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The effectiveness of aid under post-conflict conditions: A sector-specific analysis

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KIEL WORKING PAPER

**The Effectiveness of Aid
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A photograph showing a close-up of hands working at a desk. One hand is holding a yellow sticky note, while the other is resting on the desk. There are several other yellow sticky notes scattered around, along with a black marker and a white notebook. The background is slightly blurred, showing more of the desk and the person's arms.

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Julian Donaubauer, Dierk Herzer, and Peter Nunnenkamp

ABSTRACT

THE EFFECTIVENESS OF AID UNDER POST- CONFLICT CONDITIONS: A SECTOR-SPECIFIC ANALYSIS*

Julian Donaubauer, Dierk Herzer, and Peter Nunnenkamp

It is widely believed that foreign aid may help conflict-affected countries to recover after the settlement of conflicts. However, the available empirical evidence supporting this view largely neglects the heterogeneous nature of aid. Drawing on the conflict database of the Uppsala Conflict Data Program, we address the hypothesis that the effectiveness of post-conflict aid differs between specific sectors. Our focus is on social and economic infrastructure which is most likely to suffer during conflict episodes so that the need for aid is particularly pressing in this area. We find fairly robust evidence that post-conflict aid is effective in improving social infrastructure. In contrast, aid appears to be ineffective in improving economic infrastructure.

Keywords: aid effectiveness, civil conflict, social infrastructure, economic infrastructure

JEL classification: F35; O18

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1. Introduction

Collier and Hoeffler (2004) have shown that post-conflict episodes are characterized by a brief phase of supra-normal GDP growth. Furthermore, they provide evidence that foreign aid granted after the resolution of previous conflicts has helped achieve this supra-normal growth. They find that supra-normal growth cannot be attributed to automatic ‘bounce-back’ once conflicts are settled: “In the absence of aid there would be little or no growth spurt” (page 1135).

Since Collier and Hoeffler’s (2004) pioneering study it is widely believed that foreign aid is particularly effective under post-conflict conditions, even though the general effectiveness of aid continues to be debated.¹ So-called “fragile states have become increasingly important to development and security agendas since the early 2000s” (Smith Ellison 2016: 467:9). Foreign aid to conflict-affected and fragile states increased considerably from 29 percent of total aid in 1996-1998 to 41 percent in 2006-2008 (World Bank 2011).² The OECD’s Development Assistance Committee (DAC) established an International Network on Conflict and Fragility in 2009, and recent reports discussed at great length the “patterns and trends in the international architecture that affect its ability to respond effectively in fragile and violence-prone settings” (World Bank 2011: 181).³ The New Deal for Engagement in Fragile States, endorsed by more than 40 fragile states and development partners at the High-Level Forum on Aid Effectiveness in Busan, Korea, in 2011, lists “timely and predictable aid” as one of the core elements.⁴

¹ See, e.g., Clemens et al. (2012) versus Rajan and Subramanian (2008).

² The World Bank (2011: 183) observes “a dizzying array of international and bilateral aid and humanitarian agencies, NGOs, and contractors, each competing for a piece of the action” in high-profile contexts like Afghanistan, Bosnia and Herzegovina, and Haiti.

³ See also OECD (2012: 3): “The question ... is not whether to engage, but how to engage.”

⁴ For details, see: <https://www.pbsdialogue.org/en/new-deal/about-new-deal/> (accessed: October 27, 2016).

The influential contribution of Collier and Hoeffler (2004) to this process suffers from two shortcomings that we attempt to overcome in the present analysis. First of all, the heterogeneous nature of aid is not addressed. Collier and Hoeffler use aggregate aid inflows, while recent research suggests that the effectiveness of aid differs across sectors such as education or health in social infrastructure, transport or finance in economic infrastructure, or other sectors such as agriculture or the environment.⁵ Second, Collier and Hoeffler's conclusions are based on just a few (13-17, to be precise) post-conflict situations.⁶ Meanwhile, the increasing frequency of conflicts and subsequent settlements documented by the Uppsala Conflict Data Program (UCDP) and the International Peace Research Institute in Oslo (PRIO) (Gleditsch et al. 2002; Pettersson and Wallensteen 2015) allows us to base our empirical analysis on a much broader set of post-conflict situations (58 in our baseline estimations).⁷

We draw on this rich UCDP/PRIO conflict database in order to address the hypothesis that the effectiveness of post-conflict aid differs between specific sectors. Our focus is on social and economic infrastructure. Infrastructure most likely suffers during conflict episodes so that the need for aid might be particularly pressing in these sectors once conflicts have been settled. Hence, we combine two additional data sources to assess the effectiveness of post-conflict aid at the sector level: The OECD's Creditor Reporting System provides reliable data on sector-specific commitments of aid since the mid-

⁵ See Section 2 for a more detailed discussion.

⁶ The authors themselves stress that "there is no doubt that our analysis is seriously constrained by the small number of post-conflict observations" (Collier and Hoeffler 2004: 1127).

⁷ Moreover, the database provides detailed information on major characteristics of previous conflicts, including the duration of conflicts, the number of conflict-related deaths, the cause of conflicts (the so-called contested incompatibility that concerns government and/or territory), and the internationalization of internal conflicts. These characteristics are used below to test whether the effectiveness of post-conflict aid depends on the severity of previous conflicts.

1990s, while we mainly draw on the World Bank's World Development Indicators for specific measures on the need for aid with respect to social and economic infrastructure.⁸

The paper is structured as follows. Section 2 offers stylized facts on the development of infrastructure in conflict-affected developing countries and summarizes the relevant literature on aid and conflicts. We introduce our approach and variables of major interest in Section 3. Section 4 presents our empirical results, and we conclude in Section 5. We find fairly robust evidence that post-conflict aid is effective in improving social infrastructure. In contrast, aid appears to be ineffective in improving economic infrastructure.

2. Stylized facts and related literature

Drawing on the World Bank's (2012) World Development Report on Conflict, Security, and Development, Crost et al. (2014: 1833) note that "people living in conflict-affected countries are substantially more likely to be undernourished, less likely to have access to clean water and education, and face higher rates of childhood mortality." Table 1 corroborates this view by comparing conflict-affected countries (during periods of conflicts and peace) and unaffected countries with regard to eight indicators that have frequently been used in the literature to reflect the development of infrastructure.

