The indirect benefit of urban renewal and cultural heritage investments

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DEPARTMENT OF FOOD AND RESOURCE ECONOMICS
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IFRO Report

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289b

Godsbanen. Photo: Realdania

Christiansfeld. Photo: Realdania

IFRO Report 289b*

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Abstract

Realdania, a Danish philanthropic foundation, finances the renovation of buildings and urban environments with historical and cultural value as well as former industrial buildings worth protecting. Often, these industrial sites are renovated to open the site to the public, and the buildings are given a new functionality with societal value. This paper aims to investigate the indirect economic gains from these restoration and urban renewal projects. As cases, we have selected the former freight train area in Aarhus and the historic town centre of Christiansfeld.

In the report, we estimate the size of the indirect benefits for the local citizens. We do this by analysing if there has been an additional increase in housing value in the neighbourhoods around the sites, compared to similar areas, using the hedonic pricing method in a difference-in-difference setup. We also investigate the impact of the project on the local shops and businesses. We compare the probability of business survival with businesses in other comparable areas and investigate the development in the number and diversity of businesses in the project sites. Thus, we estimate a survival model with a difference-in-difference specification.

We hypothesize that the project will make the neighbouring areas more attractive. This is likely to increase the demand for housing in the area, which will cause an increase the house prices, all other things equal. Likewise, is the hypothesis that the projects will lead to a rise in the number of visitors. The increase in visitors means a more extensive customer base for the local shops. Altogether, the improved market conditions should lead to a higher survival rate.

We find that in general, houses within the freight train area are sold at a lower price compared to the rest of the city of Aarhus. However, after the opening of the area as a centre for making art, between 2012 and 2018, the prices increased by 7-12 per cent more than other regions of Aarhus. The total economic value of the indirect effects of the project to the people living close by is between 0.5 and 1 billion DKK. At the same time, the analysis shows a 20 per cent increase in the half-yearly business survival rate compared to businesses in other parts of Aarhus between 2012 and 2018. This corresponds to a different 75 per cent and 79 per cent survival after 3 years. However, diversity in businesses seems not to have changed due to the completion of the project.

Already since the foundation in 1773, Christiansfeld has been unique in a Danish context. The uniqueness, in combination with fewer houses and companies, makes the estimated results from the Christiansfeld case less stable. Thus, we cannot conclude that the project has had a significant impact on the house prices in Christiansfeld. The analysis underlines, however, that Christiansfeld, in general, is an attractive town relative to other towns in Southern Jutland. The survival analysis shows that companies in Christiansfeld have a higher probability of closing than companies have in other

comparable towns in Southern Jutland. Since the beginning of the 1990s, the supply of services has increased more relative to other towns in the analysis. In the period from 2016 to 2018, however, the analysis shows a substantial drop in the number of businesses.

Introduction

We aim to identify the indirect impact of urban renewal and cultural heritage investments made by the Realdania Foundation. The analysis will be based on the cases of Godsbanen and Christiansfeld. Godsbanen is a classic urban renewal project where an existing industrial site, in this case, a large freight train station is repurposed to accommodate cultural activities. Christiansfeld is an old town, which in 2015 was appointed as a UNESCO world heritage site. In both cases, the investment of Realdania is considered an important factor in the transformation of the area.

The investment in urban renewal and cultural heritage is likely to provide benefit to the households and companies located in vicinity to the investment projects. The hypothesis is that the investment areas become more attractive for households and companies as new services and cultural experiences are introduced into old infrastructure and buildings. At the same time, the investment in the historical buildings may improve the aesthetic and historical impression of the area, which provides an improved recreational experience for visitors and neighbours alike. The improved areas may lead to a feedback loop where the initial investment attract additional investments from external and internal parties, thus, creating an even more attractive area.

The increased attractiveness of a residential area will increase household demand for living in the area (Lundhede et al., 2013). The demand will result in higher premiums for residential properties and over time, likely increase residential supply. The additional price premium that households are willing to pay for living in the improved investment areas is an indicator of the improvement that the households experience. We will estimate the households' willingness to pay for the investment areas using hedonic house price models with a difference-in-difference setup, i.e. where we compare house price development in the selected areas with house price developments in areas that are similar, but without the initial investment.

Companies are likely to locate in areas which people find attractive (Panduro et al., 2014). Areas that attract people increase the possible customer base and at the same time expand the possible workforce from which to hire. At the same time, companies are willing to pay more to be located near each other, thus sharing infrastructure and creating the opportunity to collaborate with other business (Panduro et al., 2014). This will in some cases, lead to increased supply and increased diversity of services, which may attract even more people. Attractive urban spaces are, among other things, defined by the level of service diversity (Jensen et al., submitted). Companies and households interact and can create positive feedback loops that improve an area creating attractive places for people and companies. The feedback loop may also work in the opposite direction making places less attractive for people and companies.

The second main hypothesis is that attractive places create good business environments where companies will thrive. Strong business environments are places with a high level of activity, which sustains over time (Trkman, 2010). Many companies do not survive more than a few years (Erhvervsstyrelsen, 2018). Locations, where companies are less likely to go out of business, indicate a strong business environment. We, therefore, develop a hazard model for companies in the investment areas. If the companies in the investment areas are more likely to survive relative to other places, it is an indication of an improved business environment.

To assess the impact of the investment, there is a need to consider how the two case areas would have developed without the investment. However, such counterfactual reflections are mainly speculation. Instead, we will establish a baseline in which we compare the case areas with other comparable sites that have not received a similar investment. This way, we do not only compare the policy site to itself but to a site or multiple sites which we expect experienced a similar development with respect to population and business community before the intervention, to measure a possible deviating trend. Thereby we are able to distinguish general trends in society from the case specific trends. The case can be made that both Godsbanen and Christiansfeld are not unique due to the investments but have distinct characteristics which make the sites incomparable to other sites, i.e., it is not possible to create a baseline. To the degree possible, we address this directly in the estimation, and otherwise we consider it explicitly when interpreting the results.

The paper is organized into two parts; the first part is concerned with household willingness to pay using the hedonic house price method and the second part is concerned with the strength of the business environment in the vicinity to the investment cases using company survival rate as an indicator. The two parts include a theory section, a model section, a result section and a discussion section. The result is then combined in a general discussion of the two cases and how the results and method can be generalized and applied on similar investment project. The paper starts with a description of the two case, which clarify the expected benefits of the investments in the project areas.

The cases

Urban renewal investment – Godsbanen

Godsbanen is located in an old industrial district along Aarhus Å between the inner ring road and the city centre. With the development of the neighbouring plot of the former Ceres brewery, the area has evolved from an industrial area to mixed housing, education, and business. The area is not yet fully developed. Towards the city centre, the art museum ARoS, the Conservatory of Music, and Aarhus Music House is located. The Godsbanen area is in total approx. 43,000 m^2. The main building, the old freight train station, has a total area of 2,300 m^2. The halls behind the main building make up approximately 5,000 m^2.

Since the opening of Aarhus music house in 1995, the area has slowly transformed from an industrial area to a place for culture, art, and housing. Most importantly, the art museum Aros opened in 2004 and later on, the old industrial area the Ceres plot was developed, with the first apartment blocks finished in 2016. Thus, Godsbanen is part of an urban transformation of a large former industrial area and is not a unique project on its own.

Godsbanen was constructed from 1920-1923 as a freight railway station, which was in function until 2000. In 2004, the city council of Aarhus decided to create a culture and production centre for art and literature at Godsbanen's facilities that had been left unused for several years. In 2005, Realdania decided to fund the initiative with 50 million DDK. In 2008, Aarhus municipality took over the Godsbanen area and made an official partnership agreement with Realdania. The Renovation of Godsbanen began in 2010 and the facility opened for activities in 2012.

Today, Godsbanen consists of workshops, indoor production rooms, group-working rooms, exhibition rooms, meeting rooms, stage/production rooms, rehearsal rooms, large common areas, conference facilities, a mini-cinema, and ten apartments used by visiting artists. Godsbanen has a number of project sites in office communities that can be rented for between six months and three years for work within all kinds of art, craft, and design. Godsbanen has also a regional venue, film workshop, and film school. The purpose of Godsbanen is to gather these activities in order to create and develop living art and cultural environments in Aarhus. In addition to Godsbanen's own activities, external people hold and arrange a large number of events, workshops, conferences, meetings, etc.

