Journal of Asian Economics 55 (2018) 84–92

Contents lists available at ScienceDirect

Journal of Asian Economics

China's belt and road initiative: A preliminary quantitative assessment

Fan Zhai[1]

The Croesus Group's Beijing Office, China

ARTICLE INFO

Article history:
Received 17 March 2017
Received in revised form 31 October 2017
Accepted 25 December 2017
Available online 5 January 2018

Keywords:
Computable general equilibrium
Belt and road initiative
Regional integration

ABSTRACT

Using a global computable general equilibrium model, this paper investigates the macroeconomic impact of China's Belt and Road Initiative (BRI). Accounting for the externalities of infrastructure development with respect to trade cost reduction and energy efficiency improvement, the analysis finds BRI would bring sizable benefits to the world economy in terms of welfare and trade, even under conservative assumptions about the size of total investment under the initiative. However, China and other BRI countries need to address several important challenges in order to implement this initiative with success and realize these benefits.

1. Introduction

With rapid economic growth, China has emerged as an important exporter of capital, not only in the form of massive foreign exchange reserves – which are largely invested in US government bonds, but also in direct investment. In 2015, China's outward direct investment (ODI) flow grew by 18% to USD 145.7 billion. It surpassed the foreign direct investment (FDI) inflow of USD 135.6 billion and rendered China the net exporter of direct investment for the first time. China also overtook Japan to become the second-largest country of outbound investment.

The rapid accumulation of official foreign exchange reserves as well as the increased pressures for Chinese firms to secure resources supply and expand market access have provided important economic substance and commercial justifications for China's ODI growth. It has also been facilitated by the government's "Going Out" policy, which was launched in 1999 with the aim to expand China's outbound investment and prompt the internationalization of Chinese enterprises. Looking forward, the government's policies and initiatives will continue to help support the rapid expansion of ODI. Among them, the recent Belt and Road Initiative (BRI) is likely the most important one in China's international economic policy and will provide fresh momentum to the growth of ODI in the coming decades.

BRI, which was first announced in the fall of 2013 by President Xi Jinping, aims to prompt regional integration between China and other Asian, African, and European countries, through enhancing infrastructure and institutional linkages. It ultimately intends to establish an "international community with shared interests, destiny, and responsibility". In its broadest definition, the BRI could cover 65 countries, 4.4 billion in population, and nearly 30% of the global GDP. The BRI carries broad-based economic objectives, including "facilities connectivity, unimpeded trade, and financial integration", and its economic and financial initiatives will be complemented by greater policy coordination and deeper cultural and

[1] The author is thankful for comments from the anonymous referees, Hiro Lee and other participants of the International Conference "Trade, Industrialization and Structural Reforms in ASEAN" held in January 2017 in Ho Chi Minh City, Vietnam. The views expressed in this paper are those of the author and should not be attributed to the organization with which he is affiliated.

https://doi.org/10.1016/j.asieco.2017.12.006
1049-0078/

personnel exchanges (NDRC, MFA, & MOC, 2015). The potential scope of BRI projects is vast and its financial scale is huge: the projected investment under BRI ranges from USD 1.4 trillion to USD 6 trillion.

The economic and geopolitical motivations behind the BRI have been widely discussed. For example, Wang (2016) and Yu (2017) argue that the need for facilitating China's domestic economic transition and the response to the US Asia pivot policy have been the key drivers behind Beijing's BRI. They also suggest that the announcement of BRI represented the shift of China's foreign policy stance from passive and reactive to proactive. However, Summers (2016) argues that BRI reflects a natural expansion of China's strategy for sub-national regional development, rather than a new strategy driven by international geopolitical considerations.

So far, the BRI is still a flexible conceptual initiative and far from a well-defined action plan with top-down design. The vagueness of the BRI program leads to difficulties in quantitatively evaluating its economic impact, an interesting topic which only very few studies have addressed. Using a gravity model of world trade with explicit treatment of three transportation modes (i.e., railway, air, and maritime), Herrero and Xu (2016) estimated the trade effects of the BRI with a special focus on Europe. They found that European Union countries, especially landlocked countries, would benefit considerably in terms of expansion of trade from the improvement of transportation infrastructure under the BRI. Eastern Europe, Central Asia, and, to a lesser extent, Southeast Asia, would also expand their trade as a result of the BRI. Villafuerte, Corong, and Zhuang (2016) used an economy-wide global computable general equilibrium (CGE) model to evaluate the impacts of the BRI on Asia's trade and growth. They simulated the BRI scenarios through assuming reductions in international road and sea transport margins, as well as iceberg trading costs in the BRI countries, and found that the BRI brought large but uneven benefits to its members.

