Resilience from the Ruins.

A research on the long-term socio-economic effects of the destruction of cities by strategic bombing during the Second World War in The Netherlands, Belgium, Germany, France and Britain.

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Abstract

This research investigates the long-term socio-economic consequences of strategic bombing on cities during World War II. The study uses a comparative analysis of bombed and non-bombed cities. The results present findings suggesting that there are no statistically significant differences in average income, education levels of the workforce or mental health outcomes between the two research groups as a result of strategic bombing. However, the research finds differences between bombed and non-bombed cities. Firstly, the study indicates that bombed cities might have experienced higher rates of migration in the post-war era. Secondly, the research highlights that bombed cities have demonstrated faster population growth after the war. Finally, the study examines the influence of aid from the Marshall Plan on the development of these cities. It is observed that Marshall Plan assistance had a positive impact on the socio-economic development of both bombed and non-bombed cities. However, the research indicates that the magnitude of financial aid received did not significantly affect the long-term socio-economic outcomes.

"Although the world is full of suffering, it is also full of the overcoming of it."

Helen Keller.

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1. Introduction

On February 23rd, 2022, the world was shocked by the Russian invasion of Ukraine. After more than 75 years of peace in Europe, a war rages on the continent again. The past has shown that wars have only one benefit: they always end. Although, it is impossible to predict when the Ukrainian war will end. One thing is sure already, Ukraine must be rebuilt when the war ends. Rebuilding a country requires loads of commodities, capital, and labour. However, a country destroyed by warfare mostly loses a lot of essential capabilities required for rebuilding in the process of warfare. During war commodities are used to build defense systems, ammunition, and vehicles. Warfare is extremely expensive and most importantly many labour forces die from the effects of war. Nevertheless, in the past, we have seen demolished cities being rebuilt effectively (Diefendorf, 2015; Hein et al., 2003).

In Europe, the demolished cities were rebuilt at varying paces (Diefendorf, 2015), both in countries helped by the famous Marshall Plan organized by the United States and in Germany where poverty was enormous in 1945 because of the war (Mendershausen, 1949). Some cities were filled with shelter for the millions who had become homeless because of the bombing of their homes. On short notice, there was a huge demand for shelter. This exorbitant demand led to a short-term focused building policy (Denby, 2014). However, the short-term solutions that were desperately needed at the time may have resulted in the bombed-out areas falling behind other areas in terms of livability in the long term. On the other hand, some cities had accumulated knowledge after the ravages of World War I and were given the ideal opportunity to make their city fit for the future (Diefendorf, 2015).

Some of the short-term solutions built in the years after the war are still in place and in some places the rubble is still the ultimate proof of the destruction almost 80 years ago. While people were long happy with shelter then, today fewer people want to live in the houses that served as short-term post-war solutions. As a result, these homes are more affordable than other homes. This price difference may have led to relatively bigger share of poor people or migrants living in bombed-out cities (Murie & Mustard, 1996), as Europe became less focused on agriculture and urbanized more and more rapidly (Fielding, 1989).

The differences between urban areas destroyed in the war and those spared are visible to the naked eye in the streetscape. On top of the visible differences, there may also be invisible differences in socioeconomic relationships. Since the end of WWII, Western continental Europe has had a rich and tumultuous economic and political history with the introduction of the European Union and increasing free trade (Kesternich et al., 2014). Over time flattened

areas may have had the opportunity to be at the forefront of development or had a huge backlog. Sensationally, this might have influenced the livability of an area. For this reason, this study addresses the following research question:

How and to what extent do urban areas bombarded in the Second World War still suffer in terms of livability?

The devastating impact of bombings, both in terms of human casualties and infrastructure destruction, casts a shadow over livability. The devastation generated by such acts of violence not only disturbs the immediate lives of individuals impacted, but it can also have long-term effects on the overall quality of life and well-being of affected communities.

Livability is a broad term and can be interpreted in different ways. In the literature today, there is still no unambiguous definition of livability (Appleyard et al., 2014). In this study, livability is defined as the quality of life achieved by people living in the local environment (Ahmed et al., 2019). Livability is high whenever personal characteristics, and environmental characteristics create an environment in which it is possible to meet personal needs. This includes a person having an income to meet his/her basic needs, a social network, and a sense of belonging somewhere. In addition, the environment must provide the necessities to meet personal needs, such as schools, employment, and health care (Ahmed et al., 2019).

To determine the effect of bombing on livability regarding socio-economic relationships in urban areas, information on income, education and mental health will be used. In the past, Kesternich et al. (2014) found results for long-term effects of WWII in general on economic and health outcomes on a general level. This study adds that there are no long-term differences between destroyed cities and spared cities in the same country. In this study comparisons will be made between cities. However, this must consider the fact that many cities in the researched area have been bombed and that there are many other factors that correlate with the outcome of livability in a city. For this reason, it is not possible to apply a classical regression and multiple methods are needed to create a reliable picture of the effect of the strategic bombing campaign.

Cities may have experienced negative effects from the destruction, as they could no longer provide an opportunity for their residents to live close to work. Until the cities were rebuilt again. Bombing led to migration flows during and after World War II (Bauer et al. 2013). These migration flows possibly led to a different social composition in bombed cities. This social composition, in turn, may influence the livability of the area. Some bombed cities are known

to have high ethnic diversity, such as Rotterdam and Le Havre. A development that may have ensured that the long-term effect of devastation during the war could be positive is the consensus that already existed that cities should be redeveloped. After the Industrial Revolution, there was a proliferation of houses and factories in several cities. To reorganize cities efficiently, change was needed (Diefendorf, 2015).

1.1. Academic and social relevance

Modern research has shown that there is social segregation in cities (Musterd, 2005; Van Kempen & Şule Özüekren, 1998). The rich live in cities with the best economic opportunities and the most beautiful surroundings while the poor live together in other places. Social segregation in terms of habitat is a clear form of inequality. How this could have arisen must find its basis in the past. There is increasing research in the literature on the historical reasons for urban economic issues (Hanlon & Heblich, 2022). The results of this research could show a possible reason for the inequality between cities that have arisen from a historical perspective and whether social segregation can be caused in part by bombing during a war. Research on the effects of bombing is mainly focused on cities recovering in terms of their size, but there is still little research on the level of livability achieved by bombed-out areas relative to cities that were spared or cities that felt less from the war. Therefore, this research could add to the literature on inequality in cities and the research on the long-term socio-economic effects of the bombings in WWII. On top of that, a lot of research has been done on long-term socio-economic effects on a national basis (Ichino & Winter-Ebmer, 2004), but there is less research on a regional basis especially within the Netherlands, Belgium, France, and Britain. Germany has been researched intensively though (Maercker & Herrle, 2003).

Regarding the social relevance of this research, the total destruction of cities in Ukraine has not been seen in Europe since WWII. The destruction of Odessa and Mariupol can be compared to the total demolition of Hamburg or Dresden by the end of WWII. The goal of those bombardments was to leave a burning fire and nothing else in the place where people used to live together only a few days before. These cities will need to be rebuilt in completeness in a manner that provides a short-term solution but is also future proof. If this research shows that cities that are rebuilt after bombing are less livable than other cities, the process of rebuilding should be carefully reviewed to be fit for the future before it gets off the ground. Therefore, this research could contribute to post-bombing rebuilding plans in the future.

In this research, I will look at the regions in the Netherlands, Belgium, Germany, France, and Britain. Since 1945 The Netherlands, Belgium, and France have been free and democratic,

Britain has never been occupied during WWII and has been free and democratic as well. In Germany the case is a little different. Germany used to be split up into West- and East Germany until 1989. This can lead to differences regarding culture and therefore livability of the region. Nevertheless, it can be very interesting to take these into account if future research would like to copy this research to the Eastern European region as East Germany could be more comparable than Western European countries when comparing both. I have chosen to not take countries east of the German border into account as I assume political and cultural differences are too big between Eastern European countries like Poland and Western European countries due to USSR influences after WWII. This is a consideration that I have made to improve the trustworthiness of the outcomes of the research. Poland could be an interesting subject for comparable research in the future considering the extremely quick rebuilding of Warsaw and the fact that the war lasted the longest over there.

Within the researched region there is not an unlimited supply of observations. Strategic bombing was severe by the end of the war and only a few cities were spared. The most eye-catching bombardments in the regions for every country are Rotterdam, Hamburg, and Le Havre respectively for The Netherlands, Germany and France. However, over 140 cities were demolished by bombardments between May 11th 1940 and May 8th 1945 in the database. To determine to what extent these cities have suffered more during the war than cities that have not been bombed, comparable equivalents must be found for every city in the database. It is important that there are control variables for the inhabitants of the city and the components of welfare in those cities. A city that is economically driven by a port cannot be compared to a city in the middle of the country without a port, since their economic drivers are significantly different which has led to an incomparable development over the last 75 years. Therefore, it is important to create a trustworthy control group.

This study continues with a brief explanation of the historical perspective regarding strategic bombing in WWII in Chapter 2 and a broad theoretical framework on livability and urban development in Chapter 3. It will then discuss the data used to make a reliable comparison between bombed and spared areas in Chapter 4. Chapter 4 also explains the methods used to improve understanding of the long-term socioeconomic effects of strategic bombing. Chapter 5 will exhibit and explain the results and finally, Chapter 6 will include a conclusion and discussion.

2. Historical Perspective of Strategic Bombardments

Strategic bombing of urban areas refers to a military tactic that involves the deliberate targeting of civilian infrastructure and population centers to weaken the enemy's ability to wage war. The primary aim of strategic bombing is to destroy the enemy's ability to produce and transport goods and supplies and to demoralize the civilian population to the point where they are unable to support the war effort (Overy, 2013). This is often achieved by targeting key infrastructure such as factories and transportation networks. The effects of strategic bombing on civilian populations can be devastating, resulting in widespread destruction and loss of life. This has led to criticism of the tactic, with many arguing that it violates international humanitarian law and that the targeting of civilians is morally reprehensible (Garon, 2020). Nevertheless, strategic bombing has been a commonly used method to decrease popular support for the war during WWII. The Allies' hope was that the German population would push for capitulation out of fear of more destruction (Harmon, 2014).

Strategic bombing became a vital alternative for the bombing of military targets, such as airfields and ports, under the command of Air Marshal Arthur “Bomber” Harris. He believed that civilian worker neighborhoods could be bombed since they were contributing to the enemy’s war effort just as much as the soldiers on the frontline. Among administrators, strategic bombing was a sensitive issue at the beginning of the war because treaties in place at the time prohibited the deliberate bombing of civilians. In June 1938, British Prime Minister Neville Chamberlain issued the following instructions to British Bomber Command in the event of an outbreak of war with Germany: “Firstly, it is against international law to bomb civilians as such and to make deliberate attacks on the civilian population. Secondly, targets that are aimed at from the air must be legitimate military objectives and must be capable of identification. Thirdly, reasonable care must be taken in attacking those military objectives so that by carelessness a civilian population in the neighborhood is not bombed.” (Garret, 2014). However, by the directive of 25 May 1942 English politicians specifically sought to ‘give substance to the policy of the Political Warfare Executive which aims at discouraging the nationals of enemy occupied countries from working in German-controlled factories, as they had become military targets (Dodd & Knapp, 2008). The withdrawal of political control can be explained in two ways. First, civilian casualties were viewed as more acceptable in the ‘heat of battle. Secondly, Allied political agents in France discerned sullenness among civilians but little of the ‘hatred’ for the Western Allies, or a surge in support for Russia at the West’s expense, feared by Churchill and Eden. The strictly political objections to unrestricted bombing had disappeared. Nor were the concerns of the Free French expressed forcefully enough to have any significant effect on the policy (Dodd & Knapp, 2008). This has led to the bombing

of populated areas in the months following the implication of the directive. Therefore, strategic bombing included bombing civil objects that have become military targets.

The main goal of bombing populated areas was to break morale and undermine the support for the war from the public in enemy territory. The greatest example of trying to break support for the war by strategic bombing which is also the most horrendous is the bombing of Hiroshima and Nagasaki by the Americans. These were the first and to this day last nuclear bombings the world has ever witnessed. In WWII strategic bombing has proven to be effective. However, recently politicians and world leaders have admitted and expressed that strategic bombings were war crimes towards enemies and allies (Bissonnette, 2020; Harmon, 2014). Strategic bombings have led to significant destruction in cities within all researched countries. The rate of destruction of strategic bombings differed from critical misses where not a single person nor target was hit to the complete destruction of cities where less than 5% of the buildings survived the war. Overall, the strategic bombings claimed thousands of civilian lives and left even more people homeless.

A broader explanation of the course of action regarding strategic bombing in North-Western Europe during WWII can be found in Appendix A.

3. Theoretical Framework

3.1. Livability of an urban environment

Livability has been defined as the quality of life achieved by people living in the local environment (Ahmed et al., 2019). Livability can be determined subjectively by researching how much utility people derive from their environment and its condition. However, this is personally orientated and does not give a broader view of the entire environment. To determine the livability in a region in general, this research will focus on a combination of objective and subjective determinators that have been proven to influence livability in previous research (Steel et al., 2008).

In this research multiple variables that can contribute to estimating the livability will be considered. Income per capita is a commonly used variable to determine long term effects of a macro event or a shock (Kesternich et al., 2014). Next to that the average level of education enjoyed within the workforce of the city will be determined as a variable on livability. It could be an effect of the bombings that people have smaller appreciation for education since their ancestors could not attend school. Since schools had been closed in the years during the war and the years after the destruction in some regions. Other researchers found that German and Austrian kids experienced a significant backlog of kids from different eras due to the loss of education in the years between 1940 and 1945 (Ichino & Winter-Ebmer, 2004). This indicates that a lack of education compared to other cities can lead to decreased livability. The last continuous variable that will be used as a determinator for livability is inhabitants' mental health status. Mental health used to receive little attention in scientific research. That while a bombing is only an incident physically, it can have long-lasting mental effects in the form of trauma. Parental trauma may also have caused children in bombed-out cities to grow up with more mental problems than children of parents who never experienced a bombing (Maercker & Herrle, 2003). The relationships between the determinators mentioned and livability will be explained in the upcoming section. Next to the independent variables, control variables that have been found to influence livability such as density of population will be added (Albouy, 2008).

Previous research has made use of the Mercer quality of living index to compare the livability of cities (Okulicz-Kozaryn & Valente, 2019). In this research I have chosen not to use this index. The Mercer quality of living index only compares big cities and uses a few per country which would be too big of a constraint in the matching process of the cities to their non-bombed equivalents.

