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Fueling Growth and Financing Risk:

The benefits and risks of China's development finance in the global energy sector

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EXECUTIVE SUMMARY

In just over a decade Chinese policy banks have emerged as global leaders in development finance in general and in finance for energy projects in developing country governments in particular. Moving forward, China has founded or co-founded two new multi-lateral development banks (MDBs) and at least 13 regional and bilateral funds that will increase Chinese development finance abroad by orders of magnitude. Such a stepwise increase in global development finance arrives just in time, as the world faces major infrastructure and energy gaps and has just committed to increasing finance for sustainable development on a global scale.

China's global energy portfolio is heavily exposed to country, macroeconomic, climate, and social risks however. To mitigate such risks and meet the broader sustainable development challenge for the 21st Century, China's development finance will need to shift the composition of its global energy lending in a significant manner.

This paper provides the first estimates of China's global developmental finance institutions in general and China's policy bank lending to foreign governments for energy in particular. We find that: China's 'policy banks' and funds have doubled the availability of global development finance –and hold more assets than the major Western-backed MDBs operating in developing countries. With the onset of a new family of funds and multilateral development banks co-financed by China, China is poised to be the largest development lender in the world as Western-backed MDBs appear stagnated in their ability to increase their capital bases.

- China's national development banks already lent as much to foreign governments for energy as all the major Western-backed MDBs combined. Between 2007 and 2014 Chinese banks doubled the amount of energy financing available to national governments, adding another $117.5 billion dollars in energy finance for foreign governments. Not only did Chinese finance increase the total amount of finance, Chinese banks are financing energy projects all over the world and expanding the set of countries that receive energy financing as well.

- Chinese energy finance is exposed to significant country and macroeconomic risk. In contrast with the Western-backed development banks across the world, Chinese policy banks are engaged with countries with higher country risk ratings and in commodity-backed loans that risk stress given the fall in commodity prices and associated macroeconomic downturns in the developing world.

- Chinese development banks are heavily exposed to climate and social risk. China's energy loans are highly concentrated in fossil fuel extraction and power generation, especially coal. Indeed, Chinese development banks have provided upwards of $28 billion in financing for global coal projects—projects that accentuate climate change and social risks. Using conservative estimates of the climate and local health costs of coal plant emissions, we calculate that the yearly social cost of Chinese overseas coal-fired power plants amounts to $29.7 billion. Assuming a power plant lifetime of 30 years, total social cost could range from $117 billion to $892 billion.

As commodity prices fall and the macroeconomic outlook for many of China's borrowers declines, China will need to diversify its global energy portfolio. To meet these goals Chinese overseas development finance will need to make a significant change in composition of its lending portfolio. Such a shift will not only help China's banks mitigate the significant risks associated with the current portfolio of its policy banks, it will also enable China to meet its broader global commitments. Through the newly minted Sustainable Development Goals and again at the Paris Climate Summit of 2015 world leaders—China included— have committed to steer public finance toward energy and infrastructure in a manner that is environmentally sustainable and socially inclusive. Also in 2015, the governments of the United States and China committed to "controlling public investment flowing in projects with high pollution and carbon emissions both domestically and internationally." Later in 2016 it is anticipated that China will dub 'green finance' a global commitment under the G-20 with the establishment of G-20 study groups in both green finance and in climate finance.

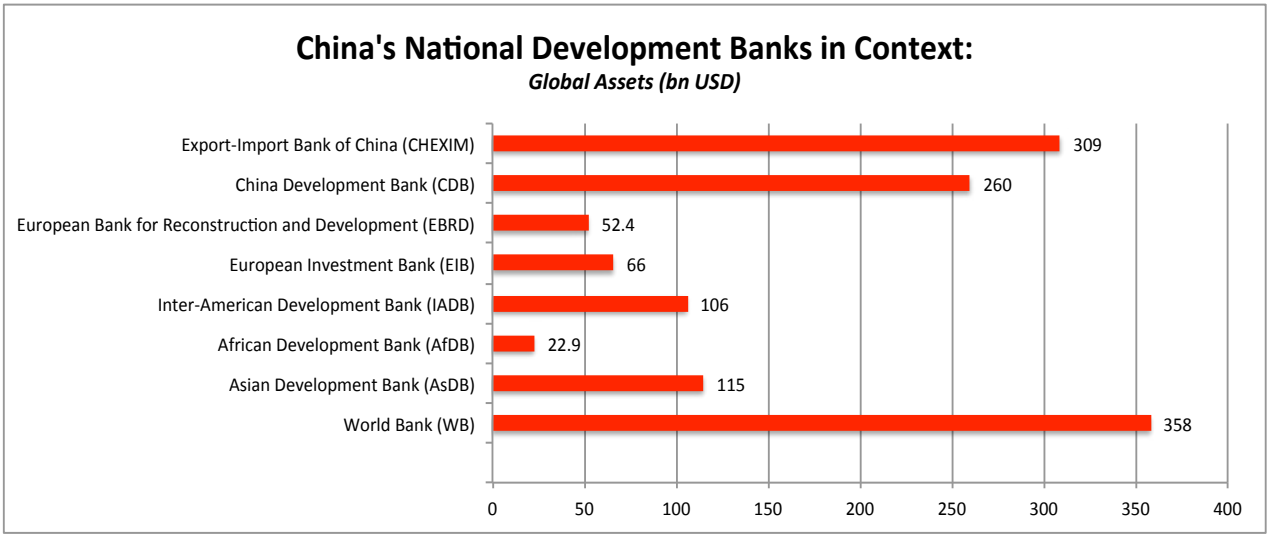
This paper is organized in four parts. Part one presents an overview and estimates of China's emerging development finance architecture. Part two exhibits our estimates of the extent to which China's development banks are financing energy projects in developing countries in comparative perspective. Part three identifies some of the risks associated with China's overseas energy investments. Part four summarizes our findings and provides suggestions for further research and policy.