This paper aims at quantitatively exploring the global impacts of the BRI. Similar to Villafuerte et al. (2016), this paper also utilizes the CGE approach to assess the economy-wide impact of the BRI. The intersectoral, general equilibrium nature of CGE models enables us to explore the interdependence of economic activities and provides useful information on aggregate welfare and its distribution. However, in comparison with Villafuerte et al. (2016), this paper advances the CGE analysis of the BRI in three particular ways: 1) Given the long-term nature of the BRI, a recursive dynamic version of the CGE model is used to incorporate the dynamic path of BRI-driven infrastructure investment and capture the effects of dynamic capital accumulation; 2) Different from the traditional CGE models with Armington (1969) assumption, the CGE model that was used in this study incorporates the recent new trade theory of firm heterogeneity *à la* Melitz (2003) to capture the inter-firm resource reallocation and the extensive margin of international trade. This feature enhances the explanatory power of CGE models in addressing modern international trade issues; 3) Rather than making ad-hoc assumptions of trade cost reduction, the model that was used in this paper establishes direct links between the reduction of trade costs and infrastructure investment, based on empirical evidence. This is extremely relevant to the topic of this study, as infrastructure is the most significant component of the BRI.

The paper tries to answer the following questions: What are the externality effects of the development of regional infrastructure along BRI routes? And how much economy-wide benefits can be expected from the investment for BRI infrastructure? This modelling exercises suggest that the countries under the BRI would gain significantly from the expansion of regional infrastructure in transport and communication. With an investment of $1.4 trillion in regional infrastructure during the period of 2015–2030, the BRI countries as a whole are likely to reap annual welfare gains of $1.5 trillion (in 2011 price) in 2030, or 2.9% of its GDP. Global trade would also be boosted by the BRI, with an expansion of 5.6% in 2030 in comparison with the baseline. The quantitative analysis suggests that investment in BRI infrastructure holds great promise for the long term development of the region.

The paper is organized as follows. Section 2 provides an overview of the BRI and its recent development. Section 3 describes the modelling approach that was used in this study. Section 4 discusses the impact of the BRI on regional welfare, growth, and trade. Then, the final section offers a conclusion.

2. An overview of the BRI: contents, progress, and impact analysis

Inspired by the ancient Silk Route, the Chinese government launched the BRI with the intention to improve regional connectivity and prompt economic cooperation by investing in infrastructure along the two routes of the initiative: the Silk Road Economic Belt and the 21st-Century Maritime Silk Road. The former connects Eastern China with Western Europe through land-based trade routes across inland China, Central Asia, Russia, and the Baltic. It also includes two sideways which link China with the Mediterranean Sea, via the Persian Gulf, and with the Indian Ocean, via South and Southeast Asia. The latter, the 21st –Century Maritime Silk Road, refers to the maritime route linking China to Europe through the South China Sea, Indian Ocean, Persian Gulf, and Mediterranean Sea.

The BRI covers broad areas of economic cooperation. Among them, the BRI identifies three priority areas for implementing the initiative. Infrastructure connectivity is probably the most prominent. Given the low level of infrastructure development in most BRI countries, removing infrastructure bottlenecks would be the most essential prerequisite to regional economic integration and development. Infrastructure construction under the BRI includes the building of railway and highway networks, port facilities, pipelines, airports, and energy and communication infrastructure. Investment in cross-border infrastructure requires massive funding and long-term commitments, and often entails political risks and diplomatic sensitivities. As a result, official investors, such as the newly established Silk Road Fund, Asian Infrastructure Investment Bank, BRICs New Development Bank, and some policy banks in China, are likely to play a leading role to support this initiative, especially at the beginning stage. Running on a commercial basis, these official institutions are more patient and more risk tolerant than private investors. Private participation will also be important to leverage these public resources, and to ensure the commercial viability of the projects. It is expected that in the longer term this public funding will catalyze and “crowd-in” private sector participation and financing, through Public-Private Partnership (PPP) or other arrangements.

Manufacturing cooperation is the second key area of the BRI. The massive investment in infrastructure projects in BRI countries will lift demand for construction, building materials, and equipment for transportation, energy, and telecommunication. China has strong expertise and comparative advantages in some of these areas. This will help absorb China’s industrial overcapacity and smooth the transition of economy to a new growth model. This “exporting excessive capacity” has led to concerns in some BRI countries, especially those low-income and resource-based countries, as the competitive pressures from the Chinese manufacturing sector, together with improved trade infrastructure, may increase their risk of deindustrialization and specialization in natural resources. However, manufacturing cooperation under the BRI could go well beyond this infrastructure-driven capacity exporting and the resource complementarity. The BRI provides a wider platform for Chinese manufacturing firms to reshape their production chains. Through investing in BRI countries, some leading Chinese manufacturing firms can allocate resources at a broader level. On the one hand, this helps Chinese firms to have greater and more stable access to resources and markets, and on the other hand it helps engage firms in some less developed BRI countries into the value chains of global manufacturing production. With the formation of regional production chains, the BRI trading relationship can be upgraded from traditional comparative and advantage-based inter-industry trade to a more dynamic FDI-based and modern intra-industry trade. This will make the BRI manufacturing cooperation more sustainable. In fact, the building of overseas industrial parks, which was inspired by Singapore’s successful experience of developing Suzhou Industrial Park as early as the 1980s, is a key component of the BRI program. The Industrial Park not only provides necessary infrastructure for the manufacturing sector, but also facilitates the formation of trade and business networks. Of course, manufacturing collaboration will need both hard infrastructure and soft infrastructure, such as regulatory reform, trade facilitation, bilateral trade agreements, and investment treaties. This is why some institutional arrangements are also included under the umbrella of the BRI.

