*Review of Development Economics, 18(3), 564–580, 2014*
DOI:10.1111/rode.12103

# The Missing Link: China's Contracted Engineering Projects in Africa

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## Abstract

This paper examines the driving forces of China's contracted engineering projects in Africa. Using data on contracted engineering projects in 52 African countries over the period 1991–2010, three groups of hypotheses are tested: (1) economic motives; (2) political ties between China and Africa; and (3) host country characteristics. We find that countries get more projects if they have large market potential and are political allies of China. Our results also suggest that Forums on China–Africa Cooperation promote projects in Africa. In contrast, host country characteristics are hardly related to the amount of engineering projects received.

## 1. Introduction

China's fast-growing economic ties with Africa have attracted considerable attention. According to the IMF's Direction of Trade Statistics, China's trade (exports plus imports) with Africa increased steadily from US$1.21 billion in 1990 to US$135.75 billion in 2011. The rise of the Chinese economy has fueled global demand for oil and other primary commodities. However, Africa's rapidly growing exports to China are not limited to fuels and other mineral products. Labor-intensive raw or semi-processed agricultural commodities that are used for further processing either for industrial use (timber, cotton) or for consumer use (food products) are also increasingly imported by China (Broadman, 2007).

Likewise, China has become one of the major capital providers for countries in Africa. Several papers have examined the driving forces of Chinese outward direct investment (ODI) in Africa.[1] Cheung et al. (2012a) examined to what extent China's ODI is driven by standard economic determinants of foreign direct investment (FDI). They conclude that there is evidence in support of the market-seeking motive, the risk-avoiding motive, and the resources-seeking motive. Once an investment decision is made, China tends to invest more in oil-producing African countries. Cheung et al. (2012b) analyzed whether also political considerations and host-country characteristics affect China's ODI in Africa. Their main findings are that in the 1990s political variables seem to dominate economic determinants of China's ODI in Africa. The likelihood that a country receives ODI from China increases if the country concerned is a political ally of China, has diplomatic relations with China, is corrupt, democratic

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The authors wish to thank participants in the 2012 IACMR Conference (Hong Kong), seminar participants in University of Groningen and the Shanghai Institute of Foreign Trade and an anonymous referee for their comments on a previous version of the paper. The views expressed do not necessarily reflect the views of DNB.

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and politically stable. In contrast, more recent data suggest that most political variables turn out to be insignificant. Instead, China's ODI in Africa is mainly driven by economic ties with the host country and the drive for natural resources.

Aid is yet another channel via which China interacts with Africa. Dreher and Fuchs (2012) find that political considerations are an important determinant of China's allocation of aid: countries that vote in line with China in the United Nations General Assembly and do not recognize Taiwan as an independent country receive more aid. In contrast to widespread perceptions, they find no evidence that China's aid allocation is dominated by natural resource endowments or is biased towards autocratic or corrupt regimes. China's aid is independent of the recipients' institutional characteristics, which seems to confirm China's non-interference principle.

In addition to trade, ODI and aid, contracted engineering projects are another important, yet so far largely ignored, channel through which China interacts with Africa. These projects include building of highways and roads, bridges, schools, shopping centers, housing and office buildings, water conservancy, dams and power plants. The amount of contracted engineering projects has increased steadily over time and displayed a significant jump in the 2000s after the first Forum (2000) on China–Africa Cooperation.[2] The dollar value of China's contracted engineering projects dwarfs its ODI in Africa. In 2010 Chinese ODI in Africa amounted to US$2.1 billion, while the contracted engineering projects amounted to US$38.3 billion. Figure 1 shows the distribution of contracted engineering projects across African countries over the period 1990–2010. As Figure 1 shows, there is quite some variability. In total, Algeria received most contracted engineering projects, i.e. US$28.73 billion; several countries, such as Swaziland, Benin, Somalia, had almost no projects in the period under consideration.

Nowadays, China's policies on contracted engineering projects in Africa are generally perceived as following the state-driven strategy of giving infrastructure and taking natural resources. Foster et al. (2009), for example, list several infrastructure projects in Africa that are paid for by natural resources between 2001 and 2007. A reason noted by, for example, Corkin et al. (2008, p. 2) is that "it is often the most resources rich states that are in dire need of infrastructure development and support." An important benefit resource-based infrastructure projects is that they may speed up the growth process. Countries do not need to wait until they can pay for infrastructural investments, as Paul Fortin, the CEO of Congo's state-owned mining company Gécamines, commented.[3] The comment was made after the parliament of Democratic Republic of Congo approved a deal with China of more than US$6 billion in infrastructure, using a copper and cobalt mining joint venture as guarantee.

So far contracted engineering projects have involved housing construction projects, manufacturing and processing industrial projects, and the construction of basic infrastructure, such as petroleum refinery, electricity, telecommunication, transportation facilities, sewerage, waste processing facilities, etc. The scope and extent of engineering projects show their potential impact on a country's industrialization process and the improvement of its living standard.

Despite their promising impact on Africa's medium to long-term growth prospects, there is only some scant attention for China's contracted engineering projects in the literature. Formal econometric analysis of the driving forces of these projects in Africa is lacking. In a related study, Bhaumik and Yap Co (2011) investigated the relationship between China's contracted engineering projects and its outward direct investment. They find that projects are well explained by classical determinants of FDI. These authors argue that China uses engineering projects as strategic means to

