

Conflict displacement and technology adoption: evidence on agricultural households in Bosnia and Herzegovina*

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This study deals with the literature about the impact of conflict-induced displacement. The aim of this paper is to study the link between conflict-induced displacement and under adoption of agricultural technologies. We exploit data from Bosnian household survey for year 2001. To account for endogeneity in the displacement status, we exploit the heterogeneity of the level of violence in the pre-war location. This level likely affected the displacement decision is disconnected from economic performance. We find evidence that displaced household are less likely to adopt fertilizer relative to stayers. Land tenure issue for displaced people in Bosnia are the most plausible candidates to explain under adoption. Finally, we draw some implications to guide design of political economy.

JEL Classification: O1 D13

Keywords: Forced Displacement; Technology Adoption; Bosnian Civil War; LSMS survey

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Introduction

The economic consequences of conflict displacements are multiple. A number of studies have proposed a measure of these consequences on schooling (Shemyakina, 2011), personal safety and health (Mitchell, 2004), poverty (Bisogno and Chong, 2002) and on the labor market performance (Kondylis, 2010). Although this literature has covered in many subjects (Ruiz and Vargas-Silva, 2013), the effect of conflict displacements on the agricultural sector is still understudied ((Kondylis, 2008) as the exception). Our contribution is to assess the effect of conflict displacements on the choice of agricultural households in post-conflict Bosnia.

The civil war outbreak following Bosnia and Herzegovina's declaration of independence during the break up of Yugoslavia. The war was determined by the desire of nationalist leader to establish ethnic separate states. The direct consequence of this conflict is the displacement of 1.3 millions of people (UNCHR, Cutts (1999)). Many of these were rural families residing on agricultural land Giovarelli and Bledsoe (2001). Displaced people integration is an exploding issue in Bosnia. Dayton Peace Agreement ended conflict and promised for all refugee and displaced the right to return in their prewar property and return home without obstruction. In 2001, approximately 600 000 displaced people and refuges have returned to Bosnia and Herzegovina, but only 100 000 have returned in area where they belong now to ethnic minority Rose et al. (2007).

Although the agricultural sector is essential to the Bosnian Economy, its productivity level remains low. The situation seems worse for farms operated by displaced household. We analyze how displacement can influence economic performance of displaced agricultural households. More precisely, we focus on analyzing the impact on technology adoption.

We exploit data from the LSMS household survey. The survey was carried out in 2001, six years only after the Dayton Peace Agreement. It provides us with reliable information on migration status, individual characteristics and on household agricultural activity. Accounting for endogeneity between displacement and individual outcome is a major issue in assessing the impact of displacement. For instance, unobservable factors such as risk aversion could be both correlated to displacement decision and to economic performance. The non-random selection of displaced people biased our estimate of the impact of displacement. To overcome this issue, we exploit spatial variation in the level of violence during the war, as suggested by Kondylis (2010). Municipality level data on war casualties is used as instrumental variable. To be a credible instrumental variable the local level of violence must affect the displacement decision of the agricultural households, and must be disconnected with their individual characteristics. Thus, the local level of violence must affect the agricultural production decisions only through its effect on displacement decisions. A careful analysis of historical document, shows that violences are specifically targeted against civilians in order to establish territorial and ethnic separation. This violence seems disconnected from pre-war local economic performance and therefore to be uncorrelated with individual characteristics. Due to their nationalist origins, violence seems fulfill both conditions. We use local level of violence at the municipality of origins as instruments to tackle the endogeneity of the

conflict displacement.

The results show that displacement negatively impacted the technology adoption in the agricultural sector. The estimated impact when the displacement is instrumented exceed the one-step estimates. Moreover, displacement may influence the technology adoption by multiple channels. Displacement lead to a loss of social capital. As showed by Granovetter (1973), weak ties are essential to integration. Displaced people may be uprooted in their new settlement. Furthermore, violence in Bosnia entail a massive displacement of population. This massive displacement may burden local economy pattern. Finally, as shown by Rose et al. (2007), land tenure issue are detrimental to Bosnian agriculture. Land tenure issue is even more common for displaced people. Our quantitative analysis shows that land tenure issue is the more relevant explanation to the under adoption of technology by displaced household. This finding has important political implication because it shows that the allocation of property right to displaced people may reduce inequality.

The next section presents some background on the yugoslavian civil war and on the agricultural situation. In the section two we explore the nexus between Displacement and Farming Decisions. The empirical strategy is presented in the third section. The section four details the data and variable used. Result and political implications are detailed and discussed in the last section.

1 Context to the Study

1.1 The consequences of the civil war in Bosnia and Herzegovina

Following the collapse of the Socialist Federal Republic of Yugoslavia, the country proclaimed independence in 1992. According to the 1991 census, the population of Bosnia was 4.4 millions. Before the war the country was home to three ethnic groups: Bosniak (48%), Serb (34%), and Croat (15 %). In this section, we focus on the consequences of the conflict. The Bosnian War began in April 1992 due to nationalist claims. In December 1995, Dayton Peace Accords (DPA) ended conflict in Bosnia. This agreement has ratified the partition of Bosnia in two entities: the Federation of Bosnia and Republika Srpska (cf.1). The entities have been based largely on the territory held by the two warring sides. The DPA left ethnionationalism undefeated, and the two entities are based on ethnic foundation (Dahlman and Tuathail, 2005).

The International Tribunal for former Yugoslavia estimate that 102 000 people went missing or dead due to the conflict. The war resulted in major changes in the country. One of these major changes is the displacement of population. We observe an important variability in the estimate of the magnitude of displacement. According to UNHCR 1.3 millions people were displaced. Annexe VII of the DPA promised all refugee and displaced the right to return in their prewar property and return home without obstruction. It was the first peace agreement with a robust right to return (Stavropoulou, 1998). Despite this annexe, until 1999 returns were very limited (Dahlman and Tuathail, 2005). Local leader were very reluctant to give refugee the right to return, and enforce wartime laws that “legalized” the reassignment to displaced people members of ethnic

majority. Because refugees belong to ethnic minorities, returns threat ethnic foundation of entity. By late 1999 international community had the capacity and power to push returns (Dahlman and Tuathail, 2005). However, the refugee status remains highly undetermined. On the one hand they occupied illegally properties left by minorities, for instance: displaced Bosnian Serbs illegally occupying Bosniak house (Dahlman and Tuathail, 2005). On the other hand, they can not easily claim their property left behind due to ethnic tensions:

‘All villages in Zvornik had seen some level of returns by 2001, though the process of returns often provoked localized violence and riots by illegal occupants’ (Dahlman and Tuathail, 2005).

After this short review of Bosnian political context, we then focus on the agricultural situation.

