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KEY POINTS

- This brief uses multiregional input–output tables to estimate the cross-border spillover benefits to Mongolia (as a close neighbor) of a border investment program in the Inner Mongolia Autonomous Region of the People's Republic of China.
- The results of the exercise suggest that induced output growth could reach 5% and create 33,000 jobs, 1.4 times higher than without indirect spillover. It also has an impact on employment, which could be 2.6 times higher.
- However, these gains could be lower if additional income cannot be fully spent within Mongolia. The country needs to keep developing its own input markets and human capital in order to fully benefit from projects along the border.

Gauging the Cross-Border Spillover Impact of An Inner Mongolia Autonomous Region Investment Program on Mongolia

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INTRODUCTION

The Inner Mongolia Autonomous Region (IMAR) is located in the northern People's Republic of China (PRC), and shares a 3,200-kilometer border with Mongolia, to the north. Regional cooperation and integration, especially with Mongolia, has played an important role in the IMAR's growth and development. Since 2010, trade between the IMAR and Mongolia has grown rapidly, from $1.2 billion in 2009 to $5.0 billion in 2018, with a consistent and significant surplus for Mongolia. The PRC mainly imports minerals, coal, and animal husbandry products from Mongolia, while exporting machinery, construction materials, and consumer products. The trade volume is expected to continue growing. Cooperation has also expanded to trade in services, notably in the areas of tourism, health, and education; and to environmental protection and other transboundary issues following the "China–Mongolia strategic partnership," established in 2011.

Border-crossing points (BCPs) and border areas play a key role in the IMAR's relations with Mongolia, as trade across land borders accounts for a significant share of the total trade volume for Mongolia, and markets in border towns are important venues for personal contacts and for cultural and economic exchange. The IMAR towns of Erenhot and Ganqimaodu are the two largest BCPs in terms of the region's total trade with Mongolia, and the volume of trade through these ports is rapidly increasing. Strategically located, Erenhot serves as a key hub for the Eurasian Land Bridge, as well

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as for Transport Corridor 4 of the Central Asia Regional Economic Cooperation (CAREC) Program. The IMAR town of Mandula has gained growing importance as a hub for imports and exports; and Arxan, also an IMAR border town, is fast becoming a key base for cross-border tourism, and will likely be a hub in the prospective eastern cross-border corridor. BCPs and border areas provide essential business and other services for port operation and maintenance, helping to create jobs and improve the livelihoods of people on both sides of the border (ADB 2020).

To illustrate cross-border spillover effects, this brief looks at the Inner Mongolia Sustainable Cross-Border Development Investment Program, an investment financed by the Asian Development Bank that aims to promote regional cooperation between the IMAR and Mongolia, and to improve the living conditions in five key BCPs and border areas. The focus of the brief is on six investment components that encompass tranche 1 of the program, to be implemented in Erenhot and Mandula. This investment program is designed to (i) improve key infrastructure in the border areas; (ii) enhance ecological conditions and trade in services, such as health care and waste management; (iii) foster income-generating opportunities for farmers and other residents in the border areas by establishing an inclusive and sustainable agricultural value chain, and by improving access to finance for small and medium-sized enterprises (SMEs), with a particular emphasis on women-led SMEs; and (iv) facilitate institutional development and capacity building for both the IMAR and Mongolia (ADB 2020).

Section 2 discusses a framework for evaluating the estimated impact of the investment activities, tracing the linkages from inputs to outputs, and showing how outputs would be translated into desired outcomes. In Section 3, the analytical framework is used to evaluate the expected cross-border spillover impact of the projects on output and employment. It also considers a scenario in which the impact might not be completely felt in Mongolia due to that country's underdeveloped input markets. Section 4 presents the conclusions.

MEASURING REGIONAL BENEFITS FROM BORDER INVESTMENTS

The methods for measuring spillover effects are shaped by a number of considerations, such as the investment's expected economic benefits, the identities of the recipients, and the transmission and allocation mechanisms. One common approach in the literature is to view spillover effects as a manifestation of a broader pattern of network effects. For example, measuring the contribution of a certain infrastructure improvement would require a view of the network as a whole, to take into account the wider network effects, including such factors as "network integration" and "network efficiency." The identification of the spillover effects will consequently result in the measurement of impact wherein the focus is not on the magnitude of the effect, but on its distribution among regions, groups, or individuals. Depending on the chosen scale of assessment, the calculation of spillover effects provides an estimate of the transfers of costs and benefits among different regions and/or groups of individuals (López Suárez et al. 2008).