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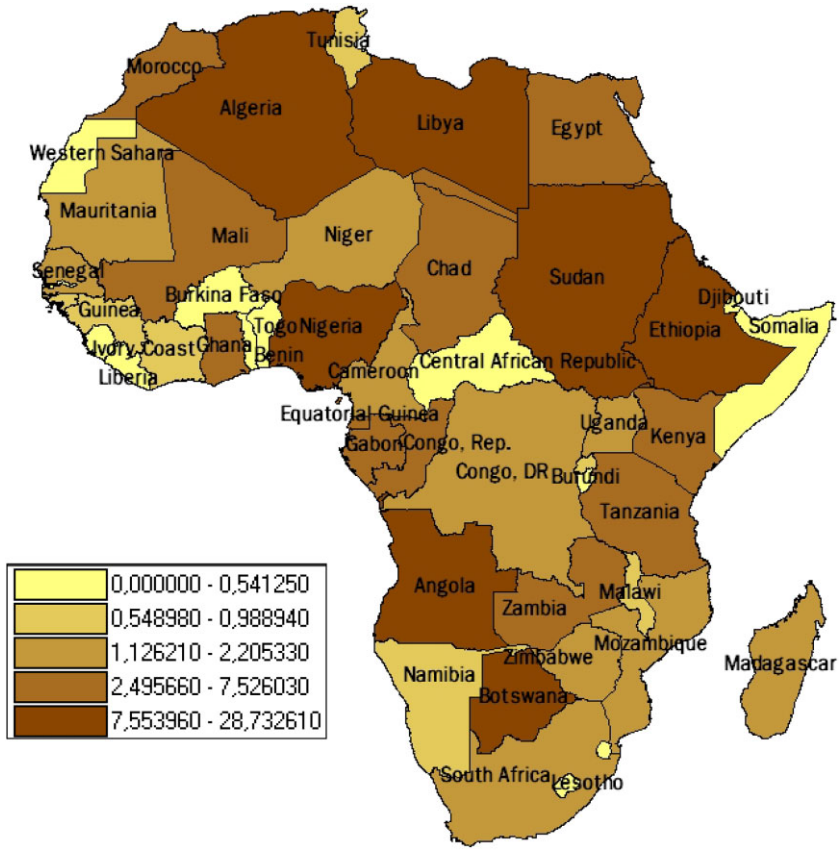


*Figure 1. The Sum of Contracted Values of Engineering Projects Signed over 1990–2010 (in US$ billions)*

seal future ODI deals. In the example of Congo, the US$6 million engineering project is used to secure the mining joint venture, which is an ODI project. This suggests that common factors drive China's ODI projects and contracted engineering projects in Africa. However, as ODI projects are paid for by equity while engineering projects are paid for by cash, loans or otherwise, ODI projects are more long-term oriented (and probably riskier) than engineering projects. These differences may cause engineering projects to be driven by different factors than ODI projects.

In this exercise, we investigate the determinants of China's contracted engineering projects in Africa and shed some light on their implications. Apart from the abundance of natural resources and other economic determinants, we examine also to what extent political considerations and host-country characteristics affect China's engineering projects in Africa. By using similar hypotheses as in our previous work on Chinese ODI in Africa, we are able to examine to what extent engineering projects are driven by different factors than ODI.

We employ annual country-specific data on contracted engineering projects in US dollars published in various issues of *China* (*Trade and*) *External Economic Statistical Yearbooks* compiled by the Department of Trade and External Economic Relations Statistics of the National Bureau of Statistics,[4] using data provided by the Ministry of Commerce of the People's Republic of China (MOFCOM). MOFCOM defines con-

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tracted engineering projects as contracted projects with foreign countries undertaken by Chinese contractors through a bidding process. Only Chinese firms that meet certain criteria will be granted a license for projects. All projects are under the supervision of the Department of Outward Investment and Economic Cooperation of MOFCOM.

The rest of the paper is structured as follows. Drawing on Cheung et al. (2012a,b), section 2 presents the hypotheses tested. Section 3 contains the main estimation results, while section 4 presents some additional findings. The final section concludes.

## 2. Hypotheses

Table 1 shows the hypotheses to be tested. The first column shows the hypotheses, while the second column shows the proxies used to test the hypotheses. The third column shows the expected sign of the proxies.

Following Cheung et al. (2012b), we distinguish between three groups of hypotheses. The first set of hypotheses refers to "standard" economic determinants of Chinese contracted engineering projects in Africa. The second group of hypotheses focuses on political ties between the host country and China, while the third subset of hypotheses refers to political and institutional characteristics of the host country. Data availability primarily determined the list of hypotheses tested. An Appendix which is available on request offers summary statistics of the data used and provides detailed information on their sources.

### *Economic Motives*

The first hypothesis is that the size of Chinese contracted engineering projects in Africa is determined by the drive for new markets. As Broadman (2007) points out, one of the main bottlenecks for trade with Africa is poor infrastructure. It is hypothesized that China will focus on those countries that, once new infrastructure will be in place, offer most opportunities for lucrative trade in view of the size of their markets. According to our first hypothesis, the market potential of the host country is expected to have a positive impact on Chinese contracted engineering projects in Africa.

> *Hypothesis* 1: China has more contracted engineering projects (in terms of contract value) with African countries with large market potential.

We use the log of real GDP per capita in US$ ($RGDPpc_{it-1}$) as a proxy for market potential of the host country $i$ in year $t-1$. Data were drawn from the World Bank's *World Development Indicators* (WDI) database.

With China's rapid economic growth, it is crucial for China to secure a stable supply of natural resources (Zhang and Konan, 2010). Engineering projects could help China to establish good relationships with African governments and further gain access to natural resources. For example, Foster et al. (2009) suggest that the Chinese government has a strategy of giving infrastructure and taking natural resources. Therefore, Hypothesis 2 is:

> *Hypothesis* 2: China has more contracted engineering projects in African countries that have an abundance of natural resources.

