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Aid, China, and Growth: Evidence from a New Global Development Finance Dataset†

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This article introduces a new dataset of official financing from China to 138 developing countries between 2000 and 2014. It investigates whether Chinese development finance affects economic growth in recipient countries. The results demonstrate that Chinese development finance boosts short-term economic growth. An additional project increases growth by between 0.41 and 1.49 percentage points 2 years after commitment, on average. While this study does not find that significant financial support from China impairs the overall effectiveness of aid from Western donors, aid from the United States tends to be more effective in countries that receive no substantial support from China. (*JEL* F35, O19, O47, P33, P34)

The scale and scope of China's overseas grants and loans now rivals or exceeds that of other major donors and lenders (Horn, Reinhart, and Trebesch 2019). Its flagship Belt and Road Initiative (BRI)—a "Belt" of road, rail, port, and pipeline projects that create an infrastructure corridor from China to Central Asia and Europe and a "Maritime Silk Road" that links China to South and Southeast Asia, the Middle East, and Africa through a series of deepwater ports along the littoral

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areas of the Indian Ocean—has "little precedent in modern history, promising more than [US]$1 trillion in infrastructure and spanning more than 60 countries" (Perlez and Huang 2017).

Whether this new source of financing for development promotes economic growth is the subject of continued speculation, controversy, and debate. Some argue that Chinese government institutions and state-owned banks have weak internal systems for appraising the economic viability of candidate projects and as such are more likely than traditional donors and lenders to fund economically inefficient "white elephant" projects (Dornan and Brant 2014, Financial Times 2016, Pilling and Feng 2018). According to *The Economist* (2017), "China seems to be repeating many of the mistakes made by Western donors and investors in the 1970s, when money flowed into big … infrastructure projects that never produced the expected economic gains." Others argue that Chinese banks and government institutions do not adequately account for repayment capacity of borrowers and that Chinese development finance may ultimately dampen the economic growth prospects of borrower countries (Onjala 2018, Hausmann 2019).

On the other hand, leaders of many developing countries praise the Chinese government for its willingness to bankroll the "hardware" of economic development—such as roads, railways, power plants, electricity grids, and telecommunication systems—and its ability to quickly implement large-scale infrastructure projects (Swedlund 2017a). Meles Zenawi, former Prime Minister of Ethiopia, claimed that "one of the main reasons for [the] turnaround in the economic fate of Africa is the emergence of the emerging nations in general and China in particular."[1]

However, this debate rests upon weak evidentiary foundations. Little is known about the economic effects of Chinese development finance because Beijing shrouds

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[1] See interview excerpts from 2012 at http://et.china-embassy.org/eng/zagx/t899134.htm (accessed October 12, 2019).

its overseas portfolio of grants and loans in secrecy (Brautigam 2009, 2). The data that do exist are insufficiently comprehensive and granular. We close this evidence gap by introducing a new, project-level dataset of official financing—including development aid and other forms of government financing—from China worldwide over the 2000–2014 period. As we describe in greater detail in Section I of this paper, we construct this dataset with the Tracking Underreported Financial Flows (TUFF) methodology developed by Strange, Cheng et al. (2017) and Strange, Dreher et al. (2017), extending AidData's Chinese Official Finance to Africa Dataset (Strange, Dreher et al. 2017) to cover 83 additional countries around the globe over a 15-year period. In total, the new dataset includes 4,304 projects financed with Chinese official development assistance (ODA) or other official flows (OOF) in 138 countries and territories around the world. It is the first dataset that enables researchers to study the effects of China's official financing (OF) activities on a global scale.[2]

In this article, we use these data to address two important questions. First, does the receipt of Chinese development finance promote economic growth? Second, does China's development finance undermine the effectiveness of development finance from Western donors? With respect to the first question, development finance from China may be no different than development finance from other sources. It might spur economic growth via increased physical investment (Clemens et al. 2012, Galiani et al. 2017, Dreher and Langlotz 2020), human capital accumulation (Arndt, Jones, and Tarp 2016), household consumption (Jackson 2014, Temple and Van de Sijpe 2017), or firm performance (Chauvet and Ehrhart 2018; Marchesi, Masi, and Paul 2020). On the other hand, several factors could reduce economic growth (Kumar and Woo 2010). First, if China mostly finances unproductive, "white elephant" projects, host governments may find it difficult to service their debts and cover their recurrent expenditures (Christensen 2010, Dabla-Norris et al. 2012). They might also find themselves using more public funding than would otherwise be necessary to rehabilitate infrastructure that has fallen into disrepair. Second, excessive amounts of debt through Chinese loans could deter foreign investment (Claessens et al. 1996; Pattillo, Poirson, and Ricci 2004; Ahlquist 2006). Third, a host government that has contracted a high level of Chinese debt might experience foreign exchange shortages, which can lead to import shortages and constrain export growth (Iyoha 1999). Fourth, unsustainable debt levels can lead to expectations of inflation and exchange rate depreciation (Fischer 1993; Hurley, Morris, and Portelance 2019).

With respect to the second question, several recent studies suggest that Chinese government financing could undermine the effectiveness of Western donor policies and practices. Hernandez (2017) provides evidence that recipients of Chinese aid receive World Bank loans with fewer policy conditions. Annen and Knack (2019) find that traditional donor countries—members of the OECD's Development

[2] Busse, Erdogan, and Mühlen (2016) analyze the growth effects of Chinese aid in Africa. However, they have no direct measure of aid and address endogeneity concerns with a generalized method of moments method that relies on internal instruments that are unlikely to be excludable. Bluhm et al. (2020) geocode a subset of the projects that we introduce in this paper and analyze the effect of Chinese transport projects on the spatial distribution of economic activity within countries and subnational regions. In related work, we geocode our project-level data for Africa and investigate whether the birth regions of national leaders receive more aid (Dreher et al. 2019) and whether such favoritism affects subnational development outcomes (Dreher, Fuchs, Hodler, Parks, Raschky, and Tierney 2021).

Assistance Committee (DAC)—are substantially less willing to reward countries that have higher-quality policies and institutions with increased aid when those countries also receive large-scale financial transfers from the Chinese government.[3] Given that policy and institutional quality are important determinants of public investment efficiency (Denizer, Kaufmann, and Kraay 2013; Presbitero 2016) and economic growth (Humphreys and Bates 2005, Jones and Olken 2005), the receipt of Chinese development finance could undermine the growth effects of Western aid by short-circuiting its link to the quality of policies and institutions in recipient countries.

To identify whether and how Chinese development finance affects economic growth, we employ instrumental variables (IV) that exploit year-to-year changes in the supply of Chinese development finance in tandem with cross-sectional variation capturing the probability that countries receive a smaller or larger share of such funding (see Section II). We then investigate the popular but untested claim that Chinese development finance might undermine the effectiveness of Western aid (e.g., Naím 2007; Brazys, Elkink, and Kelly 2017). In separate tests, we focus on OECD-DAC donors as a whole, the United States, and the World Bank.

Our main results, reported in Section III, suggest that Chinese development projects boost short-term economic growth in recipient countries between one and three years after commitment. They do so by increasing investment and—to a lesser extent—consumption. We do not find evidence that Chinese development projects are more or less effective in countries with high-quality policies and institutions. Nor do we find that significant financial support from China impairs the effectiveness of aid from Western donors (see Section IV). However, aid from the United States tends to be more effective in countries that receive no substantial support from China.

I. The Global Allocation of Chinese Development Finance

A. *New Dataset*

In this paper, we introduce a new dataset that measures foreign aid and other forms of concessional and nonconcessional government financing from China to the developing world between 2000 and 2014. We build upon Strange, Dreher et al. (2017), who provide data on China's official financing commitments to 50 African countries over the 2000–2012 period. We extend this work in three ways. First, we leverage a substantially broader set of sources to minimize the effect of incomplete or inaccurate information about individual projects. We standardize and synthesize data from four different source types—official data from Chinese ministries, embassies, and economic and commercial counselor offices; information from aid and debt management systems of finance and planning ministries in

[3] Some studies also address the question of whether Chinese government financing undermines the effectiveness of Western donor policies and practices at subnational scales. For example, Brazys, Elkink, and Kelly (2017) find that the presence of World Bank development projects in Tanzanian localities is associated with lower levels of corruption. However, in cases where Chinese and World Bank projects are geographically colocated, the corruption-reducing effects of World Bank projects vanish.

counterpart countries; English, Chinese, and local-language news reports; and case studies undertaken by hundreds of scholars and NGOs. In total, our dataset draws upon 15,500 unique sources of information, and it covers 4,304 Chinese development projects (worth approximately US$354 billion) that were officially committed, implemented, or completed between 2000 and 2014. Second, we extend the geographical coverage of the dataset to the entire developing world, including 138 countries in 5 world regions: Africa, the Middle East, Asia and the Pacific, Latin America and the Caribbean, and Central and Eastern Europe. Third, we extend the temporal coverage of the data through 2014.

We constructed the dataset using the Tracking Underreported Financial Flows methodology, which we explain in detail in online Appendix A1. This method was initially developed by several authors of this paper—in collaboration with AidData, a research lab at William and Mary (Strange, Cheng et al. 2017). It codifies a set of open-source data collection procedures that make it possible to identify detailed financial, operational, and locational information about officially financed projects that are not voluntarily or systematically recorded by official donors and lenders through international reporting systems, such as the OECD's Creditor Reporting System (CRS) or the International Aid Transparency Initiative (IATI). We present the resulting dataset in more detail in online Appendix A2.

The dataset allows analysts to distinguish between three different categories of Chinese official financing (OF): "ODA-like" projects, which are nominally intended to promote economic or social development and provided at levels of concessionality that are consistent with the ODA criteria established by the OECD-DAC; "OOF-like" projects, which are also financed by the Chinese government but either have a non-developmental purpose (e.g., export promotion) or have insufficiently high levels of concessionality to qualify as ODA (e.g., loans at market rates); and "Vague OF," which are Chinese government-financed projects that would qualify as ODA or OOF but cannot be categorized because of insufficient open-source information.[4] The vast majority of Chinese government financing each year is OOF-like; ODA-like projects represent only 21 percent of total Chinese official commitments in financial terms between 2000 and 2014 (see online Appendix B2).

To analyze the sectoral distribution of Chinese official financing, we also coded the OECD-DAC sector classification (three-digit purpose codes) for all projects. Descriptive statistics indicate that the Chinese government invests far more money in the energy, transportation, industry, mining, and construction sectors than it does in the education, health, and governance sectors (see online Appendix B3). However, a measure of project counts, rather than dollar amounts, paints a very different picture: the Chinese government funds more projects in the health, education, and governance sectors than in the economic infrastructure and production sectors. These smaller projects are disproportionately ODA-like, while the large projects in the economic infrastructure and production sectors tend to be funded with OOF-like loans.

[4] ODA projects are widely considered to be "development aid" in the strict sense of the term.

B. *Cross-Country Allocation of Chinese Development Finance*

Our dataset enables us to analyze the allocation of the Chinese government's global portfolio of aid and debt-financed projects. African countries received the largest proportion (54 percent) of the total number of projects financed by China between 2000 and 2014 (online Appendix B5). Seven of the top ten recipient countries, as measured by the number of projects, are African countries (online Appendix B6). This finding is consistent with the conventional wisdom in press accounts (Poplak 2016) and academic sources (Alden, Large, and de Oliveira 2008; Carmody 2016, chap. 3) that emphasize a new, Chinese-led "scramble for Africa" in the twenty-first century. However, a different picture emerges when one counts total dollars (rather than projects) committed. Of the 25 largest Chinese projects in financial terms, only 6 are located in Africa (see online Appendices B7 and B8 for details). More broadly, if one measures the average size of Chinese government-financed projects in terms of constant dollars, only 1 African country is on the list of top 20 recipients (South Africa at number 8; see online Appendix B9). In panel A of Figure 1, we present a map of the global distribution of Chinese official financing (based on dollar amounts). Russia, Pakistan, and Angola are the three largest recipients of Chinese official financing (see also online Appendix B10).