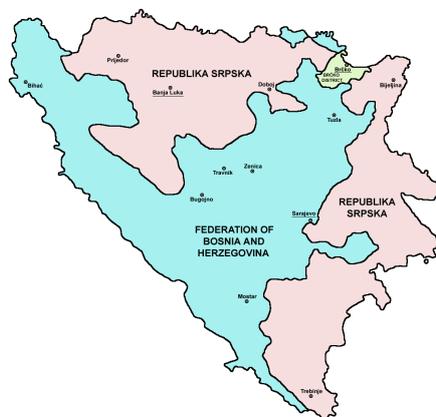


Figure 1: Entities of Bosnia and Herzegovina

1.2 The consequences of the civil war on the agricultural production

The agricultural sector is crucial to the bosnian economy because it accounts for a large part of the GDP (10.1% in 2008 Institute for statistics of Bosnia and Herzegovina (2008)). The sector accounts for 7-8% to the GDP of the federation, whereas in Republik Srpska the sector is higher at more than 17% European Commission (2006). According to the World Bank estimates, agricultural production was reduced to one third of the pre-war production level. This was partly due to the destruction of input factors.

Two farm models coexist in Bosnia: private owned small farm, and large state farm. We restrict our analysis to private owned farm because in 2006 only 5% of arable land is held by state farm. Farm Household are not broadly market-oriented. This sector use an archaic technology, often designed to state farm. Over the privatization process, this technology is transferred to farms households. And this technology is inappropriate to the needs of the private farms (European Commission, 2006). Over the past ten years

the investment is insufficient. Due to this limited investment, productivity levels remain low. Average yields of all crops are dramatically behind those achieved in Europe.

“The main reason for this, beyond the limited agro-climate conditions, are unfavorable farm structure, small and fragmented land parcels, insufficient use of certified seed and limited use of artificial fertilizer” (European Commission, 2006). The sector suffers also from the weakness of financial institutions. “The lack of favorable credit lines that are tailored to the specific characteristic and needs of agriculture is among the most often mentioned obstacles to the development of the sector” (European Commission, 2006).

Current land tenure systems are failing to support a modern agricultural sector. Bosnia and Herzegovina constitutionally established rights have yet to be fulfilled in many cases because of the stark realities of war and ethnic strife Giovarelli and Bledsoe (2001).

2 Exploring the linkages in Displacement-Farming Decisions

2.1 Forced Migration

Forced migration is a recent research topic in economic literature. Literature on forced migration is almost nonexistent in the early 2000 (Ruiz and Vargas-Silva, 2013). There is however a large amount of historical and political analysis on this subject. The economic literature has long been restricted to the study of voluntary migration : impact on the sending country, determinants of migration... But forced migration has specific attributes, therefore we cannot extend conclusion on voluntary migration to forced movement. Ruiz and Vargas-Silva (2013) provide an overview of economic literature on forced displacement, and identify four methodological difficulties faced by quantitative analysts: data limitation, challenges to separating the impact of war and violence from the impact of forced migration; treatment of location selection; and selection into assistance programs (Ruiz and Vargas-Silva, 2013). They also recommend to study the impact of forced migration on displaced people and the impact of displacement on host communities.

Sarvimäki et al. (2009) analyze long term impact of forced displacement occurring due to the second world war in Finland. Twenty-five years later displaced people have higher standard living than selected control group. They suggest that a large part of this increase is a consequence of the resettlement policies. These policies accelerate both the transition to modern activity and rural-urban migration. Conversely Vigdor (2007) and Groen and Polivka (2008) demonstrate that Katrina-displaced persons face poor labor integration.

In developing country conclusion may be different because of poor public intervention and high level of violence faced by displaced people. The mortality rate of people recently displaced is 5 to 12 times higher than stayers (Toole, 2000). In the case of Bosnia, Toole and Waldman (1993) relate the consequence of the armed conflict in province of Zenica. The infant mortality rate doubled during the first year of the war. The effect on health clearly indicates that conflict displacement can threaten long term

development. Bisogno and Chong (2002) argues that ethnic cleansing may have exacerbated the differences among regions. Violence can also alter long term mental health (Kuwert et al., 2009). There are many sector impacted by forced migration (Ruiz and Vargas-Silva (2013)). Regarding Bosnia, Kondylis (2010) shows that displaced people are positively selected. She argues that displaced people experienced a lower probability to be employed than stayers. From an economic perspective exposition to high violence can impact economic preferences (risk aversion, intertemporal preferences...), and thereafter investment choices. A short review of the literature shows that the impact of displacement differs across socioeconomic groups and over time.

Unlike Kondylis (2010), we focus here on farm households. In Bosnia, displaced farm households experienced worse economic welfare. These conditions may due to lower technology adoption. In 2.2, we explore the economic literature related to technology adoption.

2.2 Technology Adoption by farm household

The majority of developing country population lives in rural area and is heavily dependent on agricultural yields. Hence, the adoption of new technologies attracted the attention among politicians and economists. It seems to offer an opportunity to increase agricultural productivity. However, the availability of technology is not a sufficient condition to guarantee the adoption. This adoption framework was first studied by rural sociologist (Mendras (1959) for instance). Feder et al. (1985), in a highly cited article, argue that adoption is constrained

“by the lack of credit, limited access to information, aversion to risk, inadequate farm size, inadequate incentives associated with farm tenure arrangements, insufficient human capital, absence of equipment to relieve labor shortages (thus preventing timeliness of operations), chaotic supply of complementary inputs (such as seed, chemicals, and water), and inappropriate transportation infrastructure.”

However, a survey of various economic literature show that the constrains to technology adoption is specific to each environment. The research currently focus on four questions: the study of the learning process, the impact of social network, the analysis of micro-data, and the introduction of more powerful econometric and modelization tool (Doss, 2006).

Investment in new technology is a dynamic choice. Cross sectional data does not allows us to take into account the dynamic process, and this constrain is an important limitation of our analysis. Working on household decision is a necessary condition to study the impact of displacement on farm household. Some investment decisions such as machinery are taken at the village level. In Bosnia, many decision are taken at this level because of the incomplete transition to market economy (*cf.* Section 1.2). Mendola (2008) argues that the adoption of high-yielding varieties of rice is a good proxy in order to study the impact of migration on technological change. The LSMS survey does not provide us with such information. Because of data limitation on the survey and this

previous remark studying the adoption of nitrogen seems a good strategy. Nitrogen is a good proxy because agricultural technologies are introduced in package that include several components, for example, high yielding varieties, fertilizer, machinery (Feder et al., 1985). The adoption of nitrogen is an indicator of production mode change. In the next subsection, we explore how displacement may influence technology adoption.

2.3 Impact of displacement on Technology Adoption

Ciobotea (2003) shows that the impact of conflict are different between urban and rural zone. Vulliamy (1994) argue that cities are more tolerant for a multi-ethnic state, and Ciobotea (2003) exposes that the majority of Serb militia came from rural areas. Furthermore, farm households have some characteristics able to influence the impact of violence on their behavior. To our knowledge, Kondylis (2008) is the first article exploring the impact of forced displacement on agricultural household. We focus here on the impact of displacement on technology adoption. Forced displacements lead to change in investment patterns. We can distinguish five channels to explain a negative relation between displaced status and nitrogen use.