We use $Engy_{it-1}$ and $Min_{it-1}$ to proxy the host country's resource endowment level. $Engy_{it-1}$ is a host country's energy output normalized by the host country's gross

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*Table 1. Hypotheses*

| *Hypothesis* | *Variables* | *Expected sign* |
|---|---|---|
| *Economic determinants* | | |
| 1. China has more contracted engineering projects (in terms of contract value) with African countries with large market potential. | Real GDP per capita ($RGDPpc_{it-1}$) | + |
| 2. China has more contracted engineering projects in African countries that have an abundance of natural resources. | Host country's resource endowment level ($Engy_{it-1}$ and $Min_{it-1}$) | + |
| 3. China has more contracted engineering projects in African countries with which it trades a lot. | Trade with China relative to total trade volume ($Trade_{it-1}$) | + |
| 4. China has more contracted engineering projects in African countries that receive much Chinese ODI. | The stock of China's ODI scaled by the host country's population ($A(NW)ODI_{it-1}$) | + |
| 5. China has fewer contracted engineering projects with high-risk African countries. | Proxy for risk (higher value indicates less risk) ($RISK_{it-1}$) | + |
| *Political ties with China* | | |
| 6. China has more contracted engineering projects with African countries that are political allies. | Extent to which a country votes in line with China ($UNvoting_{it-1}$) | + |
| 7. China has fewer contracted engineering projects with African countries that recognize Taiwan as independent country. | Dummy variable whether a country recognizes Taiwan ($Taiwan_{it-1}$) | – |
| 8. Conferences under the aegis of the Forum on China–Africa Cooperation lead to more Chinese contracted engineering projects in Africa. | Dummies that are zero before a conference and one thereafter ($Forum_t$) | + |
| *Host country characteristics* | | |
| 9. China has more contracted engineering projects with autocratic African countries. | Proxy for democracy ($Democracy_{it-1}$) | – |
| 10. China has fewer contracted engineering projects with African countries with countries with a high degree military participation in politics. | Proxy for level of military participation in politics ($Military_{it-1}$) | – |
| 11. China has more contracted engineering projects with African countries that are corrupt. | $Corruption_{it-1}$ index provided by ICRG | – |
| 12. China has more contracted engineering projects with African countries with better institutions. | $LawandOrder_{it-1}$ index provided by ICRG | + |
| 13. China has more contracted engineering projects with African countries that are politically stable. | Proxy for political instability ($Instability_{it-1}$) | + |

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national income. The energy output includes crude oil, natural gas and coal output. $Min_{it-1}$ is mineral output scaled by the host country's gross national income. Mineral output includes bauxite, copper, iron and gold. The data on $Engy_{it-1}$ and $Min_{it-1}$ were taken from the WDI database.

Trade and ODI may affect the amount of contracted engineering projects. Having strong economic ties arguably makes it easy to arrange engineering contracts. When the Chinese government wants to invest in a certain African country or trade with it, it may provide support for some engineering projects as a favor to the host country. Therefore, we have the following hypotheses:

> Hypothesis 3: *China has more contracted engineering projects in African countries with which it trades a lot.*
>
> Hypothesis 4: *China has more contracted engineering projects in African countries that receive much Chinese ODI.*

The first proxy for economic ties is $Trade_{it-1}$, i.e. the ratio between a host country's international trade volume with China and its total trade volume (taken from the IMF DOTS dataset). Based on Hypothesis 3, we expect that extensive trade flows between China and the host country have a positive impact on the value of engineering projects in that country.

The second proxy for economic ties is the stock (i.e. accumulated flows) of Chinese ODI in the host country. The more China has invested in a country, the stronger its interests will be in that particular country. We have data on the stock of approved ODI as annually published by the Ministry of Commerce and the former Ministry of Foreign Trade and Economic Co-operation in the "Almanac of China's Foreign Economic Relations and Trade" which is available for the period 1991–2005. The variable, $AODI_{it-1}$, is the stock of China's approved outward direct investment scaled by the host country's population (in logarithms). From 2003 onwards, MOFCOM published the stock of China's outward direct investment according to IMF–OECD standard ($NWODI_{it-1}$). These data are measured differently from the stock of approved ODI so that the series cannot be merged. We scale $NWODI_{it-1}$ in the same way as $AODI_{it-1}$.

The incentive to sign contracts for engineering projects could be adversely affected by the presence of risk factors. Traditionally, many African countries are considered to be very risky (Asiedu, 2002). Risk influences the payoff of an engineering project in different stages. High risk could lead to higher construction costs, or even default at the end of the projects. According to our fifth hypothesis, high-risk countries in Africa will receive less Chinese contracted engineering projects.

> *Hypothesis* 5: China has fewer contracted engineering projects with high-risk African countries.

Following Cheung et al. (2012a,b), our proxy for the host country's risk level ($RISK_{it-1}$) is generated from two indexes provided by the International Country Risk Guide (ICRG). This variable is the first principle component of the ICRG socioeconomic conditions index and the ICRG investment profile index. The socioeconomic conditions index is an assessment of the socioeconomic pressures at work in society that could constrain government action or fuel social dissatisfaction. The rating assigned is the sum of three subcomponents, each with a maximum score of four points (very low risk) and a minimum score of 0 points (very high risk). The subcomponents are: unemployment, consumer confidence and poverty. The invest-

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ment profile index is an assessment of factors affecting the risk to investment that are not covered by other political, economic and financial risk components. The rating assigned is the sum of three subcomponents, each with a maximum score of four points (very low risk) and a minimum score of 0 points (very high risk). The subcomponents are: contract viability/expropriation, profits repatriation and payment delays. A higher value of *RISK* indicates lower risk. According to Hypothesis 5, the risk-avoiding motive will drive Chinese contractors away. Thus, *RISK* is expected to have a positive impact on Chinese contracted engineering projects in Africa.

*Political Ties between China and Africa*

Political factors play a role in China's economic relations with Africa. We therefore have the following hypotheses:

> *Hypothesis* 6: China has more contracted engineering projects with African countries that are political allies.
>
> *Hypothesis* 7: China has fewer contracted engineering projects with African countries that recognize Taiwan as independent country.

