

International Trade and Conflict:  
Determinants, Impact, Endogeneity and Data

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# Introduction

The effects of conflict can be considered a global burden: Conflicts trigger flows of migration and stir up regional, bilateral and multilateral relations. As such, they impact on the economies of countries and especially on trade flows between them. The discussion on the relationship between conflict and trade goes back to Kants perpetual peace (Kant 1795). The recent resurrection of trade barriers and growing strategic rivalries between major powers, such as the US and China (The Economist 2019, Brunnermeier et al. 2018), has put this relationship back on the agenda.

Globalisation has created winners and losers: While winners profit from increased product variety (Broda & Weinstein 2006) and improved overall macroeconomic performance (Dreher 2006), losers suffer from exacerbated income inequality within as well as between countries (Rodrik 1997, Dreher & Gaston 2008, Dutt & Mukhopadhyay 2005). Trade and trade policy thus enhance economic performance and development, but can also fuel conflicts.

While globally the poor have become richer in the past 35 years, half of the world's poor live in conflict-ridden and fragile states (The World Bank 2015). States that have experienced conflict in the past are more prone to fall into the so-called conflict trap (Collier et al. 2003, Baranyi et al. 2011) or to experience different conflicts simultaneously (see Chapter 2). Thus, conflict is an important impediment to development: Besides the tremendous effects on human life, conflicts have been shown to exacerbate and disrupt economic growth (see e.g. Nordhaus 2002, Collier 1999, Blomberg & Hess 2002). Conflicts affect trade domestically by impacting on production and consumption (see e.g. Barro 1996, Chauvin & Rohner 2009), and internationally by impacting on economic agents' engagement in commerce (see Long 2008, Abadie & Gardeazabal 2003, Guidolin & La Ferrara 2007). Furthermore, declining trade and trade volatility in turn increase relative prices and dampen real incomes leading to the loss of jobs and opportunities. As a result, people

turn to other sources of income. Especially in conflict-prone fragile states these sources of income often consist of soldiering or crime (Cali 2014).

International trade and the emergence and persistence of conflicts are thus closely and endogenously interrelated. Exploring and disentangling this relationship lies at the heart of my dissertation. I identified four methodological, data, and statistical identification shortcomings in the research on trade and conflict that will be addressed in the three following chapters. First, data limitations are not accommodated optimally in the literature on trade and conflict. Second, the predominant part of the literature does not reflect the reality of conflict types in their analysis. Third, studies on conflict and trade do not account for country-pair heterogeneity, multilateral trade resistance and heteroscedasticity. Fourth, the co-founding factors of conflict and trade, development and democracy, and the indirect simultaneous effects between these four factors, have so far not been accommodated in one study.

The analysis of political and economic factors like conflict and trade often relies on cross-country panel datasets containing information from both disciplines - economics and political science (as e.g. seen in Gates et al. 2006, Acemoglu et al. 2019, as well as in Chapters 2 and 3). The construction of these datasets suffers from one specific problem: The naming of the unit of analysis - i.e. the state or country - is not coded consistently across different sources (Boehmer et al. 2011). Countries in conflict are especially prone to these coding discrepancies: Conflicts initiate changes in borders and state names - as e.g. seen in the separation of Sudan in two states, namely South Sudan and Sudan, in 2006/2007, or the recent name change of the "Republic of Macedonia" into "Republic of North Macedonia", which put a 27-years long bilateral dispute to rest. These breaks in nations histories often lead to inconsistent country coding between data suppliers and in turn lead to a loss of the information of interest. Thus, merging different datasets is not trivial.

This first shortcoming is addressed in the first chapter of my dissertation, which deals with data discrepancies and loss of important observations when merging economic and political science variables into one dataset. It discusses the implications of inconsistencies in the coding of country names between different datasets on trade, conflicts, and democratization. The paper contributes to the literature in the following ways: First, it shows that the problem of inconsistent country coding remains despite standardization efforts

in country codes (such as the commonly used ISO-codes) and despite the development of software packages that facilitate the comparison of country codings. Second, it provides evidence that neglecting these inconsistencies leads to high numbers of missing values in the final datasets. This might in turn lead to biased statistical inference. Lastly, it provides detailed overview tables for all datasets analyzed containing information on the most profound discrepancies. The paper is joint work with Vanessa A. Boese. Vanessa conducted the analysis of the democracy datasets, while I analyzed the trade data. The work on the conflict data and the writing of the paper was shared equally. The final version of this paper is published in the *Economics of Peace and Security Journal* Volume 14, Number 1 (April 2019).<sup>1</sup>

The second chapter of my dissertation accommodates the second and third shortcoming of the literature. Until the early 2000's research operationalized conflict as interstate disputes, as data for conflicts between states were more widely available than data on other forms of violence. This data availability problem has persistently lead to a blindspot in the analysis of the developments of the past 60 years: The occurrence of interstate disputes has declined, while other forms of conflicts, such as internal conflicts and internationalized internal conflicts, increased in number and severity (see Figure 2.1 and Figure 2.3). At the same time, the growing importance of world trade in the 1980's has led researchers to examine the question of its impediments and drivers (as e.g. Ray 1981, Grieco 1990, Copeland 1990). While a lot has been written on determinants of trade such as geographic distance, borders, and currency unions (see e.g. Anderson & Van Wincoop 2003, Rose 2004), the role of different forms of conflict as trade barriers has remained poorly examined.

This is where the second paper of my dissertation ties in. It analyzes the impact of different conflict types and their distinct peculiarities on international trade. The paper contributes in two ways to the literature: First, it uses detailed data on five different conflict types which reflect contemporaneous conflict reality. This allows for a more detailed analysis of conflicts impact on trade. Second, to overcome the simultaneity bias inherent in the relationship of conflict and trade and to control for unobserved heterogeneity on the country as well as on the country-pair level, this paper uses a poisson pseudo maximum likelihood approach for panel datasets. The paper is a single authored paper.

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<sup>1</sup>See <https://www.epsjournal.org.uk/index.php/EPSJ/article/view/310>.

The fourth shortcoming is being addressed by the third chapter of my dissertation. A large literature considers additional determinants of either trade and conflict and the endogenous bilateral or multilateral relationships between them (e.g. Frankel & Romer 1999, Miguel et al. 2004, Acemoglu et al. 2019, Rodrik et al. 2004). These studies have shown that the four factors trade, conflict, development and democracy are closely interrelated and impact on each other. However, former research often falls short of using adequate data and econometric approaches to model these indirect and simultaneous effects between the four factors. With the reemergence of protectionism and erosion of democracy seen in many western countries, the question of how shocks in one of these factors translate to response reactions by the other factors gained renewed importance.

In the third chapter, a country-specific vector autoregressive model is employed, which allows for endogenous dynamic interactions between trade, democracy, development and conflict. Three contributions of this paper to the literature are made: First, adequate data on democracy and conflict is used to overcome mismeasurement problems seen in former papers. Second, the model allows for indirect as well as simultaneous effects between the four factors such that the direction of effects for each bilateral relationship can be examined. Third, a country-level analysis is intentionally chosen to account for country-heterogeneity, which is often covered up by the use of panel estimators which assume homogeneous slope parameters. The paper is joint work with Vanessa A. Boese. We developed the research idea and question together, and iterated on the initial and the final writing of the paper. Vanessa implemented the final calculations of the impulse response functions in EViews and Stata and I proceeded with the interpretation of the results. All remaining work, i.e. compiling of data, initial estimations in Stata and working through the vector autoregressive model, was shared equally.

The quintessence of my dissertation is threefold: First, data choice and processing are often neglected crucial factors of influence for results obtained by statistical and econometric analysis. Second, heterogeneity across countries needs to be allowed for in order to understand the mechanisms behind economic and political determinants such as trade and conflict. Third, dynamic interactions as well as indirect effects between these determinants need to be accounted for to understand the extensive interdependence between them. Thus, future research plans are to examine the trade of specific commodities in



the framework of different conflict types, to analyse the role of single conflict types in a dynamic vector autoregressive setting and to extend the monadic approach used in chapter 3 to a dyadic vector auto-regressive model allowing for an estimation with the gravity equation.

# Chapter 1

## 'Tis but thy name that is my enemy: On the construction of macro panel datasets in conflict and peace economics

together with Vanessa A. Boese<sup>1</sup>

### Abstract

The empirical analysis of datasets covering a large number of countries and time periods has become an integral part of conflict and peace economics. As such, numerous studies examine relationships between and among macroeconomic, political, and conflict variables and this often involves the merging of disparate datasets to combine relevant variables for which the country unit of analysis, however, is not necessarily the same. This article highlights difficulties in the data merging process and, by way of example, presents detailed country coding unit comparison for two economic (UN Comtrade and World Development Indicators), two democracy (Polity IV and V-Dem), and two conflict datasets (UCDP/PRIO Armed Conflict Dataset and COW Militarized Interstate Disputes Dataset). We find that merging datasets can result in the elimination of very large numbers of observations due to unmergeable records and that dropped observations often include the very countries or territorial entities most of interest in conflict and peace economics.

**JEL codes:** F140, N400

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<sup>1</sup>The authors would like to thank Scott Gates and Philipp Großkurth for excellent comments and suggestions. All errors are our own. Authors are listed alphabetically. All work was shared equally.

## 1.1 What's in a name?

In conflict and peace economics, the construction of large panel datasets nowadays forms the basis for the majority of empirical cross-country studies. Originating from different sources, such panel datasets contain measures on variables such as international trade, economic growth, GDP, armed conflict, democratization, and government effectiveness.<sup>2</sup> But bringing these variables together, that is merging them into a single dataset, hinges on the exact identification of the country unit under study. To permit reasonable statistical inference, the country unit for which, for example, the trade value is calculated, should respond to the same entity for which all other variables in the dataset are coded. Unfortunately, the names, and even the physical borders, with which countries are coded vary considerably across different data sources.<sup>3</sup>

At the core of the coding differences lies the question “What’s in a (country) name”? We argue that there are two complementary parts to the answer. The first regards the entity under observation, the unit of analysis: What is a country? The answer depends on the research framework. For example, the purpose of the Russett et al. (1968) state list as well as of the original Gleditsch & Ward (1999) state list was to capture recognized states in the international system. This particular definition of a country is of utmost relevance in analyses of authority structures. Nevertheless, one cannot blindly assume that the unit of analysis, that is, the country, is defined along the same criteria in economic or political datasets. Unfortunately, the burden of comparing the unit of analysis underlying different macro panel datasets lies with the scholar(s) attempting to merge them. As a consequence, we emphasize the importance of discussing the merging process in empirical studies in conflict and peace economics.

The second part to the “What’s in a (country) name?” question concerns the entity’s label: Numerous scholars have presented ways to adjust for differences in country labels. For example, Hensel (2001) provides a thorough list of alternative historical state names and Heather Ba has created Stata files allowing for the mapping of country names, Correlates

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<sup>2</sup>Examples of studies using such merged datasets include Hegre et al. (2001), Blomberg & Hess (2006), Gates et al. (2006), Martin et al. (2008), Glick & Taylor (2010), Acemoglu et al. (2019), Dunne & Tian (2015), and d’Agostino et al. (2018).

<sup>3</sup>Hence the title of this article. ‘Tis but they name that is my enemy (Act II, Scene ii, Shakespeare, 2003).

of War (COW) codes, and World Bank codes.<sup>4</sup>

That inconsistent country names across different data sources pose a problem is widely known among scholars working with macro panel datasets. Major attempts to standardize worldwide country coding already were undertaken half a century ago by Russett et al. (1968) and almost twenty years ago by Gleditsch & Ward (1999). Nevertheless, several problems remain unresolved and, unfortunately—with the emergence of readily available software packages and codes—a discussion of “what is the (country) unit of analysis” has become almost unfashionable. In spite of its tediousness and complexity, the country merging process is generally not discussed in academic papers (or in their supplementary materials).

The contribution of this article is hence twofold: First and foremost, it shows that in spite of all country coding scheme standardization efforts and relevant software packages or codes, the problem of inconsistent country coding in macro panel datasets persist. We therefore want to re-raise awareness of this problem and encourage a discussion of it in empirical cross-country studies in conflict and peace economics. Second, by way of illustration, in the Appendix to this article we provide overview tables of some of the gravest discrepancies in country coding across datasets which facilitate quick cross-dataset comparisons of country units.

### 1.1.1 Typology of inconsistencies

A typology of inconsistencies Inconsistent country names are the tip of the merging iceberg. Not only do names differ, but so does for example the period of existence for some countries. And worse, the documentation on the country coding schemes provided by the data projects is often sparse and contains errors.<sup>5</sup>

The following three types of inconsistencies between country units in different data sources and coding schemes are frequently observed and examined in this article:

1. A state name exists in one dataset but not in the other
  - (i) Reason: Different years (time series do not match and some states do not exist

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<sup>4</sup>See <http://heatherba.web.unc.edu/data-code/>.

<sup>5</sup>For discussion, see the sections on democracy, economic, and conflict data in this article.

anymore/yet).

- Example: When merging PolityIV with Comtrade data the Orange Free State cannot be merged as it ceases to exist before coding of Comtrade Data starts)
- Result: Country is unmergeable and drops out because it does not exist in one dataset

(ii) Reason: Different definition of statehood

- Example: Some datasets do not code Palestine as they do not consider it to meet formal requirements of statehood
- Result: Country is unmergeable and drops out because it does not exist in one dataset

(iii) Reason: Different state names (labels) or entities/territories (see inconsistency 3 described below)

- Example: Yugoslavia and its successors are coded vastly different in terms of names and years across all datasets. How should these countries/observations be aggregated to make them comparable across datasets and to not loose conflict observations?
- Result: Country may drop out if no action is taken

2. A country is coded under the same name, but for different years in two datasets (time series for given country are not identical in both datasets)

(i) Reason: Missing observations within time series

- Example: In V-Dem Germany, 1946-48, is not coded since the institutional framework of Germany during those years does not meet the formal criteria for the definition of their democracy indices
- Solution: Depends on application and on underlying assumptions made about reason for missingness, possibly interpolation

(ii) Reason: Country starts or ceases to exist and first/last year is not coded consistently across datasets

- Example: PolityIV codes former East Germany between 1945-1990 whereas V-Dem codes it from 1949-1990.

- Solution: Depends on application, possibly extrapolation
3. A country is coded under different names:
- 3A: For the same years in two datasets
- 3B: For different years in two datasets
- (i) Reason: It is clearly the same state only the label is different. This is often the case for 3A - or for 3B in combination with inconsistency type 2, reason (ii).
- Example: “St.” vs. “Saint” or official vs. colloquial state names (“Plurinational State of Bolivia” and “Bolivia”)
  - Solution: Use relevant Stata and R packages for renaming
- (ii) Reason: The different names might refer to different underlying entities/ territories
- Example: We provide detailed overviews of these cases in Table 10 (Democracy Datasets) and Table 14 (Economic Datasets) of the Appendix.
  - Solution: The option 3B case is by far the most difficult case as the years do not provide additional evidence on the actual entity captured. The question of how these entities could be compared in a meaningful way across datasets has no straightforward answer, rather the answer is case dependent.

Inconsistent country coding of types 1 to 3 lead to missing values in the final, merged dataset.<sup>6</sup> In this article we show that the extent of these “missing values” (they are not really missing, just missing due to inconsistencies) is vast and of particular relevance to empirical research in conflict and peace economics. Most country coding schemes differ in the naming and dating of a specific set of countries: Countries which have experienced armed conflict are less democratic and less trade open than the consistently coded ones. As a result, a merged dataset can contain a comparatively high share of missing values for this set of countries. Thus, it can no longer be considered a random sample. To minimize “missings,” and to avoid losing valuable information, the process of creating large panel

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<sup>6</sup>Note the difference between missing values and missing observations. For example, on the one hand, in the V-Dem dataset version 8 there are no observations for Germany between 1945 and 1948, leaving the panel unbalanced. In the World Development Indicators, on the other hand, the panel provided is balanced, that is, there is one observation for each country in each year. However, for a number of years the variable of interest contains a missing value. Ultimately, when merging two such sources and using the final dataset for statistical analysis, missing values and missing observations come down to the same thing: missing information. For most regressions or other analyses, software like Stata disregards observations whenever they contain missing values.

datasets should therefore be done with utmost care.

In general, there are three approaches to code countries in macro panel data: By (string) country names, by numeric code, or by alphabetic code. The most common schemes include (but are not limited to) the COW country list, the Gleditsch/Ward state list, and the ISO 3166 list of country codes.<sup>7</sup> In theory, numeric and alphabetic codes should facilitate the merging process. Unfortunately, several numeric and alphabetic codes schemes exist and often they are neither implemented consistently nor are the country codes easily translatable to each other. In R the package “countrycode” and in Stata the package “kountry” help with these issues.<sup>8</sup> These packages map country names and codes from one kind of macro country codes to another. They come with a slight disadvantage, though, as “[t]he mapping between the available dataset\_names [types of country coding schemes] is not always perfect.”<sup>9</sup> This is especially dire when using a comparatively new dataset such as V-Dem which does not follow any of the coded country schemes exactly. In addition, this assumes that each source dataset correctly applies the country coding scheme it is based on. In the following sections we show that this is not the case for several datasets. By letting Stata or R packages adjust the country names, the renaming—and subsequently the merging process—is put into a black box, inherently making it more vulnerable to mistakes.

We aim to take this data merging process out of its black box and use actual country names to prevent merging mistakes. In what follows we provide a detailed comparison of six datasets covering the indicators trade, democracy, and conflict. For each dataset a table with actual country names and years in the data is provided (see Boese & Kamin 2018*a,b*). These tables present an overview of the gravest discrepancies in country coding and allow for quick cross-dataset comparisons of country units. In addition, this article gives an overview of the extent of the country coding problem by comparing structural properties of the set of inconsistently coded countries to those of the uniformly coded ones

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<sup>7</sup>COW: A country coding scheme employed by several of the macro panel datasets studied in this article. Data can be obtained from <http://www.correlatesofwar.org/data-sets/cowcountry-codes>. There are three variables: Numeric and alphabetic country codes and statename. The dataset covers 217 countries. The country list includes 26 duplicate observations. Gleditsch/Ward: The Gleditsch & Ward (1999) state list builds on and revises the COW country list. First published in 1999, a current version is available at <http://ksbleditsch.com/statelist.html>. ISO: See <https://www.iso.org/iso-3166-country-codes.html>.

<sup>8</sup>R: See <https://cran.r-project.org/web/packages/countrycode/countrycode.pdf>. Stata: See Raciborski (2008).

<sup>9</sup>Quote: Raciborski 2008, p. 392. Raciborski (2008) continues with a short overview of the most striking inconsistencies.

and by discussing missing data as well as differences in annual coding.

On the one hand, this article provides assistance to scholars merging several source datasets. On the other, it highlights naming inconsistencies between data documentation, such as code books, and actual observations in the data. Such inconsistencies potentially lead to merging problems when blindly using the Stata or R packages (and the country coding scheme specified in the documentation) discussed above. We have the highest respect for all the data projects discussed in this article. We therefore hope that the lists of these inconsistencies are also of assistance to the data projects in aligning their documentation to their respective datasets.

The following three sections respectively provide thorough comparisons of two democracy, two trade, and two conflict datasets, including detailed tables comparing the country coding units. The article closes with a discussion of the results.

## 1.2 Democracy Data

This section compares the country coding units of two democracy datasets: V-Dem version 8 and the PolityIV dataset 2016. The tables referenced in this section can be found in the Appendix as well as in Boese & Kamin (2018*a*). We first discuss the countries listed in V-Dem version 8, then discuss the countries in the PolityIV dataset 2016, and then compare characteristics of the observations listed in both datasets with those listed in only one of the datasets.

### 1.2.1 V-Dem Data Version 8

The V-Dem dataset used for this article is V-Dem data version 8, in country year format. The variable of interest is the Electoral Democracy Index, `v2x_polyarchy`. V-Dem identifies the countries either by name, alphabetical country id, or numerical country id.<sup>10</sup> These country identifiers do not correspond to any of the prevailing country schemes implemented in the Stata or R packages mentioned above. To facilitate the merging process, we therefore provide a detailed list of county coding units in the data<sup>11</sup> and compare it to

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<sup>10</sup>Alphabetical `country_text_id`: “Abbreviated country names”. Numerical `country_id`: “Unique country ID designated for each country. A list of countries and their corresponding IDs used in the V-Dem dataset can be found in the country table in the codebook, as well as in the V-Dem Country Coding Units document”.

<sup>11</sup>See Boese & Kamin (2018*a*), worksheet “V-Dem Codebook vs. Data”.



the country list in the V-Dem code book (Coppedge, Gerring, Knutsen, Lindberg, Skaaning, Teorell, Altman, Bernhard, Cornell, Fish et al. 2018, p. 36).

V-Dem excels in terms of transparency and provides a supplementary article on “V-Dem Country Coding Units v8” which lists and discusses all polities and countries and the respective years for which they are coded as well as a detailed explanation of the country borders used in the coding.<sup>12</sup> It also provides detailed information on years in which a country is not coded (with the variables `gapstart` and `gapend`). However, there are several observations for which `v2x_polyarchy` is missing. Worksheet “Overview” in Boese & Kamin (2018a) shows the number of years for which each country is coded in V-Dem version 8, as well as its gaps (by coding decision) and its additional missing values.

For ten countries the names in dataset and documentation do not match.<sup>13</sup> These name mismatches are by no means a purely alphabetical problem. Take, for example, Vietnam. While there is no country named Vietnam, North or South, in the V-Dem dataset there is a “Republic of Vietnam” (coded from 1802–1975) and a “Democratic Republic of Vietnam” (coded from 1945–2017). The V-Dem Country Coding Units document, however, provides a detailed overview of the polities forming part of:

”Vietnam, South (35) Coded: 1802–1975. History: (...) Republic of Vietnam (also known as South Vietnam) (1955–1975).” and ”Vietnam, North (34) Coded: 1945– History: Democratic Republic of Vietnam (i.e. North Vietnam) [declared] (1945); Democratic Republic of Vietnam (1945–1949); Democratic Republic of Vietnam [independent state] (1949– ). Note: From 1976, the polity also includes areas formerly belonging to Republic of Vietnam (South Vietnam).”<sup>14</sup>

Take another example. In the documentation the numerical country id (365) is coded for two countries: Oldenburg, 1789–1867, and Saxe-Weimar-Eisenach, 1809–1867. In the dataset, however, only Saxe-Weimar-Eisenach is assigned `country_id` 365 while Oldenburg is assigned code 364.

<sup>12</sup>See Coppedge, Gerring, Knutsen, Lindberg, Skaaning, Teorell, Ciobanu & Olin (2018).

<sup>13</sup>They are: Democratic Republic of Congo, Democratic Republic of Vietnam, German Democratic Republic, Mecklenburg Schwerin, North Korea, Republic of Vietnam, Republic of the Congo, South Korea, São Tomé and Príncipe, and Timor-Leste.

<sup>14</sup>V-Dem Country Coding Units, p. 27.

### 1.2.2 Polity IV

A second dataset, capturing political authority patterns worldwide and over long periods of time, is the PolityIV project’s dataset on “Political Regime Characteristics and Transitions, 1800–2016” (for short, the PolityIV dataset).<sup>15</sup> In the dataset countries are identified by their name, an alphabetic country code, or a numeric code.<sup>16</sup> These identifiers supposedly follow the COW country coding scheme.<sup>17</sup> Table 1.1 displays the results from merging the PolityIV data with the COW country list, finding that 13 percent of the countries are unmergeable when merging by country name, 6 percent when merging by numeric code, and 10 percent when merging by alphabetic code.<sup>18</sup> The unmergeable groups largely consist of countries of particular interest in conflict and peace economics such as the Koreas, Congos, Germanies, and Serbias. As a consequence, when merging the PolityIV data using a software package taking the dataset to be in “COW coding scheme” these countries may not be properly dealt with.

Table 1.1: Number of (un)mergeable countries (PolityIV/COW country list)

Merging by	Country name	Numeric code	Alphabetic code
Unmergeable countries in PolityIV	26	11	19
Mergeable countries in PolityIV & COW	169	183	177

Number of (un)mergeable countries in a merge of the PolityIV Dataset with the COW country list

It is worth noting that country names and alphabetic and numeric codes are not coded consistently over time within the PolityIV dataset, i.e., there are 195 different country names, but only 194 different alphabetic and numeric codes. This is not due to a single country having different names and only one code, but to a number of countries and several code/label constellations. Examples include Yugoslavia (either ccode 345 and scode YUG or ccode 347 and scode YGS; that 347 and YGS also are used for Serbia and Montenegro

<sup>15</sup>See Marshall et al. (2017b).

<sup>16</sup>Alphabetic: The variable scode (“Alpha Country Code: Each country in the Polity IV dataset is defined by a three-letter alpha code, derived from the Correlates of War’s listing of members of the interstate system” (Marshall et al. 2017a, p. 12). Numeric: ccode (numerical, “Numeric Country Code: Each country in the Polity IV dataset is defined by a three-digit numeric code, derived from the Correlates of War’s listing of members of the interstate system” (Marshall et al. 2017a, p. 11).

<sup>17</sup>Supposedly: See (Marshall et al. 2017a, p. 11)

<sup>18</sup>To be clear, the share of unmergeable countries is calculated as: Number of unmergeable countries/total number of countries in PolityIV (i.e.,  $26/195 \approx 13.3\%$ ,  $11/194 \approx 5.7\%$ , and  $19/194 \approx 9.8\%$ . Note that the rows are labeled correctly although one could in fact omit “and COW” from the second row since, if countries are mergeable in a merge between COW and PolityIV, they must exist in both datasets. In the first row, however, are unmergeable countries only, i.e., those which exist only in the PolityIV dataset.

in the dataset further complicates matters), Ethiopia (either ccode 529 and scode ETI or ccode 530 and scode ETH), Pakistan (either ccode 769 and scode PKS or ccode 770 and scode PAK). Further, ccode 860 and scode ETM is used for East Timor and Timor Leste, and ccode 255 and scode GMY is used for Germany and Prussia.

Additionally, in the PolityIV dataset we note duplicate observations for Yugoslavia in 1991 and for Ethiopia in 1993. This further complicates the merging process as the scholar is forced to decide how to proceed with the duplicates.

### 1.2.3 Comparison of the democracy data

Table 1.2 describes both democracy datasets. The variable of interest in each dataset is a democracy index: `v2x_polyarchy` for the V-Dem data and `polity2` for the PolityIV data.<sup>19</sup> The total number of nonmissing observations refers to the number of observations for which the respective variable of interest contains nonmissing values.

When merging the datasets by country name and year, observations of inconsistency types 1 to 3 cannot be merged. Table 1.3 shows the number of mergeable and unmergeable observations by source dataset. As discussed, even though an observation might be listed, the variable of interest can contain a missing value. Hence the lower half of Table 1.3 proves the same information for all observations with nonmissing values. To make the number of observations comparable across datasets in Table 1.3, only observations from the time period covered by both datasets are considered (that is, V-Dem observations before 1800 as well as the year 2017 were left out to match the PolityIV time series). Around 41 percent of the V-Dem and around 9 percent of the PolityIV observations cannot be merged. To assess whether the unmergeable observations are systematically different from the mergeable ones we calculated the average levels of democracy for each group. Table

<sup>19</sup>V-Dem's `v2x_polyarchy`: Range 0 to 1 (most democratic). PolityIV's `polity2`: Range -10 to +10 (most democratic).

Table 1.2: Description of democracy datasets

Dataset	A: V-Dem	B: PolityIV
total number of observations	26,537	17,228
total number of nonmissing observations	24,115	16,992
number of countries	201	195
number of years	1789-2017	1800-2016

Table 1.3: Merging V-Dem and PolityIV data

Merging	A: V-Dem	B: PolityIV
unmergeable observations only in A	10,929	-
unmergeable observations only in B	-	1,619
mergeable observations in both:	15,609	
non-missing observations only in A	9,380	-
non-missing observations only in B	-	1,571
non-missing mergeable observations in both:	14,736	15,421

4 shows the results of two t-tests, one for V-Dem, one for PolityIV. In both datasets, the unmergeable group had a significantly lower average level of democracy (To be clear, the t-tests were carried out only on the nonmissing observations noted in Table 1.3).

### 1.3 Economic data

UN Comtrade<sup>20</sup> and the World Bank's World Development Indicators (WDI)<sup>21</sup> contain economic data. We first discuss the countries listed in the UN Comtrade data, then those in the WDI, and then compare the country coding schemes of both datasets. The tables and worksheets referenced to in this section can be found in the Appendix as well as in Boese & Kamin (2018b).

#### 1.3.1 UN Comtrade

The indicator taken from UN Comtrade is total exports in current U.S. dollars from each country to the rest of the world. The Comtrade dataset is an unbalanced panel as it only contains years for which countries have reported trade. Hence, time series differ from country to country. The first year for which some countries reported trade is 1962, the

<sup>20</sup>See *United Nations Comtrade Database* (2018).

<sup>21</sup>See *World Development Indicators* (2017a).

Table 1.4: Two sample ttests of average level of democracy (v2x\_polyarchy/PolityIV)

Dataset:	A: V-Dem	B: PolityIV
average level of democracy unmergeable group	0.1377	-0.4495
average level of democracy mergeable group	0.3428	-1.5493
difference in average democracy levels between groups	0.2051	***
		1.0998
		***

Two sample ttests of average level of democracy. Democracy variable V-Dem: v2x\_polyarchy, range: 0 (most autocratic) to 1 (most democratic). Democracy variable PolityIV: polity2, range: -10 (most autocratic) to 10 (most democratic).

Note: \*\*\* Statistically significant at the 1% level.

last year is 2017 (few observations are available for the start and end years of the time series). Comtrade offers data coded according to two different systems for international trade statistics: The Harmonized System (HS), introduced in 1988, and the Standard International Trade Classification (SITC), introduced in 1962, with the latter being less detailed than the former. To obtain the longest possible time series, we concatenated SITC classification export data, 1962–1987, with HS classification export data, 1988–2017.

In addition to gaps in the time series caused by missing observations (as discussed above) the export variable contains missing values for several observations. Missing information primarily indicates that trade was not reported and is not to be equated with zero trade flows.<sup>22</sup> This is crucial concerning the tackling of zero trade flows and appropriate model choice.<sup>23</sup>

The country name abbreviations of the official UN country list<sup>24</sup> correspond to the country names used in the Comtrade data with the exception of Côte d'Ivoire and Réunion, which contain spelling errors in the downloaded Comtrade dataset (“C%¥te d'Ivoire” and “R%©union”).

### 1.3.2 World Development Indicators

The economic indicator taken from the World Bank's WDI is trade openness, defined as the percentage share of trade of each country's GDP, that is,  $(\text{imports} + \text{exports}) / \text{GDP}$ . Starting in 1960, the time series runs to 2016. The distinction between zero trade and missing data in the WDI is equivalent to the one in UN Comtrade. In contrast to Comtrade, however, the WDI data is a balanced panel with one observation for each country and year. Nevertheless, trade openness contains missing values for several observations due to missing information on GDP, exports, or imports. In addition to countries, WDI provides aggregated information on country groups (such as “Europe & Central Asia” or “Low & Middle Income”). These were taken out of the list to facilitate reading (the full list of country groups removed is available in Boese and Kamin, 2018b, worksheet “Disregarded Country Groups”).

<sup>22</sup>For a discussion of missings in trade data see, for example, Keshk et al. (2010), Section 3.3, p. 10, Barbieri et al. (2009), p. 476, and Boehmer et al. (2011).

<sup>23</sup>See, for example, Santos Silva & Tenreyro (2006).

<sup>24</sup>The UN provides a list of country codes and names at <https://unstats.un.org/unsd/tradekb/Knowledgebase/50377/Comtrade-Country-Code-and-Name>.

To our knowledge, the World Bank does not provide an explicit country coding scheme upon which WDI data are based. However, the World Bank does provide a list of countries upon which the World Integrated Trade Solution (WITS) data are based.<sup>25</sup> It is unclear whether this list also forms the basis of the WDI dataset. Of 15,048 observations in the WDI dataset used in this article, 30 percent (4,560 observations) do not match the WITS list. Several of them are due to naming inconsistencies such as, for example, “Bahamas, The” versus “Bahamas”.

### 1.3.3 Comparing the economic data

In a comparison of the economic datasets<sup>26</sup> the sheer number of naming inconsistencies<sup>27</sup> and single appearances of countries (that is, they appear in one, but not in the other dataset)<sup>28</sup> stands out. Additional cases, difficult to handle when merging datasets, are countries that started and ceased to exist, yielding different country names for different or the same territories and for different years (inconsistency type 3). While WDI refers to each country under one name continuously for the entire time series, this is not the case for the UN Comtrade data. In Comtrade, countries are coded by different names and years. Table 14<sup>29</sup> displays the cases where this kind of inconsistency is in place. The table shows that Comtrade distinguishes the underlying country entities in much more detail. There is, for example, only one “Germany” in the WDI data as opposed to “Germany”, “Fmr Fed. Rep. of Germany” and “Fmr Dem. Rep. of Germany” in the UN Comtrade data.

Assuming that the ending of one state and the beginning of a new one are coded in detail through the year variable by WDI, can the country coding units be supposed to be the same across the two datasets? The sparsity of country coding unit documentation renders it impossible to answer this question. There is no information on whether territories changed, and on whether or how much this change was incorporated in the coding. This becomes a severe drawback to the data when complementary variables for the analysis of trade flows, such as country size, GDP, measures of distance and—most importantly—borders are taken into account.<sup>30</sup>

<sup>25</sup>[https://wits.worldbank.org/wits/wits/witshelp/content/codes/country\\_codes.htm](https://wits.worldbank.org/wits/wits/witshelp/content/codes/country_codes.htm).

<sup>26</sup>See Boese & Kamin (2018*b*), worksheet “Overview”.

<sup>27</sup>See Table 11 or Boese & Kamin (2018*b*), worksheet “naming inconsistencies” for inconsistency type 3, reason (i) (one country coded with different names but for the same year and years).

<sup>28</sup>See Tables 12 and 13 or Boese & Kamin (2018*b*), worksheet “existence asymmetry” for inconsistency types 1 and 3.

<sup>29</sup>Also see Boese & Kamin (2018*b*), worksheet “inconsistency type 3”.

<sup>30</sup>Anderson & Van Wincoop (2003), for example, demonstrated that national borders are a highly

The case of Sudan (see Table 14)<sup>31</sup> illustrates the problem: WDI codes “South Sudan” and “Sudan”. For the latter, the measure of trade openness is available for the whole time series (1960–2016). For “South Sudan”, the indicator is available from 2008–2015. UN Comtrade codes “Sudan” (2012–2015) and “Former Sudan” (1963–2011, with gaps). Hence, WDI takes 2008 as the year of birth for “South Sudan”, while Comtrade (implicitly, because it does not code “South Sudan” as a country)<sup>32</sup> codes a new state “Sudan” from 2012 onward. Similar cases are Serbia (with or without data for Kosovo or Montenegro) and China (with or without data for Hong Kong, Macao, and Taiwan).<sup>33</sup>

The country name by itself does not allow for an exact indication of the territory coded. In a statistical analysis only of trade, it might not matter whether Sudan or South Sudan is included. In conflict and peace economics, however, where relationships among conflict, politics, and economics are of high interest, such lack of accuracy effectively becomes an impediment to an appropriate econometric analysis.

Table 1.5: Description of trade datasets.

Dataset	A: Comtrade	B: WDI
total number of observations	12,768	15,048
total number of nonmissing observations*	6,790	10,643
number of countries	228	264
number of years	1962-2017	1960-2016

Note: \*The total number of nonmissing observations refers to the number of observations for which the respective variable of interest contains nonmissing values.

Table 1.5 describes both trade datasets. For Comtrade, the variable of interest is total exports in current U.S. dollars (TradeValueUS); for the WDI data, it is trade openness as a percentage of GDP (tradeop).

Table 1.6 shows the number of mergeable and unmergeable observations by source dataset. As discussed, even though an observation might be listed the variable of interest can contain a missing value. Hence the bottom half of Table 1.6 provides the same information for all observations with nonmissing values. To make the number of observations comparable

important impediment to trade.

<sup>31</sup>Boese & Kamin (2018b), worksheet “inconsistency 2.0”, rows 36–38.

<sup>32</sup>The fact that no “South Sudan” is included in the UN Comtrade data is itself somewhat astonishing since trade data is available (otherwise WDI would not be able to code it).

<sup>33</sup>See *World Development Indicators* (2017b), p. XVII.

Table 1.6: Merging Comtrade and WDI data

Merging	A: Comtrade	B: WDI
unmergeable* observations only in A	3,803	-
unmergeable observations only in B	-	6,083
mergeable observations in both:	8,965	-
non-missing observations only in A	1,449	-
non-missing observations only in B	-	3,765
non-missing mergeable observations in both	5,341	6,878

Note: \*When merging both datasets by country name and year those observations of inconsistency types 1-3 are unmergeable.

rable across datasets in Table 1.6 only observations from the time period covered by both datasets are considered, i.e., 1962–2016. About 30 percent of the Comtrade observations, and about 40 percent of the WDI observations, cannot be merged.<sup>34</sup> To assess whether the unmergeable observations are systematically different from the mergeable ones, we calculated average levels of total exports and trade openness for each group. Table 1.7 shows the results of two sample t-tests: For Comtrade, the average export level is statistically significantly higher (given the exponent) in the unmergeable than in the mergeable group. For WDI, the unmergeable country group had a significantly lower level of average trade openness.

Table 1.7: Two sample ttests of average level of trade and trade openness (Comtrade/WDI)

Dataset:	A: Comtrade	B: WDI
average level of trade variable unmergeable group	$2.72 \cdot 10^{14}$	66.16
average level of trade variable mergeable group	$3.98 \cdot 10^{13}$	76.14
difference in average total export & trade openness levels btwn both groups	$-2.32 \cdot 10^{14}***$	$9.98***$

Trade variable Comtrade: total exports, TradeValueUS, range: US\$ 37, 310 to US\$ 2.34 · 10<sup>16</sup>. Trade variable WDI: trade openness, tradeop, range: 0 to 860,8 (in %)

Looking at the naming inconsistencies (Table 11) confirms this “higher-lower” difference: The high levels of export values in the unmergeable group in Table 1.7 are driven by observations from the U.S., Germany, Macao, and Hong Kong.<sup>35</sup> Table 1.7 hence provides a good intuition to the effects of inconsistent country coding: Either the cases of high export levels or of low trade openness are lost due to merging problems. Either one is problematic in terms of statistics and, depending on the analytic aim, might lead to biased estimates.