Financial cooperation is the third important area of the BRI. In addition to the establishment of Silk Road Fund and Asian Infrastructure Investment Bank, China is seeking to expand the bilateral currency swap and settlement, developing regional bond markets, encouraging the issuance of RMB bonds, and building a currency stability system under the BRI. Enhancing China’s financial presence in the BRI countries will provide support to the global expansion of Chinese firms, leading to mutual reinforcement between financial cooperation and manufacturing cooperation. A successful implementation of the BRI will also help accelerate status of the RMB as a global currency.

Since the announcement of the BRI in 2013, some progress has been made, although the overall development has been scattered and uneven. Some infrastructure construction projects have been launched to connect Eurasian countries through air, land, and sea routes. Construction has begun on a railway between Hungary and Serbia, the Jakarta-Bandung High-Speed Rail, the China-Laos railway, and the China-Thailand railway. Also, some expressway projects are under construction. In Pakistan, some energy infrastructure projects have started. In terms of financial cooperation, substantial progress has been made in the area of financial support mechanisms, as the AIIB and the Silk Road Fund have been established and started to operate. Partly reflecting the efforts of the BRI, ODI to BRI countries increased from US$13.7 billion in 2014 to US$14.8 billion in 2015, accounting for 13% of total China’s ODI.

In May 2017, the Chinese government held the inaugural BRI Summit Forum, which was attended by 30 world leaders. During the Forum, a total of 68 countries and international organizations signed agreements on supporting the Belt and Road Initiative. Although the majority of these bilateral agreements is likely to be symbolic and lacking substance, they do represent increased recognition and understanding of the BRI from the international community. In the Forum, the Chinese government pledged to further boost funding for BRI projects. In addition, China will also provide assistance of RMB 60 billion to countries along the BRI routes that will be focused on food, housing, health care, and poverty alleviation.

3. Methodology

A global CGE model was utilized to investigate the economy-wide effects of the development of regional infrastructure in Asia. The CGE model that was used in this study is a recursive dynamic version of the global model by Zhai (2008). A key feature of the model is the incorporation of firm heterogeneity and fixed costs of exporting – in addition to variable trade costs. This enabled to investigate the intra-industry reallocation of resources and firms’ exporting decision, and thereby capture both the intensive and extensive margin of trade in the model. Dynamics of the model originate from exogenous population and labor growth, labor-augmented technological progress, as well as capital accumulation driven by savings. The model was benchmarked on GTAP 9.0 database with base year of 2011.

3.1. Production and trade

Agriculture, mining, and government services sectors are assumed to exhibit perfect competition. In each of these sectors, a representative firm operates under constant returns to scale technology. Trade is modelled using the Armington assumption for import demand. Manufacturing and private services are characterized by monopolistic competition, and their structure of production and trade follows Melitz's (2003) seminal approach. Each sector with monopolistic competition consists of a continuum of firms that are differentiated by the varieties they produce and their productivity. Firms face fixed production costs, resulting in increasing returns to scale. Also, some fixed costs and variable costs are associated with exporting activities. On the demand side, agents have Dixit-Stiglitz preference over the continuum of varieties. As each firm is a monopolist for the variety it produces, it sets the price of its product at a constant mark-up over marginal cost. A firm enters domestic or export markets if and only if the net profit from such sales is sufficient to cover fixed cost. This zero cut-off profit condition defines the productivity thresholds for a firm's entering domestic and exports markets, and, in turn, determines the equilibrium distribution of non-exporting firms and exporting firms, as well as their average productivities. Usually, the combination of a fixed export cost and a variable (iceberg) export cost ensures that the exporting productivity threshold is higher than that for production for the domestic market, so that only a fraction of firms with high productivity export. These firms supply for both domestic and export markets. The number of firms in the monopolistic sectors is assumed to be fixed.

In each sector, production technology is modelled using nested constant elasticity of substitution (CES) functions. At the top level, the output is produced as a combination of aggregate non-energy intermediate demand and value added-energy bundle. At the second level, non-energy aggregate intermediate demand is split into each commodity, according to Leontief technology. The value added-energy bundle is produced by less skilled aggregate labor, on the one hand, and a capital-land-energy bundle, on the other hand. The capital-land-energy bundle is further decomposed into capital-land bundle and aggregate energy. Then, the capital-land bundle is decomposed into capital and land (for the agriculture sector) or natural resources (for forestry, fishing, and mining sectors). At the bottom level, the capital bundle is split into its human (i.e., skilled labor) and physical capital components. Each level of production has a unit cost function that is dual to the CES aggregator function and demand functions for corresponding inputs. The top-level unit cost function defines the marginal cost of sectoral output.