To test the sixth hypothesis, we use data on voting behavior in the UN General Assembly (source: Dreher and Fuchs, 2012). We follow Dreher and Fuchs (2012) and use a variable reflecting the extent to which a country voted in line with China ($UNvoting_{it-1}$). The variable is a ratio of the number of times a country votes in line with China (either both voting yes, both voting no, both voting abstentions, or both being absent) over the total number of votes in a particular year. The expected sign of this proxy is positive. To test the seventh hypothesis, we use a dummy variable ($Taiwan_{it}$) which is one when a country recognizes Taiwan as an independent country. The data come from Rich (2009). The expected sign of this proxy is negative.

We also test for the influence of the Forum on China–Africa Cooperation. The general theme of the Forum is economic cooperation between China and Africa. The Forum in 2003 placed infrastructure development on top of the China–Africa cooperation agenda and encouraged China's enterprises to take an active role in Africa's infrastructure projects.[5] The Forum in 2006 stands out with China issuing a comprehensive policy statement ("China's African Policy").[6] The statement elucidates the principles and scope of China's policy in Africa. It singled out trade, investment and infrastructure and re-emphasized China's non-interference policy, i.e. economic assistance with no strings attached, and the Five Principles of Peaceful Coexistence.[7] Last but not least, President Hu announced the creation of the China–Africa Development Fund, which will eventually reach US$5 billion, to further Chinese firms' cooperation with Africa.[8] According to Hypothesis 8, the occurrence of such conferences will increase China's contracted engineering projects in Africa.

> *Hypothesis* 8: Conferences under the aegis of the Forum on China–Africa Cooperation lead to more Chinese contracted engineering projects in Africa.

To test this hypothesis, we use dummies for each of the conferences ($Forum_t$). Before the conference, the dummy is zero, while after the conference it is one, thereby testing whether each of the four conferences led to more projects.

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*Host-country Characteristics*

Finally, we test whether host-country characteristics influence the allocation of China's engineering projects in Africa. Some observers criticize China's policy as it tolerates, and passively exacerbates, authoritarian regimes and human right violations. For instance, Brookes (2007, p. 5) argues that "Chinese policies are . . . troubling, especially when they support authoritarian African regimes, . . . and exacerbate conflicts and human rights abuses in countries such as Sudan and Zimbabwe." Bräutigam (2009) takes issue with the image of China propping up dictatorial regimes. Indeed, Cheung et al. (2012b) do not find evidence that China has a preference for authoritarian regimes when it comes to ODI. We therefore test the following hypothesis:

> *Hypothesis* 9: China has more contracted engineering projects with autocratic African countries.

To test this hypothesis we use the variable $Democracy_{it-1}$ that ranges from 10 (full democracy) to −10 (full autocracy). The data is taken from the Polity IV database. The expected sign of this variable is negative.

According to Busse and Hefeker (2007), lower military participation leads to more foreign investment inflows. We therefore formulate the following hypothesis.

> *Hypothesis* 10: China has more contracted engineering projects with African countries with countries with a low degree military participation in politics.

To test this hypothesis, we use the variable, $Military_{it-1}$, as provided by ICRG. It measures the level of military participation in politics, with a low value (it ranges from 0 to 6) indicating a greater degree of military participation in politics. Thus, we expect a negative sign for this proxy.

Although corruption is often perceived to deter FDI because it lowers firm productivity (Faruq et al., 2013) and increases investment costs, Cuervo-Cazurra (2006) argues that investors who have been exposed to bribery at home will not be deterred by corruption abroad, but instead seek countries where corruption is prevalent. The similarities in the conditions of the institutional environment induce these investors to focus their FDI there. Indeed, Cheung et al. (2012b) report that China invests in countries in Africa with a high level of corruption. We will test whether this also holds for engineering projects. Cheung et al. (2012b) find also that countries with a poor system of law and order receive less ODI from China. This is in line with the general view that a poor institutional environment deters foreign investment (Globerman and Shapiro, 2002). We will examine whether this holds for engineering projects as well.

> *Hypothesis* 11: China has more contracted engineering projects with African countries that are corrupt.

> *Hypothesis* 12: China has more contracted engineering projects with African countries with better institutions.

To capture corruption, we include a variable $Corruption_{it-1}$ provided by ICRG. The ICRG data is based on perceived corruption by a panel of experts. The level of corruption is expressed on a scale between zero and six, where a higher score means less corruption. The expected sign is negative. Although there are many proxies available for measuring corruption, this index is the only one that is available for a long period

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of time for many countries and that has been constructed in a consistent way (Seldadyo and De Haan, 2011). To capture governance we include the $LawandOrder_{it-1}$ index of ICRG. This indicator assesses (on a six point scale) the strength and impartiality of the legal system (the law component) as well as popular observance of the law (the order component). The expected sign of this variable is positive.

Finally, we examine whether China prefers to initiate engineering projects in countries that are politically stable. There is some evidence that Chinese ODI focuses on politically stable countries (cf. Cheung et al., 2012b). However, Ramasamy et al. (2012) conclude that Chinese investments are attracted to countries that are politically unstable.

> *Hypothesis* 13: China has more contracted engineering projects with African countries that are politically stable.

For testing Hypothesis 13, we use the variable $Instability_{it-1}$. This is constructed as the first principal component of a number of indicators of political instability: assassinations, general strikes, guerrilla warfare, government crises, purges, riots, revolutions and anti-government demonstrations as provided by Databanks (2010). The expected sign is negative.

## 3. Empirical Results

As our data on China's contracted engineering projects is highly skewed, we scaled the data by the host country's population and express it in logarithms. Since there are observations that have a value of zero, we use a standard log transformation method suggested by Eichengreen and Irwin (1995) to avoid dropping those zero valued observations that result from logarithm operation.[9]

We use the following regression specification:

$$Proj_{it} = \alpha_o + \beta_1 ECI_{it-1} + \beta_2 POL_{it-1} + \beta_3 ICC_{it-1} + c_i + \beta_4 Trend + u_{it} \quad (1)$$

*ECI* is a vector of variables representing the economic motives behind China's contracted engineering projects in Africa, while *POL* is a vector of variables showing the political ties between China and the host country, and *ICC* is a vector of variables describing the host country's characteristics. $c_i$ is the unobserved country-fixed effect while *Trend* is the time trend. To avoid endogeneity problems, we use the lagged value for most of the explanatory variables.