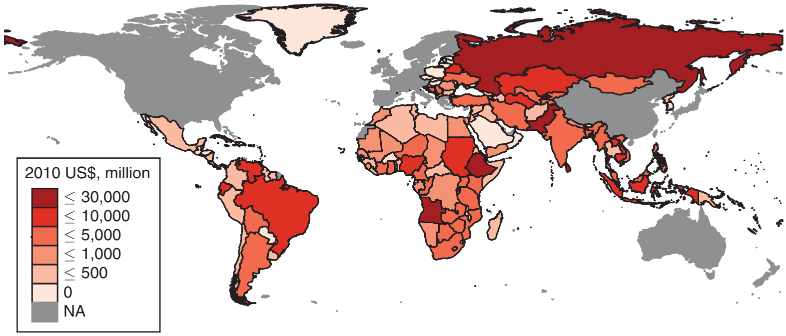
We also examine the factors associated with the allocation of Chinese government grants and loans. Following the aid allocation literature (e.g., Alesina and Dollar 2000, Hoeffler and Outram 2011), Table 1 reports results for simple project allocation regressions. The dependent variable is the number of Chinese government-financed projects in a given country and year.[5] In the selection of explanatory variables, we follow Dreher and Fuchs (2015), who study China's "historical" aid allocation since the 1950s, and Dreher et al. (2018), who study the cross-country correlates of Chinese development finance to Africa.[6] As column 1 demonstrates, our results from a simple random-effects panel regression are broadly in line with those reported in previous studies: a country receives more Chinese development projects when its voting is aligned with China in the United Nations General Assembly. Conversely, it receives fewer projects when it recognizes the government in Taipei, Taiwan, rather than the one in Beijing. These results are consistent with the idea that Beijing rewards countries for their political allegiances. Also, commercial ties and ease of communication appear to play a significant role as the number of projects increases with the logged value of China's existing trade with a particular country (in constant US dollars) and if the country's official language is English. Richer countries (oil producers and countries with higher levels of GDP per capita in constant US dollars) receive fewer projects, suggesting that these countries need less aid or that it is more difficult to buy policy concessions from them.[7] Countries that are more indebted

[5] Online Appendix B13 provides the list of all countries included in the allocation analysis.

[6] Our control variables originate from Rich (2009); Voeten, Strezhnev, and Bailey (2009); Abbas et al. (2010); Mayer and Zignago (2011); British Geological Survey (2016); Marshall, Gurr, and Jaggers (2016); UN Comtrade (2017); and the World Bank (2017). Online Appendix B14 contains the descriptive statistics of all variables employed in the allocation analysis.

[7] We code countries as oil producers if they produced oil in 1999. This measure follows the reasoning in Easterly and Levine (2003), who discuss the benefits of using an exogenous measure of oil. Our finding for oil-producing

Panel A. Financial value of Chinese development finance between 2000 and 2014 by recipient country (in millions of constant 2010 US dollars)



Panel B. Probability of receiving Chinese development finance between 2000 and 2014 by recipient country

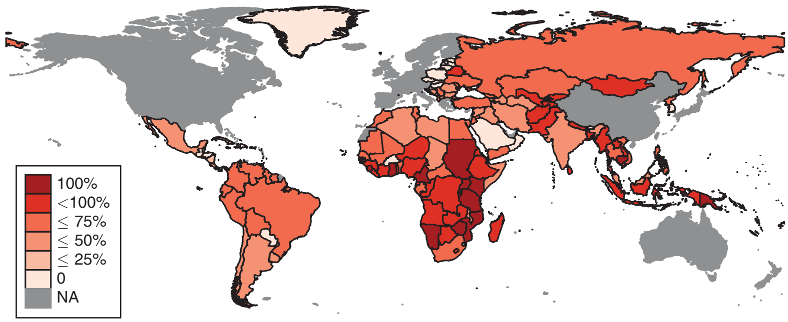


Figure 1. World Maps of Chinese Development Finance

receive fewer Chinese government-financed projects, suggesting that Beijing may fear that these countries are less likely to repay their loans. Finally, the political regime type of a recipient country does not affect whether or not it receives projects, and recipient country population size is equally insignificant.

C. *Physical Project Inputs*

We now turn to a key determinant of the overall supply of Chinese official financing in a given year—the level of domestic industrial overproduction. Following Bluhm et al. (2020), we use this variable as a component of our IV for Chinese financing. Using factor analysis, this variable measures the (logged and detrended) first factor of the Chinese production of six physical project inputs—namely aluminum, cement, glass, iron, steel, and timber, drawing on data from the National Bureau of Statistics of China (NBSC) (2019) and the United States Geological

countries is in line with previous empirical research that refines the conventional wisdom about China using aid to access natural resources (Dreher and Fuchs 2015).

Table 1—Allocation of Chinese Official Financing I (2000–2014)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Input factors ($t-1$)		0.451		0.450	0.394	0.400	
		(0.076)		(0.075)	(0.075)	(0.083)	
Reserves ($t-1$)			2.277				1.701
			(0.446)				(0.480)
OF probability, historic				3.286			
				(0.782)			
OF probability, contemp.					3.899		
					(0.585)		
UNGA voting alignment	3.285	3.927	3.520	2.571	0.399	6.227	5.570
	(1.305)	(1.315)	(1.259)	(1.229)	(1.248)	(2.039)	(1.964)
Diplomatic relations Taiwan	−1.960	−1.923	−1.893	−1.563	−0.308	−0.572	−0.524
	(0.385)	(0.388)	(0.382)	(0.359)	(0.418)	(0.738)	(0.722)
Trade with China (log)	0.571	0.404	0.409	0.353	0.332	0.104	0.147
	(0.083)	(0.078)	(0.080)	(0.082)	(0.078)	(0.124)	(0.123)
Petroleum exporter	−1.472	−1.134	−1.132	−0.699	−1.046		
	(0.444)	(0.451)	(0.444)	(0.428)	(0.377)		
Government debt (percent of GDP)	−0.008	−0.006	−0.006	−0.006	−0.006	−0.003	−0.004
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Democracy (polity score)	−0.016	−0.012	−0.014	−0.005	−0.019	−0.005	−0.006
	(0.027)	(0.026)	(0.026)	(0.025)	(0.022)	(0.050)	(0.050)
GDP per capita (log)	−0.738	−0.705	−0.721	−0.546	−0.301	0.095	0.105
	(0.172)	(0.173)	(0.172)	(0.174)	(0.171)	(0.340)	(0.337)
Population (log)	−0.130	−0.022	−0.029	−0.026	−0.006	3.748	3.263
	(0.139)	(0.138)	(0.139)	(0.122)	(0.111)	(1.650)	(1.672)
English is official language	1.389	1.343	1.352	1.265	0.888		
	(0.404)	(0.398)	(0.397)	(0.364)	(0.349)		
Observations	1,666	1,664	1,664	1,664	1,664	1,664	1,664
Number of countries	125	125	125	125	125	125	125
R^2 (overall)	0.26	0.28	0.28	0.31	0.36	0.04	0.04
R^2 (within)	0.07	0.09	0.08	0.09	0.09	0.10	0.09
R^2 (between)	0.48	0.51	0.51	0.56	0.65	0.06	0.06

Notes: Each column represents one regression. The dependent variable is the number of Chinese government-financed projects in a given country and year. Columns 1–5 use random-effects models, columns 6 and 7 fixed effects models. Standard errors are in parentheses. Abbreviations: OF—official finance (Official Development Assistance and Other Official Flows). UNGA—United Nations General Assembly.

Survey (USGS) (2019).[8] The intuition for this variable builds upon Bluhm et al. (2020) and Dreher, Fuchs, Hodler, Parks, Raschky, and Tierney (2021), who suggest that China's annual production of these raw materials is a key determinant of the availability of Chinese government financing for foreign infrastructure projects. As these two studies explain, the Chinese government considers domestic production inputs, such as steel and aluminum, to be strategically important commodities and therefore produces these materials at levels that substantially exceed domestic demand. Consequently, in years when production volumes of project inputs are

[8] We use USGS (2019) data on China's annual production of aluminum in 10,000 tons (https://www.usgs.gov/centers/nmic/aluminum-statistics-and-information, last accessed October 12, 2019). The annual production volumes of cement, pig iron, steel (all in 10,000 tons), timber (in 10,000 cubic meters), and glass (in 10,000 weight cases) have been retrieved via Quandl (2019) and complemented with information from NBSC (2019, available at http://www.stats.gov.cn/english/statisticaldata/yearlydata/YB1999e/m12e.htm, last accessed October 12, 2019).

high, one would expect the supply of Chinese government financing for economic infrastructure projects abroad to increase.

This logic extends to Chinese government-financed projects in all sectors, as the vast majority of projects in other sectors (e.g., hospitals, schools, convention centers, government buildings, and stadiums) also involve physical construction and rely heavily on imported Chinese construction materials.[9] China suffers from industrial overproduction because many of its state-subsidized firms are overleveraged, inefficient, and unprofitable (Stanway 2016).[10] To address this challenge, Chinese authorities have pursued a two-track strategy of reducing domestic supply and increasing international demand. At home, they have prohibited the development of new production facilities, expedited the closure of inefficient operations, increased the prices of key inputs such as water and power, and imposed higher product quality standards (State Council 2013). In parallel, they have attempted to stimulate global demand by subsidizing overseas infrastructure projects and making these grants, loans, and export credits conditional upon the purchase of Chinese industrial inputs, such as steel, iron, cement, and aluminum.

China's lending operations in Kenya provide a useful illustration of how this international demand stimulation strategy works in practice. Between 2010 and 2014, the Export-Import Bank of China sharply increased lending for road, rail, and bridge projects in Kenya. Chief among these infrastructure projects was the Mombasa-Nairobi Standard Gauge Railway (SGR), which received two loans from the Export-Import Bank of China worth approximately US$3.5 billion. This 475-kilometer railroad required extraordinary amounts of steel, cement, stone, sand, timber, and glass. It also required the acquisition of manufactured goods that depend upon industrial inputs, such as locomotives, train wagons, electricity transmission pylons, and cables (Republic of Kenya 2014a, b; Sanghi and Johnson 2016; Wissenbach and Wang 2017). The Chinese government took several steps to ensure that the vast majority of these project inputs would be sourced from China. The Export-Import Bank of China added a clause to its loan agreements with the Kenyan government that required the borrower to source project inputs from China on a preferential basis (Okoth 2019). China Road and Bridge Corporation (CRBC) and its Chinese subcontractors received generous tax exemptions that Kenyan firms did not enjoy, making it substantially more difficult for local firms to supply project inputs.[11] China's support for the SGR is broadly illustrative of how Chinese grant- and loan-financed projects work. They typically involve physical construction; they usually require construction inputs that are oversupplied in China; and they

[9] Online Appendix B15 lists the five largest projects (by commitment amounts) for the six most frequent sectors. The bulk of these projects are physical infrastructure projects. They not only include economic infrastructure projects like roads and railways but also social infrastructure projects like schools and hospitals. For example, four out of the five largest health-related projects are hospitals or malaria treatment centers that use large quantities of building materials.

[10] The Chinese government characterizes the problem as "industrial overcapacity," which is a term that usually refers to the difference between domestic production capacity and actual production for the domestic market. However, for the sake of clarity, we prefer the terms "industrial overproduction" and "excess industrial production" because China overproduces industrial inputs relative to demand on the domestic market. It then attempts to sell its overproduced industrial inputs to foreign buyers (often in developing countries) because of its domestic overcapacity problem.

[11] The implementation of the SGR thus coincided with a major increase in steel imports from China (Kenya National Bureau of Statistics 2015, 2017; Business Daily 2018).

often obligate recipients to import these inputs on a preferential basis (Mattlin and Nojonen 2015; Copper 2016; Ghossein, Hoekman, and Shingal 2018).

However, demand stimulation is only one part of the Chinese government's overseas strategy for reducing overcapacity. It also uses aid and debt to facilitate the offshoring of industrial input production facilities, thereby reducing the supply of such inputs in China (Kenderdine and Ling 2018). Beijing does so by generously subsidizing joint industrial production ventures between Chinese state-owned enterprises (facing excess production problems at home) and local firms. Indeed, our dataset demonstrates that the Chinese government financed the creation or expansion of more than 53 cement factories, steel mills, glass plants, and other industrial input production facilities in 27 countries between 2000 and 2014.

The authorities in Beijing have now incorporated this two-pronged strategy of international demand stimulation and industrial production offshoring into the BRI and codified it in a set of official statements and policy papers (State Council 2013, 2015a, b, c; He 2014; Stanway 2015; Shi 2018), which further underscores why we expect a strong and positive relationship between the domestic production of Chinese construction materials and the supply of Chinese government financing for foreign development projects.

Panel A of Figure 2 shows logged production numbers of six construction materials over time: aluminum, cement, glass, iron, steel, and timber. Given that they trend over time, we detrend them for our analysis. Rather than including six individual variables, using factor analysis, we extract the first factor of the detrended series (which is shown in panel B).