3.2. Income distribution, demand, and factor markets

Incomes from production accrue to a single representative household in each region. A household maximizes utility using the Extended Linear Expenditure System (ELES), which is derived from maximizing the Stone-Geary utility function. The consumption/savings decision is completely static. Savings enter the utility function as a "good" and its price is set as equal to the average price of consumer goods. Investment demand and government consumption are specified as a Leontief function. In each sector, a composite good, which is defined by the Dixit-Stiglitz aggregator over domestic and imported varieties, is used for final and intermediate demand.

Five primary factors of production are incorporated in the production function. Capital, agricultural land, and labor are fully mobile across sectors within a region. In natural resource sectors of forestry, fishing, and mining, a sector-specific factor is introduced into the production function to reflect the resource constraints. In each period, aggregate capital stock is predetermined by the investment and savings decision of previous periods. The supply of land and sector-specific factors is assumed to be elastic, with response to the changes in their respective prices. The supply of labor is fixed in each period, and its market is cleared through wage adjustment.

3.3. Macro closure

The model includes three macro closures: the net government balance, the trade balance, and the investment and savings balance. As to the first closure, we assume that government consumption and saving are exogenous in real terms. Any changes in the government budget are automatically compensated by changes in income tax rates on households.

The second closure concerns the current account balance. In each region, the foreign savings are set exogenously. With the US GDP deflator being chosen as the numéraire of the model, the equilibrium of foreign account is achieved by changing the relative price across regions (i.e., the real exchange rate).

Domestic investment is the endogenous sum of household savings, government savings, and foreign savings. As government and foreign savings are exogenous, changes in investment are determined by changes in the levels of household saving. This third closure rule corresponds to the "neoclassical" macroeconomic closure in the CGE literature.

3.4. Recursive dynamics

The model is recursive dynamic, beginning with the base year of 2011 and being solved annually through 2030. Dynamics of the model are driven by exogenous population and labor growth, as well as capital accumulation and exogenous technological progress. Population and labor force projections are based on the United Nation's medium variant forecast. Technological progress is assumed to be labor-augmented, so the model can reach a steady state in the long run.

3.5. Estimating elasticities of trade costs to transportation and communication infrastructure

Infrastructure investment can cause positive externality to the whole economy, leading a social return which exceeds private return. of the most important externalities that regional infrastructure in transport and communication brings is the increase of market access through lower trade costs. Broadly defined, trade costs include policy barriers (tariffs and non-tariff barriers), transportation costs, local distribution costs, information costs, contract enforcement costs, and other border-related barriers, such as language and currency conversion. The tariff equivalent of trade costs can range from 30 to 105%, depending on the sector, according to estimates for imports by the US (World Bank, 2005). Developing countries typically have much higher trade costs, given their relatively weaker infrastructure and poorer institutions.

Francois, Manchin, and Pelkmans-Balaoing (2009) estimated the elasticities of trade costs with respect to the quality of infrastructure for 16 Asian economies. Their results indicate that a 1% improvement in transport infrastructure would decrease the trade cost equivalents for the value traded by 0.03–0.58% in Asian developing countries during the period 1988–2003. For communication infrastructure, the trade cost reductions from its 1% improvement are somewhat smaller, ranging from 0.16 to 0.25%. This suggests that better transport infrastructure would have a more important contribution in reducing trade costs than would communication infrastructure for Asia. The impacts of both transport and communication infrastructure on trade costs are very much related to the income level of a country. Figs. 1 and 2 plot these estimated elasticities against the level of per capita GDP. As these figures show, the elasticities for communication infrastructure are positively correlated with the income level, while those for transport infrastructure are negatively correlated with the income level. On the contrary, communication infrastructure has larger impacts on trade costs in high-income countries than in low-income countries.

Using pooled OLS, the linear regression equations between elasticities of trade costs is estimated with respect to the quality of infrastructure and the logarithm of per capita GDP, based on the panel data in Figs. 1 and 2. This yields the estimated elasticities of 0.163 for transportation infrastructure and −0.025 for communication infrastructure. Then, this equation is used to forecast the values of these elasticities for the period of 2012–2030, based on levels of per capita GDP in the modelled economies, and the projected elasticities in 2030 are reported in the final two columns of Table 1.[2] Also, in order to apply these forecasted elasticities to the scenario of the BRI, the growth of infrastructure stock is assumed as identical for transportation and communication and the per capita stock of infrastructure is used as proxies of infrastructure quality. The introduction of these elasticities into the CGE model allows to capture the effect of infrastructure expansion under the BRI on the reductions of trade costs.

