction sector is comparable to that of transportation given that they have similar total VA inducement coefficients of 0.82 and 0.84, respectively. Since construction has a much higher total employment coefficient than transportation (0.15 vs. 0.08), the former would induce much more employment than the latter.

Total employment would increase by 21.9 million,[6] suggesting an employment coefficient of 0.11 per RMB10,000 yuan, which is modestly lower than the above estimate of 0.137 obtained by assuming equal allocations of final demand across sectors. Employment in the non-farming sectors would increase by 17.3 million, suggesting a non-farming employment coefficient of about 0.087, lower than the estimate of 0.107 yuan when equally allocating funds across sectors.

Table 4: Value-added and employment induced in scenario A

Sector	Increases in Final Demand (RMB, bn)	Induced VA (RMB bn)	Induced Employment (10,000 persons, 2008 wages)	Induced Employment (10,000 persons, 2009 wages)
Agriculture	0.0	68.1	484	461
Mining and quarrying	0.0	120.6	84	80
Foodstuff (3)	0.0	10.0	11	10
Textile, sewing, leather and furs products	0.0	9.0	21	20
Other manufacturing	0.0	36.4	39	37
Production and supply of Electric power, heat power and water	300.0	163.9	93	88
Coking, gas and petroleum refining	0.0	38.5	21	20
Chemical industry	0.0	42.1	53	51
Building materials and non-metal mineral products	0.0	47.4	84	80
Metal products	0.0	64.0	78	75
Machinery and equipment	0.0	81.6	111	105
Construction	680.0	182.7	441	420
Transportation, postal and telecom services	692.5	439.3	324	308
Wholesale and retail trades, hotels and catering services	0.0	86.2	102	97
Real estate, leasing and business services	140.0	119.7	57	54
Banking and insurance	0.0	47.6	34	32
Other services	187.5	126.1	259	247
Sum	2,000	1,683.2	2,296.0	2,186.7

Source: authors' estimates.

In scenario B (see Table A2), the total value added would rise by RMB1,667 billion yuan, suggesting a value-added multiplier of 0.83, marginally lower than scenario A. Non-farming vacancies would rise by 20.4 million, about three million more than in scenario A, implying a non-farming employment coefficient of about 0.102. This is because the construction sector, which features a higher employment coefficient than the transportation and real estate sectors, has been allocated a much larger proportion of the funds than in scenario A. The results of scenario C lie between scenario A and scenario B, with total value added

[6] Accordingly, if annual wages remain unchanged from 2008, total employment may increase by 23 million.

rising by 1,670 billion and non-farming vacancies by 19.5 million, suggesting a multiplier of 0.835 and an employment coefficient of 0.098. These estimates suggest that while the fiscal-stimulus package seems to be relatively effective in inducing value added, it is less effective in creating employment than the benchmark case where all funds are allocated equally across the 17 sectors.

Increases in final demand not only induce domestic value added, but also generate leakages through importing intermediate inputs. The larger the share of imported intermediate inputs in total inputs, the lower the contribution of government spending to domestic value added. By employing equation (1), we can calculate the intermediate imports induced by the fiscal stimulus at sectoral levels with the following formula

$$M_F^I = A^M (I - A^D)^{-1} F \tag{4}$$

with M_F^I being the vector of intermediate imports induced by the fiscal stimulus *F*.

Table 5 indicates that total intermediate imports amount to RMB317 billion yuan, about 19% of the induced value added and around 16% of the fiscal package. It is particularly noteworthy that the machinery and equipment sector sees an increase of intermediate imports of RMB98 billion yuan, about 1.2 times the value added induced in that sector. This is mainly because imported intermediate inputs account for a large share of total inputs in this sector. The mining and quarrying sector sees the second largest increase in intermediate imports of RMB75 billion yuan, as the cooking, gas and petroleum sector uses plenty of imported mining and quarrying products as inputs. In contrast, the construction sector sees little increase in intermediate imports.