We consider four indicators of social infrastructure (primary enrollment in education, maternal mortality, freedom from corruption, and access to safe water) and four indicators of economic infrastructure (air carrier departures, mobile cellular subscriptions, electric power consumption, and

⁸ Some indicators of infrastructure are taken from additional sources; see Section 2 and Appendix A for details.

credit to the private sector) that will also be used in the subsequent regression analysis.⁹ The results shown in Table 1 are based on simple regressions with conflict-related dummy variables plus year dummies to account for general trends in specific sectors of infrastructure. The underlying sample includes all aid recipient countries listed by the OECD's Development Assistance Committee.¹⁰ The sample consists of up to 64 conflict-affected countries which experienced at least one conflict episode with 25 or more conflict-related deaths and up to 64 countries which did not experience any conflict during the period of observation (1995-2014).¹¹

The ambiguous evidence in column (1) of Table 1 suggests that infrastructure is not generally worse in conflict-affected countries during the four years prior to the onset of conflicts.¹² While some sectors of infrastructure appear to be better developed in countries unaffected by conflicts throughout the period of observation, the opposite holds in some sectors of economic infrastructure. However, infrastructure typically worsens in conflict-affected countries during conflict episodes, compared to countries unaffected by conflicts (column 2).¹³ Negative gaps widen, particularly in sectors of social infrastructure; and negative gaps emerge in sectors of economic infrastructure where conflict-affected countries were in a relatively favorable position prior to the onset of conflicts.

Column (3) indicates that most gaps narrow again after the resolution of conflicts.¹⁴ In contrast to the pre-conflict period considered in column (1), however, infrastructure is generally worse under post-conflict conditions than in countries unaffected by conflicts throughout the period of observation. In

⁹ See Appendix A for detailed definitions and sources. All indicators are normalized to make them comparable. Higher values within the range of 0-100 point to better developed infrastructure. Note that maternal mortality (plus some alternative indicators used in robustness tests) had to be multiplied by minus one to ensure that higher values of all indicators point to better developed infrastructure.

¹⁰ However, the number of observations differs across sectors depending on data availability for the specific indicator.

¹¹ The criterion of at least 25 conflict-related deaths is used by UCDP/PRIO to define a conflict.

¹² The dummy variable would have to be significantly negative in all sectors if conflict-affected countries generally compared unfavorably with countries unaffected by conflicts throughout the period of observation.

¹³ The transport sector represents the only exception.

¹⁴ Freedom of corruption represents a striking exception in this regard.

other words, the settlement of active conflicts is not necessarily sufficient for conflict-affected countries to offset the intermediate deterioration of infrastructure, relative to countries unaffected by conflicts. This is corroborated when testing for significant differences in conflict-affected countries between times of active conflicts and post-conflict episodes. As can be seen in column (4), the post-conflict dummy proves to be statistically insignificant in four sectors; the dummy is even significantly negative when considering freedom from corruption and credit to the private sector as indicators of infrastructure. Infrastructure significantly improves only in the health and energy sectors after conflicts are settled.

Arguably, the restoration of infrastructure is crucially important for sustained post-conflict recovery. For instance, the World Bank (2011: 160) notes that “based on the World Bank Group’s Enterprise Surveys, the number one business environment constraint faced by firms working in conflict areas is the lack of electricity.” Road rehabilitation is stated as another infrastructure investment “critical to both private sector recovery and employment generation” (page 161). Given that countries tend to have exceptional financial needs for rebuilding infrastructure after the settlement of conflicts, it is obviously relevant whether foreign aid could help meet this challenge.¹⁵ All the same, this issue has received scant attention so far.

Some studies focus on the question of whether foreign aid helps sustain peace after the settlement of conflicts.¹⁶ The evidence is ambiguous. Using survival analysis, Duponchel (2008) finds that aid

¹⁵ Quinn et al. (2007: 189) call for international investment in post-conflict economic development in order “to inoculate a nation against civil war recurrence.” Kang and Meernik (2005: 106) argue that foreign aid is “certainly essential” to rebuild infrastructure.

¹⁶ Another important strand of the literature, though less important in the context of our analysis, assesses the question of whether aid increases or reduces the risk of conflicts to break out and the effects of aid on the duration of conflicts. Earlier theoretical models predict that aid renders conflicts more likely (Grossman 1992; Azam 1995). However, this view has been challenged both theoretically and empirically; see for example: Collier and Hoeffler (2002), de Ree and Nillesen (2009), Nielsen et al. (2011), and Savun and Tirone (2011). Assessing the effects of a large aid program on conflict in the

increases the duration of post-conflict peace, though with decreasing returns to scale. In contrast, the descriptive evidence for recent post-conflict episodes in Nunnenkamp (2016) suggests that the frequency of sustained peace over eight years differed only modestly between countries with high or low post-conflict aid inflows. Evaluating World Bank projects under post-conflict conditions, Flores and Nooruddin (2009b) find no systematic effect on the recurrence of conflicts once non-random selection is controlled for. However, a field experiment in Liberia suggests that post-conflict aid strengthens social cohesion at the local level (Fearon et al. 2009).

The economic effects of post-conflict aid have attracted little attention after Collier and Hoeffler's (2004) finding of positive growth effects of post-conflict aid (see Section 1). Garriga and Phillips (2014) regard aid as a signal to private investors to predict foreign direct investment (FDI) in post-conflict countries. Indeed, they find that aid helps attract FDI as long as aid granted to post-conflict countries is not perceived to be motivated by geostrategic donor interests. Flores and Nooruddin (2009a) focus on the potential dilemma between democratization and economic recovery under post-conflict conditions. In addition to showing that democratization tends to retard the recovery of GDP per capita, they qualify the role of aid for economic recovery. Specifically, the timing of aid appears to matter: aid provided only in later phases of post-conflict episodes even increases time to recovery.¹⁷ In some contrast, Kang and Meernik (2005: 106) conclude that their results on the determinants of economic recovery are "largely in line with Collier and Hoeffler's arguments on the role of foreign aid." More closely related to our analysis below, Girod (2012) assesses the role of aid for reducing infant mortality

Philippines, Crost et al. (2014) find an increase in conflict-related casualties in barely eligible municipalities, compared to barely ineligible municipalities, since insurgents try to sabotage the program. Focusing on humanitarian aid, Nunn and Qian (2014: 1630) find that "an increase in US food aid increases the incidence and duration of civil conflicts, but has no robust effect on interstate conflicts or the onset of civil conflicts." In contrast to the large number of studies on aid as a determinant of conflict, Balla and Reinhardt (2008) assess the impact of conflicts on the aid allocation of bilateral donors, regarding conflicts as part of the donors' strategic aid motives.