3.6. Externality of energy infrastructure

The major externality that energy infrastructure can bring is the improved efficiency in energy production and use. In studying a cross-border energy infrastructure project–the oil pipeline between Kazakhstan and China, Roland-Holst (2008) suggested that it may bring down the costs of China's oil imports from Kazakhstan by 40%. By focusing on the Great Mekong Subregion (GMS), IRM (2008) found that an energy-integrated GMS would be able to save the overall energy costs by 19%.

[2] For some high-income countries, the equation forecasts negative value of the trade cost elasticity with respect to the quality of infrastructure along with their GDP growth. We assume the lowest value of this elasticity is zero and force negative elasticities to zero in the model simulations.

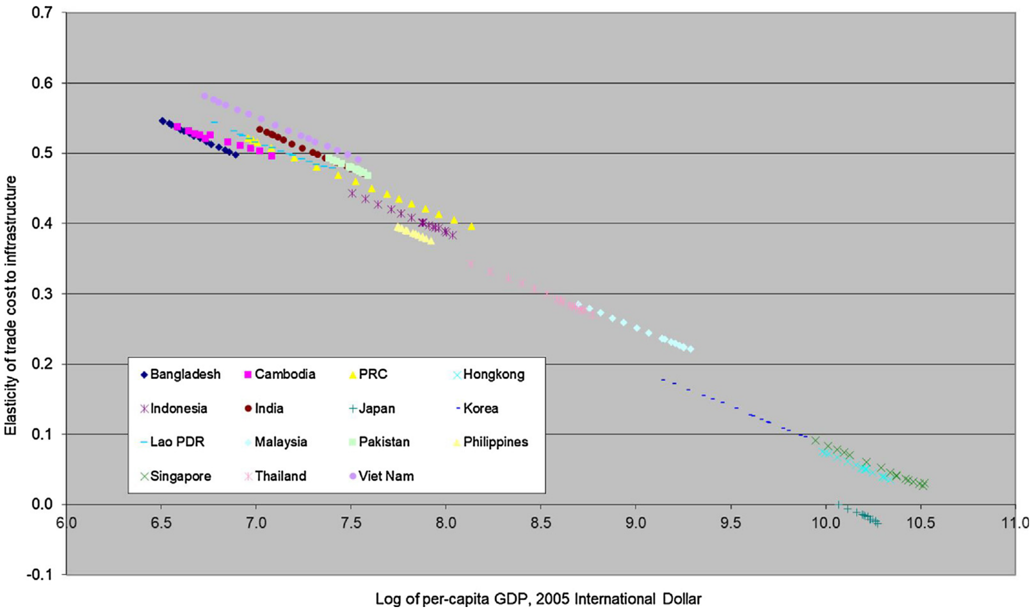

Fig. 1. Trade Cost Elasticity to Transport Infrastructure.

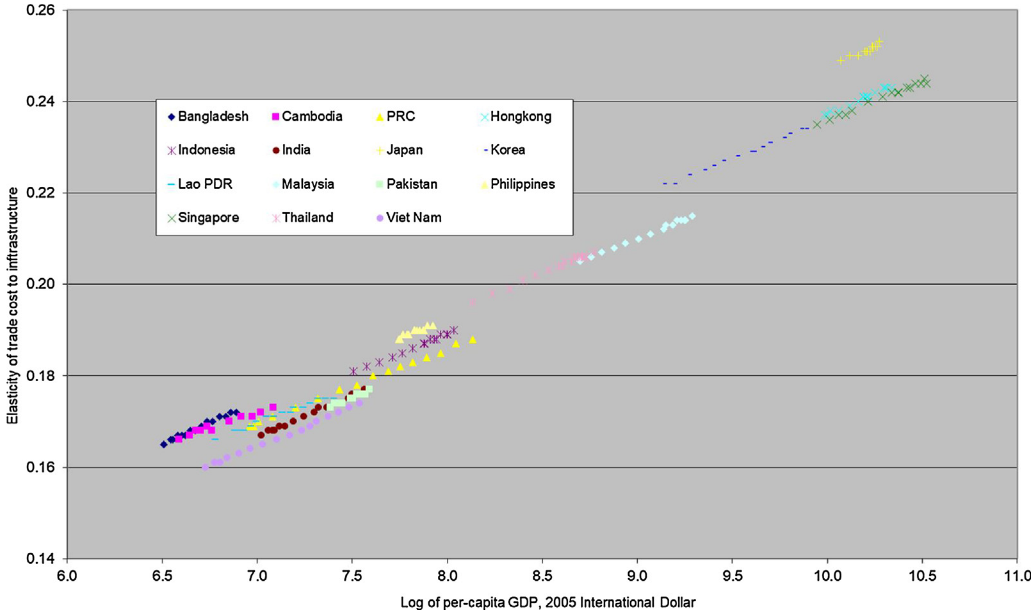

Fig. 2. Trade Cost Elasticity to Communication Infrastructure.

Based on these empirical findings, we assume that the overall efficiency of energy supply in BRI countries would improve by 2.5% in 2030 as a result of the BRI investment in regional energy infrastructure.