- The arrival of large numbers of internally displaced people may change local economic pattern. Ruiz and Vargas-Silva (2013) argue that forced migration may burden host communities in various way. However, Maystadt and Verwimp (2009) show that refugee from Burundi and Rwanda have a positive impact on local economy in Tanzania. But this impact is heterogeneous. In Bosnia this arrival may threaten local solidarity mechanism, burden local mutual trust. For instance, Posavina is the poorest canton in the Federation, and this area has received significant flows of refugees after the end of the war Bisogno and Chong (2002). Displaced people may adopt less modern technology because they live in area with less mutual trust.
- Displacement may lead to a loss of social capital. The impact of social network on technology adoption is a growing issue in economic literature (Doss, 2006). For example, Matuschke and Qaim (2009) argue that individual social networks play an important role in technology adoption process. Social network can accelerate the learning process. Furthermore social capital can play a particularly important role in the post conflict environment. This capital can be a substitute to market failure (output and financial market...). Matuschke and Qaim (2009) show the importance of studying this network at both the village and individual level. “Village-level variables may be used as suitable proxies at later diffusion stages, they tend to underestimate the role of individual networks during early phases of adoption” (Matuschke and Qaim, 2009). Granovetter (1973) in a highly influential article explores the role played by weak ties (non frequent and transitory relation) in human relation. He argues that weak ties are essential to individual integration in society; strong ties, breeding local cohesion, lead to overall fragmentation. We show in more detail in 4.2 how we exploit data in order to tacking into account social network.

- Rose et al. (2007) claim that economic progress will be threaten until it becomes possible legally and *de facto* to own property. Displaced people are highly affected by land tenure issue. Refugee statuts are subject to political tensions. Dahlman and Tuathail (2005) shows that the return of former inhabitants (belonging to ethnic minority) leads to the expulsion of farms illegally occupied by refugee belonging to ethnic majority. Foster and Rosenzweig (2010) argue that risk reduce the adoption of new technology. We have no data on illegal occupation but we exploit LSMS survey on order to test this channel (more detail in 4.2).
- Exposure to mass violence can generate trauma. As show by Kuwert et al. (2009) long-term mental disorders can occur due to forced displaced. In our case these trauma can lead to greater risk aversion. This explanation goes against exogenous preferences hypothesis often held in economic literature. Greater risk aversion may lead investment patterns. Voors et al. (2010) argue that exposure to violence reduce the rate of preference for the future. A temporary shock may reduce long term welfare by its mediation effect on investment.
- Forced displacement may lead to a loss of specific skills (Kondylis, 2008). Specific skill are numerous in the agricultural sector: field knowledge, weather, local market. In order to flee ethnic violence, households moved from one entity to another. Displaced households must thus adapt to a new environment. This lack of specific skills may entail a low productivity. This low productivity reduces opportunities to invest in new technology.

Unfortunately, we can't test empirically the last two channels due to data limitation. In the rest of this paper, we present our empirical strategy to tackle selection bias and investigate how the other channels interact with the displacement status to explain the technological adoption.

3 Empirical strategy

Our aim is to study the impact of forced displacement on the technology adoption. For that purpose, we estimate the relation:

$$A_i = \alpha + \beta D_i + \gamma X_i + \varepsilon_i \quad (1)$$

With the outcome A_i is the choice of the household i to adopt the technology and D_i its displacement status . The vector X_i represents the household-level baseline control variables and ε_i is the error term.

3.1 Impact of the selection bias

Displacement status must be correlated with unobservable factors. We might think that people who move due to violence are not randomly selected. Some unobservable characteristics are correlated with the probability to flee violence. And these characteristics

are also correlated to household’s economic performance. For instance, risk aversion is such an unobservable characteristic both correlated to displacement and to economic outcome. In order to clarify these idea, Kondylis (2010) use the following modeling. Displacement choice are a dichotomous choice D_i . Individuals base their displacement decision on the expected net variation in utility (trade-off between U_d , utility if he decides to move, and U_s if he decides to stay). The discrete choice is given by:

$$D_i = F(Z_i, C_o, P_o, V_i, u) = E [U_d(Z_i, C_o, P_o, V_i, u) - U_s(Z_i, C_o, P_o, V_i, u)] > 0 \quad (2)$$

This decision depend upon individual characteristics Z_i , the level of local violence (C), local economic conditions relative to the rest of the world P_o , a component of unobserved heterogeneity V_i and a random term u . It seems possible that unobserved parameters P_o and V_i determine post-conflict adoption. OLS estimate will produce inconsistent estimate of the effect of displacement:

“Assuming that displacement has a negative effect on work and that higher ability is positively correlated to a higher propensity to be displaced, the using OLS results, in absolute terms, in a downward bias” (Kondylis, 2010).

Kondylis (2010) suggest to exploit the heterogeneity of violence across municipality to address endogeneity. As shown in 3, the conflict incidence is not equal across municipality. We use the local level of casualties as proxy for the level of violence. Thereby, displacement in “disconnected” to individual characteristics. The local level of violence needs to fulfill the following requirement:

- To be a good predictor of displacement. The coefficient of the local level of violence on the first step equation have to be different from zero. Coefficient in 1 support this assumption for the three definitions. A high level of violence encourages people to move.

Table 1: Relation between violence and displacement

| | Displacement 1 | | Displacement 2 | | Displacement 3 | |
|--------------------|----------------|--------|----------------|--------|----------------|--------|
| Violence* | 4.83 | 4.08 | 4.54 | 3.68 | 3.59 | 3.57 |
| P-value | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Control | No | Yes | No | Yes | No | Yes |
| F-Statistic | 288 | 26.32 | 144 | 36 | 221 | 55 |

- The violence has to be disconnected with individual characteristics (exclusion restriction). This requirement is not always fulfilled. In Colombia for example, Ibáñez and Vélez (2008) argue that the distribution of violence is not random across space, but is targeted certain groups within the population. Thankfully, violence due to the civil war in Bosnia seems to fulfill this requirement. In order to test this hypothesis we have to focus more on historical evidence. Bosnia is a former territory of Yugoslavia. It became independent with the fall of the communist

regime. Years before the breakup of the Yugoslavia Republic witnessed the emergence of nationalist claims. Yugoslavia Republik was very-fractionalised. Bosnia is the most ethnically fractionalised entity in the Republic with 40 % Bosnians, 37% Serbs and 17% Croats. On June 1991, Slovenia and Croatia declared independence. These independence increase the fear of serbian minority in Bosnia. On February 1992, following a national referendum (boycotted by serbian minority), Bosnia declared independence. It was recognized by western powers. Contesting the referendum the Serb-majority territory declared independence from Bosnia. Simultaneously, Bosnian Serb set up armed militia led by Radovan Karadzic. These militia was supported by the Federal Army. On April 1992 the conflict broke out. These military operation was described as ethnic cleansing. These violence targeted civilians. Their primary aim was territorial and ethnic separation. Even in area in which the conflict relates to ethnic cleaning, the violence may be targeted to specific people (religious leader, prosperous area...) (Ruiz and Vargas-Silva, 2013). In Bosnia, historical evidence suggests, however, that casualties is disconnected from local development (Kondylis, 2010). An UN report confirms this hypothesis:

“The Serbs required absolute control in order to establish a separate nation with contiguous borders and an uncompromised geographic link with Serbia and Montenegro. That control required the subjugation, if not the disappearance, of the non-Serb population of the area.” (UN. 1994 report cited in Bultugil 2004).