<sup>34</sup>Again, to be clear:  $3,803/(3,803 + 8,965) \approx 29.7\%$  and  $6,083/(6,083 + 8,965) \approx 40.4\%$ .

<sup>35</sup>This is shown in Boese & Kamin (2018b), worksheet “Unmergeable Outliers Comtrade”. It contains all unmergeable Comtrade observations sorted by export values



## 1.4 Conflict data

In theory, the datasets for economic and political variables code each variable for all years during which a country exists. The conflict datasets, however, are fundamentally different: By design, they only code conflict variables for years in which a conflict occurred in a given country and which surpassed some conflict criteria (for example, 25 battle-related deaths). Consequently, time series and cross-section data dimensions contain gaps for country-years without armed conflict.

The UCDP Armed Conflict dataset version 18.1 (Pettersson & Eck 2018a, Gleditsch et al. 2002, *UCDP Battle-Related Deaths dataset version 18.1* n.d.) studies armed conflict above a yearly threshold of 25 battlerelated deaths. The Militarized Interstate Disputes (MID) B dataset version 4.2 (Palmer et al. 2015) captures militarized interstate disputes which can involve, for example, a display of force without incurring any battle deaths. Therefore, the gaps in the datasets will be very different, and merging them by country and years coded does not provide insights on, or a comparison of, country coding units. Nevertheless, both datasets acknowledge the importance of defining country coding units. In the remainder of this section, we show that even within each of these datasets there are inconsistencies between the country coding units as defined by the respective data project and the actual observations in the data. As a result, these observations are either dropped, potentially falsely matched, or have to be manually adjusted when using Stata or R commands for merging countries.

### 1.4.1 UCDP/PRIO Armed Conflict dataset version 18.1

The UCDP/PRIO Armed Conflict dataset acknowledges the importance of a precise description of country coding units<sup>36</sup> and dedicates an entire section of its code book<sup>37</sup> to the exact definition of country coding units. It includes a country table with numerical and alphabetical country codes, state names, and start and end years for the countries that form part of the international system of states. Tables 15 to 19 list the countries coded in the actual data and compares them to the system membership table from the

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<sup>36</sup>“The definition of a state is crucial to the UCDP/PRIO conflict list” (UCDP/PRIO Armed Conflict Dataset Codebook, 2018, p.13).

<sup>37</sup>See Section 4: “System Membership Description” (UCDP/PRIO Armed Conflict Dataset Codebook, Themnér (2018), p. 13).

UCDP/PRIO code book. The system membership table must include more observations since, by definition, it also includes countries without armed conflict. But Tables 15 to 19 show that even when restricted to countries with armed conflict there are inconsistencies in the country names (for example “Burkina Faso” and “Burkina Faso (Upper Volta)”, “DR Congo (Zaire)” and “Congo, Democratic Republic of (Zaire)”, and “Ivory Coast” and “Cote D’Ivoire”).

### 1.4.2 MID B version 4.2

The MID B version 4.2 dataset includes one observation per participant to a militarized dispute, 1816 –2010, with countries taken from the Correlates of War (COW) list. The MID B dataset itself does not contain (string) state names. Instead, countries are coded with a three-digit numerical code (ccode) and with an alphabetical code (stabb). Before joining variables from the MID B dataset with any other macro panel data, such as WDI, a first step therefore is to merge MID B with COW, but four countries cannot in fact be merged (Table 1.8. The three-digit alphabetic codes for these countries are RUM, USR, VTM, and ZAI.

This is a perfect example of the difficulties associated with merging by country as it is hardly possible to determine with certainty which underlying entity (territory) is exactly covered, for example, by USR or VTM. This also illustrates why, for this article, we chose to employ merging by country (string) names, not codes. VTM could stand for (Democratic) Republic of Vietnam, Vietnam North, Vietnam South, or Vietnam. While the exact entity coded remains unclear, it is very clear that this case contains information relevant for studies of conflict.

That the MID B dataset states that it follows the COW country list convention when in fact it does not, makes it effectively impossible to determine for some observations which actual underlying entity is considered a country during which period of time.

Table 1.8: Number of (un)mergeable countries (MID B/COW country list)

Merging by	Numeric code	Alphabetic code
Unmergeable countries in MID B	4	4
Mergeable countries in MID B & COW	191	191

Number of (un)mergeable countries in a merge of the MID B Dataset with the COW country list

## 1.5 Discussion & conclusion

Large-scale cross-country datasets are frequently merged in quantitative studies in conflict and peace economics. We find that the coding of country units overlaps across datasets only for a relatively small proportion of countries. Discrepancies in country naming or other forms of country identification such as numerical or alphabetical country IDs are frequent among countries splitting up or (re)uniting during the time period studied. Examples include Yugoslavia, Germany, Vietnam, and Sudan. If the names are not adjusted, these inconsistencies render such observations unmergeable and, when joining variables from several data sources, ultimately result in missing values. When these missing values then are dropped from an analysis, important information is lost. This loss of information is of particular severity in conflict and peace economics as countries which split up or reunite often do so accompanied by armed conflict and thus contain valuable information.

The dataset comparisons made in this article demonstrate that inconsistencies in country coding across macro panel datasets remain a relevant challenge in cross-national studies. They show that for economic datasets as well as democracy datasets the unmergeable group is of a large size (up to about 40 percent of all observations) and significantly differs from the group of mergeable observations. In particular, the group of unmergeable countries is on average less democratic than the mergeable group. Depending on the economic measure analyzed (and, with it, the country naming scheme applied), a group of countries with high exports or another group of countries with low trade openness cannot be merged.

These discrepancies can be attributed, in part, to differences in country labels. Several projects, such as Hensel (2001), and the aforementioned software codes and packages can help adjust them. However, another part of the inconsistent country coding is due to different perceptions and definitions of the unit of analysis. The exercises carried out for this article show that the actual entity captured can differ by source dataset. While this makes creating merged panel datasets consisting of economic, political, or armed conflict factors challenging in its own right, proper merging might be a necessary condition for analysis. For an armed conflict dataset, relevant state units might differ significantly from datasets on democracy or trade flows (the coding of Palestine, Hong Kong, or Macao are examples). As a result, the burden of discussing the unit of analysis studied and of ensuring that

countries correspond to the same entity across merged datasets, lies with the individual scholar or team. This article encourages scholars to discuss the merging process in their academic papers (or supplementary materials) and to not take the problem of inconsistent country names lightly. This is particularly the case in conflict and peace economics, where relevant information is systematically lost when unmergeable observations are discarded.

Furthermore, it is worth noting that country names are not the only dimension of macro panels to be carefully compared across datasets before merging. It goes well beyond the scope of this article to additionally compare the actual time periods covered. However, we point out that the time dimension underlying the calendar year coding of macro panels does not necessarily coincide with the actual calendar year. To quote from the World Bank: “In most economies the fiscal year is concurrent with the calendar year ... Most economies report their national accounts and balance of payments data using calendar years, but some use fiscal years” (*World Development Indicators 2017b*, p.117). Time inconsistencies, then, are another potential source of erroneous inference, in particular when studying the effect of conflict on the economy or the political system, or vice versa.

Last, but not least, we pay tribute to the creators of the datasets discussed in this article: Assembling and maintaining these datasets is a Herculean task. The challenges associated with inconsistent country names and units across datasets can, however, lead to serious consequences in conflict and peace economics. Unfortunately, while an easy solution to the noted problems is not likely to exist, given the different purposes each of the source datasets is created for, we hope that our comments here increase broader awareness and discussion of these problems and that our tables in the Appendix (and online) facilitate quick cross-dataset comparisons of country coding.

## Chapter 2

# Is conflict really a trade barrier? Assessing the impact of different conflict types on trade with a ppml panel approach

1

### Abstract

The study of conflicts' impact on trade has been mainly restricted to interstate disputes. Only very few studies have looked at other conflict forms and their effect on trade. At the same time, the study of impediments and enhancements to international trade has seen a lot of econometric advances to quantify the impacts in a theory-consistent manner. This paper studies the effects of five different conflict types on international trade flows in the period 1992 - 2011, including interstate and internal conflicts as well as other types of violence. A gravity equation of internal trade and a ppml high-dimensional fixed effects estimator are employed to account for country-specific as well as country-pair heterogeneity and simultaneity. Main findings are that the heterogeneity of conflict types generates negative as well as positive effects for trade.

**JEL codes:** F14, F51

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<sup>1</sup>I would like to thank Christine Merk, Holger Görg, Marie-Catherine Riekhof and Katerina Homolkova for excellent comments and support throughout the project. I would furthermore like to thank Thierry Mayer as well as participants of presentations of the project at Brown Bag Seminar 2015 in Economics, Kiel, International Conference on Economics and Security 2015, Grenoble, European Trade Study Group Conference 2015, Paris, Aarhus-Kiel Trade Workshop, Sandbjerg Gods, and Jan Tinbergen European Peace Science Conference 2016, Milan, for valuable comments and suggestions. All remaining errors are my own.

## 2.1 Introduction

In 2017, the World Bank estimated that within the six years from 2011 to 2016 the armed conflict in Syria resulted in a cumulative loss in Syrian GDP of \$226 billion - which equals the fourfold of the Syrian GDP in 2010 (The World Bank 2017). Nordhaus projected in 2002, that the invasion of Iraq would cost the US overall nearly \$2 trillion with another \$391 billion added via negative macroeconomic consequences (Nordhaus 2002). Both examples stress the negative economic impact of different types of conflict on the national level. However, the repercussions of conflict are not restricted to national borders: Conflict impacts on the economy via a domestic and a globalisation channel. While several studies have promoted *interstate armed conflict* to the status of a trade barrier (Glick & Taylor 2010, Martin et al. 2008) and although civil wars have been shown to impact negatively on economic growth (Blomberg & Hess 2002, Collier 1999), surprisingly very few have included other forms than *interstate armed conflict* in their analysis (Blomberg & Hess 2006, Long 2008, Couttenier & Vicard 2011, Marano et al. 2013, Qureshi 2013).

At the same time, the last century has witnessed a shift in distribution of conflict types. Using data on armed conflict from the Uppsala Conflict Data Program (UCDP), figure 1 shows that in the 1950s, *interstate armed conflict* (conflict between two or more states)<sup>2</sup> and extra-systemic armed conflict (colonial conflict) together were fought as often as *internal armed conflict* (conflict within one state). The picture started to change in the 1960s: Since then, the number of *internal armed conflicts* has dramatically increased, followed by a rise in internationalized *internal armed conflict* in the late 1970s. Simultaneously, extra-systemic armed conflict disappeared<sup>3</sup> and *interstate armed conflict* numbers have fallen drastically. To this day, most armed conflicts fought around the globe are hence not wars between states, but rather wars within states. Furthermore, the end of World War II denotes not only a decline in “classic” *interstate armed conflict*, but also a sharp increase in revolutions, terrorism and insurgencies (Levy 2007). Again, using data from the UCDP on *non-state conflict* (e.g. armed group clashes without government involvement such as the drug war in Mexico) and *one-sided violence* (aggression towards civilians as e.g. 9/11) Figure 2 illustrates this increase from 1989 on: *Non-state conflict* and *one-sided violence* are approximately as frequent as all armed conflict types together (i.e. the sum of all four armed conflict types shown in figure 1). The change in the frequency of

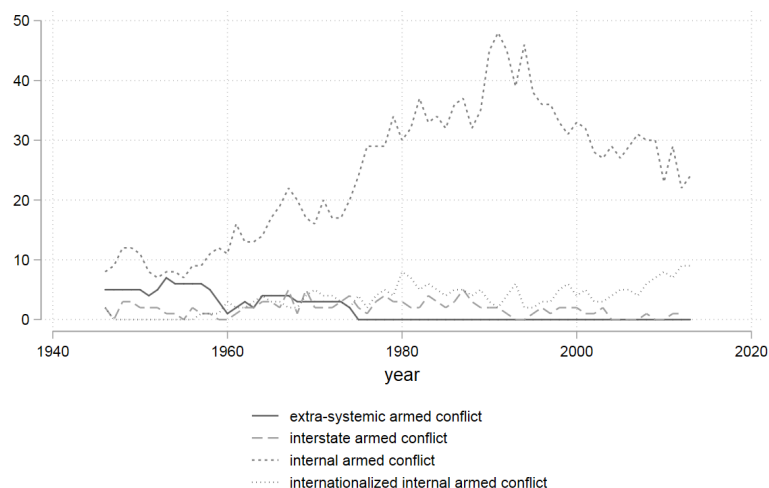
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<sup>2</sup>For detailed definitions of all conflict types, see Section 2.1.2.

<sup>3</sup>The last extra-systemic conflict ended in 1974.

different conflict types has been necessarily accompanied by a change in the overall intensity of those. Figure 3 displays the total number of battle-related deaths for the five conflict types provided by UCDP that will be used in the present study. It shows that *one-sided violence* and *internal armed conflict* - purely monadic conflict types - are the most destructive in terms of human losses.

Figure 2.1: Number of armed conflicts in the world by type, 1946-2016



Source: UCDP Armed Conflict Dataset Version 4-2014 (Gleditsch et al. 2002, Themnér & Wallensteen 2014), own visualization.

Considering the domestic and the globalisation channel of conflicts' impact<sup>4</sup>, the question remains whether internal conflict types impact on bilateral trade in the same way and to the same extent as interstate or internationalized conflict types. Assessing this question via cross-country analysis implies dealing with country-level as well as country-pair-level heterogeneity. Furthermore, multilateral trade resistance (Anderson & Van Wincoop 2003, Baldwin & Taglioni 2007) and unobservable trade barriers (Baier & Bergstrand 2007) need to be accounted for. Thus, an estimation with a full set of fixed effects, namely country-time and country-pair fixed effects, is desirable. The additional need to address heteroscedasticity and to tackle zero-trade flows by the use of poisson pseudo maximum likelihood estimation (ppml) as proposed by Santos Silva & Tenreyro (2006), led to the recent development of the ppml high-dimensional fixed effects (hdfe) estimator by Zylkin (2017), which renders the usually lengthy estimation of several fixed effects in a ppml setting possible. The use of ppml is particularly desirable in the study of conflict and trade: First, especially conflict-ridden countries tend to exhibit low or zero trade flows. Adding

<sup>4</sup>For a detailed description of the two channels see Section 2.1.1.

an arbitrary number to the dependent variable to make the equation log-linearizable (as e.g. in Eichengreen & Irwin 1995, 1997, Felbermayr & Kohler 2006) might distort the picture. The estimation in levels is thus desirable. Second, the relationship between conflict and trade is reciprocal. The ppml hufe estimator addresses this endogeneity by accounting for unobserved time-invariant heterogeneity.

The gravity equation of international trade (Tinbergen 1962) has become the workhorse for estimating the impact of policy variables such as currency unions and regional or preferential trade agreements on trade flows (see e.g. Baier & Bergstrand 2007, Glick & Rose 2002, Rose 2004). Literature examining the relationship between conflict and trade has as well in great parts<sup>5</sup> relied on the gravity equation: On the one hand, because conflict can be regarded as a policy variable, on the other hand, because the distance between trading partners influences both trade and conflict (Hegre et al. 2010, Chang et al. 2004).

Figure 2.2: Number of armed conflicts, *non-state conflicts* and *one-sided violence*, 1989-2013



Source: Uppsala Conflict Data Program; own visualization.

This paper provides evidence that the heterogeneity of conflict types and their distinct characteristics matter for their influence on trade. By employing the ppml hufe estimator in a gravity model framework and by using UCDP data on five different conflict types – namely *interstate armed conflict*, *internal armed conflict*, *internationalized internal armed*

<sup>5</sup>E.g. Morrow et al. (1999), Vicard (2008) and Rohner et al. (2013) use a game-theoretical framework for their analysis; Anderton & Carter (2001) and Barbieri & Levy (1999) employ interrupted time series analysis, and Hegre et al. (2010) use a simultaneous equations model.



*conflict*, *non-state conflict* and *one-sided violence* – this paper address the question: What is the scope and the effect of internal and interstate or internationalized types of conflict on international trade? Understanding the differences in the effects of conflicts on trade and their magnitude is essential for a better understanding of (i) the extent to which the different conflict types act as trade barriers and (ii) the losses and gains in trade as a component of the economic repercussions of conflict.

Accordingly, this paper will contribute to two strands of literature: First, by using the most fine-grained conflict categorization available from the UCDP this study accounts for the changed nature of conflicts and thus ties in with recent attempts to quantify the effects of other forms of conflict than interstate wars on international trade. Second, this paper uses the gravity model of international trade and applies the state-of-the-art ppml hufe estimator to control for unobserved heterogeneity on the country - as well as on the country-pair - level. Thus, this study contributes to the ongoing literature on determinants of international trade by adding new insights and re-evaluating earlier results from the literature.

The paper proceeds as follows: Section 2.1.1 gives an overview of the literature and establishes testable hypotheses. Section 2.1.2 provides information on the data analyzed. In Section 2.1.3 and 2.1.3 the methodology and empirical implementation are outlined, followed by Section 2.1.4 where results for all conflict types and robustness checks are presented. Section 2.1.5 discusses the results and Section 2.1.6 concludes.

### 2.1.1 Literature & Hypotheses

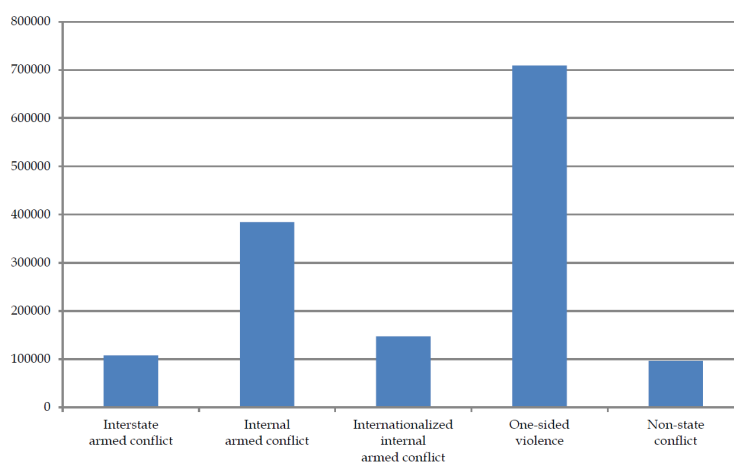
The impact of trade on international relations and the likelihood of war and peace has been studied in-depth. Given the importance for trade policy and international relations, this debate is still ongoing and shapes along the lines of the liberal and realist assumptions, with empirical<sup>6</sup> and theoretical<sup>7</sup> results in favor of both arguments: While liberalists make the case that trade promotes peace via generated economic benefits, realists argue that trade might increase conflict potential via asymmetries. However, it is notable that the relationship between trade and conflict is actually of simultaneous nature: While early

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<sup>6</sup>Studies examining empirically the impact of trade on conflict are e.g. Anderton (2003), Li & Reuveny (2011), Hegre et al. (2010), Russett & Oneal (2001), Polachek et al. (1999).

<sup>7</sup>For a detailed discussion of the two theories see e.g. Anderton et al. (2003), Barbieri & Reuveny (2005), Hegre (2014, 2018), O'Neal & Russett (1999), Polachek & Seiglie (2007).

Figure 2.3: Total battle-related deaths per conflict type, totals for 1992 – 2011



Source: UCDP Battle-Related Deaths Dataset Version 18.1 (*UCDP Battle-Related Deaths dataset version 18.1* n.d.), Pettersson & Eck (2018b); own visualization.

research claimed a one-way causality running from trade to conflict (Polachek 1980, Arad & Hirsch 1981) this assumption was later (Reuveney & Kang 1996, Hegre et al. 2010) revised by showing that [...] there is good intuitive, theoretical, and empirical reason to specify the relationship between international politics and commerce to be reciprocal; changes in either one influence the other.“ (Pollins 1989, p. 758).<sup>8</sup>

Surprisingly, there is comparably little research focusing on the impact of conflict on trade. The few studies mainly restricted their analysis to wars between states or even just wars between major powers. Within this framework, early research focused on the effects of international relations and military alliances on trade. Using data on diplomatic events Polachek (1980) and later Pollins (1989) found that the most trade-intensive country-pairs exhibit the lowest conflict involvements. Military alliances have been found to have a statistically significant positive and large effect on bilateral trade, with the effect being larger when embedded in bipolar compared to multipolar systems (Gowa & Mansfield 1993).<sup>9</sup> Furthermore, results by Mansfield & Bronson (1997) suggest that alliances that include a major power trade more than alliances without a major-power counterparts.

Later on, evidence for the liberal assumption was gathered: Barbieri & Levy (1999) found no evidence that war between major powers reduces bilateral trade, although the anticipation of war was resembled in the trade data. Along the same lines, Mansfield & Pevehouse

<sup>8</sup>For a discussion of how to deal econometrically with the simultaneity bias inherent in the study of trade and conflict, see Section 2.1.3.

<sup>9</sup>Dorussen (1999), Martin et al. (2008), Gartzke & Westerwinter (2016), Peterson (2011) discuss bi- and multipolarity in the framework of trade and conflict.

(2000) did not find a significant effect of militarized interstate disputes<sup>10</sup> (MIDs) on bilateral trade. However, these two studies contrast the results of a greater amount of papers, finding a negative relationship between MIDs and trade: Anderton & Carter (2001) found strong evidence that interstate war between major but also between non-major powers is connected to a decrease in trade between the pre- and post-war period. Martin et al. (2008) estimated that trade falls by 22% during a MID and that this negative impact remains constant for another three years after the respective war. This persistent negative effect seems to not only apply to countries in conflict, but also to neutral countries and hence impacts on global economic welfare (Glick & Taylor 2010). Overall, studies either focused on interstate disputes or major-power dyads and the majority found significant negative effects of these conflict types on trade. Although data on MIDs is frequently used in economic as well as political science analyses, it is worth noting that MIDs are defined narrowly ranging from spoken threats to combat short of war. Furthermore, one in ten MIDs (11%) between 1993 and 2010 was a dispute about fisheries (Hendrix & Roberts 2017). This limits the explanatory power of analyses using this data.

Despite the rise in internal and *internationalized internal armed conflicts* and the growing importance of *non-state conflicts* and *one-sided violence*, it is still unclear whether the findings for MIDs and major-power dyad conflicts also apply to them. Only a small group of papers has addressed this research gap. Bayer & Rupert (2004) used “civil war” - which includes military and governmental involvement, effective resistance and at least 1,000 battle deaths - and found that civil wars yield a 30% decrease of bilateral trade. It remains unclear whether their definition of conflict includes the involvement of foreign governments and it is questionable why conflicts displaying less battle deaths should not be included in the analysis. Furthermore, they applied ols estimation which was later shown to be severely biased when estimating the log-linear version of the gravity model (Santos Silva & Tenreyro 2006). Marano et al. (2013) focused on “interstate” and “intra-state conflict”, where the former refers to conflict between states including resistance of foreign domination and the latter includes ethnic conflict and conflict between rival political groups. Again, these conflict definitions do not allow for a differentiation between third-party involvement and pure monadic conflict or a mixture of both (as e.g. in *internationalized internal armed conflict*). They concluded that internal conflicts have an

<sup>10</sup>“Militarized interstate disputes are united historical cases of conflict in which the threat, display or use of military force short of war by one member state is explicitly directed towards the government, official representatives, official forces, property, or territory of another state. Disputes are composed of incidents that range in intensity from threats to use force to actual combat short of war.” (Jones et al. 1996, p.163)

even larger negative impact on trade than interstate conflicts. Long (2008) and Blomberg & Hess (2006) made use of a more detailed distinction: Long (2008) differentiated between “internal”, “internationalized internal” and “interstate armed conflict” and found that even expectations of an internal conflict can lead to a reduction of trade. Blomberg & Hess (2006) disaggregated even further and assessed the impact of violence including terrorism, revolutions, interethnic fighting and external conflict on trade. They found that the occurrence of violence has the same effect as a 30% tariff on trade, which suggests that violence has a much larger negative effect than other trade impediments. However, their results are probably biased as well because they as well applied ols estimation. Overall, studies focusing on the trade effect of different forms of conflict display two distinct features. First, they illustrate the difficulty in separating conflict types accurately by aggregating different conflict types into one category. Second, while mostly making use of the gravity equation, all studies fall short of applying the theory-consistent ppml estimator.

Conflict affects trade through a domestic and a globalization channel. On the domestic side, trade is affected by the loss of humans (either through deaths or flight), property and infrastructure as these factors are crucial for trading goods (see e.g. Donaldson 2018). During civil wars, private and social capital is redirected towards e.g. soldiering and procurement of weapons (Murdoch & Sandler 2002). Private investment and the capital stock are reduced (Barro 1996, Imai & Weinstein 2000). Altogether, this impacts negatively on production - as it shifts the production-possibility-frontier inwards - and on distribution of traded goods, as trade routes are disrupted and transportation costs increase. In addition, national income decreases - by reducing export profits and consumers’ buying power - and thus the economic growth of a country (see e.g. Chauvin & Rohner 2009, Collier 1999, 2003, Stewart & Fitzgerald 2000). In conflict, countries face the so-called “guns vs. butter trade-off”, where governments redirect large shares of GDP from public spending towards defense expenditures (Collier 2003, Anderton & Carter 2009).

On the globalization side, present and future economic activities are disrupted by rising political and economic insecurity. Economic agents limit or cease their business in view of conflict: Firms react by supplying lesser exports and consumers demand fewer imports due to risen opportunity costs (Long 2008). Results on firm’s stock performance during ceasefires compared to times of conflict are mixed: While Abadie & Gardeazabal (2003) showed that stocks perform better during truce, Guidolin & La Ferrara (2007) presented

evidence for the diamond sector in the resource-dependent economy of Angola, where firms profit by conflict. A reduction in the quality of institutions caused by corruption and imperfect contract enforcement can act as a price mark-up and reduces trade as much as tariffs do (Anderson & Marcouiller 2002).

Attributing each conflict types impact quantitatively to a specific mechanism is a herculean task (Mueller 2013). There is no data available on conflict's damages to e.g. infrastructure.<sup>11</sup> Without detailed knowledge of the quantitative magnitude of the effect of conflict for each mechanism, it remains difficult to hypothesize about affected production factors and hence trade. However, all conflict types impact on trade through the domestic and the globalization channel and can thus lead to trade disruption and/or trade diversion. Hypotheses can be derived from the detailed conflict categorization and conflict types' attributes provided by UCDP. This allows for a differentiation between the impact of internal conflicts and dyadic conflicts on bilateral trade, the impact of conflicts with government involvement and without government involvement, the impact of location of conflict and the impact of enmity between two states on trade. The domestic and the globalization channel are impacted differently by these factors. Thus, bilateral trade can as well be expected to be hit differently.

If a country in the trading dyad is location of a conflict, this country can be assumed to be hit harder by this conflict, as it faces the greater part of destruction of humans, property and infrastructure compared to a country sending troops to a conflict from afar. Marano et al. (2013) give a detailed overview of the negative effects for exporters and importers of being conflict location of interstate and internal conflicts. However, there is as well evidence that especially in resource-dependent economies producers benefit from conflict (Garfinkel et al. 2008, Guidolin & La Ferrara 2007). To test these conflicting results from the literature, the first hypothesis is as follows.

*Hypothesis (i): If a country in the trading dyad is location of a conflict, trade is impacted negatively.*

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<sup>11</sup>One way to measure conflict intensity is the number of battle-related deaths. However, these are reported per conflict and not per country. Due to e.g. NATO's mutual defense clause countries like e.g. Germany or Spain would display high numbers of battle-related deaths which would, however, not adequately reflect their actual conflict involvement and would be disproportionate compared to conflict-ridden countries. Hence, this measure might produce spurious results and is therefore inadequate.

However, there is an important difference between conflict that happens between states and conflict that happens within states. Although the fraction of conflicts that happen within states (see section 2.1.2) as well as their destruction in terms of battle-deaths (see figure 2.3) is higher compared to conflicts that happen between states, the latter might as well impact negatively on trade because it implies two rivaling states and hence might lead to the deterioration of bilateral trade relations, as the literature on trade and MIDs has shown. Long (2008) uses the same conflict categorization as the present study and finds a higher negative effect of *interstate armed conflict* than for internal conflict. More importantly, he as well estimates the impact of rivalry in the dyad and finds a large negative impact on dyadic trade.

*Hypothesis (ii): If the countries in the trading dyad are enemies in the same conflict, trade is impacted more negatively than if both in the dyad are involved in the same conflict but not enemies.*

Conflict types vary in terms of actors involved: In some governments are involved, some only involve non-state actors. These usually have no access to use public spending for conflict means. Additionally, especially the conflict types involving governments as actors display higher numbers of battle-related deaths than *non-state conflict*<sup>12</sup> (see Figure 2.3).

*Hypothesis (iii): Conflict types with government involvement impact more negatively on trade than conflict types without government involvement.*

Last but not least, the ppml hdfe estimator itself serves as a basis to hypothesize: Since the application by the authors to currency unions has only been published very recently<sup>13</sup>, there is not a wide range of research using this approach. Results by Larch et al. (2018) suggest that previous literature overestimated the positive effect of currency unions. The high number of fixed effects removes all possible country-level and bilateral heterogeneity as well as bilateral time-invariant simultaneity. Furthermore, Santos Silva & Tenreiro (2006) suggest that former studies using ols estimators overestimated the effect of geogra-

<sup>12</sup>*Non-state conflict* is the only conflict type without government involvement. Note that *one-sided violence* consists of cases where governments are involved and those where aggression is exerted only by non-state actors. The latter makes the majority of cases but the fewer battle-deaths (140246 compared to 565805 in the cases where governments are involved). This fact as well supports the argument made above.

<sup>13</sup>The paper by Larch et al. (2018) was published in November 2018.

phy on trade.

*Hypothesis (iv): Results from ppml hdfe are smaller in magnitude than those from other estimators seen previously in the literature.*

### 2.1.2 Data

In the majority of papers discussing conflict and trade the time series ends in the year 2000 or even earlier. Hence, current conflicts - as e.g. the invasions of Afghanistan and Iraq in 2003, which still shape the global political and economic present – are not included. This study incorporates the time series 1992 to 2011 to overcome this problem. In addition, observations are not limited to major-power dyads<sup>14</sup> as seen in great parts of the literature: The trade data contains information on 236 countries and includes all available export and import pairs. Bilateral trade data (in 1000 US\$) taken from the *United Nations Comtrade Database* (2008) and is defined at cost insurance and freight values. Information on the GDP of exporter and importer (in current US\$) is taken from the *World Development Indicators* (2013) (WDI). Distance accounts for geographic characteristics and represents the usual gravity controls together with preferential trade agreements. As a measure of distance the population weighted great circle distance between the countries most populated cities is used. They are taken from the Centre d’Etudes Prospectives et d’Informations Internationales (2015). Both, distance as well as preferential trade agreements, are time-variant country-pair variables and thus not removed by the high-dimensional fixed effects. Other commonly used control variables in gravity equations (such as e.g. national income measured as GDP and contiguity) and in the study of trade and conflict (as e.g. the level of democracy) are either time-variant country-level or time-invariant country-pair level variables. The applied high-dimensional fixed effects control for these characteristics.

Former studies used data on MIDs from the Correlates of War Project (e.g. Glick & Taylor 2010, Martin et al. 2008), data from the Center for Systemic Peace (e.g. Marano et al. 2013, Qureshi 2013) or self-assembled measures of conflict (e.g. Blomberg & Hess 2006, Mansfield & Pevehouse 2000). Datasets vary in definitions of conflict types, intensity

<sup>14</sup>The limitation of the analysis to major-power dyads is problematic because it creates a non-random sample and hence limits valid inference. For a discussion see e.g. Benson (2005), Lemke & Reed (2001). This procedure is seen especially in early studies on conflict and trade and is mostly due to the limited availability of trade and conflict data. Fortunately, data availability has improved significantly during the past two decades.

measurement and temporal and spatial dimensions. To the author's knowledge, the 2014 UCDP data has not yet been used for studying the impact of conflicts on trade.<sup>15</sup> This is even more surprising because the conflict typology of the UCDP has several advantages compared to other data<sup>16</sup>: Conflict categories include all possible internal and external conflicts (except the sole threat or display of the use of force<sup>17</sup>), ranging from armed group clashes without government participation, over repression exerted by governments towards civilians, to civil war with participation of external governments. Hence, there is a very clear and detailed distinction between interstate conflicts and internal conflicts, which is crucial for this study: In contrast to former research that either looked at MIDs or civil war, this fine-grained conflict categorization allows to compare their impact on trade flows. Furthermore, UCDP data has global coverage, are updated annually and provide a lot of additional information on the different conflict types.<sup>18</sup>

To obtain a dataset that covers the described broad range of conflicts, three datasets from the *Uppsala Conflict Data Program (UCDP)* (2014) /Peace Research Institute Oslo (PRIO) were combined: The Armed Conflict<sup>19</sup> dataset, the *Non-state conflict* dataset and the *One-sided violence* dataset.

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<sup>15</sup>It is worth noting that Long (2008) uses the 2002 version of the UCDP data, with a time-series running until 2001.

<sup>16</sup>For a detailed discussion of conflict data see, e.g. Boese & Kamin (2019), Keshk et al. (2010)

<sup>17</sup>Hence, the deterioration of international relations triggered by spoken threats or the display of troops, as for example currently seen in different communications of the Trump administration towards North Korea, Russia, or China, would not be included in the data, since UCDP only codes a conflict as such once 25 battle-related deaths are recorded.

<sup>18</sup>E.g. information on incompatibility, start and end date of conflict, battle-related deaths, inactive years of conflict, organizational level of warring parties, etc.

<sup>19</sup>Armed conflict by definition generally also includes extra-systemic conflict, but this category basically contains colonial conflicts. The last extra-systemic conflict ended in 1974. Hence, no extra-systemic conflict is covered by the timeseries of the present dataset.



Table 2.1: Summary statistics for all variables used specification (D)

Variable	Obs	Mean	Std. Dev.	Min	Max
year	418,027	2002.498	5.470938	1992	2011
Exports	417,211	1.91e+09	9.18e+10	0	1.50e+13
population-weighted distance	401,136	7382.622	4520.537	35.59131	19734.89
preferential trade agreement	418,023	.0775603	.2674788	0	1
i or j in <i>interstate armed conflict</i>	418,027	0.0217091	0.1457323	0	1
i or j location of an <i>interstate armed conflict</i>	418,027	0.0190969	0.1368657	0	1
i or j in <i>internal armed conflict</i>	418,027	0.2028434	0.4021173	0	1
i or j in <i>internationalized internal armed conflict</i>	418,027	0.2799436	0.4489718	0	1
i or j location of an <i>internationalized internal armed conflict</i>	418,027	0.0221923	0.1473089	0	1
i or j in <i>non-state conflict</i>	418,027	0.1402326	0.3472286	0	1
i or j in <i>one-sided violence</i>	418,027	0.1851483	0.3884183	0	1
i or j have a neighbor at war	418,027	0.4754167	0.4993959	0	1
Both in <i>interstate armed conflict</i>	418,027	0.0001364	0.0116763	0	1
Enemies in <i>interstate armed conflict</i>	418,027	0.0000646	0.0080365	0	1
Both in <i>internal armed conflict</i>	418,027	0.011449	0.1063859	0	1
Both in <i>internationalized internal armed conflict</i>	418,027	0.0450497	0.2074135	0	1
Enemies in <i>internationalized internal armed conflict</i>	418,027	0.0000885	0.0094076	0	1
Both in <i>non-state conflict</i>	418,027	0.0049518	0.0701949	0	1
Both in <i>one-sided violence</i>	418,027	0.0098965	0.0989877	0	1

From these three datasets five conflict types across a total of 128 countries are considered in this paper:

- *Interstate armed conflict* (# of events: 7)
- *Internal armed conflict* (# of events: 107)
- *Internationalized internal armed conflict* (# of events: 25)
- *Non-state conflict* (# of events: 414)
- *One-sided violence* (# of events: 206)

UCDP codes a conflict as such once a minimum threshold of at least 25 battle-related deaths per year is reached.<sup>20</sup> Armed conflict always includes at least one government as a warring party in the conflict and is defined as “[...] a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths” (Gleditsch et al. 2002, Themnér & Wallensteen 2014, UCDP/PRIO 2014, p. 1). The three armed conflict types included are defined as follows: *interstate armed conflict* “[...]occurs between two or more states”, such as e.g. the ongoing conflict between India and Pakistan in Kashmir, *internal armed conflict* “[...]occurs between the government of a state and one or more internal opposition group(s) without intervention from other states”, such as e.g. the conflict between Turkey and PKK or Israel and the Hamas, and *internationalized internal armed conflict* “[...] occurs between the government of a state and one or more internal opposition group(s) with intervention from other states (secondary parties) on one or both sides”, among those the more prominent ones such as e.g. the conflicts in Iraq or Afghanistan, but as well the ongoing conflict in Congo (Gleditsch et al. 2002, Themnér & Wallensteen 2014, UCDP/PRIO 2014, p. 9).

*Non-state conflict* does per definition not include states as warring parties, while *one-sided violence* describes the aggression against civilians by the government or an organized group. *Non-state conflict* is defined as “[...] the use of armed force between two organized armed groups, neither of which is the government of a state, which results in at least 25 battle-related deaths in a year.” (Sundberg et al. 2012a,b). Examples for *non-state conflict* are the fights between the groups Hizb-i-Islami-yi Afghanistan and the Taleban or the ongoing drug war in Mexico between different cartels.

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<sup>20</sup>Note that the numbers on battle-related deaths are not attributable to each actor, but rather are total battle-related deaths per year within the respective conflict.

