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Shock contagion, asset quality and lending behavior

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Abstract

This paper exploits the geopolitical conflict in Eastern Ukraine as a negative shock to banking sector and examines the shock transmission. We find that banks with more loans in the conflict areas during the pre-conflict period face a higher level of bad loans in other markets after the shock. This effect is stronger in the regional markets which are closer to the conflict zone. We also find evidence for the "flight to headquarters" effect in post-conflict lending. Specifically, while more affected banks tend to cut their credit supply, the larger contraction is observed in regional markets located farther from headquarters.

Keywords: geopolitical shock, credit allocation, asset quality, flight to headquarters, difference-in-differences
JEL classification: G01, G21

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1 Introduction

Exogenous shocks to a country's socio-economic conditions have an unavoidable effect on activities within financial systems. Lenders tend to adjust credit allocation across markets in response to changes in loan demand following natural disasters (Berg and Schrader, 2012; Cortés and Strahan, 2017). There is also evidence for the adjustment in credit supply as a result of liquidity shortage stimulated by nuclear tests (Khwaja and Mian, 2008). However, little is known about the impact of foreign military intervention on bank operations. Whether the intervention only disrupts banking activities in the intervened territory, or the disruption could be geographically propagated? In this paper, we aim to answer this question by exploiting an unexpected geopolitical conflict between two neighbouring countries.

We are motivated by the recent development in Ukraine. Specifically, the Ukrainian banking sector has been severely affected by the annexation of Crimea and the armed conflict in the Donetsk and Luhansk regions (oblasts), which began in Q1 2014. While Ukrainian banks were partially able to recover losses in Crimea[1], they faced the infrastructure losses in Eastern Ukraine. For example, there were numerous cases when branches of Privatbank, the Ukrainian's largest bank, were vandalized by pro-Russian rebels. At the same time, banks had difficulties in collecting loans that were issued in these regions prior to the conflict. The turmoil also led Ukrainian banks to halt operations, close branches, and freeze ATM and credit cards in those regions. Given the significance of the Donetsk and Luhansk regions to Ukraine's economy, it is important to understand how the loss of assets in the East is associated with banks' activities in the rest of Ukraine. Furthermore, since the conflict was unexpected, we can make use of it as an exogenous shock to explore the difference in lending behaviour caused by cross-bank variation in the shock exposure.

In this study, we employ a novel dataset that contains (1) balance sheet and income statement data at the bank level, (2) data on loans at the bank-market level, and (3) detailed information on branch location. These data allow us to investigate whether banks' exposure to the military conflict is associated with the scale of operations in the conflict areas as of Q1 2014 – the start date of the conflict. We also study whether the tension in banking sector in the Eastern markets provoked by the conflict is transmitted to other regional markets and to what extent the spillover effect could be mitigated. Finally, we examine banks' lending behaviour after the onset of the conflict.

Our key findings are summarized below. First, bank operations in Eastern Ukraine before the conflict determine their exposure to the conflict aftermath. More specifically, banks that issued

[1]It should be noted that Ukrainian banks' withdrawal from Crimea was in accordance with the Resolution No. 260 issued by the National Bank of Ukraine, and infrastructure of banks in Crimea was not destroyed by military activities.

more loans in the Donetsk and Luhansk regions are more likely to be affected by the conflict (conflict-exposed banks or more affected banks hereafter). After Q1 2014, the more affected banks have a higher ratio of non-performing loans (*NPL*) compared to the peers. The more exposed banks have also faced a larger decrease in their rate of loan growth. The negative effect on loan supply is less severe among banks whose *headquarters* are located further away from the conflict areas.

Second, the shock to banks in Donetsk and Luhansk is transmitted to other markets, as branches of more affected banks also face higher risk in those markets. However, the further the regional *markets* are from the East, the less significant the effect is. In other words, there is evidence for the contagion of the geopolitical shock but this spillover fades with longer distance from the markets to conflict. Third, regional loan allocation differs with distance to a bank's head office. After the onset of the conflict, banks, especially the more affected ones, are more likely to reduce lending in regions located farther from their headquarters. Our findings are robust even after controlling for bank characteristics, macroeconomic conditions, local market specific conditions, and loan demand.

Our study contributes to several strands of literature. The first strand investigates the impacts of liquidity shocks on loan creation. Using economic, financial, or environmental shocks (e.g., De Haas and Van Horen, 2012; Khwaja and Mian, 2008; Santos, 2010) as the source of liquidity constraints, existing studies show that banks tend to pass their liquidity shocks on to borrowers. More specifically, after the shocks, banks are likely to reduce their credit supply and/or charge higher interest rates. Furthermore, the liquidity shock can be transmitted from a market to others through banks' diversified networks. For instance, following the liquidity inflows from oil and gas shale discoveries in the US in 2003, exposed banks tend to expand mortgage lending in non-boom markets where they operate (Gilje et al., 2016). By contrast, the housing market collapse in 2007–2009 led multimarket banks to reduce local mortgage lending in response to high delinquency rates in other markets (Berrospide et al., 2016).

The second strand focuses on the international contagion of shock. It is suggested that banks have incentives to reduce their cross-border lending in response to the negative economic or financial conditions at home (e.g., Dungey and Gajurel, 2015; Schnabl, 2012; Peek and Rosengren, 1997; Popov and Udell, 2012). Lending reduction, consequently, negatively affects the host countries' economy. For instance, the economic bubble in Japan in 1990s was translated into the lower level of loans provided by Japanese banks to the US real estate sector, resulting in a significant decline in the real economic activity in this sector (Peek and Rosengren, 2000). Similarly, the 1998 Russian debt default was propagated to other countries in the form of loan reduction in Peru

(Schnabl, 2012) or the decline in capital investments and profitability of US firms that relied heavily on bank loans (Chava & Purnanandam, 2011).

Cross-border lending reduction might also be attributed to the home markets' regulatory or supervisory changes. Ongena et al. (2013) show that banks are likely to expand their lending activities in the oversea markets in response to the competition-decreasing regulation in the home country. Moreover, Aiyar et al. (2014) observe the decrease in international lending experienced by UK banks during the Q1 1999 – Q4 2006 period when the capital requirement was tightened. However, the effect varies with the strength of the borrowing relationship: the negative cross-border lending is less severe for the most important countries and for retail customers. We add to this literature by providing evidence for the relationship between a geopolitical shock to banks' assets and banks' activities. In particular, asset losses caused by a geopolitical conflict have a negative influence on the availability of bank credit while increasing banks' risk. Furthermore, we posit that the negative effects of the shock may be lower in areas which are farther from the source of the shock.

The third strand of literature documents the "flight to home" effect, or the "home bias" in capital allocation. In a time of distress, banks continue lending in their home countries while tightening credit supply to foreign borrowers (e.g., Giannetti and Laeven, 2012a; Popov and Van Horen, 2014). This effect is observed during the 2007–2009 financial crisis when international banks substantially reduced intra-group lending to their foreign affiliates, who, in turn, cut loan creation in their markets (Cetorelli and Goldberg, 2011; 2012). Moreover, it is shown that the degree of banks' curtailed credit growth in the host markets depends on several factors such as funding structure, pre-crisis balance sheet structure, or geographic distance between headquarter and local markets (e.g., Choi et al., 2016; Frey, 2016; Giannetti and Laeven, 2012b; Presbitero et al., 2014).

Several explanations for the "flight to home" effect have been also suggested. The first is related to political interference. Examining the difference in loan mixture and loan interest rates of local and foreign banks in response to nationalization in the UK, Rose and Wieladek (2014) observe the decline in lending to British citizens experienced by nationalised foreign banks while the similar behaviour is not observed for the nationalised local banks. Political influence on lending decisions is also acknowledged in the US, where has a highly developed political and regulatory system (Chavaz and Rose, 2018).

Another explanation is related to informational and agency costs that increase with distance from borrowers to lenders (Ahearne et al., 2004; Portes and Rey, 2005). As information on the creditworthiness of borrowers tends to be "soft", information is more likely to be gathered at local branches or local affiliates. However, soft information cannot be easily transmitted, resulting in higher costs of communication or distorted information if the local branches (subsidiaries) are more

distant from the head offices or parent banks (De Haas and Van Lelyveld, 2010). For this reason, the head offices (parent banks) have incentives to constrain lending in their more distant branches. The "home bias" is also highly related to similarity, indicated by common language or geographical distance between the home and host countries (Huberman, 2001; Chan et al., 2005).

Our results are closest to the work of De Haas and Van Horen (2012), who find that banks tend to cut credit supply by less in countries that are closer to their home countries. Similarly, we observe a "flight to headquarters" effect within a bank's network, in which the reduction in lending is more severe in markets located farther from a bank's head office. We also contribute methodologically by controlling for the difference in lending behaviour before and after the shock, as well as the difference in behaviour between more affected and less affected banks. Thus, we show the "home bias" is not isolated from the degree of a bank's exposure to the negative shock.

The rest of this paper is organized as follows. Section 2 provides facts about the 2014 geopolitical conflict between Ukraine and Russia. In Section 3, we describe our identification strategy and the dataset. Section 4 discusses the empirical results. Section 5 concludes and offers the implications of our findings.

2 The geopolitical conflict between Ukraine and Russia

The geopolitical conflict between Ukraine and Russia started in March 2014 when Russia annexed the Crimean Peninsula, sovereign Ukrainian territory. Following the annexation, pro-Russian protests took place in the Donetsk and Luhansk oblasts and escalated into an armed confrontation. As of November 2017, Russia continues to illegally occupy Ukraine's Autonomous Republic of Crimea, the city of Sevastopol, and support the pro-Russian rebels in the Donetsk and Luhansk oblasts.

The Donetsk and Luhansk oblasts are among the largest and most economically important regions in Ukraine. Further, the Donbas region (the broader Donetsk and Luhansk area) is Ukraine's industrial heartland, the core of the energy, coal mining, chemicals, construction materials, and heavy engineering sectors. As of 2014, the oblasts combined for 16% of Ukraine's GDP and their industrial outputs accounted for about 23% of the whole country's outputs. In 2012, more than 26% of Ukraine's total exports and 55% of exported metallurgical products were contributed by the Donbas region. In 2013, this region accounted for all metallurgical coal production and about 97% of thermal coal production in Ukraine.