4. Impacts of the BRI

In order to quantitatively investigate the effects of the BRI, we first establish a baseline scenario which assumes no BRI investment and serves as a basis of comparison for counterfactual scenarios with policy shocks. Then, we consider BRI scenarios which assume a total spending of US$ 1.4 trillion in infrastructure over the fifteen years from 2015 to 2029.[3] One fourth of the US$ 1.4 trillion is assumed to be invested in China, while the rest is deployed among other BRI countries in proportion to their respective infrastructure stocks. In other words, we assume a unified rate of infrastructure stock growth caused by the BRI in these countries. Specifically, we simulate three scenarios of the BRI to look at their different components. The first scenario captures the pure effects of investment increase caused by the BRI. In terms of funding, we assume that in BRI countries, excluding China, one sixth of the BRI investment is funded domestically, two thirds of them are funded by investment from China, while the remaining one sixth is funded by non-BRI countries. This leads to the changes in capital flows and the balance of payments. The second scenario introduces the reduction of trade cost arising from infrastructure investment under the BRI. The third scenario assumes a full implementation of the BRI by further including the positive externality effects from energy infrastructure investment under the BRI. These scenarios are treated in a cumulative fashion, so that the second scenario includes the first as well as the second modification; the third includes one, two, and three. The differences between the counterfactual scenarios and the baseline scenario reflect the cumulative effects of the different components of the BRI.

Table 1 presents the BRI investment as a percentage of baseline investment, the resulted increase in infrastructure stock in BRI countries as well as the projected trade cost elasticity with respect to the quality of infrastructure in 2030. Based on our assumption, the BRI leads to only 0.3% increase in total investment in China over the 2015–2029 average, in comparison with the baseline, reflecting China's already high investment levels. As to other BRI countries, Pakistan enjoys the largest investment expansion due to the BRI, with annual total investment increasing by 5.0% on average over 2015–2029. Typically, the countries with lower levels of infrastructure stock and higher levels of investment would experience less investment increase from the BRI. As a result of these additional investments, infrastructure stock would expand by 2.1% in China and 6–7% in other BRI countries in 2030.

Table 2 presents the results on real income (measured as equivalent variations from the baseline). Without considering the externality of infrastructure investment, the global gains from BRI investment amount to $252 billion in 2030 (in 2011 price), or an increase of 0.2% in baseline income. If the trade cost reduction effects of infrastructure investment were added, the global gains in 2030 would increase to $1224 billion, or 1.0% of baseline GDP. When including the externality of energy investment, it appears that the global income would rise by $1623 billion in 2030, compared with the baseline. More than

[3] We take a low estimate of the total BRI investment in the simulation scenarios as it looks more feasible at the current stage.

Table 1
Assumed BRI Investment, its Resulted Changes in Infrastructure Stock and Projected Trade Cost Elasticities in 2030.

	BRI investment as% of baseline investment (average of 2015–29)	Changes in infrastructure stock relative to baseline in 2030	Projected trade cost elasticities with respect to infrastructure in 2030	
			Transportation	Communication
China	0.3	2.1	0.054	0.240
Indonesia	0.9	5.7	0.110	0.233
Malaysia	1.0	6.3	0.000	0.249
Philippines	1.2	6.4	0.175	0.222
Singapore	0.2	6.7	0.000	0.273
Thailand	1.1	6.7	0.090	0.235
Vietnam	1.4	6.1	0.205	0.217
Bangladesh	1.6	5.8	0.287	0.205
India	2.5	5.1	0.167	0.223
Pakistan	5.0	7.0	0.284	0.205
Sri Lanka	2.5	5.7	0.063	0.239
Rest of Asian BRI countries[1]	1.7	5.9	0.261	0.209
Central Asia 5 countries[2]	2.4	5.8	0.125	0.230
Russia	0.7	7.3	0.053	0.241
Former Soviet Union 6 countries[3]	2.2	6.9	0.151	0.226
Central Europe 16 countries[4]	0.7	6.8	0.023	0.245
Saudi Arabia	0.4	6.5	0.000	0.259
Turkey	1.1	6.0	0.070	0.238
Egypt	3.1	6.2	0.148	0.226
West Asia 13 countries[5]	0.5	6.2	0.057	0.240

[1] Mongolia, Brunei, Lao PDR, Cambodia, Myanmar, Timor-Lester, Afghanistan, Bhutan, Maldives, Nepal.
[2] Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan.
[3] Armenia, Azerbaijan, Belarus, Georgia, Moldova, Ukraine.
[4] Albania, Bosnia and Herzegovina, Bulgaria, Czech, Croatia, Estonia, Hungary, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia.
[5] Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Syria, United Arab Emirates, Yemen.

90% of the global gains are captured by BRI countries. They as a whole would reap income gains of $247 billion in 2030 with expanded regional investment, of $1082 billion with the inclusion of trade costs reduction, and of $1489 billion under the scenario of the full implementation of the BRI, equivalent of 0.5%, 2.1%, and 2.9% of its baseline income, respectively.