3.2. Determinators of livability

3.2.1. Income

The literature on the effect of income on livability in the long term is ambiguous. Some research shows no relationship between the quality of life and income (Easterlin et al., 2010), while others show that both the variables go hand in hand over time (Veenhoven & Vergunst, 2013).

Income could influence livability because it determines different aspects like housing and access to amenities. This means that an increase in income leads to the opportunity to make the best use of the social and physical environment. Even more so, an increase in income in a region will lead to an improvement in the social and physical environment (Ahmed et al., 2019). This suggests that income can play a role in enhancing the livability of a region through improvements in the surrounding environment.

It is important to note that the understanding of livability has evolved over time. The economic approach to livability has been similar to how development was measured in the past, namely solely as income. Nowadays, progressive economists acknowledge that a pure economic approach was myopic (Stiglitz et al., 2009). Livability encompasses a broader range of factors, including access to education, healthcare, social connections, and environmental sustainability therefore income is not the only determinant of livability in this research. Additionally, income provides individuals with the freedom to allocate their time based on their personal preferences and priorities. With higher income, individuals have more choices in how they spend their time, which can contribute to a greater sense of well-being and satisfaction. This freedom to pursue activities that align with personal interests and values is an important aspect of livability (Veenhoven & Vergunst, 2013).

In summary, the relationship between income and livability is more complex than it has been perceived in the past. Different interpretations of the correlation between income and livability have produced mixed findings in the literature. Therefore, it is crucial for this research to recognize that livability extends beyond income alone and encompasses various dimensions that contribute to overall well-being and quality of life.

3.2.2. Education

Subjective livability indicator outcomes have repeatedly been linked to higher levels of education (Ross & Van Willigen, 1997; Davis et al., 2018). People who have had an education are more likely to make well-informed decisions about their health, which increases their access to healthcare, encourages them to adopt a healthier lifestyle and increases their understanding of illness prevention (Edgerton et al., 2011). As a result, this educated

advantage helps people live longer and have a higher quality of life overall which are indicators that the livability in a well-educated area would be relatively high. In addition, education opens doors to wider access to a variety of resources. People with a higher level of education are more equipped to navigate and take use of the possibilities, networks, and information. With this edge, they are better able to take advantage of governmental initiatives, financial resources, which improves their overall resourcefulness and socioeconomic prospects (Ansari et al., 2020).

Empirical evidence consistently indicates a negative correlation between higher levels of education and crime rates (Groot & van den Brink, 2010; Buonanno & Leonida, 2006). Education empowers individuals with the necessary skills and knowledge to pursue lawful means of achievement leading to more perceived utility. Moreover, educated communities tend to prioritize the allocation of resources towards crime prevention strategies and community policing, further contributing to a decrease in criminal behavior (Lochner, 2020). A higher level of education within the population improves the environment and therefore the livability.

3.2.3. Mental Health

Bombardments can have profound effects on the mental health of individuals and communities, with potential consequences that can be far-reaching and long-lasting. The stress and trauma caused by bombardments can strain interpersonal relationships, leading to conflicts, increased irritability, and difficulties in communication and trust (Fraser et al., 1943; Grbeša, 2004). The constrained relationships might have had their effect on children of parents who lived through a bombardment as well. Furthermore, individuals' capacity to work, study, and participate in routine activities can all be considerably hampered by the psychological effects of bombardments. This may lead to a lower quality of life and a lack of optimism for the future (Weisenberg et al., 1993). Even more extreme are the cases of serious mental issues such as post-traumatic stress disorder because of bombardments. Getting PTSD is not significantly dependent on the frequency of bombings, therefore one bombing can already have a major impact on the quality of life within a community. All those aspects together might have made the lives of people who survived a bombardment harder and could have had a long-lasting effect on the city and its inhabitants since the children of these people would possibly have been raised differently if the bombardments would have never happened.

In this research the effect that is estimated is primarily the effect of bombing on intergenerational mental health. The inhabitants of cities nowadays did not endure the bombings themselves, at least 95% of them. However, that does not mean that those second

or third generation bombing survivors have not been affected by the bombings. In the literature on generational trauma, Kassai and Motta (2006) show that descendants of Holocaust survivors are still affected by the trauma of their grandparents. Rosenheck (1986) showed that fathers with combat related PTSD had an impact on the upbringing of children. These studies indicate that trauma and violence related PTSD in ancestors can have an impact on the mental health of their spouse even in the long run and this trauma can be transmittable over generations. Other researchers found that traumatized parents showed great resilience in their parental tasks as both the second and third generation did not show any evidence of being affected in their mental health or education results compared to people whose parents did not endure trauma (Sagi-Schwartz et al., 2008).

The number of civilians killed in bombings during World War II can have lasting effects on mental health as well. An increased number of killed citizens might have increased historical trauma. The memory of civilian casualties during World War II can linger in the collective consciousness of a city's residents, shaping their perceptions of safety and well-being. The trauma experienced by those who survived or were directly affected by the bombings can influence their sense of security and attachment to their city (Fraser et al., 1943). It may also impact the social fabric of a community, as residents who experienced wartime trauma may have different needs and expectations related to livability and urban development (Walsh, 2007).

Allied bombs probably killed 600,000 German civilians, about ten times the number of British civilians killed by German bombs and missiles. In addition, American and British bombs killed a sizable number of civilians in the occupied countries; almost as many Frenchmen died from Allied bombs as Britons died from German bombs and missiles (Werrell, 1986).

Currently mental health is usually perceived lower in urban areas. In urban areas young adults have depressive symptoms more often (CBS, 2019; Eurostat, 2019). In this research only urban areas have been considered. Nevertheless, this could be important to note.

3.2.4. Correlation between the determinators

It can be expected that the income of parents influences the education of their children, since the children could stay in school longer because they were not necessary to provide income for the family. Furthermore, parents with a higher income probably had more years of education and would motivate their children to study as well. Income creates the opportunity to spend more years in school and more years in school usually lead to more income. Next to that, it has been proven repeatedly that financial stress can lead to a decreased mental health

status (Giorgi et al., 2015; Selenko & Batinic, 2011). The correlation between the factors in this research can be found in Appendix B. Researchers recently found that some reasons are significantly happier than others. This Happiness gap between Former West and East Germany is partly driven by differences in household income and employment. But this is not the only aspect; even after controlling for socioeconomic and demographic differences, the East-West gap remains significant (Petrunyk & Pfeifer, 2016).

Bombardment might have had an impact on all of the mentioned indicators of livability that may have caused bombed cities today to face a disadvantage compared to non-bombed cities. To examine the effect of strategic bombing on socioeconomic development, the following hypothesis is examined.

H1: *Cities that have been successfully bombarded in the Second World War score lower on livability than cities that have not been bombarded.*

3.3. Urban development

3.3.1. Size and location

Existing literature on the rebuilding of cities has discovered that cities are quite likely to grow back like they were before destruction. Perhaps the starkest empirical findings are from Davis and Weinstein (2002) from the natural experiment of Allied bombing, which provides a large and temporary shock to the relative size of Japanese cities. Although theories of random growth suggest that large temporary shocks should have a permanent effect on relative city size, those of locational fundamentals suggest that relative city size should gradually adjust back toward some long-run equilibrium level. In contrast, theories of increasing returns suggest that a large temporary shock could have a permanent effect, in so far as it shifts the economy between multiple equilibria. However, despite the magnitude of the shock to relative city size induced by Allied bombing, including the atom bombs dropped on Hiroshima and Nagasaki, Japanese cities return to their relative position in the distribution of city sizes within around 15–20 years (Redding, 2010).

One implication of these results is that even large temporary shocks to urban areas have no long-run impact on city size. This result suggests that locational fundamentals play a key role in shaping the distribution of economic activity across space (Davis & Weinstein, 2002). Similar to Japan in Europe, cities have grown back to a comparable relative size after WWII as before. In simple terms, sociologist Veenhoven (2000) suggests that when we talk about how livable a place is, we need to consider two important things in urban development: the qualities of the place itself and the opportunities it offers for a good life. The qualities of a place

refer to things like its environment, how pleasant or comfortable it is to live there, and how safe or clean it is. These factors can affect livability. Life chances are about the opportunities and possibilities that a place provides for us. Veenhoven (2000) mentions that cities offer a lot of variety and opportunities compared to other places. Cities have a wide range of activities, jobs, and resources that can help us succeed and have a good life. So, when we think about how livable a place is, we need to consider both the qualities of the place itself and the opportunities it offers (Glaeser 2011; Milgram 1970; Fischer 1995).

Although the bombings made the regions temporarily uninhabitable the locations where the cities were built in the first place were still the sides that offered the most opportunities in the long run. The rebuilding of cities in the exact same location could be explained by the new economic geography framework. Furthermore, this framework can give reasons why bombarded cities might have grown even more than could be expected right after the war.

3.3.2. New economic geography

New Economic Geography (NEG) is a theoretical framework that explains how economic activities are spatially distributed across regions (Krugman, 1991; Redding 2010). The NEG framework is the response to the limitations of traditional neoclassical models, which assumed that all regions were identical and that market forces would eventually lead to spatial equilibrium (Davis & Weinstien, 2002). In contrast, the NEG framework emphasizes the role of agglomeration economies, which arise from the concentration of economic activities in specific regions, and trade costs, which create barriers to the movement of goods and services between regions. These factors can create persistent regional disparities in economic outcomes and shape the patterns of industrial specialization and trade.

The article by Krugman (1991) introduces the concept of increasing returns to scale and economies of scale in economic geography. Krugman argues that the traditional models of trade, based on comparative advantage, do not account for the observed concentration of economic activities in specific regions. The author suggests that increasing returns to scale, which result from the positive feedback loops between firms and industries, can lead to the emergence of regional clusters of economic activities. Krugman (1991) presents a simple model of two industries to illustrate how increasing returns to scale can generate agglomeration economies and regional specialization. The article concludes that the concept of increasing returns has important implications for the analysis of trade patterns, industrial location, and regional policy. Economic activity is highly unevenly distributed across space, as reflected by the existence of cities and the concentration of economic functions in specific locations within cities (Redding & Rossi-Hanberg, 2017). Highly centralized specialization and

agglomeration possibly made cities a more likely target to be bombed. Whenever a region was specialized in manufacturing anything weapon related it became a target for the enemy during WWII. The agglomeration has possibly made it more apparent where to aim the strategic bombings and might have persuaded the enemy to be fiercer in their attacks in certain locations compared to others. NEG retroactively explains part of why some regions were bombed more heavily than others. The ferocity of the bombing may have influenced long-term development.

3.3.3. Population Density

If two cities have equal earnings and costs, the more populated city is considered the more suitable for the average person (Albouy 2008). More populated cities provide a better-quality life than is predicted by wages and expenses alone. Therefore, it seems logical that densely populated areas would grow faster than that a city would appear at a location where people were not clothing together before. On top of that, population density was one of the main reasons that cities were targets in the strategic bombing campaigns of the Allies and the Axis Powers. Increased population density meant that more damage could be done with less material.

3.3.4. Rebuilding cities

Due to a lack of centralized planning cities failed to innovate in the rebuilding process after the First World War. This was known by the end of WWII in France, Germany, and Belgium (Diefendorf, 2015). The Netherlands was neutral in the First World War and gained no experience since it did not experience destruction. In Belgium and France, the knowledge gained years ago was used to rebuild cities or design them more efficiently to be better suited for the future.

After the war, many cities were in ruins. Not all cities were rebuilt according to the same strategy. In Frankfurt am Main, Dortmund and Kassel, the opportunity was taken to create exit roads for automobile traffic right through the city. In the center of Münster, however, the choice was made to preserve the medieval street plan during the rebuilding. In Hamburg, they chose to erect many new buildings and Dresden did not begin the restoration and reconstruction of the city center's most iconic monuments until after the fall of the Wall in 1989.

In some countries the habitable space of land had decreased significantly, and the demographics of the population had changed intensely (Dale, 2015). The number of women had relatively increased and a bunch of them were made widows. The men that had seen war and survived, suffered from mental and physical injuries and were not all able to provide for

their families. The differences in preparation of building plans, rebuilding strategies and demographics of the population have led to great differences in rebuilding times. Some cities in the East were already completely rebuilt by 1953, only 8 years after the war. While other cities were only free of memories of the war in the form of destroyed buildings in the 90s. The differences between rebuilding speeds may have had a serious impact on the determinants of livability since being confronted with a hurtful past every day, for example, can shape a human being.

3.3.5. Destruction rates

Destruction rates might have impacted urban development, since more destruction leads to a bigger challenge in rebuilding the city. On the other hand, more devastation also led to a clean slate and the opportunity to rebuild the city in a different way. Despite the potential opportunities, it is to be expected that great devastation will lead to a long-term lag behind other cities. For this reason, the destruction of cities may have caused many people to migrate to more livable areas as seen at the beginning of the war. A decrease in inhabitants might have ensured that manufacturing cities could no longer function as before and had to redevelop themselves. Such development has likely led to a different socioeconomic composition today.

Destruction rates in this research have been assessed differently per country. German administration on destruction rates have been administered very neatly right after WWII. The Germans documented the number of square meters of the city that were filled with rubble to assess the destruction rate by dividing the square meters filled with rubble by the total surface area of the city. In the other countries I was forced to be creative, for example by dividing the amount of severely hurt and dead civilians by the total number of inhabitants at the year of the bombing to estimate a destruction rate.

The combination of historic economic theories, New economic geography theory and intuitive thoughts regarding the effect of rebuilding speed on livability has led to the following hypothesis:

H2: *Cities which were destroyed to a greater extent suffer more today regarding livability.*

In addition to the determinators of livability, migration will be added as a variable in the dataset. Rotterdam, Dresden, and Le Havre, for example, are all known for a high grade of migration and were severely damaged yet destroyed in WWII, this could be a pure coincidence. However, it will be interesting to find out whether this development can be attributed to the

destruction during WWII. Furthermore, migration rates have been found to be correlated with multiple determinators of livability in the past.

3.3.6. Migration

War and destruction both might have led to migration. Some populations in Southern France more than doubled after the Germans invaded France. However, in normal urban economic circumstances there is the assumption of the axiom of spatial equilibrium. One of the most important founding principles is that individuals cannot improve their overall utility via migration (Glaeser et al., 2016). The sudden migration of communities shows that the spatial equilibrium did not hold during WWII. The war forced people to migrate.

Excessive economic research has been done on the economic status of forced migrants after WWII. Some research has shown that they adapted quickly and did not have an economic disadvantage in comparison to others that lived in the region they migrated towards (Sarvimäki et al., 2009). Falck et al. (2011) showed that forced migrants could improve their economic situation, but in general were not able to get to the pre-migration situation. Others showed that even the second generation of forced migrants suffered a disadvantage from becoming an internally displaced person at one point in time (Bauer et al., 2013). However, there is no economic research on the effect on the city of its intellectuals and human capital being displaced and forced to migrate. When a city gets bombarded and loses all the housing and amenities. As was shown by Davis and Weinstein (2002) cities usually grow back to the size that would be expected at their location because of the economic opportunities in their geographical location.