Returning to the simple allocation regressions in Table 1, column 2 shows that this variable increases the number of Chinese development projects that the average country receives one year later. Relying on a 90 percent confidence interval, a 1 standard deviation increase in the production materials leads to an average increase of 0.3–0.6 projects per year. We choose a one-year lag since there is no reason to expect a longer delay between industrial input production and the approval of new Chinese development projects. During our entire period of study, the Chinese government had a well-established set of mechanisms in place to provide foreign grants and loans quickly.[12] Therefore, in years when the authorities considered industrial input overproduction to be a sufficiently large problem to justify the use of international development finance as a remedy, they could secure new loan- and grant-financed project approvals without much delay.[13]

[12] These mechanisms include grants and interest-free loans (via Economic and Technical Cooperation Agreements) that are administered by the Ministry of Commerce, the Concessional Loan Program, the Preferential Buyer's Credit Program administered by Export-Import Bank of China, and a suite of additional programs and instruments administered by China Development Bank and other state-owned banks and government institutions.

[13] The speed of Chinese aid delivery is frequently praised by political decision-makers in recipient countries. For example, in 2008, the then President of Senegal, Abdoulaye Wade, said that "China [helps] African nations build infrastructure projects in record time … a contract that would take five years to discuss, negotiate and sign with the World Bank takes three months when we have dealt with the Chinese authorities" (Wade 2008). On this point, also see Swedlund (2017a, 128–29).

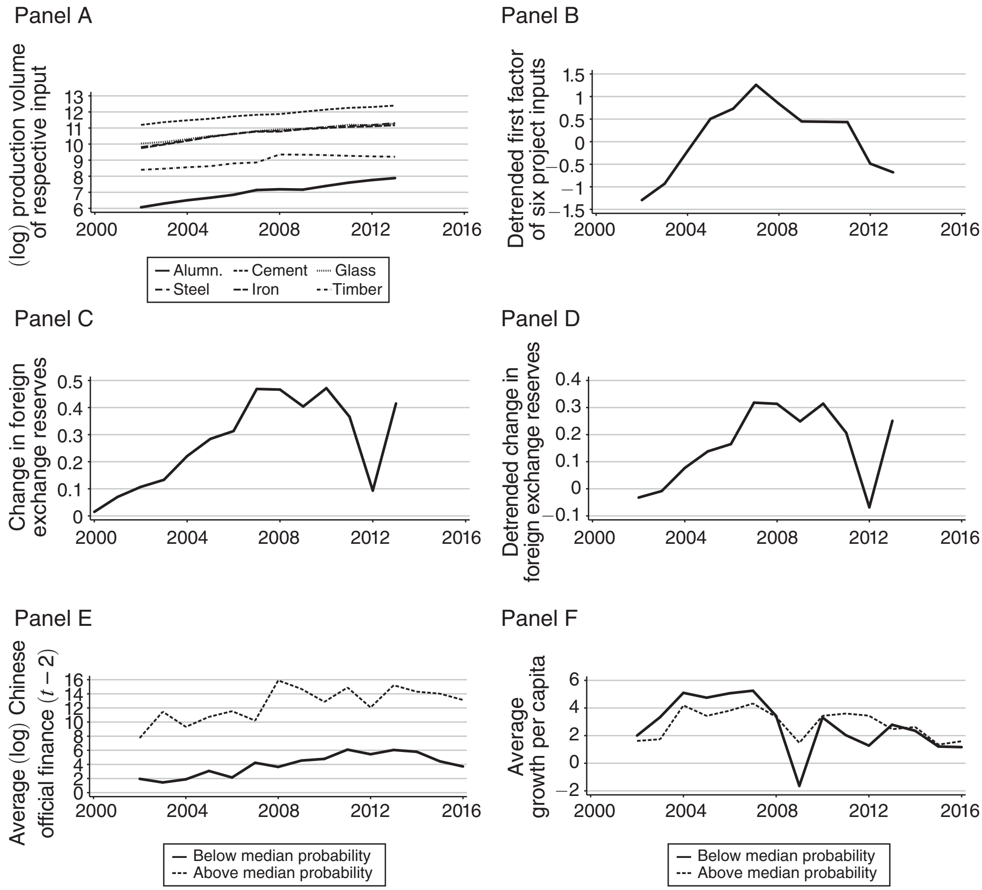


Figure 2. Chinese Development Finance and Its Inputs (2000–2016)

Notes: Panel A shows China's (logged) production of aluminum (in 10,000 tons), cement (in 10,000 tons), glass (in 10,000 weight cases), iron (in 10,000 tons), steel (in 10,000 tons), and timber (in 10,000 cubic meters) over time. Panel B shows the detrended first factor of the six input materials derived with factor analysis. Panel C reports the change in net foreign exchange reserves (in trillions of constant 2010 US dollars). Panel D reports the detrended values of the latter. Panel E shows average (logged) official finance within the group that is below the median of the probability of receiving it and the group that is above the median over time. Panel F shows the average real GDP per capita growth rate within these two groups over time. For the construction of the averages, we use observations from the sample of column 1 in Table 3.

D. *Foreign Exchange Reserves*

Column 3 of Table 1 replaces physical project inputs with a second proxy for over-time variation in the availability of Chinese financing—changes in China's foreign exchange reserves (see panel C of Figure 2 for a graphical depiction). Specifically, we use the net change in China's holdings of international reserves resulting from transactions on the current, capital, and financial accounts (in trillions of constant 2010 US dollars) as collected by the World Bank's World Development Indicators (World Bank 2017). The intuition for this variable is based on a similar logic to that of production inputs: China's need to address a domestic oversupply problem. When the Chinese government adopted its "Going Out" strategy in 1999, it did so with the expectation that it would soon face strong macroeconomic head winds. The country's foreign exchange reserves were growing due to annual trade surpluses, and the authorities knew that if they allowed these reserves to enter the domestic economy, they would increase the risk of inflation and a currency revaluation (Zhang 2011).[14] Therefore, to create favorable conditions for continued economic growth at home, they sharply increased foreign exchange–denominated loans to overseas borrowers on commercial and semicommercial terms rather than highly concessional terms.[15] Given that the country's foreign exchange reserves reportedly earned a 3 percent annual return at home during our period of study (2000–2014), Chinese government lending institutions had an incentive to price foreign currency-denominated loans to overseas borrowers above this reference rate (Kong and Gallagher 2016). Indeed, our dataset demonstrates that the average annual rate of growth in the provision of (mostly dollar-denominated) Chinese OOF was 2.5 times higher than that of Chinese ODA between 2000 and 2014.[16]

As expected, column 3 of Table 1 shows that larger net increases in China's foreign currency reserves increase the number of Chinese government-financed projects for the average recipient country one year later. Relying on a 90 percent confidence interval, a US$1 trillion net increase in foreign reserves leads on average to 1.7–3.2 additional Chinese development projects per country and year.

E. *Historical and Contemporaneous Probabilities of Receiving Aid*

Finally, we explore whether past Chinese aid recipients tend to receive more Chinese official financing today. We expect that countries that received funding from China in the past receive more development funds from China today, controlled for contemporaneous factors that influence China's allocation of funds. To measure such aid inertia, we therefore construct the share of years in which a recipient country received Chinese aid from 1970–1999 using the data collected in Dreher and Fuchs (2015).[17] More precisely, we define this variable as $h_{CHN,i} = (1/30)\sum_{y=1}^{30} h_{CHN,i,y}$, where $h_{CHN,i,y}$ is a binary variable that equals one when recipient i received at least one project from China in year y. The computed historical aid probabilities show that Nepal had the highest likelihood of receiving aid between 1970 and 1999 (80 percent), followed by Mauritania and Tanzania (both 71 percent).

[14] China had an added incentive to lend and invest overseas because of a dwindling number of "bankable" projects at home (Ansar et al. 2016).

[15] This incentive to invest in overseas assets strengthened during our 15-year period of study as the country's foreign exchange reserves soared from roughly US$200 billion in 2000 to US$4 trillion in 2014 (Park 2016).

[16] The average annual rate of growth in ODA and OOF was 37 percent and 90 percent, respectively. In online Appendix A3, we describe the relationship between China's State Administration of Foreign Exchange (SAFE) and the country's largest single source of official financing to other countries (China Development Bank) to help clarify the process by which surplus foreign exchange reserves increase the supply of Chinese official financing.

[17] In Dreher and Fuchs (2015), we draw upon a range of sources to construct our dataset on historical Chinese aid. These include US dollar amounts of loans and donations from various intelligence reports of the CIA (various), an OECD study (1987), and a book written by a German sinologist during the Cold War (Bartke 1989); information on the completion of aid projects from Bartke (1989) and the China Commerce Yearbook (and its predecessors) as published by China's Ministry of Commerce (Hawkins et al. 2010); as well as the amount of food aid in tons of grain equivalent supplied according to the United Nations World Food Programme (2011).

When we include this variable in our regression (in column 4 of Table 1), the results show that past recipients of ODA receive more official financing today, even after controlling for the usual variables included in aid allocation regressions. The coefficient implies that if a country without access to Chinese aid, such as Bhutan, had received as much aid from China as Nepal in the past, it would receive 3.1 additional Chinese government-financed projects per year in our sample period. These results suggest that countries receive projects today for reasons beyond those factors that are typically captured in the aid allocation literature.

Column 5 replaces the historical probability of receiving Chinese aid with the share of years that a country received Chinese government financing during the 2000–2014 sample period. More precisely, we define this variable as $p_{CHN,i} = (1/15)\sum_{y=1}^{15} p_{CHN,i,y}$, where $p_{CHN,i,y}$ is a binary variable that equals one when recipient i received at least one project from China in year y. Panel B of Figure 1 presents each country's probability of receiving Chinese government financing between 2000 and 2014. Thirteen countries receive official financing commitments from China in all years, and 92 countries are covered in more than half of the years from 2000–2014.

The contemporaneous and historical probability measures are strongly correlated (65.4 percent). When we replace the historical probability of receiving projects with the contemporaneous measure, the results are similar, which suggests that the countries receiving aid in more years during our sample period have a higher probability of doing so in any year, even after we control for the conventional determinants of project allocations in our regression framework.

Columns 6 and 7 in Table 1 show that these basic results (for the time-varying variables) hold when we run fixed effects models. Table 2 shows that the same holds true when we collapse the data to a time series of 15 years explaining the totality of Chinese government-financed projects in any given year (columns 1 and 2) and restrict the sample to a cross section of recipient countries in order to explain the total number of projects received over the sample period with measures that only vary across countries (columns 3 and 4). We make use of this over-time and cross-sectional heterogeneity in the supply of and recipients of China's official financing in our IV strategy below.

II. Empirical Strategy

Building on the descriptive statistics and allocation regressions in the previous section, we now analyze the causal effects of Chinese development finance on economic growth. We estimate the following regression equation for all recipient countries that are not classified by the World Bank as high-income countries in a given year:

$$(1) \qquad Growth_{i,t} = \beta_1 OF_{CHN,i,t-2} + \beta_2 pop_{i,t-1} + \beta_3 \eta_i + \beta_4 \mu_t + \varepsilon_{i,t},$$

where $Growth_{i,t}$ is recipient country i's yearly real GDP per capita growth in year t; $OF_{CHN,i,t-2}$ is a measure of Chinese development finance commitments two years before; $pop_{i,t-1}$ stands for the recipient country's (logged) population size; η_i and μ_t

Table 2—Allocation of Chinese Official Financing II (2000–2014)

	(1)	(2)	(3)	(4)
Input factors ($t-1$)	44.964			
	(15.925)			
Reserves ($t-1$)		196.042		
		(99.126)		
OF probability, historic			41.318	
			(13.347)	
OF probability, contemp.				66.033
				(9.805)
UNGA voting alignment	2,526.380	1,359.077	0.764	−64.463
	(1,019.900)	(1,735.639)	(20.405)	(27.936)
Diplomatic relations Taiwan			−28.273	7.291
			(7.442)	(7.147)
Trade with China (log)			5.148	4.201
			(2.464)	(1.877)
Petroleum exporter			−6.596	−12.538
			(6.306)	(5.081)
Government debt (percent of GDP)			−0.067	−0.055
			(0.066)	(0.061)
Democracy (polity score)			−0.078	−0.732
			(0.320)	(0.316)
GDP per capita (log)			−13.609	−4.423
			(3.582)	(2.750)
Population (log)	626.343	633.712	−1.354	0.570
	(129.171)	(191.219)	(2.559)	(2.039)
English is official language			17.746	13.361
			(5.486)	(4.878)
Observations	15	15	126	126
R^2 (within)	0.91	0.86		
R^2 (between)			0.59	0.68

Notes: Each column represents one OLS regression. The dependent variable is the number of Chinese government-financed projects in a given country and year. Standard errors are in parentheses. Abbreviations: OF—official finance (Official Development Assistance and Other Official Flows). UNGA—United Nations General Assembly.

represent country- and year-fixed effects, respectively; and ε is the error term.[18] Standard errors are clustered at the recipient-country level.