The armed conflict that started between pro-Russian rebels and the Ukrainian government in 2014 has had negative influence on the economy of these regions. Highways, railways, airports, and other transport infrastructure have been severely damaged or even destroyed. Key industrial

facilities in the Donbas have been disassembled and transported to Russian territory. Alongside the damage to the overall economy, the banking sector has also been affected. Ukrainian banks face substantial losses as loans issued in the Donbas have gone unpaid. At the same time, there were the huge deposit outflows from conflict areas. As of April 2014, the deposit decline rates in Donetsk and Luhansk were 21% and 19%, respectively (National Bank of Ukraine, 2014). Since the armed confrontation makes it impossible for banking system to operate normally, all Ukrainian banks have suspended operations in the areas of Donetsk and Luhansk that are under control of pro-Russian rebels.

The abovementioned facts raise questions related to the impact of the conflict on the banking sector. The first being whether and to what degree the unexpected losses of fixed assets in the Eastern regions are spilled over into other regions. Second, given the uncertainty about the development of the conflict, there is a question of whether banks should adjust lending activity to account for the uncertainty.

3 Data and empirical specification

3.1 Empirical methodology

3.1.1 Banks' exposure to the geopolitical shock

We document that banks' operation after the conflict is closely related to their activities in the affected regions prior to the conflict. Banks that had more loans outstanding in Donetsk and Luhansk oblasts as of Q1 2014 are more likely to be exposed to the conflict and thus face a deterioration of asset quality and a greater reduction in loan growth afterwards. To test this hypothesis, we apply the difference-in-differences approach with the continuous treatment on the quarterly bank level data:

$$L_{bt} = \beta_0 + \beta_1 Loan\ share_{b,2014\,Q1} \times Conflict_t + X_{b,t-1}\beta_2 + \epsilon_b + u_t + \varepsilon_{bt} \quad (1)$$

where *b* refers to a bank and *t* refers to a time period. The dependent variable, L_{bt}, is either (1) *NPL* which is the ratio of non-performing loans to total loans or (2) *Loan growth* which is the percentage change in the amount of loans issued by a bank. We further investigate the influence of the shock on different types of loans, namely corporate and personal loans. Our continuous treatment variable, *Loan share*, is the share of loans granted by a bank in the Luhansk and Donetsk regions as of Q1 2014. Since the overdue on loans to firms or individuals may only depend on the share of each loan type, we also measure *Loan share* separately for corporate loans and personal loans. *Conflict* is a dummy that equals to one for four quarters after Q1 2014 and zero for four quarters before Q1 2014.

In addition, the relationship between the conflict exposure and loan growth could be mitigated by the distance from the head offices to the conflict area. We implement this argument by adding a triple interaction term among *Loan share*, *Conflict*, and $Distance^{HQ\text{-}conflict}$ in the regression with *Loan growth* as the dependent variable. $Distance^{HQ\text{-}conflict}$ is the natural logarithm of the geodesic distance (in km) from the city that hosts a bank's head office to the city of Donetsk plus one.

Vector *X* includes a set of bank-specific variables that can affect banks' asset quality and loan supply. It contains *Wholesale funding* (the ratio of funding from non-bank financial institutions to total funding[2]), *Size* (the natural logarithm of total assets), *Equity/Assets* (total equity divided by total assets), *Deposits/Assets* (total deposits divided by total assets), *Provisions* (loan loss provisions divided by total assets), and *Branches* (the natural logarithm of total bank branches). We also include time (u_t) and bank (ϵ_b) fixed effect to control for the macroeconomic conditions and banks' time-invariant characteristics that can affect our dependent variables. Finally, ε_{bt} is the error term. All bank-specific variables are winsorized at the 1st and 99th percentile of their distributions.

3.1.2 Contagion of shock and post-conflict lending behaviour

Our next approach is to move from bank level data to bank-market level data and estimate the transmission of the shock to each individual region and the effect of geopolitical conflict on lending behaviour in regional markets. More specifically, we apply the following models on the quarterly bank-market data:

$$NPL_{bmt} = \beta_0 + \beta_1 Loan\ share_{b,2014\,Q1} \times Distance_m^{conflict} \times Conflict_t + \beta_2 Loan\ share_{b,2014\,Q1} \times Conflict_t + BM_{bm,t-1}\beta_3 + \beta_4 Share\ of\ branches\ of\ the\ market_{m,t-1} + \epsilon_b + \theta_{mt} + \varepsilon_{bmt} \quad (2.1)$$

$$Loan\ growth_{bmt} = \beta_0 + \beta_1 Loan\ share_{b,2014\,Q1} \times Distance_m^{HQ} \times Conflict_t + \beta_2 Loan\ share_{b,2014\,Q1} \times Conflict_t + BM_{bm,t-1}\beta_3 + \beta_4 Share\ of\ branches\ of\ the\ market_{m,t-1} + \epsilon_b + \theta_{mt} + \varepsilon_{bmt} \quad (2.2)$$

where *b* indexes banks, *m* indexes regional markets, and *t* indexes quarters. *NPL* ratio and *Loan growth* are measured at the bank-market level. Thus, in each quarter, these ratios are identical for each bank-market pair. $Distance^{conflict}$ is the natural logarithm of the geodesic distance (in km) from an oblast's administrative centre to the city of Donetsk plus one.[3] $Distance^{HQ}$ is the natural logarithm of the geodesic distance (in km) from a market to the bank's head office plus one. We hypothesize

[2] Note that total funding includes current accounts, long-term and short-term deposits and all other kinds of funds such as election funds of political parties, funds from subsidiaries etc.
[3] This is exceptional from Luhansk. The geodesic distance between the Luhansk and Donetsk oblasts are taken as zero. The empirical results are robust to the use of real distance between these two regions.

that the more affected banks that face higher asset risk than less affected peers may reduce lending in the markets farther away from its head office. The closer a market is to a bank's head office, the easier it is to control the quality of new loans issued in that market, thus reducing problems related to troubled assets.[4]

BM is a vector of bank-market specific variables including *Share of loans* (the ratio of total loans issued by a bank in a market to its total loans), *Share of branches in the market* (the ratio of a bank's number of branches in a market to the bank's total number of branches), and *Number of other bank branches* (the natural logarithm of the number of competitor bank branches in a market). We include *Share of branches of the market,* which is the ratio of the number of branches of each bank in a market to the total number of all banks' branches, to control for market-specific characteristics. The macroeconomic conditions, regional market specific effects, and non-changing bank characteristics are captured by the market-time fixed effect (θ_{mt}) and bank fixed effect (ϵ_b).[5][6] Finally, ε_{bmt} is the error term.

3.2 Data sources and sample

We employ a unique and confidential dataset of quarterly information covering the period from Q1 2008 to Q4 2016. The data combine three datasets: (1) bank income statement and balance sheet data, (2) balance sheet data at the regional market level, and (3) bank branch locations. These data allow us to measure the exposure of banks to the geopolitical conflict in Eastern Ukraine and to observe banks' asset quality and lending behaviour in each geography in the post-conflict period.

The cleaning process is as follows.[7] Matching information about banks' status as of 2016 obtained from the National Bank of Ukraine website with our data set, we can identify banks that (1) have been already liquidated and (2) were still effective as of 2016 but status was insolvent.[8] These banks are not taken into consideration in our analysis as bank liquidation in recent years is induced the National Bank of Ukraine's effort to clean up the banking system rather than is caused by the conflict. Excluding these banks can help us capture the effects of conflict exposure more precisely. Further, as the conflict is between Ukraine and Russia, Russian-owned banks may be

[4] Since our continuous treatment variable, $Loan\ share_{b,\ 2014Q1}$, and the distance variables are time-invariant, we do not include their interaction terms in the models.
[5] Standard errors are clustered at bank-market level.
[6] To control for the potential impact of the deposit outflows from the conflict zone on funding sources for lending, we add in the estimations with *Loan growth* either (1) deposits-to-assets ratio at bank level or (2) deposit growth of each region. Results from these exercises are quantitatively similar to the main results and are available upon request.
[7] More information about dataset construction can be found in Appendix B.
[8] Our results are consistent if we include banks that were effective in 2016 but had insolvent status. Results are available upon request.

affected differently i.e. there are financial sanctions against Russian banks imposed by the National Bank of Ukraine and the EU countries (GOV.UK, 2014; National Bank of Ukraine, 2017b). Thus, we exclude Russian-owned banks from the sample.[9] In the similar vein, we also remove data on banks whose head offices are based in Crimea, Donetsk, and Luhansk. Observations with unusual data are also dropped from the sample.[10] After cleaning, our dataset consists of 128 banks, allowing for the entry and exit of banks.[11]

Table 1 Descriptive statistics, bank level (Q1 2013 – Q1 2015)

	Mean (1)	SD (2)	Obs. (3)
Panel A. Banks' characteristics			
NPL^{total}	0.097	0.135	1,048
$NPL^{corporate}$	0.065	0.107	1,055
$NPL^{personal}$	0.041	0.087	1,071
Loan $growth^{total}$	0.029	0.792	911
Loan $growth^{corporate}$	0.047	0.847	918
Loan $growth^{personal}$	–0.075	0.891	951
Wholesale funding	0.045	0.088	1,081
Provisions	0.078	0.098	1,065
Deposits/Assets	0.374	0.179	1,074
Size	14.523	1.626	1,081
Branches	3.368	1.761	999
Equity/Assets	0.207	0.164	1,076
Panel B. Activities in Luhansk and Donetsk as of Q1 2014 by banks			
Loan $share^{total}$ in Donetsk and Luhansk	0.059	0.163	128
Loan $share^{corporate}$ in Donetsk and Luhansk	0.045	0.149	128
Loan $share^{personal}$ in Donetsk and Luhansk	0.012	0.042	128

This table presents descriptive statistics for bank-level characteristics for the Q1 2013 – Q1 2015 period (Panel A) and bank activities in conflict areas as of Q1 2014 (Panel B). $NPL^{corporate}$, $NPL^{personal}$, NPL^{total} are the ratios of non-performing loans issued firms, to individuals, and total non-performing loans divided by total loans, respectively. *Loan* $growth^{total}$, *Loan* $growth^{corporate}$, and *Loan* $growth^{personal}$ are the percentage changes in the amount of total loans, loans granted to firms, and loans granted to individuals, respectively. *Wholesale funding* is the ratio of deposits from non-bank financial institutions to total funding from customers. *Size* is the natural logarithm of total assets. *Equity/Assets* is the ratio of total equity to total assets. *Deposits/Assets* is the ratio of total deposits to total assets. *Provisions* is the ratio of loan loss provisions to total assets. *Branches* is the natural logarithm of total bank branches.