Although scientific evidence shows that a city grows back to the size that is the optimum for that geographical location over time, the city might never be the same again. Migration has an influence on city-level qualities, such as trust between the citizens, tolerance, commonality of ways of thought and so forth that determine the overall quality of life, but are extremely difficult to incorporate in a livability measurement. These city-level qualities become more important when an area is developed to a greater extent (Okulicz-Kozaryn & Valente, 2019).

Moreover, cities that people fled from as a result of war can become great opportunities when the war ends. Cities will grow back to their original size and will need people to build them back up (Davis & Weinstein, 2002). In the hypotheses in this research, I expect the effect of people returning to bombed cities to rebuild after the war to be bigger than the initial fled. Especially since the world globalized quickly after WWII and immigration from guest workers increased massively to rebuild the industrial hearts that had been destroyed (Cross, 1983).

These immigrant workers struggled severely in the capitalist system (Castells, 1975). This has led to uneven development within these cities. Uneven development between ethnic groups has possibly led to a lower degree of livability in the city overall.

The combination of forced migration after the destruction and the process of growing back to the “old” size would mean that there will be economic opportunities for immigration in this city from a certain point in time onwards. Therefore, it could be expected that bombed cities in economically interesting locations have seen significantly higher rates of migration after the war. How and to what extent these migration streams have affected the population in bombed cities and determined the livability in those regions will be examined with the research of the following hypotheses.

H3: *Cities that have been successfully bombarded in the Second World War have seen more migration than cities that have not been bombarded.*

H4: *Migration after the war has led to a lower score for livability in a city.*

3.3.7. International differences

The differences between bombarded countries can be split up in two timespans namely: during and after WWII. During the war the enemy differed between the researched countries, but that does not essentially mean that the party who bombed a city was the enemy. It is not without reason that soldiers are taught that it is not a possibility to come second in war. In war, there are only losers and yet one side will always declare itself the winner. Previous research has considered what the effect of victory and loss in war are in the long term (Waldinger, 2012). Tough times call for tough measures. This has led to a result of strategic bombings wherein the distinction between winners and losers is not the same distinction as grouping the cities by which side they were bombed. The Allies namely bombed Northern France to the ground to accelerate their push to Berlin. The bombings in Northern France were different from the bombings in Germany, since the civilians that would possibly suffer from displacement or loss of life were allies of their bombers. The destruction of the cities in France was purely military strategic (Overy, 2013). The Allies were interested in keeping alive with the Axis powers the belief that they would land at Caen on the north side of France as part of Operation Overlord. On the other hand, they did not want civilian casualties in territory occupied by the Germans. At the same time, the goal in bombing Germany was to do as much damage as possible. In the process, civilian casualties were not shunned. Despite this difference, destruction rates in northern France were much higher than in Germany, possibly due to qualitatively less anti-aircraft artillery. After the war ended, there may have been an urge by the Allies to help France

recover more quickly because of the havoc left behind. Nevertheless, I expect that the high rates of destruction in northern France led to lower long-term livability.

3.3.8. Help from abroad.

Judging from the way Western countries are supporting Ukraine during the war, it is reasonable to expect that they will also help to rebuild Ukraine after the war has a positive outcome. After the Second World War ended European Allied countries got a lot of help from Allies. With the highlight being the Marshall Plan. While the Germans, on the other hand, were left with a famine in a country that had little left of it and was torn apart by agreements between the powers that had defeated them.

The years immediately after World War II provided American policy makers with a unique opportunity to help shape the international economic order for a generation to come (Maier, 1977). The close of World War II brought American policy makers a rare and heady opportunity to reshape the guidelines of the international economic order. The pretensions of the Axis powers to organize continental Europe and East Asia had collapsed. The United States handed over millions and millions of dollars to Western European countries. Rebuilding war-torn areas, removing trade barriers, modernizing industry, enhancing European prosperity, and halting the rise of communism were among the objectives of the United States. The Marshall Plan advocated for the lowering of interstate obstacles, the economic unification of Europe, as well as the promotion of increased productivity and the adoption of contemporary corporate practices (Maier, 1977). The American approach was successful because for almost two decades high rates of growth made the politics of productivity apparently pay off. Whether an alternative approach could have achieved more equality remains an important but separate inquiry.

The Marshall plan consisted of a 12.4 billion US dollar capital investment of the US into Europe which would be worth 148 billion US dollar converted to today. A significant amount of this money went to France and The Netherlands, but also West-Germany got a share. The full distribution of the money can be found in Appendix C. The economic help was mainly focused on industrialized economies because they would be the most important to get the economy up and running again. In East-Germany there has not been an equivalent of the Marshall plan, Germans were even forced to rebuild Russia before proper reconstruction of East-Germany could start. This has led to West-Germany surpassing the USSR regarding welfare fairly quickly (Kesternich et al., 2014). The Marshall plan has certainly influenced the economic situation in Europe and in this research, it will become clearer whether a capital injection is enough to compensate for the loss of life and amenities in an area in regard to livability.

3.3.9. Reparations

After the ending of World War 2 on the 8th of May 1945, the leaders of the Allied forces held a conference in Potsdam. At this conference the leaders decided that Germany, who pleaded to be the only guilty party in the war at the declaration of peace, would have to pay reparations to the other combatting countries. Allied powers initially aimed to extract significant reparation payments from Germany to help fund the post-war reconstruction efforts. However, it became evident that heavy reparations would hinder Germany's recovery and European stability. The approach to reparations shifted with the lessons from Versailles in the back of their heads.

To avoid future battles, the Allies understood the importance of a stable and wealthy Europe. After two terrible world wars, there was a growing recognition that assisting war-torn countries in their economic recovery was critical for long-term peace and security (Kesternich et al., 2014). By taking a more tolerant stance toward Germany, the Allied powers hoped to establish a stable and affluent Europe capable of resisting the appeal of radical ideologies such as Nazism. Furthermore, the Allies realized that demanding large reparations from Germany would seriously hamper its capacity to recover and rebuild. The country was in the midst of massive devastation, a crumbling infrastructure, and a shattered industrial base. Demanding large reparations would have diverted resources away from reconstruction efforts, making the German economy difficult to recover and stabilize. On top of that, Tensions between the United States and the Soviet Union were rising in the immediate postwar period, culminating in the outbreak of the Cold War. The focus of the Allies switched to preventing the growth of communism in Europe, particularly in Germany. To counter the Soviet Union's influence, the Western Allies, particularly the United States, took a more pragmatic approach toward Germany (Kesternich et al., 2014). Rather than hurting Germany with reparations, they hoped to stabilize the country and integrate it into the Western block as a counterweight to the Soviet Union.

Since the Allied powers that are taken into the research group in this research have not received significant reparation payments in comparison to the Marshall plan payments, the reparation payments will not be considered by the examination whether the following hypothesis will hold.

H5: *The benefits of the Marshall plan decreased the effect of bombardment on livability.*

An important note with this hypothesis is that all countries in this research have benefited from the Marshall plan. However, the extent to which the countries could benefit have been very

different. Furthermore, East-Germany has not benefited from the capital injection since it was USSR dominated at the time.

4. Data and methodology

4.1. Data collection

4.1.1. Sources and Observations

This research includes 194 different cities across 5 countries which have been divided into 66 regions. The regions are the provinces in the researched countries. The populations of the cities differed between only tens of thousands to millions in 1940. The number of cities is limited at 194 as data was hard to collect. In many cases the data on the demographic situation of the observations was not complete. Non-bombed cities often showed more incomplete data, since they were smaller in general. This resulted in a skewed distribution between bombed and non-bombed cities. Although the data on the situation within cities nowadays is easily collectable, often smaller cities could not be included as I could not get a trustworthy image on their composition at the beginning of the war.

The data has been derived from multiple sources across different time periods. Firstly, data had to be derived from historical sources to obtain an image on which cities were comparable at the time of the strategic bombings. These statistics have come from multiple sources with population census as the most important source regarding historical populations. The historical censuses have been found at the websites of national statistical institutions. Furthermore, historical sources about the Second World War have been helpful to find out which cities were targeted and whether these cities had ports or factories that made them a target of military relevance. Also, the number of civilian deaths and the destruction rates have come from historical sources (Appendix D). To find all the historical data about the researched cities more than 50 sources were needed. On some occasions these sources have different numbers for the same variable; this was considered and resolved through customisation by using the average or validating with multiple sources.

Secondly, to determine the long-term effect of bombings data on the average income per capita in Western Europe in the year 2019 has been included. Furthermore, the educational levels of the workforce and the amount of people following education will be a factor in determining livability of the area in a region. As the last determinator of livability, the relative number of people suffering from anxiety or depressive symptoms will be researched as a measurement for the mental health of people in an area. To make an estimation of the effect

of migration the distribution of different people will be considered. All the data to create an image on the current situation has been observed on January 1st 2020.

Data is derived from different statistical organs in the researched countries, such as Centraal Bureau voor de Statistiek (2023), Statbel (2023), Statistisches Bundesamt Deutschland (2023), The Office for National Statistics (2023) and Observatoire des Territoires France (2023). These institutions hand in some of their findings at Eurostat, however not all of them. Therefore, I have chosen to use the original sources. On top of that, the Office for National Statistics has stopped sharing data with Eurostat because of Brexit since 2018.

4.1.2. Time periods

For this research two different time periods are very important. At first, this research will investigate the period between 1940 and 1945 when the strategic bombings took place in the context of the Second World War. To determine which cities should be compared in the current time a comparison between cities in the past needs to be made. In the determination of a counterfactual for a bombed city the period from the strategic bombing is leading since it is known that the cities that have been bombed were not bombed at random. Cities were bombed with specific goals although these goals are not always documented, but plausible reasons can be derived by military experts. By looking at the development of the bombed city and the non-bombed counterfactual, an estimation can be made of the effect of the strategic bombing regarding livability over the years following the bombardment.

Secondly, there is the time period wherein this research looks at the current livability in the researched cities and in which the possible effect can be found. Since most of the data on immigration is published for the situation on January 1st and mental health is one of the indicators in this research and in 2021 and 2022 mental health might have decreased enormously due to Covid-19 measures in the researched geographical region. This research will be done on the situation as it was known to be on January 1st, 2020. This is also important since the income per capita could be affected more in one region in comparison to another region by measures to refute the Covid-19 virus.

4.1.3. Geographical

This research includes only Western European countries as they are comparable regarding social relations and political influences. Western European countries have exhibited a remarkable level of equality across various dimensions. The region has demonstrated a noteworthy degree of parity in terms of economic development, with a relatively equitable distribution of wealth and resources across nations during the studied period. Furthermore,

Western European countries have actively pursued educational reforms that prioritize equal access to quality education. Social mobility has been a core principle in these nations, where policies and programs aimed at breaking socioeconomic barriers have facilitated upward mobility and try to decrease income inequalities. Political systems in Western Europe have fostered a culture of democratic governance, ensuring equal representation and participation.

The countries included in this research are The Netherlands, Belgium, France, Germany which includes former West and East-Germany and Great-Britain with the note that almost exclusively English cities have been bombed. When looking for counterfactuals the cities in all of Great Britain will be considered and next to formerly occupied Northern France the South of France which was known as Vichy France will also be taken into account. There will be three exemptions in this study when it comes to the researched cities. The city of London was bombed severely in the Battle of Britain, but it will not be considered in this research as it is unrealistic to find a counterfactual due to the size of London which cannot be compared to another city at the time. Next to London, Paris and Berlin have been left out due to their size. Cities that were German originally and are placed in Poland or Russia nowadays have been left out as well. Cities are only included whenever there are at least 50,000 inhabitants at the start of 2020.

4.2. Method

This research will consist of multiple methods. Firstly, the bombed cities will be matched to economic equivalents back in the 1940s. Descriptive analysis is then conducted separately for the bombed and non-bombed group, calculating summary statistics to understand the variables' characteristics and distributions. Utilizing the proper statistical tests, comparative analysis is used to look for significant differences between the groups before the bombings. Thereafter matching will be done and statistical tests will be executed to determine whether the treatment has had an impact on economic development over time. These regressions will show whether people in bombed cities still suffer from the consequences of destruction approximately 80 years later. This method will properly address the differences between two groups with different characteristics while also efficiently analyzing and interpreting the differences between two groups. This will help gain insightful knowledge about the long-term effect of strategic bombings. Since matching has severe disadvantages regarding the non-random distribution of the treatment, another method will be conducted to determine the effect of bombing on livability. The instrumental variable method is necessary to estimate the effect of migration, destruction rates and the Marshall Plan on livability. In the following section the methods will be explained in detail.

4.2.1. Matching

To identify which cities are the best economic and social equivalents of the cities bombed in WWII, the cities need to be matched. Matching is a statistical method used to compare two groups that are not randomly assigned. It is commonly used in observational studies or quasi-experimental designs, where the researcher cannot randomly assign subjects to different treatment groups (Rosenbaum & Rubin, 1983). The goal of matching is to create two groups that are as similar as possible on all relevant variables, except for the variable of interest. This makes it possible to isolate the effect of the variable of interest on the outcome. Therefore, this research needs cities that were comparable to the bombed cities during WWII. The matching process involves identifying subjects in the two groups who are similar on one or more variables, called matching variables. The matching variables are chosen based on their potential to affect the outcome of interest. Thereafter, observations in the treatment group are matched to an observation in the control group who is similar on the matching variables.

Matching can be done in multiple ways, but in this research only propensity score matching could be appropriate. Propensity score matching involves calculating a propensity score for each subject, which is the probability of being in the treatment group based on the matching variables. Subjects are then matched based on their propensity scores (Rosenbaum & Rubin, 1983).

4.2.2. Propensity score matching

This research will use a propensity score matching technique. This involves creating a model that estimates the probability of a city being bombed based on its observed characteristics, such as population size, industrial output, pre-war economic conditions, and geographical location. The model is then used to identify non-bombed cities that have a similar propensity score to the bombed cities (Caliendo & Kopeinig, 2008). These non-bombed cities can be used as a comparison group in order to estimate the economic impact of bombing.

The difference between the treated and non-treated group has become clear over the course of this research and is defined as being strategically bombed during WWII. The goal of the propensity score matching process is to find an economic equivalent during WWII for every bombed city. The confounding variables to determine which city is comparable to the observed bombed cities will be explained in detail in the next section.