*One-sided violence* is defined as “[...] the use of armed force by the government of a state or by a formally organized group against civilians which results in at least 25 deaths” (Eck & Hultman 2007, Kreutz 2008). Examples for *one-sided violence* are e.g. cases of repression and genocide, such as in Guatemala or Darfur. Information on government involvement is used to test hypothesis (iii).

Furthermore, UCDP reports different sides to a conflict namely side A, side B, side A second and side B second. Side A always represents the party which has the primary claim to the conflict, side B represents the opponent and the secondary sides the respective supporters. Secondary sides are only reported for the armed conflict case. Within this category, side A represents a government, side B may be a government (for example in the cases of *interstate armed conflict* and *internationalized internal armed conflict*), but can also be a non-state actor (e.g. paramilitary group, rebel group, etc.). In the category *one-sided violence*, side A may be a government, but can also be a non-state group, while in *non-state conflict* both actors are per definition non-state actors.

This is important for three reasons: First, a decision has to be made which sides to include as conflict observations. This comes down to the question whether one assumes that all sides to a conflict respond to the same level of involvement. One could argue that the side with primary claim to the conflict (namely side a) has the highest involvement level in the conflict. To obtain as many conflict observations as possible and by assuming that conflict has an impact on trade no matter on which side of the conflict an actor stands, all conflict involvements on all sides were included. Second, conflicts have to be attributable to a country to allow merging with the trade data. Accordingly, all conflict datasets were combined via the variable “Location”. For the armed conflict category “Location” is unequal to the geographical location of conflict, but describes the country of the government with the primary claim to the conflict. For the categories *non-state conflict* and *one-sided violence*, the variable “Location” indicates the geographical location of the conflict. Third, information on enmity between two countries is used to test hypothesis (ii).

Obviously, a bias arises from combining conflict observations that yield the hidden information of being a war zone, and the ones that are not: A country experiencing conflict on its territory can be expected to be more severely impacted on by that conflict than a country that is sending troops. To differentiate these cases and to test hypothesis (i) a

location dummy was created, which indicates whether the respective country is location of conflict or not.<sup>21</sup> This study does not distinguish between a country being location of one or of more than one conflict. Hence, the location dummy is equal to 1 if a country is location of at least one conflict of that type. A detailed overview of all conflict type involvement per country can be found in the appendix.

Two important features about the conflict data that have to be considered when interpreting the results have to be pointed out: First, while the *interstate armed conflict* country group largely consists of countries that also were the location of the conflict (80%), the reverse is true for *internationalized internal armed conflict*, where only 24.4% were the location of conflict. Second, the extent to which different conflict types appear simultaneously is striking: All 15 countries involved in *interstate armed conflict* have been involved in at least one other type of conflict before or during the same time. For *internal armed conflict* the picture is very similar with only one country out of 60 being solely involved in that conflict type and not in another. *internationalized internal armed conflict* paints a different picture: 65.6% are solely involved in this conflict type during the time series, but only one country in this group is conflict location. As shown above, this group mainly consists of countries that are involved in conflict from afar and those countries that are location of an *internationalized internal armed conflict* as well host other conflict types. *Non-state conflict* (96.6%) and *one-sided violence* (93.4%) again are proof for the argument made above that conflict types strikingly often appear simultaneously.

A small number of studies has looked at the impact of conflict in a neighboring country on trade for the home country: Marano et al. (2013), Qureshi (2013) and Couttenier & Vicard (2011) find negative effects of conflict in the neighboring country on bilateral trade of countries not involved. De Groot (2010) studies the regional spillover effects of conflict onto economic growth and finds a negative effect for directly contiguous countries, but a positive effect for non-contiguous countries. Furthermore, conflict in the neighboring country does not only affect the economy of the home country, but as well increases the likelihood of a conflict in the home country, as Carmignani & Kler (2016) show. To control

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<sup>21</sup>This dummy was created by means of the “Location” variable provided in the UCDP data. As described above, the information comprised by the location variable differs between the datasets. However, UCDP points out that in the armed conflict category “[...] in practice, “location” often equals the geographical location of the violence.” (*UCDP definitions, “Location”* n.d.). All armed conflicts were checked to make sure only countries that were location of conflict would be included in the dummy. Adjustments had to be made in the case of the invasion of Iraq, where the “locations” United States, United Kingdom and Australia were dropped, since the battle only took place in Iraq.

for these spillover effects, a dummy variable is added which is equal to one if a neighboring country of the exporter or the importer is in conflict. This dummy was created using the information from the “location” variables in the UCDP data and the Direct Contiguity (v3.2) Dataset from the Correlates of War Project<sup>22</sup>. From this dataset, the category “Land contiguity” is used, which is defined as “[...] the intersection of the homeland territory of the two states in the dyad, either through a land boundary or a river (such as the Rio Grande in the case of the US-Mexico border) [...]”<sup>23</sup> (*Correlates of War Project. Direct Contiguity Data, 1816-2016. Version 3.2.* 2016).

### 2.1.3 Model, Methodology & Estimation

#### Model & Methodology

The present paper employs the gravity model of international trade to examine the impact of conflict on trade. However, the single equation nature of the gravity model does not account for the simultaneity bias inherent in the study of conflict and trade and might thus lead to inconsistent and biased results (Polachek 1980, Polachek & Seiglie 2007). One option to solve this endogeneity problem would be an instrumental variable approach, but most eligible variables - such as preferential trade agreements or military expenditures - are correlated with both trade and conflict (see Hegre et al. 2010, Martin et al. 2008, Polachek & Seiglie 2007) and do hence not serve as proper instruments. The most promising alternative to deal with simultaneity is to exploit the variation over time by including country-pair fixed effects which control for omitted time-invariant country-pair characteristics (Glick & Taylor 2010, Head & Mayer 2014). Estimating the gravity equation with country-pair fixed effects has two pitfalls: First, an analysis of bilateral control variables is not possible. Second, a theory consistent estimation with the ppml model proposed by Santos Silva & Tenreyro (2006)<sup>24</sup> controlling for multilateral trade resistance is only possible if a multilateral resistance measure is constructed and implemented (as proposed e.g. by Baldwin & Taglioni 2006, Head & Mayer 2000, Head 2003). Recently, Larch et al. (2018) proposed a further development of the ppml panel estimator which introduces a full set of fixed effects - namely exporter-time, importer-time, and pair fixed effects - to the estimation. This allows the estimation of a gravity equation controlling

<sup>22</sup>Correlates of War Project. Direct Contiguity Data, 1816-2016. Version 3.2.; Stinnett et al. (2002).

<sup>23</sup>Note that, due to lack of a clear definition of “contiguity” on the part of CEPIL, a clearly defined contiguity measure for the construction of the neighbor-at-war variable was chosen, following the approach of Qureshi (2013).

<sup>24</sup>In Stata, the conventional ppml command does not allow for the inclusion of country-pair fixed effects.

for multilateral trade resistance and simultaneity and hence serves in this paper as the estimator of choice. Breusch-Pagan-tests were performed to test for the presence of heteroscedasticity. A p-value less than 0.001 was obtained in all cases, strongly rejecting the null-hypothesis of homoscedasticity. Estimating the constant elasticity model in log-linear form is thus inadequate and the ppml-specification remains the estimator of choice. Additionally, the squared correlation coefficients between observed and predicted values of the dependent variable were calculated as a measure of goodness-of-fit (reported in Tables 21 - 25). Despite the overall good fit of the gravity model in all specifications, the  $R^2$  for the ppml-specifications displays higher values than for the linear form.

Nevertheless, the ppml estimation strategy as well holds a few pitfalls that have to be considered: “In the presence of importer and exporter fixed effects a variety of potentially interesting trade determinants can no longer be identified in a gravity equation. Notably, (1) anything that affects exporters’ propensity to export to all destinations [...], (2) variables that affect imports without regard to origin, [...] and (3) sums, averages and differences of country-specific variables. If any variable of these three forms is added to a trade equation estimated with importer and exporter fixed effects, programs such as Stata will report estimates with standard errors. However the estimates are meaningless” (Head & Mayer 2014, p. 158). Hence, to include country-based time-variant dummies in the estimation, these have to be bilateralized, otherwise Stata will either drop them because of collinearity or report biased estimates. Accordingly, the dummy variables conflict, location and neighbor were bilateralized to keep them in the estimation. Thus, the conflict dummy yields the information whether the exporter or the importer have been in conflict. This implies that no conclusion can be drawn for the exporter or the importer specifically, but rather more generally for one of both being in conflict. For the case where both countries in the dyad are involved in conflict another dummy is introduced which indicates when both countries are involved in the same conflict in a given year.

To make differences visible and comparable with past results from the literature and to check for robustness the gravity model is estimated in four specifications, namely

- (A) ols with country-time fixed effects (ctfe)
- (B) ols with exporter-time and importer-time and country-pair fixed effects (hdfe)
- (C) ppml with exporter-time and importer-time fixed effects (ctfe)

(D) ppml with exporter-time and importer-time and country-pair fixed effects (hdfe)

Specification (D) is the estimator of choice. Results are presented in Table 2.2. All other results are provided in the Appendix (Tables 21 - 25). Specifications (A) and (B) are estimated with the Stata command ‘*reghdfe*’ written by Sergio Correia (2016). Specification (C) is estimated with Stata command ‘*ppml\_panel\_sg*’ written by Tom Zylkin (2017). To estimate only country-time fixed effects, pair fixed effects were suppressed with the “*nopair*” option of the ‘*ppml\_panel\_sg*’-command.

### Estimation

The present study applies a gravity model with a ppml hdfe estimator to examine the impact of different conflict types on global trade flows. An estimable specification of the conventional gravity model of international trade, which can be formally derived from a general equilibrium model of trade, production and consumption as in Anderson & Van Wincoop (2003), is used. The ppml estimator requires an estimation with the dependent variable in levels and continuous regressors in logs (equation (1)). Accordingly, regression equation (1) is given by

$$X_{ij,t} = \exp \left[ \beta_1 \text{conflict}_{ij,t} + \beta_2 \text{location}_{ij,t} + \beta_3 \text{neighbor}_{ij,t} + \beta_4 \text{both}_{ij,t} + \beta_5 \text{enemy}_{ij,t} + \beta_9 \log(\text{dist}_{ij,t}) + \beta_{10} \text{pta}_{ij,t} + \omega_{i,t} + \rho_{j,t} + \mu_{ij} \right] + \epsilon_{ij,t} \quad (2.1)$$

where *i* and *j* denote exporter and importer country, *t* denotes time, and the other variables are defined as:

$X_{ij,t}$  is the total trade value exported from origin *i* to destination *j* at time *t*;

$\text{conflict}_{ij,t}$  is a dummy being unity if *i* or *j* have been involved in the respective conflict at time *t*;

$\text{location}_{ij,t}$  is a dummy being unity if *i* or *j* have been location of the respective conflict at time *t*;

$\text{neighbor}_{ij,t}$  is a dummy being unity if the neighbor of *i* or *j* has been involved in a conflict at time *t*;

$\text{both}_{ij,t}$  is a dummy being unity if both, *i* and *j*, have been involved in the respective conflict at time *t*;

$\text{enemy}_{ij,t}$  is a dummy being unity if *i* and *j* have been enemies in the respective conflict at time *t*;

$\text{dist}_{ij,t}$  is measuring the population-weighted distance between *i* and *j* at time *t*;

$pta_{ij,t}$  is a dummy variable being unity if a preferential trade agreement exists at time  $t$ ;  $\omega_{i,t}$  and  $\rho_{j,t}$  represent the exporter-time and importer-time fixed effects;  $\mu_{ij}$  are the country-pair fixed effects, and  $\epsilon_{ij,t}$  is the error term, taking up all other influences on dyadic trade.

Regression equation (1) is estimated for each of the five conflict types.  $location_{ij,t}$  is only added to the estimation where the conflict type itself does not include this information: As described in Section 2.1.2, *internal armed conflict*, *non-state conflict* and *one-sided violence* per se take place within the country involved in the conflict. For the conflict categories *interstate armed conflict* and *internationalized internal armed conflict*, where more countries can be involved than only the country where the fighting takes place, the dummy was added.  $neighbor_{ij,t}$  controls for a minimal (or relaxed) definition of conflict involvement: It only indicates whether the neighbor is involved in a conflict.  $neighbor_{ij,t}$  does not indicate in which conflict type the neighbor is involved in, the number of conflicts the neighbor is involved in or whether or not the neighboring country is the location of a conflict.

#### 2.1.4 Results

Overview tables for each conflict type with results from all specifications (A), (B), (C) and (D) can be found in the Appendix (Tables 21 - 25). The  $R^2$ s in these tables support the choice of the preferred specification (D) which displays the best model fit. Table 2.2 shows regression results for specification (D). Each column displays the results for one conflict type. Main results from the regressions are as follows.



Table 2.2: Results for specification (D): Ppml with high-dimensional fixed effects

dep variable: exports	Interstate		Internal		Intern. internal		Non-state		One-sided	
	armed conflict	armed conflict	armed conflict	armed conflict	armed conflict	armed conflict	conflict	conflict	violence	violence
i or j in conflict	-0.0397*** (0.011)	0.1251*** (0.017)	0.1106*** (0.007)	0.0086 (0.012)	0.0500*** (0.010)					
i or j conflict location	-0.2774*** (0.036)		-0.0938*** (0.028)							
i or j have neighbor in conflict	0.0006 (0.008)	0.0017 (0.008)	0.0044 (0.008)	-0.0000 (0.008)	0.0001 (0.008)					
both in conflict	-0.0298 (0.022)	0.3187*** (0.038)	0.1270*** (0.008)	0.0491 (0.045)	0.0282 (0.036)					
Enemies	-0.1540 (0.252)		-0.4728*** (0.137)							
ln distance	0.0012 (0.005)	-0.0005 (0.005)	0.0012 (0.005)	0.0034 (0.005)	0.0049 (0.005)					
Preferential trade arrangement	0.0304*** (0.009)	0.0364*** (0.009)	0.0405*** (0.009)	0.0317*** (0.009)	0.0372*** (0.009)					
Observations	400,584	400,584	400,584	400,584	400,584					
R <sup>2</sup>	1.000	1.000	1.000	1.000	1.000					

Estimation with Importer-year, Exporter-year, and Country-pair fixed effects. Robust standard errors in parentheses.

\* p<0.1, \*\* p<0.05, \*\*\* p<0.01 indicate statistical significance at the 10, 5, and 1 percent level, respectively.

### Impact of exporter or importer being in conflict

First, only *interstate armed conflict* impacts negatively and significantly on international trade, reducing trade flows by  $e^{-0.0397} - 1 = -3.9\%$ . This negative effect is robust across all other specifications except ols hufe where it is negative but not significant (see Table 21). Second, all other conflict types impact positively and significantly on international trade except for *non-state conflict*, where the result is positive but not significant. The presence of an *internal armed conflict* displays the highest positive impact on trade (11.8%), followed by *internationalized internal armed conflict* (10.5%) and *one-sided violence* (4.8%). Note that this finding is not robust for the other specifications: Ols estimations display negative effects for all conflict types on trade (except for *internationalized internal armed conflict* and *one-sided violence* in the ols hufe-specification where the results are not significant). Surprisingly, the “classic” ppml-specification with country-time fixed effects shows a trade reduction of  $\approx 99\%$  for each conflict type. Third, being the location of an *interstate armed conflict* additionally decreases trade by 24.2%, and being the location of an *internationalized internal armed conflict* has as well a negative and significant effect (-8.9%). Only the latter result is robust across all specifications (see Table 23), while the result for *interstate armed conflict* is only robust in the ppml specifications (see Table 21). Note that the other conflict types imply by definition also the conflict location). Fourth, if the importer or exporter have a neighbor in conflict their trade is not affected: Estimates are positive, but very small and not significant. This result is robust across conflict types but only for the hufe-specifications.

### Impact of both being involved in a conflict

Generally, the “both in conflict”-specification should resemble the results from the “i or j”-specification, although magnitude and significance might differ since the cases where both countries in the trading dyad are involved in the same conflict type are expected to be fewer compared to those where only exporter or importer are involved. Overall, the results show these expected similarities: First, if both countries are involved in an *interstate armed conflict* trade is affected negatively but not significantly, with the negative result being robust across all specifications. Second, *internal armed conflict* and *internationalized internal armed conflict* display a positive impact on international trade by 27.3% and 11.9% respectively. The result for *internationalized internal armed conflict* is robust for the hufe-specifications, while *internal armed conflict* displays positive and high results in all other specifications. *One-sided violence* and *non-state conflict* display positive but

not significant estimates, which are robust only for the hdfe specifications in the former, and only for ppml hdfe in the latter case. If both countries were involved in the same *internationalized internal armed conflict* and were enemies, trade is decreased by 37.7%. This high negative effect is robust across all specifications. For *interstate armed conflict*, the result is negative but not significant. In this case, ctf specifications yield high negative and significant effects, while ols hdfe yields a positive but not significant result.

### Control variables

In the ppml hdfe specification, only two control variables are included: Distance and preferential trade agreements. While distance does not have a significant effect in this specification, preferential trade agreements have a positive and highly significant effect across all conflict types and across all specifications except for ppml ctf, where the estimate is negative and high. For distance the result is unique compared to other specifications: For ols and ppml with ctf the effects are negative, significant and high. For ols hdfe the estimate is positive and significant.

#### 2.1.5 Discussion

This paper estimates the effects of different types of conflict on trade by using a ppml hdfe approach. Major findings are that solely *interstate armed conflict* impacts negatively on exports, while *internal armed conflict*, *internationalized internal armed conflict* and *one-sided violence* have a positive effect on trade flows. Being location of an *interstate armed conflict* or an *internationalized internal armed conflict* impacts negatively and significantly on trade. Furthermore, enmity between trading states has a large negative effect when the countries are rivals in an *internationalized internal armed conflict*.

The negative impact of *interstate armed conflict* appears to be robust to the removal of all dyadic heterogeneity by hdfe. Overall, the obtained result is in line with previous findings from the literature, although the impact is much less severe than e.g. the trade decreasing effect of interstate dispute found by Martin et al. (2008) of 22%, but closer to the result of Blomberg & Hess (2006) who found a negative but not significant effect of external wars on trade. Considering the overall low number of *interstate armed conflict* (see Table 29) in comparison to the other conflict types, the still significant and negative effect on trade matches the assumption made above that *interstate armed conflict* is especially destructive in terms of production factors and trade relations. This argument is

furthermore supported by the additional high negative impact implied when being location of an *interstate armed conflict*. As aforementioned, this conflict type appears always simultaneously with other conflict types. Thus, the question remains how much of the effect of other conflict types on trade might be picked up by the effect of *interstate armed conflict*. This simultaneity in appearance of conflict types is, however, as well true for *internal armed conflict* and *one-sided violence*, which show positive effects on trade flows. These results, as well as the positive effect of *internationalized internal armed conflict* on trade, are contrary to previous findings which provided evidence for negative effects of internal wars and other forms of violence (Blomberg & Hess 2006, Marano et al. 2013). *Internationalized internal armed conflict* is a special case: First, it displays an *internal armed conflict* where external governments are involved, often so via cases such as NATO's mutual defense clause. Second, the majority of countries involved in this group are not location of the conflict – in contrast to *internal armed conflict* and *one-sided violence* - which is mirrored by the results: Once a country is location of an *internationalized internal armed conflict*, the impact is negative and significant. Additionally, the countries that are not location of an *internationalized internal armed conflict* but involved in such a conflict are usually western states such as the US or European countries. The positive effect of an *internationalized internal armed conflict* on trade might be driven precisely by these countries which profit from their involvement in conflict by increased trade in e.g. munitions but also other supplies to troops. Furthermore, the positive result for both trading partners being involved in an *internationalized internal armed conflict* might provide evidence supporting earlier findings that alliances trade more (Gowa & Mansfield 1993). The positive effects of *internal armed conflict* and *one-sided violence* on trade are much more staggering and allow for several possible interpretations. First, both conflict types include government involvement. Thus, increased trade levels could be due to increased demand for conflict goods supplied by the government as in the case of *internationalized internal armed conflict*. However, as these conflict types are purely internal, a closer look has to be taken onto the characteristics of the countries affected. As Cali (2014) demonstrates, countries in internal conflict often display a high dependence on primary export commodities and a low diversification in terms of production. The dependent variable in this analysis is the value of total exports. When a country is hit by conflict a reduction in production quantities may lead to increased prices. This is not only true for the country in conflict, but as well for trading partners who have to import higher priced commodities from other countries. Thus, the traded value might increase,

although the traded quantity decreases or stagnates. In turn, what is mirrored in the estimates might not be the suspected negative influence of conflict on production factors, but rather the shortage following these impacts and the associated market reactions (see e.g. Garfinkel et al. 2008, for a discussion of oil-dependent countries and internal conflict).

For the conflict types *interstate armed conflict* and *internationalized internal armed conflict* the additional effect of being the location of the conflict is estimated and a negative and significant effect on trade is found for both. Since the other conflict types - that are per definition conflict locations - displayed overall increases in trade, no statement can be made on the impact of being location for these types of conflict. The fact that being the location of an *interstate armed conflict* impacts on trade much more severely than solely being involved in such a conflict is a revealing result: Except Marano et al. (2013) previous studies that examined the effect of those types of conflicts did not control for the location of conflict. Thus, some of the high negative effects found might be picking up this location effect. Moreover, this study cannot confirm earlier findings on negative spillover-effects (Couttenier & Vicard 2011, Marano et al. 2013, Qureshi 2013) of a neighbor in conflict. Overall, the results for *interstate armed conflict* and *internationalized internal armed conflict* proof that hypothesis (i) cannot be rejected. However, the results from other conflict types and from the neighbor in conflict variable suggest that the effect of being the location of a conflict depends on the conflict type.

Being enemies overall presents the most tremendous decrease in trade of 37.7% for *internationalized internal armed conflict*. This is very revealing especially in the context of *internationalized internal armed conflict*, where a lot of external states are involved in an internal conflict. Being location of an *internationalized internal armed conflict* is also negative for trade, but the effect is smaller than the enmity effect. Furthermore, if two states are involved in the conflict but are not enemies, this actually yields an increase in trade. For *interstate armed conflict*, the effect of being conflict location seems to be more important than being enemies. The results are in line with the findings on rivalry from e.g. Long (2008), however, especially the results for *internationalized internal armed conflict* are novelty since, to the authors knowledge, no study on trade and conflict before included this conflict type. Hypothesis (ii) can thus be accepted.

Results for testing hypothesis (iii) are mixed. For *non-state conflict* - the only conflict

type where no governments are involved - overall no significant results are found (except for the control variable preferential trade agreements). This finding seems to confirm hypothesis (iii), namely that government involvement matters for the magnitude of the effect of conflict on trade. It has to be noted that for *non-state conflict* the lowest numbers of battle-related deaths are reported. This points towards another possible interpretation: Differences in the destruction of human capital could drive variation in the impacts of the different conflict types. However, this interpretation can be partly dismissed because the conflict types with the highest numbers of battle-related deaths - *internal armed conflict* and *one-sided violence* - also have a positive impact on trade. Nevertheless, a combination of both - low numbers of battle-deaths and no governmental involvement - lead to no effects for exports in the *non-state conflict* case. All other conflict types involve governments and display significant positive as well as significant negative results. Thus, it can be stated that government involvement in conflict matters for trade, but it does not necessarily have an negative effect: Hypothesis (iii) has to be rejected.

Hypothesis (iv) can be confirmed: Overall, estimated coefficients of the ppml hdfs specification are smaller in magnitude than results from other estimators. Moreover, the ppml panel estimator yields significant results when applying hdfs. For some conflict types, this is as well the case for the ols hdfs specification. However, the signs in these cases are reversed. Interestingly, the inclusion of country-pair fixed effects changes the results between the two ols specifications: There is no obvious pattern visible in these changes, as a lot of switches in sign and significance occur. However, overall the magnitude of the effects is reduced by the inclusion of country-pair fixed effects. A similar difference is visible between the ppml specifications. The “classic” ppml-specification with only country-time fixed effects shows a trade reduction of  $\approx 99\%$  for each conflict type. The difference between these results and the ppml hdfs-specification is striking. Country-pair heterogeneity thus seems to yield important information driving the ppml and ols ctf specification results. The  $R^2$ s support the notion that country-pair heterogeneity should be accounted for, as the hdfs specifications display the better fit compared to the ctf specifications. Moreover, the goodness-of-fit as well as the Breusch-Pagan-Test results support controlling for heteroscedasticity by the use of the ppml estimator. The results for the control variable distance supports the finding by Santos Silva & Tenreyro (2006), namely that the role of geographic characteristics is overestimated by ols. In contrary, the effect of preferential trade agreements is robust to the removal of all country-pair and

country-time heterogeneity. Hence, even in times of conflict, preferential trade agreements have a positive effect on trade.

### 2.1.6 Conclusion

This paper provides evidence that not all conflict types act as trade barriers. The study of trade and conflict should account for the heterogeneity of conflict types and their distinct characteristics. Attributes like the location of conflict and actors involved matter for the direction of impact on trade. Especially the increasing number of *internationalized internal armed conflicts* and the striking result of a 37.7% trade reduction between enemies in such a conflict as well as the trade-increasing effects of internal conflict types need to be considered in further studies. The biggest strength of the ppml hdfc estimator is the biggest caveat at the same: The high-dimensional fixed effects control for a lot of variation that might be helpful in understanding differences in the results. The variation in results complicates the determination of policy implications. Increasing trade volumes in times of conflict might not reflect the damages emanating from conflict and might cover-up actual welfare-effects. Understanding the mechanisms behind why some conflicts act as trade barriers and some seem to have a trade-increasing effect is a desirable direction of future research. Studies will have to focus on single countries to understand how conflict impacts on economic welfare and how or if this translates into changes in trade volumes. Hence, disaggregated country studies looking more closely at sector-level changes will be valuable to complement time-series cross section analyses. Country case studies focusing on the effect of different conflict types on production factors could as well contribute to understanding variation in impact and magnitude of often simultaneously appearing conflict types.

## Chapter 3

# Heterogeneity matters: On the dynamic interactions between trade, development, democracy and conflict

together with Vanessa A. Boese<sup>1</sup>

### Abstract

The past decade has witnessed a return to protectionist measures as well as a global rise in nationalist movements. Understanding the economic and political effects of such changes in trade policies or levels of democracy has gained renewed importance. There is a vast amount of literature studying the bilateral relationships between international trade flows, democracy, development and conflict. While it finds strong evidence for correlations between the four factors so far no conclusive evidence has been presented as to the direction of causal links between the factors. This paper employs a country specific vector autoregressive model allowing for endogenous dynamic interactions between trade, democracy, development and conflict. More specifically, it analyzes how shocks in one of these variables affect the others over time to investigate "what causes what". The dataset used covers 68 countries and the years 1960 to 2016. Results confirm the presence of simultaneous effects from all variables on one another. In addition, effect size and sign is substantially heterogeneous across countries providing strong evidence against the validity of the homogeneous slope parameter assumption.

**JEL codes:** F14, F51, N40, O5, P45

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<sup>1</sup>The authors would like to thank Scott Gates, Steffen Elstner, Matthias Hartmann and Håvard Hegre. All errors are our own. Authors are listed alphabetically. All work was shared equally.



### 3.1 Introduction

The study of each of the bilateral relationships between democracy, development, trade openness and armed conflict<sup>2</sup> constitutes an entire field of research. In each of these fields there is no consensus about the direction of the causal link. If there is one thing to be taken away from this literature it is that democracy, development, trade openness and armed conflict have shown to be endogenous to each other. This endogeneity should also be accounted for in statistical models. Until now the literature has usually used two types of models to examine the bilateral relationships: Either (dynamic) panel data models, usually estimated with system or difference GMM approaches, but not accounting for the indirect effects these four variables have on each other, or simultaneous equation models which can take into account the indirect effects but do not contain autoregressive parameters. However, when it comes to factors like democracy, development, trade or conflict a country's state in the last period is of high importance in determining its current state.

At the same time, the past ten years have seen a global rise in nationalism and protectionism on the one hand, and an erosion of democratic norms in several countries on the other hand. With it an understanding of the role of economic interdependence and democracy for a peaceful interconnected world gains renewed importance: How does the international system respond to changes in trade or in governance systems?

This paper employs a vector autoregressive (VAR) model that allows to control for these indirect effects. It models the dynamic relationships between democracy, development, trade and conflict in a globalized world. More specifically, it analyzes how shocks in one of these variables affect the others over time and examines the direction of effects for each bilateral relationship. Impulse response functions are used to examine the effects. These impulse response functions allow for contemporaneous correlation of errors and thereby control for endogenous effects between the four factors.

The results provide two major insights: Firstly, they confirm that all variables affect each other. Therefore, indirect effects must be accounted for in any project examining the effect of one factor on another. Secondly, there is substantial heterogeneity in effect size and direction across countries. This suggests that the homogeneity of slope parameters

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<sup>2</sup>For readability and for brevity, this paper might refer to trade openness as "trade" and to armed conflict as "conflict". However, note that the underlying definitions of these terms correspond to how they have been defined in Section 3.3.

assumption frequently employed in classic fixed effects models in cross-country analysis is inappropriate for capturing the effects of one of the variables on the others.

The rest of the paper proceeds as follows: Section 3.2 outlines the mechanisms relevant to the identification of effects in this paper. Variables and data used are introduced in Section 3.3. Section 3.4 states the hypothesis to be tested and describes model and identification strategy. Central findings are presented in Section 3.5. Model robustness is assessed in Section 3.6. The findings are discussed in Section 3.7 which as well concludes.

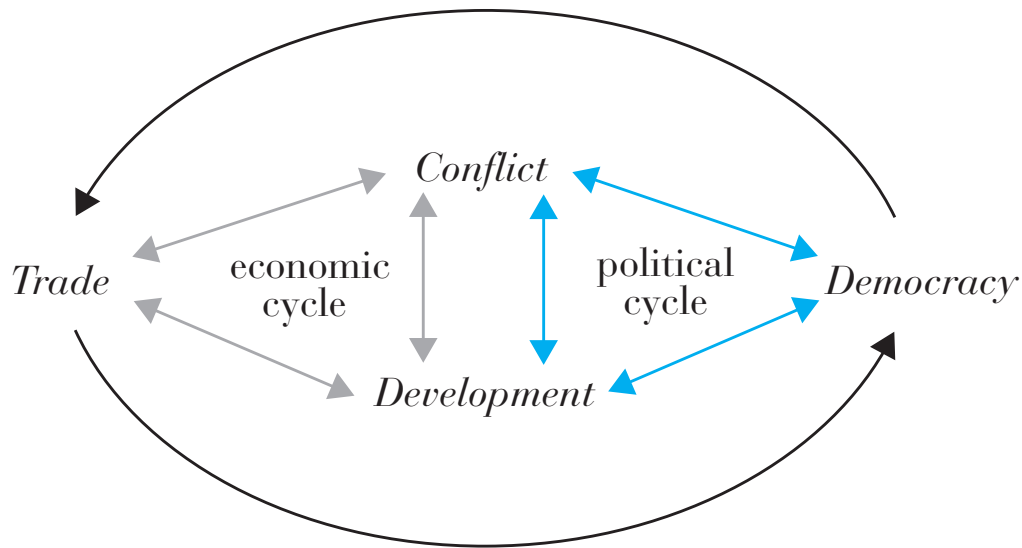
## **3.2 Why endogeneity matters, or: Integrating the economic and the political cycle**

The interactions between democracy, development, trade and conflict are depicted graphically in Figure 3.1: The right-hand side displays what is best described as a "political cycle" evolving around democracy, while on the left-hand side the "economic cycle" evolves around trade. Both cycles show how closely the four factors are interrelated. Economic and political science literature have studied the endogeneity and causal bilateral relationships between each possible pair of the four factors. The most important findings are described in the following.

### **Trade and Development**

Frankel & Romer (1999) point out the endogenous relationship between trade and development. Using income per capita, the authors find that trade raises income. Others have assessed the distributional consequences of trade: Helpman et al. (2010) find that aggregate inequality increases when countries are nearly symmetric due to reinforced within-sector effects, while Egger & Kreickemeier (2012) introduce intergroup-inequality and find that while aggregate welfare increases, so does inequality within as well as between the groups. The mechanism at work can be described as follows. Increasing trade makes a broader selection of goods and services accessible for the population which also leads to knowledge transfer, increased human capital and higher levels of development. In turn, human capital is a crucial factor for trade, both in terms of imports as well as exports: Increased human capital on the labor market leads to a rise in production possibilities concerning export goods, while increasing income will boost spending capacity and demand for imported

Figure 3.1: Mapping the endogenous interactions between trade, democracy, development and conflict



Visualization: Christian Isachsen

goods (Yanikkaya 2003).

### Trade and Conflict

Conflicts affect trade through different channels: Resources are redirected towards defense expenditures - known as the guns vs. butter trade-off - (Anderton & Carter 2009, Anderson & Marcouiller 2002), resources and goods are destroyed and production possibilities shrink due to conflict, and future and present economic activities are disrupted (e.g. capital flight, increase in transport costs, etc.) which leads to a decrease of material well-being (Long 2008). Overall, opportunity costs are rising if trade gains are lost: Utility and income decrease if consumption shifts away from preferred goods and production shifts away from areas of comparative advantage. Empirical studies have found mixed results depending on conflict data used. Trade as well affects conflict: According to the liberal theory trade promotes peace. While the majority of empiric literature supports liberal theory (Blomberg & Hess 2006, Martin et al. 2008, Keshk et al. 2010), realists argue that trade may also spark conflict (Barbieri & Levy 1999, Barbieri et al. 2009).

## **Conflict and Development**

Greed or vertical economic inequality may spur conflict (Collier & Hoeffler 2004). Furthermore, in conflict infrastructure is destroyed and water and sanitation points deteriorate. Goods and services are not available in the same way as in times of peace. Living conditions deteriorate, accompanied by an increase in diseases and malnutrition. The gap between elites and population widens and inequality gets worse: The society is captured in the conflict trap (Collier et al. 2003).

## **Democracy and Development**

Lipset (1959) describes democracy as a system that forms a political culture of negotiation and compromise. Within that framework, democracy acts as a system of redistribution of income but also of increased education. In a democracy with constraints on the executive, full participation and competitive elections, the elites are forced to produce the socially optimal quantity (Baum & Lake 2003). This leads to indirect positive effects of democratic institutions on investments (Tavares & Wacziarg 2001, Lake & Baum 2001). This stimulates human capital accumulation as well as labor productivity which in turn act as an engine for economic growth (Acemoglu et al. 2014, Boucekine et al. 2016, Rodriguez & Rodrik 2000). The relationship between democracy and development is reciprocal: Enhancements in socio-economic development determine democracy but are as well an outcome of it (Acemoglu et al. 2019, Doucouliagos & Ulubaşoğlu 2008). A stable and growing economy with increasing income will itself lead to a more educated population demanding increased participation, redistribution of power, rights and income.

## **Democracy and Conflict**

The vast democratic peace literature (see e.g. Acemoglu & Robinson 2005, Oneal et al. 1996, Gates et al. 1996, Mitchell et al. 1999) has shown that democracy is a system for the peaceful resolution of conflict. Hegre (2014) gives a good overview on this part of the literature. Conflicts in turn affect democracies with the impact being determined by the type conflict. Boese (2015) shows for example, that revolutionary conflict over the past 50 years has had a positive effect on democracy. Acemoglu & Robinson (2005) show that the distribution of power between elites and population play a critical role in the development of a state towards democracy or dictatorship.

## Trade and Democracy

The liberal theory suggests that democracies trade more (Mansfield & Snyder 2002): On the one hand, elites have less opportunities to extract protectionist rents, as democracies tend to support rather the preferences of the greater part of the consumers than those of a few producers (Tavares & Wacziarg 2001). Free trade in turn consolidates democracy. It reduces protectionist rents and thereby reduces the incentives for authoritarian groups to seek power. With increasing democracy, both exporter and importer signal compliance with the rule of law, reliability in business processes and a higher product quality (Liu & Ornelas 2014, Yu 2010). However, groups that benefit from protectionism often try to impair politics via lobbying (Tavares & Wacziarg 2001).

## Why democracy, development, trade and conflict?

The dynamic interactions between trade, development, democracy and conflict form central pillars of the literature outlined above. In addition, Subramanian & Satyanath (2004) find that trade openness, conflict and democracy are strongly (positively) correlated with macroeconomic stability. Rodrik et al. (2004) model the interactions between trade openness, democracy, geography and income to assess the relative impact of the three former variables in determining income levels. The theoretical logic underlying their paper is very close to the one applied here. The model used in our paper considers the same endogenous variables and (due to the substantial effects of conflict found in the democratic and liberal peace literature) adds conflict as an endogenous variable.<sup>3</sup>

## Endogeneity

Given the amount of findings on any of these bilateral relationships two points suggest themselves: First, the presence of simultaneous bilateral effects and second (through said simultaneous direct effects) the presence of indirect effects. Both, in consequence lead to interaction structures such as those in Figure 3.1. Several scholars have noted both, indirect effects, e.g. Persson & Tabellini (2009), Tavares & Wacziarg (2001) Rodrik et al. (2004), Baum & Lake (2003), and simultaneous effects, e.g. Persson & Tabellini (2009), Rodrik et al. (2004), Russett & Oneal (2001). However, this article is the first systematic

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<sup>3</sup>Since geography is a time-invariant characteristic it is captured in each country's intercept in our model.

study that acknowledges both points and that allows for a) all four factors being jointly determined, b) the factors to simultaneously affect each other and c) indirect effects in their econometric specification.