1. China's Development Finance Architecture in Comparative Perspective

Unlike the Western countries that have been reluctant to increase the capital base of the Multilateral Development Banks, China is increasing the paid in capital for its two global policy banks and has helped capitalize two new multilateral development banks in the New Development Bank and the Asian Infrastructure Investment Bank. According to our estimates, even before these new institutions get fully operational, China is emerging as the global leader in development finance. In recent years China has helped establish two new multilateral development banks in the Asian Infrastructure Investment Bank and the New Development Bank. China has also co-established at least 13 regional and bi-lateral funds with a number of country as well. This section provides an overview of these banks and funds, the majority of which are (or will be) significantly dedicated to financing energy and infrastructure.

Two of China's policy banks, the China Development Bank (CBD) and the Export-Import Bank of China (CHEXIM) already hold more assets than the combined sum of the assets of the Western-backed multilateral development banks. CHEXIM and the CBD have over $2 trillion in assets, whereas the Western-backed banks hold just over $700 billion. That said, China-development banks' international holdings are just 30 percent of total assets, putting the two banks' international assets at around $569 billion, giving China's policy banks roughly three quarters the amount of global assets of the major development banks.

Figure 1



Source: Authors calculations based on bank annual reports

These two 'policy banks' as they are called in China, provide non-concessional and concessional (in the case of the CHEXIM) finance in virtually every corner of the world. The CDB holds over $1.4 billion in assets with roughly $260 billion overseas—more than the World Bank Group's

International Bank for Reconstruction and Development. In just over a decade, China has doubled the amount of development finance in the world economy.

New Multilaterals

In addition to making stepwise contributions in paid in capital to its two global policy banks, China recently helped found two global development banks, the New Development Bank (NDB) and the Asian Infrastructure Investment Bank (AIIB). The NDB was launched in July 2015 by Brazil, Russia, India, China and South Africa - collectively known as BRICS countries. The NDB provides financing to developing countries to help finance sustainable infrastructure projects, releasing its first set of financing packages for clean energy and largely financed from green bond issuances in the Chinese market, in the spring of 2016. Each BRICS member is expected to put an equal share into establishing the startup capital of $50 billion with a goal of reaching $100 billion. Under the current arrangement membership will be limited to BRICS nations, though future members will eventually be added—with the BRICS countries always holding a minimum of 55 percent voting power.

The Asian Infrastructure Investment Bank (AIIB) was created to support infrastructure construction in the Asia-Pacific region. The AIIB was proposed by China in 2013 and formally started operations in December 2015 after the Articles of Agreement (AoA) entered into force with ratification from 17 member states holding 50.1 per cent of the shares. This is in accordance with the AoA that requires ratification from 10 member states holding a total number of 50 per cent of the initial subscriptions of the authorized capital stock. By May of 2016, all 57 of AIIB's Prospective Founding Members (PFMs) have ratified the AoA. The Memorandum of Understanding (MoU) specifies that the authorized capital of AIIB is $100 billion and the initial subscribed capital is expected to be around $50 billion. AIIB's investment capacity could reach $250 billion by the end of 2020 in accordance with provisions made in its AoA. The Bank will largely co-finance projects with the World Bank (WB) and Asian Development Bank (AsDB), particularly in the first years of its operations.

China-backed development funds

China has also pioneered a host of bilateral and regional development funds. These funds combine to add upwards of $116 billion in development finance provided by the Chinese in recent years. To our knowledge these funds have never been collated in one place. Our estimate of the breadth of these funds is in Table 1.

A major portion of these investments are in Asia as part of China's broader "Belt Road Initiative, with the largest being the $40 billion Silk Road Fund established in 2014 with investment from state institutions including the CHEXIM and CDB. The fund is open to investors from other countries as well and has provisions to expand maritime connectivity between

China and the rest of Asia (Central, South and Southeast Asia, the Middle East), North and Northeast Africa, and Europe. A related fund is the Green Ecological Silk Road Investment Fund, a private equity fund for improving the ecological environment in the region.

In the larger Eurasian region, investments include the China-Central and Eastern European (China-CEE) Fund— set up to facilitate financing of projects to enhance inter-connectivity in the region, specifically in Eastern Europe— and the bilateral Russia-China Investment Fund (RCIF) established by two government-backed investment vehicles, the Russian Direct Investment Fund and China Investment Corporation (CIC). The RCIF will invest 70% of its capital in Russia and other CIS countries (currently Azerbaijan, Armenia, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Uzbekistan and Ukraine) and 30% in China.

Chinese finance also plays a prominent role in the Latin America and the Caribbean. The largest to do so is the $20 billion CELAC-China Investment Fund for infrastructure projects, followed by the $10 billion dollar China-LAC Industrial Cooperation Fund for medium- and long-term financing for industrial investments. Investments in the region further include the China-LAC Cooperation Fund, initiated by the Chinese Government to finance projects in LAC region in areas including education, water conservancy, and energy. The Fund is housed at the Inter-American Development Bank and includes a private equity (PE) fund administered by the Export-Import Bank of China. In addition to these, the China-Mexico Investment Fund was set up to support Chinese and Mexican companies investing in infrastructure, mining, and energy projects in both countries.