Table 1 presents the descriptive statistics for our estimation sample at bank level. The average growth of total loans and corporate loans is 2.9% and 4.7% respectively while a negative growth of

[9] The operation of Russian-owned banks in Ukraine has been declining since 2014. According to the National Bank of Ukraine (2017a), by 2017, the share of capital of Russian banks has reduced to 8.8% and their branch network declines by 42%.
[10] Unusual data could be cases when some ratios like *NPL* ratio or *Equity/Assets* ratio etc. are greater than one.
[11] Data on loan growth and non-performing loans are adjusted for loans and bad loans in Donetsk and Luhansk.

loans issued to individual borrowers is observed. The growth of loans to corporate borrowers, however, comes with the higher level of bad loans as the *NPL* ratio for corporate loans is about 1.5 times higher than that for personal loans (6.5% versus 4.1%, respectively). In terms of lending activities in the East, the total loans issued in Luhansk and Donetsk as of Q1 2014 account for 5.9% of total loans (4.5% to corporate borrowers and 1.2% to individuals). Among other bank characteristics, loan loss provisions make up of 7.8% of total assets, a sign of a fragile banking sector. Banks tend to rely on funding from customer deposits while are less likely to raise funds from non-bank financial institutions, with the average deposit ratio and wholesale funding ratio at 37.4% and 4.5%, respectively. On average, total equity capital accounts for about 21% of total assets.

Table 2 Descriptive statistics, bank-market level (Q1 2013 – Q1 2015)

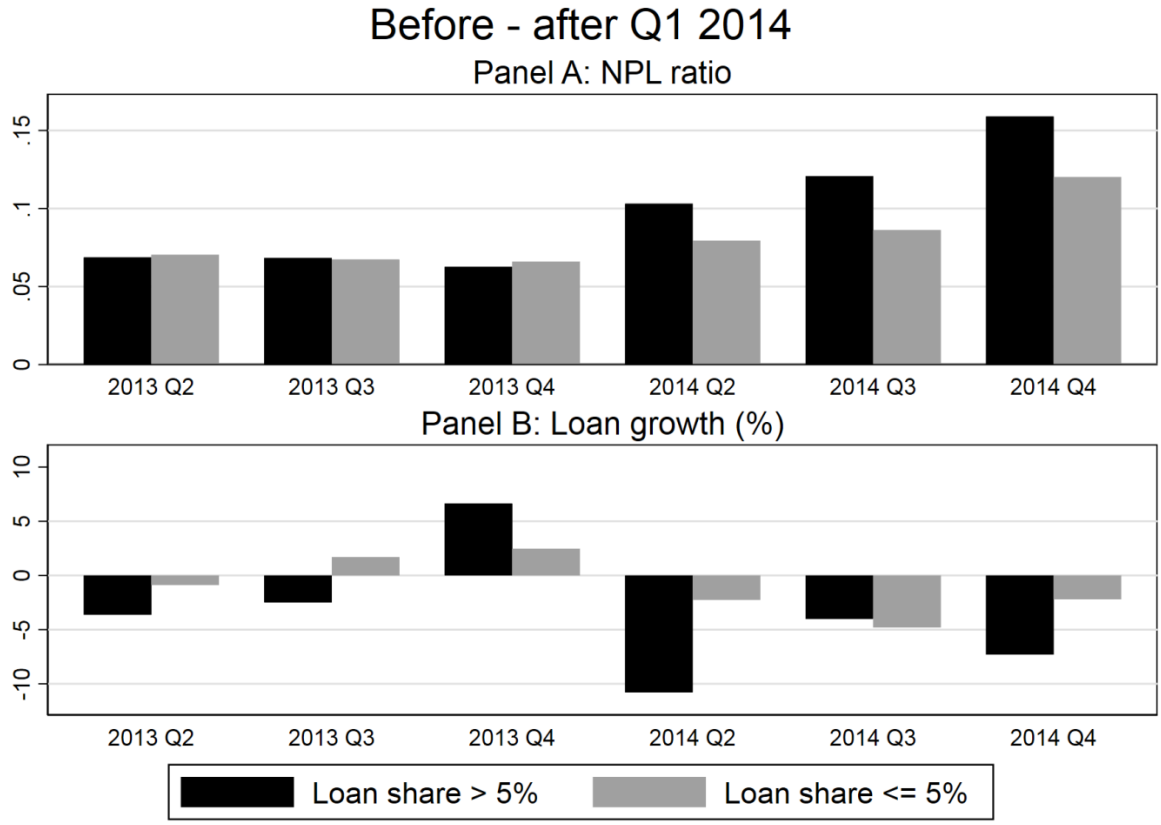
	Mean (1)	SD (2)	Obs. (3)
Panel A. Bank-market characteristics			
NPL^{total}	0.011	0.044	10,256
$NPL^{corporate}$	0.007	0.033	10,258
$NPL^{personal}$	0.005	0.030	10,272
Loan $growth^{total}$	–0.044	0.911	8,734
Loan $growth^{corporate}$	–0.070	1.367	8,769
Loan $growth^{personal}$	–0.045	0.857	8,769
Share of loans	0.100	0.257	10,274
Number of other bank branches	6.459	0.464	9,128
Share of branches in the market	0.018	0.052	10,399
Share of branches of the market	0.054	0.112	10,399
Panel B. Distance by bank-market pairs			
$Distance^{conflict}$	310.291	183.944	1,445
$Distance^{HQ}$	497.522	299.906	1,445

This table presents descriptive statistics for bank-market characteristics for the Q1 2013 – Q1 2015 period (Panel A) and distance measures by bank-market pairs (Panel B). $NPL^{corporate}$, $NPL^{personal}$, NPL^{total} are the ratios of non-performing loans issued to firms, to individuals, and total non-performing loans divided by total loans, respectively. *Loan* $growth^{total}$, *Loan* $growth^{corporate}$, and *Loan* $growth^{personal}$ are the percentage changes in the amount of total loans, loans granted to firms, and loans granted to individuals, respectively. $Distance^{conflict}$ is the geodesic distance (in km) from an oblast's administrative centre to the city of Donetsk (in km). $Distance^{HQ}$ is the geodesic distance (in km) from a market to the bank's head office (in km). *Share of loans* is the ratio of total loans issued by a bank in a market to that bank's total loans. *Share of branches in the market* is the ratio of a bank's branches in a market to that bank's total branches. *Number of other banks' branches* is the natural logarithm of the number of competitor bank branches in a market. *Share of branches of the market* is the ratio of the number of all branches in a given market to the total number of bank branches.

At the bank-market level, we exclude (1) data on loans of bank branches in Crimea and (2) branches of banks whose headquarters are in Crimea, Donetsk, and Luhansk. Similar to the cleaning process for data at bank level, we drop cases with unusual financial ratios e.g. NPL ratio is greater than one. Our cleaned sample contains 1,601 bank-market pairs. The summary statistics for the estimation sample at bank-market level are presented in Table 2. In general, there are large cross-bank and

cross-market variations in the regional distribution of bank branches. For instance, the average share of a bank's branches in a regional market is about 2% with one standard deviation equalling 5%. The level of bad loans in a bank's regional market accounts for 1.1% of total outstanding loans of the bank and most of regional markets experience a reduction in loan growth. Most banks have their head offices in Kyiv, with an average distance to other markets of about 310 km. The average distance from head offices to the conflict is about 500 km.

Figure 1 Loan growth and NPL ratio by share of loans in Luhansk and Donetsk as of Q1 2014



This figure shows the evolution of loan growth and NPL ratio of two groups of banks: one group consists of banks having 5% or less share of loans outstanding in Luhansk and Donetsk as of Q1 2014 and another group consists of banks having more than 5% share of loans outstanding in Luhansk and Donetsk as of Q1 2014.

Figure 1 provides an insight into the link between loan share in Donetsk and Luhansk as of Q1 2014 and banks' subsequent asset quality and credit supply. The chart below compares the *NPL* ratio and loan growth of two groups, including the group of banks whose loan share in the conflict areas is at least 5% (high share group) and the group of banks whose share is below 5% (low share group). Prior to the conflict, the *NPL* ratios of the two groups were nearly identical and the NPL ratios of each group remained consistent from Q2 2013 to Q4 2013. In the quarters after Q1 2014, the *NPL* ratios of both groups increased steadily. Moreover, the *NPL* ratio of the high share group was significantly higher than that of the low share group. Loan creation declined both groups of banks after

Q1 2014. However, the lending decline of the high share group is substantially steeper than the low share group, especially in the 1st quarter after the conflict started. More specifically, in Q2 2014, the high share group experienced a decrease of 10%, much larger than the low share group's 2% decline. This suggests the variation in banks' lending activities in Donetsk and Luhansk as of Q1 2014 may be related to the subsequent degree of exposure to the conflict.

4 Results

4.1 Which banks are more exposed to the geopolitical conflict?

Before estimating model (1), one needs to check the assumption about the parallel trend of the treatment between the control and treatment groups in the pre-conflict period. More specifically, before Q1 2014, banks' activities in Donetsk and Luhansk were not the main determinant of the quality of banks' assets and credit supply. Following previous studies (e.g., Autor, 2003; Gruber and Kleiner, 2012; Hoynes, Miller, and Simon, 2015), we augment the n "leads" and q "lags" of the treatment into model (1) to test the validity of this assumption.

$$L_{bt} = \beta_0 + \beta_1 \sum_{j=-n}^{q} \theta_j Conflict_{2014Q1+j} \times Loan\ share_{b,2014\,Q1} + X_{b,t-1}\beta_2 + \epsilon_b + u_t + \varepsilon_{bt} \quad (3)$$

In this specification, pre-conflict and post-conflict effects of the continuous treatment *Loan share* are indicated by the variable(s) $Conflict_{2014Q1+j}$. From Q2 2013 to Q4 2014, these binary variables equal one only in the relevant quarter and equal zero in each quarter starting from Q1 2015. We expect all coefficients on the treatment during the pre-conflict period to equal to zero ($\theta_j = 0, \forall j < 0$). Estimated coefficients shown in Figure A1 and Figure A2 meet this expectation.

The results for model (1) with the *NPL* ratio as the dependent variable are presented in Table 3. Banks that had a higher intensity of lending in Luhansk and Donetsk as of Q1 2014 are more likely to experience a higher level of loss-generating assets afterwards. More specifically, an increase of one percentage point in the share of total loans issued in Luhansk and Donetsk as of Q1 2014 is associated with a 0.058 percentage points increase in the *NPL* ratio in subsequent quarters. Similarly, an increase of one percentage point in the share of loans issued to firms in Luhansk and Donetsk as of Q1 2014 is related to an increase of 0.072 percentage points in the *NPL* ratio of corporate loans. It is worth noting that there is a large variation in the share of loans granted in Donetsk and Luhansk across banks (one standard deviation equals to 16.3 percentage points) and the level of non-performing loans in the Ukrainian banking system is already high. Thus, despite the small point estimate, the economic significance of the results is still sizeable.