Weidmann (2011) using a quantitative technique argue that territorial claims explains violence in the great majority of municipality. Weidmann (2009) argue that the occurrence of two-sided violence also depends to a large degree on the local ethnic fictionalization, with more diverse units experiencing more violence. Figure 2 confirms the hypothesis of ethnic violence. The conflict homogenized local territory.

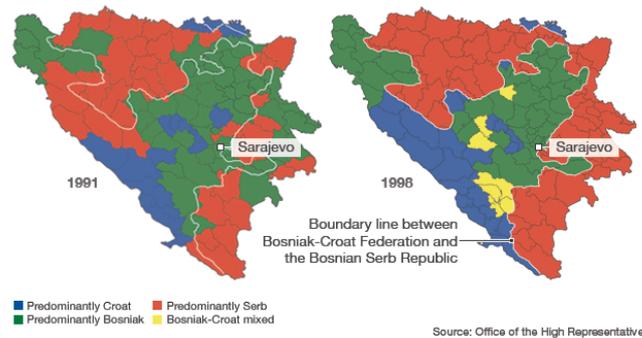


Figure 2: Ethnic repartion Before After Conflict

In order to test, these hypothesis Kondylis (2010) check whether pre-war educa-

tional attainment can predict casualties. In the absence of pre-war data on local prosperity educational achievement of people born in the municipality is used as proxy. We restrict our sample to head households born in the municipality and aged 27 and over. We find no significant relationship between local educational achievement

Table 2: Education and Local Violence

| | (1) | (2) |
|----------------------------|-------------------------|-------------------------|
| | Local level of Violence | Local level of Violence |
| Literacy | 8 | 0.08 |
| | (0.267) | (0.16) |
| % Primary | 0.0015 | -0.001 |
| | (0.764) | (0.76) |
| % Professional | 0.003 | -0.02 |
| | (0.559) | (0.561) |
| % Technical | -0.003 | -0.001 |
| | (0.46) | (0.973) |
| % General Training | 0.008 | 0.004 |
| | (0.1) | (0.3) |
| Observation | 615 | 3370 |
| P value F Statistic | 0.47 | 0.39 |
| Sample | Farm Household | All household |

The LSMS survey does not provide us with displaced status. As shown in refugee status is a burning issue in Bosnia. We have to be very cautious concerning this definition.

3.2 Definition of Displaced

The International Association for the Study of Forced Migration defines forced migration as

“the movement of refugees and internally displaced people (those displaced by conflicts) as well as people displaced by natural or environmental disasters, chemical or nuclear disasters, famine or development projects” (Ruiz and Vargas-Silva, 2013).

This definition is broad, we limit our analysis to internal displaced people due to Bosnian war. As shown in 4.1.1, we can't identify the displaced individuals from the raw data. Great care needs to be taken with this definition because status of displaced people is a sensitive and highly political issue. Therefore we use several definition in order to test the robustness of our result.

- Definition 1: an household is displaced, if the municipality of residence of the household head is different from his birth municipality. In this first definition we only taking into account households headed man. Women heads of households are mostly widows. The place of birth of a woman is not a good proxy for the place of residence. Indeed a woman as a high probability to change her place of

residence when she married. Do not consider this high probability would likely to overestimate displacement. Concerning the rest of our population sample we might think that the municipality of birth is a good proxy for the municipality of residence just before the outbreak of conflict. Before the war farm households are highly static (high cost to migrate, low liquidity of capital asset...). This definition excludes from the group of displaced returnees. This exclusion is one of the bigger variances with Kondylis (2010)'s approach. As Kondylis (2010) we exclude from our analysis people born outside Bosnia. We take this definition as benchmark because it's the fully informed.

- Definition 2: the biggest difference with the first definition is that we consider returnees as displaced. We use five self-reported to define displaced status. But this status is poorly completed (lot of missing value, specified for only 29% of our sample). Furthermore people may find incentives to hide their real status. Yet, these qualitative measures can be used to test the robustness of definition1.
- Definition 3: the survey provides information on the municipality of residence before the outbreak of the conflict. An household is displaced, if the municipality of residence of the household head is different from his municipality of residence before the outbreak. This last definition is more precise than the definition. Nevertheless, data required is poorly completed. Thus, we use this definition to test the robustness of our results.

3.3 Limitations

To control for non random sorting of displaced individual into their municipality of destination Kondylis (2010) uses municipality of destination fixed effects. In this article we can not control for this non random sorting due to the cross sectional nature of our data.

4 Data and variable description

The empirical strategy is based on three main data sources: an household cross sectional survey; a municipality level data on war casualties; and bio-climatic data. We have to be very cautious about complementary data base because sector statistics that do exist in Bosnia are often subject to large margins of error (European Commission, 2006).

4.1 Data

4.1.1 LSMS Survey

The survey was carried out in 2001 by the World-Bank. This survey was part of a more larger research project on Bosnian household. The project recorded panel data on demographics, labor and household consumption for randomly selected household between 2001-2004. Unfortunately in this article we exploit only the first wave of the

survey (*i.e* the 2001 wave), because it is the only one with specific agricultural module. This survey was carried out only six year after the Dayton Peace Agreement. The first step was to group the 137 municipalities into three strata: Urban, Rural and Mixed within each of the two entities (RS and FBH). 25 municipalities were finally selected. Municipalities were selected with probability proportional to estimated population size. The probability of selection varies for each municipality. We use survey weight because we want the statistics to be representative of the country. These data have not been post-cleaned (inference of missing value, revaluation of outliers...).

On the first wave 5400 households were interviewed between September and November. Several modules are specific to agricultural household. They provide detailed information about input, output, capital asset... The household is the unit of analysis reflecting theoretical approach in development economics. In our study we restrict our sample to 508 rural farm households. In the original data is not possible to identify the displaced individuals. We exploit information on the municipality of birth and on current municipality in order to determine the statue of the household (*c.f.* .section 3.2 for a detailed methodological information).

4.1.2 Bosnian Book of Dead

The Bosnian Book of Dead Project was carried out by the Documentation Center in Sarajevo. His main goal was to providing data and document regarding the Bosnian war. It was a very politically sensitive issues in the Bosnian post war. We are focusing here on the municipality population losses data and the 1991 census are used to compute the proportion of the pre-war population missing due to conflict. This ratio offers a good proxy of violence at the local scale. As show in 3 the impact of conflict is not evenly distributed across the country. We exploit this heterogeneity to instrument for displacement.

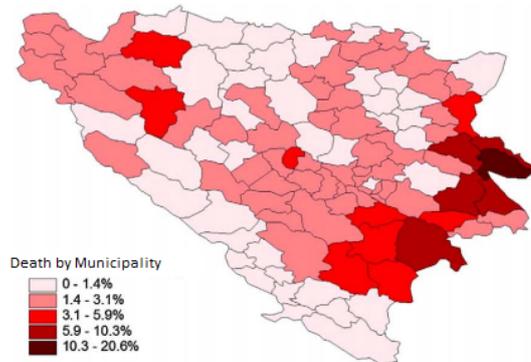


Figure 3: Death by Municipality

4.1.3 Other Data

We are very constrained by data availability. Data on agricultural sector is very scarce and state level information remain underdeveloped.