The main benefit of Godsbanen is the cultural activities that the facility supports. The activities in Godsbanen are likely to spill over into neighbouring areas to the potential benefit of local residents and local business. The hypothesis is that an increased number of visitors to Godsbanen will increase the customer base for companies that provide goods and services in vicinity to Godsbanen. This additional demand will lead to more activities on the street level, which will make the neighbourhood more attractive for local residents. This, in turn, might increase the attractiveness of the entire neighbourhood and attract new residents with a different background. Godsbanen may, therefore, be a driver (intended or not) to transform the socio-economic background of residents. Finally, residents may benefit from the repurposing of Godsbanen from an infrastructure/industrial use to a cultural use: residents are safeguarded against industrial nuisances, like air and noise pollution as the Godsbanen facility ensure that the site will not regress to industrial use again.

The urban transformation that Godsbanen is part of, which attract visitors and new resident and improve the service sector, makes for an attractive location choice for small and mid-sized companies. Business activities can be extended to external services providing meeting and lunch facilities as well as access to a potential attractive workforce. The attraction of small and mid-sized companies will potentially create a feedback loop that will attract even more companies that are looking for customers and collaboration with partners and competitors. The overall effect will potentially be a business environment that is likely to increase the chances of success.

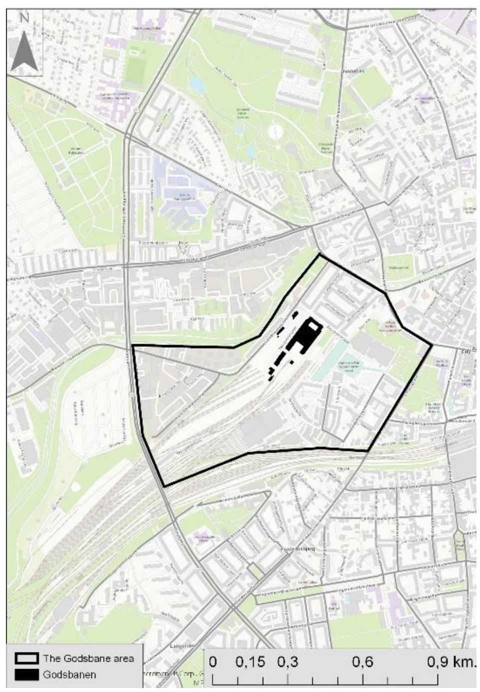


Figure 1. *A map showing Godsbanen – the black polygons. The black line on the map shows the neighbourhood of Godsbanen which is outlined by large infrastructure facilities.*

Cultural heritage investment - Christiansfeld

Christiansfeld is one of the first examples of urban planning in Denmark. The town centre was established according to the *Brødremenigheden* (the Moravian Church) in Christiansfeld's principles and ideals of openness, spaciousness, and functionality. The most important buildings in Christiansfeld are located around the town central church square. The buildings in the old town centre were all erected within a few years of each other, between years 1774 and 1800, using yellow bricks building material with red roof tiles.

The original urban plan focused heavily on green areas in the form of the relatively large gardens, which were located at the back of the houses, and the central church square with surrounding lime trees and grass. In addition, the town's long, parallel streets have views of the surrounding countryside. The architecture and urban landscape features are partially preserved today. The town centre, therefore, has a harmonious and uniform impression.

Figure 2. *An air photo of Christiansfeld*

Christiansfeld was previously the main town for a rural municipality. In many respects, Christiansfeld has developed similar to other provincial towns in southern Jutland, e.g. of Vojens, Lunderskov, Vamdrup, Gram, Rødding, Holsted, and Brørup. Single-family neighbourhoods surround the town centre. The town has a few grocery shops, a day care centre, a school, and a sport facility. Christiansfeld Mejeri and Danæg are the main employers in the town producing dairy products and packing eggs, respectively. Christiansfeld is also a commuter town being close to the main central highway in Jutland and the large business areas near the city of Kolding.

In 1993, the Danish Ministry of Culture listed Christiansfeld as a potential UNESCO world heritage site. Five years later, in 1998, the municipality of Christiansfeld initiated the idea to reinvest and renew the city centre through partnerships with private foundations. In 2002, Realdania committed to a partnership with the Brødremenigheden and Christiansfeld municipality to invest and restore the old town centre. The project consisted of three phases. The first phase was finished in 2005, the second in

2007 and the third was completed in 2015. UNESCO appointed Christiansfeld as a world heritage site in July 2015. The cultural heritage investment in Christiansfeld has since the first initiative amounted to 225 million DDK. Realdania has been the main provider of the funds, investing 49 million DDK in the first and second phase and 50 million DDK in the third phase.

The renovations of the old town centre of Christiansfeld have had the purpose of making the site even more attractive and relevant to visitors and residents. In part, the biggest benefit is the preservation of a unique historical, cultural heritage site that visitors now and in the future will be able to experience. Residents have also gained a town centre with renovated buildings and squares, new pavement and trees. These improvements has likely strengthened town life and improved the recreational potential in Christiansfeld. Compared to similar towns in the southern part of Jutland, the town provides a unique town centre that is likely to attract households and increase demand for living in Christiansfeld. Similar, business will benefit from the improved town centre by the increased number of visitors that will increase demand for local products and services. The attractiveness of the town could also increase the workforce by attracting residents from outside the town, which is important to companies in less populated regions like southern Jutland.

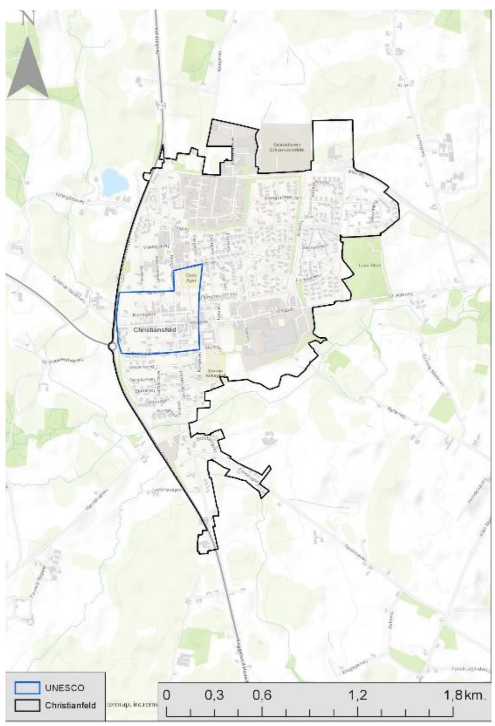


Figure 3. *The outline of the town of Christiansfeld*

Part 1

1.1 Estimating the investment-benefit for households

We use the hedonic pricing method to estimate the households' benefit of the investment in Christiansfeld and Godsbanen. In Denmark the method has previously been used to estimate e.g. the value of urban green areas (Panduro & Veie, 2013), the value of urban qualities (Lundhede et al., 2013), nuisance from wind turbines (Jensen et al., 2014) and price differentiations due to road noise (von Graevenitz, 2018). The house price method builds on a theoretical framework developed by Rosen (1974). The reasoning behind the method is that a house consists of a number of characteristics and qualities. The price of a house is a function of these. Some of the characteristics are related to the property itself (the type of building, size, etc.) while others are related to the surroundings – as you "buy" access to surroundings when buying a house. Therefore, benefits of investment in urban development are likely to affect the house price. The potential housing buyers will search the market for a property with a combination of characteristics and quality levels that fits household preferences, available at the lowest possible price. The housing market is constructed of a continuum of matches between utility maximizing buyers and profit-maximizing sellers, who are looking for a buyer to his/her property with the given characteristics at the highest possible price.