Table 3 Effects of the conflict on bank asset quality

	Total (1)	Corporate (2)	Personal (3)
Loan share^{total} in Donetsk and Luhansk×Conflict	0.058**		
	(0.025)		
Loan share^{corporate} in Donetsk and Luhansk×Conflict		0.072***	
		(0.026)	
Loan share^{personal} in Donetsk and Luhansk×Conflict			0.092
			(0.061)
Wholesale funding	–0.135***	–0.139***	–0.016
	(0.045)	(0.047)	(0.018)
Provisions	0.239	0.236	0.032
	(0.161)	(0.175)	(0.198)
Deposits/Assets	–0.057	–0.020	–0.011
	(0.035)	(0.046)	(0.023)
Size	0.025	0.002	0.015
	(0.027)	(0.023)	(0.014)
Branches	0.015	0.012	–0.001
	(0.010)	(0.010)	(0.007)
Equity/Assets	0.039	0.023	0.066
	(0.112)	(0.090)	(0.045)
Bank fixed-effects	Yes	Yes	Yes
Time fixed-effects	Yes	Yes	Yes
Observations	856	862	875

This table presents the estimated results for model (1). Columns (1)–(3) show the results for the regressions with NPL^{total}, $NPL^{corporate}$, and $NPL^{personal}$ as the dependent variable, respectively. In all regressions, a constant term is included but not reported. Standard errors clustered at bank level are presented in parentheses. $NPL^{corporate}$, $NPL^{personal}$, and NPL^{total} are the ratios of non-performing loans issued to firms, to individuals, and total non-performing loans divided by total loans, respectively. *Conflict* is a dummy variable that equals to one for four quarters after Q1 2014 and zero for four quarters before. *Wholesale funding* is the ratio of deposits from non-bank financial institutions to total funding from customers. *Size* is the natural logarithm of total assets. *Equity/Assets* is the ratio of total equity to total assets. *Deposits/Assets* is the ratio of total deposits to total assets. *Provisions* is the ratio of loan loss provisions to total assets. *Branches* is the natural logarithm of total bank branches. ∗, ∗∗, and ∗∗∗ denote 10%, 5%, and 1% significance levels, respectively.

Table 4 shows the results with *Loan growth* as the dependent variable. We find that more exposed banks are more likely to reduce their loan issuance. This negative association is both statistically and economically significant. An increase of one percentage point in the share of total loans issued in the conflict areas as of Q1 2014 is associated with a reduction of 13.9, 13.8, and 33.3 percentage points in the loan growth rate of total loans, corporate loans, and personal loans, respectively. However, the negative influence of the conflict on loan supply decreases with the distance from a bank's head office to the conflict. In other words, among the more exposed banks, the shock has a lower impact on those banks whose head offices are farther away from Donetsk.

Table 4 Effects of the conflict and distance from the head office to the conflict on loan growth

	Total (1)	Corporate (2)	Personal (3)
Loan share^{total} in Donetsk and Luhansk×Conflict	–13.909***	–13.821**	–33.294***
	(5.244)	(6.453)	(6.932)
Loan share^{total} in Donetsk and Luhansk×Conflict ×Distance$^{HQ\text{-}conflict}$	2.359**	2.306**	5.566***
	(0.925)	(1.132)	(1.218)
Wholesale funding	–0.825	–0.169	0.456
	(0.648)	(0.826)	(0.475)
Provisions	0.920	–0.754	1.634
	(1.143)	(0.943)	(1.222)
Deposits/Assets	0.641	–0.563	0.292
	(0.749)	(0.586)	(0.616)
Size	–0.060	–0.273	0.656
	(0.172)	(0.170)	(0.460)
Branches	–0.249	0.082	–0.697*
	(0.230)	(0.295)	(0.372)
Equity/Assets	–1.849	–0.553	–2.335***
	(1.351)	(0.587)	(0.617)
Bank fixed-effects	Yes	Yes	Yes
Time fixed-effects	Yes	Yes	Yes
Observations	843	850	875

This table presents the estimated results for model (3). Columns (1)–(3) show the results for the regressions with *Loan growth^{total}*, *Loan growth^{corporate},* and *Loan growth^{personal}* as the dependent variable, respectively. In all regressions, a constant term is included but not reported. Standard errors clustered at bank level are presented in parentheses. *Loan growth^{total}*, *Loan growth^{corporate},* and *Loan growth^{personal}* are the percentage changes in the amount of total loans, loans granted to firms, and loans granted to individuals, respectively. *Distance$^{HQ\text{-}conflict}$* is the natural logarithm of the geodesic distance the bank's head office to the city of Donetsk plus one. *Conflict* is a dummy variable that equals to one for four quarters after Q1 2014 and zero for four quarters before. *Wholesale funding* is the ratio of deposits from non-bank financial institutions to total funding from customers. *Size* is the natural logarithm of total assets. *Equity/Assets* is the ratio of total equity to total assets. *Deposits/Assets* is the ratio of total deposits to total assets. *Provisions* is the ratio of loan loss provisions to total assets. *Branches* is the natural logarithm of total bank branches. ∗, ∗∗, and ∗∗∗ denote 10%, 5%, and 1% significance levels, respectively.

Regarding other bank characteristics, we find that a reliance on non-core funding is positively related to asset quality. This finding supports the argument that wholesale funding has a positive effect on bank efficiency as it allows wholesale financiers to monitor banks better (e.g., Calomiris, 1999, Huang and Ratnovski, 2011).

The results offer an in-depth understanding about the degree of banks' exposure to a shock. More specifically, a bank is affected more severely if its activities in the shock areas account for a large proportion of overall operations. Additionally, the shock to a bank's assets leads to a decrease in the quality of remaining assets. In other words, after the onset of the shock, more affected banks face higher risks than less affected counterparts. Thus, more affected banks might be incented to issue higher quality loans instead of a greater quantity of loans in anticipation of further losses, resulting in a reduction in lending. However, we do not rule out the possibility that the decline in credit supply is caused by the funding shortage as widely documented in literature (e.g., Giannetti and Laeven, 2012a; De Haas and Van Lelyveld, 2014; Berrospide et al., 2016).

4.2 How is the shock transmitted?

Figure A3 presents the coefficients for the parallel trend assumption test for model (2.1). Before the conflict, the coefficients on the interaction between $Distance^{conflict}$ and *Loan share* are indistinguishable from zero, suggesting the non-existence of pre-conflict event. Table 5 shows the results of the empirical test for the shock transmission at bank-market level. We find consistent results for the impact of the share of loans in Donetsk and Luhansk as of Q1 2014 on the *NPL* ratio in the subsequent quarters. We also observe negative and significant coefficients on the interaction term between *Loan share*, $Distance^{conflict}$, and *Conflict*. In other words, the geographical distance from a market to the conflict can mitigate the negative effect of the conflict on the stability of a bank in that market.

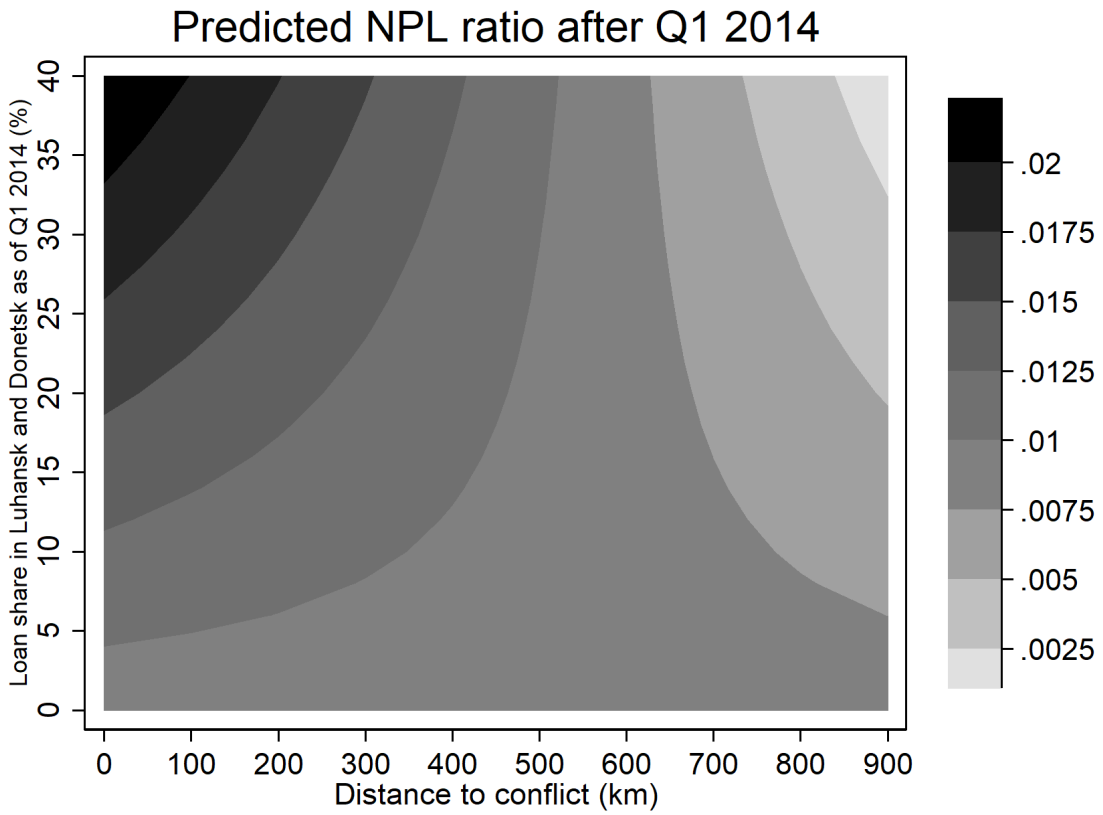
Table 5 Shock contagion

	Total (1)	Corporate (2)	Personal (3)
Loan share^{total} in Donetsk and Luhansk×Conflict	0.055*		
	(0.033)		
Loan share^{total} in Donetsk and Luhansk×Conflict×Distance^{conflict}	–0.009*		
	(0.005)		
Loan share^{corporate} in Donetsk and Luhanks×Conflict		0.066*	
		(0.034)	
Loan share^{corporate} in Donetsk and Luhansk×Conflict ×Distance^{conflict}		–0.010*	
		(0.006)	
Loan share^{personal} in Donetsk and Luhansk×Conflict			0.007
			(0.008)
Loan share^{personal} in Donetsk and Luhansk×Conflict ×Distance^{conflict}			–0.001
			(0.003)
Share of loans	0.005***	0.002**	0.003***
	(0.001)	(0.001)	(0.001)
Number of other banks' branches	0.157	0.170	0.019
	(0.192)	(0.175)	(0.078)
Share of branches in the market	0.279	0.300	0.039
	(0.337)	(0.305)	(0.130)
Share of branches of the market	0.041	0.029	–0.003
	(0.039)	(0.035)	(0.016)
Bank fixed-effects	Yes	Yes	Yes
Market-time fixed effects	Yes	Yes	Yes
Observations	9,557	9,560	9,570