Table 3.1: Selected studies on the relationships between democracy, development, trade and conflict

	Conflict	Development	Democracy	Trade
Conflict	-	Mac Ginty & Williams (2016) Justino et al. (2013) Besley & Persson (2010)	Hegre (2014) Boese (2015) Russett & Oneal (2001)	Blomberg & Hess (2006) Martin et al. (2008) Kamin (n.d.)
			...on:	
Development	Collier & Hoeffler (2004) Collier et al. (2003) Gartzke & Weisiger (2014)	-	Lipset (1959) Acemoglu et al. (2008) Rigobon & Rodrik (2005)	Yanikkaya (2003) Keesing (1967)
Democracy	Collier & Rohner (2008) Crescenzi & Kadera (2016) Hegre (2014)	Acemoglu et al. (2019) Boucekkine et al. (2016) Pozuelo et al. (2016)	-	Mansfield & Snyder (2002) Liu & Ornelas (2014) Yu (2010)
Trade	Barbieri et al. (2009) Hegre et al. (2010) Martin et al. (2008)	Frankel & Romer (1999) Rigobon & Rodrik (2005) Rodriguez & Rodrik (2000)	Rigobon & Rodrik (2005) Adsera & Boix (2002)	-

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### 3.3 Data and descriptive statistics

In this paper V-Dem's Liberal Democracy Index, *v2x.libdem*, is used as a measure of democracy.<sup>4</sup> Bernhard et al. (2017) show that the operationalization of democracy affects the results. A major drawback of the vast amount of empirical literature carried out on the interrelationships between democracy and other variables is that several studies use similar measure(s) of democracy (Altman et al. 2018, p. 14), most notably the Polity2 and Freedom House Index. Boese (forthcoming) provides a comprehensive introduction into quantitative democracy measurement and a detailed overview of the empirical analyses these two indices should not be employed for. She concludes that the comparatively new democracy indices by the Varieties of Democracy Institute (V-Dem)<sup>5</sup> were created to answer to most of the problems posed by "classic" democracy measures, such as Polity2 and Freedom House Index. Consequently, they substantially outperform them in terms of measure validity and reliability (this includes, for example, their underlying definition of democracy, their measurement scales or the theoretical justification of their respective aggregation procedures). Therefore, V-Dem's Liberal Democracy Index is employed in this paper. Its democracy definition includes the dimensions participation, contestation and constraints on the executive decision making authority.<sup>6</sup>

This paper uses the armed conflict categorization provided by the Uppsala Conflict Data Program (UCDP). A conflict is coded as such once a threshold of 25 battle-related deaths is reached. Armed conflict has four conflict sub-categories: Extra-systemic armed conflict, interstate armed conflict, internal armed conflict and internationalized internal armed conflict.<sup>7</sup> Furthermore, the armed conflict category provides information on conflict involvement of different sides to a conflict. To include all conflict observations a binary variable was created that is equal to one once a country is involved in any type of conflict. Thus, all conflict involvements - no matter on which side of the conflict a country stands - are included.

Against the background of the country-level of analysis, economic interdependence is operationalized as trade openness. Trade openness has been widely used as a measure of economic integration (see e.g. Rodriguez & Rodrik 2000). Trade as percent of GDP is

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<sup>4</sup>*v2x.libdem* is taken from the V-Dem Dataset Version 7.1, Coppedge et al. (2017).

<sup>5</sup>The V-Dem indices are available since Lindberg et al. (2014).

<sup>6</sup>For a detailed introduction into democracy measurement as well as explanations of the concepts of participation, contestation and constraints see for example Boese (forthcoming).

<sup>7</sup>The exact UCDP definitions of conflict types are provided in the Appendix



taken from the World Bank Indicators, who define the indicator as follows: "Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product." Data is available as weighted average and on annual level.

Literature including variables on socio-economic development often uses GDP per capita. Since this study includes trade openness as measure for economic interdependence and hence as an economic measure, we abstract away from including a "socio-economic" quantification, but rather introduce a measure for development. We quantify development by using the World Development Indicator "Life expectancy at birth, female". The indicator is defined as "the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life." Data is available as weighted average and on annual level. Mortality rates mirror the health conditions of a country and are therefore a commonly used indicator for development.

### 3.3.1 Descriptive statistics

The dataset used in the analysis covers 68 countries and the time period 1960 to 2016, i.e. 3,876 observations (57 observations per country). The dataset is balanced.<sup>8</sup> Table 3.2 provides the mean, standard deviation, minimum and maximum of the variables in the estimation sample.

Instead of taking the pooled sample as a basis, Table 3.3 examines the panel means of each country's time series. The variation between country means is quite substantial, especially for trade openness: The highest country mean is around 330 units whereas the country with the lowest mean displayed average trade openness levels of around 19. Since the armed conflict variable is a dummy equal to one in conflict years the minimum (maximum) value in Table 3.3 shows the minimum (maximum) percent of years in the time series a country was involved in armed conflict. The country with the lowest number of years involved in conflict was involved 2% of the 57 years, i.e. one year. The country with the highest number of years in armed conflict was involved during 89% of its time series (equivalent to 51 years).

How did the country values vary within the panels over time? Table 3.4 shows that the

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<sup>8</sup>A detailed list of countries and the respective regions included in the sample can be found in the Appendix (see Table 40).

Table 3.2: Summary statistics for pooled estimation sample

Variable	Mean	Std. Dev.	Min	Max
Liberal Democracy Index	40.84	29.76	1.22	90.34
Trade Openness	65.63	50.42	4.92	441.60
Life Expectancy, Female	66.49	12.58	29.28	87.14
Armed Conflict	0.30	0.46	0.00	1.00

within variation for each country is substantially lower than the variation between the country averages for three of four variables (democracy, trade and development). In other words, the countries in this sample rather differ from each other (in terms of their trade, democracy or development levels) than each country's values vary over their respective time series. This heterogeneity of countries is remarkable and will be captured by the model used in this paper.

### 3.4 Model and Estimation

Findings of previous studies provide a starting point for this study: They suggest the presence of simultaneity, i.e. that trade, democracy, development and conflict each affect one another bilaterally. For each bilateral relationship, studies exist showing that "A causes B" as well as "B causes A". Note, the four factors bilaterally affect each other both directly as well as indirectly through the other variables. The model used in this paper allows trade, democracy, development and conflict to be jointly determined and captures the indirect effects. As such it provides a suitable econometric framework to test the following hypothesis:

*Hypothesis: Development, democracy, trade and conflict simultaneously affect each other*

Econometric implications of this hypothesis are the following: First, to avoid omitted variable bias a model needs to include each of these factors. Second, imagine four separate "one equation"-models of each of these variables with regressors consisting of lags and current values of the other variables. In each of these equations neither the simultaneity nor the indirect effects that the variables have on each other through a third or fourth variable are accounted for. The errors are contemporaneously correlated across the four equations. By examining orthogonalized shocks, this model allows for such a contemporaneous correlation of error terms. Examining these shocks will show whether there are simultaneous effects from each variable on all others (once we account for indirect effects) or whether there are bilateral relationships for which the effects solely run "from A to B" (and not vice versa). Is there a chronological order in which these factors affect each

Table 3.3: Variation between country means

Variable	Std. Dev.	Min	Max
Liberal Democracy Index	26.46	4.41	87.62
Trade Openness	46.32	19.14	330.71
Life Expectancy, Female	11.13	45.12	80.52
Armed Conflict	0.24	0.02	0.89

Table 3.4: Within country variation

Variable	Std. Dev.	Min	Max
Liberal Democracy Index	13.98	-56.67	37.12
Trade Openness	20.70	-101.52	192.82
Life Expectancy, Female	6.00	-22.72	20.03
Armed Conflict	0.39	-0.89	0.98

The minimum (maximum) column refers to the lowest (highest) deviation a country exhibited from its respective panel mean.

other? We assume that development and democracy are slow changing variables whereas trade and conflict react to shocks much faster in comparison.

Two limitations imposed by the dataset are worth noting. First, the 68 countries used in this study constitute but a part of the global system of states. For reasons of data availability it is not possible to include further countries. Data availability, however, is correlated with some of the four variables, most prominently conflict. Afghanistan, for example, could not be included as its trade openness time series exhibited missing values for 25 of the 57 years used in the analysis. Nevertheless, the estimation sample consists of 68 countries from all regions of the world and as such is "as representative as possible". The second limitation is measure reliability. Socio-economic development is a latent factor difficult to measure. As such it is often measured in vastly differing ways. While we cannot adjust data availability, we do control for different specifications of development in the robustness checks section. Our main results are robust to these changes.

### 3.4.1 Reduced form VAR

The model used in this paper assumes that development, democracy, trade and conflict are jointly determined. To test whether there are simultaneous effects between each other the following reduced form VAR(4) model is estimated for each country  $i$ :

$$y_{i,t} = A_{i,1}y_{i,t-1} + \dots + A_{i,4}y_{i,t-4} + \kappa_i + \epsilon_{i,t}, \quad (3.1)$$

$$i \in \{1, 2, \dots, 68\}, t \in \{1, 2, \dots, 57\}$$

where  $y_{i,t} = (\textit{development}_{i,t}, \textit{democracy}_{i,t}, \textit{trade}_{i,t}, \textit{conflict}_{i,t})'$  is a  $4 \times 1$  vector of dependent variables,  $A_{i,1}, \dots, A_{i,4}$  are  $4 \times 4$  matrices of lag coefficients to be estimated and  $\epsilon_{i,t}$  is a  $4 \times 1$  white noise process. To keep the model parsimonious the  $4 \times 1$  vector  $\kappa_i$  is the sole exogenous regressor (this permits a nonzero mean  $E[y_i, t]$ ). With this model specification all current period measures of democracy, development, conflict and trade are a function of past values of each other. Hence, the total reduced-form effect that a past increase in, for example, democracy had on each of the other dependent variables can be calculated and orthogonalized effects can be examined over time.

The number of lagged values to include in the equation deserves some attention. The data used in this paper is in annual format. Including one lag hence is equivalent to adding an entire year of information to the model (in light of the slow changing nature of variables such as democracy or development this is a fair amount of time). To make sure that even a more volatile measure such as trade openness is appropriately captured in the VAR model a lag length of 4 years is selected.<sup>9</sup> From a theoretical perspective, four years is an appropriate lag length choice as it is the average electoral period length in the countries under study. Standard Information Criteria (AIC, adjusted  $R^2$ ) presented in Section 3.6 confirm this choice of lag length.

The following three assumptions on the error term are central for this model:

$$E[\epsilon_{i,t}] = 0, E[\epsilon_{i,t}\epsilon'_{i,t}] = \Sigma \text{ and } E[\epsilon_{i,t}\epsilon'_{i,s}] = 0, \text{ for } t \neq s$$

Through the non-singular matrix  $\Sigma$  the error terms are allowed to be contemporaneously correlated. However, they must be uncorrelated with their lags and lead values as well as all right-hand side variables of the model.

Given the high amount of variation across countries (rather than within each countries

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<sup>9</sup>Robustness checks with up to ten lags can be found in the Appendix. The results do not change.

time series)<sup>10</sup> the VAR(4) model is estimated country by country. This permits the slope parameters to be heterogeneous across countries. In most cross-country analyses using panel data slope parameters are assumed to be homogeneous across countries and systematic differences between countries are assumed to be captured through country specific fixed effects. Through estimating our model country-by-country it provides the slope parameters with the possibility to differ (i.e. the coefficients have the option to differ as much as to be homogeneous across countries) while including a country specific intercept,  $\kappa_i$ . In that sense the model is an extension of above mentioned panel data models.

Using impulse response functions the dynamic relationships between democracy, development, economic interdependence and conflict can be depicted graphically. To derive them, it is useful to transform model (3.1) in its Vector Moving Average, VMA( $\infty$ ), representation:

$$\begin{aligned} y_{i,t} &= A_{i,1}y_{i,t-1} + \dots + A_{i,4}y_{i,t-4} + \kappa_i + \epsilon_{i,t} \\ &= A_{i,1}Ly_{i,t} + \dots + A_{i,4}L^4y_{i,t} + \kappa_i + \epsilon_{i,t} \\ (I - A_{i,1}L - \dots - A_{i,4}L^4)y_{i,t} &= \kappa_i + \epsilon_{i,t} \end{aligned}$$

Let the lag polynomial  $\Phi_{i,4}(L) := I - A_{i,1}L - \dots - A_{i,4}L^4$  then

$$y_{i,t} = \Phi_{i,4}(L)^{-1}\kappa_i + \Phi_{i,4}(L)^{-1}\epsilon_{i,t} \quad (3.2)$$

For  $\Phi_{i,4}(L)^{-1}$  to exist,  $|\Phi_{i,4}(L)| \neq 0$ .  $\Phi_{i,4}(L)^{-1}\kappa_i = \mu_i$  where  $E[y_{i,t}] = \mu_i$  (there is no t-subscript as the process is stationary)

$$y_{i,t} = \mu_i + \sum_{s=0}^{\infty} \theta_s \epsilon_{i,t-s} \quad (3.3)$$

where  $\theta_0 = I$  and  $\theta_s$  is a function of  $\Phi_{i,4}(L)$ . This Vector Moving Average, VMA( $\infty$ ), representation is the basis upon which impulse response functions are created. The effect of the shocks  $\epsilon_{i,t}$  on  $Y_{i,t}$  are now captured by

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<sup>10</sup>See Section 3.3.1.

$$\frac{\delta y_{i,t}}{\delta \epsilon_{i,t-s}} = \theta_{s_i} \quad (3.4)$$

and can be interpreted as the effects of a shock in one variable on the others over time. Note that  $y_{i,t}$  and  $\epsilon_{i,t-s}$  are  $4 \times 1$  vectors. This allows us to calculate the response of the  $n - th$  element in  $y$  to a shock in the  $m - th$  element.

The impulse response functions depict the following situation: In the first period there is a one period (in this framework: one-year) positive shock with a magnitude of one standard deviation in the impulse variable. All other/response variables are set to their mean values in the first period. The impulse response graphs (see for example Figure 3.3 or Section C.3 of the Appendix) show the response variable's deviation from its mean in each year after the positive shock of the impulse variable in the first period. The solid line represents the point estimate of the response. The dashed lines highlight a 95 percent confidence band around that estimate. This paper focuses on responses to shocks over a ten year period.

### 3.4.2 Structural VAR

Given that the error terms are contemporaneously correlated in model (3.1) the estimated parameter values therein are impossible to interpret and further identifying assumptions are necessary. These assumptions in our case are that development and democracy are (in comparison to trade and conflict) slow changing variables, i.e. a shock in development or democracy will have an effect on trade and conflict in the same period while democracy and development will take time in responding to a shock in trade or conflict. Therefore, we assume the following ordering: Development, democracy, conflict and trade.<sup>11</sup> That means development affects all other factors contemporaneously, but is not contemporaneously affected by shocks in the other variables. Democracy affects conflict and trade contemporaneously and is affected only by contemporaneous shocks of development and so on.

From an econometric perspective implementing these assumptions means model 3.1 needs to be orthogonalized (to obtain a variance-covariance matrix of error terms with orthogo-

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<sup>11</sup>As Robustness Checks results for a different ordering are reported in Section 3.6.

nalized zero off-diagonal elements). This paper uses a Choletsky decomposition, i.e.:

$$Cy_{i,t} = CA_{i,1}y_{i,t-1} + \dots + CA_{i,4}y_{i,t-4} + C\kappa_i + C\epsilon_{i,t}, \quad (3.5)$$

where  $C\epsilon_{i,t} = u_{i,t}$  and  $Var[u_{i,t}] = \Sigma_u = \sigma_{u_i}^2 I$ .

This structural VAR(4) model is then transformed into its VMA( $\infty$ ) representations and the impulse response functions are calculated as discussed above. The next section summarizes the main findings from these orthogonalized impulse response functions.

### 3.5 Results

The hypothesis to examine is that simultaneous effects from variable A to variable B as well as from B to A are present. As there are four endogenous variables, there are 6 bilateral relationships to examine: 1. trade and democracy, 2. trade and development, 3. trade and conflict, 4. development and democracy, 5. development and conflict and 6. democracy and conflict. Each bilateral relationship consists of two parts: A affects B and B affects A. If the impulse response functions display significant effects for both of these parts simultaneous effects are present and the hypothesis can be accepted.

The VAR(4) model is estimated and impulse response functions are calculated for each country, i.e. 68 times. There is one impulse response function for every country (68) and every bilateral relationship part ( $6 \cdot 2 = 12$ ), i.e. per model specification  $68 \cdot 12 = 816$  impulse response functions are calculated. The question of how to aggregate the information contained in these functions to a displayable level is not trivial. To test our hypothesis for each part of the bilateral relationship the number of countries exhibiting a significant effect is of immediate interest. Therefore, Figure 3.2 displays the number of countries with significantly positive and negative (and no) results for each impulse-response combination. Each cell of the table constitutes one part of a bilateral relationship.<sup>12</sup>

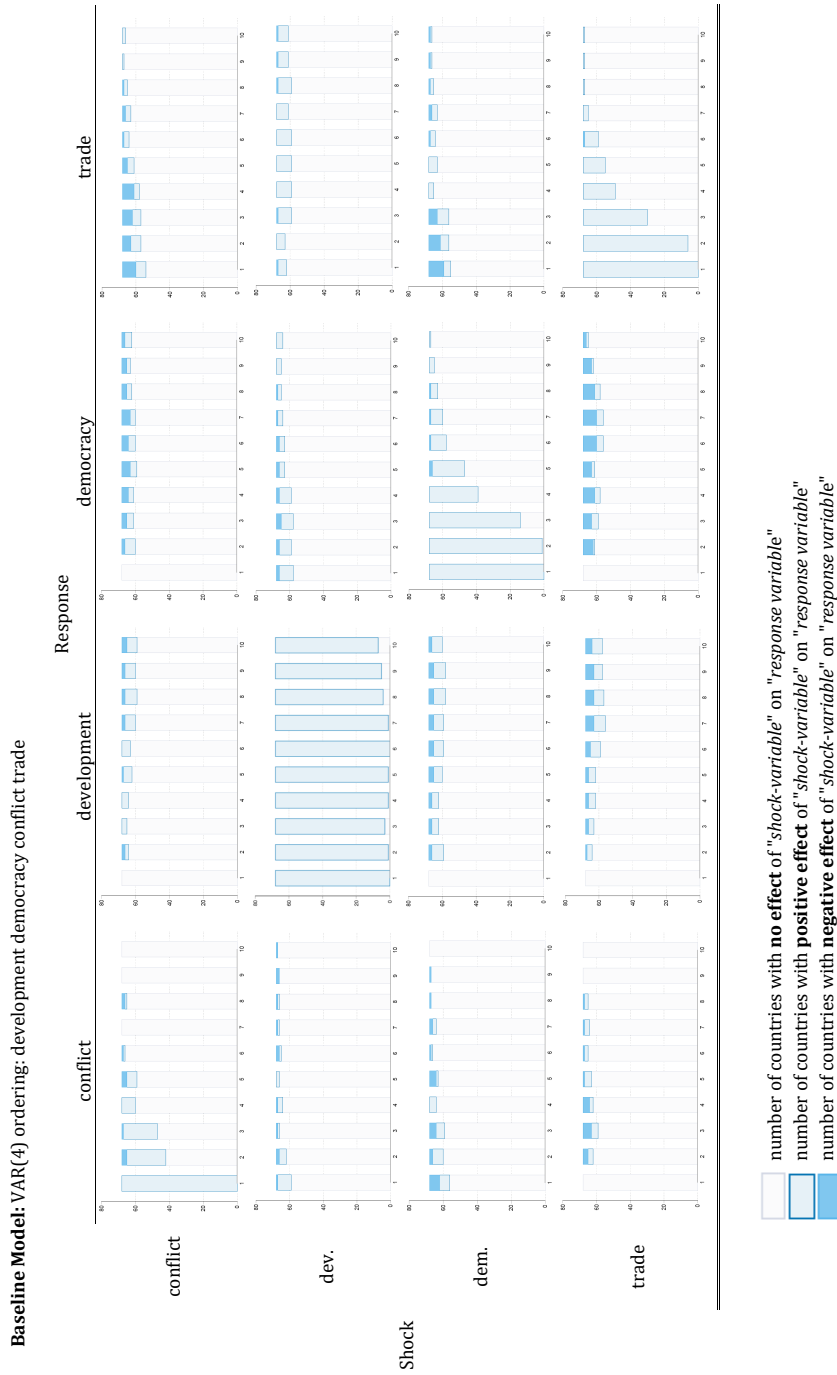
Figure 3.2 provides two fundamental insights: First, it suggests the hypothesis is true - simultaneous effects between all variables exist. For all combinations of variables "A

<sup>12</sup>Note, that the question "how does a variable respond to shocks in itself?" is not part of this analysis. The corresponding impulse response combinations are reported in Figure 3.2 solely for the sake of completeness.

affects B” as well as ”B affects A”. This is crucial. Any model estimating the effect of one of these variables on another has to account for the simultaneous relationships as well as the indirect effects. Second, for all impulse-response combinations there are positive as well as negative responses, i.e. the effects that these variables have on one another are far from homogeneous across countries. For each part of the bilateral relationships the responses differ across countries in terms of effect sign, magnitude and timing. Section C.3 of the Appendix contains the impulse response functions (as well as a discussion thereof) for countries with significant responses ordered by bilateral relationship. In fact, the responses are not even homogeneous within regions. Section C.2 of the Appendix shows that aggregating the impulse response functions on even a regional level disguises the variations contained within the country responses. A similar effect would occur had this model been estimated under a homogeneous slope parameter assumption.



Figure 3.2: Number of countries with non/significant responses to the given shocks



The sole part of a bilateral relationship for which there is an overwhelmingly positive effect is that of development on trade openness. There are only three countries for which a one period one standard deviation positive shock in development leads to negative responses: The Central African Republic, Uruguay and Nicaragua (see Figure 8). The substantial magnitude of the negative effect suggests that cross-country heterogeneity in responses cannot be neglected for this bilateral relationship either.

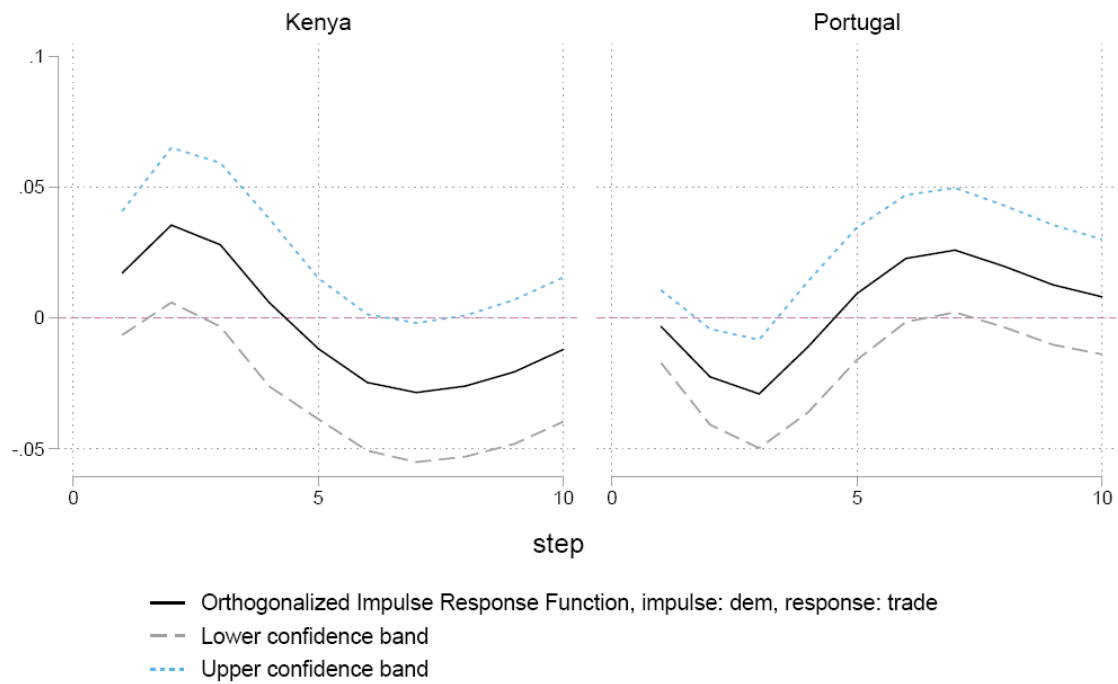
As depicted in Figure 3.2, even within one country the effect of a shock can be heterogeneous over time. In Kenya, for example, a one period one standard deviation positive shock in development leads to a significant positive effect for trade openness within the first three periods but switches to a significant negative and lasting effect in period six. For Portugal, a shock in development has the reverse effect: Within the first three periods, trade is affected negatively, but switches to a positive effect in period six. These switches can be observed across regions and in the bilateral relationships between conflict and trade, development and democracy, and conflict and democracy.

### 3.6 Robustness Checks

How sensitive are these results to the identifying assumption and the model specification? To answer this question the model was re-estimated with six different specifications all of which are discussed in the remainder of this section.

In any VAR model the choice of lag length deserves attention. The baseline model of this paper was run with a lag length of four years since this approximately equals the average electoral period. To determine whether this lag selection is appropriate, several avenues were pursued: First, standard autocorrelation tests, such as the LM-test (Null hypothesis: No serial correlation of order 1-4) were consulted. As to be expected in a cross country setting such as this one autocorrelation is present in some of the countries. Eyeballing the residual plots for these countries (provided in Section C.5) suggest no systematic presence of heavy autocorrelation. Nevertheless, to make sure autocorrelation is negligible the VAR(4) model was re-estimated in first differences. Although the number of countries displaying significant results is smaller (see Figure 29 of the Appendix) the same simultaneous effects as well as country specific heterogeneity in effect magnitude, timing and sign are visible. Comparing standard goodness-of-fit criteria for the baseline VAR(4) model in levels (Table 3.7) and in first difference (Table 3.5) confirms the VAR(4) specification in

Figure 3.3: Impulse response functions with switches in signs



Impulse response functions for Kenya and Portugal displaying a switch from a significant positive effect of democracy on trade to a significant negative effect and vice versa.

levels. In the presence of autocorrelation an alternative option is to increase lag length. Therefore, the model was re-estimated as a VAR(8) and VAR(10) model. The responses remain heterogeneous across countries and the effects still appear simultaneously for both parts of each bilateral relationship (see Figure 33 for VAR(8) and Figure 34 for VAR(10)). Comparing model fit across these three lag specifications (see Table 3.6) suggests that longer lag specification yield better fits. However, with increasing lag length four countries must be dropped from the analysis because of colinearity in the variables. To include the highest number of countries possible and since the results remain robust the lag length of four remains the preferred specification.

Table 3.5: Model fit for model in first differences

Dep. Var.	model in first differences		
	Obs.	adj. $R^2$	AIC
development	68.00	0.71 (0.43)	-4.92 (3.71)
democracy	68.00	0.11 (0.23)	4.51 (1.71)
conflict	68.00	0.20 (0.22)	0.40 (0.78)
trade	68.00	0.07 (0.17)	-1.64 (0.88)
Overall			-1.86 (3.19)

"Obs." refers to the number of countries in the analysis. Values reported for adjusted  $R^2$  and AIC by equation are pooled averages. Standard deviations are reported below each cell.

Table 3.6: Comparison of model fit across different lag specifications

Dep. Var.	Baseline VAR(4)			Lag length 8			Lag length 10		
	Obs.	adj. $R^2$	AIC	Obs.	adjusted $R^2$	AIC	Obs.	adjusted $R^2$	AIC
development	68	1.00 (0.01)	-5.02 (3.75)	64	0.13 (0.19)	-5.26 (3.91)	64	1.00 (0.01)	-6.27 (3.94)
democracy	68	0.90 (0.11)	4.34 (1.69)	64	0.89 (0.11)	4.05 (1.79)	64	0.92 (0.10)	3.03 (1.93)
conflict	68	0.45 (0.29)	0.22 (0.74)	64	0.39 (0.35)	0.09 (0.86)	64	0.58 (0.37)	-0.90 (1.48)
trade	68	0.83 (0.13)	-1.79 (0.85)	64	0.82 (0.14)	-1.96 (0.83)	64	0.87 (0.15)	-2.80 (0.94)
Overall AIC			-2.48 (3.23)			-3.69 (3.73)			-9.09 (4.63)

"Obs." refers to the number of countries in the analysis. Values reported for adjusted  $R^2$  and AIC by equation are pooled averages. Standard deviations are reported below each cell.

By choosing female life expectancy as a measure of development this paper deviates slightly from common approaches to measuring development, namely by GDP-related variables. As robustness checks the model was re-estimated using once GDP per capita growth and once logged GDP per capita as measures of development. Before discussing the results it is worth remembering (see Section 3.3) that GDP is included in the measure of trade openness used in this paper:

$$trade_t = \frac{(exports_t + imports_t)}{GDP_t}$$

This implies that

$$\frac{\delta trade_t}{\delta GDP_t} = -\frac{(exports_t + imports_t)}{GDP_t^2} < 0, \quad \text{if } exports_t + imports_t > 0 \text{ and } GDP_t \neq 0$$

as well as

$$\frac{\delta GDP_t}{\delta trade_t} = -\frac{(exports_t + imports_t)}{trade_t^2} < 0, \quad \text{if } exports_t + imports_t > 0 \text{ and } trade_t \neq 0$$

GDP per capita growth and logged GDP per capita are defined as

$$growth_t = \frac{GDPpc_t - GDPpc_{t-1}}{GDPpc_{t-1}} \quad \text{and} \quad lnGDPpc_t = ln(GDPpc_t)$$

Assuming that  $GDPpc$  is a function positively increasing in GDP the shocks examined in this paper would (*ceteris paribus*) and by pure definition of variables be expected to have the following effects: A positive shock in development, measured by  $growth_t$  or  $lnGDPpc_t$ , would correspond to an increase in GDP per capita (and consequently in GDP) leading to a decrease in  $trade_t$ . Conversely a shock in trade openness implies a reduction in GDP and with it a reduction in  $lnGDPpc_t$  and  $growth_t$ , respectively. Interestingly, for both specifications (using  $growth_t$  or  $lnGDPpc_t$ ) positive responses to shocks in trade as well as to shocks in development are clearly visible. The number of countries with trade values responding negatively to shocks in development increases substantially in comparison to the VAR(4) model, which was to be expected given the definition of the variables. The number of countries exhibiting significant results is smaller when the GDP per capita growth specification is employed, which is also unsurprising since it is a growth rather than a levels variable (the response of development to a shock in trade, for example is closer to the baseline VAR(4) result for the  $lnGDPpc_t$  specification than for the  $growth_t$  specification). According to the information criteria presented in Table 3.7 across different specifications of development baseline VAR(4) remains the preferred specification.

The ordering of the variables in the Cholesky decomposition represents a central identifying assumption of the structural VAR. To assess the model's sensitivity to this assumption a Cholesky-decomposition was employed and impulse response function were calculated using the alternative ordering: Democracy, development, trade and conflict.<sup>13</sup> The results

<sup>13</sup>The two slow changing variables were switched and so were the two fast changing variables. Deviating

Table 3.7: Comparison of model fit for different specifications of development

Dep. Var.	Baseline VAR(4)			GDP p.c. growth			log GDP p.c.		
	Obs.	adj. $R^2$	AIC	Obs.	adj. $R^2$	AIC	Obs.	adj. $R^2$	AIC
development	68	1.00	-5.02	67	0.13	8.02	68	0.97	-1.35
		(0.01)	(3.75)		(0.19)	(0.76)		(0.05)	(0.75)
democracy	68	0.90	4.34	67	0.89	4.41	68	0.90	4.35
		(0.11)	(1.69)		(0.11)	(1.73)		(0.10)	(1.70)
conflict	68	0.45	0.22	67	0.39	0.29	68	0.40	0.25
		(0.29)	(0.74)		(0.35)	(0.75)		(0.34)	(0.74)
trade	68	0.83	-1.79	67	0.82	-1.74	68	0.83	-1.77
		(0.13)	(0.85)		(0.14)	(0.84)		(0.15)	(0.84)
Overall AIC			-2.48			10.72			1.20
			(3.23)			(2.75)			(2.71)

"Obs." refers to the number of countries in the analysis. Values reported for adjusted  $R^2$  and AIC by equation are pooled averages. Standard deviations are reported in parentheses below each cell.

(see Figure 30) remain very similar.

### 3.7 Discussion & Conclusion

This paper estimates the simultaneous effects of trade openness, democracy, armed conflict and development on each other by employing a VAR model. The previous section confirms that the results are robust to a number of different model specifications and that standard information criteria confirm the model choice. The two central findings obtained are: i. the prevalence of simultaneous effects between development, democracy, trade and conflict and ii. the substantial heterogeneity in responses across and even within countries. These findings partially explain as to why the literature so far displayed findings in favor of each direction: First, because the effects are mixed and impacts run both ways of each bilateral relationship. Second, the contemporaneous determination of the four factors needs to be accounted for econometrically. Third, heterogeneity of responses across countries and over time needs to be allowed for.

A large part of the literature has accounted for simultaneity in the bilateral study of each of the four factors by, e.g. the use of lags, fixed effects, simultaneous equation models or IV approaches (see e.g. Rigobon & Rodrik 2005, Martin et al. 2008). However, the present study proves that solely examining bilateral relationships without controlling for

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from the slow- and fast-changing setup (i.e. ordering the variables with trade (or conflict) as first or second variable in the VAR) would imply that the a slow changing variable like democracy or development responded to a shock in trade (or conflict) within that same period, which seems unreasonable.

time-varying other influences is not enough (as seen e.g. in Frankel & Romer 1999, Acemoglu et al. 2019). Simultaneous effects of more than two factors have to be accounted for.

Furthermore, the results of this paper strongly advocate against the widely assumed homogeneity of slope parameters. Section C.3 of the Appendix thoroughly discusses the variation of effects across countries. This is especially important in the study of these four factors, as a lot of research tries to establish "one result fits all" findings. In this regard, the present study has to disagree with recent aggregate findings such as that democracy causes growth (Acemoglu et al. 2019), democracy does not cause growth (Pozuelo et al. 2016) or trade promotes peace (Hegre et al. 2010). Additionally, this finding touches upon ideological grounds: Institutions like the World Bank as well as OECD and other advocates for the liberal cause untiringly and unceasingly insist that trade aids development, reduces conflict and helps to establish democracy (Rodriguez & Rodrik 2000). This paper finds that they are all right, but at the same time, they are all wrong: All depends on the country you are looking at.

This finding of heterogeneous effects is in line with the results of the studies that relax the homogeneous slope parameter assumption (to different degrees),<sup>14</sup> most notably Cervellati et al. (2014). Cervellati et al. (2014) replicate a seminal study, Acemoglu et al. (2008), which finds a robust null-effect of development (income) on democracy once country fixed effects are included. In their replication Cervellati et al. (2014) find that once the effects of income on democracy are allowed to differ across countries there is substantial heterogeneity in slope parameters. They conclude that this heterogeneity (and with it the wide range of point estimates of slope parameters across countries) can provide a plausible reason for the null-result in Acemoglu et al. (2008) or any model assuming homogeneity of slope parameters in this context.

Additionally, heterogeneity is not limited to the cross-section, but also is important on the within-country level - as discussed in Section 3.5 and shown in Table 3.4. This finding is another valid argument against the homogeneous slope parameter assumption on the one hand, but as well for the incorporation of heterogeneity over time.

Certain limitations to the model are worth noting. First, in the interest of parsimony no

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<sup>14</sup>See for example Rigobon & Rodrik (2005), Narayan et al. (2011).

exogenous control variables are added. The number of possible extensions to this model is limited by page-restrictions only. In future research, an interesting approach would be, for example, to expand on the conflict dimension. The conflict category used in this paper consists of several quite different forms of conflict. This aggregate measure hides the heterogeneous effects of different conflict types (see Kamin n.d.). Such conflict types could be added to the model one by one as well as a location variable indicating whether a given country was the location of a conflict in a given year or not. Secondly, for a better understanding of bilateral trade and bilateral conflict, the country-year format employed in this paper could be extended into a country-pair-year format. Bilateral trade and conflict heavily depend on country pair characteristics. Including such information in the model would be an interesting extension.



# Appendices

## A Appendix Chapter 1

The tables in this Appendix are also online (see Boese & Kamin 2018*a,b*, which provide a much more detailed overview of which countries and years actually contain nonmissing values in each of the datasets).

### A.1 Democracy Datasets Comparison

See Boese & Kamin (2018*a*) for a very detailed listing of all countries and their respective time series covered. Countries for which only the names/labels differ are listed in Table 8 (that is, countries of inconsistency type 3, reason 1.). In the worksheet “Overview” (Boese and Kamin, 2018*a*), these countries are highlighted in grey.

Table 8: Countries for which only the names/labels differ.

V-Dem Version 8	Polity IV, Version 2016
Bosnia and Herzegovina	Bosnia
Burma/Myanmar	Myanmar (Burma)
Democratic Republic of Congo	Congo Kinshasa
German Democratic Republic	Germany East
North Korea	Korea North
Piedmont-Sardinia	Sardinia
Republic of Vietnam	Vietnam South
Republic of the Congo	Congo Brazzaville
Slovakia	Slovak Republic
South Korea	Korea South
South Yemen	Yemen South
United Arab Emirates	UAE
United States of America	United States
Württemberg	Wuerttemberg

Countries for which the underlying entity has no perfect match in the other dataset are listed in Table 9. A “perfect match” refers to a counterpart in terms of names and years

(and potentially borders). This includes countries of inconsistency types 1 and 3. Countries representing the same or similar historical units are grouped.

Countries unmergable due to name and time inconsistencies are listed in Table 10. This includes countries of inconsistency type 3. Note: # obs=number of observations; N=total number of available observations in data; missing=number of missing years/observations for given country between its first and last year.