We use two measures of $OF_{CHN,i,t-2}$: the number of Chinese development projects and their logged financial value.[19] The latter comes with the obvious advantage that it accounts for the size of projects. However, one important caveat is that 39 percent of the projects lack information on their financial value. Therefore, while we present results using financial values of Chinese development projects in most tables for comparison, our preferred measure is project counts.

Of course, Chinese development finance may be endogenous to economic growth. One likely source of endogeneity is reverse causation in which the economic

[18] We provide a list of all countries included in our analysis in online Appendix C1. See https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lendinggroups for the World Bank Country and Lending Groups (World Bank 2020, last accessed May 12, 2020). Table C2 of online Appendix C provides descriptive statistics.

[19] Note that we added a value of one before taking logs, to ensure we do not lose observations with zero OF.

characteristics of recipient countries influence the receipt of Chinese development projects. On the one hand, the Chinese government might provide more support to countries with low growth, which would be consistent with its stated goal to make "great efforts to ensure its aid benefits as many needy people as possible" (State Council 2011). On the other hand, the Chinese government might prefer to channel more development finance to countries with faster growth if these recipients provide more attractive commercial opportunities (Dreher et al. 2018). The fact that a large number of variables that are excluded from our models potentially correlate with economic growth and the receipt of Chinese development finance also presents a risk of omitted-variable bias.

To account for the endogeneity of Chinese development finance, we employ an IV strategy based on our allocation analysis above. Specifically, we estimate the following first-stage regression:

$$(2) \qquad OF_{CHN,i,t-2} = \gamma_1 Material_{t-3} \times p_{CHN,i} + \gamma_2 Reserves_{t-3} \times p_{CHN,i} + \gamma_3 pop_{i,t-1} + \gamma_4 \eta_i + \gamma_5 \mu_t + u_{i,t-2}.$$

Our first instrument for $OF_{CHN,i,t-2}$ is the interaction of (lagged, detrended, and logged) Chinese production materials, $Material_{t-3}$, which varies over time, and the probability of receiving Chinese development finance $p_{CHN,i}$, which varies across recipient countries. As discussed above, we extract the first factor of the logged and detrended production figures using factor analysis to capture their joint variation and use it as the time-varying part of our instrument. We interact it with the probability of receiving Chinese development finance as the share of years in the 2000–2014 period a country has received positive amounts of Chinese development finance, $p_{CHN,i}$, which varies between recipient countries exclusively.[20] Our second instrument is the (lagged and detrended) change in China's net foreign exchange reserves, $Reserves_{t-3}$, again interacted with the probability of receiving Chinese development finance $p_{CHN,i}$. Both *Material* and *Reserves* affect the availability of Chinese projects over time, while $p_{CHN,i}$ affects project availability across recipients (see previous section). We expect positive coefficients on both interacted variables. To be precise, we expect that countries that frequently receive development projects from China will benefit disproportionally from increases in both China's overproduction of physical project inputs and foreign reserves.

An obvious concern is that these instruments violate the exclusion restriction because the probability of receiving Chinese projects may directly affect economic growth (for the same reasons described above). However, our growth regressions control for the effect of the probability of receiving Chinese development finance as well as the levels of *Material* and *Reserves* through the inclusion of

[20] This follows the analyses in Nunn and Qian (2014) and Dreher and Langlotz (2020); also see Werker, Ahmed, and Cohen (2009). When we replace the contemporaneous probability of receiving development finance with the "historical" probability of receiving funding prior to the sample period (as introduced in Section I above), the results are similar overall, but in some regressions they are statistically weaker (see online Appendix C4). This is unsurprising given that presample probabilities are less directly related to the number of projects in any year and thus a less powerful predictor.

recipient-country- and year-fixed effects. Given that we control for the effects of the probability of receiving Chinese development finance, its interaction with an exogenous variable results in an exogenous instrument (under the assumption of parallel trends; see Nizalova and Murtazashvili 2016; Goldsmith-Pinkham, Sorkin, and Swift 2020; Bun and Harrison 2019). The intuition of this approach is that of a (continuous) difference-in-differences regression, where we investigate a differential effect of China's production of raw materials and changes in foreign reserves on the amount of development finance to countries with a high compared to a low probability of receiving Chinese projects. The identifying assumption is that growth in countries with differing probabilities of receiving Chinese projects will not be affected differently by changes in the availability of construction material and foreign reserves, other than via the impact of China's development finance, controlling for recipient-country- and year-fixed effects. In other words, as in any difference-in-differences setting, we rely on a (conditionally) exogenous treatment and parallel pretrends across groups in the variables of interest. Controlling for year-fixed effects, Chinese production of input materials and the change in its foreign reserves cannot be correlated with the error term and are thus exogenous to official financing. In order for different trends to affect our results, these trends across countries with a high compared to a low probability of receiving projects from China would have to vary in tandem with year-to-year changes in the production of input materials and foreign exchange reserves.[21]

Following Christian and Barrett (2017), Figure 2 displays the variation in the availability of Chinese production materials and changes in Chinese foreign exchange reserves (and their detrended versions) in concert with the variation in per capita aid and growth for two different groups that are defined according to the median probability of receiving aid. The results give little reason to believe that the parallel-trends assumption is violated. The probability-specific trends in Chinese development finance and growth, respectively, are mostly parallel across the regular recipients (those with an above-the-median probability of receiving projects from China) and irregular recipients (those with a below-the-median probability of receiving projects from China). There is also no obvious nonlinear trend in regular recipients compared to irregular recipients that is similar for Chinese development finance and growth.[22]

The exogeneity of our interacted instrument would be violated if changes in detrended input materials or foreign reserves affected recipient-country growth differentially in countries with a high probability of receiving Chinese projects compared to countries with a low probability of receiving Chinese projects for reasons unrelated to China's official financing. Figure 2 illustrates that the first factor of the

[21] Given that we have two plausibly valid instruments, we use both of them jointly, which allows us to test the overidentifying restrictions. Below, we show that we obtain similar results when we use them separately, which suggests that both instruments are valid or that both are invalid. We judge the latter to be unlikely as this would suggest that the IVs would have to be correlated with each other in such a way that they are both similarly correlated with the error term of the growth regression for reasons other than Chinese projects.

[22] A skeptical reader might be concerned that the emergence of the Global Financial Crisis might drive our results. A first look at the upper left panel of Figure 2 shows that the detrended production of construction materials plateaued from the year 2007 to 2008, while the bottom right panel shows that per capita GDP growth declined less in the group that is more likely to receive Chinese development finance. It is reassuring that our results hardly change when we exclude the years 2007 and 2008 from our regressions (see online Appendix C3).

logged and detrended Chinese input production and the detrended changes in net foreign reserves follow no obvious trends over time.

However, production of construction materials could be correlated with overall export volumes or foreign direct investment. Frequent recipients of Chinese government loan- and grant-financed projects also tend to attract higher levels of Chinese trade and investment (e.g., Morgan and Zheng 2019), which could imply that any differential effects of China's development finance on growth that we observe result from trade and investment rather than government-financed projects. To address this concern, we control for the yearly volume of Chinese foreign direct investment (FDI) outflows (from United Nations Conference on Trade and Development 2017) and Chinese exports (from World Bank 2017) interacted with the probability of receiving Chinese development finance in robustness tests below. Finally, we offer three placebo tests related to the material-based part of our instrument. We test whether (i) Chinese exports, (ii) Chinese outward foreign direct investments, and (iii) Chinese government-financed projects that do not rely on physical inputs from China (such as budget aid or debt relief agreements) can be predicted with our material-based instrument. For the first two tests, we control for Chinese projects so that our instrument based on the probability to receive projects should not predict exports or FDI well. If our material-based instrument is valid, it should also not predict projects that do not rely on construction materials.

Our specification deviates from the extant literature on aid and growth in a number of ways (e.g., Clemens et al. 2012, Galiani et al. 2017, Dreher and Langlotz 2020).[23] First, we analyze ODA and OOF as separate regressors in addition to investigating them in concert. While existing literature focuses mostly on the potential growth effects of ODA, it is only one component of twenty-first century development finance. During our period of study (2000–2014), most of the official financing provided by China (62–77 percent) and the World Bank (64 percent) was not Official Development Assistance (ODA).[24] By contrast, most of official financing provided by the United States and other OECD bilateral donors was not ODA.[25] This source of variation might help to explain heterogeneous "aid" impacts across donors. Indeed, Cordella and Ulku (2007) find that the provision of more concessional forms of development finance increases growth in poor and highly indebted countries. Similarly, Khomba and Trew (2017) conclude that grants are more effective than loans at generating (localized) growth effects.[26] To account for this

[23] Dreher, Lang, and Ziaja (2018) survey this literature.

[24] Only 21.6 percent of total official financing from China clearly meets the OECD-DAC criteria for ODA, whereas we lack sufficient information to classify 15.6 percent of China's official finance as either ODA or OOF. Similarly, 64.3 percent of official financing flows from the World Bank were channeled through the IBRD (OOF), and only the remaining 35.6 percent were channeled through the IDA (ODA) between 2000 and 2014 (calculations based on World Bank 2017).

[25] Between 2000 and 2014, the United States provided US$394.6 billion of official financing to other countries. Ninety-three percent of these official financing flows (US$366.4 billion) qualified as ODA, and 7 percent (US$28.1 billion) qualified as OOF. Between 2000 and 2014, the OECD-DAC as a whole provided US$1.753 trillion of official financing to other countries; 80.6 percent of these flows (US$1.413 trillion) qualified as bilateral ODA, and 19.4 percent (US$339.2 billion) qualified as OOF. Data have been retrieved from OECD (2017) and AidData's Core Research Release (Tierney et al. 2011), Version 3.1, on October 6, 2017.

[26] On the other hand, Odedokun (2004) provides evidence that the receipt of grants discourages domestic tax collection and undermines fiscal discipline, and Dovern and Nunnenkamp (2007) find that grants do not provide larger growth dividends than loans.

potential source of variation, we vary our definition of "treatment" and separately investigate the growth effects of more concessional finance (ODA) and less concessional (or market-based) forms of official financing (OOF) from China. In order to do so, we use the interaction of China's production of construction materials and changes in foreign reserves with the probability of recipient country i receiving Chinese ODA or OOF, respectively.

Second, we rely on project commitments rather than disbursements. Given that projects should only affect economic growth after disbursement, the latter are preferable over the former. However, comprehensive data on disbursements from Chinese government-financed projects are not available and are virtually impossible to consistently measure with open-source data collection methods. In our main specification, we lag commitments by two years in order to allow for sufficient time for commitments to affect outcomes. We base our lag duration on a subsample of 300 projects in the dataset for which there is information on the actual project start and end dates.[27] The observed average project duration amounts to 664 days, and thus we apply a 2-year lag in our baseline regressions.[28] This lag structure is also consistent with the conventional wisdom among development practitioners and government officials in host countries that Chinese development projects are quickly implemented (e.g., Swedlund 2017a, 128–29). While our data suggest 2 years may thus be an appropriate lag period, the 300-project subsample is not necessarily representative (and may suffer from selection effects), so we perform analyses using various lag lengths below.

Third, most previous studies analyze aid amounts either in per capita terms or as a share of GDP. One disadvantage of this approach is that it restricts the effect of population or GDP to be the same as those of aid. As Annen and Kosempel (2018) argue, there are no obvious theoretical reasons for adopting this approach. Their simulations also show that using aid-over-GDP ratios introduces a downward bias relative to using levels of aid. Therefore, following Ahmed (2016) and many others, we use (logged) commitments in levels as the variable of interest and control for population size (but test robustness to scaling commitments with population or GDP).