This table presents the estimated results of shock transmission. Columns (1)–(3) show the results for the regressions with NPL^{total}, $NPL^{corporate}$, and $NPL^{personal}$ as the dependent variable, respectively. In all regressions, a constant term is included but not reported. Standard errors clustered at bank-market level are presented in parentheses. $NPL^{corporate}$, $NPL^{personal}$, NPL^{total} are the ratios of non-performing loans issued to firms, to individuals, and total non-performing loans over total loans, respectively. $Distance^{conflict}$ is the natural logarithm of the geodesic distance (in km) from a market to the city of Donetsk plus one. *Conflict* is a dummy variable that equals to one for four quarters after Q1 2014 and zero for four quarters before. *Share of loans* is the ratio of total loans issued by a bank in a market to that bank's total loans. *Share of branches in the market* is the ratio of a bank's branches in a market to that bank's total branches. *Number of other bank branches* is the natural logarithm of the number of competitor bank branches in a market. *Share of branches of the market* is the ratio of bank branches in a market to the total number of bank branches. ∗, ∗∗, and ∗∗∗ denote 10%, 5%, and 1% significance levels, respectively.

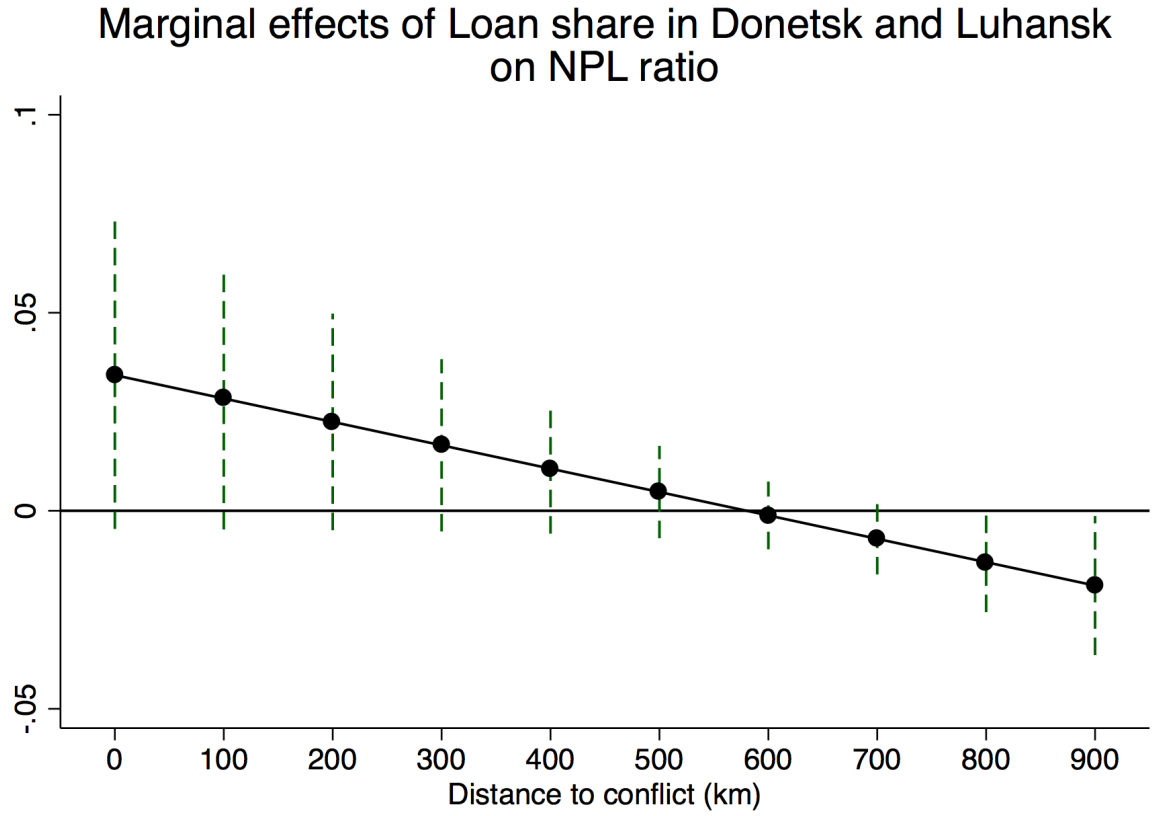
The marginal effects of loan share in Luhansk and Donetsk as of Q1 2014 and *Distance*^{conflict} on the *NPL* ratio are shown graphically in Figure 2. Comparing asset quality of bank branches located in the markets which are 100 km away from the conflict, the *NPL* ratio increases with banks' higher share in Luhansk and Donetsk as of Q1 2014 when holding all other characteristics equal. The most affected banks are those having more than 35% share of loans in the unrest areas while the least affected banks are those having a *Loan share* of less than 5%. However, the degree of the impact varies across these banks' markets as the *NPL* ratio indeed declines as the distance to the conflict increases. More specifically, when we compare the association between of *Loan share* and asset quality of branches in markets located 100 km and 500 km away, the *NPL* ratio of the closer group is about as twice as the ratio of the farther group (Figure 3).

Figure 2 Marginal effects of the triple interaction on the NPL ratio



This figure shows the effect of the interaction between the conflict exposure (indicated by *Loan share* in Luhansk and Donetsk as of Q1 2014) and distance to conflict (*Distance*^{conflict}) on the post-conflict *NPL* ratio, holding other variables at their means. The darker colour reflects the higher effect on the NPL ratio, our risk measure.

Figure 3 Marginal effects of Loan share in Donetsk and Luhansk as of Q1 2014 on the NPL ratio with distance to conflict



This figure shows the sensitivity of the effect of *Loan share* in Luhansk and Donetsk as of Q1 2014 on the post-conflict *NPL* ratio with changes in $Distance^{conflict}$, holding other variables at their means.

Our results can be explained using the remoteness concept widely used in trade literature, which suggests that a country chooses its trade partners based on both geographic distance and remoteness (e.g., Nitsch, 2000; Anderson and Van Wincoop, 2003). This means the probability of trade contracts between two countries increases the closer they are located geographically. However, holding the bilateral distance constant, a country pair tends to have more bilateral trades if they have few neighbours near-by. Building on this principal and based on the geographical characteristics, we document that within a bank's network, branches in Donetsk and Luhansk tend to be more connected with other branches in near-by markets. By contrast, the connectedness decreases with branches located farther away, in Ukraine's case, to the West. Consequently, the negative shock to a bank's branches in the East is likely to spread to the closest neighbours and less likely to be transmitted to that bank's branches in more distant markets.

4.3 Lending behaviour after the shock

To this end, we have found that banks that are more exposed to the conflict in the East tend to reduce lending after the start of the shock. That effect also faded the farther a bank's head office was from the conflict. Next, we look at whether more exposed banks supply credit disproportionally in markets located farther from its head office.

The results for the parallel assumption test are shown in Figure A4. Again, we note the coefficients on the interaction term between *Loan share*, $Distance^{HQ}$, and *Conflict* are close to zero before Q1 2014. Immediately after the conflict, the coefficients turn to be negative, satisfying the validity of the assumption. The results for model (2.2) are presented in Table 6. We find that after the conflict, the banks more exposed to the conflict have incentives to cut loan creation in markets farther from its head office, while the reduction in loan creation is lower in markets closer to the head office.