Table 9: Countries for which the underlying entity has no perfect match in the other dataset

V-Dem Version 8	Polity IV, Version 2016
Barbados	
Brunswick	
Colombia	Colombia
	Gran Colombia
Czech Republic	Czech Republic
	Czechoslovakia
Democratic Republic of Vietnam	Vietnam North
	Vietnam
German Democratic Republic	Germany East
Germany	Germany
	Prussia
	Germany West
Guatemala	United Province of CA (Central America)
Hamburg	
Hanover	
Hesse-Darmstadt	
Hesse-Kassel	
Hong Kong	
Iceland	
Ivory Coast	Ivory Coast
	Cote D'Ivoire
Maldives	
Mecklenburg Schwerin	
Nassau	
Oldenburg	
	Orange Free State
Palestine/British Mandate	
Palestine/Gaza	
Palestine/West Bank	
Russia	USSR
Saxe-Weimar-Eisenach	
Serbia	Serbia
	Serbia and Montenegro
	Yugoslavia
Seychelles	
Somaliland	
South Korea	Korea South
	Korea
South Sudan	South Sudan
Sudan	Sudan
	Sudan-North
São Tomé and Príncipe	
Timor-Leste	Timor Leste
	East Timor
Vanuatu	
Yemen	Yemen
	Yemen North
Zanzibar	

Table 10: Countries unmergeable due to name and time inconsistencies

V-Dem Version 8, 201 countries					Polity IV, Version 2016, 195 countries				
country	year		# obs. in data		country	year		# obs. in data	
	first	last	N	missing		first	last	N	missing
Bosnia and Herzegovina	1992	2017	26	0	Bosnia	1992	2016	25	0
					Yugoslavia	1921	2002	83	-1
Colombia	1789	2017	229	0	Colombia	1832	2016	185	0
					Gran Colombia	1821	1832	12	0
Czech Republic	1918	2017	100	0	Czech Republic	1993	2016	24	0
					Czechoslovakia	1918	1992	75	0
Democratic Republic of Vietnam	1945	2017	73	0	Vietnam North	1954	1976	23	0
					Vietnam	1976	2016	41	0
Germany	1789	2017	225	4	Germany	1868	2016	105	44
					Prussia	1800	1867	68	0
					Germany West	1945	1990	46	0
Ivory Coast	1900	2017	118	0	Ivory Coast	1960	2015	56	0
					Cote D'Ivoire	2016	2016	1	0
Russia	1789	2017	229	0	Russia	1800	2016	148	69
					USSR	1922	1991	70	0
Serbia	1804	2017	213	1	Serbia	1830	2016	102	85
					Serbia and Montenegro	2003	2006	4	0
South Korea	1789	2017	229	0	Korea South	1948	2016	69	0
					Korea	1800	1910	111	0
Sudan	1900	2017	118	0	Sudan	1956	2011	56	0
					Sudan-North	2011	2016	6	0
South Yemen	1900	1990	91	0	Yemen South	1967	1990	24	0
Yemen	1789	2017	162	67	Yemen	1990	2016	27	0
					Yemen North	1918	1990	73	0
Timor-Leste	1900	2017	118	0	Timor Leste	2016	2016	1	0
					East Timor	2002	2015	14	0

## A.2 Economic Datasets Comparison

Table 11 is a listing of unmergeable names/labels in the UN Comtrade and WDI datasets, due to inconsistency type 3, and shows a large share of countries with high export levels (Boese and Kamin, 2018b, contains the list sorted by total exports; worksheet “Unmergeable Outliers Comtrade”). The spreadsheet also provides a list of country groups/regions which were not included in the comparison; worksheet “Disregarded Country Groups”).

Tables 12 and 13 show countries for which the underlying entity has no perfect match in the other dataset. A “perfect match” refers to a counterpart in terms of names and years (and potentially borders). This includes countries of inconsistency types 1 and 3. Countries representing the same or similar historical units are grouped.

Table 14 shows countries unmergeable due to name and time inconsistencies. This includes countries of inconsistency type 3 (N=total number of available observations in data).

Table 11: Countries for which the names/labels differ

UN Comtrade exports	WDI trade openness
Bolivia (Plurinational State of)	Bolivia
Bosnia Herzegovina	Bosnia and Herzegovina
Cabo Verde	Cape Verde
Cayman Isds	Cayman Islands
Central African Rep.	Central African Republic
China, Hong Kong SAR	Hong Kong
China, Macao SAR	Macao SAR, China
Congo	Republic of the Congo
Czechia	Czech Republic
Côte d'Ivoire	Ivory Coast
Dem. Rep. of the Congo	Democratic Republic of Congo
Dominican Rep.	Dominican Republic
FS Micronesia	Micronesia, Fed. Sts.
Faeroe Isds	Faroe Islands
Gambia	The Gambia
Lao People's Dem. Rep.	Laos
Myanmar	Burma/Myanmar
Rep. of Korea	South Korea
Rep. of Moldova	Moldova
Russian Federation	Russia
Saint Kitts and Nevis	St. Kitts and Nevis
Saint Lucia	St. Lucia
Saint Vincent and the Grenadines	St. Vincent and the Grenadines
Sao Tome and Principe	São Tomé and Príncipe
Solomon Isds	Solomon Islands
TFYR of Macedonia	Macedonia
Turks and Caicos Isds	Turks and Caicos Islands
US Virgin Isds	Virgin Islands (U.S.)
USA	United States of America
United Rep. of Tanzania	Tanzania
Viet Nam	Vietnam
Yemen	Yemen, Rep.

Table 12: Countries for which the underlying entity has no perfect match in the other dataset, A-R

UN Comtrade exports	WDI trade openness
	American Samoa
Belgium	Belgium
Belgium-Luxembourg	
	British Virgin Islands
	Channel Islands
Cook Isds	
	Curacao
Czechia	Czech Republic
Czechoslovakia	
East and West Pakistan	
	Equatorial Guinea
Ethiopia	Ethiopia
Fmr Ethiopia	
Fmr Tanganyika	
Fmr Yugoslavia	
French Guiana	
Germany	Germany
Fmr Dem. Rep. of Germany	
Fmr Fed. Rep. of Germany	
	Gibraltar
Guadeloupe	
	Guam
India	India
India, excl. Sikkim	
	Isle of Man
	Kosovo
	Liechtenstein
	Marshall Islands
Mayotte	
	Monaco
Montserrat	
	Nauru
Neth. Antilles	
Neth. Antilles and Aruba	
Niue	
	North Korea
	Northern Mariana Islands
Panama	Panama
Fmr Panama, excl. Canal Zone	
Peninsula Malaysia	
	Puerto Rico
Réunion	

Table 13: Countries for which the underlying entity has no perfect match in the other dataset, S-Z

UN Comtrade exports	WDI trade openness
Sabah	
Saint Kitts, Nevis and Anguilla	
Saint Pierre and Miquelon	
	San Marino
Serbia and Montenegro	
	Sint Maarten (Dutch part)
State of Palestine	
	St. Martin (French part)
Sudan	Sudan
Fmr Sudan	
	South Sudan
USA	United States of America
USA (before 1981)	
	Uzbekistan
Viet Nam	Vietnam
Fmr Rep. of Vietnam	
Yemen	Yemen, Rep.
Fmr Arab Rep. of Yemen	
	West Bank and Gaza



Table 14: Countries unmergeable due to name and time inconsistencies

UN Comtrade exports years available (coded and non-missing)				WDI tradeopenness years available (coded and non-missing)			
country	year		N	country	year		N
	first	last			first	last	
Belgium	1999	2017	19	Belgium	1960	2016	57
Belgium-Luxembourg	1962	1998	30				
Bosnia Herzegovina	2003	2017	15	Bosnia and Herzegovina	1994	2016	23
Czechia	1993	2017	24	Czech Republic	1990	2016	27
Czechoslovakia	1968	1987	20				
Pakistan	1972	2017	31	Pakistan	1967	2016	50
East and West Pakistan	1962	1971	10				
Ethiopia	1995	2016	21	Ethiopia	2011	2016	6
Fmr Ethiopia	1962	1987	21				
Fmr Yugoslavia	1962	1987	26				
Germany	1991	2017	27	Germany	1970	2016	47
Fmr Dem. Rep. of Germany	1985	1987	3				
Fmr Fed. Rep. of Germany	1962	1990	29				
India	1975	2017	43	India	1960	2016	57
India, excl. Sikkim	1962	1974	13				
Panama	1978	2016	32	Panama	1960	2016	57
Fmr Panama, excl. Canal Zone	1962	1977	16				
Serbia	2005	2017	13	Serbia	1995	2016	22
Serbia and Montenegro	1992	2004	9				
State of Palestine	2007	2016	10	West Bank and Gaza	1994	2016	23
Sudan	2012	2015	2	Sudan	1960	2016	57
Fmr Sudan	1963	2011	37	South Sudan	2008	2015	8
Viet Nam	2000	2016	17	Vietnam	1986	2016	31
Fmr Rep. of Vietnam	1963	1973	11				
Yemen	2004	2015	12	Yemen, Rep.	1990	2016	27
Fmr Arab Rep. of Yemen	1975	1981	6				

### A.3 Conflict Dataset

Tables 15 to 19 provide a comparison of country coding units in the UCDP/PRIO Armed Conflict dataset 18.1 to the coding units supplied in the relevant code book. Countries with inconsistent labels are written in [blue](#); countries which only exist in the dataset but not in code book are written in [red](#).

Table 15: Comparison of country coding units in UCDP/PRIO Armed Conflict dataset 18.1 and the coding units supplied in the relevant code book, A-Co

Countries coded as state actors in side A or B of the UCDP/PRIO Armed Conflict Dataset 18.1				System Membership Table (Table 3), UCDP/PRIO Armed Conflict Dataset Codebook p.15-20		
country	year		# obs.	State Name	year	
	first	last			first	last
Afghanistan	1978	2017	47	Afghanistan	1946	2012
Albania	1946	1946	2	Albania	1946	2012
Algeria	1963	2017	30	Algeria	1962	2012
Angola	1975	2017	36	Angola	1975	2012
Argentina	1955	1982	8	Argentina	1946	2012
				Armenia	1991	2012
Australia	2003	2003	2	Australia	1946	2012
				Austria	1946	2012
Azerbaijan	1991	2017	15	Azerbaijan	1991	2012
				Bahamas	1973	2012
				Bahrain	1971	2012
Bangladesh	1975	2017	21	Bangladesh	1971	2012
				Barbados	1966	2012
				Belarus (Byelorussia)	1991	2012
				Belgium	1946	2012
				Belize	1981	2012
				Benin	1960	2012
				Bhutan	1949	2012
Bolivia	1946	1967	3	Bolivia	1946	2012
Bosnia-Herzegovina	1992	1995	9	Bosnia-Herzegovina	1992	2012
				Botswana	1966	2012
				Brazil	1946	2012
				Brunei	1984	2012
				Bulgaria	1946	2012
Burkina Faso	1985	1987	3	Burkina Faso (Upper Volta)	1960	2012
Burundi	1965	2015	19	Burundi	1962	2012
Cambodia (Kampuchea)	1967	2011	42	Cambodia (Kampuchea)	1953	2012
Cameroon	1960	2017	10	Cameroon	1960	2012
				Canada	1946	2012
				Cape Verde	1975	2012
Central African Republic	2001	2013	8	Central African Republic	1960	2012
Chad	1966	2017	43	Chad	1960	2012
Chile	1973	1973	1	Chile	1946	2012
China	1946	2008	45	China	1946	2012
Colombia	1964	2016	53	Colombia	1946	2012
Comoros	1989	1997	2	Comoros	1975	2012
Congo	1993	2016	6	Congo	1960	2012

Table 16: Comparison of country coding units in UCDP/PRIO Armed Conflict dataset 18.1 and the coding units supplied in the relevant code book, Co-Ira

Countries coded as state actors in side A or B of the UCDP/PRIO Armed Conflict Dataset 18.1				System Membership Table (Table 3), UCDP/PRIO Armed Conflict Dataset Codebook p.15-20			
country	year		# obs.	State Name	year		
	first	last			first	last	
DR Congo (Zaire)	1960	2017	30	Congo, Democratic Republic of (Zaire)	1960	2012	
Costa Rica	1948	1948	1	Costa Rica	1946	2012	
Ivory Coast	2002	2011	4	Cote D'Ivoire	1960	2012	
Croatia	1992	1995	3	Croatia	1991	2012	
Cuba	1953	1961	5	Cuba	1946	2012	
Cyprus	1974	1974	2	Cyprus	1960	2012	
				Czech Republic	1993	2012	
				Czechoslovakia	1946	1992	
				Denmark	1946	2012	
Djibouti	1991	2008	7	Djibouti	1977	2012	
Dominican Republic	1965	1965	1	Dominican Republic	1946	2012	
				East Timor	2002	2012	
Ecuador	1995	1995	2	Ecuador	1946	2012	
Egypt	1948	2017	29	Egypt	1946	2012	
El Salvador	1969	1991	16	El Salvador	1946	2012	
				Equatorial Guinea	1968	2012	
Eritrea	1997	2016	12	Eritrea	1993	2012	
				Estonia	1991	2012	
Ethiopia	1960	2016	131	Ethiopia	1946	2012	
				Fiji	1970	2012	
				Finland	1946	2012	
France	1946	1962	55	France	1946	2012	
Gabon	1964	1964	1	Gabon	1960	2012	
Gambia	1981	1981	1	Gambia	1965	2012	
Georgia	1991	2008	8	Georgia	1991	2012	
				German Democratic Republic	1949	1990	
				German Federal Republic	1949	2012	
Ghana	1966	1983	3	Ghana	1957	2012	
Greece	1946	1949	4	Greece	1946	2012	
Grenada	1983	1983	2				
Guatemala	1949	1995	34	Guatemala	1946	2012	
Guinea	2000	2001	2	Guinea	1958	2012	
Guinea-Bissau	1998	1999	2	Guinea-Bissau	1974	2012	
				Guyana	1966	2012	
Haiti	1989	2004	3	Haiti	1946	2012	
Honduras	1957	1969	3	Honduras	1946	2012	
Hungary	1956	1956	2	Hungary	1946	2012	
Hyderabad	1947	1948	4				
				Iceland	1946	2012	
India	1948	2017	220	India	1947	2012	
Indonesia	1950	2005	52	Indonesia	1946	2012	
Iran	1946	2017	62	Iran (Persia)	1946	2012	
Iraq	1948	2017	78	Iraq	1946	2012	

Table 17: Comparison of country coding units in UCDP/PRIO Armed Conflict dataset 18.1 and the coding units supplied in the relevant code book, Ire-O

Countries coded as state actors in side A or B of the UCDP/PRIO Armed Conflict Dataset 18.1				System Membership Table (Table 3), UCDP/PRIO Armed Conflict Dataset Codebook p.15-20		
country	year		# obs.	State Name	year	
	first	last			first	last
Israel	1948	2014	86	Ireland	1946	2012
				Israel	1948	2012
				Italy/Sardinia	1946	2012
				Jamaica	1962	2012
Jordan	1948	2016	6	Japan	1946	2012
				Jordan	1946	2012
				Kazakhstan	1991	2012
Kenya	1982	2017	4	Kenya	1963	2012
				Kosovo	2008	2012
Kuwait	1990	1991	2	Kuwait	1961	2012
				Kyrgyz Republic	1991	2012
Laos	1959	1990	22	Laos	1954	2012
				Latvia	1991	2012
				Lebanon	1946	2012
Lebanon	1948	2017	17	Lebanon	1946	2012
Lesotho	1998	1998	1	Lesotho	1966	2012
Liberia	1980	2003	7	Liberia	1946	2012
Libya	1987	2017	8	Libya	1951	2012
				Lithuania	1991	2012
Macedonia, FYR	2001	2001	1	Luxembourg	1946	2012
				Macedonia (FRY)	1991	2012
Madagascar	1971	1971	1	Madagascar (Malagasy)	1960	2012
				Malawi	1964	2012
Malaysia	1958	2013	15	Malaysia	1957	2012
				Maldives	1965	2012
				Mali	1960	2012
Mali	1985	2017	18	Malta	1964	2012
				Mauritania	1960	2012
Mauritania	1975	2011	6	Mauritius	1968	2012
				Mexico	1946	2012
Mexico	1994	1996	2	Moldova	1991	2012
Moldova	1992	1992	1	Mongolia	1946	2012
				Montenegro	2006	2012
				Morocco	1956	2012
Morocco	1963	1989	17	Mozambique	1975	2012
Mozambique	1977	2016	18	Myanmar (Burma)	1948	2012
Myanmar (Burma)	1948	2017	275	Namibia	1990	2012
				Nepal	1946	2012
Nepal	1960	2006	14	Netherlands	1946	2012
Netherlands	1946	1962	5	New Zealand	1946	2012
				Nicaragua	1946	2012
Nicaragua	1957	1990	13	Niger	1960	2012
Niger	1991	2017	10	Nigeria	1960	2012
Nigeria	1966	2017	20	North Korea	1948	2012
North Korea	1949	1953	10	Norway	1946	2012
				Oman	1946	2012
Oman	1957	1975	8			

Table 18: Comparison of country coding units in UCDP/PRIO Armed Conflict dataset 18.1 and the coding units supplied in the relevant code book, P-T

Countries coded as state actors in side A or B of the UCDP/PRIO Armed Conflict Dataset 18.1				System Membership Table (Table 3), UCDP/PRIO Armed Conflict Dataset Codebook p.15-20		
country	year		# obs.	State Name	year	
	first	last			first	last
Pakistan	1948	2017	55	Pakistan	1947	2012
Panama	1989	1989	3	Panama	1946	2012
Papua New Guinea	1990	1996	6	Papua New Guinea	1975	2012
Paraguay	1947	1989	3	Paraguay	1946	2012
Peru	1965	2010	24	Peru	1946	2012
Philippines	1946	2017	104	Philippines	1946	2012
				Poland	1946	2012
Portugal	1961	1974	36	Portugal	1946	2012
				Qatar	1971	2012
Rumania	1989	1989	1	Rumania	1946	2012
Russia (Soviet Union)	1946	2017	44	Russia (Soviet Union)	1946	2012
Rwanda	1990	2016	17	Rwanda	1962	2012
Saudi Arabia	1979	1979	1	Saudi Arabia	1946	2012
Senegal	1990	2011	10	Senegal	1960	2012
Serbia (Yugoslavia)	1991	1999	5	Serbia	2006	2012
				Yugoslavia (Serbia)	1946	2006
Sierra Leone	1991	2001	11	Sierra Leone	1961	2012
				Singapore	1965	2012
				Slovakia	1993	2012
				Slovenia	1992	2012
				Solomon Islands	1978	2012
Somalia	1964	2017	32	Somalia	1960	2012
South Africa	1966	1988	30	South Africa	1946	2012
South Korea	1949	1953	5	South Korea	1948	2012
South Sudan	2011	2017	9	South Sudan	2011	2012
Spain	1957	1991	11	Spain	1946	2012
Sri Lanka	1971	2009	27	Sri Lanka	1948	2012
Sudan	1963	2017	49	Sudan	1956	2012
Suriname	1987	1987	1	Surinam	1975	2012
				Swaziland	1968	2012
				Sweden	1946	2012
				Switzerland	1946	2012
Syria	1948	2017	27	Syria	1946	2012
Taiwan	1949	1958	4	Taiwan	1949	2012
Tajikistan	1992	2011	10	Tajikistan	1991	2012
Tanzania	1978	1978	2	Tanzania/Tanganyika	1961	2012
Thailand	1946	2017	32	Thailand	1946	2012
				Tibet	1946	1950
Togo	1986	1986	1	Togo	1960	2012
Trinidad and Tobago	1990	1990	1	Trinidad and Tobago	1962	2012
Tunisia	1961	2016	3	Tunisia	1956	2012
Turkey	1974	2017	41	Turkey/Ottoman Empire	1946	2012
				Turkmenistan	1991	2012

Table 19: Comparison of country coding units in UCDDP/PRIO Armed Conflict dataset 18.1 and the coding units supplied in the relevant code book, U-Z

country	year		# obs.	State Name	year	
	first	last			first	last
Uganda	1971	2017	41	Uganda	1962	2012
Ukraine	2014	2017	7	Ukraine	1991	2012
United Kingdom	1946	2003	56	United Arab Emirates	1971	2012
United States of America	1950	2017	23	United Kingdom	1946	2012
Uruguay	1972	1972	1	United States of America	1946	2012
Uzbekistan	1999	2004	3	Uruguay	1946	2012
Venezuela	1962	1992	3	Uzbekistan	1991	2012
Vietnam (North Vietnam)	1965	1988	24	Venezuela	1946	2012
South Vietnam	1955	1975	32	Vietnam, Democratic Republic of	1954	2012
Yemen (North Yemen)	1948	2017	27	Vietnam, Republic of	1954	1975
South Yemen	1972	1986	5	Yemen (Arab Republic of Yemen)	1946	2012
Zimbabwe (Rhodesia)	1967	1979	9	Yemen, People's Republic of	1967	1990
				Zambia	1964	2012
				Zanzibar	1963	1964
				Zimbabwe (Rhodesia)	1965	2012

Countries coded as state actors in side A or B of the System Membership Table (Table 3),  
UCDDP/PRIO Armed Conflict Dataset 18.1 UCDDP/PRIO Armed Conflict Dataset  
Codebook p.15-20

## B Appendix Chapter 2

### B.1 Data Adjustments

When merging economic data with policy variables such as conflict, good care has to be taken to not lose observations due to country naming inconsistencies (see Boese & Kamin (2019) for an extensive discussion). The following country names from the conflict data were adapted to the country names in the trade data to make them compatible: “Bosnia-Herzegovina” in “Bosnia and Herzegovina”, “Cambodia (Kampuchea)” in “Cambodia”, “DR Congo (Zaire)” in “Congo, Dem. Rep.”, “Ivory Coast” in “Cote d’Ivoire”, “Korea” in “Korea, Rep.”, “Kyrgyzstan” in “Kyrgyz Republic”, “Laos” in “Lao PDR”, “Macedonia” in “Macedonia (FYR)”, “Madagascar (Malagasy)” in “Madagascar”, “Myanmar (Burma)” in “Myanmar”, “Russia” in “Russian Federation”, “Slovakia” in “Slovak Republic”, “Syria” in “Syrian Arab Republic”, “United States of America” in “United States”, “Yemen (North Yemen)” in “Yemen”, “Serbia (Yugoslavia)” in “Yugoslavia”, “Zimbabwe (Rhodesia)” in “Zimbabwe”. A special case is Ethiopia: As location, “Ethiopia” is coded since 1992 in the conflict data, “Eritrea” since 1997. In the trade data “Eritrea” is coded since 1993, “Ethiopia (incl. Eritrea)” only in 1992, “Ethiopia (excl. Eritrea)” since 1993. UCDP coincides with the list of UN member states where Eritrea is only coded from 1993 on. Hence, for 1992 Ethiopia was renamed “Ethiopia (incl. Eritrea)” and from 1993 on “Ethiopia (excl. Eritrea)” in accordance with the trade data. Within the trade data another pitfall in country naming has to be addressed: “Czechoslovakia” exists in the trade data only for the year 1992. From 1993 on the country is divided in “Czech Republic” and “Slovak Republic”. Since there are no conflict observations for these countries in these years, the naming remained as is. Furthermore, the *internal armed conflict* in South Sudan in 2011 and the *internationalized internal armed conflict* in Lesotho in 1998 are not included due to missing trade data.



## B.2 Alternative Specifications / Robustness Checks

### Estimation of ols with country-time fixed effects

$$\begin{aligned}
 \ln(X_{ij,t}) = & \beta_0 + \beta_1 \text{conflict}_{ij,t} + \beta_2 \text{location}_{ij,t} + \beta_3 \text{neighbor}_{ij,t} \\
 & + \beta_4 \text{both}_{ij,t} + \beta_5 \text{enemy}_{ij,t} + \beta_6 \log(\text{dist}_{ij,t}) + \beta_7 \text{pta}_{ij,t} \\
 & + \beta_8 \text{contiguity}_{ij} + \beta_9 \text{comlang}_{ij} + \beta_{10} \text{colony}_{ij} + \beta_{11} \text{comcol}_{ij} \\
 & + \omega_{i,t} + \rho_{j,t} + \epsilon_{ij,t}
 \end{aligned} \tag{6}$$

where  $i$  and  $j$  denote exporter and importer country,  $t$  denotes time, and the other variables are defined as:

$X_{ij,t}$  is the logged total trade value exported from origin  $i$  to destination  $j$  at time  $t$ ;

$\text{conflict}_{ij,t}$  is a dummy being unity if  $i$  or  $j$  have been involved in the respective conflict at time  $t$ ;

$\text{location}_{ij,t}$  is a dummy being unity if  $i$  or  $j$  have been location of the respective conflict at time  $t$ ;

$\text{neighbor}_{ij,t}$  is a dummy being unity if the neighbor of  $i$  or  $j$  has been involved in a conflict at time  $t$ ;

$\text{both}_{ij,t}$  is a dummy being unity if both,  $i$  and  $j$ , have been involved in the respective conflict at time  $t$ ;

$\text{enemy}_{ij,t}$  is a dummy being unity if  $i$  and  $j$  have been enemies in the respective conflict at time  $t$ ;

$\text{dist}_{ij,t}$  is measuring the population-weighted distance between  $i$  and  $j$  at time  $t$ ;

$\text{pta}_{ij,t}$  is a dummy variable being unity if a preferential trade agreement exists at time  $t$ ;

$\text{contiguity}_{ij}$  is a dummy variable being unity if  $i$  and  $j$  share a common border;

$\text{comlang}_{ij}$  is a dummy variable being unity if  $i$  and  $j$  have a common official language;

$\text{colony}_{ij}$  is a dummy variable being unity for pairs that have had a colonial relationship in the past;

$\text{comcol}_{ij}$  is a dummy variable being unity for having a common colonizer past 1945;

$\omega_{i,t}$  and  $\rho_{j,t}$  represent the exporter-time and importer-time fixed effects;

$\epsilon_{ij,t}$  is the error term, taking up all other influences on dyadic trade.

### Estimation of ols with high-dimensional fixed effects

$$\begin{aligned} \ln(X_{ij,t}) = & \beta_0 + \beta_1 \text{conflict}_{ij,t} + \beta_2 \text{location}_{ij,t} + \beta_3 \text{neighbor}_{ij,t} + \beta_4 \text{both}_{ij,t} + \\ & \beta_5 \text{enemy}_{ij,t} + \beta_6 \log(\text{dist}_{ij,t}) + \beta_7 \text{pta}_{ij,t} + \omega_{i,t} + \rho_{j,t} + \mu_{ij} + \epsilon_{ij,t} \end{aligned} \quad (7)$$

where  $i$  and  $j$  denote exporter and importer country,  $t$  denotes time, and the other variables are defined as:

$\ln(X_{ij,t})$  is the logged total trade value exported from origin  $i$  to destination  $j$  at time  $t$ ;  
 $\text{conflict}_{ij,t}$  is a dummy being unity if  $i$  or  $j$  have been involved in the respective conflict at time  $t$ ;

$\text{location}_{ij,t}$  is a dummy being unity if  $i$  or  $j$  have been location of the respective conflict at time  $t$ ;

$\text{neighbor}_{ij,t}$  is a dummy being unity if the neighbor of  $i$  or  $j$  has been involved in a conflict at time  $t$ ;

$\text{both}_{ij,t}$  is a dummy being unity if both,  $i$  and  $j$ , have been involved in the respective conflict at time  $t$ ;

$\text{enemy}_{ij,t}$  is a dummy being unity if  $i$  and  $j$  have been enemies in the respective conflict at time  $t$ ;

$\text{dist}_{ij,t}$  is measuring the population-weighted distance between  $i$  and  $j$  at time  $t$ ;

$\text{pta}_{ij,t}$  is a dummy variable being unity if a preferential trade agreement exists at time  $t$ ;

$\omega_{i,t}$  and  $\rho_{j,t}$  represent the exporter-time and importer-time fixed effects;

$\mu_{ij}$  are the country-pair fixed effects, and

$\epsilon_{ij,t}$  is the error term, taking up all other influences on dyadic trade.

### Estimation of ppml with country-time fixed effects

$$\begin{aligned} X_{ij,t} = \exp \left[ & \beta_1 \text{conflict}_{ij,t} + \beta_2 \text{location}_{ij,t} + \beta_3 \text{neighbor}_{ij,t} + \beta_4 \text{both}_{ij,t} + \right. \\ & \beta_5 \text{enemy}_{ij,t} + \beta_6 \log(\text{dist}_{ij,t}) + \beta_7 \text{pta}_{ij,t} + \beta_8 \text{contiguity}_{ij} \\ & \left. + \beta_9 \text{comlang}_{ij} + \beta_{10} \text{colony}_{ij} + \beta_{11} \text{comcol}_{ij} + \omega_{i,t} + \rho_{j,t} \right] \\ & + \epsilon_{ij,t} \end{aligned} \quad (8)$$

where  $i$  and  $j$  denote exporter and importer country,  $t$  denotes time, and the other variables are defined as:

$X_{ij,t}$  is the total trade value exported from origin  $i$  to destination  $j$  at time  $t$ ;

$\text{conflict}_{ij,t}$  is a dummy being unity if  $i$  or  $j$  have been involved in the respective conflict

at time  $t$ ;

$location_{ij,t}$  is a dummy being unity if  $i$  or  $j$  have been location of the respective conflict at time  $t$ ;

$neighbor_{ij,t}$  is a dummy being unity if the neighbor of  $i$  or  $j$  has been involved in a conflict at time  $t$ ;

$both_{ij,t}$  is a dummy being unity if both,  $i$  and  $j$ , have been involved in the respective conflict at time  $t$ ;

$enemy_{ij,t}$  is a dummy being unity if  $i$  and  $j$  have been enemies in the respective conflict at time  $t$ ;

$dist_{ij,t}$  is measuring the population-weighted distance between  $i$  and  $j$  at time  $t$ ;

$pta_{ij,t}$  is a dummy variable being unity if a preferential trade agreement exists at time  $t$ ;

$contiguity_{ij}$  is a dummy variable being unity if  $i$  and  $j$  share a common border;

$comlang_{ij}$  is a dummy variable being unity if  $i$  and  $j$  have a common official language;

$colony_{ij}$  is a dummy variable being unity for pairs that have had a colonial relationship in the past;

$comcol_{ij}$  is a dummy variable being unity for having a common colonizer past 1945;

$\omega_{i,t}$  and  $\rho_{j,t}$  represent the exporter-time and importer-time fixed effects;

$\epsilon_{ij,t}$  is the error term, taking up all other influences on dyadic trade.

### B.3 Results from all specifications, (1)-(4), per conflict type

Table 20: Summary statistics for variables only used in the other specifications

Variable	Obs	Mean	Std. Dev.	Min	Max
$\ln(\text{Exports})+1$	417,211	7.349204	4.245883	0	30.33898
Contiguity	408,651	.021708	.1457286	0	1
Common official language	408,651	.161184	.367701	0	1
Colony	408,651	.0178294	.1323312	0	1
Common colonizer	408,651	.0959719	.294553	0	1

Table 21: Results from all specifications for *interstate armed conflict*

dep variable:	ols ctfe		ols hdfe		ppml ctfe		ppml hdfe	
	(A)	(B)	(C)	(D)	ln exports	ln exports	exports	exports
i or j in conflict	-5.8710*** (0.570)	-0.1874 (0.260)	-9.8625*** (0.239)	-0.0397*** (0.011)	ln exports	ln exports	exports	exports
i or j conflict location	0.8196** (0.405)	0.0883 (0.277)	-2.0051*** (0.343)	-0.2774*** (0.036)	ln exports	ln exports	exports	exports
i or j have neighbor in conflict	-0.2964*** (0.008)	0.0041 (0.007)	-9.4284*** (0.073)	0.0006 (0.008)	ln exports	ln exports	exports	exports
both in conflict	-11.2881*** (1.175)	-0.6876 (0.561)	-13.0725*** (0.470)	-0.0298 (0.022)	ln exports	ln exports	exports	exports
Enemies	-1.5899* (0.832)	0.2168 (0.642)	-2.1332** (0.925)	-0.1540 (0.252)	ln exports	ln exports	exports	exports
ln distance	-1.4471*** (0.007)	0.0351*** (0.012)	-0.4186*** (0.140)	0.0012 (0.005)	ln exports	ln exports	exports	exports
Preferential trade arrangement	0.3516*** (0.017)	0.0903*** (0.013)	-2.0598*** (0.386)	0.0304*** (0.009)	ln exports	ln exports	exports	exports
Contiguity	0.3624*** (0.029)		-2.3922*** (0.443)		ln exports	ln exports	exports	exports
Common official language	0.6064*** (0.015)		1.9425*** (0.191)		ln exports	ln exports	exports	exports
Colonial link ever	1.1545*** (0.030)		-1.3923*** (0.338)		ln exports	ln exports	exports	exports
Common colonizer post-1945	0.7795*** (0.019)		2.4004*** (0.317)		ln exports	ln exports	exports	exports
Observations	399,784	397,185	400,584	400,584				
R <sup>2</sup>	0.669	0.914	0.701	1.000				

Results from all specifications for *interstate armed conflict*. "ctfe": Estimation with importer-year and exporter-year fixed effects. "hdfe": Estimation with importer-year, exporter-year and country-pair fixed effects. Robust standard errors in parentheses. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01 indicate statistical significance at the 10, 5, and 1 percent level, respectively.

Table 22: Results from all specifications for *internal armed conflict*

dep variable:	ols ctfe		ols hdfe		ppml ctfe		ppml hdfe	
	(A)	(B)	(C)	(D)	exports	exports	exports	exports
i or j in conflict	-3.2240*** (0.140)	-0.1219*** (0.040)	-11.1333*** (0.109)	0.1251*** (0.017)				
i or j have neighbor in conflict	-0.2953*** (0.008)	0.0041 (0.007)	-9.3849*** (0.079)	0.0017 (0.008)				
both in conflict	-6.3451*** (0.283)	-0.2216*** (0.085)	-14.3118*** (0.305)	0.3187*** (0.038)				
ln distance	-1.4438*** (0.007)	0.0345*** (0.013)	-0.4624*** (0.164)	-0.0005 (0.005)				
Preferential trade arrangement	0.3434*** (0.017)	0.0904*** (0.013)	-2.3678*** (0.440)	0.0364*** (0.009)				
Contiguity	0.3528*** (0.029)		-2.8576*** (0.475)					
Common official language	0.6090*** (0.015)		2.0722*** (0.198)					
Colonial link ever	1.1541*** (0.029)		-1.7686*** (0.372)					
Common colonizer post-1945	0.7853*** (0.019)		2.9706*** (0.275)					
Observations	399,784	397,185	400,584	400,584				
R <sup>2</sup>	0.673	0.914	0.704	1.000				

Results from all specifications for *internal armed conflict*. "ctfe": Estimation with importer-year and exporter-year fixed effects. "hdfe": Estimation with importer-year, exporter-year and country-pair fixed effects. Robust standard errors in parentheses. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01 indicate statistical significance at the 10, 5, and 1 percent level, respectively.

Table 23: Results from all specifications for *internationalized internal armed conflict*

dep variable:	ols ctfe		ols hdfe		ppml ctfe		ppml hdfe	
	(A)	(B)	(C)	(D)	exports	exports	exports	exports
i or j in conflict	-3.3601*** (0.101)	-0.0048 (0.019)	-10.4284*** (0.070)	0.1106*** (0.007)				
i or j conflict location	-1.8610*** (0.375)	-0.0249 (0.091)	-3.0445*** (0.530)	-0.0938*** (0.028)				
i or j have neighbor in conflict	-0.2777*** (0.008)	0.0038 (0.007)	-8.9502*** (0.101)	0.0044 (0.008)				
both in conflict	-6.6233*** (0.204)	0.0671* (0.039)	-11.0822*** (0.092)	0.1270*** (0.008)				
Enemies	-1.2943*** (0.286)	-0.4677** (0.232)	-0.7897 (1.013)	-0.4728*** (0.137)				
ln distance	-1.4457*** (0.007)	0.0350*** (0.012)	-0.5987*** (0.106)	0.0012 (0.005)				
Preferential trade arrangement	0.3898*** (0.017)	0.0877*** (0.013)	-2.1190*** (0.343)	0.0405*** (0.009)				
Contiguity	0.3417*** (0.029)		-1.6422*** (0.464)					
Common official language	0.6037*** (0.015)		0.9388*** (0.209)					
Colonial link ever	1.1802*** (0.029)		-1.3900*** (0.408)					
Common colonizer post-1945	0.7444*** (0.019)		1.1150*** (0.276)					
Observations	399,784	397,185	400,584	400,584				
R <sup>2</sup>	0.675	0.914	0.876	1.000				

Results from all specifications for *internationalized internal armed conflict*. "ctfe": Estimation with importer-year and exporter-year fixed effects. "hdfe": Estimation with importer-year, exporter-year and country-pair fixed effects. Robust standard errors in parentheses. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01 indicate statistical significance at the 10, 5, and 1 percent level, respectively.

Table 24: Results from all specifications for *non-state conflict*

dep variable:	ols ctfc		ols hdfe		ppml ctfc		ppml hdfe	
	(A)	(B)	(C)	(D)	exports	exports	exports	exports
i or j in conflict	-2.7892*** (0.165)	-0.0712* (0.038)	-11.2456*** (0.152)	0.0086 (0.012)				
i or j have neighbor in conflict	-0.2987*** (0.008)	0.0041 (0.007)	-9.3886*** (0.074)	-0.0000 (0.008)				
both in conflict	-5.6267*** (0.336)	-0.2183*** (0.084)	-15.0118*** (0.337)	0.0491 (0.045)				
ln distance	-1.4464*** (0.007)	0.0360*** (0.012)	-0.3759** (0.152)	0.0034 (0.005)				
Preferential trade arrangement	0.3405*** (0.017)	0.0907*** (0.013)	-2.0573*** (0.396)	0.0317*** (0.009)				
Contiguity	0.3175*** (0.029)		-2.5299*** (0.495)					
Common official language	0.6060*** (0.015)		2.1474*** (0.195)					
Colonial link ever	1.1537*** (0.030)		-1.6651*** (0.364)					
Common colonizer post-1945	0.7919*** (0.019)		2.9023*** (0.291)					
Observations	399,784	397,185	400,584	400,584				
R <sup>2</sup>	0.671	0.914	0.706	1.000				

Results from all specifications for *non-state conflict*. "ctfc": Estimation with importer-year and exporter-year fixed effects. "hdfe": Estimation with importer-year, exporter-year and country-pair fixed effects. Robust standard errors in parentheses. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01 indicate statistical significance at the 10, 5, and 1 percent level, respectively.