In the market, we observe a large number of houses with different characteristics sold at different prices. It is possible to isolate the average marginal price for an extra level of each characteristic or a little bit higher quality. Rosen (1974) shows that the estimate of the hedonic house price model can have a welfare economic interpretation. The parameter estimates in the house price model can be interpreted as household's Marginal Willingness to Pay (MWTP) for housing characteristics, which are accounted for in the model. Bartik (1988) argues that the results of the house price model can be used to estimate the welfare economic impact of non-marginal changes as the upper bar of the welfare change. He reasoned that households would have a decreasing utility of consumption. Therefore, the ex-ante MWTP estimate of a house price model will overestimate the impact of a discrete change in housing consumption level. The intuition of decreasing utility of consumption was developed further by Bajari and Benkard (2005). They impose a restriction on the household utility function, which ensured that the utility function enveloped the MWTP estimated by the house price model. The approach has been used to a very limited extent in environmental economics (Panduro et al., 2018; von Graevenitz, 2018). In this paper, we estimate the value of non-marginal changes, which means that the parameter estimate of the hedonic model should be interpreted with caution.

The estimates of the hedonic house price models are vulnerable to endogeneity. To counter this issue, researchers have looked for quasi-experiments where changes in the provision of a public good can be isolated in the house price model. There is some debate on how to interpret model estimates from such analysis. Kuminoff and Pope (2014) argues that the "capitalization effects" estimated by the hedonic house price model of a discrete change in housing consumption of a public good will differ from households' willingness to pay. Here the capitalization effect is defined as the level of a price change before relative to after an event in the housing market. The capitalization effect is then a conflation of household WTP and the change in the equilibrium price function. To underline their point, Kuminoff and Pope (2014) use a case from the US. They show that household WTP estimated by a standard hedonic model setup will underestimate the welfare effect of public-school improvement by as much as 75 per cent. Banzhaf (2015/2019) supplements these findings by showing that the effect estimated by difference-in-difference hedonic model for a public good is a lower bound welfare measure. The model estimates in this analysis should be understood in this context, i.e., as lower bound welfare measure of discrete events.

To estimate the welfare economic benefit of a public good like investments in urban renewal by the house price method directly, we use a difference-in-difference hedonic house price model. The intuition of this model is that rather than estimating the house price itself, the development in house prices after the investment is estimated and compared with matching cases where no investment has taken place. The difference-in-difference model set-up mimics a natural experiment. The objective is to establish causality. Still, unobserved events, global or local, can in principle influence the house prices in the same direction at the same point in time. This should be considered when interpreting the results.

1.2 The hedonic house price model setup

The impact of urban renewal and cultural heritage investment in Godsbanen and Christiansfeld is estimated using a difference-in-difference hedonic house price model that includes a spatial-temporal lag innovation. The model uses a simple linear OLS estimator with semi-log functional form.

Formally, the model specification is:

$$Log(P_{ijt}) = \beta_0 + \beta_1 area_j + \beta_2 event_t + \beta_3 area_j * event_t + \boldsymbol{\beta} \quad X_i + \rho \, info_i + \varepsilon_{ijt} \qquad (1)$$

Where, P is the property price individual sold properties (*i*), and X is a matrix of housing characteristics, e.g., proximity to infrastructure and green areas, square meters and so forth. The βs are the parameter estimates, which indicate the effect of the associated variable. $area$ is a dummy variable, which has the value 1 if the property is in the treatment group and 0 otherwise. The treatment group in the Godsbanen analysis is defined by large infrastructure systems that carve out a section of the city where Godsbanen is located. The treatment group in the Christiansfeld case is the entire town relative to other towns in the southern part of Jutland (see survey section). The variable $event$ is a dummy variable indicating events such as time of project investment or time of project accomplishment specific to Godsbanen or Christiansfeld. The interaction term $area$* $event$ captures the effect of the event on the treatment group while the treatment and event per se is controlled for separately. This way, the interaction term captures the effect of urban renewal and cultural heritage investment in the area of interest. However, events within the same period, which have an impact on the housing market, not controlled for in the model could influence the estimate, either in a positive or negative direction.

ϱ is a parameter estimate of the information effect ($info$) that households obtain by looking at the prices of similar houses. The variable info is constructed by first restricting the distribution of sold properties that enters the model in time and space and secondly from the restricted distribution identifying the median price of the five nearest houses in mathematical space. The restriction to the distribution of sold houses is set to 1 km and 365 days of each house. From the restricted distribution, the five nearest houses are found using propensity score matching. Each sold property is matched based on the following characteristics: size, age, number of rooms, distance to nature and urban diversity.

The info variable is applied to capture spatial autocorrelation similar to models that have a spatial lag term. The main difference between the two terms is that more reflection has gone into what constitutes a neighbour in the creation of the info variable – a classical spatial lag dependent term often only account for space. An additional benefit of the info variable is that the info variable can be treated as a regular variable. This is not the case for a spatial lag dependent term, which suffers from endogeneity.

In both cases, we estimate the models with robust standard errors as a Breuch-Pegan test indicates heteroscedasticity. That means the error-term is not constant for different levels of the explanatory variables. The robust standard errors correct for this.

1.3 Data

The data were collected from the OIS database that contains the Building and Housing register (BBR), the Property Register (ESR) and Public Sales and Assessment register (SVUR). Data contain a large number of spatial variables constructed from the spatial Geodanmark database and the central business register (CVR). The housing data that were constructed from the OIS database contain unique geographical coordinates for each address. This made it possible to construct spatial variables in the R environment using the packages rgdal and rgeos (Bivand & Rundel, 2018; Bivand et al., 2018; R core team, 2019). The spatial variables capture location-based housing characteristics relevant to households, such as the presence of a nearby train station or location of a green space relative to each house.

All distance measures in the models are Euclidian distances. The variables are defined as the proximity rather than the distance. We chose this representation to ease interpretation of the estimates: the closer you live to a positive good, the higher the estimate and vice versa. The proximity is calculated as $proximity = cutoff - distance$. Beyond the cut-off, the proximity is set to zero. That is, after the cut-off, the variable does not have an effect on the price. The cut-off distance is the distance, after which the variable does no longer have a significant impact on the price based on previously findings (e.g. Lundhede et al. 2013; Panduro & Veie 2013). Cut-off distances are provided in the summary table in Appendix A.

The dataset includes a number of structural variables such as the size of the house, the number of rooms, the type of house, if it has a parking lot or an outhouse, a dummy variable for the year of construction and renovation within an interval, wall materials, roof materials, and the heating source. The dummy variables for construction years are pooled based on different peaks in construction observed in the dataset. Houses constructed within the same period are assumed to be similar with respect to materials and style. This simplification has been used in previous studies (Panduro & Veie, 2013; Panduro & von Graevenitz, 2015), but is a generalization and does not necessarily capture the condition of the house. The dataset also contains variables for the proximity to forest, lake, and wetland, and the proximity to infrastructure such as highways and larger roads, railways, and train stations. Further, the urban diversity variable is an index for the diversity of the service industry in the neighbourhood. Finally, the dataset has variables controlling for the time of sale, as a continuous variable for the specific date and as dummy variables for year of sale. By including these variables, we control for various trends in the price development, such as the financial crisis or the long-term general increase in prices.

The housing data for Godsbanen consist of apartment sales from year 2001 to 2018. Only apartments sold at a price above 100.000 DKK and below 15 million DKK enter into the analysis. Small apartments below 10 m^2 and very large apartments above 800 m^2 were removed from the analysis, as these homes are too different from other apartments. The likeliness that these extreme apartments are part of the regular market in the area is small.

The entire market for owned apartments in the largest area of Aarhus is 21,904 apartments by the end of 2018. In the analysis, we have 20702 sales during the entire period. The same apartment could be s sold more than once. Within the outer ring road O2, the entire market consists of 14,764, whereas the analysis is based on 15,739 sales. Within the inner ring road of Aarhus O1, our sample is 11,388 apartments, whereas the entire market is 10,879 apartments. Within the Godsbanen area, the entire market for owned apartments is constituted by 1,408 apartments. The analysis is performed on 1,398 sales.