Although matching is extremely helpful in this research, it is important to note that matching has flaws that need to be considered. Matching leads to a reduced generalizability (Rosenbaum & Rubin, 1983). This research was meant to show the long-term impact of

bombardments on socio-economic factors, but due to matching the results will not be easy to generalize to other time periods and geographical regions. Furthermore, matching does not control for an incomplete number of confounding variables. Unknown variables create differences between observations and their equivalent that have not been considered in the matching process. Lastly, there is a possible selection bias if the equivalents have been matched on inappropriate confounding variables.

Once non-bombed cities have been identified and matched to the bombed cities, a range of statistical methods can be used to estimate the long-term impact of bombing. The statistical method to determine the effect of bombing on socio-economic variables will be discussed in section 4.5.

4.3. Matching characteristics

The cities that have been bombed were, unfortunately for this research, not chosen at random. Bombings were meant to destroy ports, air bases, other key infrastructure, and factories for war material. The bombings were executed to weaken the war efforts of the enemy. Several geographical and demographical characteristics that most cities that have been bombed had in common are the strategic position in regard to air or naval warfare, the population density and the proximity to the conflict. The presence of ports and air bases in a city or close to cities, may have led to a city being targeted by a bombing run. The presence of a military target close to a city can, however, also lead to an accidental hit of the city. On top of that, cities which contained production factories for weapon systems could be targeted more often, the Ruhr area is a clear example of factories as strategic targets. Lastly, some places had value for some leaders in historical context. Adolf Hitler, for example, thought of Paris as a city that must be held even though it had close to no strategic value to the German war efforts by August 1944.

After WWII the theory on strategically bombing cities has not been elaborated any further since threatening to bomb targets was enough to coerce the enemy most often. Since WWII we have not seen two equally strong enemies with an equal share in the outcome anymore. Therefore, the theory on which cities have been targeted is not totally conclusive (Horowitz & Reiter, 2001; Belkin et al., 2002).

In previous urban economic research on bombed cities the only variables that have been considered were population and possibly the destruction rate to determine the effect of bombardments on city growth (Brakman et al., 2002). Since, they did not compare bombed cities to cities that were not bombed regarding livability but only regarding population growth the economic drivers or reasons for bombing might have been less important in their research.

In this research, a set of cities has been carefully selected and grouped based on several urban indicators. These indicators were chosen to help categorize and compare the cities effectively. The specific criteria used for matching the cities included:

Population density, location in regard to the enemy, military strategic value, presence of a port and the cultural value a city had to the public. Lastly, I will elaborate on how some cities were not supposed to be hit when you look at the relevant factors that are expected to increase the chance of being targeted and were still hit by mistake and how this can affect the matching process. By matching cities based on these indicators, the research aims to group them into categories that share common characteristics, allowing for meaningful comparisons and analyses.

4.3.1. Population Density and Location in regard to the enemy

Population dense regions might have been targeted during WWII, as a dense population was an ideal target for maximized destruction. Often densely populated regions were more urbanized and there was more valuable infrastructure to be destroyed in a small region. Those areas may be targeted in order to disrupt if a city is a major industrial center, the destruction of factories and other industrial infrastructure could severely impact the enemy's ability to produce war materials. Beyond these quite evident reasons to bomb cities there was a last reason to bomb cities which was to break the morale. Breaking morale was perceived to be more efficient when more people would be hit by the effects of war which was more likely to happen in densely populated areas.

Furthermore, location in regard to the enemy has been taken into account. Being located close to enemy airfields might increase the chance of getting hit in a strategic bombardment. Nevertheless, it is not a given that being closer to an enemy air base automatically leads to a greater chance of being hit. In fact, it may be the case that air defenses in one corridor are better than in another part of the country. Nonetheless, a shorter flight is often less risky, and the opposing air force is more likely to see a target closer by as an attractive place to strike without suffering significant losses. Also, the closer a city is to the home base of the enemy bomber command, the more likely it is to become a target out of expediency.

4.3.2. Military strategic relevance

The second chance-enhancing factor for a city to be bombed is the military placement and its geographical relation to friendly Air Force airfields and Naval bases. Next to that, later in the war the possibility of creating a beachhead to land close to the city proved to enhance the

probability of being bombed. Coastal cities were also more likely to be bombed as they were always closer to coastal defense systems like batteries and radar stations that were vital to intercept enemy squadrons. It was not without good reason that general warnings to civilians to leave coastal areas were agreed upon, but anything more specific was refused for the aircrews' safety (Dodd & Knapp, 2008). Strategic targets in Britain, for example, were mostly coastal towns as the Germans had been preparing amphibious landings in the beginning of the war (Operation Sea Lion never materialized).

In France bombings by Allied Air Forces were renounced as highly strategic as they were important towards weakening German defenses to liberate the European mainland. Therefore, historic sources call every bombing on cities in Northern France by the end of the war of military strategic value. However, it can be doubted whether these bombardments were necessary and proportional keeping in mind that the German Luftwaffe had been decimated by June 1944. Although, it is debatable whether there were necessary the bombings accelerated the Allies effort in their race to Berlin. The bombings had a substantial role in the Allied "Transportation plan". The goal of the transportation plan was to cross German efforts to transport their troops to strategic points to defend their occupied area. The allies bombed bridges, rail centers and marshaling yards which were often located in city centers. The location of these targets has often led to collateral damage.

In this research, military strategically relevant can be defined as being at a location that has seemed to be on the route of war. This means that cities that were on the way between Northern France towards Berlin were as well as British coastal cities that were supposed to be occupied in Operation Sea Lion in September 1940. On top of that, cities close to friendly airfields and naval bases were deemed to be militarily strategically relevant.

4.3.3. Cultural damage

At a certain point in the war, after the Allied attack on Lubeck, the target cities for strategic bombings on the German side changed. On 14 April 1942 Adolf Hitler ordered "that the air war against England be given a more aggressive stamp. Accordingly, when targets are being selected, preference is to be given to those where attacks are likely to have the greatest possible effect on civilian life. Besides raids on ports and industry, terror attacks of a retaliatory nature the so called "*Vergeltungsangriffe*" are to be carried out on towns other than London" This was the start of the infamous Baedeker Blitz. The aim was to begin a tit-for-tat exchange with the hope of forcing the RAF to reduce their attacks. To increase the effect on civilian morale, targets were chosen for their cultural and historical significance, rather than for any military value (Overy, 2013).

Some cities like Norwich were chosen as targets to destroy cultural value for the public instead of reducing the war effort. On the other hand, some cities have stayed unharmed since they were seen as a potential playing ground by the Germans once occupied. Blackpool, for example, was meant to become a residence for Hitler. In conclusion, cultural value within a city has an ambiguous effect on the likelihood that a city will be made a target for strategic bombing. Cities that were deemed to be of such cultural value that they could be targeted to break morale of the people by the enemy have been taken into this research as militarily strategically relevant as well.

4.3.4. Ports

Ports served as logistical gateways during World War II, forming the backbone of supply lines for both military and civilian needs. The significance of this function cannot be overstated. The bulk of war materiel, including tanks, artillery, ammunition, and food, was transported through ports. Ships laden with cargo docked at ports, where goods were offloaded and distributed to the front lines. Disruptions in the supply chain could lead to dire consequences for military operations. Ports also played a crucial role in supplying civilian populations. Cities and regions heavily relied on imported goods, and ports were the primary entry points for these necessities. Ensuring a steady flow of goods through ports was essential for maintaining public morale and societal stability.

The proximity of industrial centers to ports allowed for the efficient transportation of war materials between factories and ships. This minimized the time and cost required to move goods from production facilities to the front lines. Ports were essentially the interface between manufacturing and military distribution which made them high-value targets. Industrial ports had the capability to quickly convert to wartime production. When war broke out, many civilian industries pivoted to manufacturing military equipment. The availability of nearby ports made it possible to transport newly produced weapons, vehicles, and supplies directly to military vessels, expediting their delivery to where they were needed most. Recognizing the significance of industrial ports, the Axis powers often targeted these facilities in bombing campaigns to disrupt enemy war production (Overy, 2013).

Ports were indispensable logistical hubs, facilitating the movement of troops, equipment, and supplies. Additionally, their proximity to industrial centers ensured efficient transportation and rapid conversion of industries to support the war effort. These functions made ports pivotal in shaping the course of the war. Therefore, it was expected that the presence of a port enhanced the chance of being targeted as a city.

4.3.5. Weapon industry

The last characteristic that increased the chance of bombing was the production of weapons or at least supporting the arms industry by making tires or producing fuel. The arms industry consisted of a large arsenal of different weapons from the small caliber weapons wielded by infantry units to the aircraft carriers built in shipyards in ports. In this study, contributing to the production of one or more of these weapons systems meant contributing significantly to the enemy's war effort. There is a high correlation between contributing to the weapon industry as a city and being bombed during WWII. At the beginning of bombing campaigns Air Forces only aimed at the factories, raffineries and docks to destroy existing weapon systems or intervene in the process of weapon production to impede the growth of the enemy's arsenal and thereby weaken the enemy. This characteristic became more important as it became clear that the war would not be won soon. The Oil campaign at the beginning of the War described what made industrial hearts within enemy territory important targets to reduce production.

4.3.6. Mistakes

During times of war, the fog of war and the intricacies of aerial warfare can lead to terrible mistakes, such as the unintentional bombing of residential areas. For starters, pilots and navigators face substantial hurdles due to navigational errors and severe weather circumstances. Identifying accurate targets in the pandemonium of warfare can be challenging, especially when depending on visual cues or obsolete maps. Pilots may struggle to precisely locate military locations, resulting in inadvertent bombs of neighboring civilian populations. This happened to some Dutch cities bordering Germany's Ruhr area. Secondly, the precision of aerial bombardments is greatly dependent on the accuracy and quality of intelligence reports (Overy, 2013). Incorrect or obsolete intelligence might lead to misidentification of enemy positions, resulting in unintentional assaults on civilian areas. The Germans have been focusing on cities that make a significant effort to the allies' war effort. However, they might not have known which cities exactly have made an important effort and therefore it is possible that cities that would have been bombed with additional information on the enemy's side were now spared. Furthermore, the difficulties of communication in the midst of combat can heighten the potential of mistaken bombings. To verify target placements and avoid errors, ground forces and aircrews must keep open lines of contact. However, pandemonium can lead to misunderstandings resulting in aircrews dropping bombs in unexpected places. Furthermore, night bombardment increased the possibility of inadvertent civilian casualties (Overy, 2013). Working under cover of darkness made accurate targeting difficult and the employment of area bombing tactics increased the potential of collateral damage. The difficulty to identify targets in low-visibility situations increased the likelihood of

bombs landing on civilians, highlighting the devastating effects of accidental bombings during warfare.

Mistakenly hit cities can be very relevant in research like this, since it is easier to find a counterfactual for them with comparable economic drivers as they might have not been targets. Mistakenly hit cities might have a counterfactual that is more alike and has not been bombed since they had no reason to bomb a counterfactual of a mistakenly hit city. Furthermore, mistakenly hit cities will probably have more diversified counterfactuals.

4.4. The risks of propensity score matching

The dataset provides 194 cities, this is divided 147 bombarded cities and 47 that remained spared. It is a realistic possibility that this number of observations will not provide enough cities to match all cities to a counterfactual that is alike but has different treatment. Since I assume that cities have not been bombed at random it is possible that a lot of cities will be matched to a few cities with characteristics that would have made them targets but have not been hit. In this case the urban development in a lot of cities would be compared to a few individual observations. This would lead to biased results. If this is the case, I will apply a second method to determine whether bombardment during WWII has had long term effects on livability in cities.

4.5. Hypothesis testing

After the matching process, T-tests will be applied to assess whether the two groups differ significantly on livability nowadays. To estimate a difference between the groups an independent sample T-Test will be conducted. This test is used to compare the means of two independent groups to determine whether they are significantly different from each other on the indicators of livability. After conducting the t-test and calculating the p-value, the decision is made based on a predetermined significance level, set at 0.05. If the p-value is less than 0.05, the null hypothesis is rejected in favor of the alternative hypothesis. In the context of t-tests, the interpretation involves discussing the practical and substantive significance of the findings. A significant result suggests that there is evidence to conclude that the two groups have different means and that the cities have developed differently over the course of the 75 years after the bombing.

On top of the indicators of livability the average rate of people with a migration background will be compared between bombed and non-bombed cities nowadays. As has been discussed in the hypothesis on migration, war led to people fleeing from their homes during war and to people coming back in to rebuild the city (Bauer, 2013). It is likely that non bombed cities were

not in dangerous locations and had a smaller need to be rebuilt and therefore saw less foreign migration. To test the differences in migration rates nowadays between bombed and non-bombed cities a T-test will be conducted as well. Thereafter, to estimate the impact of a higher rate of people with migration backgrounds within cities a regression on the livability indicators will be examined with the migration rate as an independent variable.

4.6. Instrumental variable

The instrumental variable method will complement the T-tests in this study. In fact, examining the causal effect of multiple factors is better done by using an instrumental variable regression. The instrumental variable (IV) method is a powerful tool in the domain of causal inference. The instrumental variable is used to mitigate endogeneity or unobserved confounding when examining the relationship between an independent variable and a dependent variable (Angrist & Krueger, 2001). The IV method is a viable alternative to a classical Ordinary Least Squares (OLS) regression, since I expect that being bombarded is endogenous. Some variables that have influenced the current livability of a city were suspected reasons to be bombed, such as a port or intensive industry.

The IV method introduces an external variable, the instrument, which serves as a proxy for the endogenous variable. This enables the estimation of the causal effect of X on Y. The IV approach is governed by stringent criteria that the instrument must satisfy, primarily related to its relevance and exogeneity. The relevance is estimated in the first of the two estimations made in an instrumental variable regression.

In the context of World War II, where I seek to investigate the causal impact of bombing on long term socio-economic development, the distance to the nearest enemy airfield emerges as a potential instrumental variable. The relevance criteria requires that the instrument is associated with the endogenous variable, but not with the result. The importance of the distance to the nearest enemy airfield as an instrument stems from the probable assumption that places located closer to enemy airfields were more likely to be bombed. The exogeneity requirement states that the instrument should be free of unobservable confounders that could influence both the endogenous variable and the outcome variable (Angrist & Krueger, 2001). The distance to the next enemy airfield can be regarded as exogenous in the context of our investigation since it is less likely to be impacted by unobservable factors that directly impact the chance of bombing due to marginalized air defense on the European mainland. The exogenous nature of the instrument is less likely to be influenced by factors such as a region's strategic importance, civilian population characteristics, and other variables potentially connected with bombing occurrences.