Table 5: Intermediate imports induced by Government spending in scenario A

Sector	Induced VA (RMB bn)	Induced Intermediate Imports (RMB bn)	Ratio of Induced Intermediate Imports to VA (%)
Agriculture	68.1	8.7	12.8
Mining andand quarrying	120.6	74.8	62.0
Foodstuff	10.0	1.8	18.2
Textile, sewing, leather and furs products	9.0	4.4	49.5
Other manufacturing	36.4	12.0	32.9
Production and supply of Electric power, heat power and water	163.9	0.2	0.1
Cooking, gas and petroleum refining	38.5	19.6	50.9
Chemical industry	42.1	38.8	92.1
Building materials and non-metal mineral products	47.4	2.0	4.3
Metal products	64.0	29.2	45.7
Machinery and equipment	81.6	97.7	119.8
Construction	182.7	0.1	0.0
Transportation, postal and telecom services	439.3	7.6	1.7
Wholesale and retail trades, hotels and catering services	86.2	5.9	6.8
Real estate, leasing and business services	119.7	7.1	5.9
Banking and insurance	47.6	4.1	8.5
Other services	126.1	2.8	2.3
Sum or Aggregate	1,683.2	316.8	18.8

Source: authors' estimates.

In sum, the effects of the fiscal-stimulus package of RMB2 trillion yuan can be summarized as follows: (a) value added may increase by close to RMB1,700 billion yuan, suggesting a short-run multiplier of around 0.84; (b) non-farming vacancies may rise by 17 million to 20 million; and (c) intermediate imports are expected to surge by more than RMB300 billion yuan. The following caveats need to be kept in mind when interpreting these findings:

- There is still high uncertainty on how the fiscal spending will be allocated across sectors. The three scenarios illustrate that the allocation could alter the impact of the fiscal spending by sizeable margins.

- The IO table approach does not consider the costs involved in labour mobility across sectors. The effectiveness of the fiscal package in creating jobs will be

higher if it is complemented with policies to facilitate job seekers to pick up new skills.

- The IO table approach is static and does not capture the endogenous adjustments in relative prices. We address this issue in the following section using a dynamic structural model.

V. THE FISCAL MULTIPLIER IN A DYNAMIC STRUCTURAL MODEL

The effectiveness of fiscal policy and size of the fiscal multiplier depend not only on the production and employment structure of the economy, which is well captured by the IO table, but also on the cyclical conditions of the economy. In order to better understand the transmission mechanisms of fiscal shocks through the economy at a particular cyclical juncture, and their interactions with monetary policy, it is necessary to use a dynamic structural model to explore the interactions between key macro variables in an economy. Here we use the Global Integrated Monetary and Fiscal (GIMF) model developed at the International Monetary Fund (IMF) and calibrated by the Hong Kong Monetary Authority (HKMA) to study the impacts of China's government spending on the domestic economy.[7] The GIMF is a dynamic stochastic general equilibrium (DSGE) multi-country model with overlapping generations which integrates domestic supply, demand, trade, and international asset markets in a single theoretical structure, thereby allowing transmission mechanisms to be fully articulated. The GIMF model embraces rich layers of demand and supply and is well suited for analyzing the domestic effects of monetary policy, fiscal policy, and structural reforms, as well as the global and regional implications of these policies and other events. The HKMA version of the GIMF model consists of eight regions: the US, Euro area, Japan, Mainland China, Korea, Australia-New Zealand, rest of the EMEAP (EMEAP6) and rest of the world.[8]

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[7] Detailed description of the model can be found in Kumhof and Laxton (2008), and calibration of the model for the Asia-Pacific region is demonstrated in N'diaye et al. (2008).

[8] EMEAP is the abbreviation of the Executives' Meeting of East Asian-Pacific Central Banks. Founded in 1991, EMEAP is a cooperative organization of central banks and monetary authorities in the East Asia and Pacific region. It comprises central banks and monetary authorities of the following eleven economies: Australia, Mainland China, Hong Kong SAR, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore, and Thailand.

The GIMF is flexible in capturing various forms of monetary policy, including a clear commitment to stabilizing output growth and inflation under a flexible exchange rate regime or under a managed float exchange rate regime. Fixed exchange rate regime is also easy to simulate. Short-term interest rate is the main monetary policy instrument. In the case of China, we assume that the central bank uses the monetary policy instrument to manage output, inflation as well as the exchange rate of the renminbi against the US dollar.[9] Regarding fiscal policy, the model has some key non-Ricardian features, making fiscal policy matter both in the short term and in the longer term. Fiscal policy instruments include government investment and consumption, transfers, and various forms of taxes. Government investment is modeled to be more productive than government consumption as the former features a higher coefficient in the Cobb-Douglas-type production function than the latter.