Table 1

Chinese Development Funds in the World Economy	
	$USB
Asia	
Silk Road Fund	40
The Green Silk Road Fund	4,8
China-ASEAN Fund (with ADB)	1
Eurasia	
China-Central and Eastern Europe Investment Fund	4
Russia-China Investment Fund	2
Latin America and Caribbean	
CELAC-China Investment Fund	20
China-LAC Industrial Cooperation Fund	10
China-LAC Investment Fund (with IADB)	5
China-Mexico Investment Fund	2,4
Africa	
China -Africa Development Fund	10
Africa Growing Together Fund(with AfD)	2
China-Africa Production Capacity/Industrial Cooperation Fund	10
Global South	
South-South Climate Fund	3,2
South-South Cooperation Fund	2
Total	**116,4**

Source: Author's calculations

Over the last decade China has created a significant platform of public and private investments in Africa. To date the largest of such initiatives is the China-Africa Industrial Capacity Cooperation Fund Company Limited (CAICCF), jointly established by the China Foreign Exchange Reserves and Export-Import Bank of China. With $10 billion in pledges, the fund would support infrastructure development, particularly in the transit sector, as well as provide financing for manufacturing and agriculture projects. Among the state-backed funds is the China-Africa Development Fund (CAD Fund), a Chinese private equity fund financed by the CDB, set up in order to stimulate investment in Africa by Chinese companies in power generation, transportation infrastructure, natural resources, and manufacturing. This fund has $10 billion in pledges and has disbursed upwards of $2billion. The Africa Growing Together Fund (AGTF), is a fund inside the African Development Bank financed by the People's

Bank of China, is to finance eligible sovereign and non-sovereign guaranteed development projects in Africa.

In the larger arena China seeks to strengthen South-South relations and contribute to global development. To this end, China announced the creation of the $3.1 billion South-South Climate Cooperation Fund in a China-U.S. joint presidential statement on climate change in September 2015, to be used to finance initiatives in developing countries worldwide to combat climate change. China also pledged $2 billion in the creation of a South-South Cooperation Fund aimed to assist developing countries in implementing their post-2015 development agenda, as announced last year at the United Nations Sustainable Development Summit at the UN headquarters in New York. Plans to create an Academy of South-South Cooperation and Development was also announced, with the aim to facilitate studies and exchanges by developing countries on theories and practices of development suited to their respective national conditions.

2. Estimating Chinese Energy Finance: A Comparative Analysis

China has doubled the amount of energy finance to national governments since 2007. Given the enormous energy and infrastructure gaps facing the world economy, and recent commitments to fill those gaps, such finance is sorely needed and welcome. However, China's energy portfolio is heavily exposed to significant country and macroeconomic risk, as well as climate and social risks.

In this section of the paper we present our estimates of CDB and CHEXIM finance to national governments for energy projects across the world. We estimate that between 2005 and 2014, China's policy banks have provided upwards of $128 billion in finance to foreign governments for energy. Comparing China's energy finance with that of the major regional Western-backed MDBs operating in developing countries between 2007 and 2014 (the years we could compile comparative data), China almost matches the financing of all the major Western-backed MDBs combined. Table 2 presents the summary data from our exercise.

Table 2

Development Bank Finance for Energy, 2007-2014

Bank	*($USm)*	*annual ave*
World Bank	72,219	10,317
AsDB	25,410	3,630
IADB	9,631	1,376
AfDB	11,676	1,668
China Banks	117,590	16,799
China Banks	117,590	16,799
MDBs	118,936	16,991
Total	236,526	

Source: Author's estimates and bank annual reports

China doubles global energy finance

Chinese policy banks have doubled the amount of finance for energy projects (extraction, refining, power plants, and distribution) to developing countries. As Table 2 exhibits, between 2007 and 2014 China's banks have provided upwards of $117 billion in energy finance. The CDB provided 60 percent of the total for Chinaand averaged roughly $8.3 billion per year in loans and the CHEXIM provided 40 percent of the loans at approximately $5 billion per year—combining to $13.5 billion per year. The largest single development bank financier of energy is the World Bank, averaging $10 billion per year. The ADB provides $3.6 billion, and the IADB and AfDB provide $1.3 and $1.6 billion respectively.

Methodology

We relied on a number of data sources and methods to generate the estimates for China policy bank lending to foreign governments for energy projects. Chinese banks do not regularly publish detailed figures on their loan activities. The methodology and approach is thus built out of two parallel efforts and approaches to estimate the total amount of Chinese development bank finance in Latin America and in Africa led by researchers at Boston University and Johns Hopkins University research teams (see Gallagher and Irwin, 2015; Gallagher and Myers, 2016; Brautigam and Gallagher, 2014; and Hwang, Brautigam, and Eom, 2016). These databases for Africa and Latin America examine a wide range of sources, including government finance ministry and central bank, Chinese bank, and press reports in both China and borrowing countries, in order to compile a list of loans and their characteristics. In-depth interviews with key officials also provide helpful information. Loans are not included in these databases unless there are at least two sources of verification outside of a press report. These teams received verification from both CDB and CHEXIM in some informal interviews that the loans we include in the database are valid and that our estimates are in the right order of magnitude but we are not able to confirm our estimates at a project-by-project basis.

For Chinese energy finance outside of Africa and Latin America we first compiled finance estimates from the previous work of others such as Downes, 2012; Herve-Mignucci and Wang, 2015; NRDC, 2015; Ueno, Yanagi, and Nakano, 2014; and Aidata, 2014). Finally, we then deployed the same methodology as the Africa and Latin America databases—and thus including only those projects from these sources and an independent global search that that we were able to confirm according to our criteria above.