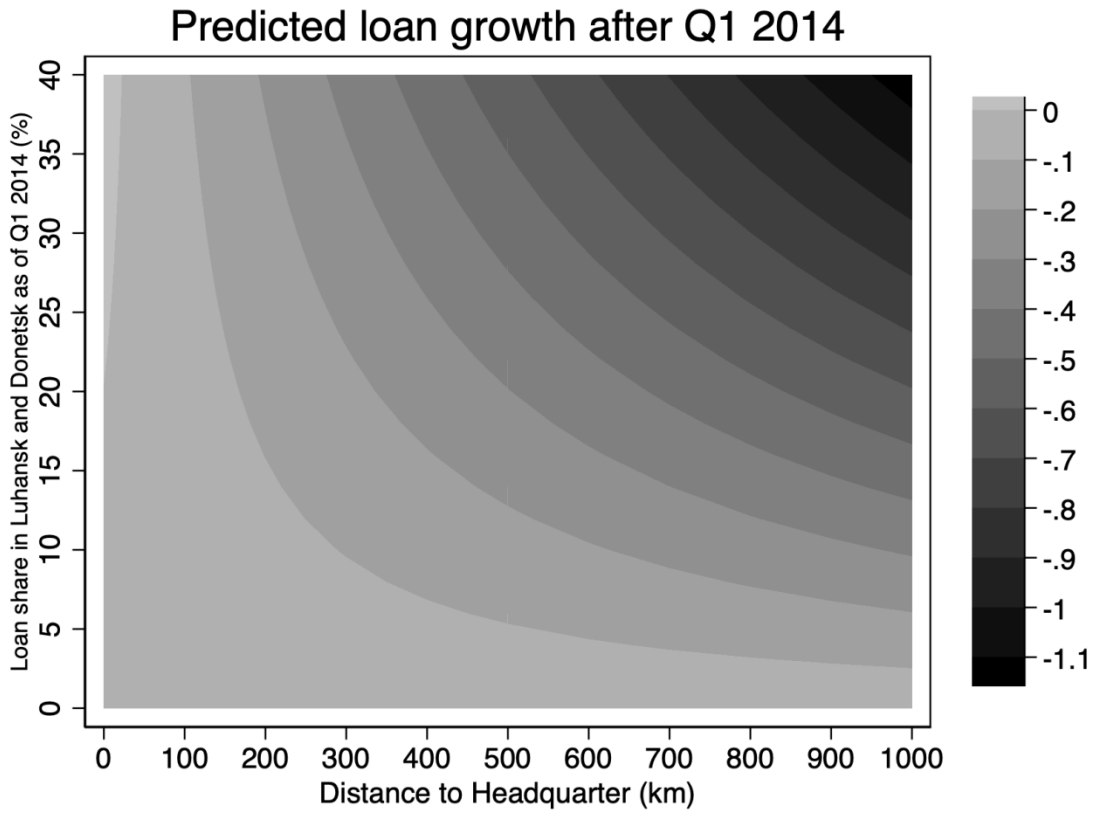
Table 6 Post-conflict lending behaviour

	Total (1)	Corporate (2)	Personal (3)
Loan share^{total} in Donetsk and Luhansk×Conflict×Distance^{HQ}	–0.308**	–0.340*	–0.191
	(0.149)	(0.183)	(0.174)
Loan share^{total} in Donetsk and Luhansk×Conflict	0.853	1.181	–0.021
	(0.892)	(1.001)	(0.975)
Share of loans	–2.610***	–2.613***	–0.066
	(0.794)	(0.681)	(0.074)
Number of other banks' branches	–8.334	–8.972	–5.647
	(8.290)	(9.800)	(6.078)
Share of branches in the market	–17.285	–19.782	–11.069
	(12.183)	(14.391)	(10.174)
Share of branches of the market	1.711	2.548	0.201
	(1.337)	(1.605)	(0.804)
Bank fixed-effects	Yes	Yes	Yes
Market-time fixed effects	Yes	Yes	Yes
Observations	7,804	7,821	7,826

This table presents the estimated results of post-conflict lending behaviour. Columns (1)–(3) show the results for the regressions with *Loan growth*^{total}, *Loan growth*^{corporate}, and *Loan growth*^{personal} as the dependent variable, respectively. In all regressions, a constant term is included but not reported. Standard errors clustered at bank-market level are presented in parentheses. *Loan growth*^{total}, *Loan growth*^{corporate}, and *Loan growth*^{personal} are the percentage changes in the amount of total loans, loans granted to firms, and loans granted to individuals, respectively. *Conflict* is a dummy variable that equals to one for four quarters after Q1 2014 and zero for four quarters before. $Distance^{HQ}$ is the natural logarithm of the geodesic distance (in km) from a market to the headquarter plus one. *Share of loans* is the ratio of total loans issued by a bank in a market to that bank's total loans. *Share of branches in the market* is the ratio of a bank's branches in a market to that bank's total number of branches. *Number of other bank branches* is the natural logarithm of the number of competitor branches in a market. *Share of branches of the market* is the ratio of the number of all branches in a market to the total number of bank branches. ∗, ∗∗, and ∗∗∗ denote 10%, 5%, and 1% significance levels, respectively.

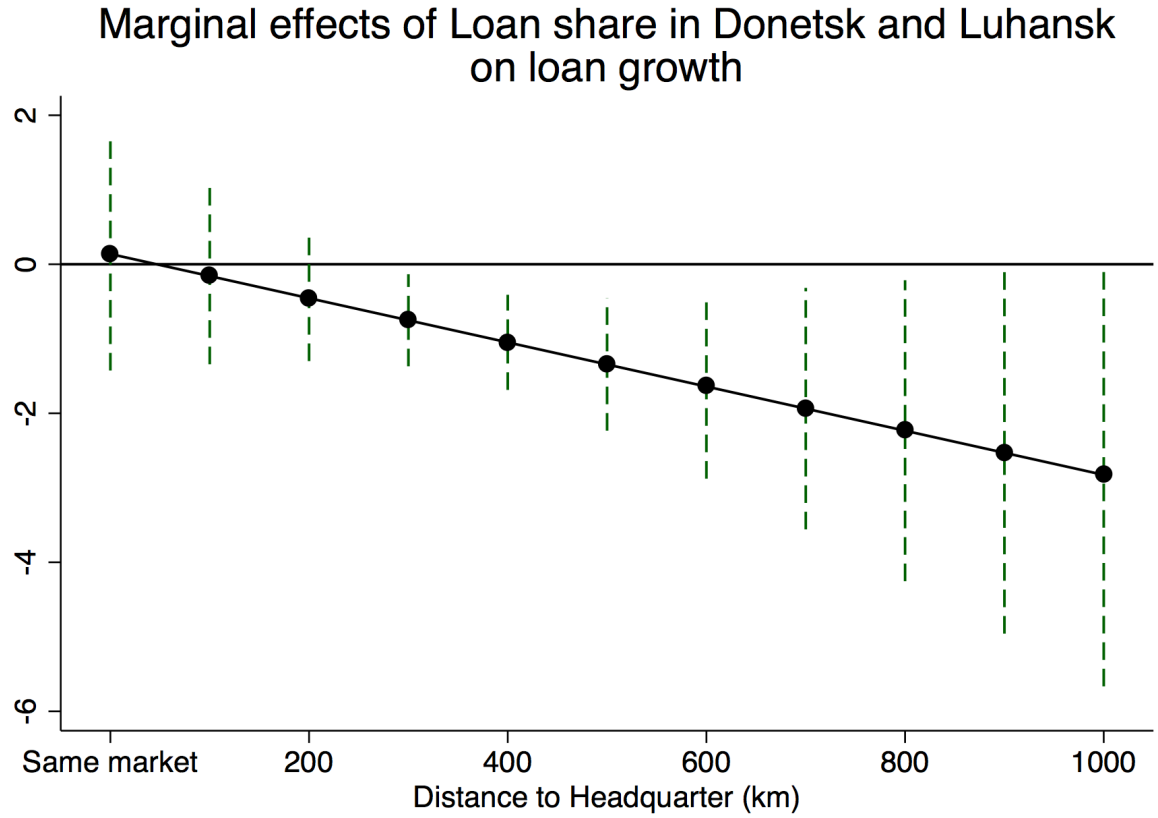
Figure 4 presents the marginal effects of *Loan share* and *Distance*^{HQ} on loan growth. Branches belonging to less affected banks and located in the same markets as the bank's head office experienced the smallest decrease in the rate of loan growth. The reduction of credit supply increases with a higher *Distance*^{HQ} or/and higher *Loan share*. For example, among branches located 200 km from their head office, the branches of banks with a 30% *Loan share* face a sharper decrease in loans than do branches of banks with a 10% *Loan share*. In addition, among banks with 40% of loans issued in Luhansk and Donetsk as of Q1 2014, branches located 1,000 km away from the head offices have reduced lending most. To better understand how the link between conflict exposure and loan reduction is amplified by the distance between the branches and their head office, we perform the sensitivity test as shown in Figure 5. We observe that the decline in the rate of loan growth in the market located 400 km away from the head office is about a half of the decrease in loan growth of branches located 700 km away from their head offices.

Figure 4 Marginal effects of the triple interaction on loan growth



This figure shows the impact of the interaction between conflict exposure (indicated by *Loan share* in Luhansk and Donetsk as of Q1 2014) and distance to headquarter (*Distance*^{HQ}) on the post-conflict loan growth, holding other variables at their means. The darker colour reflects the higher level of loan reduction.

Figure 5 Marginal effects of loan share in Donetsk and Luhansk on loan growth with distance to headquarter



This figure shows the sensitivity of the effect of *Loan share* in Luhansk and Donetsk as of Q1 2014 on loan growth with changes in $Distance^{HQ}$, holding other variables at their means.

These findings support the "flight to headquarters" effect suggested by De Haas and Van Horen (2012). More specifically, after the onset of the conflict, more affected banks tend to rebalance the loan portfolios in favour of markets located closer to the head office. This may be explained by several factors. First, greater distance between local branches and their head offices reflects higher monitoring costs and more severe agency problems. That may result in lower efficiency and increased risks (Berger and DeYoung, 2001; Deng and Elyasiani, 2008; Alessandrini et al., 2012). Because more exposed banks already face a higher level of troubled assets than less exposed banks, the former may have an incentive to reallocate credit to branches located closer to their head office. This would facilitate loan management and monitoring, thus reducing loss-generating assets.

Second, information on local borrowers, whether "soft" or "hard" information, is most likely collected at local branches (Alessandrini et al., 2008; Agarwal and Hauswald, 2010). Loan officers tend to rely on "soft" information in lending, which is not easily conveyed from the local office to the head office, the centre of decision-making. As a result, banks are more willing to lend to borrowers located closer to the head office as banks are better informed about the borrowers. In

other words, greater distance between the head office and the local market, as well as the centralized decision-making process, leads to a significant reduction in credit supply in more distant markets. Further, even if lending decisions are made solely based on "hard" information, physical distance still matters as greater distances decrease the probability of default recovery (Mian, 2006). Because the more exposed banks already face substantial losses from the conflict, re-allocating loans closer to the headquarters is a means to prevent greater losses.

Third, to some extent, the observed "flight to home" effect could be driven by the political considerations that are taken into account in lending decisions. Rose and Wieladek (2014) find the reduction in loans granted by foreign banks to British citizens following nationalization in the UK in the 1997–2010 period. In other words, there is evidence for financial protectionism imposed by nationalised foreign banks. Examining political interference in lending in the US, Chavaz and Rose (2018) acknowledge that banks that received the 2008 Troubled Asset Relief Program tend to expand lending in the areas inside the district of their "home" Congress representative. In the context of our study, the majority of banks have their headquarters located in Kyiv, which is the economic, financial, and geographic centre of Ukraine. Thus, one could argue that there is a certain degree of political interference when banks choose to provide more loans in regions closer to their headquarters.

4.4 Controlling for credit demand

Since the conflict happened at the same time with the economic recession, it is possible that our results are driven by lower loan demand caused by worsening economic outlook rather than the contagion effect. For instance, while many industries experienced the reduction in production, some industries such as mining or manufacture of metal faced the deeper decline than others. At the same time, these industries are also two major industries in Eastern Ukraine, making them more vulnerable to the conflict. Hence, it is more difficult for firms in these industries to cope with the changing macroeconomic and geopolitical environment, thus more likely to contract their borrowing. Consequently, banks that specialised in lending to these industries face a greater reduction in loan growth.

It could be also the case that reduction in post-conflict lending is a result of the heterogeneity in banks' response to the conflict rather than the conflict itself (Khwaja and Mian, 2008). For example, after the onset of the conflict, banks specialised in risky borrower pools (which are also more vulnerable during the conflict and crisis time) might have to cut these types of lending in all markets. In other words, the slowdown of credit growth of ex-ante riskier banks might be induced by the intention to reduce their loan portfolio risk rather than greater exposure to the conflict. In

these scenarios, estimations with time and market-time fixed effects are not sufficient enough to absorb the change in credit demand.