First, we simulate the cyclical background under which the fiscal package was announced namely, a substantial decline in the external demand and a negative shock to domestic confidence as a result of the global financial crisis. To be precise, the US GDP growth is assumed to decline by 2 percentage points, with the negative shock dying out in two years. In the GIMF model, external trade is the main channel through which US shocks are transmitted into others. To capture the spillovers of the US shock to other economies through financial linkages, we assume that domestic demand in those economies weakens in line with their financial exposure to the US.[10] Secondly, we introduce a positive shock to government spending in China on top of the external shocks. Assuming that the ratio of government spending to GDP in China rises by two percentage points for one year,[11] and that the exchange rate of the renminbi against the US dollar becomes more flexible in two years as global economy stages a gradual recovery,[12] we show the effects of the fiscal stimulus on the main economic variables in Figure 1. On a net basis, private consumption would rise by close to 2% as demand for labour goes up. In contrast, private investment would shrink by about 0.5% initially due to the somewhat higher interest rate after the fiscal stimulus is introduced. Investment would start to rise in the third year as the crowding-out effects dissipate. Imports would surge by about 2.8%, reflecting a significant leakage reduced by the government spending, as illustrated in the IO analysis. As a result, the ratio of trade balance to GDP in real terms would fall by over 0.7 percentage points in the first year.

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[9] We assume that an extended Taylor-type rule is employed by the central bank, with the coefficient for the exchange rate of the renminbi against the US dollar being 0.8. The reader is referred to N'Diaye et al. (2008) for more details of the monetary policy rule.

[10] Table 2 in N'Diaye et al. (2008) illustrates the financial exposure of regional economies to the US, in the form of holdings of US portfolio securities.

[11] This is a rough estimate of the rise in the ratio of China's central government deficits to GDP in 2009. In the simulations government spending is assumed to be financed by government debt, with tax rates remaining unchanged. Here we assume 95% of the fiscal impulse is government investment and the remaining 5% is government consumption. This is consistent with the package shown in Table 2.

[12] To be precise, we lower the coefficient of the exchange rate against the US dollar in the monetary policy rule from 0.8 to 0.6. China's foreign exchange rate risk premium is also modelled to decline slightly relative to the US dollar.

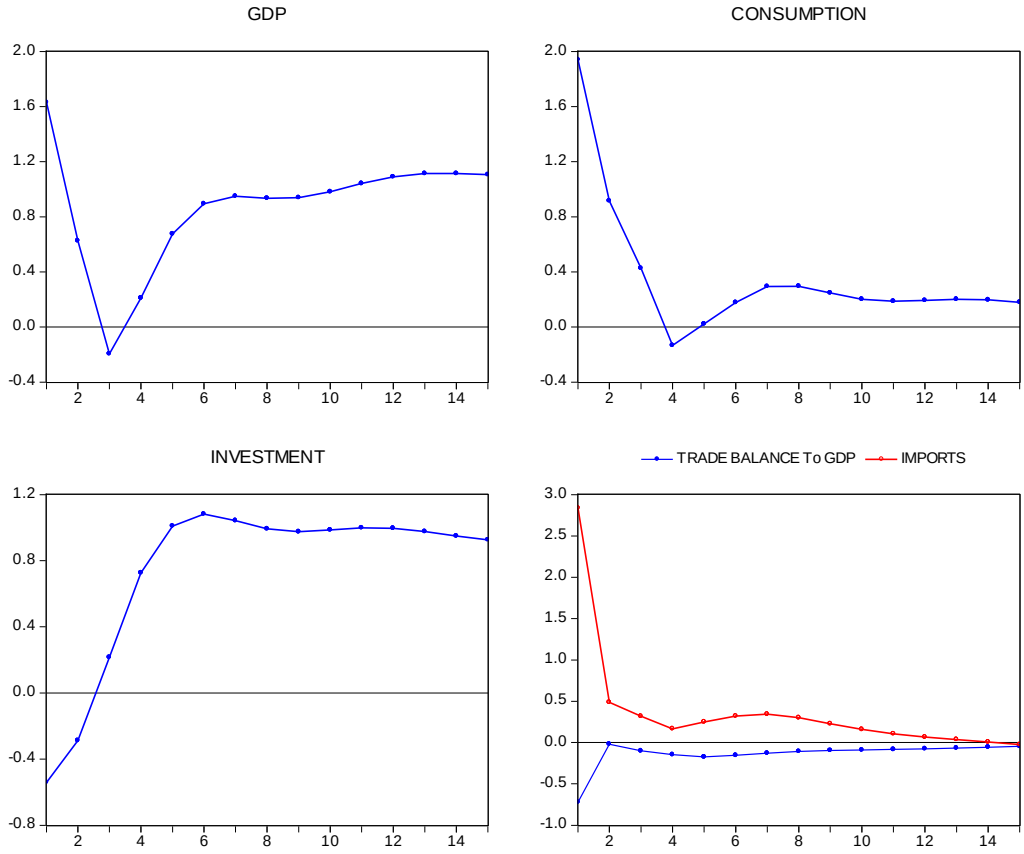
The overall impact of the fiscal expansion is an increase in GDP of about 1.6% in the first year, implying a short-run multiplier of 0.8. This is slightly lower than the estimate of around 0.84 in the IO analysis. The main reason is, as mentioned in the previous section, government spending is usually less productive than private spending. Indeed, the coefficient of public capital stock in the Cobb-Douglas-type production in the GIMF is calibrated as 0.1 which is notably lower than that for private capital stock, following estimates in literature.[13] In our earlier IO analysis, however, we can not distinguish the multiplier of government spending from that of private spending, and may have overestimated the effects of the fiscal stimulus.