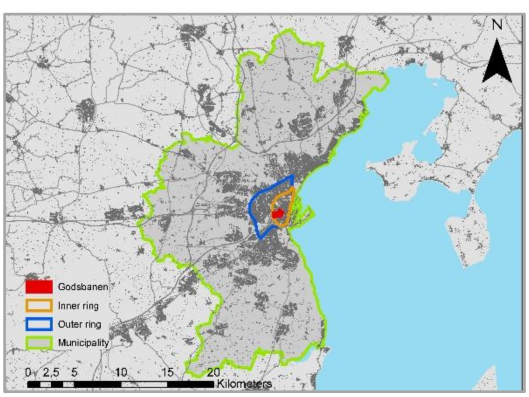
The housing data for Christiansfeld consist of 4,496 housing sales from the year 2000 to 2018. Data for Christiansfeld are restricted to single-family houses and rowhouses as there are very few apartments within the survey area. Only houses sold at a price above 100.000 DKK and below 13 million DKK enter into the analysis. Houses smaller than 20 m^2 and very large houses above 400 m^2 were removed from the analysis, as these homes are too different from other houses. The likeliness of these extreme houses to be part of the regular housing market in the area is small. Similarly, only houses within the town-polygons are a part of the dataset, not houses located in the rural areas.

The analysis is based on 787 sales out of the totally 1,016 owned houses in Christiansfeld. In the eight towns together, there are 10,223 owned houses. The analysis is performed on 4,496 sales.

1.4 The baseline - survey area

Godsbanen is located in a section of Aarhus city that borders railway lines, large roads and the Aarhus Å. In this analysis, we define this section as the Godsbanen area. We assume that the benefits, which can be attributed to Godsbanen, can be found here. We essentially assume that the benefit of Godsbanen is spatial discontinuous. Infrastructure intersects the city, which cut the urban landscapes into actual and perceived sections. In this manner, infrastructure, nature areas and parks create borders in the urban landscape, which restrict and concentrate activities that make the sections distinctly different from each other, in other words that make them neighbourhoods (Panduro & Veie, 2013). The apartment in the Godsbanen area enters into our model as the treatment group in equation 1, while the rest of the survey area is treated as baseline.

Results may be sensitive to the choice of the area entering the treatment group 0 (baseline). Therefore, three distinct survey areas are used in the model estimation, one at municipality level, one at the outer ring road level of Aarhus and one at the inner ring road level of Aarhus. The outer and inner ring are defined by roads, which facilitate much of the transportation in Aarhus. The ring roads also outline different levels of urbanity. The inner ring represents the city centre while the outer ring represents a larger urban area. Outside the outer ring, Aarhus turns into commuter suburbs.



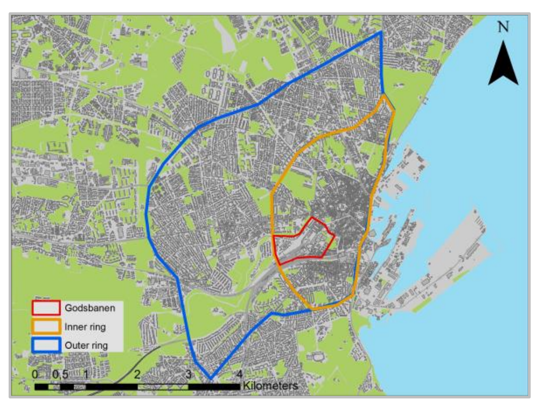


Figure 4. *The map to the left presents an overview of the different analysis areas. That is the municipality, the outer ring, and the inner ring. The right map shows a more detailed map of the outer ring and the inner ring of Aarhus.*

In the Christiansfeld case, the entire town of Christiansfeld is defined as treatment area. Initially all properties in southern Jutland were defined as the non-treated area (baseline), but variation is huge in this dataset (covering countryside to cities over large distances). Thus, the baseline consists of selected towns in southern Jutland. The towns are of similar size and have all previously been the main town of a municipality before the structural reforms of the Danish municipalities in 2007. The towns of Vojens, Lunderskov, Vamdrup, Gram, Rødding, Holsted, and Brørup are all included in the analysis. While the baseline towns share similar characteristics, Christiansfeld is distinctly different, being the only cultural heritage site.

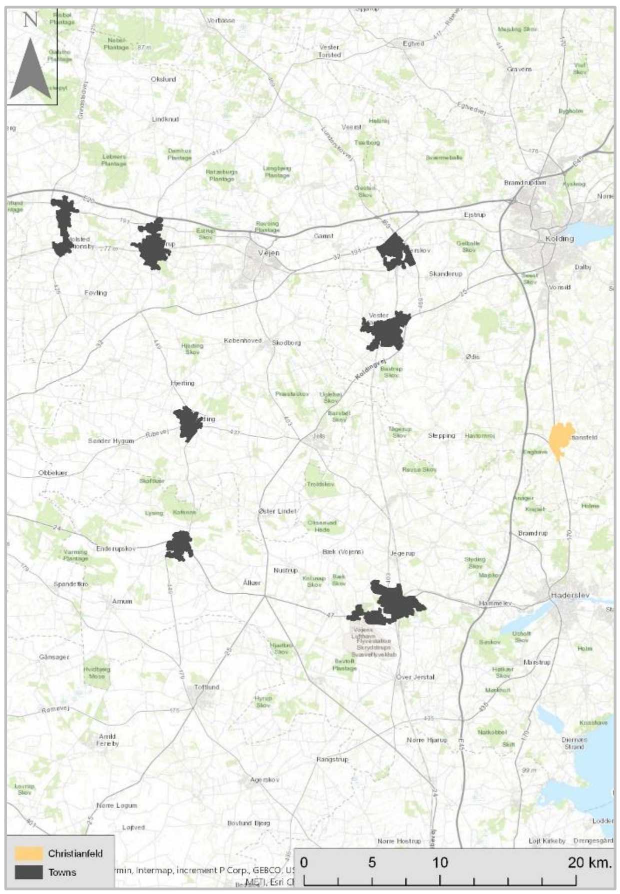


Figure 5. *The map for Christiansfeld and the location of the other towns in the analysis*

1.5 Results

Godsbanen – Results

In table 1, selective variables and model statistics for the Godsbanen case are presented. Three models are presented with different spatial extent of the survey area, i.e., at municipality level, Outer ring of

Aarhus and Inner ring of Aarhus, respectively. Full model estimates can be found in Appendix C. The model estimates are presented with robust standard errors. All three models have a reasonable explanation power.

The variables in table 1 include dummy variables for the periods of 2008-2011 and 2012-2018 and a spatial dummy variable that describe whether the apartments are located in the Godsbanen area. The period of 2008-2011 represents the planning and construction period of Godsbanen and the period of 2012-2018 represents the period that Godsbanen have been open for activities. The period dummies and the Godsbanen dummy are all negative in all models. These results indicate that sales prices are lower in the Godsbanen area relative to the other areas in the survey areas and that prices in the survey areas in general have been lower relative to the baseline period 2001-2007. The interaction between the early period of 2008-2011 and the Godsbanen dummy is also negative. However, the interaction between the later period 2012-2018 and the Godsbanen dummy is positive, having a price increase between 7 and 12 per cent depending on the model.

To ensure the robustness of the model estimates the outline of the Godsbanen area was varied using both a more spatially restrictive area to describe Godsbanen and spatially less restricted area to describe the Godsbanen area. A similar pattern like the one presented in table 1, was found for both alternatives to the Godsbanen area. Furthermore, we tested an additional pseudo-event at the city centre of Aarhus happening during the period of 2012-2018. Essentially accounting for non-existing events in other areas of the city. The treatment and event where modelled using a similar difference-in-difference approach as the outline in equation 1. We did this to ensure that the impact of Godsbanen found in the models in table 1 were not part of a greater price trend covering the larger city centre. We found the estimates for Godsbanen in table 1 were stable with the additional pseudo sensitivity specification.