Fourth, we employ annual data rather than data averaged over three-, four-, or five-year periods (e.g., Clemens et al. 2012, Dreher and Lohmann 2015, Galiani et al. 2017, Dreher and Langlotz 2020). In order for our tests to show an effect of development finance that actually exists with an 80 percent probability, we would require several thousand observations rather than the sample of roughly 420 observations that we would have if we averaged our data over 5-year periods.[29] This is a broader empirical challenge within the aid effectiveness literature (Ioannidis, Stanley, and Doucouliagos 2017).[30] However, while much of the literature focusing

[27] In subsetting the data, we exclude projects with a project length of zero days, which is typically the case for monetary grants. However, even in these cases, the *recipient* government will need time to implement these projects, which makes a time lag necessary.

[28] Historical Chinese aid data also reveal a median of two years between project start and completion (data from Bartke 1989).

[29] This high number of required observations is driven by our fixed effects setting as both country- and time-fixed effects capture most of the variation in the dependent variable so that the variation caused by development finance conditional on these fixed effects is small.

[30] According to Ioannidis, Stanley, and Doucouliagos (2017), only about 1 percent of the 1,779 estimates in the aid-and-growth literature surveyed have adequate power (see also Doucouliagos 2019, Dreher and Langlotz 2020).

on Western donors makes use of samples starting in the 1970s, the first year for which we have comprehensive data on Chinese development finance is 2000.[31] Our main regressions thus use yearly data rather than averages over longer periods of time since this substantially increases the power of our tests. Our results must therefore be interpreted differently than much of the extant aid effectiveness literature. We primarily test whether Chinese development finance affects growth in the short run, and we can only draw tentative conclusions about whether it has longer-lasting effects by looking at various lag lengths.[32]

Fifth, we differ from much of the extant literature in our choice of control variables. Our main regressions are parsimonious. They control for fixed effects for years τ and countries η and the (logged) population size of recipient countries pop_i. Typical regressions in the aid effectiveness literature include additional control variables such as initial-period per capita GDP, ethnic fractionalization, assassinations, proxies for institutional and economic policies, and proxies for financial development (e.g., Burnside and Dollar 2000). All of these variables are arguably endogenous and introduce bias even if Chinese development finance is instrumented using a perfectly excludable IV. Given that our exclusion restriction holds absent the inclusion of these control variables, their omission reduces the efficiency of the estimator but does not bias our estimates.[33]

III. Does Chinese Development Finance Promote Growth?

A. *Main Results*

Table 3 presents our main results on the potential growth effects of Chinese development finance for the 2002–2016 period.[34] We show results using OLS in panel A. We start with the number of Chinese projects as the variable of interest in columns 1–3 and then turn to the logged financial amounts in columns 4–6. As shown in column 1, the number of Chinese government-financed projects is positively correlated with economic growth in recipient countries. Relying on a 90 percent confidence interval,[35] an additional Chinese project is associated with a growth rate that is 0.07 to 0.23 percentage points larger. The results are similar when we examine OOF projects only (in column 2) or a more narrowly defined measure of Chinese aid—those projects that meet the OECD-DAC criteria for ODA (column 3). The positive correlations persist when we look at amounts rather than numbers, but they are statistically weaker. Though the point estimate is positive, it is estimated less precisely: a

[31] Chinese aid volumes are also available for years prior to 1987 (Dreher and Fuchs 2015), but these values are not necessarily comparable to post-2000 data as they are gathered using different data collection procedures.

[32] Nevertheless, it is reassuring that we obtain similar results when we use three-year averages rather than annual data.

[33] When testing for robustness, however, we do include the variables most commonly used in the aid effectiveness literature. One might object that population size should not be included in fixed effects regressions, given that it hardly varies over time. Omitting population barely changes our results.

[34] Recall that we measure Chinese development finance annually between 2000 and 2014 and rely on two-year lags.

[35] In what follows, we routinely discuss the range of predicted effects based on the 90 percent confidence interval, unless stated otherwise.

Table 3—Growth Effects of Chinese Official Financing, Baseline Results (2002–2016)

	All projects (1)	OOF projects (2)	ODA projects (3)	(log) All amounts (4)	(log) OOF amounts (5)	(log) ODA amounts (6)
Panel A. OLS estimates—Dependent variable: GDP per capita growth						
Chinese OF $(t-2)$	0.147	0.203	0.158	0.009	0.025	0.023
	(0.049)	(0.082)	(0.064)	(0.019)	(0.020)	(0.019)
(log) population $(t-1)$	5.824	6.471	5.794	6.439	6.258	6.342
	(2.893)	(2.905)	(2.856)	(2.910)	(2.968)	(2.890)
Panel B. Reduced-form estimates—Dependent variable: GDP per capita growth						
Reserves $(t-3)$ × probability	0.086	2.009	0.046	0.160	2.437	0.354
	(2.905)	(3.858)	(2.912)	(3.176)	(4.007)	(3.316)
Input $(t-3)$ × probability	1.285	0.501	1.482	1.277	0.518	1.475
	(0.453)	(0.706)	(0.441)	(0.473)	(0.737)	(0.488)
(log) population $(t-1)$	5.123	6.341	4.268	5.234	6.230	4.615
	(3.020)	(2.924)	(3.067)	(3.042)	(2.932)	(3.087)
Panel C. 2SLS estimates—Dependent variable: GDP per capita growth						
Chinese OF $(t-2)$	0.948	0.761	1.450	0.995	0.142	1.086
	(0.327)	(0.697)	(0.465)	(0.562)	(0.123)	(0.544)
(log) population $(t-1)$	2.137	6.392	0.031	-0.493	5.109	-0.961
	(3.367)	(2.892)	(3.726)	(7.775)	(3.171)	(6.894)
Panel D. First-stage estimates—Dependent variable: Chinese OF $(t-2)$						
Reserves $(t-3)$ × probability	2.476	−1.167	3.142	2.394	16.571	3.017
	(1.810)	(2.928)	(1.275)	(4.308)	(9.464)	(4.661)
Input $(t-3)$ × probability	0.968	1.192	0.484	0.920	3.735	0.914
	(0.327)	(0.561)	(0.228)	(0.656)	(1.613)	(0.741)
(log) population $(t-1)$	3.045	−0.022	2.774	5.669	7.882	5.005
	(1.377)	(0.640)	(1.051)	(5.265)	(4.767)	(4.202)
Number of countries	150	150	150	150	150	150
Observations	2,061	2,061	2,061	2,061	2,061	2,061
Cragg-Donald F-statistic	34.69	34.89	34.92	3.01	37.93	4.00
Kleibergen-Paap F-statistic	39.40	28.95	31.67	3.73	18.00	4.33
Hansen J-statistic (p-value)	0.43	0.51	0.10	0.62	0.98	0.57

Notes: Each column per panel represents one regression. The dependent variable in panels A–C is the recipient country's annual real GDP per capita growth in year t. The variable of interest, *Chinese OF* $(t-2)$, denotes Chinese development finance commitments lagged by two years and is measured as a project count in columns 1–3 and as logged financial amounts in columns 4–6. Columns 1 and 4 cover all official finance (OF) projects, columns 2 and 5 focus on Other Official Flows (OOF), and columns 3 and 6 focus on Official Development Assistance (ODA). All regressions include country- and year-fixed effects as control variables. Standard errors are in parentheses.

doubling of the amount of Chinese OF to the average recipient country is associated with a growth rate that is between −0.02 and 0.03 percentage points larger 2 years after the commitment.[36]

The results in panel A reflect correlations that are likely biased due to endogeneity. Therefore, we employ our IV strategy to account for reverse causality and other potential sources of endogeneity. Panel B presents reduced-form estimates, replacing the respective official financing variables with our instruments. Panel C shows the second stage of the regressions estimated with 2SLS, while we provide

[36] $-0.023 \times \ln(2) = -0.016$ and $0.041 \times \ln(2) = 0.028$.

the corresponding first-stage results in panel D. In all but one of the first-stage regressions, both instruments show the expected positive sign; i.e., increases in the supply of Chinese project inputs, both material and financial, generate disproportionately large increases in projects for countries that are regular recipients of Chinese support. As illustrated by the Kleibergen-Paap *F*-test statistics reported at the bottom of the table, our instruments are strong for the regressions focusing on the number of aid projects (columns 1–3) but weaker in two of the three regressions focusing on dollar amounts (in columns 4 and 6, where we focus on total financing and ODA, respectively). While the two instruments are not individually significant at conventional levels in all first-stage regressions, they are jointly significant throughout. This is not surprising given the high correlation between them (0.76), arising from the fact that years with high production volumes are those with larger export surpluses, which in turn increase China's foreign reserves. Our results are robust when we use either of the two instruments in our regressions (rather than both) and/or when we replace the contemporaneous probability of receiving OF with the arguably more (unconditionally) exogenous measure of the "historical" probability of receiving aid (see online Appendix C4 for details).

In all regressions, the Hansen test fails to reject the overidentifying restrictions. As the results for the first-stage regressions show, a 1 standard deviation increase in both IVs leads to 0.21–1.53 additional Chinese projects (based on column 1 of panel D).[37] According to the reduced-form estimates, a 1 standard deviation increase in both IVs increases economic growth by between −0.20 and 1.79 percentage points (based on the 90 percent confidence interval in column 1 of panel B).[38]

Turning to our key results, panel C shows that Chinese official financing increases economic growth. According to column 1, Chinese OF projects increase growth, and the same holds when we analyze Chinese ODA separately (in column 3). Overall, the 2SLS effects are stronger than the correlations obtained with OLS. Quantitatively, an additional Chinese project increases growth by between 0.41 to 1.49 percentage points. The corresponding range is an increase of 0.69–2.21 percentage points for ODA, which is substantially larger compared to the OLS estimate. The downward bias of the OLS results is in line with expectations, to the extent that China provides more ODA to needier countries (see Tables 1 and 2 as well as Dreher and Fuchs 2015, Dreher et al. 2018).

The estimated effects are sizable given average economic growth rates of 2.8 percent for the recipient countries in our sample.[39] The same holds when we focus on financial amounts instead of project numbers (in columns 4–6). A doubling of Chinese official finance that the average country receives in a year—amounting to an increase in US$146 million—implies a 0.05–1.33 percentage point increase in growth 2 years after commitment. The effect is again larger for aid in the strict sense of the term, where a doubling of funding (corresponding to an increase of

[37] Lower bound: $0.112 \times (-0.502) + 0.610 \times 0.430$. Upper bound: $0.112 \times 5.454 + 0.610 \times 1.507$.

[38] Lower bound: $0.112 \times (-4.722) + 0.610 \times 0.536$. Upper bound: $0.112 \times 4.895 + 0.610 \times 2.034$.

[39] In our dataset, the average financial size of Chinese OF (ODA) projects is US$133 million (US$43 million).

US$33 million in the average country) would increase growth by between 0.13 to 1.37 percentage points.[40]

Our results are less clear-cut when we focus on Chinese OOF, which is a less concessional and more commercially oriented type of development finance. While the point estimate of the 2SLS regression in column 2 of Table 3 implies that an additional OOF project increases growth by 0.76 percentage points, the 90 percent confidence interval ranges from −0.39 to 1.91. It is, however, important to distinguish a precisely estimated zero-effect from a positive coefficient that is estimated imprecisely (see, e.g., Dreher and Langlotz 2020). 2SLS is always less efficient than OLS, which indicates a positive and significant effect of OOF projects on growth here. We thus consider it important to also compare the coefficient of the IV estimate to the (significant but biased) coefficient from the OLS regression. According to the t-test from seemingly unrelated estimation, the coefficients are not statistically different, and the same holds true when we compare the IV estimates for OOF in column 2 with the significant and positive estimates for ODA projects in column 3. For these reasons, we refrain from making strong claims about the potentially differential effects of Chinese ODA and OOF.[41]

Table 4 investigates the timing of the growth effects in detail. We estimate a variant of Table 3, where we change the lag structure of Chinese OF. We change the lag structure of the instruments in analogy—e.g., when we lag China's official finance by four years, the corresponding instruments are lagged by five years. For the reader's convenience, we also include the results of our baseline specification where we use the second lag. Our results in column 1 suggest that Chinese projects increase growth from 1 to 3 years after being committed as the 3 corresponding coefficients are all positive and statistically significant at least at the 5 percent level. The coefficient is strongest for the second lag. Coefficients are insignificant at conventional levels contemporaneously and four as well as five years after commitments; in the sixth year, the coefficient turns negative. When we restrict the regression to the same sample but lag aid by two rather than six years, the coefficient is positive and large, indicating that the longer lag rather than the reduced sample changes the result. As a placebo test, we also investigate the effect of future aid on current growth; the coefficient is negative, with a t-statistic close to zero. Columns 2–6 replicate the regressions with the alternative dependent variables. The results are

[40] To get at the growth effects of aid dollars, we also replicated the analysis with Chinese OF in millions of US dollars rather than logs (see online Appendix C11). According to these estimates, an increase in Chinese OF by US$146 million lifts economic growth by 1.6 percentage points, on average. Our estimates imply that a US$33 million increase in Chinese ODA increases economic growth by 2.01 percentage points.