This study adopts a two-stage regression analysis, the standard method for implementing instrumental variables (Kelejian, 1971). The first stage involves regressing the endogenous variable, bombing, on the instrumental variable which is proximity to the closest enemy airfield. In this first stage estimation, the relevance of the instrumental variable as predictor of the instrumented variable is estimated. The resulting predicted values for bombing serve as instrumental variables in the second-stage analysis, where the long-term economic effects are estimated while controlling for the potential endogeneity of bombing.

Secondly, being militarily strategically relevant can be introduced as an instrumental variable since it does not have a severe effect on the socio-economic factors nowadays apart from through bombing. Military strategic relevance was determined by the geographical location during the war. However, military strategic relevance has no effect on socio-economic factors nowadays. This is true for all cities, apart from the exceptions like cities that were of military relevance due to their cultural value. The cultural objects might have been of influence in the development of the city. Nevertheless, I think being of military strategic relevance could be a reasonable instrumental variable to being bombed as a second option.

In the estimations this study will use both, proximity to the closest enemy airfield and military strategic relevancy, as instrumental variables to find out whether one of them is a better instrumental variable or if they can be used combined. On top of that, the instrumented variable will not only be a dummy for being bombed. The rate of destruction will also be demonstrated as the instrumented variable to find out whether the rate of destruction has influenced livability nowadays. I have chosen to substitute bombed and destruction rate in the regressions as they are highly correlated with each other, since being bombed is a prerequisite to being destroyed to a certain extent. The results will be interesting as it might be expected that cities that have faced worse destruction have had a greater backlog and might score worse regarding livability nowadays.

5. Results

5.1. Descriptive statistics

Table 1: Descriptive statistics between Bombed and Non-Bombed cities on January 1st 2020.

Variable	Bombed	Non-Bombed	P-score
Population 2020	372114	317815	0.113
Average Income	22.921	22.021	0.055
Low Education	45.551	44.611	0.585
Student	11.072	8.321	0.002
High Education	40.72	40.483	0.916
Mental Health	8.748	7.0179	0.003
Migration	19.425	16.186	0.013

The results for the descriptive statistics show that bombed cities in general do not score worse than non-bombed cities. Apart from regarding mental health wherein cities are facing significantly more cases of anxiety and depression symptoms, as the difference between bombed and non-bombed cities is 1.7 percent on average and the result is highly significant with a p-value of 0.003. Furthermore, bombed cities have a more mixed composition of the community as the proportion of residents from immigrant backgrounds is significantly higher than in the community in non-bombed cities ($p = 0.013 < 0.05$). The average income seems to be higher in formerly bombed cities, but the difference between the means on average income between the two groups is not significant at the 5% significance level. Moreover, the mean regarding population is higher in bombed cities. Lastly, there are no significant differences in the education level within the workforce in the cities in different groups. However, formerly bombed cities house significantly more students per 1000 inhabitants, since the p-value for the difference is smaller than 0.05.

Although significant in some cases, the results in Table 1 cannot be explained by the effect of bombing. Over the last 75 years there might be several reasons that bombed cities and non-bombed cities differ in the statistics stated in Table 1. The results in the following sections will give an estimation of the effect of being bombed during the strategic bombing campaign on livability.

5.2. Propensity scores

The propensity scores within the original data set show a lack of comparable untreated counterfactuals to estimate the long-term effect of bombardment on socio-economic development in North-Western Europe. The propensity score ranges from 0 to 1, with 0

representing a low probability of receiving the treatment and 1 representing a high probability. Given their observable confounders, a city with a high propensity score is therefore more likely to receive the treatment. In contrast, a low propensity score means that, based on their observed features, a city was less likely to be bombed. A high propensity score in the context of propensity score analysis often denotes the presence of covariate qualities that are substantially related to receiving the treatment. It indicates the likelihood of being in the treatment group based on the data, not whether the treatment is effective or not. The means of the propensity scores between bombed and non-bombed cities are presented in Table 2.

Table 2: T – test on the means of Propensity scores between bombed and non-bombed cities.

Group	**Observations**	**Mean**	**Std. error**
Non bombed	33	0.59	0.029
Bombed	117	0.83	0.17
Combined	150	0.78	0.17
Difference		0.24*** (0.000)	0.036

*** p<0.01, ** p<0.05, * p<0.1, p-value of the difference has been added between brackets.

The results in Table 2 show that the cities that have been bombed, indeed have high propensity scores. The high propensity scores of most of the bombed cities led to a matching process wherein a lot of bombed cities with characteristics that increased the chance of bombing have been matched to the few cities that had all the characteristics increasing the chance of bombing but have been spared. The results show that mistakenly bombed cities had significantly lower propensity scores of being bombed than intentionally bombed cities. This indicates that strategic bombings were meticulously planned in most cases. Since, the mistakenly bombed cities have lower propensity scores they could be matched to better counterfactuals within the dataset. The results for propensity scores indicate that there is proof that targeted cities had certain characteristics that caused them to be bombed where other cities were not. The propensity scores are evidence of targeted bombing by both sides during World War II. The distribution of propensity scores in general and for treated and non-treated cities can be found in Figures 1, 2 and 3 of Appendix E.

A high weight of matched cities to only a few untreated cities would have led to a non-randomized group. The research question can therefore better be answered by a regression based on only the mistakenly bombed cities. The mistakenly bombed cities have been matched to counterfactuals and regressions have been examined. The propensity score estimations lead to 13 mistakenly bombed or mistakenly spared cities that could be matched to its two nearest neighbors, leading up to 35 different observations that could be used to

examine the long-term effects of bombardment on socio-economic development within cities. The matched cities and their counterfactuals can be found in Appendix F.

5.3. Matching characteristics

Table 3: Means on variables of Bombed and non-Bombed cities.

Variable	Bombed	Non-Bombed	P-score
Population 1940	284843	119209	0.000
Weapon industry	0.453	0.367	0.185
MS Relevant	0.470	0.25	0.000
Distance from enemy	610.3	648.6	0.138
Port	0.34	0.03	0.000
Density	2762	2573	0.522
Observations	150	R^2	0.237

A look into the comparing tests between the bombed cities and the cities that remained intact in Table 3 shows that in some cases the bombed cities show significantly higher rates for some of the matching characteristics. Firstly, out of all bombed cities one third had an important port where for the non-bombed cities no more than three percent contained a port within the city. This is a significant difference between the treated and the untreated group which has determined the treatment. On top of that, cities that have been bombed were significantly more often militarily strategically relevant than cities that were not. Lastly, the total population has had a significant impact on the chance of being bombed. Bigger cities were more likely to be bombed. All these observations are statistically significant at the 1% significance level ($p < 0.01$).

Furthermore, bombed cities were on average 38.3 kilometers closer to the closest military airfield than non-bombed cities. Factors regarding the population in cities indicated that bombed cities were more likely to be densely populated. However, the results for these observations were not significant at a 5% significance level ($p > 0.05$). Strikingly, bombed cities were not more often relevant in the weapon industry than their non-bombed counterfactuals. This can be correlated to the fact that in the war economy almost every factory that could contribute to the war effort was deployed to do so. In this research all these manufacturing settlements have been considered as relevant for the weapon industry. Lastly, the population density between bombed and non-bombed cities was not significantly different ($p > 0.05$). It could have been expected that bombed cities would be significantly more densely populated, since one of the main objectives of the strategic bombing campaign was breaking the morale among civilians. This objective made densely populated cities great targets.

5.3.1 Mistakes

In this research mistakenly hit cities and cities that were spared by accident have been linked to counterfactuals and compared separately. The assumption behind this diversification is that these cities have been hit at random and not for their specific characteristics that have made them targets. The evidence for these assumptions is presented in Table 4.

The results of the comparisons between the bombed and non-bombed cities when only looking only at the mistakenly hit and spared cities in Table 4 show different results than Table 3. There are no significant differences between the bombed and non-bombed cities in Table 4. The difference between the means regarding the matching characteristics are all highly insignificant. This finding is an indication for the randomness of the mistakes in strategic bombing. The results show that the groups of bombed and non-bombed cities that remained can be used to test the hypotheses on livability. The factor port was left out as there were no mistakenly bombed cities that had a port. Keeping the variable port in the estimation would lead to an omitted variable.

Table 4: Means of mistakenly bombed cities and their counterfactuals.

Variable	**Treated**	**Control**	**P-score**
Population 1940	142499	112883	0.326
Weapons	0.278	0.222	0.710
MS Relevant	0.222	0.25	0.850
Distance from enemy	567.2	562.9	0.943
Density	1257	1116	0.543
Observations	35	R^2	0.063

5.4. Livability

To estimate the difference in livability independent sample T-tests have been conducted on the mistakenly hit or spared cities and their counterfactuals. The T-tests have been examined on every indicator of livability and are presented in Table 5. Most of the indicators do not show significantly different results for bombed cities than for the non-bombed cities.

Table 5: T-tests on the indicator variables for livability

Population	**Observations**	**Mean**	**Std. error**
Non Bombed	17	172399	19108
Bombed	18	224304	29792
Difference		51905* (0.079)	35854
Low education			
Non Bombed	14	50.93	10.77
Bombed	16	48.69	9.64
Difference		2.24 (0.276)	3.73

Income			
Non Bombed	17	22887	964
Bombed	18	23293	531
Difference		406 (0.355)	1085
Mental Health			
Non Bombed	17	9.29	0.50
Bombed	18	8.60	0.81
Difference		0.68 (0.242)	0.97
Share of Students			
Non Bombed	15	9.38	1.98
Bombed	17	15.59	2.78
Difference		6.21** (0.0432)	3.50
High Education			
Non Bombed	14	39.86	3.25
Bombed	16	42.94	2.67
Difference		3.08 (0.233)	4.17

*** p<0.01, ** p<0.05, * p<0.1, p-value of the difference has been added between brackets.

All factors considered it does not appear to be that cities that were bombed during the Strategic Bombing Campaign in WWII still suffer from the damage that has been done approximately 80 years ago. Firstly, the bombed cities that were greater initially, although insignificant, have not been surpassed on average by non-bombed cities. In fact, the bombings might have impacted their growth positively. The difference between the average population has grown and bombed cities are even bigger now on average. The average population of bombed cities is 224304 people in 2020 where the average population of non-bombed cities is equal to 172399 people. This difference is not significant at the 5% level, since the P-value of the T-test on population is 0.079. Nevertheless, this result indicates that bombed cities have materialized the opportunities to grow after being bombed.

The average income per capita in bombed cities does not significantly differ from the income in cities that have not been bombed during WWII. Regarding education the results in this research do not show evidence of a lower level of education within the workforce in bombed cities. Therefore, education wise livability in cities does not suffer from the strategic bombings. Lastly, mental health in bombed cities does not seem to be worse than in non-bombed cities. Income, education and mental health show insignificant results in the comparison. These results are an indication that cities recover from a bombing over the course of 75 years or that the impact of bombing can be resolved so quickly that it will not have a long-term impact on development.

To estimate the level of education in a city apart from the workforce the share of students in a city has been tested. The bombed cities show a significantly larger share of students in 2020.

The p-value of this result is 0.043 which is smaller than 0.05. This might be a result of pure coincidence as cities which were historically known to house a lot of students were bombed by accident. It can also be a result of bombed cities choosing to build a university in the rebuilding process. Appendix F shows that in this case it is most likely to be a result of historic university cities like Nijmegen, Enschede, Maastricht and Leuven being bombed by accident. Since there was no data available on the share of students in cities when they were matched, it is possible that the difference in share of students between bombed and non-bombed cities already existed before the bombings. Therefore, this result might be biased.

5.5. Migration

Lastly, migration has been considered using a T-test. The results show that the bombed cities have seen more migration. However, the result is not significant at the 5% significance level since the p-value is equal to 0.084. This result, shown in Table 6, indicates that there has been more migration into bombed cities. More migration into bombed cities could be a result of the way the city has been rebuilt (Bauer, 2013). If the authorities have chosen to provide more housing spaces than they provided before the war, then the city could house more people while the population growth halted during the war on average (Bosker et al., 2007). This meant that there were more houses for less people which created opportunities for immigrants. The results from this T-test are to a certain extent inconclusive on the hypothesis that bombed cities have seen more migration after the war. The result is not significant at the 5% level, but it surely indicates that bombing has had a positive effect on the share of inhabitants with a migration background within a city compared to cities that were not bombed.

Table 6: Means of migration rates nowadays between bombed and non-bombed cities.

Group	Observations	Mean	Std. error
Non bombed	17	17.55	1.69
Bombed	18	21.40	2.12
Combined	35	19.53	1.39
Difference		3.86* (0.084)	2.74

*** p<0.01, ** p<0.05, * p<0.1 and p-value of the difference has been added between brackets.

5.6. Instrumental variable

In this instrumental variable estimation two instrumental and two instrumented variables have been used to estimate the effect of bombing on livability. Both variables are most likely to have no effects on the dependent variables apart from their effect through the destruction by strategic bombing.

Table 7: The First stage IV regressions with different IVs with Bombed as the Instrumented Variable

Bombed	**IV = MS relevant**	**IV = Log (Distance^2)**	**IVs Combined**
MS Relevant	0.225***		0.227***
	(0.067)		(0.068)
Log (Distance^2)		-0.014	0.006
		(0.048)	(0.477)
Working_low	0.000	0.000	0.001
	(0.004)	(0.004)	(0.004)
Student	0.011	-0.012	0.011
	(0.007)	(0.007)	(0.007)
Education_high	-0.007**	-0.007**	-0.007**
	(0.004)	(0.004)	(0.004)
Mental	0.007	0.007	0.007
	(0.011)	(0.012)	(0.012)
Migration	0.005	0.000	0.005
	(0.004)	(0.004)	(0.005)
Population2020	0.000**	0.000***	0.000**
	(0.000)	(0.000)	(0.000)
Constant	0.622*	0.982	0.532
	(0.323)	(0.731)	(0.734)
Observations	145	148	145
Sargan Statistic	0.000	0.000	1.303
Second Stage			

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table 8: The First stage IV regressions with different IVs with Destruction as the Instrumented Variable

Destruction	**IV = MS relevant**	**IV = Log (Distance^2)**	**IVs Combined**
MS Relevant	16.741***		12.963**
	(5.868)		(6.035)
Log (Distance^2)		-11.017***	-8.506**
		(3.836)	(4.072)
Working_low	0.096	-0.011	0.050
	(0.330)	(0.323)	(0.324)
Student	0.580	-0.889*	0.706
	(0.542)	(0.522)	(0.536)
High Education	-0.816***	-0.946***	-0.910***
	(0.280)	(0.278)	(0.275)
Mental	2.343**	2.176**	2.253**
	(0.979)	(0.953)	(0.961)
Migration	0.064	-0.417	-0.909
	(0.443)	(0.407)	(0.441)
Population 2020	0.000	0.000**	0.000

	(0.000)	(0.000)	(0.000)
Constant	21.345	180.421***	137.249**
	(26.386)	(57.459)	(61.229)
Observations	95	98	95
Sargan Statistic Second Stage	0.000	0.000	0.012

Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.1

The first stage regressions in Table 7 and 8 show that military strategic relevance is a relevant instrumental variable which is suitable for all the regressions. In all the first stage estimations military strategically relevant shows a significant result for the relevance of the instrument since the p-value is smaller than 0.05. In all the regressions where the logarithm of the distance towards the enemy squared has been left out as an instrumental variable military strategic relevance is even significant at the 1% level. The distance to the closest enemy airfield does not show a significant result for any of the regressions in Table 7. Whenever destruction is used as the instrumented variable, the log of the distance to the enemy squared is a relevant instrumental variable, see Table 8 Column 2 and 3. However, the Sargan statistic for overidentification shows that the instrumental variable is only valid when both are used combined. Whenever the only one of the instrumental variables is used the Sargan statistic for over-identification is equal to 0.000. This means that the null hypothesis should be rejected. The null hypothesis of the Sargan test is that the instruments used in the IV regression are valid and satisfy overidentification restrictions (Sargan, 1958). In other words, the instruments are uncorrelated with the error term. Since, the instrumental variables are not valid on their own the instrumented variables will be used together in the rest of this research.