As discussed before, a major advantage of the dynamic model over the IO analysis is while the latter is static in nature, the former can illustrate the dynamic effects of the fiscal stimulus. Figure 1 shows that the effects of the fiscal-stimulus package on GDP fade rapidly in the subsequent two years after it is launched, with the rise in GDP falling from 1.6% in the first year to around 0.6% in the second year, suggesting a mid-term multiplier of around 1.1. GDP would see a small decline in the third year since the recovery in private investment is not significant enough to offset adverse trade balance effects caused by the appreciation in REER. In addition, the figure indicates that GDP growth would turn positive in the fourth year and trend upwards in subsequent years. A closer look at the simulation results, however, suggests that the rebound should be mainly attributed to the recovery in external demand rather than to the fiscal stimulus directly. In fact, China's fiscal expansion would exert some non-negligible positive effects on its major trade partners, shielding them to some extent from the global economic downturn.[14] The expansion of exports, together with the dissipation of crowding-out effects and leakage, propels domestic investment, consumption and, as a result, prompts GDP growth in the longer term.

[13] He, Zhang and Shek (2007) find that the coefficient of infrastructure in the production function is around 0.08 in China, while that of private capital stock is about 0.6.

[14] The simulation shows that China's fiscal stimulus may boost the GDP growth of EMEAP6, Korea, Australia-New Zealand and Japan by about 0.40, 0.35, 0.10 and 0.09 percentage points respectively in the first year.

Figure 1: Effects of Government spending in China in the face of external downside shocks (in percent)



Source: authors' estimates.

When interpreting the simulation results, the following comments merit mentioning:

- Based on the fiscal-stimulus package composition illustrated in Table 2, we have assumed in the simulation exercise that 95% of the government spending to be investment, with the remaining 5% consumption. We have also conducted a counterfactual study by allocating the whole fiscal-stimulus package to government consumption and find that the multipliers would be lower than those obtained above, being 0.75 in the short run and about 0.93 in the medium term. This is because government consumption is less productive than government investment.

- The effectiveness of fiscal stimulus hinges greatly upon the cyclical economic condition under which it is launched. While most studies on China's fiscal stimulus do not consider this factor, in the above dynamic analysis we have mimicked the initial conditions of this package, namely, a global slowdown originating in the US. To see what roles initial conditions may play, we have conducted a counterfactual analysis by assuming that the government spending is introduced when the economy is at its steady state and the output gap is zero.

The simulation shows that the impacts of the stimulus would differ significantly from what is shown above. To be precise, inflation would pick up by 1.5 percentage points mainly owing to resource constraints, with policy interest rate rising by about a similar magnitude to counteract inflationary pressure. The crowding-out effects would lead to a 2% decline in private investment. Accordingly, the multiplier would be 0.81 in the first year, and turn negative in the second year.