Table 25: Results from all specifications for *one-sided violence*

dep variable:	ols ctfe	ols hdfe	ppml ctfe	ppml hdfe
	(A) ln exports	(B) ln exports	(C) exports	(D) exports
i or j in conflict	-3.3043*** (0.156)	-0.0014 (0.034)	-10.8925*** (0.108)	0.0500*** (0.010)
i or j have neighbor in conflict	-0.2956*** (0.008)	0.0041 (0.007)	-9.3709*** (0.075)	0.0001 (0.008)
both in conflict	-6.5661*** (0.316)	0.0273 (0.072)	-14.0048*** (0.275)	0.0282 (0.036)
ln distance	-1.4467*** (0.007)	0.0350*** (0.012)	-0.4311*** (0.152)	0.0049 (0.005)
Preferential trade arrangement	0.3407*** (0.017)	0.0905*** (0.013)	-2.2148*** (0.415)	0.0372*** (0.009)
Contiguity	0.3279*** (0.029)		-2.6122*** (0.463)	
Common official language	0.6089*** (0.015)		1.9449*** (0.196)	
Colonial link ever	1.1535*** (0.030)		-1.5047*** (0.368)	
Common colonizer post-1945	0.7834*** (0.019)		2.6475*** (0.281)	
Observations	399,784	397,185	400,584	400,584
R <sup>2</sup>	0.672	0.914	0.699	1.000

Results from all specifications for *one-sided violence*. "ctfe": Estimation with importer-year and exporter-year fixed effects. "hdfe": Estimation with importer-year, exporter-year and country-pair fixed effects. Robust standard errors in parentheses. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01 indicate statistical significance at the 10, 5, and 1 percent level, respectively.



## B.4 Country list of countries included in the analysis

Table 26: Country list, (A-F)

Afghanistan	Central African Republic
Albania	Chad
Algeria	Chile
American Samoa	China
Andorra	Christmas Island
Angola	Cocos (Keeling) Islands
Anguila	Colombia
Antigua and Barbuda	Comoros
Argentina	Congo
Armenia	Congo, Dem. Rep.
Aruba	Cook Islands
Australia	Costa Rica
Austria	Cote d'Ivoire
Azerbaijan	Croatia
Bahamas, The	Cuba
Bahrain	Cyprus
Bangladesh	Czech Republic
Barbados	Czechoslovakia
Belarus	Denmark
Belgium	Djibouti
Belgium-Luxembourg	Dominica
Belize	Dominican Republic
Benin	East Timor
Bermuda	Ecuador
Bhutan	Egypt
Bolivia	El Salvador
Bosnia and Herzegovina	Equatorial Guinea
Botswana	Eritrea
Br. Antr. Terr	Estonia
Brazil	Ethiopia(excludes Eritrea)
British Indian Ocean Ter.	Ethiopia(includes Eritrea)
British Virgin Islands	Faeroe Islands
Brunei	Falkland Island
Bulgaria	Fiji
Burkina Faso	Finland
Burundi	Fr. So. Ant. Tr
Cambodia	France
Cameroon	Free Zones
Canada	French Guiana
Cape Verde	French Polynesia
Cayman Islands	

Table 27: Country list, (G-Q)

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Gabon	Macedonia (FYR)
Gambia, The	Madagascar
Georgia	Malawi
Germany	Malaysia
Ghana	Maldives
Gibraltar	Mali
Greece	Malta
Greenland	Marshall Islands
Grenada	Martinique
Guadeloupe	Mauritania
Guam	Mauritius
Guatemala	Mexico
Guinea	Micronesia, Fed. Sts.
Guinea-Bissau	Moldova
Guyana	Monaco
Haiti	Mongolia
Holy See	Montserrat
Honduras	Morocco
Hong Kong, China	Mozambique
Hungary	Myanmar
Iceland	Namibia
India	Nauru
Indonesia	Nepal
Iran	Netherlands
Iraq	Netherlands Antilles
Ireland	Neutral Zone
Israel	New Caledonia
Italy	New Zealand
Jamaica	Nicaragua
Japan	Niger
Jordan	Nigeria
Kazakhstan	Niue
Kenya	Norfolk Island
Kiribati	Northern Mariana Islands
Korea, Dem. Rep.	Norway
Korea, Rep.	Oman
Kuwait	Pakistan
Kyrgyz Republic	Palau
Lao PDR	Panama
Latvia	Papua New Guinea
Lebanon	Paraguay
Lesotho	Peru
Liberia	Philippines
Libya	Pitcairn
Lithuania	Poland
Luxembourg	Portugal
Macao	Qatar

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Table 28: Country list, (R-Z)

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Reunion	Syrian Arab Republic
Romania	Tajikistan
Russian Federation	Tanzania
Rwanda	Thailand
Saint Helena	Togo
Saint Pierre and Miquelon	Tokelau
Samoa	Tonga
San Marino	Trinidad and Tobago
Sao Tome and Principe	Tunisia
Saudi Arabia	Turkey
Senegal	Turkmenistan
Seychelles	Turks and Caicos Isl.
Sierra Leone	Tuvalu
Singapore	Uganda
Slovak Republic	Ukraine
Slovenia	United Arab Emirates
Solomon Islands	United Kingdom
Somalia	United States
South Africa	Uruguay
South Sudan	Us Msc.Pac.I
Spain	Uzbekistan
Sri Lanka	Vanuatu
St. Kitts and Nevis	Venezuela
St. Lucia	Vietnam
St. Vincent and the Grenadines	Wallis and Futura Isl.
Sudan	Western Sahara
Suriname	Yemen
Swaziland	Yugoslavia
Sweden	Zambia
Switzerland	Zimbabwe

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## B.5 Country involvement per conflict type

Table 29: Countries involved in an *interstate armed conflict*.

Country	First year	Last Year	N	Location
Australia	2003	2003	166	
Cambodia	2011	2011	113	Yes
Cameroon	1996	1996	93	Yes
Djibouti	2008	2008	87	Yes
Ecuador	1995	1995	101	Yes
Eritrea	1998	2008	201	Yes
Ethiopia (excluding Eritrea)	1998	2000	417	Yes
India	1992	2003	1339	Yes
Iraq	2003	2003	77	Yes
Nigeria	1996	1996	105	Yes
Pakistan	1992	2003	1276	Yes
Peru	1995	1995	102	Yes
Thailand	2011	2011	136	Yes
United Kingdom	2003	2003	168	
United States	2003	2003	170	
Total	1992	2011	4551	80%

N indicates the total number of involvements (country-year). Location indicates whether the country was the location of the conflict. The percentage indicates the fraction of countries that were location of an *interstate armed conflict*.

Table 30: Countries involved in an *internal armed conflict*, (A-N).

Country	First year	Last year	N
Afghanistan	1992	2000	754
Algeria	1992	2011	1863
Angola	1992	2009	734
Azerbaijan	1993	1995	132
Bangladesh	2005	2006	293
Bosnia and Herzegovina	1993	1995	122
Burundi	1992	2008	926
Cambodia	1992	1998	430
Central African Republic	2002	2011	344
Chad	1992	2010	1057
China	2008	2008	162
Colombia	1992	2011	2658
Comoros	1997	1997	47
Congo	1993	1993	54
Cote d'Ivoire	2002	2011	473
Croatia	1995	1995	73
Djibouti	1992	1999	162
Egypt	1993	1998	676
Eritrea	1997	2003	133
Georgia	1992	2004	185
Guatemala	1992	1995	364
Guinea	2000	2001	203
Haiti	2004	2004	92
India	1992	2011	2967
Indonesia	1992	2005	1518
Iran	1992	2011	1900
Iraq	1992	1996	207
Israel	1992	2011	2561
Liberia	2000	2003	346
Libya	2011	2011	85
Macedonia (FYR)	2001	2001	76
Mali	1994	2009	413
Mauritania	2011	2011	104
Mexico	1994	1996	232
Moldova	1992	1992	30
Mozambique	1992	1992	60
Myanmar	1992	2011	1874
Nepal	1996	2006	1033
Niger	1992	2008	440
Nigeria	2004	2011	388

N indicates the total number of involvements (country-year).

Table 31: Countries involved in an *internal armed conflict*, (P-Y).

Country	First year	Last year	N
Pakistan	1994	2011	1440
Papua New Guinea	1992	1996	254
Peru	1992	2010	1413
Philippines	1992	2011	2729
Russian Federation	1993	2011	2430
Rwanda	1992	2002	499
Senegal	1992	2011	857
Sierra Leone	2001	2001	92
Somalia	1992	2002	379
Sri Lanka	1992	2009	2168
Sudan	1992	2011	1931
Syrian Arab Republic	2011	2011	120
Tajikistan	1992	2011	389
Thailand	2003	2011	1437
Turkey	1992	2011	2868
Uganda	1992	2007	1304
United Kingdom	1998	1998	143
Uzbekistan	1999	2004	172
Venezuela	1992	1992	88
Yemen	1994	1994	56
Total	1992	2011	46940

N indicates the total number of involvements (country-year).

Table 32: Countries involved in an *internationalized internal armed conflict*, (A-L).

Country	First year	Last year	N	Location
Afghanistan	2001	2011	1235	Yes
Albania	2004	2011	918	
Algeria	2004	2004	120	Yes
Angola	1997	2002	424	Yes
Armenia	1992	2011	620	
Australia	2001	2011	1765	
Austria	2006	2011	761	
Azerbaijan	1992	2011	850	Yes
Belgium	1999	2011	1416	
Bosnia and Herzegovina	1992	2011	871	Yes
Bulgaria	2004	2011	1177	
Canada	1999	2011	1918	
Central African	2001	2011	430	Yes
Chad	1997	2004	333	
Congo	1997	2002	344	Yes
Congo, Dem. Rep.	1996	2001	6	Yes
Croatia	1992	2011	969	Yes
Czech Republic	1999	2011	1304	
Denmark	1999	2011	1752	
Dominican Republic	2004	2004	119	
El Salvador	2004	2011	843	
Estonia	2004	2011	978	
Finland	2006	2011	912	
France	1999	2011	1942	
Georgia	2004	2011	983	Yes
Germany	1999	2011	1939	
Ghana	1999	1999	106	
Greece	1999	2011	1185	
Guinea	1992	1999	570	
Guinea-Bissau	1998	1999	72	Yes
Honduras	2004	2004	125	
Hungary	1999	2011	1031	
Iceland	1999	2011	965	
Iraq	2004	2011	694	Yes
Ireland	2006	2011	763	
Italy	1999	2011	1937	
Japan	2001	2002	337	
Jordan	2001	2011	799	
Kazakhstan	2004	2008	500	
Kenya	2011	2011	128	
Kuwait	2005	2005	124	
Kyrgyz Republic	2000	2000	69	
Latvia	2004	2011	971	
Libya	2001	2001	92	
Lithuania	2002	2011	1247	
Luxembourg	1999	2011	902	

N indicates the total number of involvements (country-year). Location indicates whether the country was the location of the conflict.

Table 33: Countries involved in an *internationalized internal armed conflict*, (M-Z).

Country	First year	Last year	N	Location
Macedonia (FYR)	2004	2011	768	
Malaysia	2010	2011	287	
Mali	1999	2004	204	
Mauritania	2010	2010	112	Yes
Moldova	2004	2008	481	
Mongolia	2004	2011	618	
Namibia	2000	2002	303	
Netherlands	1999	2011	1928	
New Zealand	2002	2011	1244	
Nicaragua	2004	2004	105	
Niger	2004	2004	89	
Nigeria	1992	1999	779	
Norway	1999	2011	1706	
Pakistan	2002	2009	1279	
Philippines	2004	2004	160	
Poland	1999	2011	1826	
Portugal	1999	2011	1360	
Romania	2002	2011	1445	
Russian Federation	1993	2008	768	
Rwanda	1996	2011	555	Yes
Saudi Arabia	2004	2007	613	
Senegal	1998	1999	190	
Sierra Leone	1992	2000	579	Yes
Singapore	2009	2011	445	
Slovak Republic	2003	2011	1206	
Slovenia	2006	2011	823	
Somalia	2006	2011	456	Yes
South Africa	1998	1998	138	
Spain	1999	2011	1754	
Sudan	2003	2011	702	Yes
Sweden	2006	2011	937	
Switzerland	2006	2007	334	
Tajikistan	1993	1996	185	Yes
Tonga	2004	2011	183	
Turkey	1999	2011	1387	
Uganda	1997	2011	941	Yes
Ukraine	2004	2011	881	
United Arab Emirates	2009	2011	442	
United Kingdom	1999	2011	2104	
United States	1999	2011	1950	
Uzbekistan	1993	2000	171	Yes
Yemen	2009	2011	284	Yes
Yugoslavia	1999	1999	116	Yes
Zimbabwe	1998	2001	460	
Total	1992	2011	70844	24,4%

N indicates the total number of involvements (country-year). Location indicates whether the country was the location of the conflict. The percentage indicates the fraction of countries that were location of an *internationalized internal armed conflict*.



Table 34: Countries which are involved in a *non-state conflict*, (A-R).

Country	First year	Last year	N
Afghanistan	1992	2011	1052
Algeria	1995	1998	264
Bangladesh	1993	2001	372
Bolivia	2000	2000	94
Brazil	1994	2011	1483
Burundi	1997	2007	340
Cameroon	1992	1998	314
Canada	1995	1998	274
Central African Republic	2011	2011	81
Chad	1999	2007	292
China	2009	2009	158
Colombia	1993	2005	1350
Comoros	1998	1998	50
Cote d'Ivoire	1995	2011	815
Djibouti	1995	1995	45
Ecuador	2003	2003	135
Egypt	2011	2011	131
Georgia	1997	1998	150
Ghana	1992	2008	736
Guatemala	2005	2008	265
Guinea	2000	2011	200
Honduras	2010	2010	125
India	1992	2011	2163
Indonesia	1997	2001	610
Iraq	1992	2007	668
Israel	2006	2007	293
Jamaica	2001	2001	129
Kenya	1992	2011	2199
Kyrgyz Republic	2010	2010	87
Lebanon	1992	2008	845
Liberia	1992	1996	289
Madagascar	2002	2009	237
Mali	1994	1999	231
Mexico	1993	2011	1275
Myanmar	1995	2007	650
Nepal	2007	2007	118
Niger	1997	1997	64
Nigeria	1992	2011	2249
Pakistan	1992	2011	1454
Papua New Guinea	1999	2001	151
Philippines	1993	2011	670
Russian Federation	1994	1994	107

N indicates the total number of involvements (country-year).

Table 35: Countries involved in a *non-state conflict*, (S-Y).

Country	First year	Last year	N
Senegal	2006	2006	125
Sierra Leone	1994	1995	116
Somalia	1992	2011	1217
South Africa	1992	1998	696
Sri Lanka	1994	2006	567
Sudan	1992	2011	2046
Syrian Arab Repu	2011	2011	120
Tajikistan	1992	1992	25
Tanzania	1997	1997	90
Thailand	1996	1996	134
Turkey	1997	1997	139
Uganda	1998	2009	1091
Yemen	2004	2010	204
Total	1992	2011	29785

N indicates the total number of involvements (country-year).

Table 36: Countries involved in *one-sided violence*, (A-M).

Country	First year	Last year	N
Afghanistan	1997	2011	1403
Algeria	1993	2009	1121
Angola	1993	2003	653
Azerbaijan	1992	1992	25
Bahrain	2011	2011	105
Bangladesh	1992	2004	838
Bosnia and Herzegovina	1992	1995	151
Brazil	1993	2005	269
Burundi	1994	2006	815
Cambodia	1992	1998	357
Cameroon	1994	1994	76
Central African Republic	2001	2011	609
Chad	1992	2007	748
China	2008	2008	162
Colombia	1993	2010	2284
Congo	1993	2002	398
Cote d'Ivoire	1993	2011	839
Croatia	1993	1995	127
Egypt	1995	2005	672
Georgia	1993	1995	95
Guatemala	1992	2011	480
Guinea	1996	2009	565
Guyana	2008	2008	99
Haiti	1993	2005	187
Honduras	2004	2004	125
India	1992	2011	2967
Indonesia	1992	2004	1481
Iran	2009	2009	145
Iraq	1992	2011	965
Israel	1994	2006	1068
Jordan	1992	2005	210
Kenya	2007	2011	561
Lebanon	1994	2006	343
Liberia	1992	2003	712
Libya	2011	2011	85
Madagascar	2009	2009	124
Mali	1992	2009	232
Mauritania	2009	2009	116
Mexico	1997	2011	414
Morocco	2003	2003	146
Mozambique	1992	1992	60
Myanmar	1992	2011	1691

N indicates the total number of involvements (country-year).

Table 37: Countries involved in *one-sided violence*, (N-Z).

Country	First year	Last year	N
Namibia	2000	2002	207
Nepal	1996	2006	951
Niger	1995	1998	132
Nigeria	1994	2011	1475
Pakistan	1998	2011	1521
Papua New Guinea	1992	1996	113
Peru	1992	1993	173
Philippines	1995	2009	1030
Russian Federation	1995	2011	1453
Rwanda	1992	2009	433
Saudi Arabia	2003	2004	306
Senegal	1992	2002	501
Sierra Leone	1992	2002	683
Somalia	1992	2011	407
South Africa	1992	1994	299
Spain	2004	2004	166
Sri Lanka	1992	2009	1479
Sudan	1992	2011	2046
Syrian Arab Republic	2011	2011	120
Tajikistan	1992	1992	25
Tanzania	2001	2007	247
Thailand	1995	2011	1859
Togo	1993	2005	145
Turkey	1992	1999	713
Uganda	1995	2010	1538
United Kingdom	1993	2005	274
United States	2001	2001	170
Yemen	2011	2011	86
Zambia	1993	2000	148
Zimbabwe	2008	2008	122
Total	1992	2011	43345

N indicates the total number of involvements (country-year).

## B.6 Enmity per dyad and year

Table 38: Countries that are enemies in an *interstate armed conflict*, by year.

		year
Pakistan	India	1992
Peru	Ecuador	1995
Nigeria	Cameroon	1996
Pakistan	India	1996
Pakistan	India	1997
India	Pakistan	1998
Pakistan	India	1999
India	Pakistan	2000
Pakistan	India	2001
India	Pakistan	2002
United Kingdom	Iraq	2003
United States	Iraq	2003
Australia	Iraq	2003
India	Pakistan	2003
Thailand	Cambodia	2011

Table 39: Countries that are enemies in an *internationalized internal armed conflict*, by year.

		year
Croatia	Bosnia and Herzegovina	1993
Guinea	Nigeria	1997
Guinea	Sierra Leone	1997
Nigeria	Sierra Leone	1997
Rwanda	Angola	1998
Rwanda	Chad	1998
Guinea	Nigeria	1998
Guinea	Sierra Leone	1998
Nigeria	Sierra Leone	1998
Rwanda	Zimbabwe	1998
Uganda	Zimbabwe	1998
Rwanda	Zimbabwe	1999
Uganda	Zimbabwe	1999
Uganda	Namibia	2000
Uganda	Zimbabwe	2000
Australia	Afghanistan	2001
France	Afghanistan	2001
Canada	Afghanistan	2001
Italy	Afghanistan	2001
Netherlands	Afghanistan	2001
United Kingdom	Afghanistan	2001
Jordan	Afghanistan	2001
United States	Afghanistan	2001
Turkey	Afghanistan	2001
Russian Federation	Afghanistan	2001
Germany	Afghanistan	2001
Poland	Afghanistan	2001
Japan	Afghanistan	2001
Rwanda	Angola	2001
Rwanda	Namibia	2001
Rwanda	Zimbabwe	2001
Russian Federation	Georgia	2008

## C Appendix Chapter 3

### C.1 List of countries and regions included in the analysis

Table 40: Countries and regions included in the analysis

region	country
Latin America	Argentina , Bolivia , Chile, Dominican Republic, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Suriname, Trinidad and Tobago, Uruguay
Middle East & North Africa	Algeria, Iran, Morocco, Turkey
Sub-Saharan Africa	Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Democratic Republic of Congo, Gabon, Ghana, Ivory Coast, Kenya, Madagascar, Mauritania, Niger, Nigeria, Republic of the Congo, Rwanda, Senegal, South Africa, Sudan, Togo, Uganda
Western Europe, Australia & North America	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom, United States of America
Asia	China, India, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, Sri Lanka, Thailand

## C.2 Regional Impulse Response Functions

The regional impulse response functions were computed as follows: In a first step the VAR-model is estimated separately for each country. This has the advantage of allowing for heterogeneous slope parameters across countries (as opposed to estimating a panel model with fixed effects). Secondly, for each country the given Cholesky-decomposition is employed and impulse response functions are calculated. Third, regional impulse response functions are derived by taking the average of the corresponding countries' point estimates. Confidence bands, however, may not be pooled across countries by using averages since they are based on non-linear quantiles. Averages over confidence bands would yield unclear coverage, i.e. it would be unclear whether the confidence bands coverage retains its nominal size of 95%. Regional confidence bands are therefore computed employing the following variance decomposition:

For each forecasting step ( $s = 1, 2, \dots, 10$ ) the regional variance that consists of within and between variance:

$$\sigma_{s,regional}^2 = \sigma_{s,within}^2 + \sigma_{s,between}^2, \quad (9)$$

with

$$\sigma_{s,within}^2 = \frac{1}{N} \sum_{i=1}^N variance_{i,s},$$

where  $i = 1, 2, \dots, N$  is the number of countries in the regional group and  $variance_{i,s} = standarderror_{i,s}^2 \cdot \tau$ .  $\tau$  refers to the degrees of freedom adjusted lengths of each country's timeseries, i.e.  $\tau = T - L - L * K - 1$ , where  $T = 57$  years, lag length  $L = 4$ , number of control variables  $K = 4$ , and  $-1$  for the intercept. Therefore,  $\tau = 57 - 4 - 4 * 4 - 1 = 36$ .

For the regional between variance the heterogeneity of the point estimates is exploited. It is computed using the following formula:

$$\sigma_{s,between}^2 = \frac{1}{N} \sum_{i=1}^N [IRF_{i,s} - \frac{1}{N} \sum_{i=1}^N IRF_{i,s}]^2$$

where  $IRF_{i,s}$  are the point estimates obtained for each step  $s = 1, 2, \dots, 10$  and each country  $i$  in the region ( $N$  =total number of countries in the region).

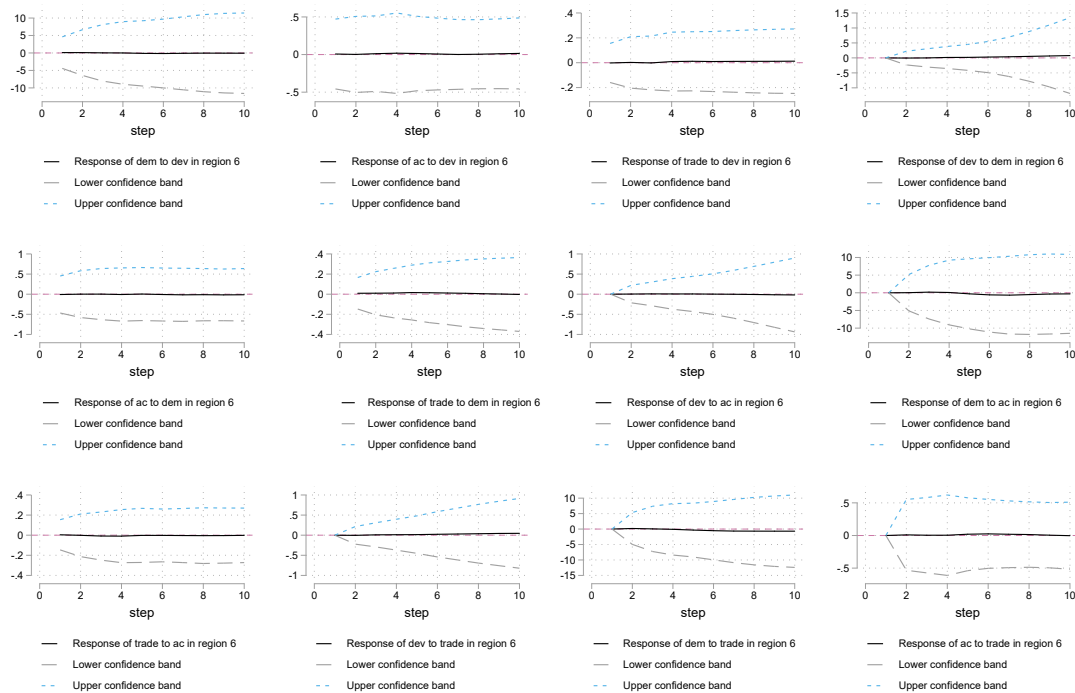
Once  $\sigma_{s,regional}^2$  is computed regional confidence bands for each step can be calculated as upper (lower) 95%:  $\overline{IRF}_s + (-) \sigma_{s,regional} \cdot 1,96$ , where  $\overline{IRF}_s$  is the simple regional average



of the point estimates.

Since the heterogeneity of responses is substantial across countries the regionally aggregated impulse response functions in Figure 4 display no effect. Note that this result is solely driven by the regional heterogeneity of effects, not by their inexistence.

Figure 4: Regional impulse response functions for Asia.



”ac” stands for ”armed conflict”, ”dev” for development, and ”dem” for democracy

### C.3 Impulse Response Functions - Baseline Model

This section displays and discusses the impulse response function of the baseline model: VAR(4), ordering: Development, democracy, conflict and trade.

For the sake of space only impulse response functions for countries with significant effects are shown. The impulse response functions are grouped by bilateral relationship.

#### Trade openness and development

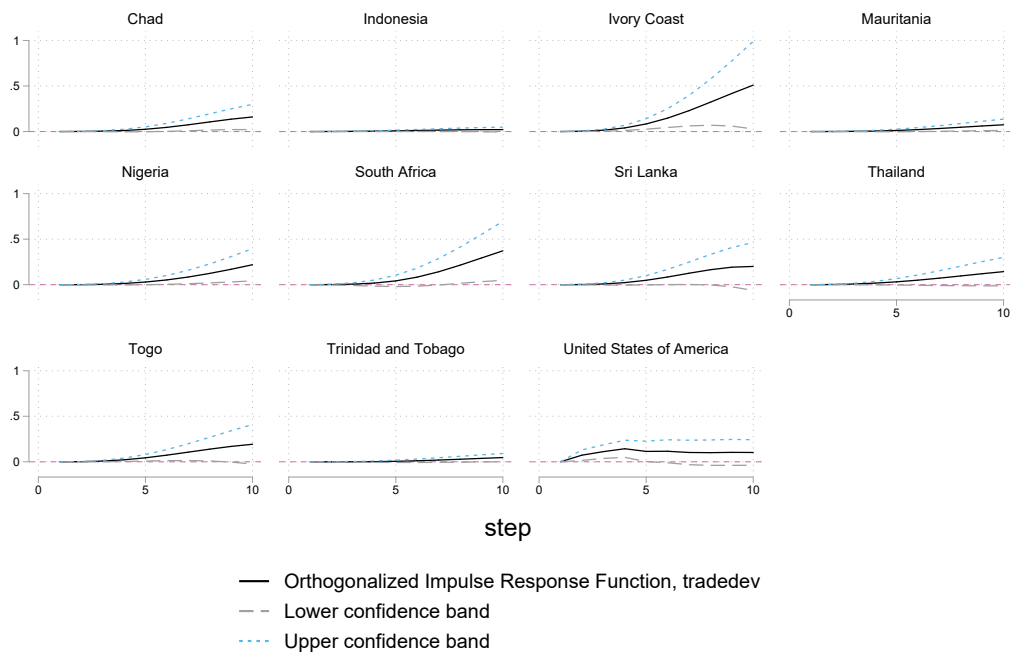
Trade openness seems to have a negative effect on development only in a handful of countries. However, in these countries the effect is strong and persistent. Affected countries are exclusively African or Latin American. Nevertheless, the largest positive impacts of trade openness on development can as well be seen in Africa: The biggest effect is displayed by Ivory Coast. Smaller, but significant positive results are seen for Asian countries. Interestingly, the largest advocate for free trade profits from it: The US show a significant development effect from a positive shock in trade openness.

Development only has a negative result for three countries: Central African Republic,

Nicaragua and Uruguay, with the biggest effect for Nicaragua. In turn, development has a positive effect on trade openness for a huge number of countries: Across all regions countries trade openness is affected positively by a positive shock in development, with the largest impacts in Rwanda and Suriname, followed by the US, Algeria, Republic of the Congo and Senegal.

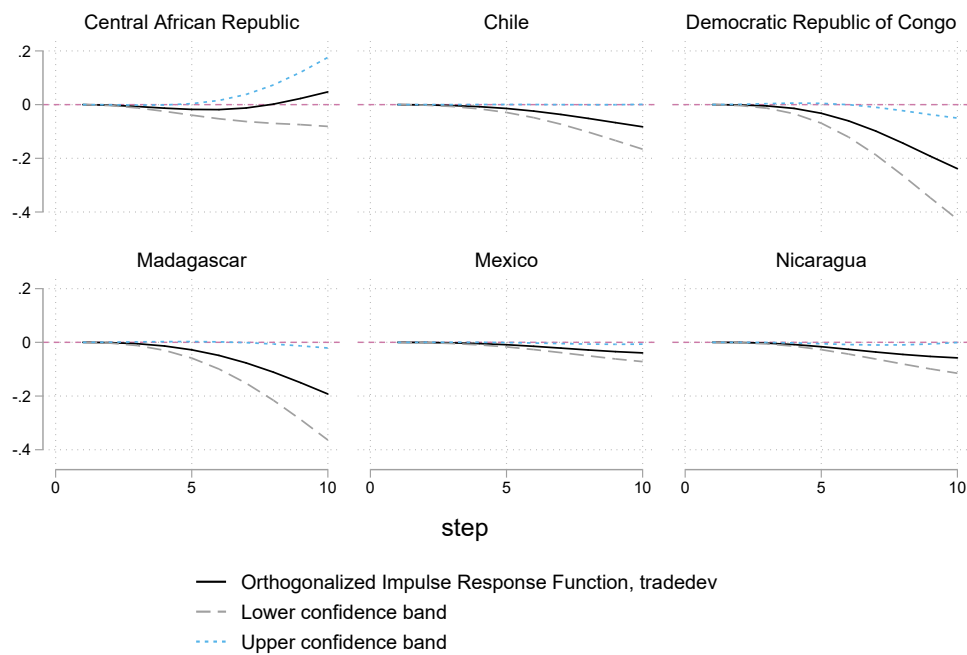
Summary: Development causes rise in trade openness in a large number of countries, while negative effects are rare. Trade openness does not necessarily cause rise in development: Positive effects are rarely large. However, the same applies to negative effects of trade openness.

Figure 5: IRF: Positive effects of trade on development.



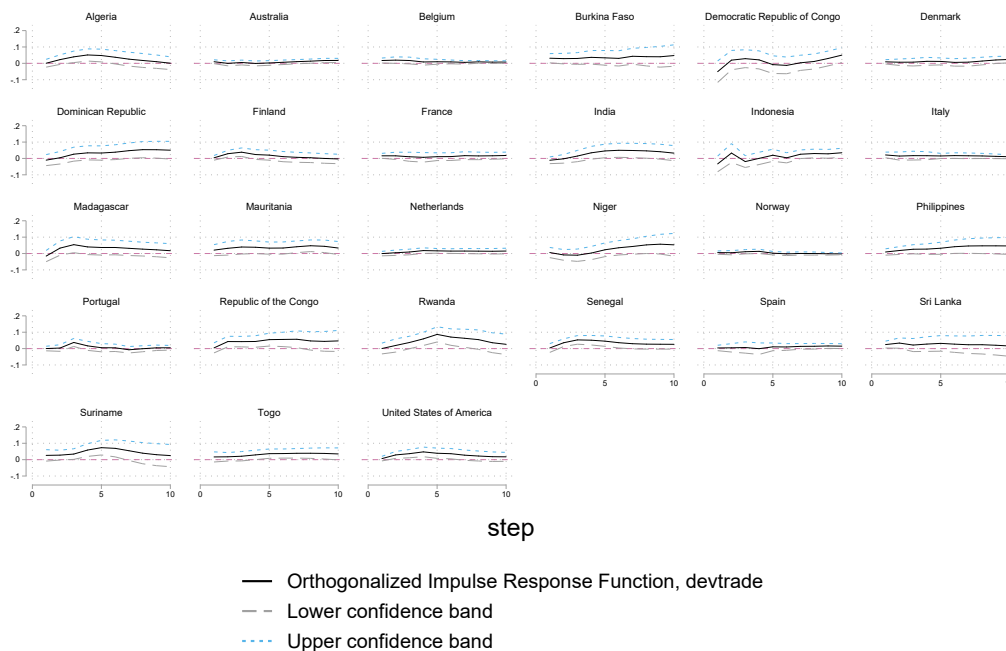
Impulse response functions for countries with significant positive effects of trade on development during at least one step.

Figure 6: IRF: negative effects of trade on development.



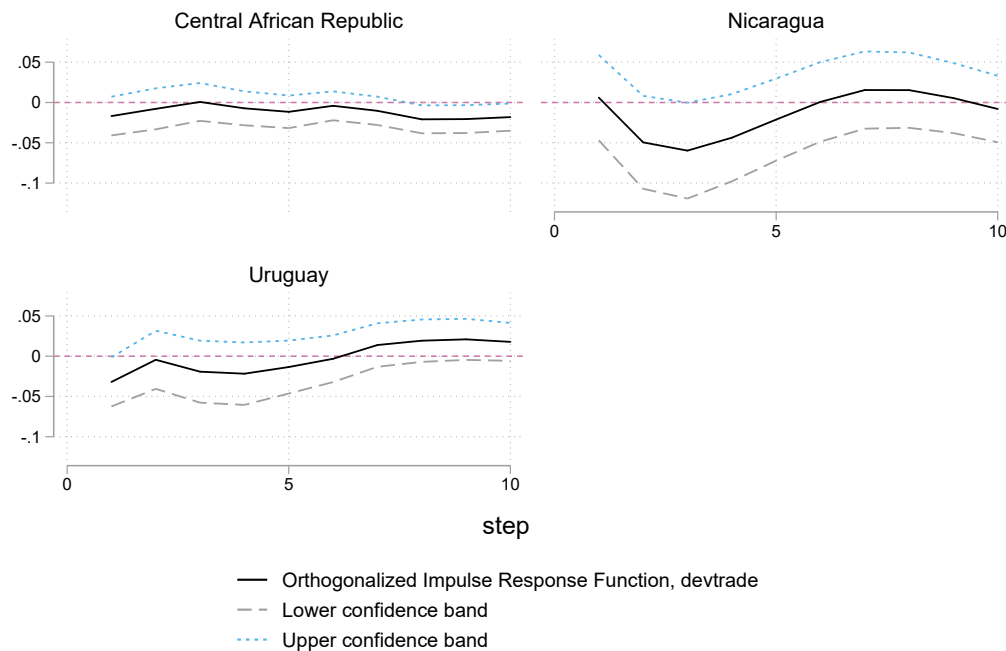
Impulse response functions for countries with significant negative effects of trade on development during at least one step.

Figure 7: IRF: positive effects of development on trade.



Impulse response functions for countries with significant positive effects of development on trade during at least one step.

Figure 8: IRF: negative effects of development on trade



Impulse response functions for countries with significant negative effects of development on trade during at least one step.

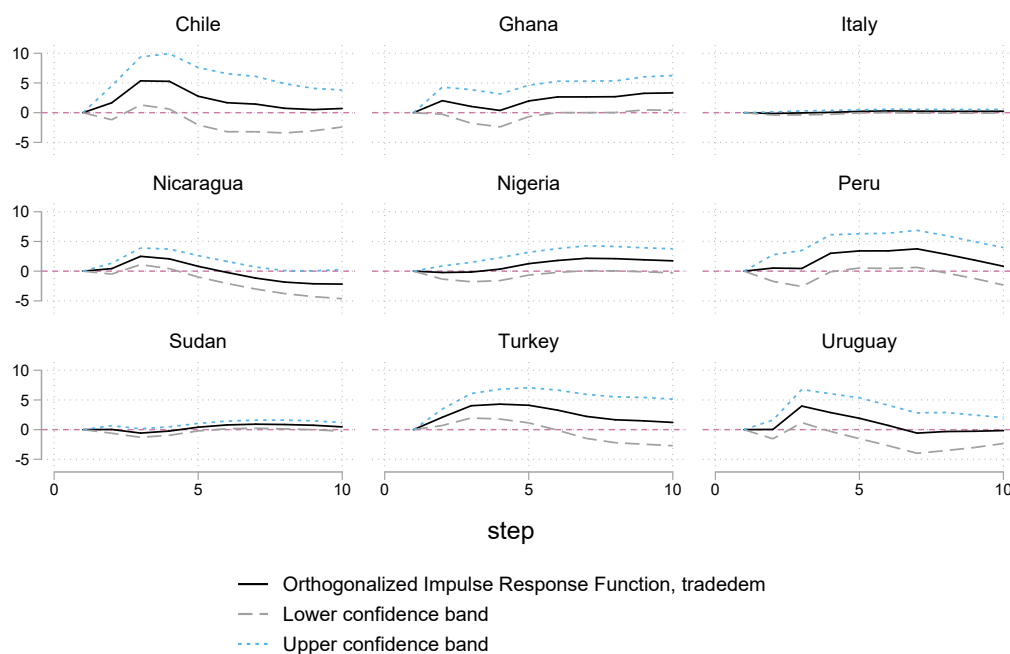
## Trade openness and democracy

The highest positive effects of a shock in trade openness on democracy can be seen in Chile and Turkey. Especially Latin American countries display positive responses. While only 9 countries show positive results, 19 countries show negative responses in democracy after a positive shock in trade openness. This group is very heterogeneous and represents all 5 regions. Negative results are largest for Republic of Congo, South Korea and Niger.

Compared to the results seen before, responses for each direction are more balanced in this group. Trade openness is negatively affected by a shock in democracy in 15 countries of all regions, most notably Rwanda and Iran. Interestingly, especially China's trade openness profits from positive shocks in democracy. Other substantial effects of democracy on trade can be seen for Suriname, Republic of the Congo and Democratic Republic of the Congo.