The natural environment influences the decision made by farmer. We need to account for this bio-climatic variation. For this we exploit pluviometry data. The FAO partitioned the national map into four areas (cf. 4) . From work mapping we were able to define for each municipality zone to which it belongs. Variability in annual rainfall is important across Bosnia.

“Bosnia can be divided into three climatic regions with more or less sharp boundaries or moderate transition zones: northern region, hilly mountain region, and southern region” (FAO, 2008).

In our sample household are located in northern region (green zone on map 4) in hilly mountain region (blue zone on map 4) and on southern region (pink zone on map 4).

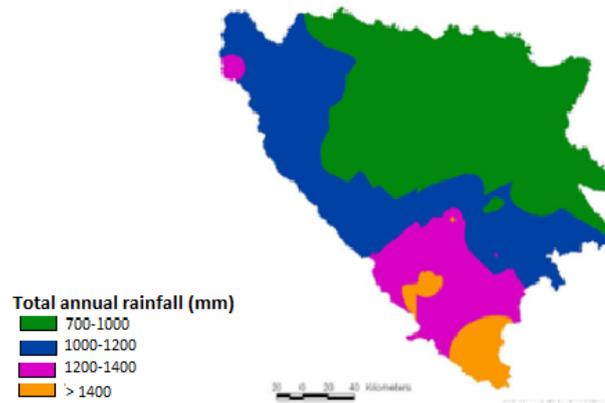


Figure 4: Rainfall Bosnia

4.2 Variables Used

To conduct relevant empirical strategy we use several control variables. A careful review of the literature and the considerate of local environment have guided us in their selection.

- A_i : dummy variable equals to 1 if the household uses nitrogen.
- D_i : dummy variable equals to 1 if the household is displaced. We explain the methodology used to construct this dummy variable in the sub-section 3.2.
- *Age*: age of household head. The impact of age on technology adoption is undetermined. Old household head have less incentive to adopt technology (less educated,

high fixed cost...). However young household head are more often liquidity constrained.

- *Educ*: dummy variable equal to 1 if household head has ever attended school. We expect a positive relation between education and technology adoption.
- *AUA*: agricultural Useful Area used by the household. This variable is use in order to taking into account scale economy.
- *Price* : price in local monetary unit for 1 kg of nitrogen. LSMS survey provide information on price only for user household. For no user we extrapolate information by geographical inference (average price reported by neighboring households). This information is self reported by agricultural household (and not observed by interviewers). We assume that households are price taker, so price are considered as exogenous.
- *CreditAcces* : dummy variable equal to 1 if the household has borrowed money in the last 12 months. Literature has cited low credit access as one of the major constraints to agricultural modernization. Credit access is also a proxy of household wealth (collateral need for loan...)
- *RefusalCredit* : dummy variable equal to 1 if the household has tried to borrow money from any person or institution and were refused.
- *Climat_i*: dummy variable equal to 1 if the household live in climatic region_i identified in map 4.
- *Rs*: dummy variable equal to 1 if the household lives in Republik Sprska.
- *Owner*: dummy variable equal to 1 if the household owned at least one plots of land among all plots used by the household. This dichotomous variable is a proxy for land tenure conflict. If the household owns plots cultivated, he is less likely to face land tenure issue. –j dveloppe t-on les limites de cette mesure?
- *Proportion of Displaced*: $\frac{\text{Displaced People Living in the Municipality}}{\text{Population of the Municipality}}$. This variable captures externatlities due to massive influx of refugee. Ruiz and Vargas-Silva (2013) recommend to study the impact of forced migration for host communities. Forced migration may lead to change in social and economic structure. Voors et al. (2010) argue that “few recent careful micro level studies suggesting that exposure to conflict may contribute to social capital”.
- *Same Municipality* : this variable count for each household_j the number of head household having both the same municipality of residence and the same municipality of birth. This number is weaker for displaced people. It provides us with a measure of “diaspora” effect. It is a way to identify the impact of loss of social network on technology adoption. This variables captures how household head is “well connected “ in his municipality of residence. It is a proxy because we can not properly identified if household *i* knows household *j*.

4.3 Empirical Evidence

Displaced integration is a sensitive issue able to threaten foundation of entity. “All estimates concur that the magnitude of the GDP loss was far above the loss of any other transition countries, even of those suffered similar wars during their transition processes” (Bisogno and Chong, 2002). Kondylis (2010) finds that “displaced men experience higher unemployment levels, and displaced women are more likely to drop out of the labor market. We restrict our analysis to farm household.

As show in table 3 displaced people seem younger and better trained.

Table 3: Caractrisitiques Individuelles

| | Displaced | Stayers |
|---|-----------|---------|
| Age of Household Head | 48.8 | 51.7 |
| Literacy Rate | 16% | 20% |
| Proportion of individuals whose highest level is primary | 52% | 54% |
| Proportion of individuals whose highest level is vocational diploma | 8% | 8% |
| Proportion of individuals whose highest level is technical diploma | 25% | 27% |
| Proportion of individuals whose highest level is general secondary diploma | 4% | 1% |
| Proportion of individuals living today in Republik Sprska | 22% | 20% |

Kondylis (2010) and Rose et al. (2007) both argue that displaced people are less integrated and experienced difficult economic condition. As shown in table 4, the economic situation of displaced farms household seems worse than stayers. They have worse access to land, smaller farms, and poorer credit access.

Table 4: Economical Characteristics

| | Dplac | Non Dplac |
|---|-------|-----------|
| Proportion of Owner | 44% | 91% |
| Average size of the farm | 1.4 | 2.8 |
| Credit Acces in the last 12 months | 14% | 21% |
| Credit Refused in the last 12 months | 89% | 91% |

Table 4 shows that displaced farm households have lower yields. These differences in performance persist when we take into account geographical localization (*cf.* agro-climatic area shows on figure 4) (these calculus are not show here). These lows yields can be explained by the lower use of fertilizer, or the lower capital assets.

Table 5: Individual Characteristic

| | Displaced | Non Displaced |
|---|-----------|---------------|
| Average Yields Corn | 2.9 | 4.6 |
| Average Yields Potatoes | 12.4 | 12.2 |
| Average Yields Wheat | 1 | 2.09 |
| Average Yields Oat | 0.4 | 0.7 |
| Capital Assets held | 172 754 | 270 382 |
| Amount of Fertilizer per hectare | 137 | 205 |

5 Results

5.1 Displacement and nitrogen adoption

We first present estimate of the impact of displacement on technology adoption. As shown in section 3.1, the probit estimation of the impact of displacement may be biased. By comparing Probit and instrumental Probit, we show that the impact of displacement are greater when instrumenting. This difference between the two estimates comes from a positive selection of the displaced people. This confirms the result of Kondylis (2010). Thus, we focus here on the interpretation of equation (4) (5) and (6). According to the equation (4) in table 6, the displacement status reduce the likelihood of adoption to more than one half. The sign and the magnitude of the control variables are in line with the economic theory. Equation (5) shows that education play a reduced role in technology adoption. Then (6), shows that credit constrains reduce adoption. Borrowed money in the last 12 months increase the likelihood of adoption. More interestingly, (5) and (6) shows that education differential and credit constrain are not responsible for the poor conditions of displaced, because the estimated impact of displacement is stable over these specifications.