[41] This interpretation finds further support in regressions that use the probability of receiving any project (rather than just OOF projects) as part of our instrument. In such regressions, the coefficients for the number and amounts of OOF projects are high and statistically significant at the 1 percent and 5 percent levels. While the power of the instrument is slightly lower, the first-stage F-statistics easily remain above ten. While this effect could result in part from the correlation of ODA projects with OOF projects, making the instrument less clearly excludable, this result demonstrates the difficulty in distinguishing between the two types of financing, given the correlation between them and the correlation among the IVs we use for them. Though the share of ODA in all official finance varies substantially across countries (see online Appendix B18), the insignificant difference in the effect of the two makes it unlikely that such differences make the aid differentially effective in countries receiving different combinations of financing.

Table 4—Growth Effects of Chinese Official Financing, Various lags (2SLS, 2002–2016)

	All projects (1)	OOF projects (2)	ODA projects (3)	(log) All amounts (4)	(log) OOF amounts (5)	(log) ODA amounts (6)	Observations (7)
Chinese OF $(t+1)$	−0.004	0.406	−0.143	0.131	0.107	−0.054	2,103
	(0.284)	(0.474)	(0.365)	(0.278)	(0.085)	(0.260)	
Chinese OF (t)	0.425	0.476	0.687	0.478	0.122	0.450	2,114
	(0.273)	(0.504)	(0.380)	(0.331)	(0.091)	(0.323)	
Chinese OF $(t-1)$	0.811	0.840	1.227	0.851	0.154	0.889	2,089
	(0.286)	(0.586)	(0.409)	(0.463)	(0.108)	(0.457)	
Chinese OF $(t-2)$ (baseline)	0.948	0.761	1.450	0.995	0.142	1.086	2,061
	(0.327)	(0.697)	(0.465)	(0.562)	(0.123)	(0.544)	
Chinese OF $(t-3)$	0.888	0.535	1.541	0.955	0.095	1.270	1,915
	(0.365)	(0.851)	(0.509)	(0.553)	(0.142)	(0.632)	
Chinese OF $(t-4)$	0.489	0.426	0.977	0.480	0.012	0.802	1,768
	(0.319)	(0.792)	(0.415)	(0.376)	(0.125)	(0.415)	
Chinese OF $(t-5)$	0.113	0.176	0.416	0.111	−0.027	0.349	1,619
	(0.281)	(0.696)	(0.345)	(0.291)	(0.109)	(0.266)	
Chinese OF $(t-6)$	−0.142	−0.188	0.162	−0.037	−0.060	0.210	1,471
	(0.263)	(0.532)	(0.325)	(0.267)	(0.104)	(0.239)	
Chinese OF $(t-2)$ (reduced sample)	2.650	1.523	2.976	1.447	0.335	1.738	1,468
	(1.009)	(1.382)	(1.130)	(0.911)	(0.267)	(1.054)	

Notes: Each cell represents one regression. The dependent variable is the recipient country's annual real GDP per capita growth in year t. The variable of interest, *Chinese OF* $(t-h)$, denotes Chinese development finance commitments lagged by h years and is measured as a project count in columns 1–3 and as logged financial amounts in columns 4–6. Columns 1 and 4 cover all official finance (OF) projects, columns 2 and 5 focus on Other Official Flows (OOF), and columns 3 and 6 focus on Official Development Assistance (ODA). The "reduced sample" regression using the second lag restricts the sample to the observations included in the regression using the sixth lag (where we lose three additional observations due to the exclusion of countries with high income, which varies over time). All regressions include (log) *Population* $(t-1)$ and country- and year-fixed effects as control variables. Standard errors are in parentheses.

similar. Finally, our main results are also similar when we use three-year averages rather than yearly data (see online Appendix C12).

In Table 5, we seek to understand the mechanisms linking aid to growth by investigating how Chinese official financing affects specific components of GDP, all measured in differences of logged constant values. Specifically, we investigate the effects of Chinese official financing on gross capital formation, net exports, household final consumption expenditure, and government final consumption expenditure, with overall consumption being the sum of the two, and gross domestic savings. This decomposition creates a basis for expectations about the future effects of Chinese projects: if aid is consumed in its entirety, there would be little reason to expect future growth to increase as a consequence, while strong effects on investment might promote future growth (to the extent investments are productive). As shown in Table 5, Chinese projects increase both investment and consumption in recipient countries, with the effect on investment being stronger in terms of magnitude and statistical significance. Specifically, an additional Chinese project leads to an increase in gross capital formation of 2.4 [0.6; 4.2] percent and an increase in consumption of 0.5 [−0.1; 1.0] percent (90 percent confidence intervals in brackets). Chinese ODA also increases imports by 2.4 [0.3; 4.4] percent as one would expect

Table 5—Chinese Official Financing and Components of GDP (2SLS, 2002–2016)

	Coefficient	Standard error	Countries	Observations	Cragg-Donald F-statistic	Kleibergen-Paap F-statistic	Hansen J-statistic
Panel A. Gross fixed capital formation							
OF	0.024	(0.011)	117	1,481	30.00	33.55	0.22
OOF	−0.014	(0.027)	117	1,481	29.19	22.84	0.44
ODA	0.04	(0.015)	117	1,481	28.84	29.55	0.07
Panel B. Gross fixed private capital formation							
OF	0.083	(0.071)	103	1,215	21.46	34.79	0.37
OOF	0.173	(0.210)	103	1,215	14.86	22.52	0.87
ODA	0.112	(0.096)	103	1,215	26.00	28.71	0.31
Panel C. Foreign direct investment inflows							
OF	0.030	(0.050)	149	1,852	36.79	32.00	0.72
OOF	0.089	(0.073)	149	1,852	47.14	14.43	0.95
ODA	0.038	(0.061)	149	1,852	34.83	31.97	0.65
Panel D. Imports							
OF	0.012	(0.009)	121	1,532	32.57	32.10	0.86
OOF	−0.016	(0.023)	121	1,532	32.53	24.72	0.00
ODA	0.024	(0.012)	121	1,532	30.11	27.53	0.18
Panel E. Exports							
OF	0.003	(0.010)	121	1,532	32.57	32.10	0.43
OOF	−0.038	(0.022)	121	1,532	32.53	24.72	0.36
ODA	0.016	(0.013)	121	1,532	30.11	27.53	0.72
Panel F. Consumption, overall							
OF	0.005	(0.003)	116	1,470	31.67	36.03	0.01
OOF	0.004	(0.009)	116	1,470	31.67	25.13	0.93
ODA	0.006	(0.004)	116	1,470	29.38	30.30	0.00
Panel G. Consumption, household							
OF	0.004	(0.003)	116	1,470	31.67	36.03	0.02
OOF	0.007	(0.009)	116	1,470	31.67	25.13	0.49
ODA	0.006	(0.005)	116	1,470	29.38	30.30	0.01
Panel H. Consumption, government							
OF	0.005	(0.009)	116	1,470	31.67	36.03	0.10
OOF	0.007	(0.029)	116	1,470	31.67	25.13	0.90
ODA	0.007	(0.013)	116	1,470	29.38	30.30	0.14
Panel I. Savings							
OF	−0.032	(0.020)	127	1,404	26.72	30.51	0.86
OOF	−0.005	(0.035)	127	1,404	20.90	26.02	0.56
ODA	−0.041	(0.032)	127	1,404	27.49	24.10	0.94

Notes: Each row represents one regression. The dependent variable is—in first differences, logged constant 2010 US dollars, with a value of one added before taking logs—indicated in the panel header. The variable of interest, *Chinese OF* $(t-2)$, denotes Chinese development finance commitments lagged by two years and is measured as a project count. In separate rows, we show results for all official finance (*OF*) projects, Other Official Flows (*OOF*) projects, and Official Development Assistance (*ODA*) projects. All regressions include (log) *Population* $(t-1)$ and country- and year-fixed effects as control variables. Standard errors are in parentheses.

if construction materials for such projects are imported from China or elsewhere. In summary, the positive effects on short-run growth that we observe are best explained via increases in investment and—to a lesser extent—consumption.[42] To the extent

[42] The table also reports results for foreign direct investment. The effect of Chinese projects is positive, on average, but not precisely estimated.

that these investments are productive, longer-run effects on growth would be a likely consequence; however, we lack the data to test this expectation.

B. *Robustness and Extensions*

As an important test for robustness, we explore specifications that control for annual amounts of Chinese outward FDI and exports to a country. The results of these tests are shown in panels A and B of online Appendix C7 and confirm our previous results. Panels C and D focus only on the foreign reserves-based instrument and include Chinese overall (rather than country-specific) trade and FDI as interactions with the probability of receiving Chinese aid. This accounts for potential confounding wherein physical-input-based movements in Chinese FDI and exports, rather than development finance, account for differential growth effects in countries that regularly receive Chinese development finance compared to irregular recipients.[43] The results are similar. The final test that we report in the table is a placebo regression, where we explain Chinese official financing with future (rather than lagged) values of our instruments (panel E). The substantially lower first-stage F-statistics show that our instruments in $t + 1$ do not explain aid in t well. Overall, these tests provide additional support for the main results reported in Table 3.

While we do not report these results in a table, we also ran specifications where we instrument Chinese exports and FDI with our instrument based on physical construction materials (controlling for Chinese financing). Results for these placebo regressions show very weak first-stage F-statistics as one would expect if official financing (rather than exports and investments) is the key method to transfer surplus material to countries that regularly receive Chinese development projects. As a further placebo test, we replaced the number of all projects with the number of projects that should be unrelated to the availability of physical inputs. This subset of projects includes items like budget aid, support to nongovernmental organizations, and debt relief agreements. If our instrument captures the availability of physical project inputs, it should not be a strong predictor of projects that do not rely on these inputs. Again, the first-stage F-statistics are very low in these placebo regressions as one would expect.

Next, our main results are qualitatively unchanged when we replicate the regressions in Table 3, controlling for the most common determinants of growth found in the aid effectiveness literature: the average number of assassinations in a recipient country, its government surplus as a share of GDP, its rate of inflation, money as a share of GDP, and trade openness (see online Appendix Table C6 for details).[44]

[43] Given that aid is included in exports, we do not use the physical-input-based instrument for this test. Using the physical-input-based instrument, we also tested whether China's exports of construction materials to a country increase two years after the commitment of Official Finance. Specifically, we use trade data from UN Comtrade (2017) and take the sum of exports of iron and steel (SITC code 67), lime, cement, and fabricated construction materials (661), cork and wood (24), aluminum (684), and glass (664) divided by recipient-country GDP. As shown in online Appendix C10, the effects of OF on exports of construction material are similar compared to those on growth as one would expect if the support is given in the form of physical inputs into projects.

[44] The excludability of our instrument does not depend on these additional control variables but their inclusion arguably introduces endogeneity, which is why we omit them in our baseline specifications in Table 3. Data originate from Wilson (2017) and World Bank (2017). We linearly interpolate the control variables to maximize sample

We also explore robustness to outliers. A partial leverage plot of our main result in Table 3 hints at the possibility that a small number of outliers may drive our results (see panel A of online Appendix C5). However, when we replicate the regressions without these observations, we find that they do not affect our results in a substantive way (panel B of online Appendix C5). Our main conclusions in our 2SLS setting also hold when we replace logged levels of Chinese official financing with per capita amounts or amounts as a share of recipient-country GDP (online Appendix C13).[45] Finally, we compare our baseline results with regressions that include only projects that reached at least the implementation stage (online Appendix C14) or completion stage (online Appendix C15). As one would expect, results are stronger for the subset of projects that reached at least the implementation stage or completion stage than for the full set of projects in the baseline model specification (which include officially committed projects, projects in implementation, and completed projects).