Although we have gone to great pains to provide as reliable estimates as possible, they should not be taken as precise figures. It is possible that we have underestimated Chinese global energy by failing to document certain loans that we have missed—especially outside Africa and Latin America. It is also possible that we may overestimate in some cases, especially for those loans made in only recent years that may not fully come to fruition or become canceled.

China's energy finance is truly 'global'

The CDB and CHEXIM are truly global development banks, providing finance to all corners of the world in a manner similar to that of the World Bank. Moreover, Chinese policy banks largely do not overlap with country set of energy borrowers working with the World Bank, therefore

expanding the overall set of countries with access to development bank finance for energy.

Project-level data is available for the World Bank dating back to 2005. Therefore, for Table 3 we can compare the geographical distribution of Chinese policy bank lending to that of the World Bank.

Table 3

Geographical Distribution of Chinese and World Bank Energy Finance, 2005-2014		
	China Banks	***World Bank***
Africa	17,883	18,063
Middle East & North Africa	366	5,121
South Asia	17,513	14,107
Latin America & Caribbean	33,232	9,672
Europe & Central Asia	42,889	17,137
East Asia & Pacific	15,907	13,565
Total	127,789	77,665

Source: Author's estimates and WB annual reports

As we can see, Chinese banks provided more than one and a half times the amount of energy finance than the World Bank did during the period, and provided more finance to each region of the world except for in Africa and in the Middle East. When comparing Chinese energy finance for foreign governments with the regional MDBs for the period 2007 to 2014, the two China banks provide more energy finance to Asia as a whole than does the ADB ($33.5 billion versus $25.4 billion), more energy finance to Latin America and the Caribbean than does the IADB ($33.2 versus $9.6 billion), and more finance to Africa than does the AfDB ($17.8 billion versus $11.6 billion).

3. Risks Associated with Chinese Overseas Energy Finance

China's global energy portfolio is heavily exposed to country, macroeconomic, climate, and social risks however. To mitigate such risks and meet the broader sustainable development challenge for the 21st Century, China's development finance will need to shift the composition of its global energy lending in a significant manner. This section of the paper identifies two broad

sets of risk that are associated with China's overseas development finance. The first is country and macroeconomic risk, where Chinese policy banks are engaged with countries with higher country risk ratings and in commodity-backed loans that risk stress given the fall in commodity prices and associated macroeconomic downturns in the developing world. The second is climate and social risks, where China's coal and large hydropower plants are associated with significant social conflict and environmental cost. Indeed, using estimates of the emissions associated with China's overseas coal projects, we calculate that the annual social costs of China's overseas coal assets are upwards of $27 billion per year.

Country and Macro-economic Risk

Chinese finance also appears to go to a different set of countries in the world—expanding the set of nations with access to energy finance. Table 4 lists the top 20 country recipients of Chinese and World Bank energy finance—representing 98 percent of all China's energy loans and 67 percent of the World Bank's between 2007 and 2014. Thirteen countries on China's top 20 list do not receive financing from the World Bank in any significant amount. These thirteen countries receive roughly $76 billion in financing from the Chinese banks—more than the entire amount of energy finance provided by the World Bank during the period.

Table 4

Twenty Top Recipients of Chinese Energy Finance			
Country	***Amount ($m)***	***no WB***	***OECD risk rating***
Russia	31.000	*	4
Brazil	12.576		4
India	8.944		3
Ecuador	8.374	*	6
Turkmenistan	8.100	*	6
Pakistan	6.948	*	7
Indonesia	6.935		3
Venezuela	6.020	*	7
Vietnam	5.171		5
Argentina	4.914	*	7
Ethiopia	2.277	*	7
Niger	2.215	*	7
Sudan	2.084	*	7
Cambodia	1.776	*	6
Ghana	1.713		6
Kazakhstan	1.647	*	6
Sri Lanka	1.341	*	6
Bosnia & Herzegovina	1.326	*	7
Zambia	1.187		5
Tanzania	1.164		6

Source: Author database and OECD (2016)

Chinese banks are expanding the amount of energy finance available to foreign governments in part because the Chinese appear to be willing to take on more risk. The average OECD risk rating for the World Bank's top 20 recipients of energy finance is 5.25 (where 1 is low risk and ten is high). The Chinese bank's risk average is just a bit higher at 5.75, but the 13 countries on China's list that do not appear on the World Bank's have an average country risk rating of 6.4.

Part of the reason why Chinese banks may be willing to take on more risk may be because they are less beholden to Western credit ratings. A recent G-24 Finance Ministers report showed that the Western-backed MDBs have become highly concerned about their credit ratings and have become less apt to lend to certain groups of countries whereas China's banks can rely on deep Chinese capital markets (Humphrey, 2015). Moreover, these banks may be willing to take on more risk because China's foreign policy is to not discriminate on the basis of borrowing country governments' domestic policy and behavior, whereas the MDBs often have a set of domestic policy conditions that make it less apt to finance certain governments. Finally, Chinese banks appear to

take on more risk because they secure some of the loans with commodities.

Commodity-backed loans and Macroeconomic Risks

Securing loans with commodities to borrowers with higher country risk were an innovative hedge for China's policy banks during the commodity boom, but may now accentuate the macroeconomic risks that China faces in its loan portfolio to developing countries. Almost half of the energy projects financed by Chinese development banks (in terms of dollar volume) are 'commodity backed' whereby a portion of the loan is repaid in the form of collateral. Almost all of the energy loans in our database that are commodity backed, about 40 percent of all loans, are backed by oil sales. However, Ghana secured a Chinese loan for its Bui Dam hydropower project with the export of cocoa beans. In countries without good credit ratings and therefore little ability to reliably provide guarantees, a resource guarantee increases security and lowers risk, and allows projects to be financed at better interest rates. That said, across Africa, China has secured loans from copper, diamond, cocoa and other sales (Brautigam and Gallagher, 2014). This form of finance has been practiced in China for over a decade and by Japan for a considerable amount of time (Brautigam, 2009). Indeed, securing loans to municipalities through land collateral was a cornerstone of the CDB's domestic finance strategy on the Chinese mainland (Forsyth and Sanderson, 2014).