¹⁷ See also Flores and Nooruddin (2009b) who find that the World Bank's post-conflict aid has no systematic effect on economic recovery.

after the settlement of conflicts. She finds aid to be effective, though only in recipient countries with low strategic importance to donors and low income from resource rents. It remains open to question, however, whether aid is particularly effective under post-conflict conditions in achieving specific objectives such as a reduction in infant mortality.¹⁸

The studies on post-conflict recovery typically use aggregate aid flows.¹⁹ This is a serious limitation when it comes to specific outcome variables such as social and economic infrastructure. Flores and Nooruddin (2009b) explicitly call for more finely grained outcome variables and sector-specific analyses. The need for “distinctive sectoral intervention” is also stressed by Chauvet et al. (2010: 19).²⁰ Indeed, sector-specific studies suggest that the effectiveness of aid in achieving specific objectives differs even under normal conditions in aid recipient countries. On the one hand, several studies find that aid for education is quite effective under normal conditions to improve sector-specific outcome variables such as primary enrollment ratios (e.g., Dreher et al. 2008; Christensen et al. 2011; D’Aiglepierre and Wagner 2013; Birchler and Michaelowa 2016). It also appears that democratic governance is effectively supported by targeted aid (Finkel et al. 2007; Kalyvitis and Vlachaki 2010).²¹ On the other hand, it is disputed whether aid for health is effective under normal conditions (e.g., Williamson 2008; Mishra and Newhouse 2009; Nunnenkamp and Öhler 2011). The evidence is equally ambiguous for aid targeted at economic infrastructure such as transportation and communication (Vijil

¹⁸ Girod (2012: 198) explicitly notes that the results are essentially the same for a larger sample of all developing countries, including those unaffected by conflicts.

¹⁹ Savun and Tirone (2011) provide an exception. They use democracy assistance to show that democratizing countries that receive high levels of aid are less likely to experience civil conflict. Girod (2012) uses aid in the health sector in a robustness test.

²⁰ According to Chauvet et al. (2010), World Bank projects targeting specific sectors such as transport and urban development are rated particularly successful under post-conflict conditions. See also Demekas et al. (2002: 21) who argue that “using total aid imposes a potentially significant bias on the empirical specification” by not differentiating between humanitarian and economic objectives of aid.

²¹ This is often called democracy aid; in the Creditor Reporting System, the corresponding sector is ‘Government and civil society.’

and Wagner 2012; Donaubauer et al. 2016; Donaubauer and Nunnenkamp 2016). Focusing on aid that donors classify to specifically address climate-related energy issues, Kretschmer et al. (2013) find aid to be effective in reducing the energy intensity of GDP, while it appears to be ineffective in reducing carbon emissions.

All these studies on the effectiveness of sector-specific aid do not differentiate between normal and post-conflict conditions in the aid recipient countries. However, it can reasonably be expected that the effectiveness of aid also differs across sectors under post-conflict conditions. Taken together, the discussion in this section leads to the following hypothesis:

Foreign aid can help improve the infrastructure in conflict-affected developing countries. However, this does not necessarily apply to all sectors of infrastructure. Specifically, post-conflict aid can be expected to be more effective in sectors of social infrastructure.

3. Method and variables

We estimate a parsimoniously specified baseline model to assess the effectiveness of post-conflict aid in improving social and economic infrastructure:

$$(1) \text{Change_infra}_{sjt} = \alpha + \beta \text{Aid}_{sjt} + \gamma \text{Postconf}_{jt} + \delta (\text{Aid}_{sjt} * \text{Postconf}_{jt}) + \epsilon \text{Infra_level}_{sjt-1} + \eta_{sj} + \theta_t + \mu_{ijt}$$

where η_{sj} are country-sector fixed effects, θ_t represent time dummies, and μ_{ijt} is the error term.²² The dependent variable is the rate of change of infrastructure in sector s and country j . Period t represents three-year moving averages to smooth the volatility of annual rates of change. We consider eight

²² Country-sector fixed effects account for time-invariant heterogeneity, while the time dummies capture temporal factors affecting all aid recipients in essentially the same way (e.g., shifts in donor priorities at the sector level). Reported standard errors are robust.

sectors of infrastructure. Social infrastructure comprises education, health, water and sanitation, and government and civil society; economic infrastructure comprises transport, communication, energy, and banking and finance. For each of these sectors, we select a preferred indicator reflecting the development of sector-specific infrastructure (see Appendix A, where we also list alternative indicators used in robustness tests). We perform panel regressions with all eight sectors included and, alternatively, with either the four sectors of social infrastructure or the four sectors of economic infrastructure included.

Sector-specific aid, *Aid*, represents our variable of principal interest on the right-hand side of equation (1). The above listed sectors of social and economic infrastructure relate exactly to the aid sectors of the OECD's Creditor Reporting System (<http://stats.oecd.org/index.aspx?DataSetCode=CRS1>). We use three-year moving averages of donor commitments of aid in these eight sectors, in percent of the recipient country's GDP, since disbursements of sector-specific aid suffered from serious under-reporting until recently. Under-reporting was an issue even for sector-specific commitments prior to the mid-1990s. Consequently, our period of observation is limited to 1995-2014.

Postconfl represents a dummy variable which is set to one for post-conflict episodes. In the baseline estimations, we set *Postconfl* to one once peace is sustained for four years after the settlement of conflicts.²³ In addition to *Aid* and *Postconfl* per se, we interact these two variables. The coefficient on this interaction term, δ , should prove to be significantly positive if post-conflict aid was effective in improving infrastructure under post-conflict conditions.

²³ We extend the required period of peace after the settlement of conflicts to eight years in our robustness tests. As noted before, UCDP/PRIO uses the criterion of at least 25 deaths to define a conflict prior to settlement. As detailed below, we modify this criterion in additional estimations.