Displaced households have a lower probability to adopt nitrogen. In the next section, we will try to understand which factors influence this relation.

5.2 Exploring the source of the poor conditions of displaced

In section 2.3, we have identified five factors able to explain the negative relation between displacement and technology adoption. As shown in section 2.3, we can carry out an identification strategy only for three of them: loss of social capital, the impact of mass arrival of refugee, and the impact of land tenure issue. Ai and Norton (2003) argue that the magnitude of the interaction effect in non linear models does not equal the marginal effect of the interaction term. Therefore we present for each channels, figure representing the correct magnitude of the interaction effect. Unfortunately there is no way to estimate the correct interaction effect after an instrumentation. We are constrained to limit our analysis to Probit. Coefficients of interaction term (not interpretable) are in table 7.

5.2.1 The loss of social capital

As showed in Section 2.3 displacement entails the loss of social capital. Granovetter (1973) shows that weak ties are indispensable to individuals opportunities. But displacement has an heterogeneous impact of social loss. Some people relocated near “diaspora” from their former municipality, other relocated in area without such “diaspora”. *Same Municipality* is a proxy used to identify how much a household is isolated in this new settlement. According to our definition two household are closed if the head household having both the same municipality of residence and the same municipality of birth. According to specification (1) in table 7 social capital does not seem to play a significant role in nitrogen adoption to bosnian households (stayers and displaced). As showed in Figure 5, the impact of the loss of social capital for displaced people seems reduced.

Table 6: Baseline Estimation

| | (1) | (2) | (3) | (4) | (5) | (6) |
|-------------------------|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | Adoption Probit | Adoption Probit | Adoption Probit | Adoption IVProbit | Adoption IVProbit | Adoption IVProbit |
| Displacement (d) | -0.372** (0.146) | -0.372** (0.147) | -0.374*** (0.136) | -0.551*** (0.153) | -0.539*** (0.160) | -0.542*** (0.159) |
| Age | 0.003** (0.001) | 0.004** (0.002) | 0.004** (0.002) | 0.002 (0.002) | 0.003 (0.002) | 0.003 (0.002) |
| Total AUA | 0.112*** (0.036) | 0.111*** (0.036) | 0.107*** (0.035) | -0.030 (0.021) | -0.030 (0.021) | -0.031 (0.022) |
| Price | -0.315 (0.197) | -0.310 (0.199) | -0.285 (0.192) | 0.077 (0.268) | 0.086 (0.266) | 0.089 (0.266) |
| Climat1 (d) | -0.314*** (0.0879) | -0.316*** (0.086) | -0.316*** (0.081) | -0.451*** (0.083) | -0.453*** (0.083) | -0.452*** (0.084) |
| Climat2 (d) | -0.673*** (0.139) | -0.677*** (0.134) | -0.682*** (0.135) | -0.626*** (0.076) | -0.632*** (0.075) | -0.633*** (0.075) |
| RS | -0.685*** (0.123) | -0.686*** (0.124) | -0.676*** (0.122) | -0.261*** (0.069) | -0.264*** (0.069) | -0.264*** (0.069) |
| Educ | | -0.086 (0.129) | -0.077 (0.127) | | -0.086 (0.113) | -0.086 (0.113) |
| Credit Acces(d) | | | 0.099** (0.044) | | | -0.001 (0.056) |
| Refusal Credit | | | -0.071 (0.046) | | | -0.017 (0.055) |
| N | 508 | 508 | 508 | 508 | 508 | 508 |

Note: (1) (2) (3) are Probit estimation (4) (5) (6) are IvProbit; The coefficients are marginal effect ; * $p < 0.10$ ** $p < 0.05$ *** $p < 0,01$; Standard errors in parentheses ;(d) for discrete change of dummy variable from 0 to 1

5.2.2 Mass Arrival of Refugees

Mass arrival of refugee may burden host communities. To estimate this impact we use the variable: *Proportion of Displaced*. Coefficient in equation (3) table 7, shows that the mass arrival of refugee does not lead to a negative pressure on local economy. The adoption of fertilizer is not reduced in municipality where lot of refugee people are localized. This is maybe due to the lag between displacement and the time the LSMS survey. Furthermore, figure 6 shows that the impact of mass arrival seems reduced for displaced people.

Figure 5: Impact of the loss of social capital

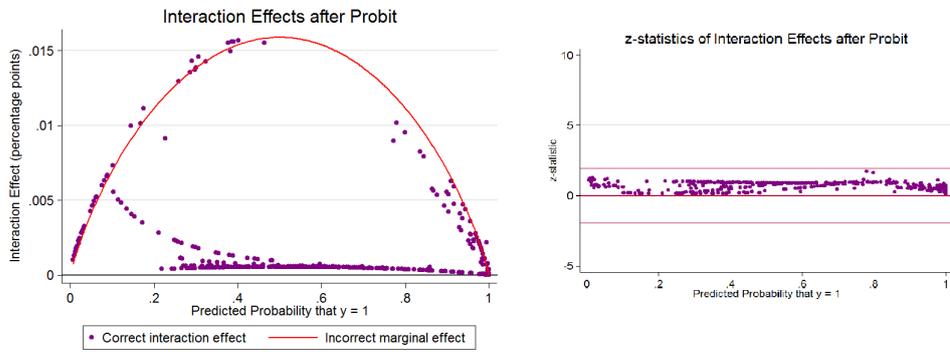


Figure 6: Impact of Mass Arrival of Refugee on technology adoption for displaced people

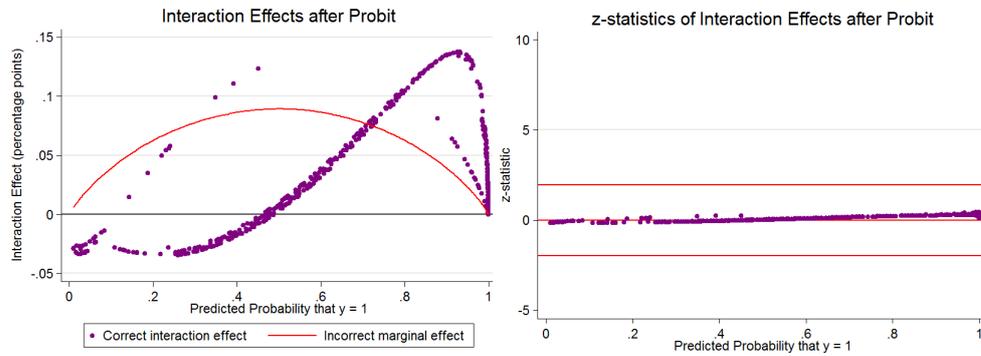
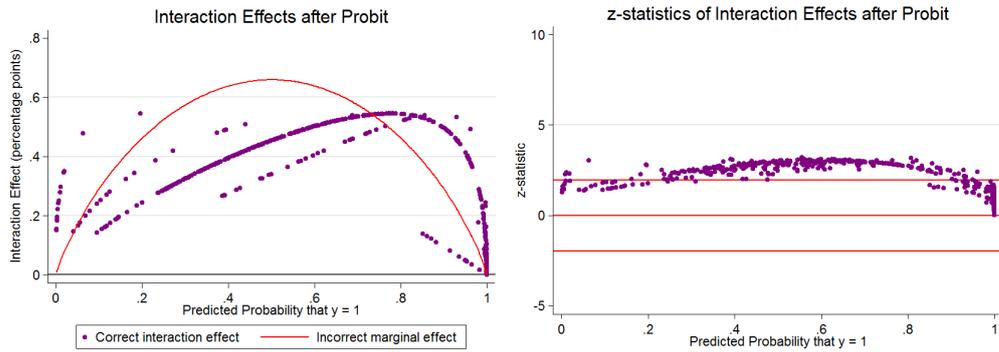