Table 5

China's Oil-Backed Lines of Credit: Illustrative List

Date	*Country*	*Purpose*	*Energy Sector*	*Energy sub-sector*	*Lender*	*Amount ($m)*
2009	Brazil	Exploit pre-salt oil fields	Oil	Extraction/Refinery	CDB	10,000
2003	Congo-B	Imboulou Hydropower	Hydro	Power Generation	Ex-Im Bank	238
2011	Ecuador	Various	Misc.	Power Generation	CDB	2,000
2010	Ecuador	80% discretionary, 20% oil	Oil	Extraction/Refinery	CDB	1,000
2002	Nigeria	Omotosho Power Plant I	Gas	Power Generation	Ex-Im Bank	115
2002	Nigeria	Papalanto Gas-Fire Power Station	Gas	Power Generation	Ex-Im Bank	115
2005	Russia	oil export revenue-backed loan agreements	Oil	Extraction/Refinery	CDB	6,000
2009	Russia	oil export revenue-backed loan agreements	Oil	Extraction/Refinery	CDB	10,000
2009	Russia	oil export revenue-backed loan agreements	Oil	Extraction/Refinery	CDB	15,000
2009	Sudan	Al-Fulah Power Plant	Gas	Power Generation	Ex-Im Bank	680
2000	Sudan	El-Jaili Power Station	Gas	Power Generation	Ex-Im Bank	149
2010	Sudan	Power transmission to South Kordofan	Electricity	Distribution	Ex-Im Bank	274
2009	Turkmenistan	development of South Yolotan natural gas field	Gas	Extraction/Refinery	CDB	4,000
2012	Venezuela	Purchase of oil-related goods and services from China	Oil	Extraction/Refinery	CDB	500

The mechanics of the guarantee work as follows. The process usually begins with a framework agreement between a host country ministry of finance and a Chinese policy bank. Chinese bank then asks for a letter of application from the borrowing country's ministry of finance, an engineering, procurement and construction (EPC) contract with a Chinese company, a project feasibility study, and an environmental impact assessment. Following that, a Chinese importer signs a purchase agreement with the (usually state-owned) company selling the commodity. The borrowing government would then sign the loan agreement with the Chinese bank, and the proceeds from a specified amount of the export (usually in quantity, rather than value) get deposited into an escrow account with the Chinese bank and drawn down to repay the EPC contract loan. Thus it is not the export commodity itself that repays the loan, as in a true barter system, but the proceeds from the sale of the commodity (Brautigam, 2009; Brautigam and Gallagher, 2014).

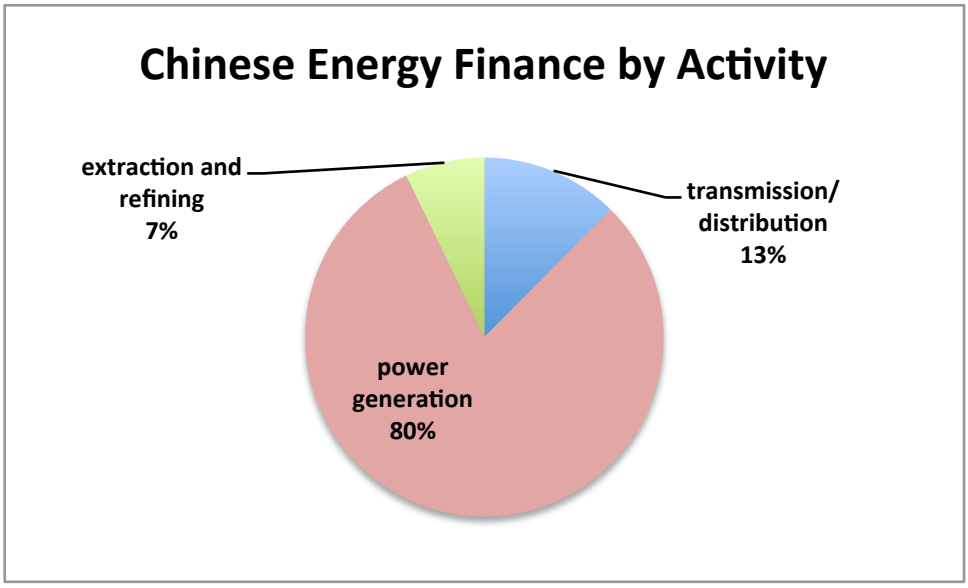
During the commodity boom, that itself was partly fueled by China, commodity-backed loans looked like a good bet. As long as commodity prices were rising China's policy banks appeared to be hedging country risk by guaranteeing repayment through commodity sales. In the current environment however commodity backed loans appear to be doubly risky. Commodity prices are down significantly, with the overall commodity price index down 19 percent since August of 2015 and oil and gas down 32 percent--and thus so are growth prospects in much of the developing

world, especially for commodity producers in Africa, Latin America, and Asia (IMF, 2016). Lack of export demand and low growth prospects are triggering currency depreciations and capital outflows as well—accentuating financial fragility and further credit downgrades. With commodity prices down export revenue may fall short of the dollars necessary to repay bank loans to China and beyond. What is more, lower commodity prices bring less foreign exchange to host country governments to cover the commodity-sale losses. Currency depreciations mean host countries have to come up with significantly more units of local currency in order to pay the dollar-denominated loans to China's policy banks.