In their paper, which offers a critical evaluation of cross-border infrastructure investments in Asia, Fujimura and Adhikari (2010) grouped the benefits of near border and/or cross-border investments to be monitored into the following categories:

- market gains through the expansion of the domestic market via economies of scale and through improvements in market connectivity;
- efficiency gains in the form of cost savings coming from a reduction in time and vehicle-operating costs due to the lessening of physical and nonphysical barriers to trade (e.g., better roads and railways and improved trade facilitation in the form of customs harmonization); and
- welfare gains such as contributions to trade, job creation, and increased regional and global integration, benefiting all participating regions and countries.

To trace the distribution of gains from border and near border investment projects, this brief adopts an analytical framework that utilizes a system of input–output tables (IOTs) based on Wassily Leontief's economic input–output model. This quantitative framework is ideal for examining and depicting the workings of different economies and the interactions among them. The IOTs also lay out the transactional linkages among various sectors of an economy by mapping the relationships between production and trade, thus enabling a regionalized and globalized perspective of the production environment.[1] This decomposition process isolates the initial, intraregional, and interregional feedback effects, showing the impact of interregional trade linkages on an economy's sector-specific production activities.

The system of IOTs is commonly used for estimating the impact of economic shocks and for analyzing the ripple effects throughout an economy, taking trading partners into account. As demonstrated in this analysis, the IOTs provide an intuitive framework for studying and analyzing trade in an environment where production is globally distributed (ADB 2015). To quantify the spillover impact of the proposed IMAR investment program, we used the ADB multiregional IOTs to compute the indirect sectoral impact of the program (ADB 2018).

[1] As every sector-specific production process can be represented as the linear combination of the contributions of all industrial sectors in the sector space, the intermediate use matrix and the associated matrix of technical coefficients are square. Further, in the matrix representation of a realistic economy, no column sum in the matrix of technical coefficients is greater than 1, and at least one column sum is less than 1 (implying nonnegative value added in every sector). Given these characteristics of the technical coefficient matrix, a powerful economic analytical tool known as the "Leontief inverse" can be derived from it.

THE CASE OF THE INNER MONGOLIA AUTONOMOUS REGION INVESTMENT PROGRAM

The combined investments in the six components would strengthen ties between the IMAR and Mongolia in terms of: trade facilitation and cross-border connectivity; improved environment, health, and living conditions; promotion of businesses, especially SMEs, to help alleviate poverty; and the facilitation of policy dialogues between Mongolia and the PRC, including knowledge exchange through strategic trainings in agriculture and trade.

Estimated Direct Spillover Benefits for Mongolia

This study identified the economic benefits that would be generated by the infrastructure, smart systems, and innovative technologies that would be built or introduced under the investment components in the IMAR. With Erenhot and Mandula acting as portals, some of the benefits could spill over into regions beyond—especially across the border into Mongolia. The IMAR program's economic analysis estimated the direct spillover benefits, and the results appear in Table 1, which shows the benefits to Mongolia arising from the investment components 1, 2, and 4 of tranche 1 of the program. These are the components for which spillover effects were predicted.

What follows is a description of the estimated spillover effects of the IMAR investment program during program components 1, 2, and 4.

- Under project 1, Mongolians would be given an equal opportunity to work in the Erenhot economic cooperation zone (ECZ) through an inter-government agreement allocating 50% of job vacancies to Mongolians. About 900 project-related port jobs, offering the same pay scale as the Chinese workers, would result in economic gains for the Mongolian workers who are hired. The net present value (NPV) of the project spillover benefit is estimated at $124 million.[2] Similarly, the demand for quality coal from Mongolia would result in new jobs for Mongolian coal miners and truck drivers. By 2030, with a project storage capacity of 15 million tons, over 12,000 created jobs would generate spillover benefits for Mongolia, with an estimated NPV of $775 million.