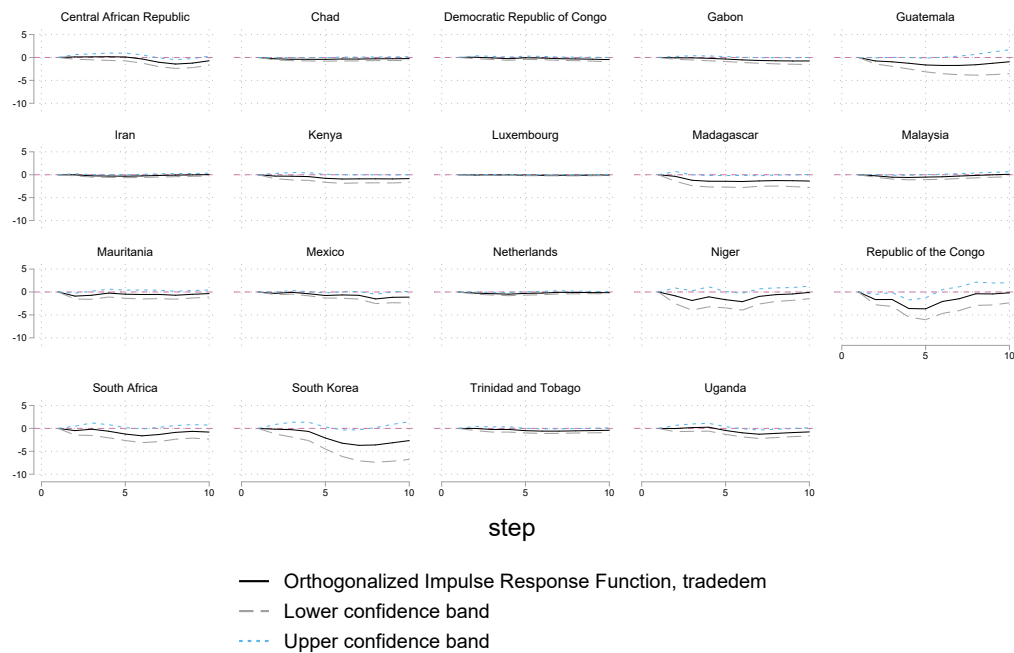
Summary: The responses to a shock are heterogeneous in both parts of the bilateral relationship between trade openness and democracy.

Figure 9: IRF: positive effects of trade on democracy.



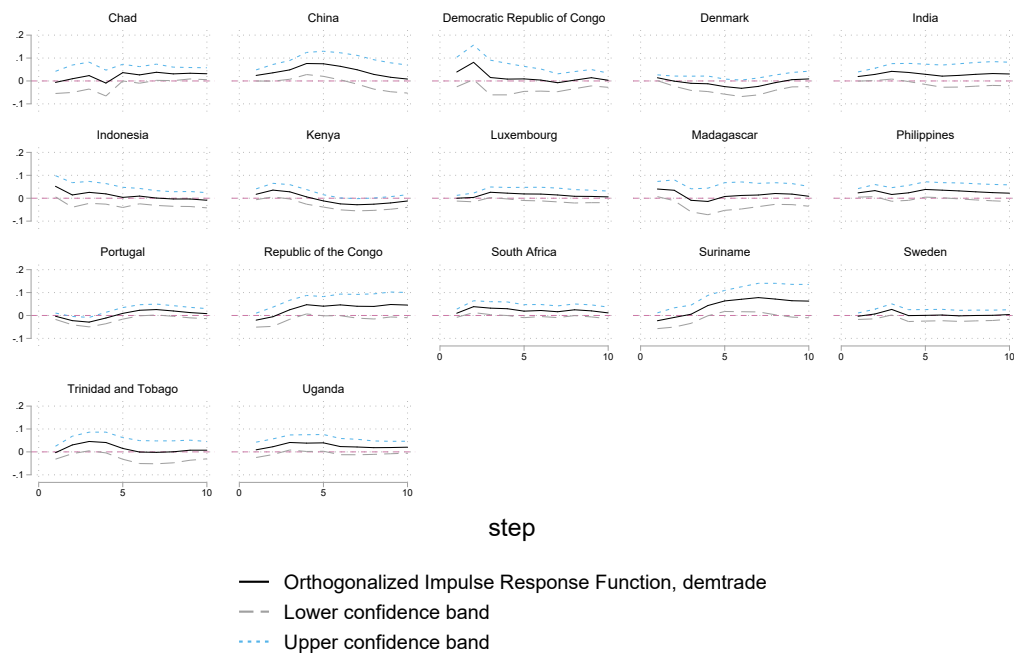
Impulse response functions for countries with significant positive effects of trade on democracy during at least one step.

Figure 10: IRF: negative effects of trade on democracy.



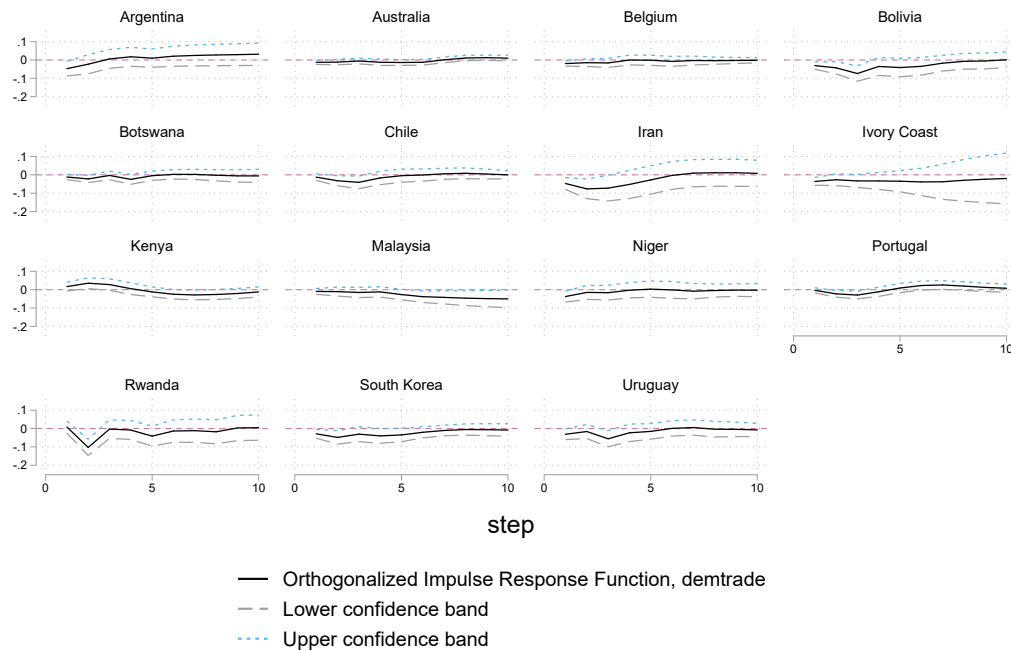
Impulse response functions for countries with significant negative effects of trade on democracy during at least one step.

Figure 11: IRF: positive effects of democracy on trade.



Impulse response functions for countries with significant positive effects of democracy on trade during at least one step.

Figure 12: IRF: negative effects of democracy on trade.



Impulse response functions for countries with significant negative effects of democracy on trade during at least one step.

### Trade openness and conflict

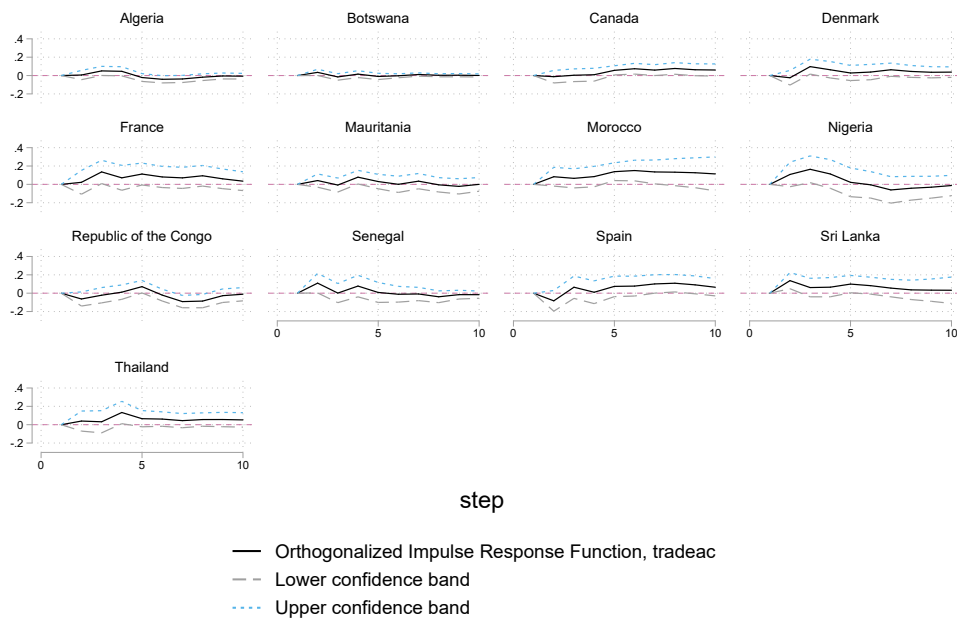
Overall a shock in trade openness leads to very heterogeneous responses across all countries. Interestingly, for this shock regional homogeneity is present to some extent. Four western states out of 13 countries show a positive response in armed conflict to a shock in trade. In Latin America, the only significant effects are negative deviations (of substantial magnitude, e.g. Nicaragua  $-0.2$ ) from the country means in 3 of 10 countries. All other regions contain countries with heterogeneous responses, which suggest conflict location as a potentially important variable to include in further research.

Overall, as well as in the reverse case, the responses of trade openness to a shock in armed conflict are heterogeneous across countries and regions. From the MENA region, only one country displays a significant response, which is Turkey, and the response is positive. However, no general result for this relationship can be stated.

Summary: Trade and conflict simultaneously affect each other. The effects are heterogeneous across countries, although there is some slight regional homogeneity.

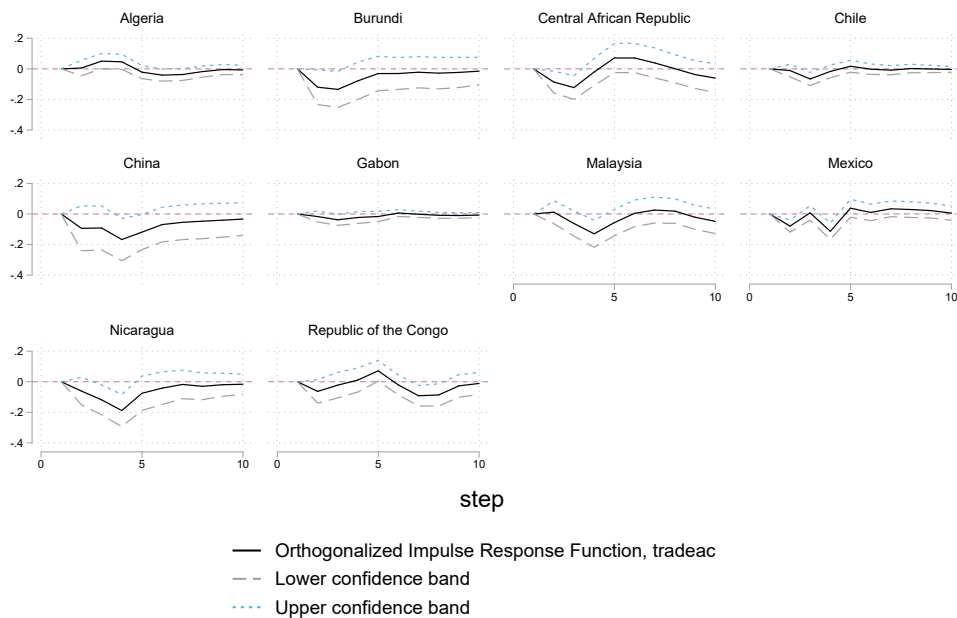


Figure 13: IRF: positive effects of trade on conflict.



Impulse response functions for countries with significant positive effects of trade on conflict during at least one step.

Figure 14: IRF: negative effects of trade on conflict.

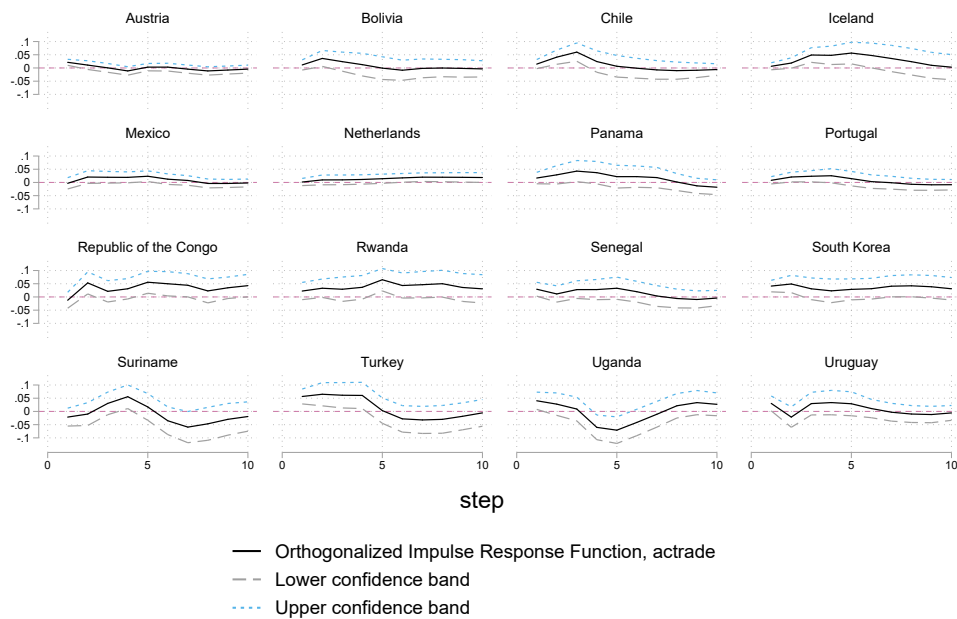


Impulse response functions for countries with significant negative effects of trade on conflict during at least one step.

## Democracy and development

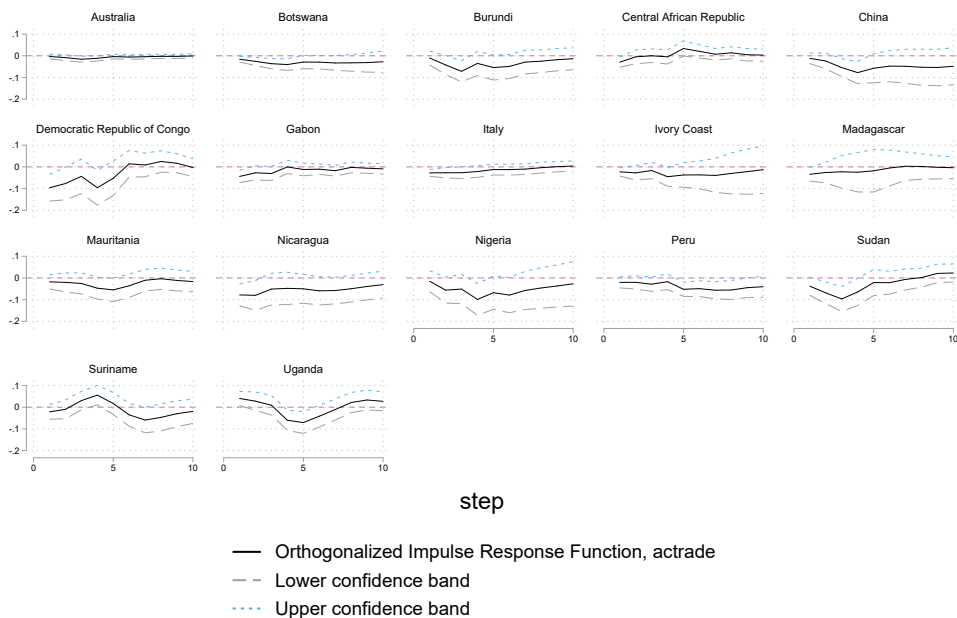
In line with the slow moving and slow reacting nature of the two variables, democracy and development, observed effects of democracy on development mostly appear after 5 periods

Figure 15: IRF: positive effects of conflict on trade.



Impulse response functions for countries with significant positive effects of conflict on trade during at least one step.

Figure 16: IRF: negative effects of conflict on trade.



Impulse response functions for countries with significant negative effects of conflict on trade during at least one step.

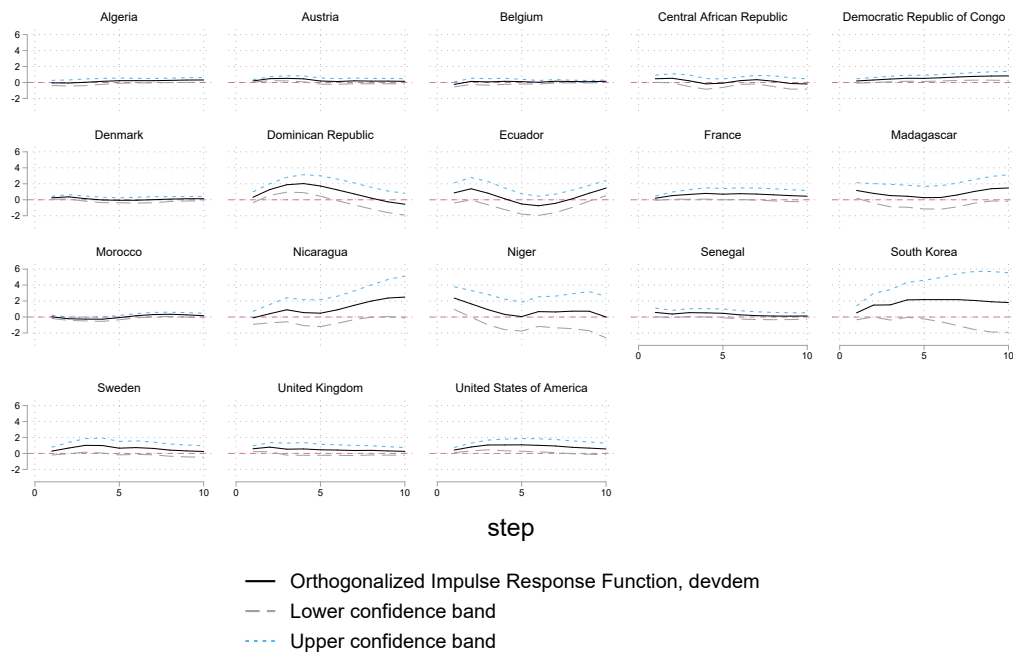
(i.e. in the long run) and they are long lasting (e.g. Ghana, Gabon, CAR, Senegal), that is they last for several periods in a row. In Sub-Saharan Africa, 5 of 21 countries show

significant responses and all of them are positive. In Asia, only Sri Lanka shows an effect (positive between periods 4-9) In Western States 2 of 19 countries show a positive effect. Here, the effect is short (one or at most two periods) and occurs right after the shock (or within the first 5 periods). No effect is visible in any MENA country. On average democracy has mostly positive effects on development in this sample, if any. Over all regions the only countries which show a negative effect are three countries in Latin America. (Chile, Honduras and Mexico). These display long lasting negative effects of democracy on development.

The IRFs mostly provide evidence for positive effects of development on the level of democracy. In Sub-Saharan Africa and Western States the significant effects were entirely positive. However, there are two notable negative responses: In Indonesia a shock in development leads to a very strong negative response (up to -3 deviation from its country mean and over the first 7 periods). In Argentina, democracy also responds negatively (with deviations from its democracy average of up to -4.5 points) during periods 2 to 6. Morocco is an interesting case as there, democracy first responds negatively to a shock in development, but then adjusts and responds positively in periods 7-9. It is worth noting, though, that Morocco's response is rather small in magnitude, i.e. its democracy value never deviates more than +/-0.3 from its average.

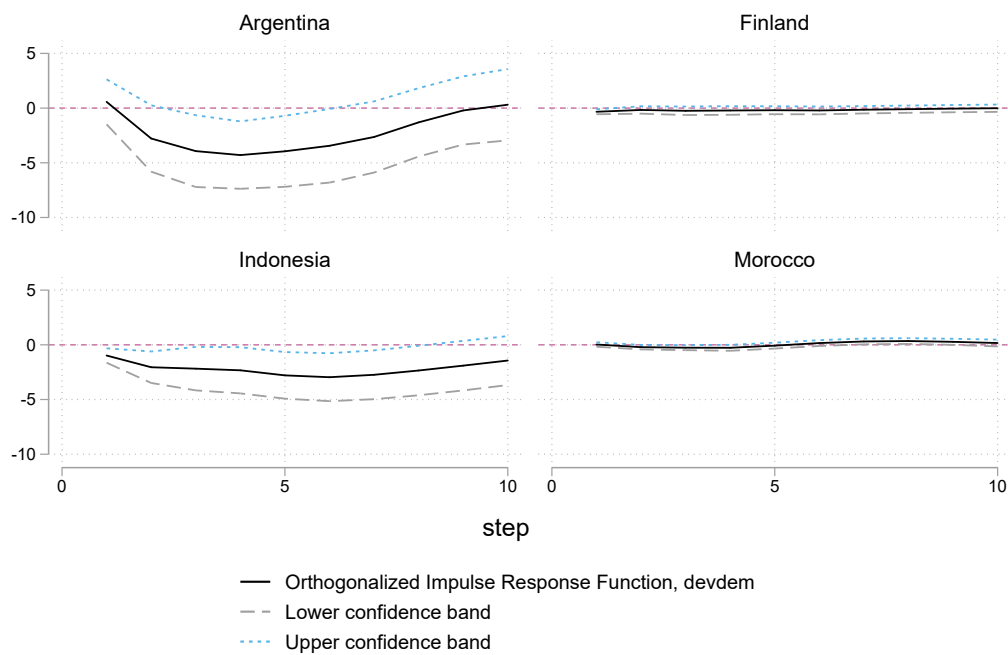
Summary: In total the impulse response functions point towards mutual positive effects of democracy on development and vice versa. There are, however, a few notable exceptions where negative responses occur. Due to the magnitude of these responses they should not be overlooked.

Figure 17: IRF: Positive effects of development on democracy.



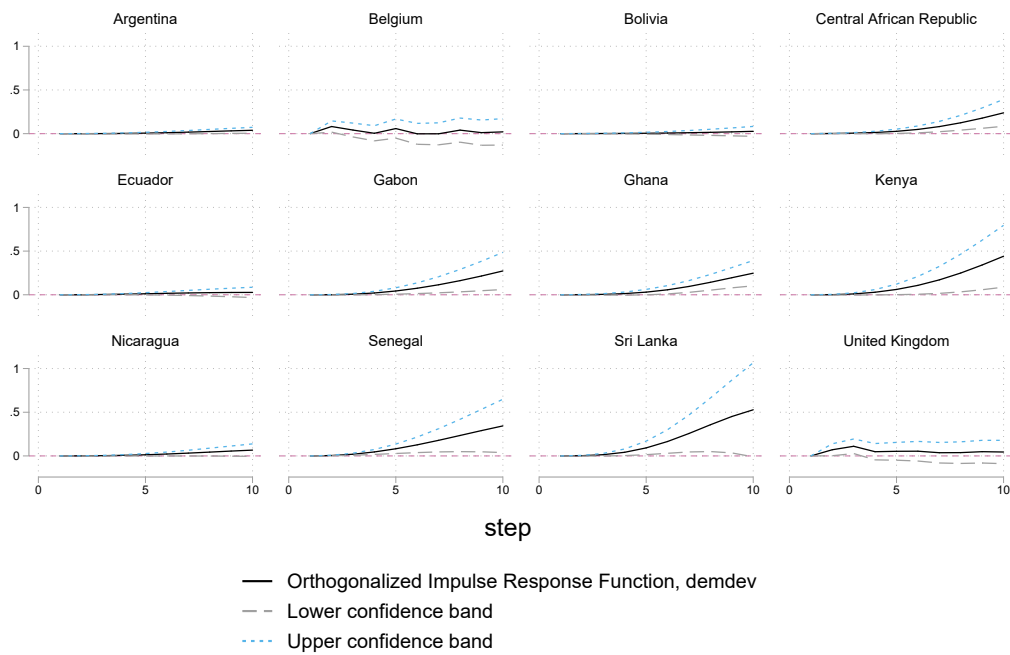
Impulse response functions for countries with significant positive effects of development on democracy during at least one step.

Figure 18: IRF: Negative effects of development on democracy.



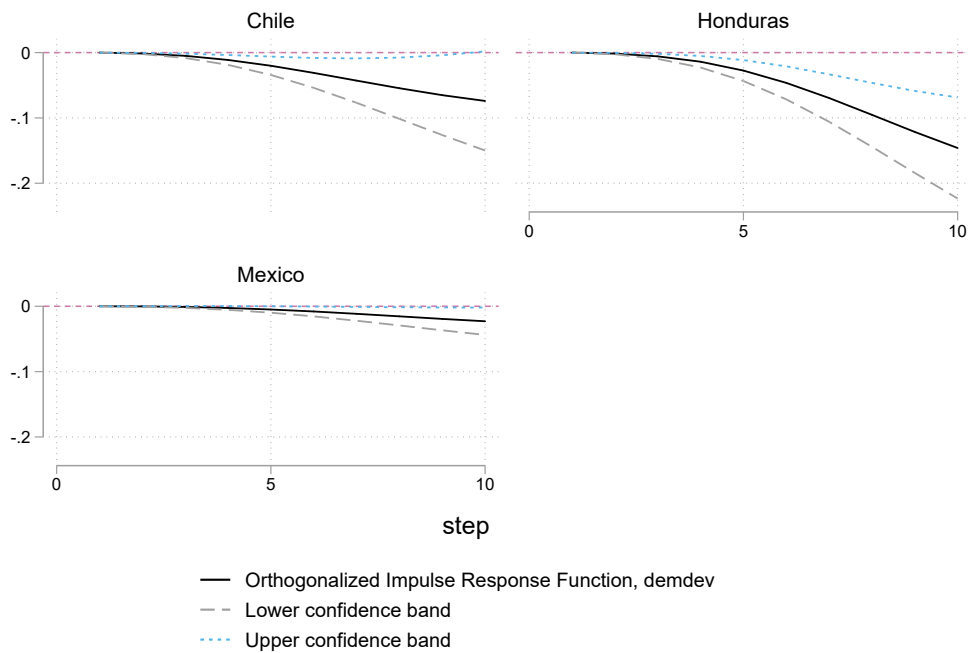
Impulse response functions for countries with significant negative effects of development on democracy during at least one step.

Figure 19: IRF: Positive effects of democracy on development.



Impulse response functions for countries with significant positive effects of democracy on development during at least one step.

Figure 20: IRF: Negative effects of democracy on development.



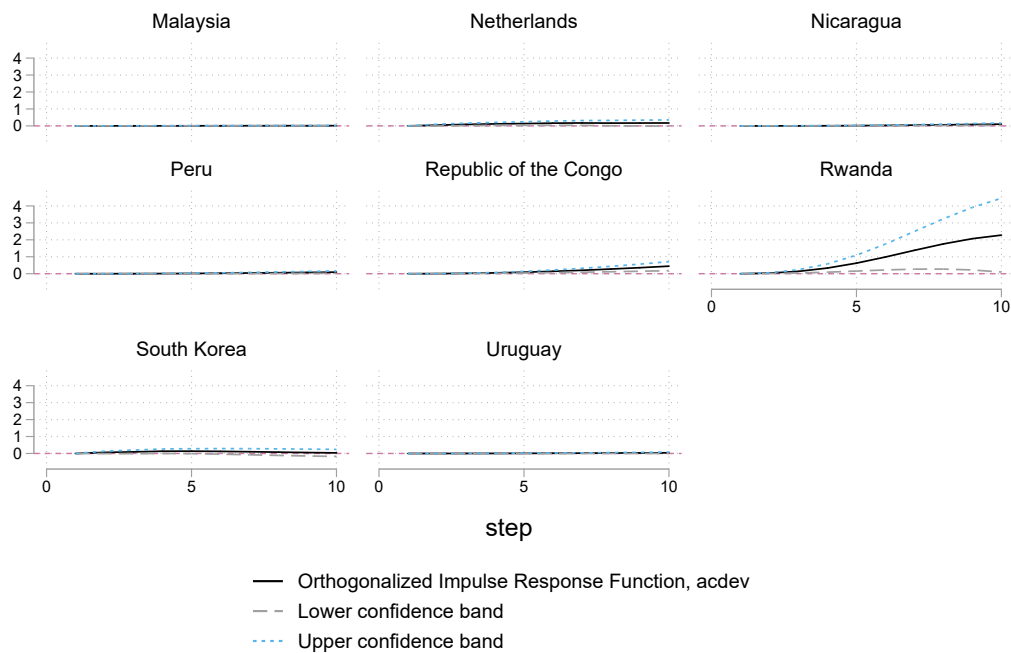
Impulse response functions for countries with significant negative effects of democracy on development during at least one step.

## Conflict and development

There are comparatively few countries in which a shock of armed conflict has significant effects on development. None of the countries in the MENA region, for example, show any significant effect. When there are effects they are mostly positive and appear only after 5 periods (for example in Nicaragua, Peru and Uruguay). In Sub-Saharan Africa this pattern is particularly pronounced for the Republic of Congo and Rwanda. In the Central African Republic on the other hand, conflict has a strong negative impact over the last three periods. Interestingly, the only country with a similar pattern is Austria. The Netherlands are a notable case as a shock in conflict there leads to up to  $+0.18$  positive deviation from its country average in development. In this model, both armed conflict and democracy have mostly positive effects on development. The magnitude of these effects is higher after shocks in democracy than in armed conflict.

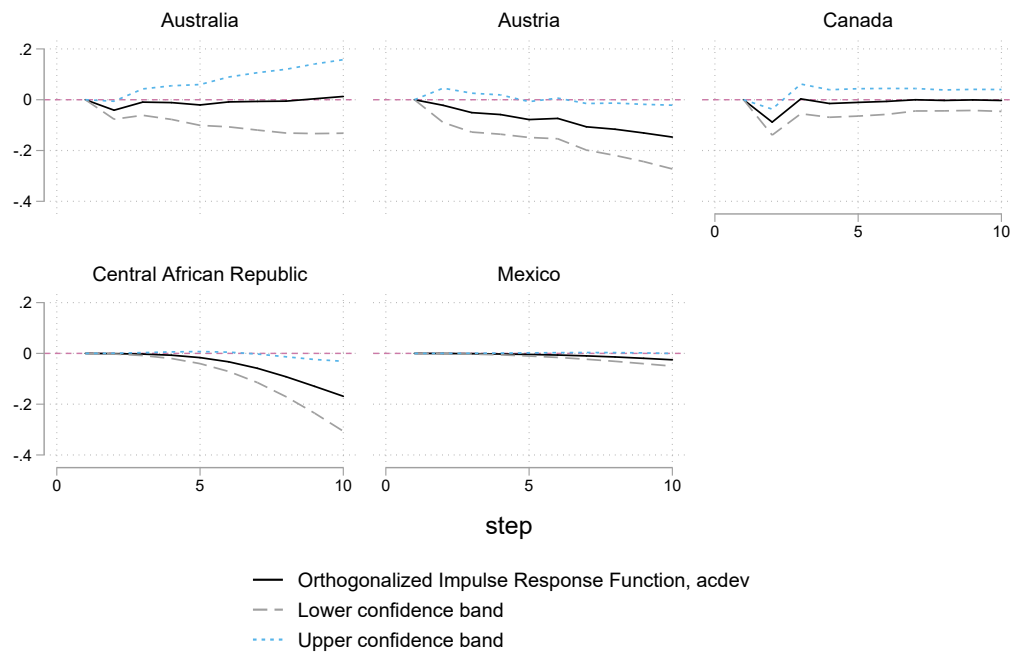
Development has comparatively smaller effects on armed conflict than democracy, i.e. the responses are on average of a smaller magnitude (most of the countries deviate less than  $.1$  points from their conflict average over the entire 10 periods) and they occur in a smaller number of countries. In several countries a positive shock in development leads to a positive response of armed conflict. In Western states this effect is very short lived and only visible in the first period. In Sub-Saharan Africa, Rwanda, the Democratic Republic of Congo and Sudan are most notable examples: Their conflict values deviate around  $+0.12$  over at least two periods after a positive shock in development. There are 7 countries for which a positive shock in development leads to a negative deviation from their country means in armed conflict. Once more conflict location suggests itself as an important factor to include in further research especially regarding the effects of conflict.

Figure 21: IRF: Positive effects of conflict on development.



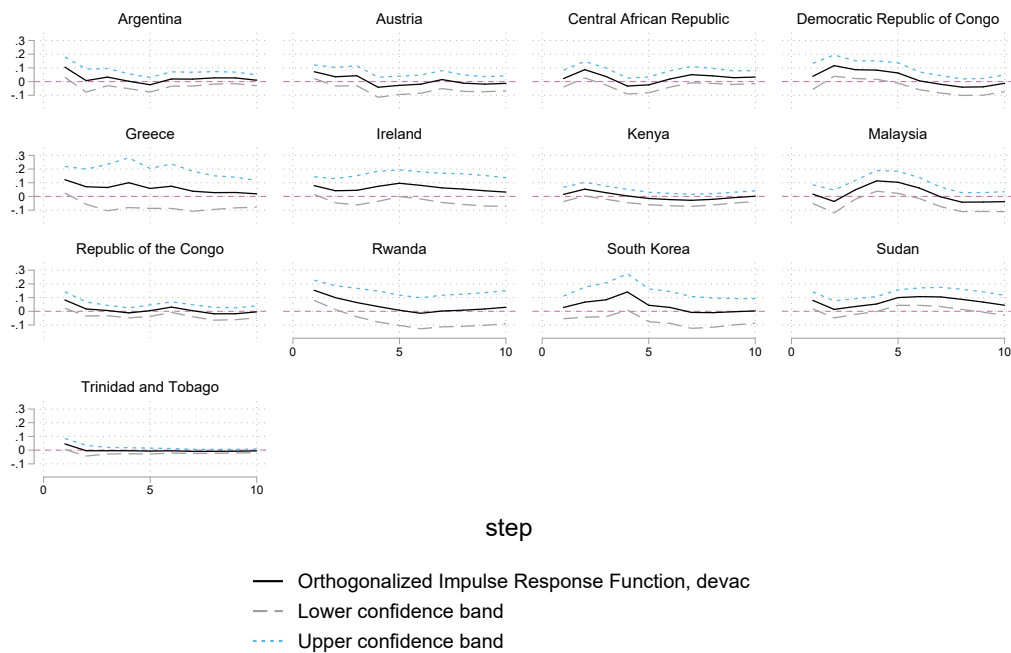
Impulse response functions for countries with significant positive effects of conflict on development during at least one step.

Figure 22: IRF: Negative effects of conflict on development.



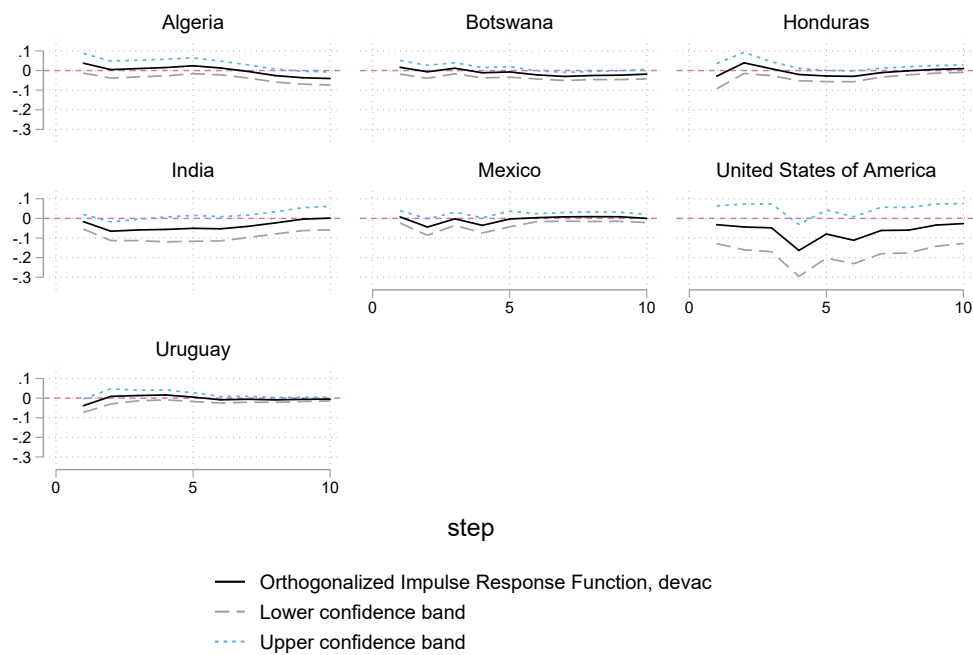
Impulse response functions for countries with significant negative effects of conflict on development during at least one step.

Figure 23: IRF: Positive effects of development on conflict.



Impulse response functions for countries with significant positive effects of development on conflict during at least one step.

Figure 24: IRF: Negative effects of development on conflict.



Impulse response functions for countries with significant negative effects of development on conflict during at least one step.