Furthermore, we account for the lagged level of infrastructure in our baseline estimations (*Infra level*). We expect the coefficient ε to be significantly negative since better developed infrastructure in initial years should be associated with less positive changes of the dependent variable. We consider additional control variables in extended specifications of the baseline model in equation (1), including time-varying characteristics of aid recipient countries (population, GDP per capita, and democracy),²⁴ *Aid* in squared terms to test for diminishing returns to aid, and other types of aid.²⁵

Clearly, aid tends to be endogenous. On the one hand, reverse causality is an issue to the extent that donors grant more aid to needier recipient countries, e.g., in terms of deficient infrastructure. On the other hand, simultaneity is an issue to the extent that donors “pick winners” by granting aid primarily to recipient countries where governments are known to be development oriented (Flores and Nooruddin 2009b: 3). We address endogeneity concerns in several ways. First of all, we include fixed effects at the country-sector level in all our estimations to account for time-invariant heterogeneity. Second, we include several control variables in extended specifications to account for time-varying heterogeneity. Third, we focus on the differential impact of aid on infrastructure under post-conflict conditions. This resembles Clemens et al. (2012) who argue that differencing in combination with lagging the aid variable helps reduce endogeneity concerns. Finally, we perform additional estimations by using lagged inflows of other types of aid as instruments for our sector-specific aid variables.²⁶

²⁴ Data on population and GDP per capita are taken from the World Bank’s World Development Indicators. *Democracy* is a dummy variable set to one if a country was considered to be an electoral democracy in the respective year, and zero otherwise. Data are from Freedom House’s report on Freedom in the World (<https://freedomhouse.org/report-types/freedom-world>).

²⁵ Summary statistics are presented in Appendix B.

²⁶ See Section 4 for details.

4. Results

Baseline results: Table 2 reports our baseline results which are based on the parsimonious specification according to equation (1) in Section 3. As noted above, we control for unobserved (time-invariant) heterogeneity by accounting for fixed effects at the country-sector level. We also include time dummies which capture factors affecting the development of our indicators of infrastructure in all aid recipient countries in essentially the same way. For instance, the sectoral focus of aid donors shifted strongly towards social infrastructure in the second half of the 1990s and the early 2000s. In subsequent years, donors rebalanced their sectoral aid structure by increasing aid for economic infrastructure over-proportionately.²⁷

The panel regression shown in column (1) of Table 2 includes all eight sectors of (social and economic) infrastructure. The four sectors of social infrastructure are considered separately in column (2), while the four sectors of economic infrastructure are considered in column (3). For all three estimations, the lagged level of the sector-specific indicators of infrastructure (*Infra_level*) proves to be significantly negative at the one percent level. As was to be expected, positive (negative) changes in these indicators were stronger (weaker) when the lagged level was relatively low.

Turning to our variables of principal interest, the results in column (1) suggest that sector-specific aid, *Aid*, generally tends to be effective in improving infrastructure in the recipient countries.²⁸ At the same time, we find that social and economic infrastructure does not automatically improve once a conflict has been settled. The coefficient on the dummy variable *Postconfl*, reflecting sustained peace for four years after the end of a conflict, is statistically insignificant. While this appears to be in contrast to

²⁷ For details, see the OECD's Creditor Reporting System (<http://stats.oecd.org/index.aspx?DataSetCode=CRS1#>).

²⁸ As indicated before, however, this result could be due to donors granting aid primarily to recipient countries with governments being committed to economic and social development. We return to this issue below.

Collier and Hoeffler (2004) who reported supra-normal GDP growth under post-conflict conditions, the insignificant finding on *Postconfl* is in line with the stylized facts reported in Section 2, according to which few indicators of infrastructure improved significantly when comparing post-conflict situations with conflict episodes in aid recipient countries. However, the significantly positive interaction between *Postconfl* and *Aid* indicates that sector-specific aid is particularly effective in improving infrastructure under post-conflict conditions. In terms of quantitative impact, an increase in the aid-to-GDP ratio by one percentage point is associated with an improvement of infrastructure growth rates by roughly 2.7 percentage points.

Columns (2) and (3) reveal that the results on aid in all eight sectors are driven by the subset of four sectors of social infrastructure. *Aid* per se and its interaction with *Postconfl* prove to be significant at the five percent level for social infrastructure in column (2). The point estimate implies that an increase of *Aid* by one percentage point raises growth rates of social infrastructure by 1.6 percentage points in post-conflict situations. By contrast, we do not find aid to be effective in improving economic infrastructure. The insignificant coefficient on *Aid* in column (3) is in line with Donaubauer and Nunnenkamp (2016), who conclude from a difference-in-difference-in-differences analysis that aid for economic infrastructure has been ineffective. More interestingly, aid for economic infrastructure does not appear to be more effective under post-conflict conditions.

Robustness: The baseline results shown in Table 2 are fairly robust to the choice of indicators of infrastructure, the exclusion of specific sectors of social or economic infrastructure, and the exclusion of outliers with regard to our dependent variable (i.e., the change in indicators of infrastructure). All these robustness tests are summarized in Table 3. For the sake of brevity, we only report the coefficients on *Aid* and the interaction between *Aid* and *Postconfl*.

The choice of sector-specific indicators of infrastructure often involves conflicts between data availability and the validity of information on needs for aid. For instance, we prefer primary enrollment ratios over secondary enrollment ratios in the baseline estimations since the former indicator has substantially broader coverage, even though the latter indicator may be conceptually superior in reflecting needs for aid in the education sector. Hence, we test in the upper panel of Table 3 whether using alternative indicators affects our baseline results.²⁹ It is reassuring that the choice of indicators has little effect. For all eight sectors in column (1), the interaction term between *Aid* and *Postconfl* sometimes loses its statistical significance. Importantly, however, the striking difference between strongly effective aid in social infrastructure, particularly under post-conflict conditions, and ineffective aid in economic infrastructure holds when using alternative indicators.

The exclusion of specific sectors of social or economic infrastructure in the middle panel of Table 3 takes into account that our baseline results could be affected when the available information on needs in a particular sector is generally deficient. For instance, school enrollment rates cannot capture needs related to the quality of education. Hence, we replicate the estimations after dropping one sector at a time. Again, our major results hold. This applies especially for the different effects of post-conflict aid between social and economic infrastructure.³⁰

Our baseline results also carry over to the bottom panel of Table 3 after excluding outliers. The dependent variable takes some exceptionally large positive values. However, we lose only 400 out of 11,765 observations for all eight sectors when excluding changes in indicators above 100%. The loss of observations is marginal and restricted to sectors of economic infrastructure when applying higher

²⁹ Appendix A presents the complete lists of preferred and alternative indicators of sector-specific infrastructure.