Table 2 presents the results for the period 1991–2010. We test the three groups of hypotheses first separately. We take the significant variables as identified in each round of regressions and then use a general-to-specific approach to come up with our final model. Column (1) of Table 2 shows the results for the economic determinants, excluding $RISK_{it-1}$ and $AODI_{it-1}$ as these variables reduce sample size most. In column (2) we include $RISK_{it-1}$, which reduces the sample size to 33 countries. Since including $AODI_{it-1}$, i.e. the stock of approved ODI, further reduces the sample to 25 countries and the sample period to 1991–2005, we test the hypothesis of China's ODI in section 4 after we have decided upon our preferred model specification using the unrestricted sample. Columns (3) and (4) show results for the second and third groups of variables, i.e. the political determinants and the host-country characteristics. In column (5), we include all variables that are significant. Column (6) shows the results following the general-to-specific approach.

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*Table 2. Empirical Results using the Largest Possible Sample for Each Regression*

| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* |
|---|---|---|---|---|---|---|
| $RGDPpc_{it-1}$ | 1.340*** | 1.170** | | | 0.775** | |
| | (0.304) | (0.443) | | | (0.355) | |
| $Engy_{it-1}$ | –0.002 | 0.022 | | | | |
| | (0.011) | (0.019) | | | | |
| $Min_{it-1}$ | –0.005 | 0.020 | | | | |
| | (0.025) | (0.029) | | | | |
| $Trade_{it-1}$ | 4.288** | 5.670** | | | 5.863*** | 6.154*** |
| | (1.864) | (2.354) | | | (2.002) | (2.016) |
| $RISK_{it-1}$ | | 0.044 | | | | |
| | | (0.037) | | | | |
| $UNvoting_{it-1}$ | | | –0.101 | | | |
| | | | (0.391) | | | |
| $Taiwan_{it-1}$ | | | –0.550* | | –0.386 | |
| | | | (0.311) | | (0.269) | |
| *Forum2000* | | | –0.181 | | –0.259** | –0.083 |
| | | | (0.119) | | (0.112) | (0.138) |
| *Forum2003* | | | 0.292*** | | 0.015 | 0.076 |
| | | | (0.105) | | (0.123) | (0.100) |
| *Forum2006* | | | 0.623*** | | 0.453*** | 0.526*** |
| | | | (0.110) | | (0.117) | (0.129) |
| *Forum2009* | | | 0.364*** | | 0.131 | 0.212 |
| | | | (0.128) | | (0.155) | (0.142) |
| $Democracy_{it-1}$ | | | | –0.035 | | |
| | | | | (0.022) | | |
| $Military_{it-1}$ | | | | 0.212*** | 0.127* | 0.170** |
| | | | | (0.077) | (0.064) | (0.073) |
| $Corruption_{it-1}$ | | | | 0.043 | | |
| | | | | (0.092) | | |
| $LawandOrder_{it-1}$ | | | | –0.148** | –0.051 | |
| | | | | (0.065) | (0.075) | |
| $Instability_{it-1}$ | | | | –0.019 | | |
| | | | | (0.041) | | |
| *Trend* | 0.103*** | 0.100*** | 0.079*** | 0.158*** | 0.091*** | 0.076*** |
| | (0.012) | (0.015) | (0.016) | (0.017) | (0.020) | (0.016) |
| *Constant* | –7.94*** | –7.419** | 0.770* | –0.336 | –4.575** | –0.184 |
| | (1.822) | (2.710) | (0.389) | (0.399) | (2.222) | (0.244) |
| Obs. | 831 | 603 | 933 | 703 | 612 | 639 |
| $R^2$ | 0.542 | 0.594 | 0.442 | 0.520 | 0.625 | 0.594 |
| No. of id | 45 | 33 | 52 | 37 | 33 | 34 |

*Notes*: Fixed-effect estimator is used in all models. Robust standard errors are in parentheses. ***,**,*Denote significance at the 1%, 5% and 10% levels, respectively.

As the availability of the data differs per variable, the number of observations in each column of Table 2 differs. Following the same set-up as Table 2, Table 3 shows the results if we restrict the sample to the 33 countries and years (1991–2010) for which all required data are available.

Our results suggest that some economic determinants play an important role in driving China's contracted engineering projects in Africa. First of all, the host cou-

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*Table 3. Empirical Results using Only Those Countries for which All Data Are Available*

| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* |
|---|---|---|---|---|---|---|
| $RGDPpc_{it-1}$ | 1.358** | 1.183** | | | 0.828* | 0.817* |
| | (0.530) | (0.495) | | | (0.431) | (0.432) |
| $Engy_{it-1}$ | 0.029 | 0.029 | | | | |
| | (0.022) | (0.022) | | | | |
| $Min_{it-1}$ | 0.021 | 0.027 | | | | |
| | (0.024) | (0.024) | | | | |
| $Trade_{it-1}$ | 5.528** | 5.370** | | | 5.543*** | 5.769*** |
| | (2.482) | (2.455) | | | (1.986) | (2.046) |
| $RISK_{it-1}$ | | 0.046 | | | | |
| | | (0.039) | | | | |
| $UNvoting_{it-1}$ | | | 1.382** | | 1.127** | 1.111** |
| | | | (0.521) | | (0.496) | (0.480) |
| $Taiwan_{it-1}$ | | | –0.294 | | | |
| | | | (0.263) | | | |
| *Forum2000* | | | –0.118 | | –0.198 | –0.166 |
| | | | (0.127) | | (0.121) | (0.128) |
| *Forum2003* | | | 0.098 | | –0.049 | –0.0119 |
| | | | (0.126) | | (0.140) | (0.124) |
| *Forum2006* | | | 0.699*** | | 0.486*** | 0.506*** |
| | | | (0.127) | | (0.106) | (0.108) |
| *Forum2009* | | | 0.283 | | 0.160 | 0.184 |
| | | | (0.170) | | (0.173) | (0.174) |
| $Democracy_{it-1}$ | | | | –0.038* | –0.016 | |
| | | | | (0.022) | (0.016) | |
| $Military_{it-1}$ | | | | 0.233** | 0.150** | 0.127* |
| | | | | (0.087) | (0.061) | (0.064) |
| $Corruption_{it-1}$ | | | | 0.065 | | |
| | | | | (0.077) | | |
| $LawandOrder_{it-1}$ | | | | –0.124* | –0.058 | |
| | | | | (0.063) | (0.064) | |
| $Instability_{it-1}$ | | | | –0.013 | | |
| | | | | (0.047) | | |
| *Trend* | 0.088*** | 0.089*** | 0.093*** | 0.160*** | 0.094*** | 0.080*** |
| | (0.014) | (0.014) | (0.015) | (0.018) | (0.025) | (0.018) |
| *Constant* | –8.220** | –7.502** | –0.796* | –0.586 | –5.965** | –5.896** |
| | (3.194) | (3.012) | (0.430) | (0.444) | (2.583) | (2.565) |
| Obs. | 570 | 570 | 570 | 570 | 570 | 570 |
| $R^2$ | 0.560 | 0.563 | 0.522 | 0.489 | 0.594 | 0.592 |
| No. of id | 33 | 33 | 33 | 33 | 33 | 33 |

*Notes*: Fixed-effect estimator is used in all models. Robust standard errors are in parentheses. ***,**,*Denote significance at the 1%, 5% and 10% levels, respectively.

ntry's GDP turns out to be significant in most of the models. Although it is insignificant in the final model when the unrestricted sample is concerned, it remains significant through all the models when the restricted sample is used. Thereby the results provide some support for Hypothesis 1. Likewise, trade often comes up significantly, thereby providing support for Hypothesis 4. The other hypotheses in the first category are not supported by our findings. Notably the insignificance of the abun-

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dance of natural resources of the host country is quite remarkable, as there is some evidence suggesting that Chinese ODI flows more to resource-rich countries in Africa.

Our results also provide some support for the role of political factors: in the restricted sample (in Table 3), the more countries vote in line with China in the UN, the more contracted engineering projects they receive. Recognizing Taiwan as a state drives away China's contracted engineering projects. Also the Forum conferences turn out to be significant, thereby providing support for Hypothesis 8. Jointly, the coefficients of the Forum dummies are significant, and also the coefficients of some conferences, notably the 2006 one, turn out to be positive and significant.

Finally, our results do not provide much support that host-country characteristics matter. The only significant factor is $Military_{it-1}$, i.e. the military's participation in politics. Our results suggest that countries with less military participation in politics receive more contracted engineering projects. $LawandOrder_{it-1}$ is marginally significant, suggesting that countries with poor legal institutions get more projects. However, other host-country characteristics that determine China's ODI in Africa according to previous studies, like corruption and political instability, do not affect China's engineering projects in Africa. It suggests that when contracted engineering projects are concerned, the non-interference policy is implemented more thoroughly.

## 4. Additional Results

*Hypotheses*

This section reports the results of two tests. First, it reports the outcomes for Hypothesis 4, i.e. do countries which have received a lot of Chinese ODI also receive more engineering projects from China? Second, we examine whether the lack of infrastructure in the host country has an impact on China's engineering projects. The results are reported in Table 4.

In column (1), $AODI_{it-1}$ is added to the model specification of column (6) in Table 2 with the sample period narrowed to 1991–2005. To control for the additional change in the construction of the ODI stock in 2007, a dummy variable for that year (*Year2007*), and the interaction with the stock of ODI and this dummy ($NWODI_{it-1} \times Year2007$) are included in column (2). This further restricts the sample period to 2003–2010. The same regressions are shown in columns (4) and (5), but now for the restricted sample of countries as used in Table 3. In our previous work, we found that contracted engineering projects affect Chinese ODI in Africa. Our findings here are consistent with the view that projects affect ODI, but not the other way around.

In columns (3) and (6) we add an indicator of the amount of infrastructure in a country to examine whether our results change if we control for this variable. Our indicator, $PavedRoad_{it-1}$, is the percentage of paved road over total roads and is taken from the WDI dataset. The fact that it is insignificant shows no support for the hypothesis that countries that need more infrastructures receive more contracted engineering projects from China. Possible explanations are that those countries lack the basic infrastructures which make engineering projects profitable for Chinese contractors, or that they do not have sufficient funds to finance the projects.

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*Table 4. Additional Results (Including the Stock of ODI and the Stock of Infrastructure)*

| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* |
|---|---|---|---|---|---|---|
| $RGDPpc_{it-1}$ | | | | 0.326 | 2.229 | 0.085 |
| | | | | (0.366) | (1.377) | (0.582) |
| $Trade_{it-1}$ | 4.006*** | 2.277 | 4.773** | 3.681** | 1.803 | 4.739** |
| | (1.302) | (1.417) | (2.295) | (1.391) | (1.948) | (2.271) |
| $Military_{it-1}$ | 0.134** | 0.084 | 0.074 | 0.118* | 0.062 | 0.062 |
| | (0.064) | (0.121) | (0.072) | (0.062) | (0.112) | (0.070) |
| $UNvoting_{it-1}$ | | | | 1.204** | 0.430 | 1.624** |
| | | | | (0.518) | (1.352) | (0.608) |
| *Forum2000* | –0.074 | | –0.043 | –0.092 | | –0.100 |
| | (0.153) | | (0.157) | (0.162) | | (0.163) |
| *Forum2003* | 0.296** | | –0.112 | 0.244* | | –0.090 |
| | (0.128) | | (0.200) | (0.125) | | (0.187) |
| *Forum2006* | | 0.404* | 0.699*** | | 0.542* | 0.658** |
| | | (0.225) | (0.253) | | (0.281) | (0.263) |
| *Forum2009* | | 0.115 | 0.441 | | 0.187 | 0.482 |
| | | (0.250) | (0.282) | | (0.269) | (0.348) |
| $AODI_{it-1}$ | –0.029 | | | –0.026 | | |
| | (0.120) | | | (0.116) | | |
| $NWODI_{it-1} \times Year2007$ | | 0.049 | | | 0.071 | |
| | | (0.117) | | | (0.121) | |
| *Year2007* | | 0.290 | | | 0.350* | |
| | | (0.187) | | | (0.199) | |
| $PavedRoad_{it-1}$ | | | 0.007 | | | 0.011 |
| | | | (0.008) | | | (0.006) |
| *Trend* | 0.076*** | 0.091 | 0.077*** | 0.077*** | –0.041 | 0.075*** |
| | (0.026) | (0.105) | (0.020) | (0.025) | (0.151) | (0.020) |
| *Constant* | –0.014 | 0.122 | –0.055 | –2.963 | –12.14 | –1.960 |
| | (0.209) | (1.584) | (0.308) | (2.500) | (8.057) | (3.632) |
| Obs. | 350 | 217 | 329 | 344 | 185 | 294 |
| $R^2$ | 0.398 | 0.418 | 0.559 | 0.409 | 0.399 | 0.534 |
| No. of id | 25 | 32 | 34 | 25 | 32 | 32 |

*Notes*: Fixed-effect estimator is used in all models. Robust standard errors are in parentheses. ***,**,*Denote significance at the 1%, 5% and 10% levels, respectively.

### *Estimates usingthe Generalized Method of Moments (GMM) System*

In the previous section, we take the easy way to use the lagged one-year explanatory variables to deal with the possible reverse causality and endogeneity issues. Another common method to deal with endogeneity is using instruments for endogenous variables. Thus, for the sake of robustness of our results, we use the generalized method of moments (GMM) system estimator, developed by Arellano and Bover (1995) and Blundell and Bond (1998) to check our results again in this section. The results are reported in Table 5.

Column (1) reports the specific model we derived using the FE estimator for the full sample (i.e. column (6) in Table 2). Columns (2) and (3) apply the GMM system to the model in column (1). We assume most explanatory variables to be endogenous in column (2), while in column (3), we assume variables of *ECI* to be endogenous (e.g. $Trade_{it-1}$) and variables in *POL* and *ICC* to be predetermined (i.e. $Military_{it-1}$).

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*Table 5. Robustness Checks using GMM Estimator*

| | (1) Full Sample FE | (2) Full Sample Sys-GMM | (3) Full Sample Sys-GMM | (4) Restricted Sample FE | (5) Restricted Sample Sys-GMM | (6) Restricted Sample Sys-GMM |
|---|---|---|---|---|---|---|
| $RGDPpc_{it-1}$ | | | | 0.817* | –0.084 | –0.109 |
| | | | | (0.432) | (0.551) | (0.326) |
| $Trade_{it-1}$ | 6.154*** | 6.181* | 6.909** | 5.769*** | 8.176*** | 8.946*** |
| | (2.016) | (3.089) | (3.335) | (2.046) | (2.523) | (2.566) |
| $UNvoting_{it-1}$ | | | | 1.111** | –2.067 | 0.178 |
| | | | | (0.480) | (3.332) | (0.543) |
| $Military_{it-1}$ | 0.170** | 0.0720 | 0.143 | 0.127* | 0.151 | 0.240* |
| | (0.073) | (0.137) | (0.157) | (0.064) | (0.129) | (0.141) |
| *Forum2000* | –0.083 | –0.046 | –0.018 | –0.166 | –0.207 | –0.148 |
| | (0.138) | (0.135) | (0.134) | (0.128) | (0.219) | (0.118) |
| *Forum2003* | 0.076 | 0.052 | 0.052 | -0.012 | 0.112 | 0.007 |
| | (0.100) | (0.087) | (0.086) | (0.124) | (0.173) | (0.086) |
| *Forum2006* | 0.526*** | 0.540*** | 0.530*** | 0.506*** | 0.366** | 0.425*** |
| | (0.129) | (0.116) | (0.100) | (0.108) | (0.138) | (0.098) |
| *Forum2009* | 0.212 | 0.235 | 0.208 | 0.184 | 0.0597 | 0.164 |
| | (0.142) | (0.169) | (0.166) | (0.174) | (0.216) | (0.180) |
| *Trend* | 0.076*** | 0.075*** | 0.070*** | 0.079*** | 0.087*** | 0.083*** |
| | (0.016) | (0.018) | (0.018) | (0.018) | (0.024) | (0.017) |
| *Constant* | –0.184 | 0.102 | –0.094 | –5.896** | 1.998 | 0.0838 |
| | (0.244) | (0.357) | (0.422) | (2.565) | (5.423) | (1.877) |
| Obs. | 639 | 639 | 639 | 570 | 570 | 570 |
| $R^2$ | 0.594 | | | 0.592 | | |
| No. of id | 34 | 34 | 34 | 33 | 33 | 33 |
| Arellano–Bond test: AR(1) | | 0.000 | 0.000 | | 0.000 | 0.001 |
| Arellano–Bond test: AR(2) | | 0.439 | 0.467 | | 0.128 | 0.215 |
| Sargan test | | 0.193 | 0.370 | | 0.481 | 0.554 |
| Hansen test | | 0.300 | 0.469 | | 0.811 | 0.831 |

*Notes*: Two-step GMM system estimator is used here. *Forum2000–Forum2009* and *Trend* are treated as exogenous while the rest explanatory variables were treated as endogenous variables in columns (2) and (5). $UNvoting_{it-1}$ and $Military_{it-1}$ are treated as predetermined variables in columns (3) and (6). For endogenous variables, two-periods lags were used as instruments in the first-difference equations and their once lagged first-differences were used in the levels equation. For predetermined variables one-period lags were used as instruments in the first-difference equations and their first-differences were used in the levels equation. The set of instruments are collapsed to limit instrument proliferation. Robust standard errors are corrected for small-sample bias using Windmeijer's (2005) approach and reported in parentheses. ***,**,*Denote significance at the 1%, 5% and 10% levels, respectively.