We next explore potential heterogeneity in our results. Several studies suggest that aid effectiveness is conditional on recipient political institutions and donor interests that shape allocation patterns. For example, Chinese aid effectiveness may vary across well-governed and poorly governed countries (Burnside and Dollar 2000; Angeles and Neanidis 2009; Baliamoune-Lutz and Mavrotas 2009; Denizer, Kaufmann, and Kraay 2013) or across countries that are more or less politically aligned (Dreher, Minasyan, and Nunnenkamp 2015; Dreher, Eichenauer, and Gehring 2018).[46] We therefore interact the number of Chinese projects (in terms of OF, OOF, and ODA, respectively) with (i) the Burnside-Dollar "good-policy" indicator, (ii) the absence of corruption, (iii) democratic accountability, (iv) the absence of ethnic tensions, (v) the absence of press freedom, (vi) the recipient's voting coincidence with China in the United Nations General Assembly, and (vii) a binary indicator for left-wing recipient governments.[47] We implement these regressions with a Control Function (CF) approach (based on the residuals from the first-stage regressions shown in Table 3 and using bootstrapped standard errors with 500 replications), assuming that the extent of the bias does not depend on the variable we interact with aid.[48] Most interactions are insignificant (see online Appendix C8). The exception is the indicator for left-wing governments, where we find that ODA is less effective when given to countries with such governments.

Finally, we investigate sectoral heterogeneity in the growth effects of aid. Clemens et al. (2012) decompose total aid flows into "early-impact" aid flows

size. The number of observations is lower compared to those in Table 3 because of countries with data missing for all years.

[45] Note that the first-stage *F*-statistics are weaker, though they remain above the rule of thumb value of ten for the regressions including all flows when we use the physical aid-input-based instrument only, with results of the second stage again being similar (not reported in tables). Given that these approaches involve scaling the aid with a variable that should not be predicted by our instruments, the weaker first stage is unsurprising.

[46] Others have argued that China is better able than Western donors to transact with poorly governed countries because it employs financial modalities, such as commodity-backed loans, that reduce the risks of financial misappropriation, loan repayment delinquency, and default (e.g., Brautigam 2011).

[47] Our sources for these data are Dreher and Langlotz (2020); the International Country Risk Guide (ICRG) (2017); Voeten, Strezhnev, and Bailey (2009); Freedom House (2017); and Beck et al. (2001).

[48] An alternative to this approach is 2SLS employing the interaction of the instrument with the variable we interact projects with as second instrument, but this approach treats the interaction with the endogenous variable as a separate endogenous variable and thus "can be quite inefficient relative to the more parsimonious CF approach" (Wooldrige 2015, 429).

(e.g., economic infrastructure) that plausibly affect near-term growth outcomes and aid flows that likely only generate growth over longer periods of time. They find relatively strong impacts of aid on growth when they limit their analysis to "early-impact" aid flows. However, they do not test whether donors are differentially effective at promoting economic growth when they support the same types of "growth" sector activities (e.g., highways, bridges, railroads, dams, airports, seaports, electricity grids). Policymakers in developing countries frequently claim that China is more efficient at implementing social and economic infrastructure projects than its Western counterparts (Wade 2008, Souleé-Kohndou 2016). However, a popular counterargument suggests that in its zeal to help partner countries install the "hardware" of economic development in an efficient manner, China has prioritized speed over quality. Critics charge that China has financed white elephant projects—e.g., hospitals without the necessary equipment and personnel and roads that wash away—that provide few economic benefits, while Western donors and lenders have learned through decades of experience to design and implement development projects in careful and sustainable ways (Dornan and Brant 2014, Financial Times 2016, *The Economist* 2017).

We estimate the growth effects of aid channeled to three broad sectors as defined by the OECD: Economic Infrastructure and Services, Social Infrastructure and Services, and Production Sectors.[49] To instrument these different project numbers and flows, we rely on the sector-specific probability of receiving aid to calculate our interacted instruments. That is, rather than focusing on the probability of receiving any financing, we use the probability of receiving funds in these three sectors. Our results show positive effects of Chinese official finance on recipients' economic growth in all three broad sectors (see online Appendix C9). The positive growth effects are most pronounced in the production sector. The estimated effects are larger for ODA than OOF in all three sectors. It is thus unlikely that differential effects across ODA versus OOF result from the different sectoral composition of ODA and OOF, respectively.[50]

Taken together, our results are robust to alterations in the definition of our dependent variable, the inclusion of a number of control variables, and the omission of potential outliers. Placebo regressions show the expected insignificant coefficients. The positive effects of Chinese projects are independent from recipient countries' governance and institutional quality and visible across different sectors.

[49] The "Social Infrastructure and Services" category includes health, education, governance, and water supply and sanitation projects; the "Economic Infrastructure and Services" category includes transportation projects (e.g., roads, railways, and airports), energy production and distribution projects, and information and communication technology (ICT) projects (e.g., broadband internet and mobile phone infrastructure); and the "Production Sector" category includes agriculture, fishing, forestry, mining, industry, trade, and tourism projects. Online Appendix B16 confirms that there are differences in the sectoral composition of ODA and OOF projects, on average. Online Appendix B18 shows the share of projects received in these sectors in all projects for the countries of our sample.

[50] We also experimented with a measure of "Early-impact Financing," attempting to focus on sectors that might affect growth in the short term according to Clemens et al. (2012). Since we have only three-digit rather than five-digit codes, we code a three-digit sector as "Early-impact Financing" if the larger part of the underlying financial value is in five-digit sectors that are coded as "Early-impact Aid" in Clemens et al. (2012). The results we obtained with this measure are similar to those reported in Table 3.

IV. Does Chinese Development Finance Harm the Effectiveness of Western Aid?

This section complements our primary analysis by investigating whether and to what extent Chinese official financing reduces the effectiveness of Western aid. Given that Western bilateral donors only give minimal amounts of OOF, we analyze ODA from all OECD-DAC donors combined and then separately focus on three large Western donors: the United States, the International Development Association (IDA), and the International Bank for Reconstruction and Development (IBRD). To this end, we introduce basic aid effectiveness regressions using the interaction of a given donor's total aid budget in a year with the recipient-specific probability of receiving aid from that donor, broadly following Temple and Van de Sijpe (2017). Rather than using variables that affect the availability of aid, aid budgets directly measure the amounts available in a given year. The exclusion restriction relies on the assumption that changes in a donor's aid budget over time do not differentially affect growth in countries with a low probability of receiving aid from that donor compared to growth in countries with a high probability of receiving aid, other than via the aid from that donor.[51]

Specifically, we use the interaction of the respective donor's financial budget, computed as the sum of all its ODA commitments in a given year, with the recipient-specific probability of receiving aid from the respective donor as an instrument for the OECD-DAC, the United States, the two World Bank windows, and—to facilitate comparison—for China as well.[52] Building on Lang (2020), we calculate the World Bank's aid "budget" with measures of its aid resources: the IBRD's equity-to-loans ratio and the IDA's "funding position."[53] Lang suggests the IMF's liquidity ratio interacted with the probability that a country is under an IMF program as an instrument for IMF loans. We follow this approach by using similar proxies for the World Bank. In order to measure the availability of IBRD resources, we rely on the IBRD's equity-to-loans ratio, which has been consistently reported in the IBRD's annual financial statements since 1994.[54] The equity-to-loans ratio is a measure of the IBRD's "ability to issue loans without calling its callable capital"

[51] Using the interaction with aid budgets is arguably less exogenous than the interaction used in our primary analysis. As Dreher and Langlotz (2020) explain, the exclusion restriction of the interacted aid budget instrument could well be violated "given that growth shocks in recipient countries could directly affect donors' aid budgets …, while growth shocks in non-recipient countries might not." They point to a paper by Rodella-Boitreaud and Wagner (2011), who find that donors increase their aid budgets in response to increased demands for their aid rather than just responding with reallocations of aid. Nevertheless, we believe that this approach is reasonable for the purposes of achieving comparability across donors.

[52] For the group of DAC donors, our instrument is taken from Dreher and Langlotz (2020). Aggregated aid (across donors) is based on a zero-stage-regression, where bilateral aid from all DAC donors to all recipients is predicted based on the excludable instrument.

[53] Alternatively, one might think of aggregating country-specific commitments to derive the Bank's total "aid budget." For the Bank, however, we expect the liquidity ratios to be more suitable to indicate budgetary leeway since, unlike the DAC donors, the Bank has no fixed budget that it will spend largely independent of the demand for its resources.

[54] "Equity" is defined as the sum of usable paid-in capital, general reserves, special reserves, and cumulative translation adjustments. It does not include the "callable capital" that the IBRD's shareholders are legally obligated to provide if and when it is needed. "Loans" are defined as the sum of loans outstanding and the present value of guarantees.

(Bulow 2002, 245).[55] In order to measure the availability of IDA resources, we rely on a measure of IDA's "funding position," which is defined by the World Bank as "the extent to which IDA can commit to new financing of loans, grants and guarantees given its financial position at any point in time and whether there are sufficient resources to meet undisbursed commitments of loans and grants" (IDA 2015, 24). The Bank only began reporting its funding position on an annual basis in 2008, so we reconstruct the 1990–2007 time series by using the World Bank's method of calculating this indicator. More specifically, with the information reported in the IDA's annual financial statements, we first sum the Bank's net investment portfolio and its nonnegotiable, non-interest-bearing demand obligations (on account of members' subscriptions and contributions) and then divide this figure by the sum of the Bank's undisbursed commitments of development credits and grants.[56]

Using this alternative instrument, our findings for Chinese ODA projects and amounts are comparable to those obtained using the previous instruments in Table 3. Again, we find significant, positive growth effects for Chinese ODA projects one, two, and three years after the commitment of aid (see online Appendix D1).[57] Again, the coefficient is largest two years after commitment. According to the coefficient, one additional Chinese ODA project increases growth by between 0.68 to 2.48 percentage points 2 years after commitment. This is remarkably close to the corresponding increase of 0.69–2.21 percentage points for our baseline IV discussed above.

Though we would ideally like to focus on the same time periods when comparing across donors, when we restrict the sample for the Western donors and lenders to the period for which we have aid data for China (2000–2014), our instruments for Western aid are insufficiently powerful according to the first-stage *F*-statistics. Our comparison thus relies on comparable Local Average Treatment Effects (LATEs) but draws from different samples in terms of the time period and recipient countries covered. Besides aid from China, we similarly find that bilateral ODA from Western donors boosts economic growth in recipient countries (columns 3 and 4 of online Appendix D1). Focusing on the effects 2 years after commitment, we find that a doubling of OECD-DAC ODA (US ODA) to the average recipient country increases growth by between 0.40 and 2.33 (0.25 and 1.82) percentage points 2 years after commitment.

[55] One Executive Director to the World Bank memorably characterized the IBRD's callable capital in this way: "Management and the Board should think about callable capital as a Christian thinks about heaven, that it is a nice idea but no one wants to go there because the price of admission is death" (quoted in Kapur, Lewis, and Webb 1997, 991).

[56] Since 2008, the Bank has summed its net investment portfolio and its "unrestricted" demand obligations. However, prior to 2008, the Bank did not separately report its "restricted" and "unrestricted" demand obligations. Therefore, we rely instead on the total nonnegotiable, non-interest-bearing demand obligation figures reported in the Bank's pre-2008 financial reports. The Bank's "restricted" demand obligations from 2008 to 2014 were almost negligible (less than 1 percent of total demand obligations), so this difference in the way IDA's funding position is calculated from 1999 to 2007 and 2008 to 2014 is small and unlikely to be consequential. Likewise, the Bank reported its "net investment portfolio" as a stand-alone figure from 2008 to 2014 but not in earlier years. Therefore, as an approximation of the Bank's net investment portfolio in each year between 2000 and 2007, we sum "Investments—Notes B and F" and "currencies due from banks" less "net payable from investment securities transactions." As an approximation of the Bank's "net investment portfolio" in each year between 1990 and 1999, we sum cash and investments immediately available and not immediately available for disbursement.

[57] Online Appendix D2 replicates Table 3 using the aid-budget instrument. Overall, the results are very similar to the ones described above. Online Appendix D3 reproduces these results with the 1970–1999 probabilities of receiving projects. The results are again qualitatively similar in those specifications with large first-stage *F*-statistics for the number of all projects and ODA projects.

Comparing these effects to those of Chinese ODA amounts (in $t-2$) shown in column 2, we cannot reject the hypothesis that bilateral aid from China and Western donors have equal effects on growth (p-values: 0.78 for DAC and 0.77 for the United States; see last row of online Appendix D1). However, we do not observe any significant growth effects of IBRD loans or IDA grants (columns 5 and 6). Compared to these negative coefficients, Chinese ODA registers more positive effects.[58]

Having benchmarked the effectiveness of Chinese aid vis-à-vis the World Bank, the United States, and OECD-DAC donors as a whole, we next consider whether interactions between Chinese and traditional donors' aid impinge upon the effectiveness of that aid. More specifically, we test whether and to what extent Western aid is differentially effective at increasing economic growth when given to countries that do not also receive substantial support from China.