Table 7 and 8 also show differences in the number of observations. The regressions with the destruction rate as the instrumented variable miss a third of the observations in the regressions with the dummy for being bombed as the instrumented variable. This decrease in observations is a result of the incompleteness of data. On multiple occasions the destruction rate could not be estimated in a trustworthy manner and therefore the destruction rate was unknown. The results in Table 7 and 8 in combination with the Sargan overidentification test show that the best way to put the regressions on the indicators of livability is by using military strategically relevance and the log of distance to the enemy squared as the instrumental variables and being bombed as the instrumented variable. Therefore, the IV regressions on the livability indicators have been conducted using these variables. Nevertheless, destruction

rate might still have had an impact in the selected group with complete information and this group will still be examined.

5.7. Livability in the IV regression

Table 9: IV regressions on Average Income

Average Income	**Model 1**	**Model 2**	**Model 3**
Bombed	-0.495	-1.069	-0.033
	(1.509)	(1.451)	(1.728)
Low Education	0.067***	0.091***	0.064***
	(0.022)	(0.023)	(0.022)
Student	-0.134***	-0.118***	-0.154***
	(0.040)	(0.040)	(0.037)
High Education	0.201***	0.206***	0.205***
	(0.021)	(0.021)	(0.023)
Mental Health	-0.035	-0.016	-0.031
	(0.058)	(0.058)	(0.059)
Migration	0.074***	0.053**	0.068***
	(0.022)	(0.023)	(0.022)
Population	0.000*	0.000**	0.000**
	(0.000)	(0.000)	(0.000)
Marshall		2.211***	
		(0.763)	
Marshall plan in Millions			-0.008
			(0.017)
Constant	11.676***	8.689***	11.543***
	(2.013)	(2.231)	(2.328)
Observations	145	144	126
R-squared	0.657	0.668	0.673
Sargan Statistic	1.303	0.061	2.405

Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.1

The regression in Table 9 shows no significant effect for being bombed on average income within a city, ceteris paribus. The p-values for bombing were very high in all cases, so the results were very insignificant. This indicates that cities that have been bombed have recovered from the bombing. Furthermore, an increase in the average migration rate leads to an increased average income within a city of 74 euros per percent of inhabitants with a migration background, ceteris paribus. The coefficient of 0.074 represents an increase of 74 euros since the average income is in thousands of euros. On top of that, an increase in the number of students leads to a decrease in average income of approximately 134 euros on average and more highly educated people within the workforce will increase the average income by an amount just over 200 euros per year. Also, the share of low educated people increases the average income significantly. Improved average mental health has no significant effect on income. Furthermore, the positive and significant coefficient for population means

that the average income is greater in bigger cities which is consistent with urban economic literature (Henderson, 2010). Shortly, average income is impacted by several control variables but the dummy for being bombed has no effect on the outcome.

The tables on the other indicators are presented in Appendix G, Table 1, 2 and 3. These tables show similar results. Enduring a bombing during WWII has not had a significant effect on the current level of education within the workforce of a city, nor has bombing had a significant effect on the number of people suffering from anxiety or depressive symptoms within a city.

The most prominent results that are shown in the tables in Appendix G are that high education and mental health show a significant negative relationship (Appendix G, Table 1). This means that people who enjoyed a high level of education and have a job seem to suffer from anxiety or depression significantly less often than people who have not enjoyed high education. There is a significant positive effect for migration on the rate of highly educated people as well. This is no coincidence since migration was also positively correlated with the average income.

Another significant finding from the regression is that a higher population within the researched cities has a negative effect on the share of low educated people (Appendix G, Table 2). This could mean that an infinite amount of people in the city would lead to only average and highly educated people. However, this result is not shown in the share of highly educated people since it does not have a significant positive coefficient for population (Appendix G, Table 3).

Furthermore, mental health is significantly impacted by multiple variables within this study. The share of students within a city has a significant positive effect on the number of cases of depression or anxiety (Appendix G, Table 1). This indicates that students suffer from mental health issues more often. On top of that, population and migration rate are positively correlated with the number of cases of mental health issues (Appendix G, Table 1). This finding is in line with the conclusion of the CBS in 2019 that urban areas face more mental health problems and it adds that bigger cities face these issues more often. Lastly, the study shows that a bigger share of students within a city significantly increases the share of highly educated people within the workforce which is a result of students finding a job in the city they used to study (Appendix G, table 3).

5.8. Marshall plan

For the hypotheses on the Marshall Plan, the assumption is made that the money has been equally divided among cities in proportion to population by 1940. The large, industrialized countries received relatively more money because their recovery would contribute more than

proportionally to the economic progress of the entire area. The countries that fought alongside the Americans also received relatively more compared to the neutral countries and the former Axis powers. The table in Appendix C shows the amounts by country, the amounts are indicative because there is no consensus on the exact definition of U.S. aid under this plan.

In the estimations two different variables have been included apart from each other to account for the impact of the Marshall plan. Firstly, a dummy is included to investigate whether cities who received help from the plan have benefitted from the help and still have an advantage on cities that did not receive help. Secondly, the number of millions put into the rebuilding of a city has been considered under the assumption that cities received the money relative to their population in 1940. This to find out whether cities who received more money over the course of the European Recovery Program have been benefiting from this bonus ever since. This estimation adds value since cities in different countries have received different amounts of money over the course of the program.

The results in Table 9 Model 2 show that the cities that received help after the war have a significantly higher average income nowadays than cities that did not receive help. Ceteris paribus, a capital injection seems to have led to increased average income. However, this finding must be nuanced since the only cities that did not receive help from the plan were cities located in former East-Germany. Nevertheless, the regression in Table 9 shows that cities in former East-Germany still suffer from the absence of help. Germany in general, namely, does not have a backlog on the other researched countries regarding average income, see Appendix H, Figure 1. The intensified international trade between European countries could also be the reason for the greater economic growth in non-USSR influenced countries (Kesternich et al., 2014). Since most cities in this researched are assumed to have received help from the Marshall plan the amount of help could be a better estimate for the effects of the aid that was given in the second half of the 1940s.

The variable in Table 9 Model 3 is defined as the number of millions that a city has received under the assumption that every city collected the same amount per citizen counted in 1940. The coefficient indicates the effect per million that a city has received. However, the results show no significant indications that the amount of money a city has received has had an impact on the livability indicators nowadays (Table 9 Model 3).

Overall, the incomes in cities that received money from the Marshall plan are higher than in the cities that did not, but there is no indication that a higher amount per citizen received during the Marshall plan has led to an advantage in livability nowadays.

Regarding mental health the result for the effect of the amount given as during the Marshall plan has a significant negative effect on the rate of people suffering from anxiety or depressive symptoms, see Appendix G Table 1 Model 3. The result shows that every extra million invested in a city by 1950 due to the Marshall plan decreases the rate of people suffering from anxiety or depression by 0.050, ceteris paribus. This finding is striking since the sum of the aid did not have a significant effect on other livability factors. A decreased rate of anxiety and depressive symptoms might be a result of national policy that improves mental health in the countries that received more money during the plan. Another explanation for this finding might be that the countries that benefited more from the aid were quicker in the rebuilding of the country and have prevented generational trauma by the quick recovery. Regarding the level of education, the amount of aid received during the Marshall plan had no significant effect.

5.9. Destruction rate

To estimate the effect of the rate of destruction of the future development of the city the IV regressions have also been executed using destruction as the instrumented variable. I have chosen to use to use the log of distance towards the enemy squared as the instrumental variable because it is more certain to be uncorrelated with the outcome than the variable military strategically relevant. The log of distance towards the enemy squared is a relevant instrumental variable as is shown by table 7 Column 2. Although it has been explained that there is a possible selection bias by only using the cities with complete information, it is still interesting whether cities that have been destroyed to a greater extent suffer from the destruction nowadays. The results of the IV regressions are presented in Table 10 and Appendix I, Table 1, 2 and 3.

Table 10: IV regressions on Average Income

Average Income	**Model 1**	**Model 2**	**Model 3**
Destruction	0.019	-0.007	0.025
	(0.022)	(0.024)	(0.026)
Low Education	0.037	0.066**	0.031
	(0.026)	(0.027)	(0.026)
Student	-0.172***	-0.143***	-0.176***
	(0.045)	(0.045)	(0.045)
High Education	0.204***	0.194***	0.208***
	(0.028)	(0.028)	(0.031)
Mental Helath	-0.059	0.021	-0.055
	(0.093)	(0.095)	(0.099)
Migration	0.124***	0.077**	0.097***
	(0.033)	(0.037)	(0.033)
Population	0.000	0.000**	0.000
	(0.000)	(0.000)	(0.000)
Marshall		2.206**	

		(0.863)	
Marshall plan in Millions			0.028
			(0.035)
Constant	12.211***	9.611***	12.554***
	(2.145)	(2.318)	(2.204)
Observations	95	95	83
R-squared	0.639	0.659	0.642
Sargan Statistic	0.012	0.141	0.113

Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.1

Table 10 shows similar results to Table 9. The coefficient for the destruction rate is highly insignificant. This finding is in line with the findings when the dummy for being bombed was used as the instrumental variable. The controlling variables also do not show serious differences apart from small changes in the coefficient. The fact that the results do not show significant differences when the destruction rate is used as the instrumented variable indicates that there is no clear effect of the potential selection bias due to a heavy decrease in the number of observations between Table 10 and Table 9.

The insignificant coefficients for the rate of destruction in all regressions mean that cities that have been bombed to a greater extent due to strategic bombing do not suffer from decreased livability nowadays. The findings on being bombed and the destruction rate indicate that cities do no longer suffer from a strategic bombardment approximately 80 years ago regarding livability, independent of the rate of destruction.

6. Conclusion and discussion

At the most turbulent time in international security, it is important to recognize the long-term effects of war on society. Devastation and traumatic events possibly have an effect long after those who experienced them in the flesh are no longer around. In an era where misinformation and historical revisionism can gain traction, it is essential to promote accurate historical education and awareness of its impact. Remembering the past and the broader consequences of war that we still deal with nowadays, can help societies better understand the importance of tolerance, peace, and cooperation to prevent such tragedies from happening again. By showing that a war that took place 80 years ago still has its impacts on Western European society nowadays this research is a valuable addition to the literature.

6.1. Contribution to the literature

This study adds the long-term effects of strategic bombing in Western European countries to the elaborate research that has been done into the effects of strategic bombing in Germany

(Maercker & Herrle, 2003). Another addition to existing literature is the timespan that has been researched, other studies have been finished a decade ago (Bauer, 2013; Kesternich et al., 2014). This study shows that World War II is still relevant in our society. Furthermore, this research shows that the impact of strategic bombing was not permanent regarding income, education level and mental health (Table 8 and Appendix G, Table 1, 2 and 3).

The results of this research show that cities do not only grow back to the size they would have had if the bombing had not taken place because of the economic opportunities in their geographical location (Davis & Weinstein, 2002). This research shows that populations of bombed cities also manage to benefit from the economic opportunities in the long run and do not remain backlogged regarding populations compared to cities that did have a less fatal destiny during WWII (See Table 4, 8 and 9). This research is a testament to the resilience of communities. Urban populations seem to be recovered in economic, educational and health terms within a 75-year time frame from destruction (Table 4, 8 and 9). World War II left lasting marks on the streets, but this research shows no evidence that cities that suffered physically in the war do still suffer in terms of socio-economic factors and livability than cities that were not harmed by strategic bombing.

Regarding the Marshall plan the democratic influences and international helpfulness have helped to develop Western Europe, since the former USSR influenced regions in Germany still fall behind. However, it cannot be concluded that the money has been the deciding factor in this area or whether it was the international community that traded with each other and took advantage of opportunities for economic growth. The fact that the amount of money that cities received does not have an influence on livability anymore is an indication that international trade has played an important role.

The findings from this research, since they are mainly insignificant, cannot give a conclusive image on the effect of strategic bombing during WWII on the livability in the bombed cities nowadays. It could be derived that there is no effect anymore, since the results are insignificant. The effect might have been significant in the short run but just as the impact on city growth the effects on livability might have had only a temporary effect (Brakman & Garretsen, 2004). However, the methods and data used in this research lead to several limitations that undermine the certainty at which a conclusion can be drawn.

6.2. Limitations

This study is based on a lot of different data. For this reason, it has several limitations. The first of the flaws in the study finds itself in the limited size of the dataset. Next to that the way

the observations had to be matched to their counterfactual created a limitation. Cities have been matched to their equivalent on only a few characteristics due to low availability of urban economic data from 1940. Furthermore, the data for several countries came from different databases which can lead to discrepancies in how researchers have interpreted the data. Lastly, it was proven to be difficult to match cities that had significant ports, since these ports were clear targets for the Axis powers as well as the Allies during WWII. The strategic value of bombing a port has become clear in the evaluation of which cities were bombed.