Climate Risk: Fossil Fuel Extraction, Hydropower, and Coal Plants

The majority of Chinese energy finance flows into fossil fuel extraction, large hydroelectric projects, and coal plants—exposing Chinese policy banks to significant climate change and social risk. Most Chinese energy finance flows toward power generation projects, with distribution and extraction coming in second and third (see Figure 2). In terms of distribution the Chinese have financed oil and gas pipelines such in Brazil, Angola and elsewhere. Chinese policy banks have also provided financing for transmission lines such as the Cambodia Phnom Penh—Baray Power Transmission and Transformation Project. In terms of extraction the Chinese banks are financing pre-salt exploration in Brazil and refineries in Russia.

Figure 2



Source: Authors calculations

Ninety-three percent of all Chinese investment in the power sector is dominated by coal and hydroelectric finance. Sixty-six percent of the power generation projects financed by Chinese policy banks are in the coal sector. The second largest destination for Chinese power generation

finance is in hydroelectric power plants at 27 percent. Table 6 shows how Chinese investment in power generation stands in stark contrast to the other MDBs engaged in the energy sector.

Table 6

Distribution of Power Projects across Development Banks, 2007-2014

	China	*WB*	*IADB*	*AfD*	*AsDB*
coal	66%	0%	0%	3%	7%
gas	2%	25%	1%	0%	0%
oil	5%	2%	6%	3%	0%
hydro	27%	50%	79%	53%	62%
wind	1%	5%	0%	0%	15%
solar	0%	16%	12%	41%	6%
bioenergy	0%	2%	1%	0%	10%
Renewable	28%	73%	93%	94%	93%
Renewable Non-hydro	1%	23%	14%	41%	31%

Source: Authors calculations based on own estimates and bank annual reports

Chinese financial commitments in renewable energy are the smallest when compared to the MDBs. On average, the MDBs devote 88 percent of their energy finance portfolio to renewable energy. China devotes 28 percent of its portfolio to renewables. Hydropower is the largest recipient of MDB renewable energy financing, as is the case with China. Whereas China has provided just one percent of its power generation portfolio toward renewable energy sources outside of the hydropower sector, the MDBs invest 27 percent on non-hydro renewable energy. China is financing a modest wind power projects in Ecuador and Ethiopia, as well as solar power in the Sudan.

The most striking contrast is in the coal sector, where Chinese banks earmark 66 percent of their power generation portfolio. Chinese policy banks are financing more than 45 coal plants across the globe for upwards of $28 billion in financing. Chinese policy banks comprise 89 percent of the coal plants currently being financed by the MDBs in the sample. China's banks are followed by the AfD, which finances 6 coal projects in Africa and the ADB finances four.

Table 7 lists the twelve largest coal-fired power plants financed or co-financed by Chinese

policy banks. These 12 projects represent 60 percent of all of the coal plants (by dollar volume) in China's portfolio. With the exception of the IGCC plant in the United States, researchers at the University of Tokyo estimate that Chinese overseas coal plants are relatively less efficient than those that are financed by Japan's overseas development bank and export credit agency (Ueono et al, 2014). Moroever, researchers at the Climate Policy Initiative project that China has planned another $35 to $72 billion in new coal plants in Pakistan, India, Bangladesh, Russia, Vietnam, and beyond (Herve-Mignucci and Wang, 2015).

Table 7

China's Largest Policy Bank Financed Coal Projects

Country	*Project Name*	*Lender*	*Amount ($m)*
India	Various power plants of Reliance Power	CDB & Ex-Im Bank	5,450
Indonesia	Bangko Tengah, aka South Sumatra 8 or Sumsel-8	CDB	1,200
Australia	China First Coal	Ex-Im Bank	1,200
Vietnam	Vinh Tan 1 Coal-Fired Thermal Power Plant	CDB, Ex-Im Bank, ICBC, BOC & Sinosure	1,170
Kazakhstan	Upgrade Atyrau Refinery	Ex-Im Bank	1,130
India	Sasan UMPP	CDB, Ex-Im Bank & Sinosure	1,100
Vietnam	Duyen Hai 1	Ex-Im Bank & Sinosure	1,008
Vietnam	Duyen Hai 3	CDB, Sinosure/BOC & ICBC	1,000
US	Summit IGCC Plant Odessa Texas	Ex-Im Bank	1,000
Sri Lanka	Norochcholai 2	Ex-Im Bank	891
Bosnia & Herzegovina	Tuzla 7	Ex-Im Bank	882
Indonesia	Celukan Bawang	CDB	880

According to a parallel analysis using these data, the majority of coal-fired power plants in our analysis (58 percent) deploy sub-critical coal technology—the most energy efficient and thus most carbon dioxide intensive. However, some of China's coal-fired power plants deploy 'cleaner' coal technologies such as an ultra-supercritical plant in Egypt and the trend may be going in this direction. Since 2013, only 26% of China supported coal plants used sub-critical technology and clustered in Asia, Eastern Europe and Africa (Gallagher, 2016).

Holding assets in coal is increasingly associated with risk. According to a study by Oxford University researchers, over 290 GW of coal plants will need to be closed by 2020 to meet climate change and local health regulations. Investors globally are thus reassessing their coal holdings to account for the fact that they may become 'stranded assets'. Fixed income and equity investors are reassign yields and dividends and even considering divesting. In light of this, credit rating agencies too are reassessing rates and ratings needed to compensate for the increased risk of coal assets (Caldecott et al, 2015).