- Under project 2, improved health services through the hospital project would result in cost savings to both Chinese and Mongolian emergency patients. Previously, most cases could not be treated locally due to the lack of appropriate medical equipment, but after the hospital project, Mongolian patients who would have sought medical care in Hohhot, Beijing, or Ulaanbaatar would now save on travel costs. Another benefit would be the reduction of cases of premature death and permanent disability. The impact of the hospital project is estimated at an NPV of $1.44 million.

- Project 4 would generate spillover benefits from the Mandula quarantine project, under which the Xiaoweiyang Company would import 300,000 sheep annually from Mongolia. The sheep would undergo a product safety check at the facility. The Xiaoweiyang Company would also utilize embryo technology to improve the weight of the sheep and the quality of the mutton, and would introduce a traceability system to ensure brand quality. As the demand for Xiaoweiyang sheep increases with proliferation technology and assurance of brand quality, there would be direct economic gains for Mongolian herders in terms of higher mutton prices. The NPV of the spillover benefits is estimated of $130,000.

Table 1: Direct Spillover Benefits for Mongolia, Measured in Gross Output and Employment

Project	Gross Output ($ million)	Employment (no. of workers)
Project 1	899.65	12,900
Project 2	1.44	
Project 4	0.13	
Total	**901.22**	**12,900**

Notes:

1. The components referred to in this table refer to the first, second, and fourth parts of an investment program proposed by the Asian Development Bank for the Inner Mongolia Autonomous Region, in the People's Republic of China.
2. Component 3 is not included in this table because this component is not expected to produce any spillover effects.
3. A blank cell indicates that the column head does not apply.
4. The net present value of spillover impact was converted to basic prices in United States dollars using an exchange rate between Chinese yuan and United States dollars in 2018, which was: $1 = CNY6.62.

Source: Estimates from the Asian Development Bank.

Measuring the Indirect Impact at the Sector Level

The estimated direct spillover effects from the output of projects 1, 2, and 4 would, in turn, induce indirect effects on the various economic sectors in Mongolia. The input–output model estimates three types of impact: initial (direct), secondary (indirect), and tertiary (indirect). These impact ripple throughout an economy when a change is made to a given input level. Through the use of this model, the change in output across sectors due to a change in inputs in one or more related sectors can be estimated as follows:

- The initial (direct) impact of the project would be an initial change in expenditure—referring to the assumed direct spillover benefits of the IMAR project in Mongolia.

- The secondary (indirect) impact would be due to the suppliers of the inputs hiring workers in Mongolia to meet demand.

- Then the tertiary (indirect) impact would result from these workers purchasing more goods and services.

[2] The annual and periodic costs and benefits were estimated and evaluated for a time span of about 25 years (2020–2044), allowing for construction periods that start in 2020 (but last for varying lengths of time, depending on the project), followed by a benefit period of about 25 years.

Tables 2 and 3 report the estimated sectoral and total spillover effects in Mongolia—measured in terms of changes in gross output and employment. The gross output and employment changes (in absolute values and percentages) are based on the expected net present value (in 2018 terms) of the IMAR spillover benefits for Mongolia during the projection period. The exercise follows the structure of household expenditure and gross fixed capital formation in Mongolia's 2018 national IOT. Based on this structure, 63% of income change would go to household expenditure, while the remaining 37% would be allocated to gross fixed capital formation.

The simulation results suggest that project 1 would have the largest impact in Mongolia, both in output and employment. An increase in output of over $1.2 billion and the creation of 33,000 jobs are expected as a result of the direct and indirect spillovers. This is almost 1.4 times the output and 2.6 times the employment benefits expected from the direct spillovers alone. These improvements in output and employment brought by the direct and indirect spillovers would be seen mainly in the mining sector, which would account for 62% of the total output arising from project 1, while some associated services, such as financial intermediation, construction, utilities, and transport, would also benefit. Given that the mining sector is capital intensive, employment creation (accounting for only 30% of the total) would be smaller than the output change, leaving other, more labor-intensive, sectors such as retail and wholesale trade to benefit. Project 1 would cause the gross output to grow by 5.3% and employment by 2.7% over the program period.

Projects 2 and 4 would still provide direct and indirect effects, but these effects would be much smaller than those expected from component 1 (i.e., in the ECZ and in the mining pits). The impact would be mainly seen in the agriculture, food and beverage, and construction sectors in the form of a $2.2 million rise in Mongolia's gross output and the creation of 160 jobs.