Table 1. *Model diagnostics and selected parameter estimates for Godsbanen.*

	Large model	Outer ring model	Inner Ring model
2008-2011	-0.288*** (0.010)	-0.304*** (0.012)	-0.296*** (0.015)
2012-2018	-0.409*** (0.016)	-0.413*** (0.018)	-0.399*** (0.023)
The Godsbane area	-0.070*** (0.017)	-0.0007	-0.099*** (0.021)

	Large model	Outer ring model	Inner Ring model
The Godsbane area * 2008-2011	-0.00132	-0.055** (0.028)	-0.072** (0.029)
The Godsbane area * 2012-2018	0.118*** (0.020)	0.085*** (0.020)	0.069*** (0.022)
Constant	12.668*** (0.042)	12.905*** (0.062)	12.178*** (0.133)
Spatial-temporal lag	0.157*** (0.007)	0.148*** (0.009)	0.150*** (0.010)
Observations	20,702	15,739	11,388
R^2	0.682	0.653	0.59
Adjusted R^2	0.682	0.652	0.588
Residual Std. Error (df = 20640)	0.305	0.308	0.32
F Statistic (df = 61; 20640)	727.199***	590.836***	354.117***

Note: The full model can be found in Appendix C

Christiansfeld – Results

We estimate three models for the Christiansfeld case: a linear model and two spatial-temporal lag models. We estimate the spatial-temporal lag models with the full dataset and with a smaller dataset where we have removed influential outliers based on the Cook's distance (Cook & Weisberg, 1982) using the Cook's distance function from the CAR 3.0-3 package in R (Fox & Weisberg, 2019). The full dataset has 4,496 sales from 2000 to 2018. The dataset used for the first spatial-temporal lag model has 4,233 as the observations from sales year 2000 have no value in the temporal spatial lag variable. The dataset with removed outliers contains 3,975 sales from 2001 to 2018. In table 2, model estimation is presented for the Christiansfeld case for selected variables. The model estimates are presented with heteroscedasticity robust standard errors. The entire model estimates can be found in Appendix B.

Model fit

Models 1 and 2 explain about 37 per cent of the variation in house prices in the dataset (Adjusted R^2 = 0.37 and 0.38), whereas model 3 has a better fit with an adjusted R^2 of 0.60.

After having restricted the dataset to houses from 100.000 DKK to 13 million DKK, model fit improves considerable, but much unexplained variation in the prices remains. This is due to a high diversity in the quality of the houses, which is unobserved in the data, and also due to a small number of sales. When the number of sales in the data is low, few outliers have a large influence on the price. In model 3, we have removed sales that are highly different from the rest of the dataset and have a large influence on the parameter estimates. When we exclude these observations, the model has a higher explanatory power.

The value of living in Christiansfeld and of the urban renewal

Across all models, the variable of living in Christiansfeld has a significant and positive effect. The effect is measured relative to houses in the town Brørup. The price of a house in Christiansfeld is on average between 12.7 and 22.6 per cent higher than the price of a house in Brørup. Christiansfeld has the largest positive difference of all towns when looking at the estimates from model 3 and the second largest when looking at model 1 and 2 – here Vamdrup is larger.

To measure the effect of the urban renewal, corresponding time variables interacted with the treatment area are included for phase two of the Christiansfeld project which ended in 2007, and phase three which ended in 2015. Christiansfeld was also appointed a UNESCO world heritage in July 2015.

The interaction between the treatment group and the investment event, shows that the houses prices increase by about 5 per cent during the second half of phase 3 (2012-2015) and by about 12 per cent in the period 2016-2018 after the completion of the project in phase three relative to before 2007. Only estimates of the effect after the project was completed are significant at 10 per cent level and only for model 1 and 2.

In conclusion, only two out of the three models show an effect. The third model, the one with the best model fit, shows no effect. It can be argued that effects of urban renewal are long-term and therefore effects are only seen in the long run. Yet, the signal found here is, at best, very weak. Therefore, we do not proceed to calculate welfare effects of the investments.

Table 2. Selective model estimate for Christiansfeld

	Model 1	Model 2	Model 3
Christiansfeld	0.183*** (0.070)	0.127* (0.073)	0.226*** (0.052)
Vojens	-0.004 (0.028)	-0.013 (0.029)	0.005 (0.021)
Lunderskov	0.146*** (0.035)	0.109*** (0.037)	0.132*** (0.027)
Vamdrup	0.200*** (0.027)	0.176*** (0.029)	0.171*** (0.020)
Gram	-0.237*** (0.064)	-0.210*** (0.066)	-0.147*** (0.047)
Rødding	-0.027 (0.068)	-0.021 (0.070)	-0.004 (0.050)
Holsted	-0.246*** (0.035)	-0.199*** (0.036)	-0.163*** (0.026)
Year 2007-2011	0.240*** (0.032)	0.198*** (0.033)	0.174*** (0.023)
Year 2012-2015	0.124** (0.060)	0.125** (0.061)	0.068 (0.043)
Year 2016-2018	0.228*** (0.083)	0.193** (0.083)	0.094 (0.059)
Christiansfeld * y2007-2011	-0.007 (0.053)	-0.009 (0.055)	-0.003 (0.039)
Christiansfeld * y2012-2015	0.057 (0.061)	0.061 (0.063)	0.047 (0.045)
Christiansfeld * y2016-2018	0.128* (0.066)	0.123* (0.068)	0.049 (0.049)
Spatial temporal lag median		0.00000*** (0.00000)	0.00000*** (0.00000)

	Model 1	Model 2	Model 3
Observations	4,496	4,233	3,976
R^2	0.369	0.378	0.603
Adjusted R^2	0.361	0.370	0.597
Residual Std. Error	0.432 (df = 4441)	0.432 (df = 4177)	0.295 (df = 3920)
F Statistic	48.117*** (df = 54; 4441)	46.238*** (df = 55; 4177)	108.251*** (df = 55; 3920)

Note: *p<0.1; **p<0.05; ***p<0.01

1.6 Welfare impact of Godsbanen on the neighbourhood

The model estimates in table 1 indicate that apartment prices have increased with 7-12 per cent in the Godsbanen area after the opening of Godsbanen relative to other parts of the City of Aarhus. There are 2,514 apartments located within the Godsbanen area – this number includes privately owned, community owned and non-profit apartments. The apartments in the Godsbanen area modelled to have predicted selling prices ranging from 1.9 to 7 million DDK with a mean price of 3.3 million DDK in June 2018. The parameter estimates of the models indicate that the mean apartment will have an additional price premium of 230,000 to 400,000 DDK relative to similar apartments not affected by the Godsbanen project. The aggregated price increase for the 2,514 apartments range from 0.57 to 0.97 billion DDK depending on which model is used. This price increase can be interpreted as the capitalized effect resulted from the urban development in the Godsbanen area, including potential feedback loop effects.

The capitalized impact of Godsbanen is calculated using equation 2:

$$Impact = \sum_{i=1}^{N} \hat{P}_i * \hat{\beta}_3 \qquad (2)$$

The predicted price ($\hat{P}$) is estimated for each individual apartment (i) in the Godsbanen area for the three hedonic models presented in Appendix C. The prices are predicted for June 2018. The predicted price is multiplied with the parameter estimate ($\hat{\beta}_3$) that describe the interaction term between the temporal development and the Godsbanen area (see equation 1) and then aggregated over the *N* apartments.

Godsbanen has been a major factor to the urban development in the Godsbanen area. Still, other factor may also have influenced and increased the attractiveness of the area. The development of the other cultural institutions in the vicinity may have been a contributing factor for the overall attractiveness of the area. Even the urban transformation of post-industrial/harbour sites has in general attracted development.

The capitalized impact can be interpreted in a welfare economic context as the lower bound for the actual welfare impact. The implication is that the 0.57 to 0.97 billion DDK represent a lower-bound estimate of the true welfare economic impact. How much higher the effect is difficult to say with the chosen identification method.