³⁰ The only notable exception is that the interaction between *Aid* and *Postconfl* becomes significantly positive at the 10% level for economic infrastructure in column (3) when excluding the transport sector.

thresholds for the dependent variable. Consequently, the significantly positive results for aid in social infrastructure are unaffected when excluding only extreme outliers.

Sector-specific versus other aid: In Table 4, we return to the preferred indicators for all eight sectors of infrastructure. The aim in this step is to compare the effects of sector-specific aid with the effects of other types of aid (*Other aid*). *Other aid* is calculated as the difference between total aid flows to the recipient country minus aid flows in the particular sector; i.e., *Other aid* varies across sectors. We replace sector-specific aid by *Other aid* in columns (1), (3) and (5) of Table 4, while we enter both sector-specific aid (*Aid*) and *Other aid* simultaneously in columns (2), (4) and (6).

As can be seen, *Other aid* turns out to be statistically insignificant at conventional levels when included in the estimations instead of sector-specific aid. The interaction of *Other aid* with *Postconfl* is insignificant in column (1) for all eight sectors and in column (5) for economic infrastructure, while it is significantly positive at the 10% level in column (3) for social infrastructure.³¹ The considerably weaker evidence for *Other aid*, compared to sector-specific aid, is reassuring. Our analysis resembles previous studies on the effects of sector-specific aid (e.g., Clemens et al. 2012) by implicitly assuming that aid is not perfectly fungible. The contrast between significantly positive findings for sector-specific aid and insignificant results for *Other aid* suggests that this assumption is plausible.³²

What is more, our baseline results for *Aid* and its interaction with *Postconfl* are hardly affected when adding *Other aid* to the specification. Specifically, we again find sector-specific aid to be effective in improving social infrastructure, particularly under post-conflict conditions. The robustness of this result, in combination with the insignificant results for *Other aid* in column (4), reduces concerns that

³¹ However, the significant interaction term in column (3) no longer holds when including also sector-specific aid in column (4).

³² Our results are in line with the recent assessment of Morrissey (2015: 98) who concludes: “The extent to which aid is fungible is over-stated and even where it is fungible this does not appear to make the aid less effective.”

our baseline results are seriously biased due to simultaneity problems. In particular, if donors granted aid primarily to recipient countries with governments strongly committed to economic and social development, one would expect significantly positive results for *Other aid*, too. Nevertheless, we perform additional instrumental variables regressions in the following sub-section.

Instrumental variables estimation: Clemens et al. (2012) argue that attempts to control for the endogeneity of aid typically relied on invalid instruments. Given the difficulty of finding fully convincing instruments, we essentially followed Clemens et al.'s suggestion to focus on the differential impact of aid under post-conflict conditions. However, compared to the nexus between aggregate aid and economic growth, the instrumentation of sector-specific aid as a determinant of sector-specific outcomes may be somewhat easier. In the following, we use the first and second lags of *Other aid* as instruments to account for the potential endogeneity of sector-specific aid. The results of these 2SLS estimations are reported in Table 5.

As can be seen, both instruments prove to be relevant and exogenous. At the same time, we no longer find any positive effects of *Aid* per se on the change in economic and/or social infrastructure. Endogeneity concerns thus appear to be justified. It should also be noted that, in contrast to column (1) of Table 2, the interaction between *Postconfl* and *Aid* is no longer significant in column (1) of Table 5. Importantly, however, our findings from the baseline specification carry over when focusing on the differences between post-conflict aid in social and economic infrastructure: post-conflict aid in social infrastructure again proves to be strongly effective, while aid in economic infrastructure appears to be ineffective.

Extended period of peace and different conflict intensities: In Table 6, we consider an extended period of peace after conflicts have been settled. More precisely, we modify the post-conflict dummy by

setting it to one only when peace lasts for (at least) eight years, instead of four years. In this way, we account for the possibility that post-conflict aid may take time to become more effective in improving infrastructure, notably economic infrastructure. It should be noted in this context that Collier and Hoeffler (2004) find particularly strong growth effects of post-conflict aid 4-7 years after the settlement of conflicts. However, our baseline results could also become weaker by excluding shorter periods of peace given that post-conflict aid improves social infrastructure in the short run already.

Indeed, the effects of post-conflict aid in the four sectors of social infrastructure weaken somewhat in Table 6. The interaction between *Aid* and *Postconfl_ext* becomes less significant in column (3), and even insignificant at conventional levels when adding *Other aid* to the specification in column (4). At the same time, aid in the four sectors of economic infrastructure continues to be ineffective when extending the period of peace. Taken together, the results in Table 6 do not support the view that post-conflict aid takes more than the four years considered in our baseline model to become effective in improving infrastructure.

In Table 7, we distinguish particularly severe conflicts with at least 1,000 deaths per year from less severe conflicts. Severe conflicts are relatively rare so that the number of observations is reduced only modestly when excluding these conflicts in columns (2), (4), and (6) of Table 7. All the same, it is important to note that our previous results are hardly driven by rare, though particularly severe conflicts. The only relevant change, compared to the baseline results in Table 2, is that the interaction between *Aid* and *Postconfl* is no longer significant at conventional levels when considering all eight sectors of infrastructure in column (2). All three interaction terms are affected only modestly, in terms of significance or size, when excluding the larger number of less severe conflicts in columns (1), (3), and (5).

Our baseline results also hold when accounting for other dimensions of the severity and type of conflicts.³³ Post-conflict aid is consistently effective in improving social infrastructure, whereas it is ineffective in improving economic infrastructure, when (i) excluding conflicts with a ‘contested incompatibility’ that concerns either territory or government; and (ii) excluding inter-state wars or internationalized internal conflicts as types of conflicts that are potentially more difficult to settle.

Extended specification: In Table 8, we extend our parsimonious model in equation (1) by controlling for some (time-varying) variables which are potential determinants of both infrastructure and aid. For instance, previous studies suggest that infrastructure is better developed in richer and smaller countries (e.g., Donaubauer et al. 2016). At the same time, aid typically increases less than proportionately with rising population of the recipient countries and most donors grant less aid to richer countries (Neumayer 2003). For similar reasons, we also account for the level of democracy, even though it is disputed in the aid allocation literature whether donors grant more aid to more democratic recipient countries. We also include sector-specific aid in squared terms to take into account that aid may suffer from diminishing returns. Furthermore, we add a dummy variable to account for previous conflicts.