Figure 7: Displacement and Land Tenure Issue



5.2.3 Land tenure issue

As shown by Rose et al. (2007), land tenure issue is a major concern in Bosnia. LSMS survey does not provide reliable information in land tenure issue. Due to this lack of information, we use ownership status to take account of land tenure issue. An household formally owner of the land is less likely to face land tenure issue. Coefficient in equation (5) (table 7), shows that ownership status does not encourage household taken as a whole to invest in new technology. However figure 7 showed that ownership status seems to encourage investment for refugee. The interaction effect between Displacement status and Ownership status is always positive. This effect is greater for household with a high predicted probability of adoption (between 0.4 and 0.8). Furthermore, this interaction effect is positive and significant for household with an intermediate probability of adoption (between 0.2 and 0.8).

Government should facilitate land of displaced people access in order to foster the growing of a modern sector. This result confirm Rose et al. (2007) assertion that “economic progress will be obstructed until it becomes possible legally and *de facto* to own property”. Refugees are caught in an “institutional poverty trap”. They suffer from the highly political instability in Bosnia. Their time horizon are very restricted. They cannot easily exercise their rights to return on their land left behind because they now belong to ethnic minority. And their incentive to invest in land they “illegally” occupied is reduced, because they faced a high risk of expulsion.

Table 7: Channel Identification

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--|-------------------------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|
| | Adoption | Adoption | Adoption | Adoption | Adoption | Adoption |
| Displacement (d) | -0.430*** (0.150) | -0.515** (0.206) | -0.385*** (0.145) | -0.409* (0.668) | -0.412*** (0.246) | -0.701*** (0.144) |
| Age | 0.00467** (0.002) | 0.00465** (0.002) | 0.00467** (0.002) | 0.004** (0.002) | 0.00491** (0.002) | 0.00457** (0.002) |
| Total AUA | 0.106*** (0.0354) | 0.105*** (0.0353) | 0.108*** (0.0350) | 0.435*** (0.0352) | 0.111*** (0.0353) | 0.109*** (0.0347) |
| Price | -0.292 (0.192) | -0.294 (0.191) | -0.285 (0.194) | -0.288 (0.195) | -0.279 (0.191) | -0.274 (0.182) |
| Cclimat1 (d) | -0.283*** (0.0945) | -0.283*** (0.0937) | -0.324*** (0.0960) | -0.322*** (0.095) | -0.319*** (0.08) | -0.321*** (0.077) |
| Climat2 (d) | -0.668*** (0.140) | -0.671*** (0.142) | -0.704*** (0.165) | -0.701*** (0.636) | -0.683*** (0.162) | -0.699*** (0.141) |
| RS (d) | 0.329*** (0.0550) | 0.328*** (0.0554) | 0.328*** (0.0569) | 0.327*** (0.057) | 0.329*** (0.0547) | 0.331*** (0.0566) |
| Educ | -0.0716 (0.128) | -0.0735 (0.126) | -0.0758 (0.129) | -0.075 (0.128) | -0.0792 (0.126) | -0.0671 (0.126) |
| Credit Acces(d) | 0.101** (0.0443) | 0.0999** (0.0441) | 0.0987** (0.0454) | 0.0983** (0.045) | 0.0986** (0.0446) | 0.0964** (0.0436) |
| Refusal Credit (d) | -0.0753 (0.0463) | -0.0760* (0.0457) | -0.0745 (0.0467) | -0.075 (0.046) | -0.0720 (0.0471) | -0.0535 (0.0456) |
| Same Municipality | -0.000341 (0.000361) | -0.0003 (0.0003) | | | | |
| Same Municipality*Displacement | | 0.009 (0.0128) | | | | |
| Propotion of Dispalced | | | 0.0695 (0.216) | 0.051 (0.237) | | |
| Propotion of Dispalced*Displacement | | | | 0.055 (0.347) | | |
| Owner (d) | | | | | -0.0489 (0.0555) | -0.0915** (0.0460) |
| Owner (d)*Displacement | | | | | | 0.167*** (0.0367) |
| N | 508 | 508 | 508 | 508 | 508 | 508 |

Note: The coefficients are marginal effect of Probit estimate ; * $p < 0.10$ ** $p < 0.05$ *** $p < 0,01$; Standard errors in parentheses ;(d) for discrete change of dummy variable from 0 to 1

Conclusion

This article explores the impact of displacement for agricultural households using 2001 LSMS survey. As displacement decision is likely to be correlated with unobservable

characteristics, We exploit the spatial variation of violence during the war to tackle this issue. We exploit the spatial variation of violence during the war to tackle this issue. We showed that displacement entails poor economic conditions for agricultural households. Displaced households seem to choose older technology production. The main candidate to explain the negative impact of displacement is land conflict faced by refugee.

Refugee status is often a stumbling points during peace negotiation. Displaced people are “caught in a political trap”, because return of refugee may burden ethnic foundation of entity. Their future is highly insecure because they occupied illegally land and they cannot claim their former property left behind. We think that the bosnian government should entail land reform and clarify refugee status in order to encourage the development of a modern agricultural sector.

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Appendix

Robustness Check

Table 8: Baseline Estimation (Definition 2)

| | (1) | (2) | (3) | (4) | (5) | (6) |
|----------------------------|-----------------------|-----------------------|----------------------|-----------------------|----------------------|----------------------|
| | Adoption Probit | Adoption Probit | Adoption Probit | Adoption IvProbit | Adoption IvProbit | Adoption IvProbit |
| Dispalcemement2 (d) | -0.216 (0.132) | -0.215 (0.132) | -0.216* (0.126) | -0.466** (0.180) | -0.458** (0.187) | -0.462** (0.184) |
| Age | 0.004*** (0.001) | 0.005** (0.001) | 0.005** (0.001) | 0.002 (0.002) | 0.002 (0.002) | 0.002 (0.002) |
| Total AUA | 0.114*** (0.038) | 0.113*** (0.037) | 0.111*** (0.036) | -0.0284 (0.021) | -0.0285 (0.021) | -0.0315 (0.022) |
| Price | -0.362* (0.191) | -0.357* (0.193) | -0.343* (0.189) | -0.00504 (0.267) | 0.00215 (0.264) | 0.00837 (0.264) |
| Climat1 (d) | -0.297*** (0.0861) | -0.299*** (0.0847) | -0.302*** (0.080) | -0.435*** (0.090) | -0.436*** (0.090) | -0.435*** (0.090) |
| Climat2 (d) | -0.689*** (0.132) | -0.693*** (0.128) | -0.698*** (0.128) | -0.620*** (0.0801) | -0.623*** (0.079) | -0.626*** (0.076) |
| RS (d) | 0.332*** (0.0568) | 0.332*** (0.0571) | 0.323*** (0.0553) | 0.244*** (0.0590) | 0.245*** (0.0588) | 0.245*** (0.0585) |
| educ | | -0.0840 (0.123) | -0.0759 (0.122) | | -0.0541 (0.112) | -0.0527 (0.112) |
| Credit Access (d) | | | 0.106** (0.041) | | | 0.0172 (0.056) |
| Refusal Credit(d) | | | -0.0523 (0.047) | | | -0.0410 (0.075) |
| N | 508 | 508 | 508 | 508 | 508 | 508 |