Table 3. *Capitalized impact of Godsbanen*

Model	N number of apartments	Min price	Mean price	Median price	Max price	Capitalized Impact
Large Model	2514	1.9	3.3	3.1	6.9	972
Outer ring	2514	1.9	3.4	3.2	7.1	717
Inner ring	2514	2.1	3.3	3.2	6.7	571

Note: All prices are in million DDK in 2018 prices and are priced from the three models

Part 2

2.1 Estimating the investment-benefit for companies

The benefit that companies obtain from being in a more attractive town centre or urban area is not easily observable as most of it is private information. Yet, outside factors do affect companies, and here we attempt to estimate these. The survival of a business is generally related to the economic situation within the firm and therefore business survival may be a good instrument for measuring whether a town has a strong business environment and, in part, whether urban renewal investments change the survival rate of business in the town/urban area. To measure such changes in the composition in a town or urban area, we can look at opening and closing of businesses. While opening can be driven by the same factors, it is also highly dependent on expectations. Closing on the other hand, says something about how successful they are ex post – i.e. whether expectations hold. Therefore, looking at a survival analysis – how long-time businesses survive is an indicator of competitor advantages. If compared with other and similar locations, but without large investments in urban development, differences in survival between the sites can be an indicator of an effect of the investment. Thus, as for the Part 1, we rely on a difference-in-difference approach. While survival analysis is an indicator of the economic benefit of urban renewal/investment, it is not directly transferable into a welfare economic estimate like the house price analysis. We therefore look at it as an indicator itself.

2.2 Survival analysis

Sampling and censoring

This report uses flow sampling to gain information regarding business survival in eight Danish cities. We do this by collecting data on all firms that start up in the sampling period, which runs from 1996 until 2016. Along the sampling, we survey the firms until 2019, which gives an effective survey period of 23 years. This is visualised in figure 5, for which the black dots mark the start each firm and white dots the time of closure of the firm.

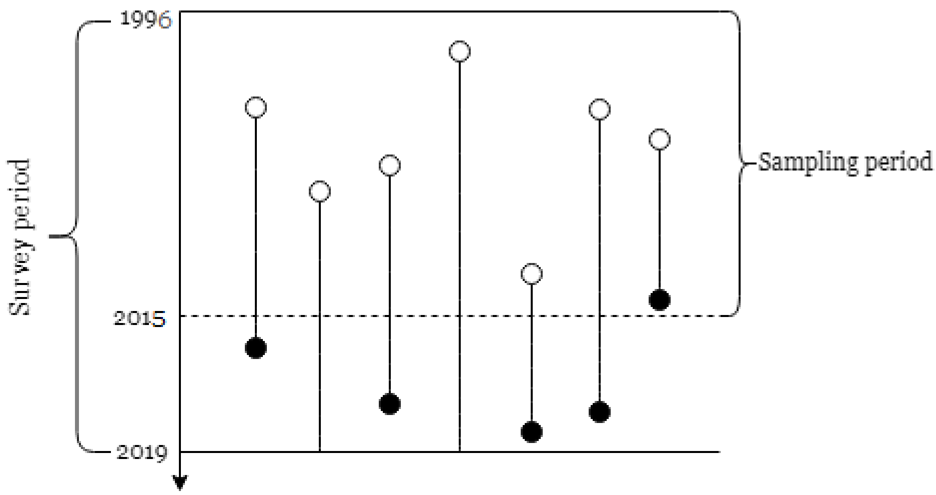


Figure 6. *Visual representation of censoring.*

Note: White dots represent start dates, black dots end dates and any missing dots are censored observation that still exist.

The variables of interest in these types of models are both the duration of the firm and whether the firm cease to exist at the end of the observable period. By the nature of this type of data, we will end up with some firms that have not ceased to exist by the end of the period. These firms are censored, by the nature of time, as some firms will have survived until today. The cox proportional hazard model is better suited to handle the firms that survive to the end of the analysis period.

2.3 The cox proportional hazard model

In order to estimate the survival rate depending on differences in characteristics of individual firm observation, we employ an estimation strategy that incorporates the concurring element of the data. One such model is the cox proportional hazard model (Cameron & Trivedi, 2005) allowing for time varying covariates:

$$\lambda(t|\boldsymbol{X}) = \lambda_0(t)\phi(\boldsymbol{X}(t), \beta)$$

The model explains the hazard rate λ in a given period t. The right hand side contains a baseline hazard, $\lambda_0(t)$ which represents the risk that a business cease to exist in a given period t, where all other factors are zero $x_i = 0$, at duration t, and thereby serve as a reference group. $\phi(.)$ is an adjustment parameter, which depends on the $(n \times k)$ matrix $\boldsymbol{X}$ of firm-specific characteristics. We assume a simple exponential hazard function $\phi(.) = \exp(.)$. Thus, when estimating the $(k \times 1)$ vector of parameters

(β), a negative operational sign will decrease the hazard rate - i.e. increase the survival rate - and vice versa. This method then extends easily to incorporate the difference-in-difference setup:

$$\lambda\left(t \middle| X(t), area_j, event_h\right) = \lambda_0(t) * \exp\left(\beta_1 area_j + \beta_2 event_h + \beta_3 area_j * event_h + \boldsymbol{\beta} X(t)\right) * v$$

Although the interpretation is different from the ordinary setup, this gives an interpretable effect measure. As in the ordinary difference-in-difference setup, this includes a variable for the area (β_1) to control for the general area difference, the event in this case the investment (β_2) and an interaction term, which is our effect measure (β_3). Lastly, we have some general control variables for the type of firm and the activity of the firm ($\boldsymbol{\beta}$).

2. 4 Data sources

The data used in this analysis are supplied by the Danish Business Authority's Danish Business register (CVR) which logs all Danish based firms in a digital database. In order for a firm in Denmark to function, it has to have a valid CVR-number, which functions as a unique identification for the overall business. The register logs information about every Danish business such as location, main type of operation, secondary type of operation, approximate number of employees, business type, etc. A Danish firm is by law restricted to change its information in this system every time a change is made to it.

The register has several parts. The main one is described above. The second is the production unit register, which is a register that logs information on each unit under a CVR-number that produces a good or service. The production units are logged separately and given unique codes, p-numbers. The p-number contains information about the geographical address, the type of operation done at the production unit, the CVR number of the main firm and other site-specific characteristics. This is the main register of interest for our analyses.

To create a geographical file, we merge the CVR register containing addresses with The Danish Agency for Data Supply and Efficiency's Address register (AWS.dk). We refer to the same database for geographical data, in this analysis, as in the housing analysis.

2.5 Descriptive statistics

Diversity index

Business diversity may be seen as another measure of urban development. It is made by looking at how many different types of service that is present at different site. The changes in service diversity for the Godsbanen area is depicted in figure 6. The changes in diversity for the Godsbanen area happens before the opening of Godsbanen in 2012 after which the diversity level stabilises. There does not seem to be an effect of the opening of the Godsbanen.

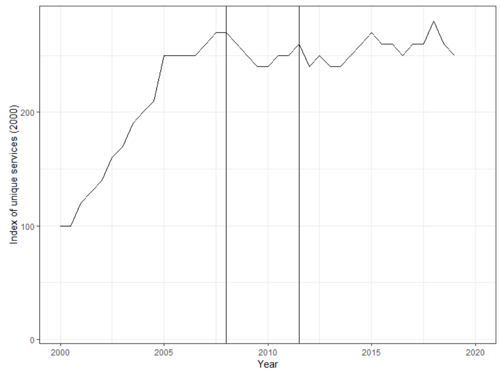


Figure 7. *The relative increase in services in the Godsbanen area from 1990 to 2019.*

Note: The line is indexed in 2000 to 100.

The service diversity of the central part of the town of Christiansfeld and seven other towns centre similar to Christiansfeld is investigated similar to the Godsbanen case. The town centre represents the "shopping" area of each of the eight towns.