China and India will be the biggest beneficiaries, gaining $258 billion and $332 billion respectively under the scenario of full implementation of the BRI. In relative terms (as a share of GDP), Southeast Asian countries, such as Malaysia, Thailand, and Vietnam, are the major winners, mainly due to their high trade dependence. Their real income gains generally account for more than 7.5% of GDP under the full BRI scenario. The block of six former Soviet Union countries (Belarus, Ukraine, Moldova, Armenia, Azerbaijan, and Georgia) also experience relatively large gains, mainly due to their large trade linkage with other BRI countries and high regional energy dependence. As to BRI countries in South Asia, Central Asia, Middle East, and Europe, their gains range from 3 to 5% of their GDP. It is not surprising that the relative gain of China is only 1.1% of GDP, the smallest among BRI countries, given its already high infrastructure stocks and its relatively small trade linkages with other BRI countries.

Non-BRI economies would also slightly gain from the development of BRI infrastructure. Reflecting their respective geographic proximity to the BRI block, EU, Japan, and the US would respectively gain 0.3%, 0.2%, and 0.1% of their GDP in 2030, relative to the baseline scenario. These results highlight the trade creation effect of regional infrastructure building, which could not only serve as an important tool to stimulate regional integration, but also facilitate the global participation of regional economies.

Table 3 shows the BRI infrastructure expansion would boost both global and regional trade. Global trade is expected to expand by 5%, while exports and imports of BRI countries as a block would jump by 11% in 2030. The countries with high levels of regional trade dependence, such as Southeast Asia and the block of former Soviet Union countries, would experience the largest increase in trade. China's exports to other BRI countries would increase by 11.4%, while its imports from other BRI countries would increase by 13.9%. Reflecting the intensified trade linkages among BRI countries, the share of intra-regional trade of the BRI region in 2030 would rise by 2.7% points, from 44.8% in the baseline to 47.5% in the scenario of full implementation of the BRI. The BRI also brings modest positive spillover effects to non-BRI members, with Australia & New Zealand, Japan, Europe, and the US all expanding their trade with BRI countries as a result of the BRI.

Table 2
Gains in Real Income, 2030.

	Scenario 1: Pure effects investment increase caused by BRI		Scenario 2: Scenario 1 plus trade costs reduction		Scenario 3: Scenario 2 plus energy efficiency improvement	
Region	As% of GDP	Billion 2011 US dollar	As% of GDP	Billion 2011 US dollar	As% of GDP	Billion 2011 US dollar
Australia & New Zealand	0.0	1	0.2	6	0.2	5
Japan	0.0	−1	0.2	12	0.2	14
China	0.0	8	0.5	115	1.1	258
Indonesia	0.5	13	1.9	45	2.4	59
Malaysia	0.7	5	6.1	46	7.6	57
Philippines	0.6	5	2.9	22	3.3	24
Singapore	0.2	1	6.0	30	6.7	34
Thailand	0.7	4	7.3	46	8.7	55
Vietnam	0.5	2	9.0	37	10.2	42
Bangladesh	0.3	1	2.6	10	3.0	11
India	1.4	100	3.3	243	4.5	332
Pakistan	2.7	14	4.1	22	4.6	25
Sri Lanka	1.2	2	3.2	6	4.0	8
Rest of Asian BRI countries	0.8	4	4.5	22	4.9	24
Central Asia 5 countries	1.3	10	3.1	23	3.9	29
Russia	0.4	11	2.8	66	4.0	94
Former Soviet Union 6 countries	1.0	5	5.9	31	7.7	40
Central Europe 16 countries	0.3	9	3.4	88	4.6	118
Saudi Arabia	0.6	8	3.4	41	4.2	51
Turkey	0.7	11	2.5	36	3.2	47
Egypt	1.5	8	3.2	17	3.9	21
West Asia 13 countries	0.7	25	3.5	136	4.1	160
USA	0.0	0	0.1	16	0.1	19
EU	0.0	3	0.3	71	0.3	79
Rest of the world	0.0	2	0.2	37	0.1	18
BRI countries	0.5	247	2.1	1082	2.9	1489
World	0.2	252	1.0	1224	1.3	1623

Source: CGE model simulations.

Table 3
Trade Effects of BRI in 2020 (scenario 3, % change from baseline).

