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**Addressing Excess Capacity -- The Effect of China's FDI in the Iron and Steel Industry in Five Central Asian States**

**—— a GTAP-FDI Model Perspective**

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## Abstract

This paper uses an extended GTAP model which incorporates foreign affiliate sales and foreign direct investment stock (FDI) data to quantify the economy-wide effect of China's overseas investment in the iron and steel industry under the "One Belt, One Road" initiative. In particular, the paper uses a GTAP-FDI model which makes capital sector specific and allows sector-specific capital to flow across countries. The model is calibrated with a 2011 baseline of 7 regions (China, USA, Kazakhstan, Kyrgyzstan, rest of the three Central Asian states (Tajikistan, Turkmenistan and Uzbekistan). The model simulates the economy-wide/sectoral effects of five Central Asian states unilaterally reduce their investment barriers towards Chinese overseas FDI to their iron and steel industry, by reducing the cost of using capital for Chinese iron and steel firms in their countries by 50 percent. The results indicate that compared to the baseline, Kazakhstan's welfare increases by $42.8 million. Kyrgyzstan's welfare would increase by $4.78 million, and the welfare for the other three Central Asian states would increase by $5.28 million. The production of Chinese iron and steel companies in Kazakhstan would increase by 17.2 percent, while overall production in Kazakhstan's iron and steel industry would increase by 1.73 percent, which is $147 million in value terms. Overall production in Krgyzstan's iron and steel industry would increase by 0.34 percent; overall production in the other three Central Asian states would increase by 0.38 percent.

## Introduction

This paper uses an extended GTAP model which incorporates foreign affiliate sales and foreign direct investment stock (FDI) data to quantify the economy-wide effect of China's overseas investment in the iron and steel industry under the "One Belt, One Road" initiative. The "One Belt, One Road" initiative is a development strategy and framework, proposed by Chinese current President Xi Jinping in 2013 that concentrates on enhancing trade and investment relationships primarily between the People's Republic of China and the rest of Eurasia, which consists of two main components, the land-based "Silk Road Economic Belt" (SREB) and oceangoing "Maritime Silk Road" (MSR) (Caixin, 2014). The "Silk Road Economic Belt" includes countries in Central and West Asia, with which China plans to increase its overseas FDI, particularly in sectors that China has domestic excess capacity, such as the iron and steel industry (Fan, 2016; Wilson, 2016).

China has been the world's largest steel producer since 1996. However, Chinese domestic demand has not kept pace with the increasing production capacity recently, and the gaps between actual production and consumption continued to expand. In 2014, China produced 823 million metric tons (MMT) of steel and consumed only around 740 MMT, therefore leaving roughly an 83 MMT surplus available for export to the global steel market (OECD, 2015). In the meantime, China's capacity utility rate for the steel industry was only 72 percent in 2012, much lower than the normal level, which is around 80 percent (Fan, 2016). As a result, the Chinese government has been keen on reducing the excess capacity in China's iron and steel industry, and one of the strategies is to encourage Chinese firms, in particular state-owned enterprises in the iron and steel industry, to increase their FDI overseas.

One of the major regions China targets on to increase its overseas iron and steel FDI to is the five central Asia states, namely, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. In 2015, China Metallurgical Group Corporation, Masteel (one of the largest iron and steel enterprises in Mainland China) and FerrumCorp in Germany jointly signed a memorandum to establish a joint-venture in Kazakhstan producing iron and steel. Meanwhile, other Chinese state-owned iron and steel companies, such as Bao Steel and Jisco, also plans to establish manufacturing facilities in Kazakhstan. China also plans to invest in establishing iron and steel manufacturing facilities in the northern region of Tajikistan, which is expected to increase domestic employment in the country (Kazinform, 2016).

Given the theoretical and policy significance of this topic, this paper uses an extended GTAP model (GTAP-FDI model), which was developed by Lakatos and Fukui (2014) and revised by Tsigas and Yuan, to quantify the economy-wide effect of the aforementioned five Central Asian states reducing its investment restrictions in their iron and steel industry towards China's outward FDI.

## Literature Review

The Petri (1997) model was the first CGE model that considers foreign commercial presence (Lakatos and Fukui, 2014). The model uses the Armington assumption of national product differentiation, and distinguishes among different products by both the firm location and firm ownership. Moreover, Petri's model allocates a given investment budget across different sectors and countries, and defines investor preferences as a nested imperfect transformation function (Lakatos and Fukui, 2014). Another example

of CGE models that incorporates the FDI is FTAP (Hanslow, Phamduc & Verikios, 2000). The FTAP model is a version of the standard GTAP model that incorporates the FDI using Petri's assumption. The major difference between the FTAP model and Petri's model is that the FTAP model assumes that foreign affiliates located in a given region are closer substitutes for domestic firms located in that region than they are for their respective parent firms, while Petri's model implicitly assumes that foreign affiliates and their parent companies are closer substitutes regardless of where they are located.