The evidence on the control variables is mixed. In contrast to the estimation for economic infrastructure in column (3) of Table 8, changes in social infrastructure are significantly and positively correlated with population in column (2). As expected, infrastructure tends to develop more favorably when GDP per capita is higher, though the coefficient is not significant in column (3). Democracy does not appear to be related with changes in infrastructure. Neither do we find evidence for diminishing

³³ Detailed results on these robustness tests are not shown; they are available from the authors on request.

returns of sector-specific aid. Finally, active conflicts tend to be negatively associated with improvements in infrastructure.

More importantly, the inclusion of these control variables hardly affects our major results.³⁴ In particular, the significantly positive interactions between *Aid* and *Postconfl* are essentially the same in Tables 8 and 2. This also means that the striking contrast persists between the effectiveness of post-conflict aid in improving social infrastructure and its ineffectiveness in improving economic infrastructure.

5. Summary and conclusion

Foreign aid to conflict-affected and fragile states has increased considerably since Collier and Hoeffler's (2004) pioneering study on the economic growth effects of post-conflict aid. While the general effectiveness of aid continues to be debated controversially, it is widely believed that aid can help conflict-affected countries to recover after the settlement of conflicts.

However, compelling empirical evidence supporting this view continues to be scarce. In particular, the heterogeneous nature of post-conflict aid has been largely neglected so far. Drawing on the conflict database of the Uppsala Conflict Data Program and the International Peace Research Institute in Oslo (Pettersson and Wallensteen 2015), we address the hypothesis that the effectiveness of post-conflict aid differs between specific sectors. Our focus is on social and economic infrastructure which is most likely to suffer during conflict episodes so that the need for aid is particularly pressing in this area.

³⁴ This also holds when including an additional dummy variable set to one if a country experienced more than one conflict within a year to the specification in Table 8 (not shown). Likewise, our major results are not affected when modifying the definition of *Conflict_active* by considering only previous conflicts with duration of at least 30 days or at least six months.

Performing panel regressions to assess the effectiveness of aid under post-conflict conditions, we find that post-conflict aid helps improve social infrastructure, i.e., outcomes in education, health, water and sanitation, and governance. In contrast, aid appears to be ineffective in improving economic infrastructure, i.e., outcomes in transportation, communication, energy, and finance. Our baseline results prove to be robust to various modifications. For instance, the contrast between post-conflict aid targeted at social versus economic infrastructure holds when excluding specific sectors of social or economic infrastructure, when considering alternative indicators of infrastructure outcomes, and when controlling for other types of aid. Likewise, our major findings are hardly affected when looking at longer periods of sustained peace, accounting for different intensities of previous conflicts, and including additional control variables. Finally, the contrast also holds when using lagged observations of other types of aid as instruments to account for the potential endogeneity of aid specifically targeted at social or economic infrastructure.

The major implication of our analysis is that it seems to be insufficient to increase the overall volume of foreign aid in order to help economic and social recovery after the settlement of conflicts. The call for “timely and predictable aid” which represents a core element of the New Deal for Engagement in Fragile States, endorsed at the High-Level Forum on Aid Effectiveness in Busan, Korea, in 2011, should be complemented by careful sector-specific targeting of post-conflict aid.

Our findings suggest that re-building schools, health centers, and sanitation facilities as well as helping governments and civil society to improve governance could be priority targets for effective post-conflict aid. However, refined analyses may reveal differences in effectiveness even within social infrastructure. At the same time, our insignificant results for economic infrastructure do not necessarily imply that donors should not grant post-conflict aid in this field. Rather, more specific

targeting and closer monitoring may be required for post-conflict aid to help restore transport, communication, energy or financial networks.

More detailed case studies could obviously be useful to identify specific needs in post-conflict episodes and guide donors accordingly. The crux is, however, that detailed accounts of specific needs and possible priorities for aid take time – especially under post-conflict conditions when information tends to be scarce and unreliable and data gathering figures far down the political agenda.

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Table 1 – Comparison of indicators of infrastructure between countries during periods of conflict and peace

Sectors: indicator	Conflict-related dummy variables:			
	1 for conflict-affected countries during four peaceful years prior to conflict; 0 for countries unaffected by conflicts	1 for conflict-affected countries during episodes of conflict; 0 for countries unaffected by conflicts	1 for conflict-affected countries during post-conflict episodes; 0 for countries unaffected by conflicts	1 for conflict-affected countries during post-conflict episodes; 0 for conflict-affected countries during episodes of conflict
	(1)	(2)	(3)	(4)
Education: primary enrollment ratio	-5.953***	-6.899***	-3.221***	1.080
Health: maternal mortality ratio	-7.355***	-8.711***	-4.907***	2.021**
Government & civil society: freedom from corruption	0.019	-8.879***	-10.060***	-2.930***
Water & sanitation: access to safe water	-4.765	-16.410***	-11.480***	1.294
Transport: air carrier departures	-2.394***	-2.197***	-2.029***	0.013
Communication: mobile cellular subscriptions	1.434**	-5.557***	-4.451***	0.803
Energy: electric power consumption	0.820***	-1.268***	-0.384***	0.419***
Banking & finance: Domestic credit to the private sector	13.010***	-4.040***	-3.960***	-1.936***

Notes: Based on pooled regressions with normalized indicators of infrastructure as dependent variables and conflict-related dummy variables as described above each column plus year dummies on the right-hand side. ***, **, * indicate significance of the conflict-related dummy variable at the one, five, and ten percent level, respectively.

Table 2 – Baseline results

	(1)	(2)	(3)
	Social and economic infrastructure	Social infrastructure	Economic infrastructure
Variables			
Infra_level (lagged)	-1.698*** (0.138)	-0.347*** (0.0375)	-2.476*** (0.224)
Aid	1.795* (0.951)	0.736** (0.300)	3.669 (3.138)
Postconfl	0.0008 (2.564)	-1.520** (0.689)	1.745 (5.221)
Aid * Postconfl	2.652* (1.442)	1.618** (0.701)	3.059 (5.772)
Constant	46.04*** (2.983)	13.62*** (1.521)	41.23*** (3.174)
Observations	11,765	6,750	5,015
R-squared	0.086	0.061	0.126
Number of cross-sections	916	486	430

Notes: Robust standard errors are reported in parentheses. Significance at the one, five, and ten percent level is indicated by ***, ** and *, respectively. Coefficients for country-sector and time fixed effects are not reported.