6.2.1. Size of the dataset

This research was conducted over cities in Western Europe during WWII. The group of observations is fairly specialized since only the cities that have at least 50000 nowadays have been included and the data on cities in 1940 is very hard to collect. The results of this study were mainly insignificant. Nevertheless, I do not think these results would have changed whenever the dataset had been larger or more complete. This study shows that there are no significant differences nowadays between cities that were bombed and cities that were not bombed during WWII. The inclusion of smaller cities that were not bombed would not have added value as they would not have been realistic counterfactuals to bombed cities which were larger most of the time. On top of that, some countries were bombed to such an extent that there were close to no cities that were spared and could have been included. A bigger dataset could be created by including more cities from different countries, but an important condition of this choice would be to control for differences in culture and these are extensive and difficult to measure.

6.2.2. Research methods

Conducting a quantitative study comparing socio-economic development across multiple cities can offer valuable insights, but it also comes with several challenges and limitations. Urban development is a complex and context-specific process influenced by a multitude of factors. Each city has its unique history, culture and geographical layout. Attempting to generalize findings from one city to another can oversimplify the intricate dynamics at play. Quantitative studies often focus on quantifiable data points and may miss the qualitative aspects of urban development. By conducting a quantitative study into complex urban issues, the matter is simplified. Simplification can lead to overlooking the multifaceted nature of urban development.

With matching cities to a counterfactual comes the assumption that a city would have developed itself comparably to its counterfactual would it not have been bombed. In the New economic geography theory, multiple reasons have been given why cities develop differently

(Krugman, 1991). Next to that, other researchers have declared that cities develop differently for a bunch of reasons (Dale, 2015; Redding & Rossi-Hanberg, 2017). Therefore, this assumption is too blunt to draw a conclusion from the results that are leaning on the assumption that cities have a trustworthy counterfactual. Within cities there must have been unknown variables in individual cases which would lead to certain results or nonoptimal matching. The range of different databases that needed to be used to create an as complete as possible historical database has led to some observations missing for variables which has influenced the matching process as well. Furthermore, the treatment was not randomly distributed in this case which made a lot of the observations unsuitable for matching. The need for random distribution has led to a low number of observations that were suitable for matching.

Secondly, this research contained regressions using an instrumental variable. This method can have its deficiencies as well. In this case the strength of the instruments was debatable. Although there are multiple reasons why the distance to the closest enemy airfield is an excellent predictor of the probability of being bombed, it turned out to be irrelevant. Military strategic relevance was a better instrumental variable. Although, it is difficult to measure it can be assumed that cities that were of military strategic relevance because of their cultural value have developed different than other cities. Furthermore, military strategic relevance was based on location and location is an important factor for urban development according to the new economic geography theory (Krugman, 1991).

6.2.3. Trustworthiness of data back in 1940

Beyond the sensitivity of the methods, there are several factors that affect the reliability of the results of this study regarding the data. The trustworthiness of data from 1940 pales in comparison to current data due to several factors, primarily revolving around data collection methods. In the past, data collection heavily relied on manual techniques. These labor-intensive methods were prone to human errors and biases, resulting in limited information. That is oppossed to today's data that is complete because there are all kinds of data collection tools available. Another critical aspect impacting the reliability of data from 1940 is historical context and bias. During that era, data collection was influenced by prevailing societal norms, cultural attitudes, and political climates. These biases could compromise the objectivity and accuracy of the information gathered. In contrast, current data acknowledges and addresses potential biases and ethical considerations to enhance its credibility and validity.

On top of that, the effect measured in this study is a causal effect with the treatment and the observed characteristics being far from each other regarding time. Determining the effect of an event that occurred 80 years ago presents several challenges, primarily due to the passage

of time, limited documentation, and the complex interplay of multiple factors. The limited documentation from 80 years ago complicates the process of evaluating the event's impact. Historical records might have been incomplete which might have hindered the construct of an accurate narrative of the bombing and the long-term effects. The paucity of data can lead to gaps in understanding, leaving important aspects of the event and its effects open to interpretation.

Besides that, determining the effect of an event from 80 years ago requires grappling a good understanding on all factors that might influence causality. Over the course of eight decades other events may have occurred, intertwining and influencing each other. Isolating the impact of a single event becomes challenging when attempting to account for the myriad of subsequent developments that may have shaped the present circumstances.

6.3. Future research

This study could be followed by multiple different studies on the effects of war on urban development and socio-economic demographics. A study of the economic and social effects of living in cities with protracted crisis conditions is a remarkable research direction that could grow out of this study on the impact of bombings on urban life. These crisis environments include not just episodes of extreme violence but also persistent causes of unrest such as protracted military conflicts, economic unpredictability and political unrest. Investigating the psychological health, social cohesiveness, and adaptive capacities of urban dwellers facing crises offers the potential to provide insights useful in the creation of support systems and treatments intended to lessen the negative effects of those extreme circumstances. Principles of urban planning and public policy are made clearer by a thorough understanding of how people and groups adapt to stressors and thrive during these situations. This research would align with the recent developments in international security on the world stage and the increased focus on mental health. The finding from this research that a high level of devastation may have led to a decrease in mental health within a city over the long term can be seen as an indication that such research would be valuable.

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Appendices

Appendix A

The Netherlands

In May 1940 Germany stepped across the Dutch border in the East, this invasion with soldiers on foot would soon be followed by fierce air attacks on Dutch cities in the west of the country. Between May 11th and May 14th the hearts of Dutch port cities Middelburg and Rotterdam were bombed, the Germans threatened to put The Hague, Amsterdam, Utrecht and Haarlem to the ground as well. The Dutch realized that they were no match for the Germans' air superiority, by 1940 the Dutch Royal Air Force did not even exist yet, and surrendered to prevent further destruction. The Hague, Amsterdam, Utrecht and Haarlem were spared. Pretty soon after the Dutch capitulation to the Germans the Brits bombed the city of Den Helder severely in the summer of 1940. Later in WWII the cities of Nijmegen and Arnhem were harmed by Allied bombardments.

The precise number of civilians killed as a result of the air raids in The Netherlands is unknown. There were almost 8,000 victims of air raids after 15 May 1940, according to an anonymous record kept between 1940 and 1945 in the NIOD archives. This overview, according to Korthals Altes (1984), is insufficient and, in several places, erroneous. He thinks that 10,000 Dutch bombing victims died.

Belgium

During WWII Belgium was damaged significantly, none of its provinces were spared and in total 23,3% of the existing buildings before the war had been damaged or destroyed (Rijksarchief, 2023). In Late 1944 and the beginning of 1945 the Germans did their last offensive operation which would result in the Battle of the Bulge. The objective of this operation was to regain power over the Port of Antwerp. Since Antwerp had an important production center and a port that was highly beneficial for reinforcements for the Allies, it was heavily attacked when the Germans needed to retreat. Apart from Antwerp, Belgium did not have cities that have purposely been attacked more severely than others.

Germany

At the beginning of the war Berlin had already been bombed in 1940 as part of the Battle of Britain. This resulted in relatively few deaths. Of an entirely different order were the planned bombings carried out beginning in 1942 under British commander Arthur "Bomber" Harris.

The first bombing of Cologne, under the code name Operation Millennium, took place in May 1942 and caused relatively few deaths. For this reason, engineers were specially employed to develop firebombs that would cause as many casualties as possible. That the engineers were successful was demonstrated during Operation Gomorrah in 1943 in the great firestorm in Hamburg, in which about 40,000 people were killed.

In 1944 and 1945, German rockets V1s and V2s from mainland Europe were aimed primarily at London. They were imprecise, resulting in more than eight thousand civilian casualties. Whether in response to German war tactics or not, the Allies proceeded to bomb German cities on a massive scale. The most famous bombing was that of Dresden, partly because it took place in February 1945, when few people expected it anymore and there were many refugees in the city. Numbers were quoted of 300 thousand fatalities, but recent research has shown that there were about 25 thousand.

After the war, many German cities were in ruins. Not all cities were rebuilt in the same way. In Frankfurt am Main, Dortmund and Kassel, the opportunity was taken to create exit roads for automobile traffic right through the city. In the center of Münster, however, the choice was made to preserve the medieval street plan, including the iconic arcades. In Hamburg, they chose to erect many new buildings in the red brick characteristic of the city. And Dresden did not begin the restoration and reconstruction of the Frauenkriche until 1994, after the fall of the Wall.

France

France is the most bombed befriended country in the Allies' rally to Berlin. In all 1570 cities and towns were bombed during the entire War. These bombings resulted in the death of at least 68,778 French inhabitants.

Towards the end of WWII and especially in the period towards Operation Overlord which was kicked off with D-Day on June 6th 1944 the bombings intensified significantly. The Allies aimed at the demolition of a certain number of Norman cities "to transform them into fields of ruins that were difficult for the German troops to cross" according Andrew Knapp (2014).

This strategy continued after D-Day, leading for example to the destruction of 75% of the city of Lisieux (Calvados). The Nord-Pas-de-Calais was also a heavily bombed area. Important defensive forces and installations were located there, as the Germans had long been convinced that the Allied landings would take place along this coast. The Allies wanted to maintain this illusion at all costs, and between January and May 1944, more than a third of the

operations recorded took place in this region. The THOR database (2023) lists 5,343 missions on French soil alone for the first five months of the year, almost as many as since 1939.

Britain

Britain’s contribution to the war started on September 3th 1939 as it declared war on Germany. After almost a year of war the “Phoney War” ended and Britain actually contributed to battle. This marked the start of one of the most important battles of World War II named the Battle of Britain, which took place from July to October 1940. The German Luftwaffe and the Royal Air Force engaged in a violent aerial combat. The RAF's effective defense of Britain against the German air force's unrelenting bombing campaign prevented a German invasion and preserved British sovereignty, making the fight a pivotal moment in the war.

After the Battle of Britain ended, Britain's strategic bombing campaign started. It was aimed to cripple Germany's war machine and undermine its industrial and civilian infrastructure. The campaign began in 1940 and intensified over the years, involving relentless night bombing raids on German cities and industrial centers.

Appendix B

	Pop~2020	Ave~2020	Mental	Educat~h	Workin~w
Populat~2020	1.0000				
Average~2020	0.0509	1.0000			
	0.4935				
Mental	0.1183	-0.2548	1.0000		
	0.1118	0.0004			
Education_~h	0.1283	0.6327	-0.2463	1.0000	
	0.1037	0.0000	0.0016		
Working_low	-0.2672	0.0040	-0.0013	-0.4513	1.0000
	0.0006	0.9597	0.9873	0.0000	

Appendix C

Country	1948/49	1949/50	1950/51	Cumulative	Share
Belgium	195	222	360	777	6,1%
France	1085	691	520	2296	18,0%
Netherlands	471	302	355	1128	8,9%
United Kingdom	1316	921	1060	3297	25,9%
West Germany	510	438	500	1448	11,4%
Total	3577	2574	2795	8946	**70,3%**

Source: *The Marshall Plan Fifty Years Later*, Palgrave MacMillan, VK (2001) ISBN 9780333929834

Appendix D

Source: Knopp (2001). The shaded sections indicate the share of dwellings that was destroyed in the respective cities in 1945. The size of the circle represents the city-size: a small, medium or large sign indicates that this city had respectively a population of <100.000, 100.000-500.000, or >500.000 people.

Appendix E

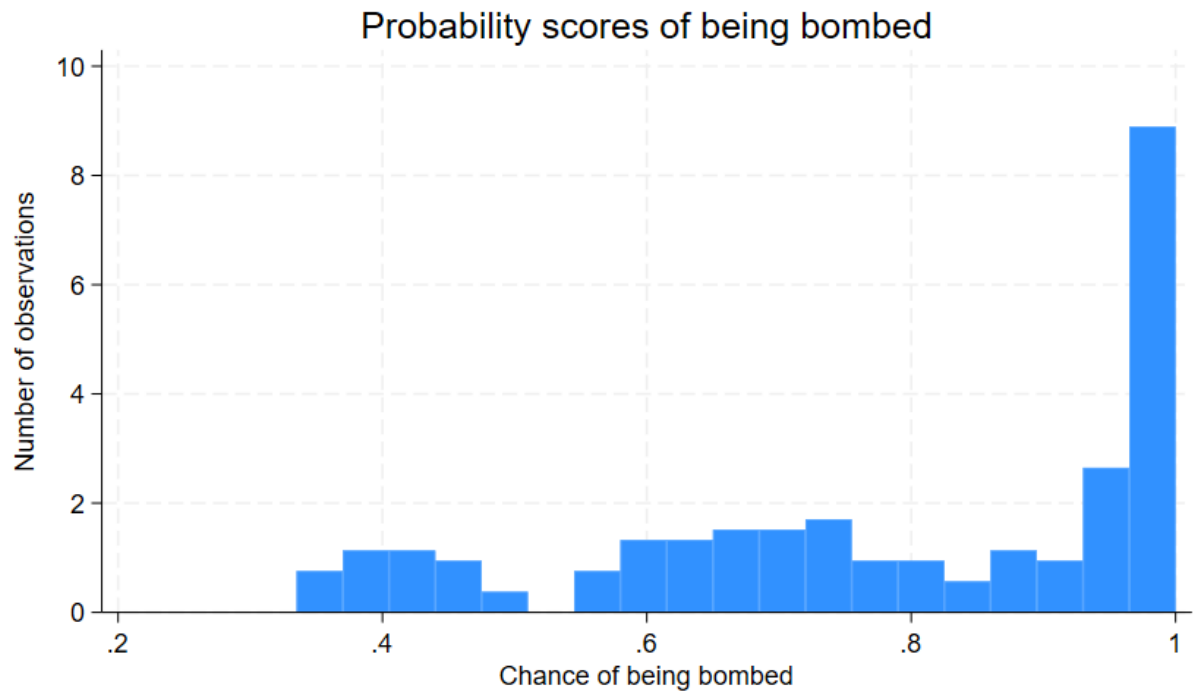

Figure 1: Graph on the probability scores of being bombed by city.