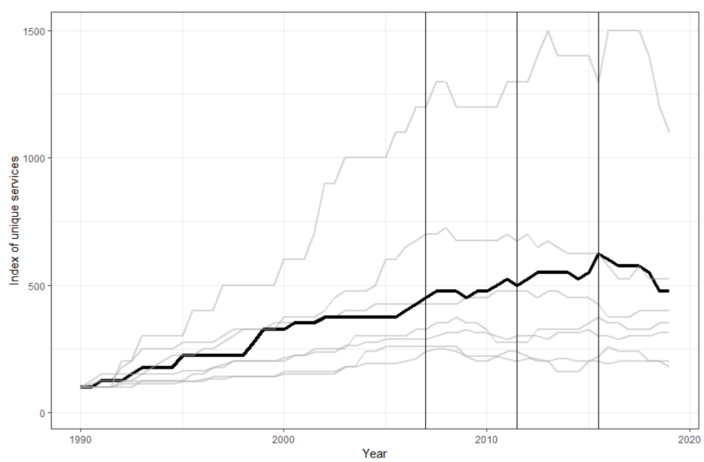


Figure 8. *Change in number of unique services relative to the start year 1990 for Christiansfeld (black line) and the seven comparable cities in southern Jutland (grey lines).*

The main visual finding from this figure is that Christiansfeld is in the high end of the development, and especially during the late 1990's, it rises. Lunderskov stands out in figure 8 as having a high increase in diversity. This is due to the very low amount of service diversity in 1990 so relatively small increases will give the impression of high service diversity development.

At the end of the period, we see a drop in the index. This might be a result of an increased specialisation focus within the city, to supply services related to higher extend then previous in tourism related industries.

Voluntary association

Because the investment in Christiansfeld is closely related to the local environment, we look at changes in voluntary associations. This is used as a proxy to the amount of local activity within the towns, compared to the other eight towns. As seen in figure 8, there is no general sign that the amount of voluntary associations rose more in Christiansfeld than the other towns after the investment ended (year 2015). There is a general tendency for more voluntary association to start in the period, but nothing seems linked to the investment.

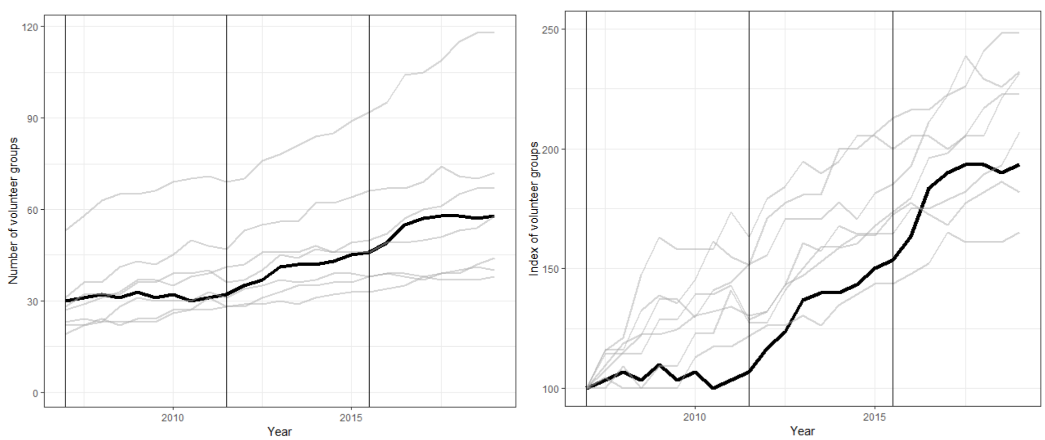


Figure 9. *Depict the increase in the number of volunteer groups in Christiansfeld and the comparing cities. Left is real number of volunteer groups, right is index set in 2007.*

One problem with this type of analysis on the available data would be that most voluntary associations have their address with the founder or ongoing chairperson, which might not be in the city, and in some situations even in other nearby cities.

Cox proportional hazard model - Godsbanen

Table 4. *Cox proportional hazard model - Godsbanen*

	Model 1
Year 2008-2011	0.201*** (0.024)
Year 2012 -	-0.220***(0.036)
Godsbanen	0.173*** (0.048)
Start time	0.097***(0.003)
Godsbanen * Y2008-2011	0.099 (0.078)
Godsbanen * Y2012	-0.234*** (0.07)
Activity code dummies	....
Firm structure dummies	....
Observations	1,032,581.00
R^2	0.021
Max. R^2	0.0479
Log Likelihood	-325214.00
Wald Test	23,317.000*** (df=94)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 4 above shows the result of running the time varying cox proportional hazard model for the Godsbanen area and the rest of Aarhus. For this area, we find negative estimates of the post-opening period, meaning positive effects on survival for the firms in the area. Furthermore, we find higher effects in the later years. The post-opening effect is that the half-yearly survival rate increases by 20 per cent in Godsbanen compared to the firms in the rest of Aarhus. This corresponds to a different 75 and 79 per cent survival after 3 years. Otherwise, we do see that the Godsbanen area has lower survival rates before the investment, which might suggest that the area was not very beneficial for local business. It can be added, that during the reconstruction period this rate fell even more, although the effect is non-significant.

Cox proportional hazard model – Christiansfeld

Table 5. *Cox proportional hazard model – Christiansfeld*

	Model 1
Year 2007 - 2011	0.086 (0.064)
Year 2012 - 2015	-0.250*** (0.082)
Year 2016	0.713*** (0.108)
Christiansfeld	-0.301* (0.154)
Christiansfeld * Year 2007 - 2011	0.277 (0.213)
Christiansfeld * Year 2012 - 2015	-0.022(0.226)
Christiansfeld * Year 2016	0.435**(0.219)
Start time	0.091*** (0.008)
Area dummies	….
Firm structure dummies	….
Activity code dummies	….

	Model 1
Observations	46912
R squared	0.028
Max. R squered	0.504
Log Likelihood	-15791
Wald Test	1,289*** (df = 97)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 5 above shows the estimation results from the time varying cox proportional hazard model for Christiansfeld. The key factor of this model is that there is no effect on the short term of the investment (Christiansfeld * Year 2007 – 2011 & Christiansfeld * Year 2012 – 2015), but we find positive estimates, meaning negatives effect on survival, on the post investment (y2016:Christiansfeld). This might suggest that the local firms had too high expectations of the effect, so more shops had to shut down. Although this is the case we see a general increase in the survival rate over the entire period which strengthens our result towards no or very small effects in regards to business survival of the investment.

Though some of the results are significant, it should be pointed out that the model only, to a very low degree, explains the general variation in the data. This is highly likely to be a case of unobservable variation missing in the model, such the amount of start capital, turnover, profit etc. that are all known to be highly correlated with the survival rate.

3. Discussion

In this report, we analysed the indirect benefit from investing in industrial revitalization projects and cultural heritage projects represented by the Godsbanen and Christiansfeld cases. The results can not be transferred to other projects given the uniqueness of Godsbanen and Christiansfeld cases. However, the methods to understand the indirect benefits of Godsbanen and Christiansfeld can be applied to similar projects.

Godsbanen

Our results show that it has become more attractive to live in the Godsbanen area over time. In the period 2012-2018 prices for apartments has increased 7-12 per cent more in the Godsbanen area than in other parts of Arhus. The aggregated welfare gain experienced by the Godsbanen area renewal is between 0.57 and 0.97 billion DKK. Our results also show that companies located in the Godsbanen area are 1.2 times more likely to survive compared to companies in the rest of Aarhus in the same period. Service diversity is an indicator variable for attractive urban spaces. Therefore, the hypothesis was that service diversity would increase with increased number of visitors to the neighbourhood. We found that the diversity of service provision increased at the beginning of the 00s and does not seem to have changed since the opening of Godsbanen in 2012. Therefore, we must reject this hypothesis.

Christiansfeld

The results for Christiansfeld are less clear-cut. The house price models show that Christiansfeld has always been an attractive town compared to other provincial towns in southern Jutland based on the price premium for houses in Christiansfeld, other things equal. The models do not show very robust results and we cannot show that project in Christiansfeld has been important for people's housing choices. For two out of three models, we find a positive willingness to pay for the period after the completion of the project, which in time coincides with the appointment of Christiansfeld to UNESCO world cultural heritage site - but again the results are uncertain.

House prices are, in principle, capitalized future values. The services and characteristics in neighbourhoods are expected to persist. When people buy a home, it is among other things based on such an expectation of the future, which is of course uncertain. This uncertainty can reduce household’s willingness to pay, as the uncertainty of outcome is a cost to the household. This may be one explanation for the lack of robust results in relation to the appointment of UNESCO site. Another is the data as discussed below.