Note: (1) (2) (3) are Probit estimation (4) (5) (6) are IvProbit; The coefficients are marginal effect ; * $p < 0.10$ ** $p < 0.05$ *** $p < 0,01$; Standard errors in parentheses ;(d) for discrete change of dummy variable from 0 to 1

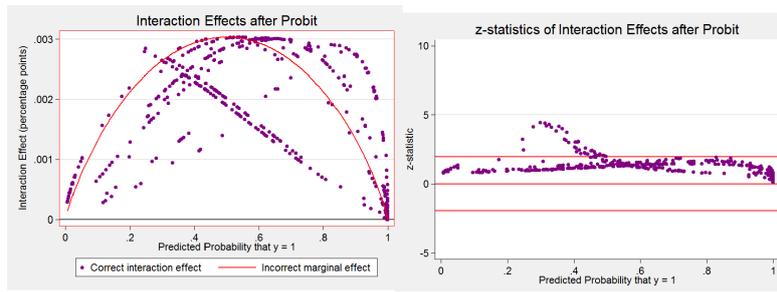


Figure 8: Interaction Loss of Social Capital and Displacement (Definition 2)

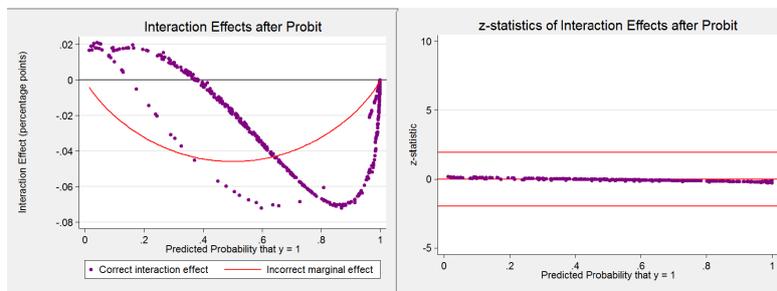


Figure 9: Interaction Mass Arrival and Displacement (Definition 2)

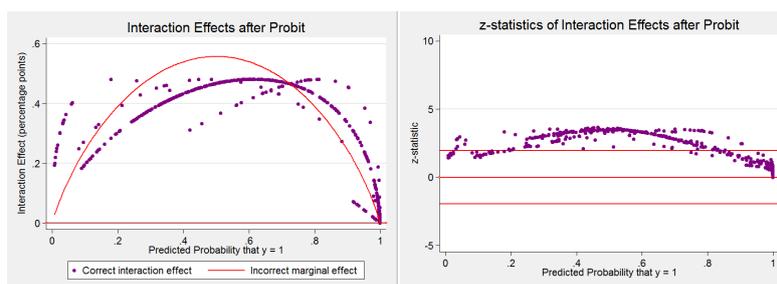


Figure 10: Interaction Land Tenure Issue and Displacement (Definition 2)

Table 9: Marginal effect Iv-Probit

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--|------------|------------|-----------|-----------|-----------|-----------|
| | Adoption | Adoption | Adoption | Adoption | Adoption | Adoption |
| Displacement (d) | -0.622*** | -0.632*** | -0.568*** | -0.505* | -0.647*** | -0.716*** |
| | (0.156) | (0.112) | (0.153) | (0.294) | (0.130) | (0.0730) |
| Age | 0.00300 | 0.00298 | 0.00287 | 0.00302 | 0.00334 | 0.00265 |
| | (0.00270) | (0.00270) | (0.00274) | (0.00269) | (0.00273) | (0.00244) |
| Total AUA | -0.0356 | -0.0374* | -0.0292 | -0.0260 | -0.0209 | -0.0263 |
| | (0.0241) | (0.0222) | (0.0216) | (0.0259) | (0.0195) | (0.0218) |
| Price | 0.0820 | 0.0789 | 0.0928 | 0.0960 | 0.105 | 0.104 |
| | (0.264) | (0.264) | (0.268) | (0.270) | (0.261) | (0.220) |
| Climat1 (d) | -0.347** | -0.334** | -0.461*** | -0.469*** | -0.472*** | -0.419*** |
| | (0.138) | (0.132) | (0.0845) | (0.0877) | (0.0820) | (0.0704) |
| Climat2 (d) | -0.587*** | -0.574*** | -0.653*** | -0.664*** | -0.643*** | -0.519*** |
| | (0.0927) | (0.0916) | (0.0715) | (0.0763) | (0.0732) | (0.0824) |
| RS (d) | 0.227*** | 0.234*** | 0.224*** | 0.226*** | 0.209*** | 0.149** |
| | (0.0532) | (0.0581) | (0.0546) | (0.0532) | (0.0547) | (0.0709) |
| Educ | -0.0654 | -0.0629 | -0.0812 | -0.0799 | -0.0810 | -0.0721 |
| | (0.113) | (0.113) | (0.113) | (0.116) | (0.111) | (0.0898) |
| Credit Access | 0.000860 | 0.000178 | -0.00445 | 0.00146 | -0.0146 | -0.0485 |
| | (0.0553) | (0.0547) | (0.0560) | (0.0572) | (0.0573) | (0.0616) |
| Refusal Credit(d) | -0.00410 | -0.00259 | -0.0248 | -0.0231 | -0.0213 | -0.0184 |
| | (0.0582) | (0.0586) | (0.0547) | (0.0556) | (0.0588) | (0.0749) |
| Same Municipality | -0.00113 | -0.00104* | | | | |
| | (0.000786) | (0.000594) | | | | |
| Same Municipality*Displacement | | -0.0108 | | | | |
| | | (0.0153) | | | | |
| Proportion of Dispalced | | | 0.125 | 0.131 | 0.158 | 0.304 |
| | | | (0.115) | (0,118) | (0,134) | (0.256) |
| Proportion of Displaced*Displaced | | | | -1.159 | | |
| | | | | (2,878) | | |
| Owner (d) | | | | | -0.213** | -0.350** |
| | | | | | (0,106) | (0.159) |
| Owner*Displacement | | | | | | 2.908 |
| | | | | | | (3.010) |
| N | 508 | 508 | 508 | 508 | 508 | 508 |

Note: (1) (2) (3) (4) (5) (6) are IvProbit; The coefficients are marginal effect ; * $p < 0.10$ ** $p < 0.05$ *** $p < 0,01$; Standard errors in parentheses ;(d) for discrete change of dummy variable from 0 to 1