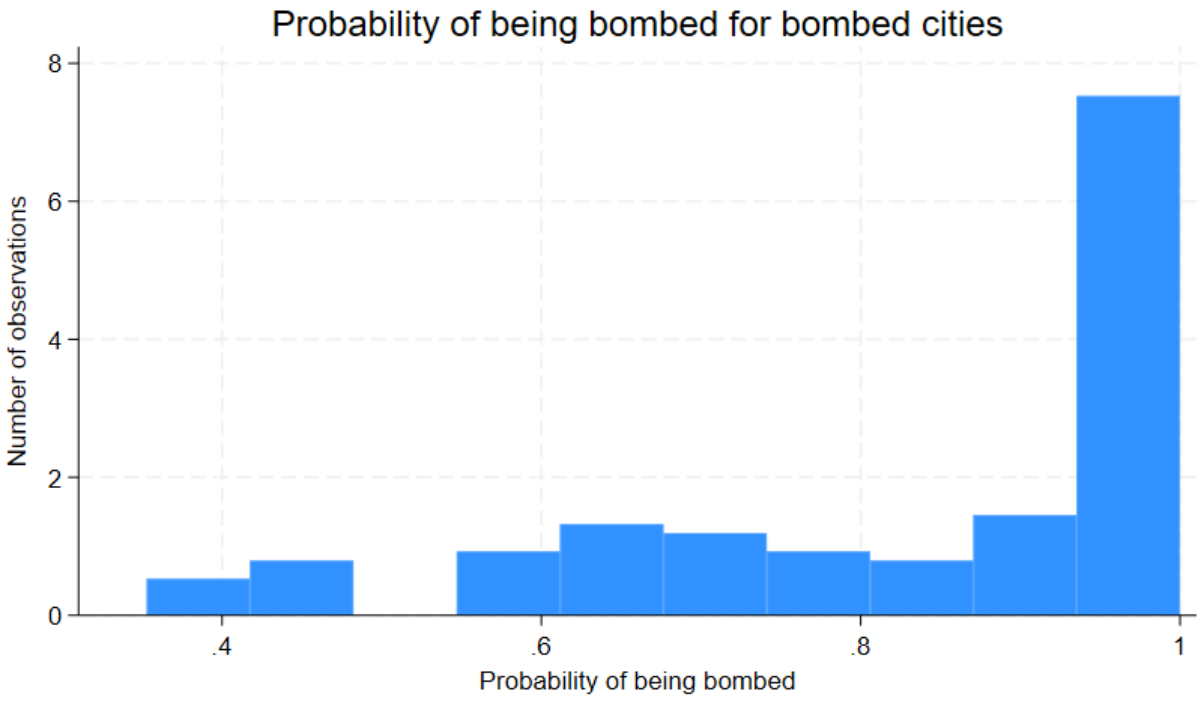

Figure 2: Graph on the probability scores of being bombed by bombed city

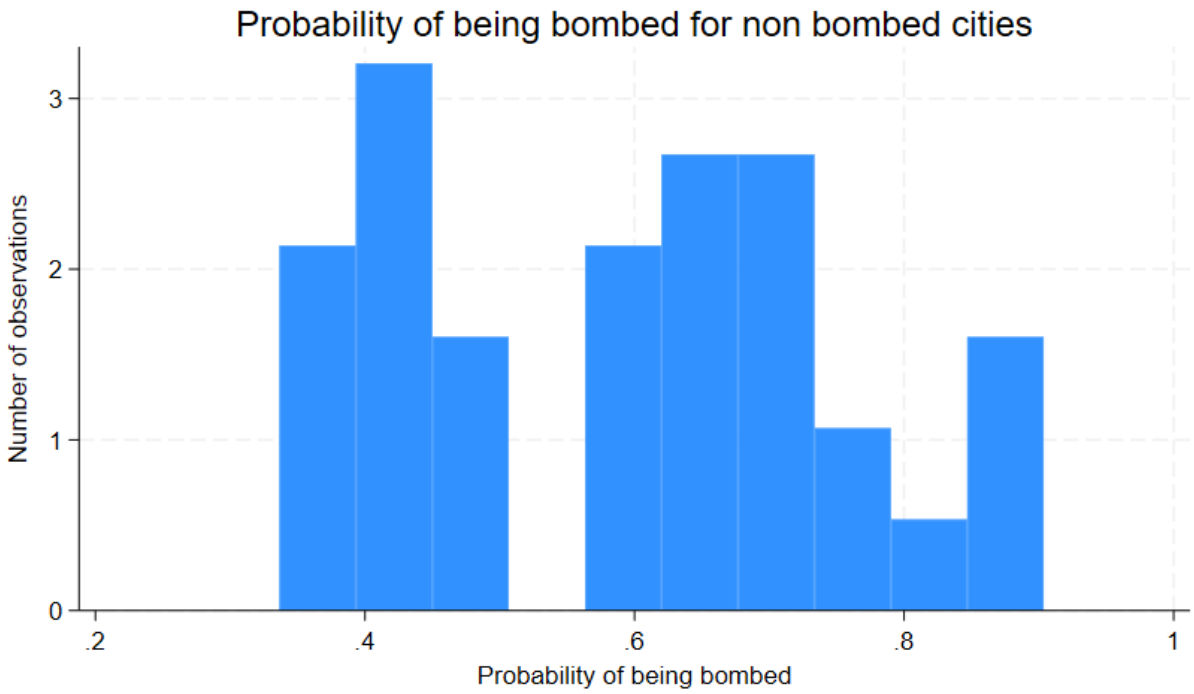

Figure 3: Graph on the probability scores of being bombed by non-bombed city

Appendix F

City	Propensity score	Counterfactual 1	Counterfactual 2	Bombed
Stoke-on-Trent	0.672	Bradford (0.653)	Bournemouth (0.689)	N
Blackpool	0.735	Norwich (0.600)	Bournemouth (0.689)	N
Nimes	0.452	Dijon (0.603)	Grenoble (0.710)	Y
Besancon	0.481	Angers (0.467)	Troyes (0.583)	N
Maastricht	0.471	‘s Hert (0.403)	Tilburg (0.476)	Y
Nijmegen	0.748	Leeuwarden (0.65)	Munster (0.732)	Y
Enschede	0.430	Zwolle (0.367)	Tilburg (0.476)	Y
Hengelo	0.353	Amersfoort (0.336)	Zwolle (0.367)	Y
Gelsenkirchen	0.903	Bochum (0.890)	Mannheim (0.915)	N
Halle	0.871	Kassel (0.842)	Karlsruhe (0.843)	N
Erfurt	0.670	Saarbrucken (0.667)	Mainz (0.746)	N
Kortrijk	0.370	Oostende (0.38)	Bruges (0.404)	Y
Leuven	0.391	Bruges (0.404)	Aalst (0.432)	Y

Appendix G

Table 1: IV regressions on Mental Health

Mental Health	**Model 1**	**Model 2**	**Model 3**
Bombed	-1.575	-1.249	-1.108
	(2.264)	(2.193)	(2.721)
Low Education	-0.017	-0.030	-0.009
	(0.033)	(0.036)	(0.035)
Student	0.124**	0.119**	0.100
	(0.060)	(0.060)	(0.061)
High Education	-0.107***	-0.115***	-0.095**
	(0.038)	(0.039)	(0.043)
Average Income	-0.092	-0.060	-0.090
	(0.125)	(0.128)	(0.145)
Migration	0.098***	0.105***	0.117***
	(0.033)	(0.034)	(0.035)
Population	0.000**	0.000*	0.000***
	(0.000)	(0.000)	(0.000)
Marshall		-1.093	
		(1.167)	
Marshall plan in Millions			-0.050**
			(0.026)
Constant	13.408***	14.391***	11.943***
	(3.357)	(3.453)	(4.307)
Observations	145	144	126
R-squared	0.109	0.127	0.173

Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.1

Table 2: IV regressions on Low education share within the workforce

Low Education	**Model 1**	**Model 2**	**Model 3**
Bombed	-4.256	-0.064	-5.736
	(5.730)	(5.019)	(7.181)
Student	-0.470***	-0.441***	-0.413***
	(0.148)	(0.133)	(0.157)
High Education	-0.420***	-0.449***	-0.479***
	(0.093)	(0.085)	(0.105)
Average Income	0.876***	1.097***	0.927**
	(0.308)	(0.278)	(0.373)
Mental Health	-0.090	-0.173	-0.027
	(0.219)	(0.197)	(0.243)
Migration	0.126	0.196**	0.123
	(0.086)	(0.079)	(0.096)
Population	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Marshall		-12.694***	
		(2.480)	
Marshall plan in Millions			0.021
			(0.070)
Constant	52.638***	57.127***	54.538***
	(7.690)	(6.833)	(10.425)

Observations	145	144	126
R-squared	0.462	0.570	0.408

Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.1

Table 3: IV Regressions on high educated share of the workforce

High Education	Model 1	Model 2	Model 3
Bombed	1.047	3.614	-1.022
	(5.156)	(5.090)	(5.907)
Low Education	-0.333***	-0.416***	-0.336***
	(0.072)	(0.077)	(0.071)
Student	0.703***	0.624***	0.705***
	(0.117)	(0.119)	(0.117)
Average Income	2.330***	2.410***	2.417***
	(0.233)	(0.235)	(0.269)
Mental Health	-0.541***	-0.563***	-0.440**
	(0.194)	(0.193)	(0.200)
Migration	0.155**	0.211***	0.126
	(0.076)	(0.077)	(0.079)
Population	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Marshall		-8.403***	
		(2.640)	
Marshall plan in Millions			0.037
			(0.057)
Constant	-2.182	6.215	-2.127
	(7.857)	(8.004)	(9.466)
Observations	145	144	126
R-squared	0.720	0.722	0.732

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix H

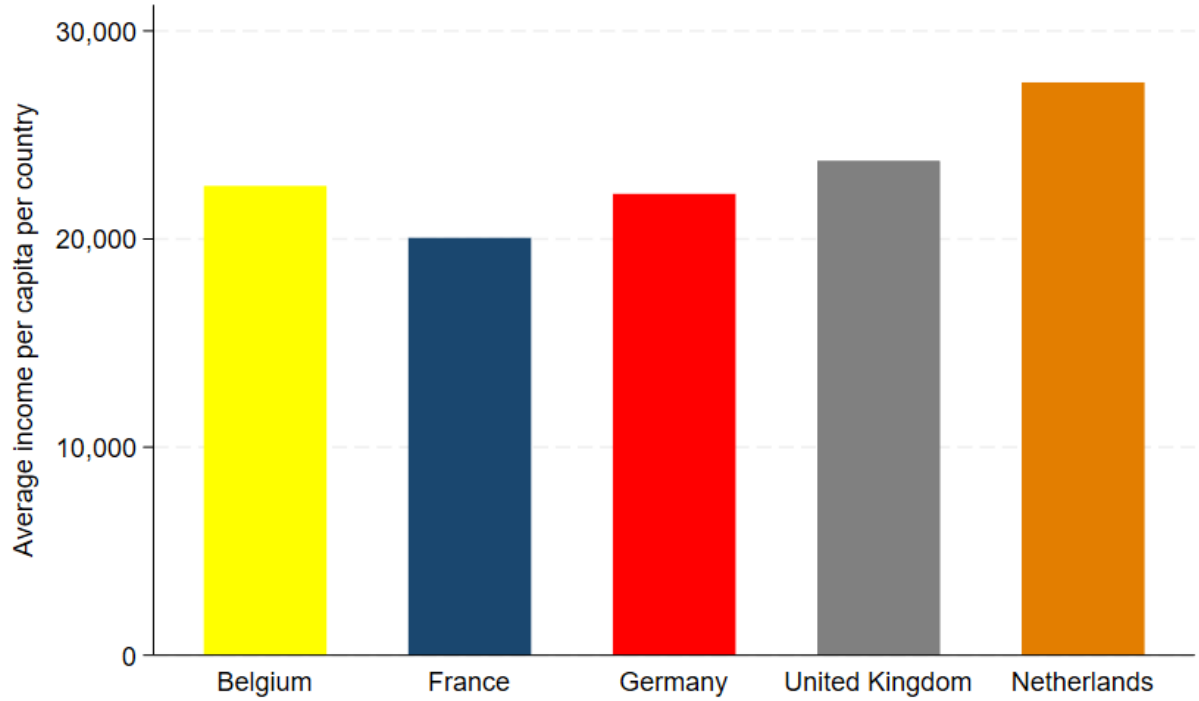

Figure 1: The average income per researched country on January 1st 2020

Appendix I

Table 1: IV regressions on Mental Health

Mental Health	**Model 1**	**Model 2**	**Model 3**
Destruction	0.013	0.027	0.028
	(0.029)	(0.030)	(0.036)
Low Education	-0.034	-0.049	-0.033
	(0.034)	(0.036)	(0.037)
Student	0.078	0.062	0.070
	(0.069)	(0.068)	(0.076)
High Education	-0.095*	-0.089*	-0.080
	(0.054)	(0.053)	(0.067)
Average Income	-0.044	-0.021	-0.032
	(0.142)	(0.142)	(0.169)
Migration	0.066	0.087*	0.074
	(0.047)	(0.049)	(0.049)
Population	0.000*	0.000	0.000
	(0.000)	(0.000)	(0.000)
Marshall		-1.240	
		(1.127)	
Marshall plan in Millions			-0.044
			(0.051)
Constant	12.453***	13.089***	11.146***
	(3.180)	(3.219)	(3.634)

	95	95	83
Observations	0.240	0.262	0.270
R-squared	0.013	0.027	0.028

Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.1

Table 2: IV regressions on the rate of lower educated people in the workforce

Low Education	**Model 1**	**Model 2**	**Model 3**
Destruction	0.042	0.255*	-0.033
	(0.112)	(0.148)	(0.163)
Student	-0.505**	-0.610**	-0.403*
	(0.204)	(0.247)	(0.236)
High Education	-0.326**	-0.185	-0.454**
	(0.165)	(0.201)	(0.224)
Average Income	0.563	0.630	0.676
	(0.435)	(0.521)	(0.542)
Mental	-0.353	-0.882*	-0.200
	(0.396)	(0.498)	(0.507)
Migration	0.024	0.313	0.023
	(0.147)	(0.194)	(0.154)
Population	-0.010***	-0.014***	-0.010*
	(0.003)	(0.004)	(0.005)
Marshall		-13.314***	
		(3.809)	
Marshall Plan in Millions			0.068
			(0.154)
Constant	56.809***	57.413***	58.993***
	(7.615)	(9.122)	(8.845)
Observations	98	98	83
R-squared	0.410	0.154	0.392

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table 3: IV Regression on the rate of highly educated people in the workforce

High Education	**Model 1**	**Model 2**	**Model 3**
Destruction	0.058	0.290	0.016
	(0.114)	(0.231)	(0.142)
Low Education	-0.312***	-0.516***	-0.305***
	(0.098)	(0.182)	(0.105)
Student	0.773***	0.644***	0.748***
	(0.144)	(0.223)	(0.144)
Average Income	2.417***	2.798***	2.499***
	(0.316)	(0.522)	(0.342)
Mental Health	-0.943**	-1.635**	-0.757
	(0.453)	(0.822)	(0.529)
Migration	0.069	0.377	0.102
	(0.143)	(0.272)	(0.137)
Population	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Marshall		-13.750**	
		(6.208)	

Marshall plan in Millions			0.005
			(0.133)
Constant	-2.191	8.251	-4.559
	(9.232)	(14.103)	(9.439)
Observations	98	98	83
R-squared	0.676	0.294	0.718

Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.1

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