To address such concerns, we perform additional tests as follows.[12] First, we add to model (2.2) the interaction between *Conflict* and an indicator of banks' industry specialization. This indicator is measured as the share of loans granted to the mining and metallurgy industries as of the end of 2013. If the reduction in loan growth is merely stemming from lower credit demand from these industries, then the effects of conflict exposure should become insignificant. The estimated results presented in Table 7 indeed shows that the negative effects of shock exposure on post-conflict lending are unchanged. This finding, to some extent, is similar to Khwaja and Mian (2008), who find evidence for the transmission from banks' liquidity constraints to borrowing firms even when firms' loan specialization of is taken into account.

Table 7 Post-conflict lending behaviour – Controlling for industry specialization

	Total (1)	Corporate (2)	Personal (3)
Loan share^{total} in Donetsk and Luhansk×Conflict	0.832	1.158	–0.204
	(0.931)	(1.053)	(0.983)
Loan share^{total} in Donetsk and Luhansk×Conflict×Distance^{HQ}	–0.272*	–0.269	–0.154
	(0.153)	(0.179)	(0.176)
Share of loans granted to mining and metal industries×Conflict	–0.215*	0.166	–0.278***
	(0.124)	(0.196)	(0.106)
Share of loans	–3.201***	–4.018***	–0.032
	(0.521)	(0.629)	(0.047)
Number of other banks' branches	–3.653	–2.888	–8.134
	(7.248)	(8.817)	(6.206)
Share of branches in the market	–8.178	–8.403	–15.260
	(10.563)	(12.764)	(10.178)
Share of branches of the market	–0.442	–0.046	0.942
	(0.910)	(1.002)	(0.858)
Bank fixed-effects	Yes	Yes	Yes
Market-time fixed effects	Yes	Yes	Yes
Observations	7,785	7,802	7,807

This table presents the estimated results of post-conflict lending behaviour controlling for banks' specialization. Columns (1)–(3) show the results for the regressions with *Loan growth*^{total}, *Loan growth*^{corporate}, and *Loan growth*^{personal} as the dependent variable, respectively. In all regressions, a constant term is included but not reported. Standard errors clustered at bank-market level are presented in parentheses. *Loan growth*^{total}, *Loan growth*^{corporate}, and *Loan growth*^{personal} are the percentage changes in the amount of total loans, loans granted to firms, and loans granted to individuals, respectively. *Conflict* is a dummy variable that equals to one for four quarters after Q1 2014 and zero for four quarters before. *Distance*^{HQ} is the natural logarithm of the geodesic distance (in km) from a market to the headquarter plus one. *Share of loans granted to mining and metal industries* is the share of loans granted by a bank to the mining and metallurgy industries as of the end of 2013. *Share of loans* is the ratio of total loans issued by a bank in a market to that bank's total loans. *Share of branches in the market* is the ratio of a bank's branches in a market to that bank's total branches. *Number of other banks' branches* is the natural logarithm of the number of competitor bank branches in a market. *Share of branches of the market* is the ratio of the number of all branches in a given market to the total number of bank branches. ∗, ∗∗, and ∗∗∗ denote 10%, 5%, and 1% significance levels, respectively.

[12] Our results in this section are quantitatively similar to the presented results if we include in the estimations either (1) the triple interaction term between *Conflict*, *Loan share*$_{b,\ 2014Q1}$, and each of the industry specialization/sensitivity to borrowers' quality indicators or (2) both of the triple interaction term and the two-way interaction term that we report in Tables 8 and 9.

Second, we add in model (2.2) the interaction terms between *Conflict* and (1) *pre-conflict ROA*, (2) *pre-conflict Equity/Assets*, and (3) *Risky* to control for banks' sensitivity to quality of borrowers in each region. Variable *Risky* is the indicator of the ex-ante riskiness of borrower pools, which equals to one if banks' average *NPL* ratio over the 2010–2013 period is above or equal the sample median and zero otherwise. If the reduction in loan growth is induced merely by the risky ex-ante lending, one would expect the effects of conflict to be insignificant. However, results in Table 8 indicate that our main results are robust to the inclusion of pre-shock characteristics.

Table 8 Post- conflict lending behaviour – Controlling for the riskiness of borrower pools

	Total (1)	Corporate (2)	Personal (3)
Loan share^{total} in Donetsk and Luhansk×Conflict	0.569	1.194	–0.284
	(0.883)	(1.000)	(0.971)
Loan share^{total} in Donetsk and Luhansk×Conflict×Distance^{HQ}	–0.276*	–0.334*	–0.163
	(0.146)	(0.181)	(0.170)
Share of loans	–2.596***	–2.647***	–0.075
	(0.757)	(0.682)	(0.073)
Number of other banks' branches	–7.856	–11.440	–5.113
	(8.352)	(9.856)	(6.656)
Share of branches in the market	–16.758	–22.970	–10.500
	(12.166)	(14.553)	(11.225)
Share of branches of the market	1.412	2.407	–0.039
	(1.278)	(1.552)	(0.880)
pre-conflict ROA×Conflict	13.074***	10.707	11.771***
	(4.774)	(7.931)	(4.058)
pre-conflict Equity/Assets×Conflict	–1.148**	–1.157*	–0.951*
	(0.539)	(0.660)	(0.489)
Risky×Conflict	0.094*	–0.197***	0.103**
	(0.056)	(0.073)	(0.048)
Bank fixed-effects	Yes	Yes	Yes
Market-time fixed effects	Yes	Yes	Yes
Observations	7,804	7,821	7,826

This table presents the estimated results of post-conflict lending behaviour controlling for banks' risky borrower pools. Columns (1)–(3) show the results for the regressions with *Loan growth^{total}*, *Loan growth^{corporate},* and *Loan growth^{personal}* as the dependent variable, respectively. In all regressions, a constant term is included but not reported. Standard errors clustered at bank-market level are presented in parentheses. *Loan growth^{total}*, *Loan growth^{corporate},* and *Loan growth^{personal}* are the percentage changes in the amount of total loans, loans granted to firms, and loans granted to individuals, respectively. *Conflict* is a dummy variable that equals to one for four quarters after Q1 2014 and zero for four quarters before. *Distance^{HQ}* is the natural logarithm of the geodesic distance (in km) from a market to the headquarter plus one. *Share of loans* is the ratio of total loans issued by a bank in a market to that bank's total loans. *Share of branches in the market* is the ratio of a bank's branches in a market to that bank's total branches. *Number of other banks' branches* is the natural logarithm of the number of competitor bank branches in a market. *Share of branches of the market* is the ratio of the number of all branches in a given market to the total number of bank branches. *Risky* is a dummy variable which equals to one if a bank's average *NPL* ratio over the 2010–2013 period is above the sample median, zero if its average NPL ratio over the 2010–2013 period is below the sample median. *pre-conflict ROA* and *pre-conflict Equity/Assets* are the banks' average *ROA* ratio and *Equity/Assets* ratio over the 2010–2013 period, respectively. ∗, ∗∗, and ∗∗∗ denote 10%, 5%, and 1% significance levels, respectively.

5 Conclusion

In this paper, we investigate the impact of the 2014 geopolitical conflict in Eastern Ukraine on banks' activities and the transmission of this shock to banks' operations in other parts of Ukraine. While the results are largely in-line with the current literature on the impact of financial shocks on credit supply, our study is different in several ways. First, we examine the extent to which a geopolitical shock that causes losses in bank fixed assets can affect asset quality and lending volume. We find that a bank's exposure to the conflict is linked to its operations in the conflict areas as of the time of the shock. Banks with more outstanding loans in the Luhansk and Donetsk oblasts as of Q1 2014 are more likely to be affected by the negative shock. As a result, in the post-conflict period, the more exposed banks experience a higher level of troubled assets and a deeper reduction in credit supply compared to their less exposed peers.

Second, we investigate the spillover of the shock from the East to other markets. While the negative shock to the banking sector in Luhansk and Donetsk is transmitted to other parts of the country, the effect is lessened farther from the conflict zone. This supports the argument that interconnectedness and geographical diversification are channels for the transmission of the shock (e.g., Iyer and Peydro, 2011; Berrospide et al., 2016). However, the amplification of the conflict is mitigated by the distance from the markets to the conflict areas. For example, for a bank that is severely affected by the shock, its branches located in markets farther from Donetsk experience a lower *NPL* ratio compared to branches located near the conflict.

Third, we document the difference in the post-conflict credit supply across the markets and reiterate the "flight to headquarters" effects. Although the conflict-exposed banks tend to cut lending more than the less exposed peers, the magnitude of the lending reduction differs across markets. Banks are likely to scale back lending by less in markets located near their head offices as issuing loans to nearer markets simplifies control and monitoring over borrowers for the head office, thus reducing risks.

Although it is hard to avoid the risks associated with a geopolitical shock, there are ways to mitigate the risks for banks while maintaining services provided to customers. For instance, banks should adopt advanced information technology in operations more, which allow banks to control effectively the activities in distant markets. Thus, banks can reduce risks in lending in distant markets and consequently are more willing to supply credit in those markets. The adoption of information technology also makes banks less rely on the physical presence of local branches. Thus, in the event of unexpected shock like to geopolitical conflict, the losses in fixed assets could be lessened.