Table 3 – Robustness tests: alternative indicators, sectors excluded, and outliers excluded

Robustness test	Variable	(1) Social and economic infrastructure	(2) Social infrastructure	(3) Economic infrastructure
<i>Alternative indicators:</i>				
Education	Aid	1.760*	0.677*	–
	Aid * postconfl	2.578*	1.712**	–
Health	Aid	2.487**	0.880***	–
	Aid * postconfl	3.001**	1.578**	–
Government and civil society	Aid	1.304	0.200	–
	Aid * postconfl	3.087*	0.714**	–
Water & sanitation	Aid	1.750*	0.731**	–
	Aid * postconfl	2.365	1.592**	–
Transport	Aid	1.382	–	1.203
	Aid * postconfl	3.475**	–	8.800
Communication	Aid	2.427**	–	3.887
	Aid * postconfl	2.733	–	-2.842
Energy	Aid	1.787*	–	3.923
	Aid * postconfl	2.336	–	-0.565
Banking and finance	Aid	1.841*	–	3.941
	Aid * postconfl	2.711*	–	3.431
<i>Sectors excluded:</i>				
Education	Aid	2.504**	0.769*	–
	Aid * postconfl	2.270	1.626**	–
Health	Aid	1.895	1.068**	–
	Aid * postconfl	2.394	2.186**	–
Government and civil society	Aid	1.699	0.266**	–
	Aid * postconfl	3.253*	0.482**	–
Water & sanitation	Aid	1.837*	0.863**	–
	Aid * postconfl	3.142*	2.038**	–
Transport	Aid	0.995	–	-2.077
	Aid * postconfl	3.408**	–	15.24*
Communication	Aid	1.624**	–	4.518
	Aid * postconfl	0.977	–	1.353
Energy	Aid	1.816*	–	4.021
	Aid * postconfl	2.445	–	1.529
Banking and finance	Aid	1.869*	–	4.080
	Aid * postconfl	2.830*	–	3.031
<i>Outliers excluded:</i>				
DV>500	Aid	1.083	0.736**	1.070
	Aid * postconfl	3.285**	1.618**	5.379
DV>300	Aid	1.319**	0.736**	2.051
	Aid * postconfl	2.474**	1.618**	4.583
DV>100	Aid	0.655*	0.717**	0.226
	Aid * postconfl	1.952***	1.629**	2.137

Notes: See Appendix A for list of preferred and alternative indicators. “–” if no change compared to baseline results in Table 1. Robust standard errors are reported in parentheses. Significance at the one, five, and ten percent level is indicated by ***, ** and *, respectively. Coefficients for control variables, country-sector and time fixed effects are not reported. Outliers are defined in terms of the dependent variable (DV) and dropped when certain thresholds (500, 300, and 100 %, respectively) are exceeded.

Table 4 – Sector-specific aid versus other aid

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Social and economic infrastructure		Social infrastructure		Economic infrastructure	
Infra_level (lagged)	-1.696*** (0.138)	-1.698*** (0.138)	-0.344*** (0.0375)	-0.346*** (0.0375)	-2.470*** (0.225)	-2.470*** (0.225)
Aid (sector-specific)		1.986* (1.032)		0.701** (0.289)		4.132 (3.294)
Other aid	-0.114 (0.224)	-0.136 (0.230)	0.0267 (0.0353)	0.0239 (0.0351)	-0.392 (0.643)	-0.452 (0.660)
Postconfl	0.763 (2.693)	0.249 (2.705)	-1.106 (0.731)	-1.433* (0.749)	4.143 (5.880)	3.391 (5.928)
Aid * Postconfl		3.403 (2.289)		1.649** (0.716)		4.937 (6.083)
Other Aid * Postconfl	0.0935 (0.253)	-0.0693 (0.305)	0.0871* (0.0506)	-0.0155 (0.0413)	-0.225 (0.636)	-0.268 (0.651)
Constant	47.29*** (3.240)	46.72*** (3.186)	13.74*** (1.520)	13.50*** (1.508)	44.73*** (4.630)	43.69*** (4.571)
Observations	11,765	11,765	6,750	6,750	5,015	5,015
R-squared	0.086	0.087	0.056	0.061	0.126	0.127
Number of cross-sections	916	916	486	486	430	430

Notes: Robust standard errors are reported in parentheses. Significance at the one, five, and ten percent level is indicated by ***, ** and *, respectively. Coefficients for country-sector and time fixed effects are not reported.

Table 5 – Instrumental variables estimations

Variables	(1) Social and economic infrastructure	(2) Social infrastructure	(3) Economic infrastructure
Infra_level (lagged)	-1.746*** (0.0779)	-0.331*** (0.0346)	-2.460*** (0.122)
Aid	-12.13 (11.40)	-0.124 (1.085)	-72.41 (49.62)
Postconfl	-3.103 (3.727)	-1.625*** (0.616)	-8.251 (8.192)
Aid * Postconfl	11.25 (7.367)	2.102** (0.932)	58.63 (35.88)
Observations	11,251	6,417	4,834
R-squared	0.072	0.053	0.017
Number of cross-sections	895	482	413
First stage <i>F</i> -statistic	39.12	29.70	11.63
Hansen <i>J</i> -test (<i>p</i> -value)	0.86	0.23	0.55

Notes: Robust standard errors are reported in parentheses. Significance at the one, five, and ten percent level is indicated by ***, ** and *, respectively. Coefficients for country-sector and time fixed effects are not reported. *Aid* is instrumented with the first and second lag of *other aid*.