VI. CONCLUDING REMARKS

This paper utilises the input-output table and a DSGE model to assess the effect of China's fiscal-stimulus package on its output and employment. We find that the aggregate effect on output and employment of a given amount of fiscal spending depends on the distribution of such spending among different economic sectors. The fiscal stimulus could generate 18 to 20 million new jobs in non-farming sectors. The size of the impact seems large, but displaced workers might face costs moving into sectors that require new skills. Policy measures that facilitate such transition would help to make the fiscal policy more effective in job creation.

The effectiveness of the fiscal stimulus hinges not only upon the production and employment structure of an economy, but also upon its cyclical conditions, the exchange rate regime, its openness and other factors. Our estimates show that while the fiscal multiplier on output ranges between 0.80 and 0.84 in the short run, it is about 1.1 in the medium term under the current cyclical background of a significant global economic downturn. The distinction between the short term and medium term effects is important for the discussion of the economic outlook in 2009. As most studies on the fiscal package in China do not make this distinction, they might have overstated the size of the fiscal multiplier.

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Appendix

Table A1: Input-output table with non-competitive imports

	Intermediate demands	Final demands	Gross domestic output (X_i) or imports (M_i)
	1,2,…, n	Domestic final demand + exports	
Domestic intermediate inputs 1 2 : n	X_{ij}^{D}	F_i^{D}	X_i
Imported intermediate inputs 1 2 : n	X_{ij}^{M}	F_i^{M}	M_i
Value added Fixed asset depreciation Labour income Net taxes on production Operation surplus	V_j		
Total inputs	X_j		

Source: Chen et al (2007).

Table A2: Results of scenario B

Sector	Increases in Final Demand (RMB, bn)	Induced VA (RMB, bn)	Induced Employment (10,000persons, 2008 wage)	Induced Employment (10,000persons, 2009 wage)
Agriculture	0	98.2	697.3	664.1
Mining and quarrying	0	149.7	103.8	98.8
Foodstuff	0	11.5	12.3	11.7
Textile, sewing, leather and furs products	0	9.7	22.8	21.7
Other manufacturing	0	42.5	45.6	43.4
Production and supply of Electric power, heat power and water	450	229.4	129.9	123.7
Coking, gas and petroleum refining	0	29.5	16.3	15.5
Chemical industry	0	51.1	64.7	61.6
Building materials and non-metal mineral products	0	86.0	152.4	145.1
Metal products	0	93.5	114.5	109.1
Machinery and equipment	0	72.3	98.1	93.4
Construction	1362.5	354.4	855.4	814.7
Transportation, postal and telecom services	0	129.3	95.3	90.8
Wholesale and retail trades, hotels and catering services	0	96.1	113.6	108.2
Real estate, leasing and business services	0	42.2	20.1	19.2
Banking and insurance	0	41.5	29.6	28.2
Other services	187.5	129.6	266.8	254.1
Sum	2,000	1,666.5	2,838.5	2,703.3

Source: authors' estimates.

Table A3: Results of scenario C

Sector	Increases in Final Demand (RMB, bn)	Induced VA (RMB, bn)	Induced Employment (10,000persons, 2008 wage)	Induced Employment (10,000persons, 2009 wage)
Agriculture	0	90.2	640.7	610.2
Mining and quarrying	0	129.8	90.0	85.7
Foodstuff	0	11.1	11.8	11.3
Textile, sewing, leather and furs products	0	9.5	22.2	21.1
Other manufacturing	0	41.1	44.2	42.1
Production and supply of Electric power, heat power and water	300	169.8	96.1	91.6
Coking, gas and petroleum refining	0	33.0	18.2	17.4
Chemical industry	0	48.2	61.1	58.2
Building materials and non-metal mineral products	0	74.8	132.6	126.2
Metal products	0	84.6	103.6	98.6
Machinery and equipment	0	74.9	101.6	96.7
Construction	1165.8	305.3	736.8	701.7
Transportation, postal and telecom services	300	265.9	196.0	186.7
Wholesale and retail trades, hotels and catering services	0	92.4	109.3	104.1
Real estate, leasing and business services	46.7	68.6	32.8	31.2
Banking and insurance	0	43.3	30.9	29.4
Other services	187.5	127.6	262.6	250.1
Sum	2,000	1,670.1	2,690.3	2,562.2

Source: authors' estimates.