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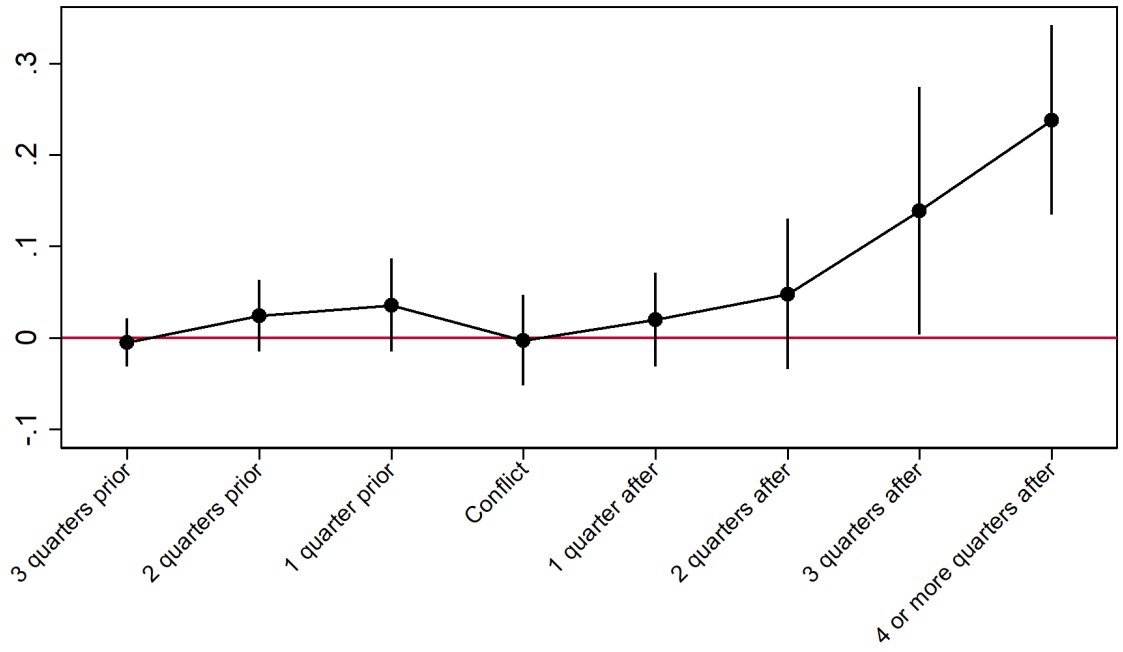
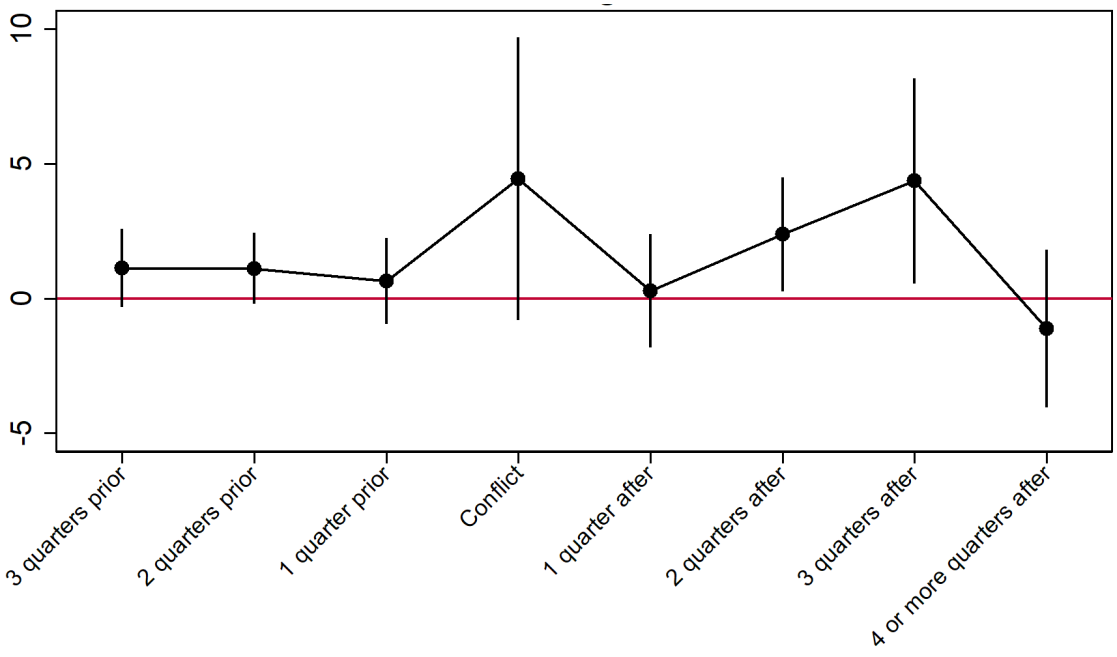
Appendix A

Figure A1 Impact of Loan share in Donetsk and Luhansk as of Q1 2014 on the NPL ratio over time



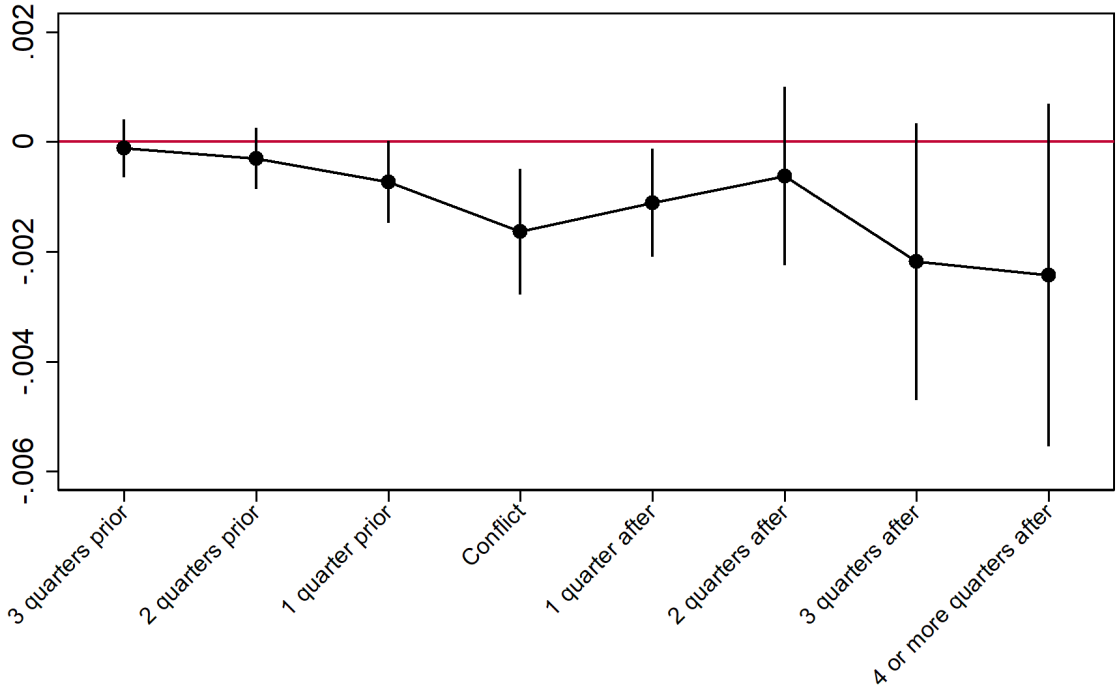
The figure represents the lead and lag effects of the share of loans in Donetsk and Luhansk as of Q1 2014 on the *NPL* ratio.

Figure A2 Impact of Loan share in Donetsk and Luhansk as of Q1 2014 on loan growth over time



The figure represents the lead and lag effects of the share of loans in Donetsk and Luhansk as of Q1 2014 on loan growth.

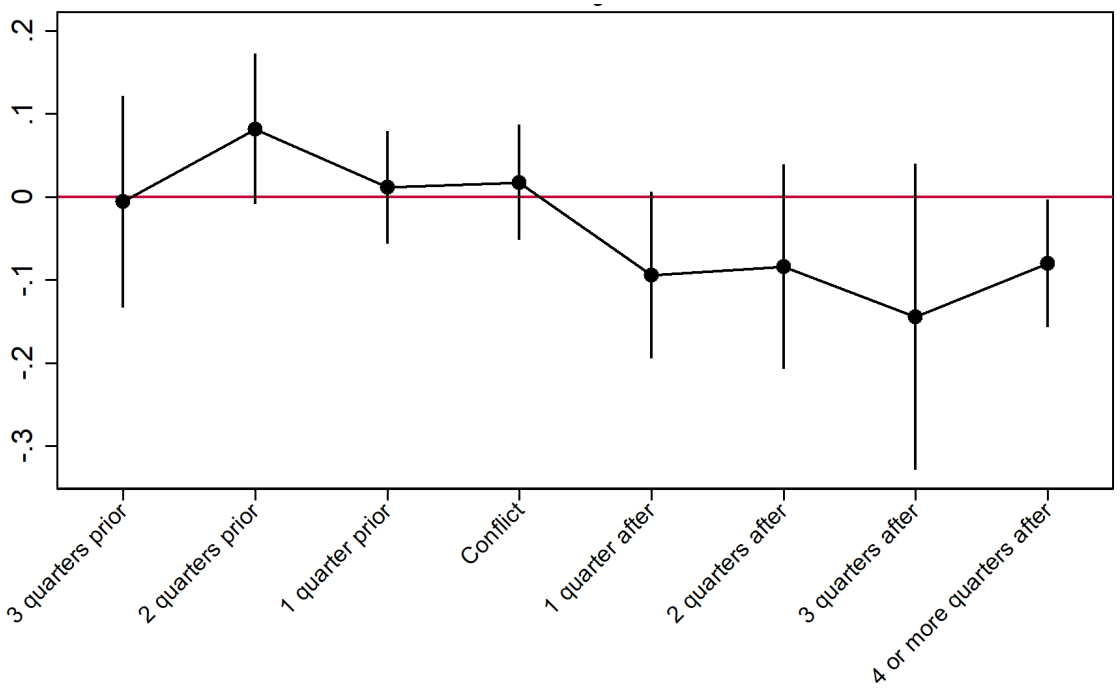
Figure A3 Impact of the interaction between Loan share in Donetsk and Luhansk as of Q1 2014 and Distance to conflict on the NPL ratio over time



Confidence level: 90%

The figure represents the lead and lag effects of the interaction between share of loans in Donetsk and Luhansk as of Q1 2014 and $Distance^{conflict}$ on the *NPL* ratio.

Figure A4 Impact of the interaction between Loan share in Donetsk and Luhansk as of Q1 2014 and Distance to headquarter on loan growth over time



Confidence level: 90%

The figure represents the lead and lag effects of the interaction between share of loans in Donetsk and Luhansk as of Q1 2014 and $Distance^{HQ}$ on loan growth.

Appendix B Dataset construction

	No. of banks	Notes
Before cleaning	175	
Dropping liquidated/insolvent banks	144	
Dropping Russian-owned banks	135	In 2014 Q1: – These banks' loans accounted for 14% of total loans. – These banks' loans granted in Donetsk and Luhansk accounted for 24% of loans issued in these regions.
Dropping banks that have headquarters located in Crimea, Donetsk, and Lugansk.	128	In 2014 Q1: – These banks' loans accounted for 1.3% of total loans. – These banks' loans granted in Donetsk and Luhansk accounted for 18% of loans issued in these regions.

This table presents the number of banks we obtained after each cleaning step and some related notes.

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