Table 6 – Extended post-conflict period of peace

	(1)	(2)	(3)	(4)	(5)	(6)
	Social and economic infrastructure		Social infrastructure		Economic infrastructure	
Variables						
Infra_level (lagged)	-1.699*** (0.138)	-1.695*** (0.138)	-0.348*** (0.0377)	-0.347*** (0.0378)	-2.473*** (0.222)	-2.464*** (0.223)
Aid (sector-specific)	1.688* (0.864)	1.896* (0.976)	0.930*** (0.359)	0.853** (0.347)	3.823 (2.790)	4.582 (2.892)
Other aid		-0.122 (0.221)		0.0355 (0.0313)		-0.568 (0.580)
Postconfl_ext	-6.317* (3.578)	-5.095 (3.162)	-0.578 (0.834)	-0.535 (0.898)	-11.20 (7.541)	-8.639 (6.792)
Aid * Postconfl_ext	5.490*** (2.082)	7.651** (3.026)	1.418* (0.836)	1.386 (1.036)	6.730 (6.419)	12.08 (7.857)
Other aid * Postconfl_ext		-0.319 (0.221)		0.000780 (0.0606)		-0.607* (0.358)
Constant	46.34*** (2.986)	46.92*** (3.181)	13.50*** (1.523)	13.34*** (1.507)	41.76*** (2.998)	44.90*** (4.299)
Observations	11,765	11,765	6,750	6,750	5,015	5,015
R-squared	0.087	0.088	0.060	0.060	0.128	0.129
Number of cross-sections	916	916	486	486	430	430

Notes: Robust standard errors are reported in parentheses. Significance at the one, five, and ten percent level is indicated by ***, ** and *, respectively. Coefficients for country-sector and time fixed effects are not reported.

Table 7 – Results for different conflict intensities

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Social and economic infrastructure excluding less severe conflicts	excluding severe conflicts	Social infrastructure excluding less severe conflicts	excluding severe conflicts	Economic infrastructure excluding less severe conflicts	excluding severe conflicts
Infra_level (lagged)	-1.649*** (0.144)	-1.663*** (0.136)	-0.297*** (0.0368)	-0.335*** (0.0356)	-2.327*** (0.232)	-2.393*** (0.218)
Aid	1.289 (0.848)	1.746* (0.946)	0.705** (0.305)	0.764** (0.308)	3.119 (2.871)	3.395 (3.217)
Postconfl	-1.597 (2.470)	0.0504 (2.539)	-1.872** (0.752)	-1.849*** (0.697)	-1.335 (5.253)	2.174 (5.184)
Aid * Postconfl	3.795*** (1.260)	2.082 (1.436)	1.840** (0.729)	1.589** (0.708)	3.714 (5.295)	2.499 (5.496)
Constant	46.30*** (3.196)	46.14*** (3.088)	11.41*** (1.417)	13.17*** (1.458)	40.68*** (2.974)	42.01*** (3.444)
Observations	9,549	11,068	5,530	6,361	4,019	4,707
R-squared	0.081	0.083	0.048	0.057	0.118	0.122
Number of cross-sections	885	908	474	483	411	425

Notes: Robust standard errors are reported in parentheses. Significance at the one, five, and ten percent level is indicated by ***, ** and *, respectively. Coefficients for country-sector and time fixed effects are not reported. “Less severe conflicts” are defined as conflicts with less than 1,000 conflict-related deaths per year. Conflicts with at least 1,000 deaths per year are coded as “severe”.

Table 8 – Extended specification including additional controls

Variables	(1) Social and economic infrastructure	(2) Social infrastructure	(3) Economic infrastructure
Infra_level (lagged)	-1.723*** (0.141)	-0.373*** (0.0399)	-2.505*** (0.222)
Aid	3.305** (1.638)	1.106** (0.437)	8.646 (8.634)
Postconfl	-0.320 (2.473)	-1.611** (0.720)	0.554 (5.053)
Aid * Postconfl	2.584* (1.475)	1.564** (0.698)	1.054 (6.427)
Population (logged)	10.60 (18.25)	5.666** (2.835)	-49.16 (44.92)
Democracy	-0.345 (2.035)	-0.345 (0.485)	1.121 (4.389)
GDP per capita (logged)	11.29** (5.730)	3.156** (1.387)	14.17 (15.45)
Aid squared	-0.131 (0.0931)	-0.0294 (0.0192)	-0.643 (0.867)
Conflict active	-4.241** (1.927)	-1.680*** (0.625)	-5.478 (4.132)
Constant	-205.2 (303.6)	-97.88** (47.53)	734.4 (774.7)
Observations	11,765	6,750	5,015
R-squared	0.088	0.065	0.129
Number of cross-sections	916	486	430

Notes: Robust standard errors are reported in parentheses. Significance at the one, five, and ten percent level is indicated by ***, ** and *, respectively. Coefficients for country-sector and time fixed effects are not reported.

Appendix A – List of sectors and indicators

Sector	Preferred indicator	Alternative indicator
<i>Social infrastructure:</i>		
Education	Gross enrollment ratio, primary (%)	Gross enrollment ratio, secondary (%)
Health	Maternal mortality ratio (per 100,000 live births)	Child mortality rate, under five (per 1,000 live births)
Government and civil society	Freedom from corruption, source: HF	Bureaucratic quality, source: ICRG
Water & sanitation	Access to improved water source (% of population)	Access to improved sanitation (% of population)
<i>Economic infrastructure:</i>		
Transport	Air transport, registered carrier departures (per capita)	Registered commercial vehicles (per capita), source: VDA
Communication	Mobile cellular subscriptions (per 100 people)	Internet users (per 100 people)
Energy	Electric power consumption (kWh per capita)	Electric power transmission and distribution losses (% of output)
Banking and finance	Domestic credit to private sector by banks (% of GDP)	Broad money (% of GDP)

Notes: Data are from the World Bank's World Development Indicators, if not stated otherwise: HF: Heritage Foundation; ICRG: International Country Risk Guide; VDA: Verband der Automobilindustrie (German Association of the Automotive Industry).

Appendix B – Summary statistics for the main variables

	Observations	Mean	Std. dev.	Min	Max
Infra growth	11,765	10.488	44.125	-79.805	1969.037
Infra_level	11,765	22.347	30.936	-99.540	99.793
Aid (sector-specific)	11,765	0.400	0.834	0.000	26.702
Other aid	11,765	6.157	8.540	0.006	118.251
Postconfl	11,765	0.244	0.429	0.000	1.000
Population (logged)	11,765	16.125	1.821	9.168	21.029
Democracy	11,765	0.525	0.499	0.000	1.000
GDP per capita (logged)	11,765	7.577	1.034	5.255	9.865
Conflict active	11,765	0.142	0.349	0.000	1.000

Notes: Summary statistics are based on the sample and variables in column (1) of Tables 1, 3, and 5.