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The reason that we consider variables in both POL and ICC as predetermined variables is that political and institutional factors are less likely to encounter reverse causality issue. The data on political and institutional factors are usually survey data, which are the numerical records of surveyed people's perception about the existing political and institutional quality. Thus, it is plausible that those data are predetermined. Nevertheless, as shown in columns (2) and (3), the results are very similar.

Comparing the results in columns (2) and (3) with those in column (1), the results are almost identical as well, except that $Military_{it-1}$ becomes insignificant, but its sign is still positive.

We now turn to the system GMM estimation based on the restricted sample data. Column (4) reports the results of the FE estimates for the restricted sample (i.e. column (6) in Table 3). The model is re-estimated with GMM in columns (5) and (6). In column (3), we assume that all explanatory variables are endogenous except the forum dummies and trend variable, while in column (4) we consider variables in *POL* and *ICC* to be predetermined (i.e. $Military_{it-1}$ and $UNvoting_{it-1}$). Once again, the results in columns (3) and (4) are very similar to those in column (1) of Table 3, except that the real GDP per capita turns insignificant. All models using system GMM passed the Arellano–Bond test and the Sargan–Hansen test of over-identification, indicating that our model specification is appropriate.

## 5. Discussion and Conclusions

Table 6 shows the hypotheses tested and our findings. In addition, the table compares our results for China's engineering projects in Africa with our previous findings for Chinese ODI in Africa. Engineering projects and ODI are both attracted to African countries that have large market potential (at least in the restricted sample), deep trade ties with China and are political allies. Although Cheung et al. (2012b) find that

*Table 6. Outcomes and Comparison with Results on ODI*

| *Hypothesis* | *Expected sign* | *Estimation results* | *Comparison with ODI* |
|---|---|---|---|
| 1. Market potential | + | + | + |
| 2. Natural resources | + | | + |
| 3. Trade | + | + | + |
| 4. Chinese ODI | + | | |
| 5. Risk level | + | | + |
| 6. Political allies | + | + (in line with China) | + (–, in line with the USA) |
| 7. Taiwan recognition | – | | |
| 8. Forum on China-Africa Cooperation | + | + | |
| 9. Autocracy | – | | – |
| 10. Military participation in politics | + | + | |
| 11. Corruption | – | | – |
| 12. Quality of institutions | + | | – |
| 13. Politically stability | + | | – |

*Notes*: In Cheung et al. (2012b), the data on UN General Assembly voting in line with China was not available. Thus, they used the data on voting in line with the USA as the opposite of voting in line with China. The negative coefficient was expected there.

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the role of being a political ally of China is negligible after 2002 for Chinese ODI in Africa it is significant for engineering projects where all data concerned is available for the whole period from 1991 to 2010.

There are also several factors that influence engineering projects but do not affect ODI. Conferences under the aegis of the Forum on China–Africa Cooperation promote engineering projects in Africa, especially the Forum in year 2006. The reason for Forum 2006 to stand out could be the establishment the China–Africa Development Fund, which eases the financial burden for African countries to take on projects from China. Another reason could be the issuing of "China's African Policy".

Another distinctive feature is the negative impact from the degree of military participation in politics. A high degree of military participation in politics implies policy distortions and a high level of political risk, which makes engineering projects less attractive. As to host-country characteristics, the significant determinants of ODI, i.e. level of corruption, political stability and institutional quality, do not influence engineering projects. Engineering projects are also not driven by the resource-seeking motive, the lack of infrastructure of the host country and the stock of ODI from China.

Our study shows that although there are some common determinants of China's ODI and contracted engineering projects in Africa, the drivers of engineering projects are not the same as those of ODI projects. Engineering projects are more motivated by economical and political factors but less influenced by host-country characteristics.

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## Notes

1. Several papers, including Cheung and Qian (2009), Kolstad and Wiig (2012) and Ramasamy et al. (2012), examine China's FDI in general and do not focus on its involvement in Africa.
2. The Forum on China–Africa Cooperation (FOCAC) is an official forum between the People's Republic of China and countries in Africa. There have been four summits held to date; the most recent one was in November 2009 in Sharm el-Sheikh (Egypt). Previous summits were held in October 2000 in Beijing, December 2003 in Addis Ababa and November 2006 in Beijing.
3. Reported by John Vandaele, "China Outdoes Europeans in Congo," InterPress Service (Johannesburg), 8 February 2008.
4. *China External Economic Statistical Yearbooks* are published from 1994 (providing data for 1991–1993) to 2005. From 2006 onwards, it was merged into *China Trade and External Economic Statistical Yearbooks*. We use contract value to show how Chinese contractors make their decisions based on the current condition of the host country.
5. http://www.fmprc.gov.cn/zflt/eng/zyzl/hywj/t157710.htm.
6. http://www.focac.org/eng/zfgx/dfzc/t481748.htm.
7. Five Principles, see http://www.fmprc.gov.cn/eng/topics/seminaronfiveprinciples/t140777.htm.
8. China–Africa Development fund: http://www.cadfund.com/en/NewsInfo.aspx?NId=80.
9. The Eichengreen and Irwin (1995) method transforms a variable, $y$, into its logarithm value in a way such as $\ln y = \ln (y + 1)$. In our case, $y$ is $Proj_{it}$, the annual contracts signed value for foreign engineering projects per capita in US dollars. By doing this, it allows us to keep as many observations as possible.

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