The analysis using the IOTs highlights the point that total spillover effects will be much higher if indirect impact are also considered. In the case of the IMAR investment program, the output would be 1.4 times higher and the employment 2.6 times higher. This result assumes, however, that Mongolia would be sourcing all the additional demand for goods and services domestically. This would be necessary if Mongolia were to fully benefit from the investment. The spillover effect would be lower if Mongolia would have to import inputs, as most of the additional income would be spent abroad and/or the additional employment would be sourced from abroad, including from the PRC. The next section examines a scenario in which such leakages take place.

The Spillover Benefits with Trade Leakages

We calculated the above estimates under the assumption that Mongolia would be able to benefit fully from the incremental changes generated by the IMAR investment program. In reality, however, Mongolia may have to source inputs from other countries due to its limited domestic supplies. Leakages would thus occur through the purchases of foreign goods and services and through the hiring of foreign workers. As Mongolia is significantly dependent on the import and export activities with its close neighbors, the PRC and the Russian Federation, trade leakages are considered in this section.[3]

Table 2: Mongolia Gross Output Growth Caused by Cross-Border Spillover from an Inner Mongolia Autonomous Region Investment Program

Program Component Output	Major Sectors Impacted	Change in Gross Output ($ million)	Induced Gross Output Growth (%)
Outputs of project 1	Mining and Quarrying	773.060	3.363
	Financial Intermediation	54.652	0.238
	Construction	49.684	0.216
	Electricity, gas, and water supply	47.395	0.206
	Inland Transport	41.262	0.179
	All other sectors	261.285	1.137
	Subtotal	**1,227.338**	**5.339**
Outputs of project 2	Food, beverages, and tobacco	0.372	0.002
	Agriculture, hunting, forestry, and fishing	0.309	0.001
	Construction	0.287	0.001
	All other sectors	1.135	0.005
	Subtotal	**2.103**	**0.009**
Outputs of project 4	Agriculture, hunting, forestry, and fishing	0.114	0.00050
	Financial Intermediation	0.008	0.00004
	Inland Transport	0.003	0.00001
	All other sectors	0.013	0.00005
	Subtotal	**0.138**	**0.00060**
Total		**1,229.579**	**5.349**

Note: Component 3 is not included in this table because this component is not expected to produce any spillover effects.

Source: Estimates from the Asian Development Bank.

[3] A main constraint of this approach is that the national IOT representation for the PRC has been used instead of the more specific IOT for the IMAR. This compromises the accuracy of the program impact measure to an extent, as we had to shift to a more general IOT, at the national level, compared with the granularity and explicitness of the IMAR IOT.

Table 3: Mongolia Employment Growth Caused by Cross-Border Spillover from an Inner Mongolia Autonomous Region Investment Program

Program Component Output	Major Sectors Impacted	Change in Employment ('000)	Induced Employment Growth
Outputs of project 1	Mining and Quarrying	7.063	0.564
	Agriculture, hunting, forestry, and fishing	4.872	0.389
	Wholesale Trade and Commission Trade	2.933	0.234
	Renting of M&Eq and Other Business Activities	2.448	0.195
	Retail Trade; Repair of Household Goods	2.361	0.188
	All other sectors	13.995	1.117
	Subtotal	**33.672**	**2.687**
Outputs of project 2	Agriculture, hunting, forestry, and fishing	0.051	0.004
	Wholesale Trade and Commission Trade	0.013	0.001
	Construction	0.013	0.001
	All other sectors	0.060	0.005
	Subtotal	**0.137**	**0.011**
Outputs of project 4	Agriculture, hunting, forestry, and fishing	0.0189	0.00151
	Financial Intermediation	0.0003	0.00002
	Inland Transport	0.0001	0.00001
	All other sectors	0.0007	0.00006
	Subtotal	**0.020**	**0.002**
Total		**33.829**	**2.700**

M&Eq = machinery and equipment.

Note: Component 3 is not included in this table because this component is not expected to produce any spillover effects.

Source: Estimates from the Asian Development Bank.