The global coal sector is also considered to be increasingly associated with significant social risk as well. Global climate change activists, local communities, and others have waged global

campaigns to halt the expansion of coal plants across the globe. Such efforts have left many stranded assets in the global coal sector and have carried real costs for investors. Chinese banks are increasingly the target of such campaigns that in the end could lead to stranded assets for China's policy banks that would not only hurt their bottom line, but their reputation moving forward. Such is the case in Bangladesh, where local police killed four people in April 2106 during a public demonstration against a coal-fired power plant planned in Chittagong (Vidal, 2016).

Global campaigns have led to the banning of coal finance for many of the Western-backed MDBs, as well as a set of OECD guidelines that restrict coal financing by export-credit agencies. The majority of the Western-backed MDBs now have policies in place that limit their ability to invest in coal given that coal is the most carbon intensive form of fossil fuel combustion. The World Bank and the IADB now follow policies where they do not fund coal plants except under specific circumstances whereby there are no feasible alternatives and the electricity generated would prioritize the poor and under "exceptional circumstances where countries have few or no prospects for other energy sources" (Jowit 2010). In 2013, the United States government issued an executive order limiting the ability of the United States to participate in the financing of coal projects unless under similar circumstances and in 2014 issued a further executive order mandating that US development finance be climate resilient (US Treasury, 2013; 2014). In the wake of the Paris climate agreements the OECD has also agreed upon guidelines that limit export-credit agency finance for coal as well. What is more, even private banks are now the target of coal financing as have some Chinese banks (NRDC et al, 2015).

Coal is of growing scrutiny because of its significant social and environment costs. According to calculations by Gallagher (2016), the coal-fired power plants in our database are estimated to release 594 million metric tons (MMT) of carbon dioxide over on an annual basis. Put in perspective, these emissions amount to 11% of total U.S. emissions and 6% of total Chinese emissions in 2014 during the most recent year available. Taken together China's policy bank financed overseas coal plants would be the eighth largest emitter of carbon dioxide emissions, more on an annual basis than Canada, Brazil, Saudi Arabia, or the United Kingdom. If a 30-year lifetime of these plants is assumed, China-financed coal plants will cumulatively emit 17,828 MMT of carbon dioxide, equal to more than triple total U.S. emissions in 2015, 1.5 times Chinese emissions in 2014, or slightly more than U.S. and Chinese emissions put together on an annual basis (Gallagher 2016).

Based on those emissions estimates, in this paper we estimate the economic costs of China-financed coal plants world wide. If social damage to human health from fossil fuels in power generation is considered in economic terms, along with the externalities associated with CO2 emissions (assumed to be $50/ton of CO2), the cost of fossil fuel-fired power generation rises. The range of costs associated with climate change externalities is high, reflecting uncertainty about the rate and severity of the negative impacts of climate change under different scenarios and different

discount rates. To manage this uncertainty, the International Renewable Energy Agency (IRENA) has analyzed the impact of the estimated avoided external costs of CO2 emissions for 26 countries, assuming external costs of $20/ton of CO2 and also $80/ton of CO2 to allow for uncertainty over the potential costs of climate change (IRENA, 2016). For this paper we used the midpoint of the range to calculate external costs of carbon dioxide emission from Chinese development finance investment in coal-fired powers from 2001 to 2015. The annual social cost of Chinese overseas coal-fired power amounts to $29.7 billion. Assuming a power plant lifetime of 30 years, the total cost ranges from $117 billion to $892 billion assuming a range of discount rates from 7 percent to zero. A four percent discount rate would put the total social cost of these power plants at $661 billion.

China's commitments in renewable energy may face climate and social risks as well. Chinese financial commitments in renewable energy are the smallest when compared to the MDBs. Going back to Table 6, on average, the Western-backed MDBs in developing regions devote 88 percent of their energy finance portfolio to renewable energy. China devotes 28 percent of its portfolio to renewables. Hydropower is the largest recipient of MDB renewable energy financing, as is the case with China. As can be seen in the table, the other MDBs exhibited here are less engaged in the hydroelectric sector, especially in large hydro projects.

Large hydroelectric projects tend to highly controversial with local communities and in some regions hydro projects can actually increase greenhouse gas emissions. The Latin American region is a case in point, where tropical hydroelectric projects have long been associated with increases in methane emissions and emissions from associated deforestation. Comprehensive reviews of estimates find that tropical hydroelectric plants tend to emit 7 to 15 times more emissions than non-tropical hydropower, and 2 to 3 times more emissions than gas, oil, or coal plants (Barro et al, 2011; Steinhurst et al, 2012). This is due to the fact that methane emissions are more potent from tropical dams, and because new roads and infrastructure sprout as a resulting from new dams can cause further carbon emitting deforestation (Fearnside 1997, 2012, 2015).

In addition to emissions increases huge changes caused by large dams can lead to the loss of aquatic biodiversity, massive costal erosion and other problems. These environmental impacts are exacerbated when local regulations are relatively weak. For example, In the Brazilian Amazon, every kilometer of legal road in wilderness areas is often accompanied by three kilometers of illegal roads (Barber et al. 2014). Even improvement of existing roads and highways may exacerbate the negative impacts because better road conditions facilitalte more and faster traffic in sensitive areas, which in turn, increase the likelihood of road kill of animals (Benítez-López, Alkemade and Verweij, 2010; Laurance, Goosem and Laurance, 2009). Similar impacts can be found in large hydro plants and mining projects in remote areas, as they often need to construct road and power transmission networks. As noted earlier, it is estimated that the deforestation of Amazon

will increase 950,000 hectares by 2032 due to the construction of 12 dams on the Tapajós River and their road networks (Barreto et al, 2014). In 2014, the US Congress also passed legislation that included a provision whereby "The Secretary of the Treasury shall instruct the United States executive director of each international financial institution that it is the policy of the United States to oppose any loan, grant, strategy or policy of such institution to support the construction of any large hydroelectric dam, (Brossard, 2014).