## Democracy and conflict

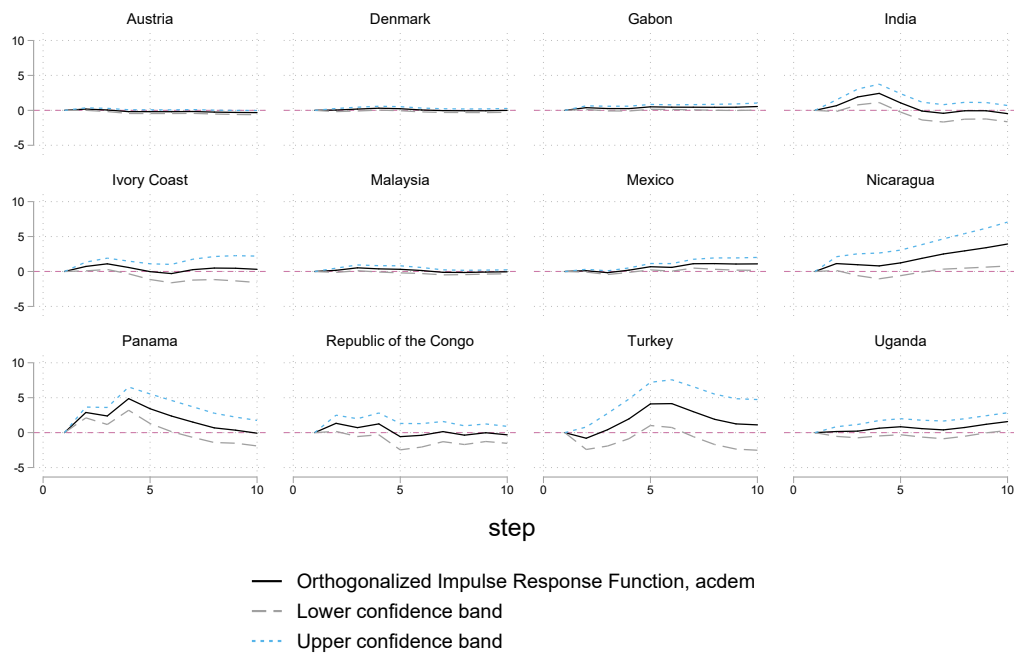
The effects of armed conflict on democracy are very heterogeneous across countries, in terms of magnitude as well as timing. There are positive and negative responses across all regions. Significant responses occur at all steps. There is no striking similarity or difference. The positive impact of armed conflict on democratization is especially striking in Central America: Mexico, Nicaragua and Panama display some of the largest significant results in the whole shock group, while results for regions 4, 5, and 6 show mixed results. In region 2, Turkey is the only country showing a significant result, which as well as in Central America shows that armed conflict increases democratization. Overall, timing of these shocks is very diverse.

The effects of a shock in democracy on conflict are highly heterogeneous across countries. For example, there is a significant negative effect at some point in the first five years in all MENA countries, particularly strong in Iran. A strong significant positive effect on the other hand is visible in India and Malaysia within the first five periods. These are the only countries in Asia displaying any response. In general most reactions seem to happen in the first five periods. Responses after that mostly occur in Western States (Australia) or are very small (e.g. Togo or Suriname). Although some countries in region 5 show positive results, these results are very small (Norway, Netherlands, Spain, UK). A striking but as well intuitive result is that the biggest negative responses of armed conflict to a positive shock in democratization are seen in the western countries (Australia, Canada, Portugal): Conflict involvement decreases the more democratic a country becomes. The reverse is true for regions 4 and 6, where a positive shock in democratization leads to more armed Conflict.

Summary: The impulse response functions show evidence for both armed conflict affecting democracy levels and vice-versa. In general the responses of democracy occur over longer periods of time whereas conflict reacts rather punctually (few steps at a time). There is evidence of simultaneity in a wide range of countries (e.g. Morocco: Democracy has a negative impact on armed conflict and armed conflict has a negative impact on democracy; or India and Malaysia where during the first five steps democracy has a positive effect on armed conflict and so does armed conflict on democracy). This simultaneity can at times take counter intuitive forms, e.g. in South Africa: Armed conflict has a negative effect on democracy in the long run. In the short run democracy has a positive effect on armed

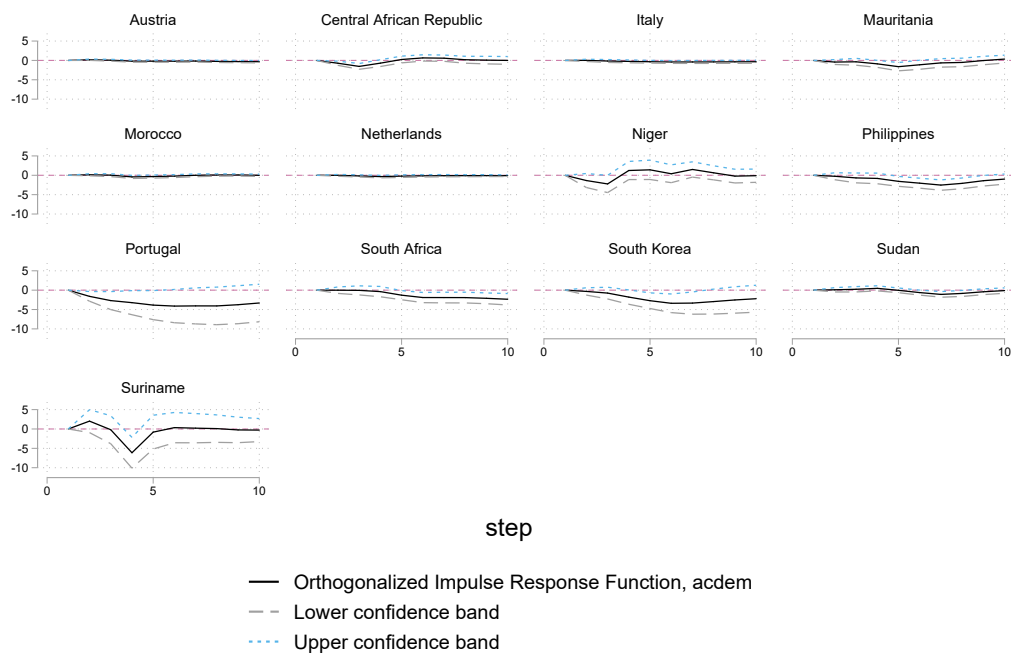
conflict.

Figure 25: IRF: Positive effects of conflict on democracy.



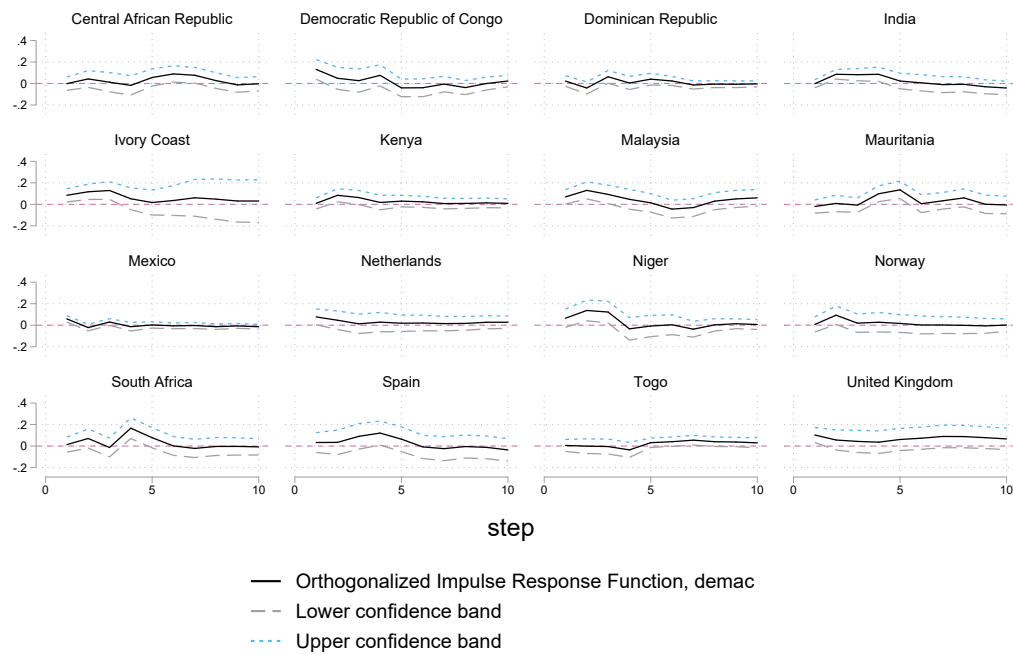
Impulse response functions for countries with significant positive effects of conflict on democracy during at least one step.

Figure 26: IRF: Negative effects of conflict on democracy.



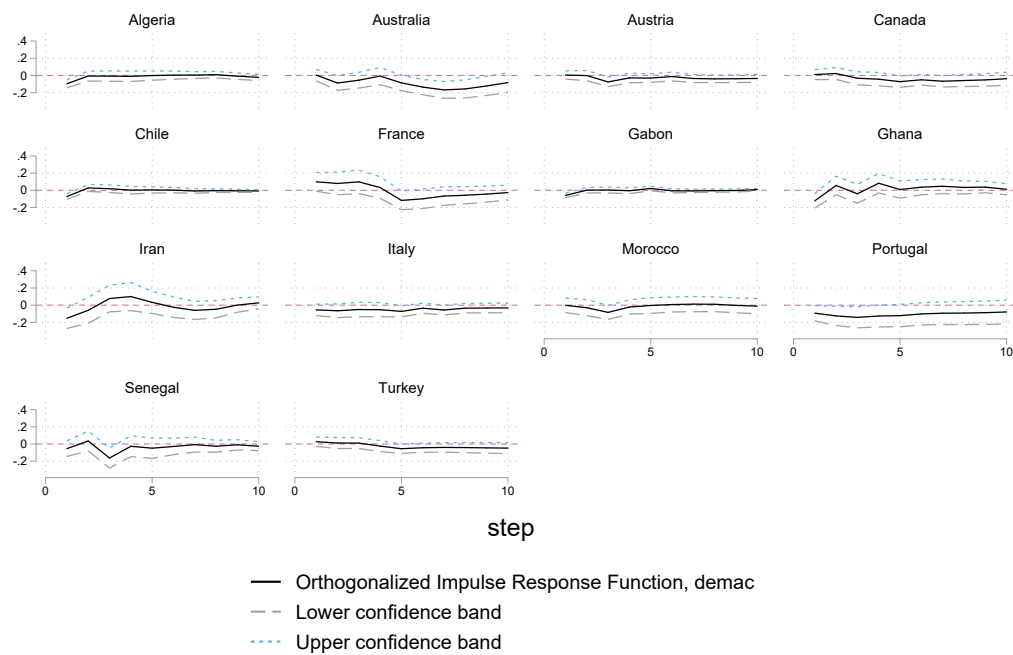
Impulse response functions for countries with significant negative effects of conflict on democracy during at least one step.

Figure 27: IRF: Positive effects of democracy on conflict.



Impulse response functions for countries with significant positive effects of democracy on conflict during at least one step.

Figure 28: IRF: Negative effects of democracy on conflict.



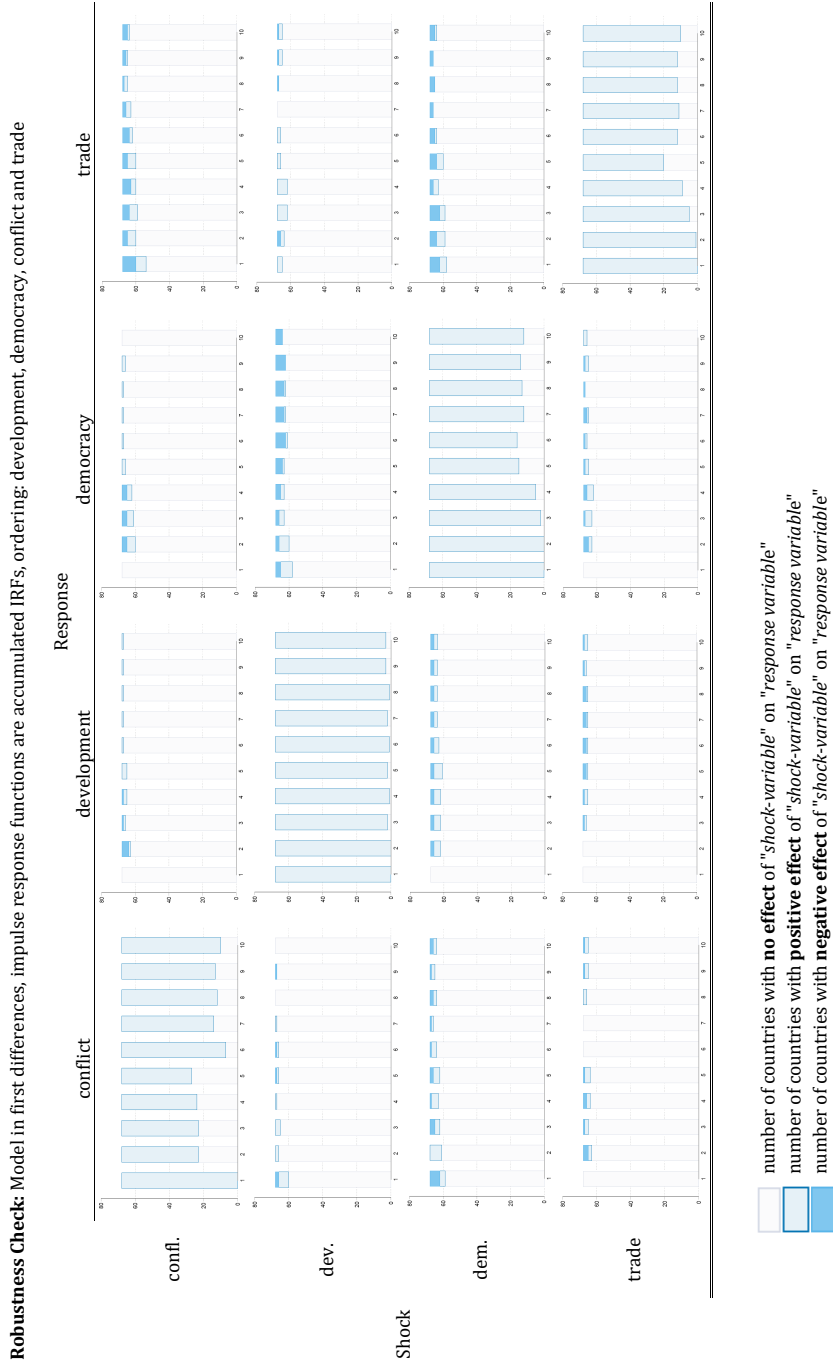
Impulse response functions for countries with significant negative effects of democracy on conflict during at least one step.

## C.4 Robustness Checks

On the following pages tables with the number of countries responding with positive, negative or no changes to a given shock are presented for all model specification discussed in Section 3.6:

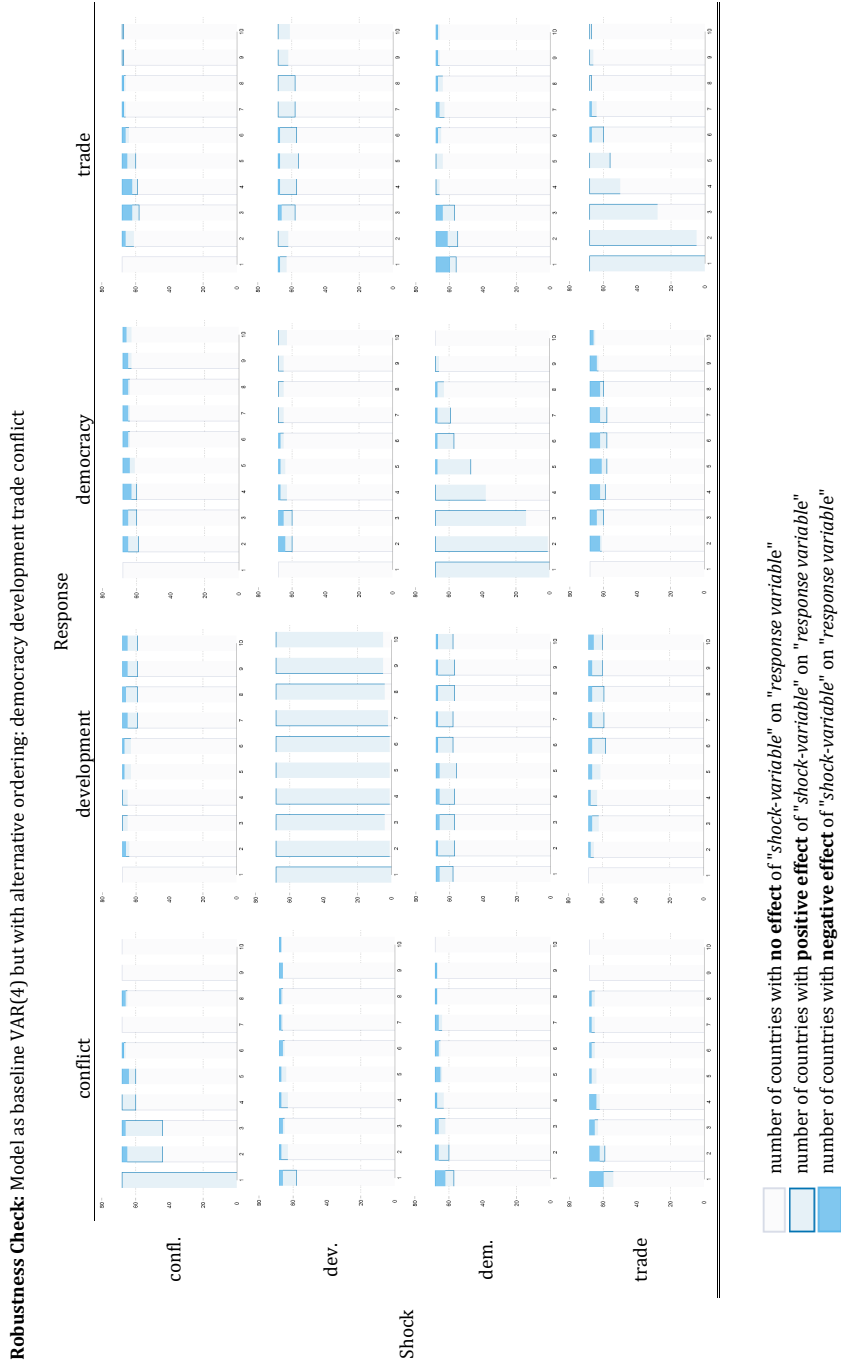
1. VAR(4) model in first difference
2. VAR(4) model with alternative ordering (democracy, development, trade and conflict)
3. VAR(4) model with GDP per capita growth instead of female life expectancy
4. VAR(4) model with logged GDP per capita instead of female life expectancy
5. VAR(8) model
6. VAR(10) model

Figure 29: Robustness Check: Model in first differences.



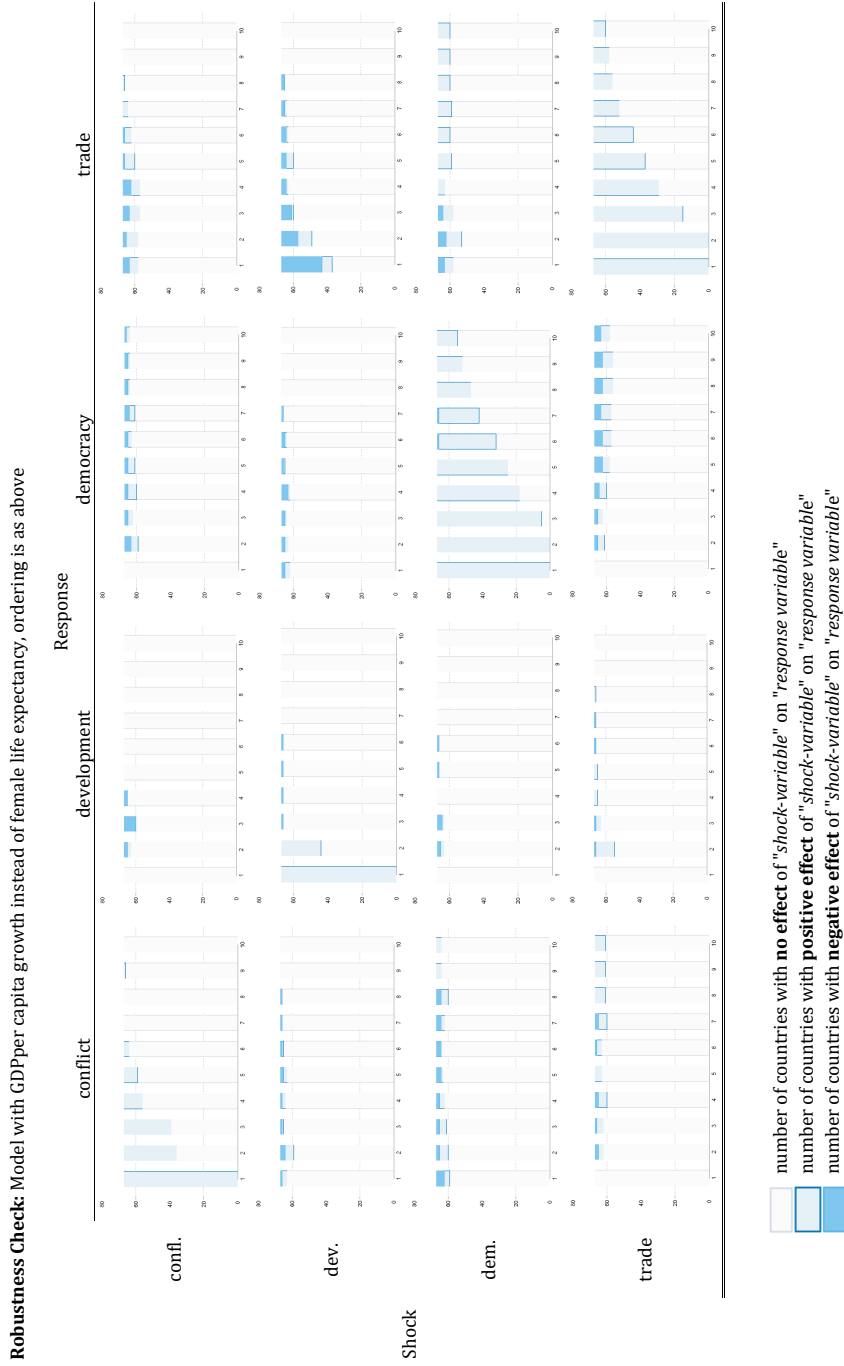
Number of countries with non/significant responses to the given shocks

Figure 30: Robustness Check: Model with alternative ordering (democracy, development, trade and conflict).



Number of countries with non/significant responses to the given shocks

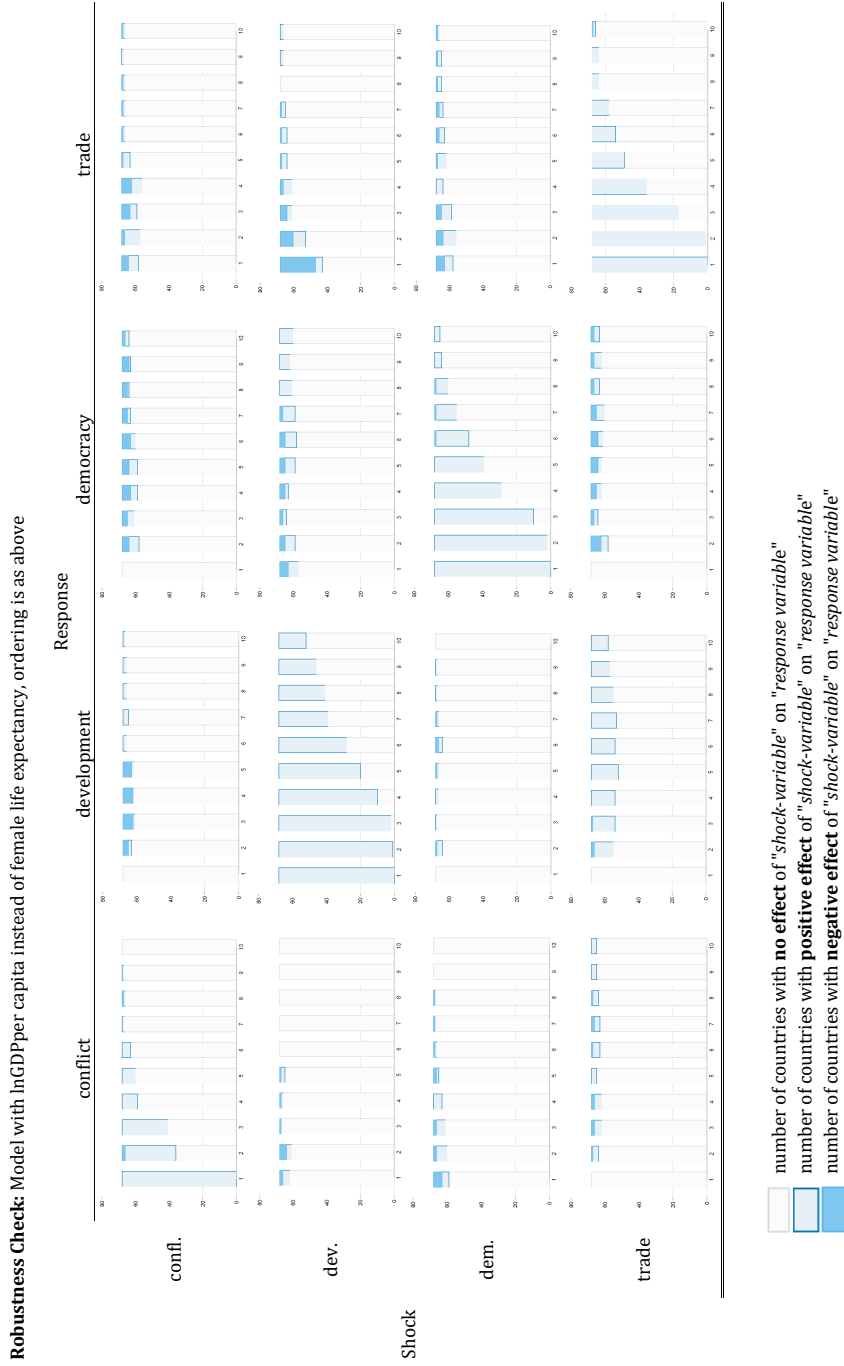
Figure 31: Robustness Check: Model with GDP per capita growth.



Number of countries with non/significant responses to the given shocks

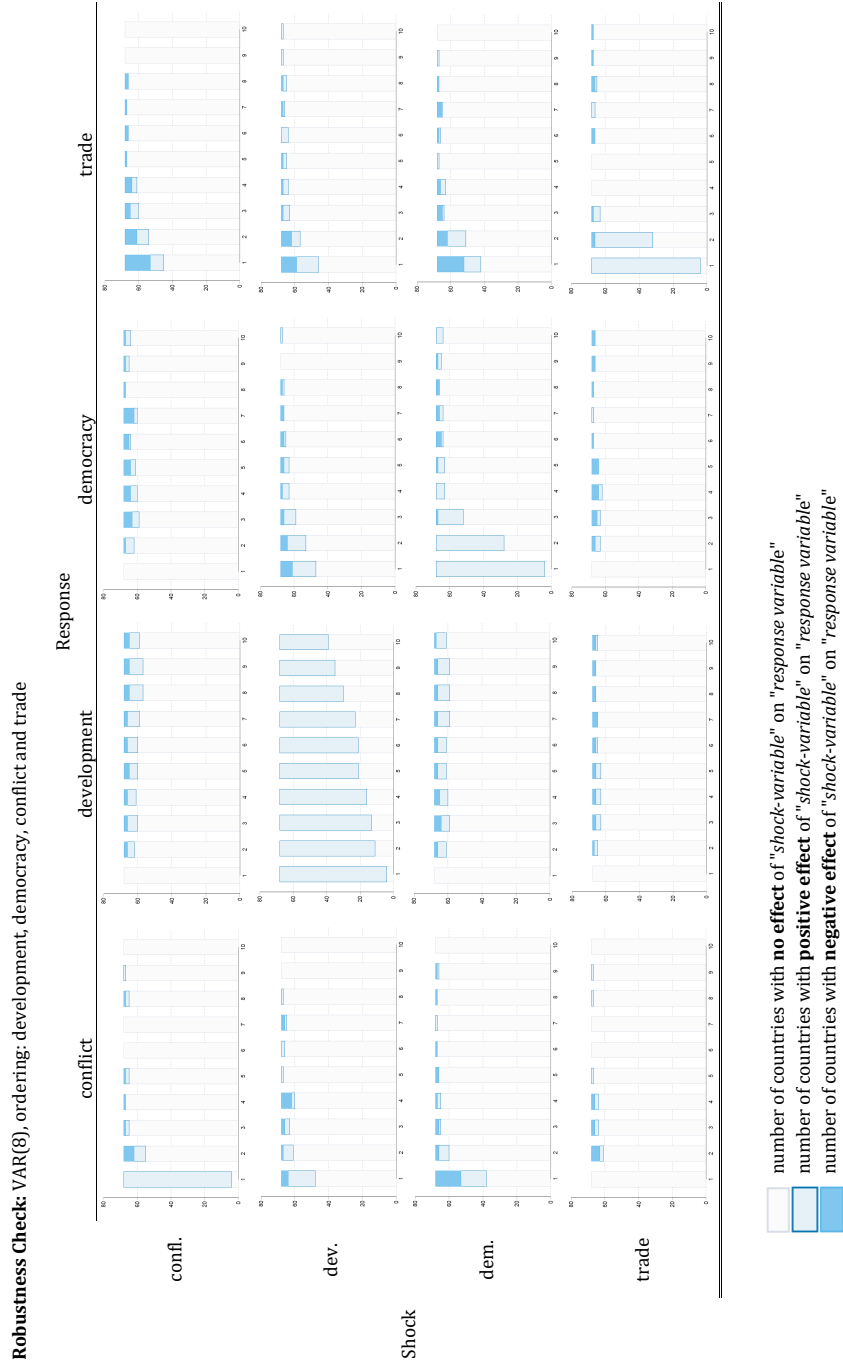


Figure 32: Robustness Check: Model with logged GDP per capita.



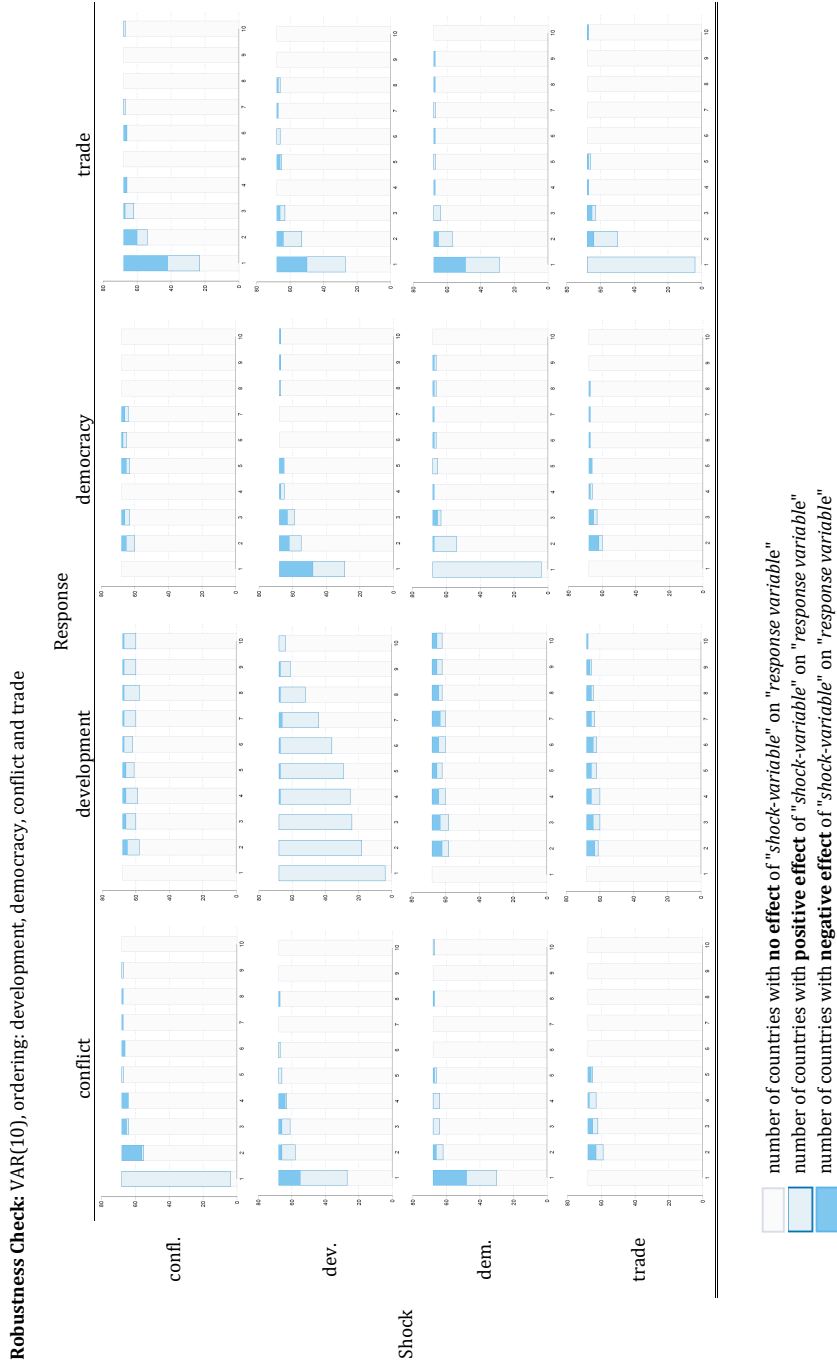
Number of countries with non/significant responses to the given shocks

Figure 33: Robustness Check: Model with lag length 8.



Number of countries with non/significant responses to the given shocks

Figure 34: Robustness Check: Model with lag length 10.



Number of countries with non/significant responses to the given shocks

## C.5 Examining residual autocorrelation

Figure 35: VAR(4): Residual plots for countries with LM-test p-values between .01-.05

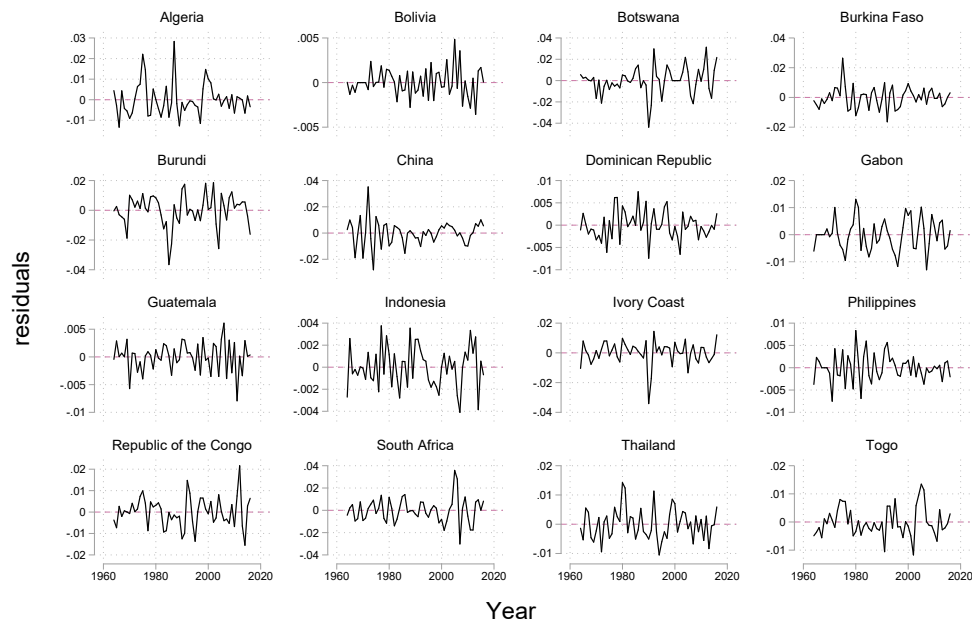
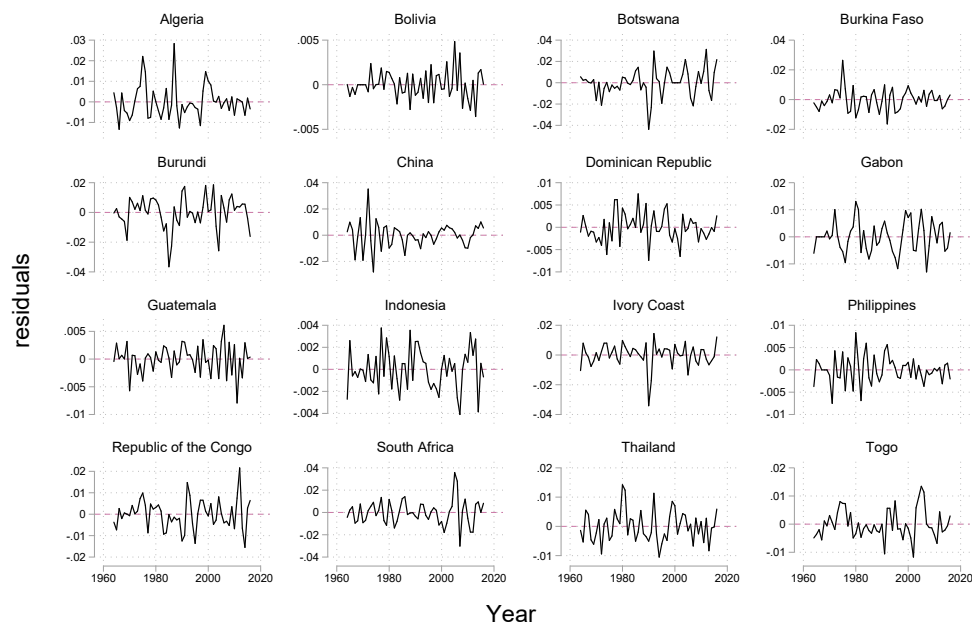


Figure 36: VAR(4): Residual plots for countries with LM-test p-values below .01



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## Erklärung zum selbständigen Verfassen der Arbeit

Ich erkläre hiermit, dass ich meine Doktorarbeit "*International Trade and Conflict: Determinants, Impact, Endogeneity and Data*" selbstständig und ohne fremde Hilfe angefertigt habe und dass ich als Koautor maßgeblich zu den weiteren Fachartikeln beigetragen habe. Alle von anderen Autoren wörtlich übernommenen Stellen, wie auch die sich an die Gedanken anderer Autoren eng anlehnenden Ausführungen der aufgeführten Beiträge wurden besonders gekennzeichnet und die Quellen nach den mir angegebenen Richtlinien zitiert.

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