Table 4 shows the spillover effects—measured in terms of changes in gross output and employment—in Mongolia, the PRC, the Russian Federation, and to an aggregate "rest of the world." The spillover benefits for Mongolia of the IMAR investment program is marginally reduced when we take into account the country's dependence on international trade, with the gross output change due to the IMAR program dropping by almost 4% (from $1.230 billion without trade leakages to $1.185 billion with the trade leakages). This is evident in the spillover drop for the output of project 1, as the expected increase in Mongolia's gross output due to additional coal mining activity would probably be offset by Mongolia's need to import extra equipment and related materials from the PRC, the Russian Federation, and the rest of the world. Factoring in Mongolia's trade relationship with other countries, Table 4 subsequently shows the estimated IMAR program spillover benefits within the PRC and shared with other countries. Interestingly, as the IOT modeling traces the indirect effects, some of the IMAR spillover benefits in Mongolia appear to be going back to the PRC. This is reflected in Table 4 as the positive output change in the PRC, possibly arising from the increased Mongolian need for inputs from the PRC, which would result in increased PRC exports to Mongolia.

In terms of the impact on Mongolian employment, the total change is lowered by 9% (from 33,830 more workers hired without trade leakages to 30,947 after leakages are considered), while the aggregate change in employment for all countries and areas included is higher, at 42,069 more workers. When the calculation includes trade leakages, the IMAR program spillover benefits are shared among a broader range of countries. They are also shared among a broader range of sectors. In addition to mining, employment is also boosted in the food, beverage, tobacco, construction, agriculture, real estate, and wholesale trade sectors. Hence, due to increases in final demand, together with their multipliers, the aggregate change in employment is higher compared with the total change in the no-trade scenario.[4]

CONCLUSION

A national or cross-border project is expected to offer net benefits for the participating countries. Part of the planning process for such a project is to determine the spillover benefits. Corresponding analysts and evaluators must look at short-term and long-term project outcomes and impact, together with their distribution at the local, national, and cross-border (subregional and regional) levels. A tool such as an input–output analysis framework can be useful for quantifying the indirect impact and distributional effects.

[4] Note that these calculations are based on the structure of Mongolia's household final consumption expenditure (HFCE) and gross fixed capital formation (GFCF). The main determinant of changes observed in this scenario is the structure through which the spillover benefits are shared among the sectors. This implies that the use of a different assumption or structure could significantly change the results.

Table 4: Cross-Border Spillover benefits from an Inner Mongolia Autonomous Region Investment Program

Program Component Output	Location	Change in Gross Output ($ million)	Rise in Employment (no. of workers)
Outputs of project 1	Mongolia	1,183.578	30,823
	PRC	289.627	4,854
	Russian Federation	96.087	2,028
	Rest of the world	261.382	4,212
	Subtotal	**1,830.674**	**41,917**
Outputs of project 2	Mongolia	1.593	104
	PRC	0.624	11
	Russian Federation	0.349	7
	Rest of the world	0.639	10
	Subtotal	**3.205**	**132**
Outputs of project 3	Mongolia	0.138	20
	PRC	0.010	0
	Russian Federation	0.004	0
	Rest of the world	0.018	0
	Subtotal	**0.171**	**20**
	Subtotal for Mongolia	**1,185.309**	**30,947**
Total		**1,834.050**	**42,069**

PRC = People's Republic of China.

Note: Component 3 is not included in this table because this component is not expected to produce any spillover effects.

Source: Estimates from the Asian Development Bank.

The objective of this brief is to illustrate these impact using the proposed IMAR investment program. The results are interesting and intuitive. The analysis using the IOTs shows that the estimated spillover effects are much higher if indirect impact are taken into account. In the case of the IMAR investment program, the output in Mongolia would be 1.4 times higher and employment 2.6 times higher than without the indirect spillover. These gains, however, will be lower if the additional income cannot be fully spent within Mongolia. The IMAR program's indirect spillover benefits in Mongolia drop when the calculations consider the country's dependence on imported inputs, with the gains in gross output declining by 4%. Mongolia will have to keep developing its own input markets and human capital in order to fully benefit from border projects.

The results suggest that multiregional input–output modeling is a promising methodology for estimating the possible spillover benefits of border investments. Investment projects that promote the creation of special production or trade zones to serve as economic corridors—allowing for a broader set of output and employment impact going beyond national borders—require additional time and resources for impact distribution analysis in order to substantiate the project rationale and mitigate coordination failure. Regional benefits beyond the sum of domestic benefits should be identified and estimated to the extent possible.

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