Lakatos and Fukui (2014) developed a newer version of the GTAP model that incorporates FDI and foreign affiliate sales into the model. One major difference between this model and the FTAP model is that this model represents the heterogeneous production technologies for firms differentiated by the region of ownership (Lakatos and Fukui, 2014). With this feature, this model is able to differentiate between domestic and foreign firms by ownership. Lakatos and Fukui (2014) use this model to analyze the reduction of investment barriers in India's retail services sector, and this paper uses a revised version of the Lakatos and Fukui (2014) model to analyze the impact of five Central Asian states reducing their investment barriers towards Chinese overseas investment into their iron and steel industry.

**Structure of the GTAP-FDI Model**

The standard GTAP model without foreign affiliate sales data incorporated is a comparative static, multi–regional and multi–sector computable general equilibrium model. On the supply side, land and capital stock are assumed to be fixed at the national level. Firms are assumed to be perfectly competitive on the market, substituting between capital and labor according to a constant elasticity of substitution (CES) function, while using intermediate inputs in fixed proportions to the valued–added composite. Imported products from different regions are assumed to be imperfect substitutes, and so do the domestic produced and imported commodities in each country/region. Firms then allocate expenditure between domestically produced and imported commodities. On the demand side, a representative regional household receives all income generated in the region and allocates it among private consumption, government consumption, and savings.

As an extension of the standard GTAP model, the major difference between the GTAP-FDI model and the standard GTAP model is that the former incorporates an additional level of nesting representing the region of ownership — Using the iron and steel industry as an example -- in the first stage, consumers allocate expenditure between domestically produced and imported iron and steel. Then, in the second stage, there is an additional nesting in the sense that domestically produced iron and steel are further divided by either produced by domestic firms or foreign firms. Meanwhile, expenditure on imported iron and steel is allocated across different importing regions, and finally allocated across ownership categories to various multinational companies in these importing regions, respectively.

On the supply side, compared to the standard GTAP model, the GTAP-FDI model differentiates between domestic firms and foreign-owned affiliates of multinational companies (Lakatos and Fukui, 2014). Using the domestic supply of iron and steel as an example -- it is composed of output of both domestic iron and steel firms and foreign-owned iron and steel firms located in that country. Foreign-owned firms are then further differentiated by country of ownership. Furthermore, each of these firms combines value-

added and intermediate inputs using a Leontief technology to produce final goods, which implies that intermediate inputs, as well as final demand, are differentiated by not only the regions of firm location, but by regions of firm ownership as well (Lakatos and Fukui, 2014).

**Incorporating the Feature of Capital Mobility into the GTAP-FDI Model**

Past trade and FDI theories suggest that a reduction in bilateral trade costs is associated with a higher level of bilateral trade. However, a reduction in trade costs will make bilateral investment less economical, and should therefore tend to reduce bilateral FDI (McCulloch 1985, 1993; Bergstrand and Egger, 2007). There are also abundant empirical evidences supporting the aforementioned theory. For instance, using a structural gravity model with panel dataset from 1990 to 2000 among 17 OECD countries, Bergstrand and Egger (2007) found that free trade agreements (FTAs) between two countries are associated with a lower level of bilateral investment. Using U.S. outbound FDI for the years 2005 to 2015 and applying the same gravity model of FDI as in Bergstrand and Egger (2007), USITC (2016) also found that U.S. bilateral and regional trade agreements had a significant negative effect on U.S. outbound FDI in manufacturing industries.

There are also econometric studies that have tested and confirmed that the aforementioned inter-modal switching between exports and FDI happened not only in merchandise trade and FDI, but also in the services sector. Riker (2015) uses U.S. foreign affiliate sales data from 2009 to 2012 to analyze how mode 1 and mode 3 barriers affect foreign affiliate sales. The econometric results indicate that eliminating restrictions on mode 1 cross-border exports of services would reduce foreign affiliate sales by 24.2 percent on average.