Large hydro plants have been the focus of social concern as well. The World Bank-backed Ixiamas-San Buenaventura road project has become the focus of significant concern. Critics of the project worry that the project will increase deforestation and illegal logging in Bolivia, overfishing, a decrease in tourist revenue, and contamination of local waterways. In addition, there are concerns that the project will trigger the displacement of indigenous peoples and erode traditional cultural values (Bank Information Center, 2015). The Mareña Renovables wind farm in Oaxaca Mexico, financed by the IADB, has split local communities. The project has been halted due to local protests on more than one occasion, even though there is significant support from some community members. In 2014, members of two indigenous communities brought a petition of 2000 signatures to the IADB demanding that the bank rescind its plans (Nauman, 2013). China has experienced significant opposition to its large hydro dams in Asia and Africa as well (International Rivers, 2012).

Whereas China has provided just one percent of its power generation portfolio toward renewable energy sources outside of the hydropower sector, the MDBs invest 27 percent on non-hydro renewable energy. China is financing a modest wind power projects in Ecuador and Ethiopia, as well as solar power in the Sudan. There is enormous potential for China's development banks to diversify into these types of renewable energy investments. Solar and wind energy are now price competitive with coal and gas, but are hindered by up front capital costs. Indeed, solar, wind, and biomass production could more than double by 2030 if such costs were addressed (IRENA, 2016). Development banks are uniquely poised to smooth such cost structures given their longer-term maturity horizons and deeper levels of capital.

4. Summary and Implications for Policy

Over the past decade China's national development banks have accumulated global assets that rival the assets of the Western-backed MDBs. Moreover, China's banks have already emerged as the leading financiers of energy projects to developing country governments, doubling the amount of energy financing since 2007. In addition to its national development banks, China has recently co-founded two major multilateral development banks and at least thirteen regional funding instruments that will increase China-backed development finance by at least an order of

magnitude. This new source of development finance is a tremendous opportunity for the world economy, but it also carries new risks.

For this paper we track the rise of China's national development banks, China's newly co-founded MDBs, and China's numerous funds across the world. We then compare those estimates with the published assessments of Western-backed MDB financing. We find that Chinese banks and funds already hold more assets than their Western-backed counterparts even before the two new MDBs that China has co-founded—the Asian Infrastructure Investment Bank (AIIB) and the New Development Bank (NDB)—have started giving loans.

We also estimate the levels of energy financing that China's two 'policy banks'—the China Development Bank (CDB) and the China Export-Import Bank (CHEXIM)--provide to foreign governments and compare those to their Western MDB counterparts. We estimate that China's development banks have provided upwards of $128 billion in energy finance to developing country governments between 2005 and 2014. Comparable data for the MDBs only exists for the period 2007 to 2014, and during that period China's development banks provided $117 billion during the period or $16 billion per year—roughly the same amount as the World Bank and the regional MDBs combined.

China's national development banks have truly 'gone global.' The CDB and CHEXIM have a presence in almost every major region of the world. What is more, these two banks have expanded into countries that the traditional MDBs have shied away from, thus expanding the set of countries that have access to long-run energy financing.

Chinese banks now appear to be significantly exposed to country, macro-economic, and other risks. Many of the nations that receive the bulk of China's overseas energy finance have a higher risk of default than the top recipients of energy finance from the Western-backed MDBs. Indeed, many of the recipients of Chinese energy finance are commodities exporters in Asia, Africa, and Latin America that are experiencing accentuated macro-economic turbulence. While commodity-backed loans to these countries seemed like a way to hedge some of the country risk involved with China's loans, the global fall in commodities prices exarcerbates the level of risk entailed with these loans.

Given the massive energy and infrastructure gaps facing developing countries, and the need to transform the world economy toward a low-carbon energy future, this finance is very welcome and could not come at a better time. That said, China's energy portfolio is also exposed to climate and social risk. According to our estimates, the vast majority of the energy finance provided by Chinese development banks is in the fossil fuel sector—both in terms of extraction/refining and in power generation. Eighty percent of all Chinese development bank energy finance is in power generation. Sixty-six percent of all power generation by these two banks is in the coal sector.

China's renewable energy portfolio is concentrated in large hydropower projects which can also have climate risk and are often a source of significant social risks for Chinese banks.

Diversifying China's global energy portfolio toward cleaner energy technologies will help Chinese policy banks mitigate the risks associated with primary commodities and meet broader sustainable development goals. Through the newly minted Sustainable Development Goals and again at the Paris Climate Summit of 2015 world leaders—China included-- have committed to steer public finance toward energy and infrastructure in a manner that is environmentally sustainable and socially inclusive. Also in 2015, the governments of the United States and China committed to "controlling public investment flowing in projects with high pollution and carbon emissions both domestically and internationally." Later in 2016 it is anticipated that China will dub 'green finance' a global commitment under the G-20.

It will be a significant challenge for the Chinese banks and the newly created China-backed funds to shift toward a more sustainable energy portfolio. China is uniquely poised because it controls a variety of instruments that could be blended toward supporting a global energy finance agenda that is more low-carbon and socially inclusive. China is suited to blend non-concessional and concessional finance, as well as its climate change funds, to broker deals that can deliver sustainable energy to borrowers and benefit the bottom line for China's policy banks. Such will be the central challenge for these institutions over the next half decade.

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