Scholars, journalists, and policymakers have previously argued that China's disregard for the quality of host country policies and institutions diminishes the effectiveness of aid from more "enlightened" donors (Crouigneau and Hiault 2006, Collier 2007, Naím 2007, Pehnelt 2007, Woods 2008, *The Economist* 2009).[59] By way of example, in 2009, the Executive Vice President of the Asia Society relayed a specific account where this dynamic seemed to be at work: "Cambodia was considering a $600m loan from the World Bank that had conditions about transparency and anti-corruption and accountability. The Cambodians basically told the World Bank to go to hell and the next day they received a $601 [million] loan from the Chinese with no conditions" (Duke 2009).

Several recent studies suggest that anecdotes like this one may reflect a broader empirical pattern. Hernandez (2017) provides evidence that recipients of Chinese aid receive World Bank loans with fewer conditions. Therefore, to the extent that World Bank conditionality facilitates the adoption of growth-promoting policy and institutional reforms, Chinese aid may slow economic growth by indirectly impeding these reforms. Brazys and Vadlamannati (2020) show that the receipt of Chinese aid reduces the likelihood that host countries will implement market-liberalizing reforms.[60] Annen and Knack (2019) also find that Western aid has become more sensitive to the quality of policies and institutions in recipient countries, but this relationship is compromised when the Chinese government provides large-scale financing (in excess of US$2 billion). Therefore, to the extent that high-quality policies and institutions support economic growth in recipient countries, Chinese aid may have detrimental effects on economic growth rates.[61]

[58] These findings should be interpreted with caution, given that the results for the OECD-DAC and the United States are based on a longer panel (1978–2016) as the instrument failed to reach relevance on the shorter 2002–2016 sample. Similarly, the results for the IBRD refer to the 1997–2016 and for the IDA to the 1993–2016 period. When we disaggregate aid into three sectors (economic infrastructure, social infrastructure, and production) for China, the DAC, and the United States, our results suggest that irrespective of the source of ODA, support for the "Economic Infrastructure and Services" sector and the "Social Infrastructure and Services" sector consistently yields positive economic growth returns. For "Production Sector" activities, OECD-DAC ODA increases economic growth, but ODA in this same sector from China and the United States does not (see online Appendix D4).

[59] Swedlund (2017b) provides a counterargument.

[60] Likewise, Li (2017) finds that Chinese aid has blunted the democratizing effects of DAC aid to sub-Saharan Africa, while Kersting and Kilby (2014) also recover evidence that Chinese aid undermines democratic governance.

[61] On the other hand, Strange, Dreher et al. (2017) find that Chinese aid can help prevent civil conflict when recipients are faced with sudden withdrawals of Western aid. Therefore, to the extent that political stability promotes

Arguably, whether or not a country becomes a "Chinese aid orphan" is not exogenous as China's aid allocation decisions are made according to commercial, geopolitical, and need-based criteria (Dreher and Fuchs 2015, Dreher et al. 2018). We address this issue by using the predicted number of Chinese projects rather than the actual number to select the sample of countries that China neglects. Specifically, we use the first-stage regression results from column 1 of Table 3 to split the sample. We define "aid orphans" as countries that are predicted to receive an average number of projects per year below the sixtieth percentile of the distribution over the sample period (four projects). Running seemingly unrelated estimations, we compute Wald tests to identify statistically significant differences in the effect sizes compared to the coefficients of the full sample. In addition, we run regressions that restrict the sample period to the years after 2001, where "orphans" are defined in each individual year, rather than for the whole sample period. However, aside from the IBRD, first-stage F-statistics are low, so we only report results for this specification for the regression focusing on the IBRD.

Table 6 shows the results, with panel A reporting results for the full sample and panel B those restricted to "Chinese aid orphans." Again, focusing on the effects 2 years after commitment, we find that a doubling of DAC ODA (US ODA) to the average Chinese "aid orphan" country increases growth by between 0.46 and 2.58 (0.58 and 3.26) percentage points 2 years after commitment. The coefficients of IDA aid and IBRD loans are negative but far from reaching statistical significance.

Comparing the results of the sample restricted to "aid orphans" to those of the full sample, we find no significant differences for total OECD-DAC aid (see column 1, with the p-value given in the last line of the table), IBRD loans (columns 3 and 4), and IDA credits (column 5). When we focus on aid from the United States (in column 2), results are mixed. While the effect of US aid is positive whether or not we exclude Chinese "aid darlings," its effect on growth is statistically larger in the sample focusing on China's "aid orphans" (0.58–3.26) compared to the full sample (0.25–1.82).[62] Overall, claims that Chinese aid systematically impairs the effectiveness of Western aid are not supported by our findings.[63]

V. Conclusions

China has become a major source of global development finance, but the nature and consequences of its official financing activities are poorly understood. The absence of systematic evidence and rigorous analysis on the economic growth

economic growth, Chinese aid could also have indirect positive effects. According to Zeitz (2020), the World Bank reacts to competitive pressure by emulating China's focus on infrastructure. Whether and to what extent such change in policy affects growth is an empirical question.

[62] Online Appendix D5 reports results without accounting for the endogeneity of Chinese projects. We define "Chinese aid orphans" as countries that completed fewer projects in the 1960–2005 period than the sixtieth percentile of the sample. Results are overall similar. The exception is a significantly different coefficient for IBRD funding. While not significantly different from zero, the coefficient is positive and larger than those of the overall sample, indicating that in this—endogenously selected sample—IBRD funding is more effective in countries that did not receive a large number of Chinese projects.

[63] We test the robustness of these findings using different thresholds for how we define "aid orphans." Our results are unchanged when we use the fortieth or seventieth percentiles to split our sample.

Table 6—Growth Effects of Western Official Financing for the Full Sample and the Sample for Chinese "Aid Orphans" (Based on the Predicted Number of Chinese Projects)

	DAC ODA (1)	US ODA (2)	IBRD (3)	IBRD (4)	IDA (5)
Panel A. Full sample					
2SLS estimates—Dependent variable: GDP per capita growth					
OF $(t-2)$	1.972	1.495	−0.375	−0.442	−0.243
	(0.845)	(0.687)	(0.482)	(0.397)	(1.019)
First-stage estimates—Dependent variable: OF $(t-2)$					
Budget $(t-3)\times$ probability	0.036	1.932	0.141	0.192	−0.025
	(0.011)	(0.475)	(0.085)	(0.090)	(0.008)
Number of countries	157	157	154	152	157
Observations	4,995	4,996	2,808	2,370	3,373
Kleibergen-Paap *F*-statistic	9.81	16.51	2.75	4.62	9.56
Panel B. Aid orphans					
2SLS estimates—Dependent variable: GDP per capita growth					
OF $(t-2)$	2.196	2.765	−0.445	−0.463	−1.550
	(0.929)	(1.175)	(0.323)	(0.303)	(3.205)
First-stage estimates—Dependent variable: OF $(t-2)$					
Budget $(t-3)\times$ probability	0.047	1.373	0.426	0.577	−0.012
	(0.016)	(0.422)	(0.222)	(0.234)	(0.009)
Number of countries	89	89	89	103	89
Observations	2,771	2,772	1,623	1,213	1,927
Kleibergen-Paap *F*-statistic	8.25	10.56	3.68	6.07	1.70
First year	1978	1978	1997	2002	1993
Last year	2016	2016	2016	2016	2016
Pr $>\chi^2$	0.67	0.01	0.83	0.94	0.54

Notes: The dependent variable is the recipient country's annual real GDP per capita growth in year t. The variable of interest, indicated in the column header, denotes development finance commitments by the respective donor lagged by two years and is measured as logged financial amounts. All regressions include (log) *Population* $(t-1)$ and country- and year-fixed effects as control variables. Pr $>\chi^2$ reported in the last row corresponds to testing the hypothesis that the effect of DAC/US/IBRD/IDA official finance in countries that are predicted to be "Chinese aid orphans" is different from the effect in the full sample. Columns 1, 2, 3, and 5 define "aid orphans" as countries that are predicted to receive an average number of projects per year below the sixtieth percentile of the distribution over the sample period according to the regression in column 1 of Table 3 (four projects). Column 4 restricts the sample period to the years after 2001, where "orphans" are defined in each individual year, rather than for the whole sample period. Standard errors are in parentheses.

effects of Chinese development finance represents a major blind spot in the literature. We address this gap by estimating the average economic growth effects of Chinese development finance. We also test the popular claim that significant support from China impairs the effectiveness of aid from Western donors and lenders.

Our results show that Chinese development finance boosts economic growth in recipient countries in the short run. For the average recipient country, we estimate that an additional Chinese project increases growth between 0.41 to 1.49 percentage points 2 years after the financial commitment (using a 90 percent confidence interval). Focusing on amounts rather than project numbers, we find that a doubling of Chinese development finance to the average recipient country—amounting to an increase in US$146 million—implies a 0.05–1.33 percentage points increase in growth 2 years after commitment. These effects persist across different aid sectors and appear to be driven by increases in investment and—to a lesser extent—consumption. While our analysis shows that the direct effects of Chinese development finance fade four years after the aid has been committed, we lack sufficient data to measure the long-run effects that may result from higher levels of gross capital formation. We also test for heterogeneity across a number of dimensions and do not find that Chinese development finance is differentially effective if given to countries with higher-quality policies or institutions. Nor do we find empirical support for the idea that significant financial support from China impairs the overall effectiveness of aid from Western donors. Overall, this evidence should allay some of the fears that policymakers have expressed about China acting as "rogue donor" that undermines the effectiveness of Western assistance (e.g., Naím 2007, Bolton 2018).

Our findings also speak to broader policy and academic debates about the economic impacts of the BRI, a massive, Chinese-led initiative to increase regional connectivity across dozens of countries. The BRI includes hundreds of the very same types of projects that we assess in this article (e.g., roads, railways, tunnels, bridges, power plants, electricity transmission lines, telecommunication networks, and industrial production facilities). However, while most of the projects in our sample have already been implemented and their economic effects can be estimated, this is not the case for the vast majority of projects that have been formally designated as "BRI projects" as the initiative was not officially launched until late 2013. To the extent BRI projects are financed, allocated, and implemented similarly to the development projects in our dataset, one might expect these projects to also register positive, short-term effects on economic growth. On the other hand, if China's BRI portfolio is substantially more focused on "connective infrastructure" projects that resolve spatial bottlenecks, increase mobility, generate employment opportunities, create and link new markets, or otherwise reduce costs between subnational jurisdictions and countries, there may be larger and longer-term economic effects that we have not captured in our analysis (de Soyres et al. 2019, Bluhm et al. 2020).[64] Future studies should therefore reevaluate the questions addressed in this paper as more time series data on Chinese development finance become available.

Of course, any potential short- and long-term gains from the BRI must be weighed against the various costs of these projects. One particular concern is the extent to which BRI infrastructure projects result in high levels of sovereign debt on lending terms that are less concessional than the debt-financed projects in our dataset. Countries with rising public debt-to-GDP ratios in excess of 50–60 percent tend to experience economic growth slowdowns (Chudik et al. 2017), and there are now roughly 15 BRI member countries in immediate danger of crossing—or even far surpassing—these thresholds (Hurley, Morris, and Portelance 2019). Therefore, any future attempts to estimate the long-run economic growth impacts of Chinese official financing ought to address the possibility of sovereign debt accumulation threshold effects as well as unique features of Chinese government lending such as collateralization (Hausmann 2019) and longer time horizons (Kaplan 2016, forthcoming). Any efforts to make projections about the long-run socioeconomic impacts of Chinese development finance should also account for the fact that

[64] Indeed, authoritative Chinese policy documents on the BRI heavily emphasize transportation infrastructure and economic connectivity (e.g., National Development and Reform Commission 2015).

Chinese development projects can create negative externalities such as local corruption, public acceptance of authoritarian norms, ethnic tensions, government-initiated violence against political opponents, and environmental degradation (BenYishay et al. 2016; Blair and Roessler 2016; Brazys, Elkink, and Kelly 2017; Kishi and Raleigh 2017; Isaksson and Kotsadam 2018a, b; Gehring, Kaplan, and Wong 2019; Isaksson 2019). Some of these questions have already been addressed with the data introduced in this paper, but more research is warranted to fully understand the implications of Chinese development projects around the globe.

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