	Total exports	Exports to China	Exports to other BRI countries	Imports	Imports from China	Imports from other BRI countries
Australia & New Zealand	0.9	0.6	5.2	1.1	0.0	12.9
Japan	2.0	3.7	9.7	2.2	1.8	8.7
China	4.0	–	11.4	4.0	–	13.9
Indonesia	14.8	15.7	25.0	14.5	12.1	30.3
Malaysia	18.3	16.7	26.5	16.4	12.7	29.5
Philippines	18.0	30.5	31.5	15.6	16.6	26.5
Singapore	27.2	26.5	40.8	25.3	14.3	38.6
Thailand	23.0	22.2	31.0	19.8	17.8	27.3
Vietnam	34.2	39.5	44.6	24.8	21.5	42.9
Bangladesh	16.7	31.2	30.5	14.4	11.2	22.5
India	16.2	16.1	21.9	13.2	20.3	19.6
Pakistan	26.1	26.3	35.6	17.4	21.7	18.8
Sri Lanka	11.8	20.6	29.3	9.1	3.9	12.8
Rest of Asian BRI countries	22.2	17.4	36.7	17.1	6.5	25.2
Central Asia 5 countries	13.3	10.5	21.3	14.2	10.4	24.9
Russia	7.9	8.3	13.1	10.2	6.6	21.5
Former Soviet Union 6 countries	22.4	8.9	28.0	17.5	12.8	23.9
Central Europe 16 countries	13.8	14.2	21.9	11.7	9.5	20.0
Saudi Arabia	6.7	5.5	14.7	8.4	7.7	21.4
Turkey	15.0	10.5	20.8	11.0	12.2	25.4
Egypt	18.0	16.0	27.5	13.9	12.2	23.8
West Asia 13 countries	8.1	5.8	16.5	9.0	4.9	16.6
USA	1.4	3.3	10.2	1.1	0.9	10.4
EU	0.9	4.1	9.8	1.3	1.3	10.1
Rest of the world	0.6	−0.5	7.7	0.5	1.2	10.5
BRI Countries	10.9	14.0	19.2	10.5	11.5	20.8
World	5.6	5.2	14.9	4.8	4.1	15.3

Source: CGE model simulations.

5. Conclusions

The paper aims at quantitatively investigating the macroeconomic impact of China's BRI. Using a global CGE model and focusing on the area of infrastructure investment under the BRI, our quantitative exercises suggest important potential benefits of the BRI to the economies along and beyond BRI routes. With a moderate assumption of BRI investment in the coming 15 years, the simulation results find that the annual global welfare gains would be about US$1.6 trillion in 2030, accounting for 1.3% of the global GDP. More than 90% of this gain is expected to be captured by BRI countries. The BRI is also expected to boost global trade by 5% in 2030.

However, to reap these benefits, China and other BRI countries need to work together to overcome some serious challenges and ensure an effective implementation of this important initiative. Typical challenges include: lack of a cohesive and reliable institutional and legal environment in most BRI countries, high political risks along BRI routes to carry out infrastructure projects, shortage of qualified individuals in Chinese firms, and the massive funding requirement. Nevertheless, some preliminary progress has been made, and more diligent work is expected to continue.

References

Armington, P. S. (1969). Theory of demand for products distinguished by place of production. *International Monetary Fund Staff Papers*, *16*(1), 159–178.
Francois, J., Manchin, M., & Pelkmans-Balaoing, A. (2009). Regional integration in Asia: The role of infrastructure. chapter 7. In J. F. Francois, G. Wignaraja, & P. Rana (Eds.), *Pan-Asian integration: Linking East and South Asia*, UK: Palgrave Macmillan.
Herrero, A. G., & Xu, J. (2016). *China's belt and road initiative: Can Europe expect trade gains? Bruegel working paper series*. Issue 5.
Integriertes Ressourcen Management (IRM) (2008). *Economics of energy integration: Application of MESSAGE model in the GMS*. Austria.
Melitz, M. J. (2003). The impact of trade on intra-Industry reallocations and aggregate industry productivity. *Econometrica*, *71*(6), 1695–1725.
National Development and Reform Commission (NDRC), Ministry of Foreign Affairs (MFA), & Ministry of Commerce (MOC) (2015). *Vision and actions on jointly building Silk Road Economic Belt and 21st-century Maritime Silk Road*. Beijing, China, available at en.ndrc.gov.cn.
Roland-Holst, D. (2008). Regional infrastructure projects involving West Asia: General equilibrium assessments for Kazakhstan and PRC, background paper prepared for the study. *Infrastructure and regional cooperation*. Tokyo: ADBI.
Summers, T. (2016). China's 'New Silk Roads': Sub-national regions and networks of global political economy. *Third World Quarterly*, *37*(9), 1628–1643.
Villafuerte, J., Corong, E., & Zhuang, J. (2016). The one belt, one road initiative: Impact on trade and growth. *Paper presented at the 19th annual conference on global economic analysis*.
Wang, Y. (2016). Offensive for defensive: The belt and road initiative and China's new grand strategy. *The Pacific Review*, *29*(3), 455–463.
World Bank (2005). *Global economic prospects 2005: trade, regionalism and development*. Washington D.C: World Bank.
Yu, H. (2017). Motivation behind China's 'One belt, one road' initiatives and establishment of the Asian Infrastructure Investment Bank. *Journal of Contemporary China*, *26*(105), 353–368.
Zhai, F. (2008). Armington meets Melitz: Introducing firm heterogeneity in a global CGE model of trade. *Journal of Economic Integration*, *23*(3), 575–604.