Given the ample empirical evidence of the aforementioned substitutional relationship between bilateral trade and FDI, this paper improved the Lakatos and Fukui (2014) version of the GTAP-FDI model by building the linkage of bilateral trade and FDI into the model. In particular, the revised version of the FDI model used in this paper assumes that capital is sector specific but could move across countries.[1]

Meanwhile, this paper also changes the fixed labor supply assumption in the GTAP-FDI model into a flexible labor supply. Under the fixed labor supply assumption, the aggregate labor supply in each country remains unchanged, which implies that workers do not work more (either by working longer hours or by joining the labor force) in response to an increase in wages. However, reduction in investment barriers in the iron and steel industry in five Central Asian states is expected to affect labor supply in this sector in the five Central Asian states accordingly. In order to accurately measure the employment effects, this paper therefore alters the aggregate labor supply elasticity in the model to reflect the flexible labor supply assumption. Under the flexible labor supply assumption, the aggregate labor supply elasticity is greater than zero, which implies that the labor supply will expand in response to a rise in wages. A labor supply elasticity of 0.4 was used for the United States and 0.44 for developing

[1] Here is the specific change to the model language: qoes_mnc("capital",j,location,ownership) = qo_l("capital",j,ownership) - endwslack_mnc("capital",j,ownership)
+ ETRAE("capital") * [pm_l("capital",j,ownership) - pmes_mnc("capital",j,location,ownership)];

countries in the model. This elasticity implies that, for every 1 percent rise in wages in Kazakhstan, workers in Kazakhstan will increase their supply of labor by 0.44 percent.

**Simulation Methodology**

To simulate the effects of five Central Asian states reducing investment barriers in their iron and steel industry towards Chinese overseas FDI, this paper uses the GTAP version 9 dataset (with a 2011 baseline), with the foreign affiliate sales and FDI stock data incorporated into the model. The current GTAP version 9 database, which is composed of 140 regions, is aggregated into 7 regions, namely, China, Kazakhstan, Kyrgyzstan, rest of the three Central Asian states (Tajikistan, Turkmenistan and Uzbekistan), United States and the rest of the world.

Using the baseline year of 2011, one simulation was conducted to calculate the effects on the five central Asian states and China:

1) Five Central Asian states unilaterally reduces its investment barriers towards Chinese overseas FDI to their iron and steel industry, by reducing the cost of using capital for Chinese iron and steel firms in their countries by 50 percent.

**Results**

Within the simulation model, the most relevant summary measure of the economy–wide effects of is the simulated change in economic welfare. The change in economic welfare provides a measure of the comprehensive effect of the reduction of investment barriers in the iron and steel industry in these five Central Asian states towards Chinese overseas FDI. The results from simulation 1 indicate that compared to the baseline, Kazakhstan's welfare increases by $42.8 million. That is, when investment barriers faced by Chinese iron and steel companies in Kazakhstan reduced by 50 percent (measured by the cost of using capital for Chinese iron and steel companies reducing by 50 percent), the annual benefits (i.e. in terms of purchasing power) to Kazakhstan consumers would increase by $42.8 million in the economy of 2011. This amount equals to 0.023 percent of the Kazakhstan GDP. Kyrgyzstan's welfare would increase by $4.78 million, and the welfare for the other three Central Asian states would increase by $5.28 million.

The production of Chinese iron and steel companies in Kazakhstan would increase by 17.2 percent, while overall production in Kazakhstan's iron and steel industry would increase by 1.73 percent, which is $147 million in value terms. Overall production in Krgyzstan's iron and steel industry would increase by 0.34 percent; overall production in the other three Central Asian states would increase by 0.38 percent.

**References**

Caixin Online, 2014, "One Belt, One Road," http://english.caixin.com/2014-12-10/100761304.html

Fan, Rui, 2016, "China's Excess Capacity: Drivers and Implications", *Law Offices of Stewart and Stewart*. http://www.stewartlaw.com/Content/Documents/China's%20Excess%20Capacity%20-%20Drivers%20and%20Implications.pdf

Lakatos, Csilla, and Tani Fukui. “The Liberalization of Retail Services in India”, World Development, Vol 59, pp. 327–340, 2014.

Kazinform, 2016, “China Plans to Invest 200 million Dollars in Tajikistan to Establish Iron and Steel Manufacturing Facilities,” http://www.inform.kz/cn/2_a2914625

Wilson, William T., 2016, “China's Huge 'One Belt, One Road' Initiative Is Sweeping Central Asia,” *Heritage Foundation*. http://www.heritage.org/research/commentary/2016/11/chinas-one-belt-one-road-inititative

Yuan, Yi, 2015, “Iron and Steel Industry Expands Overseas under the One Belt One Road Initiative,” *21st Century Economic Report*, http://m.21jingji.com/article/20150509/0eadbc946c49e78186273cf430197858.html