The results of our company analysis show that companies in Christiansfeld are more likely to close than companies are in some of the other major provincial towns in southern Jutland. That is the opposite of our expectation. One possible explanation may be that companies had to high expectations to the investments in Christiansfeld. The service supply has increased since the beginning of 1990 and has increased relatively more compared to other provincial towns. In the last period from 2016 to 2018, the service supply decreased in Christiansfeld.

Issues with the baseline

Godsbanen and Christiansfeld are placed in contexts that make the projects unique. It makes the cases difficult to compare with other locations. Therefore, it is difficult to establish a credible baseline. For Godsbanen, the entire Godsbanen area is compared to the rest of Aarhus, while Christiansfeld is compared to other provincial towns in southern Jutland. We have chosen to analyse the effect of the projects with the difference-in-difference technique. This approach is "state of the art" in empirical causal analysis, in situations where controlled experiments are not possible. With the difference-in-difference approach, the effect of the opening of the Godsbanen and the renovation of Christiansfeld should be isolated.

Nevertheless, the method is no stronger than the data it is based on, including how the baseline is defined. It relies on correlating changes over time to a given event – and other changes that the researchers are unaware of and which have occurred at that same time may play a role. This means that defining comparative sites and controlling for other effects is essential. Christiansfeld is by far more special than Godsbanen. This makes the establishment of a credible baseline considerably more difficult for Christiansfeld, but it also means that the analysis of the Godsbanen project is more robust. This challenge is likely to apply to other benefit analysis of cultural heritage projects. The calculations of the indirect benefit from industrial revitalization projects will be easier to implement and deliver more robust results than the cultural heritage projects, as the revitalization projects typically can be based on a stronger baseline.

Other values

The report only deals with the indirect benefits of Godsbanen and Christiansfeld. We have not analysed the direct benefits that arise when people make use of the facilities of Godsbanen or visit Christiansfeld. We have also not investigated the benefits of the preservation and existence of Godsbanen and Christiansfeld. Both aspects are crucial if you want to understand the total value of Godsbanen and Christiansfeld.

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Appendix - A

A1 Descriptive Statistics of Christiansfeld datasets

Descriptive statistics Christiansfeld Model 1							
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Log(price)	4,496	13.684	0.541	11.527	13.385	14.039	16.293
Size (in m^2)	4,496	141.950	42.474	44	113	163	462
Rooms	4,496	4.761	1.371	2	4	5	14
Car park	4,496	0.104	0.306	0	0	0	1
Outhouse (in m^2)	4,496	2.894	7.819	0	0	0	100
Rowhouse (dummy)	4,496	0.112	0.315	0	0	0	1
Farmhouse (dummy)	4,496	0.011	0.104	0	0	0	1
Built before 1875 (dummy)	4,496	0.050	0.218	0	0	0	1
Built 1875-1894 (dummy)	4,496	0.022	0.146	0	0	0	1
Built 1895-1909 (dummy)	4,496	0.049	0.217	0	0	0	1
Built 1910-1944 (dummy)	4,496	0.105	0.307	0	0	0	1

Built 1945-1959 (dummy)	4,496	0.104	0.306	0	0	0	1
Built 1960 -1979 (dummy)	4,496	0.407	0.491	0	0	1	1
Built 1980-1994 (dummy)	4,496	0.112	0.316	0	0	0	1
Built 1995-2009 (dummy)	4,496	0.139	0.346	0	0	0	1
Built 2010-2018 (dummy)	4,496	0.011	0.106	0	0	0	1
Brick (dummy)	4,496	0.864	0.343	0	1	1	1
Concrete (dummy)	4,496	0.007	0.085	0	0	0	1
Flat roof (dummy)	4,496	0.027	0.163	0	0	0	1
Tile roof (dummy)	4,496	0.167	0.373	0	0	0	1
Thatched roof (dummy)	4,496	0.001	0.033	0	0	0	1
Woodburning stove (dummy)	4,496	0.166	0.372	0	0	0	2
Heatpump (dummy)	4,496	0.013	0.113	0	0	0	1
Electric heating	4,496	0.018	0.133	0	0	0	1

Central heating (dummy)	4,496	0.266	0.442	0	0	1	1
District heating (dummy)	4,496	0.509	0.500	0	0	1	1
Renovation in 1970s	4,496	0.083	0.276	0	0	0	1
Renovation in 1980s	4,496	0.045	0.207	0	0	0	1
Renovation in 1990s	4,496	0.053	0.224	0	0	0	1
Renovation in 2000s	4,496	0.054	0.226	0	0	0	1
Renovation in 2010s	4,496	0.033	0.180	0	0	0	1
Urban diversity (number of different services)	4,496	14.450	7.767	0	8	20	29
Nearness forest (0-1000 m)	4,496	769.894	157.870	131.369	669.112	895.097	993.584
Nearness lake (0-600 m)	4,496	210.339	163.432	0.000	49.683	341.716	584.929
Nearness wetland (0-600 m)	4,496	91.492	152.624	0.000	0.000	165.037	577.026
Nearness highway (0-1000 m)	4,496	6.261	46.307	0.000	0.000	0.000	593.900

Nearness large roads (0-500 m)	4,496	252.815	171.264	0.000	82.483	405.066	492.059
Nearness railway (0-500 m)	4,496	93.970	145.890	0	0	175.4	484
Nearness trainstation (0-5000 m)	4,496	2,890.902	1,836.713	0.000	0.000	4,346.076	4,974.838
Christiansfeld (dummy)	4,496	0.100	0.300	0	0	0	1
Vojens (dummy)	4,496	0.238	0.426	0	0	0	1
Lunderskov (dummy)	4,496	0.119	0.324	0	0	0	1
Vamdrup (dummy)	4,496	0.204	0.403	0	0	0	1
Gram (dummy)	4,496	0.090	0.286	0	0	0	1
Rødding (dummy)	4,496	0.061	0.240	0	0	0	1
Holsted (dummy, base)	4,496	0.088	0.283	0	0	0	1
Sales date (numerical)	4,496	14,046.220	1,917.426	10,959	12,480.8	15,611.5	17,674
2007-2011 (dummy)	4,496	0.279	0.449	0	0	1	1
2012-2015 (dummy)	4,496	0.153	0.360	0	0	0	1

2016-2018 (dummy)	4,496	0.125	0.331	0	0	0	1

Descriptive Christiansfeld Model 2							
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Log(price)	4,233	13.694	0.545	11.527	13.385	14.047	16.293
Size (in m2)	4,233	142.018	42.501	44	113	163	462
Rooms	4,233	4.761	1.369	2	4	5	14
Car park	4,233	0.107	0.309	0	0	0	1
Outhouse (in m2)	4,233	2.927	7.894	0	0	0	100
Rowhouse (dummy)	4,233	0.111	0.314	0	0	0	1
Farmhouse (dummy)	4,233	0.010	0.101	0	0	0	1
Built before 1875 (dummy)	4,233	0.048	0.215	0	0	0	1
Built 1875-1894 (dummy)	4,233	0.021	0.143	0	0	0	1
Built 1895-1909 (dummy)	4,233	0.049	0.216	0	0	0	1
Built 1910-1944 (dummy)	4,233	0.106	0.308	0	0	0	1

Built 1945-1959 (dummy)	4,233	0.104	0.305	0	0	0	1
Built 1960 -1979 (dummy)	4,233	0.408	0.491	0	0	1	1
Built 1980-1994 (dummy)	4,233	0.110	0.313	0	0	0	1
Built 1995-2009 (dummy)	4,233	0.142	0.349	0	0	0	1
Built 2010-2018 (dummy)	4,233	0.012	0.109	0	0	0	1
Brick (dummy)	4,233	0.863	0.344	0	1	1	1
Concrete (dummy)	4,233	0.007	0.084	0	0	0	1
Flat roof (dummy)	4,233	0.028	0.165	0	0	0	1
Tile roof (dummy)	4,233	0.166	0.372	0	0	0	1
Thatched roof (dummy)	4,233	0.001	0.034	0	0	0	1
Woodburning stove (dummy)	4,233	0.165	0.372	0	0	0	2
Heatpump (dummy)	4,233	0.013	0.113	0	0	0	1
Electric heating	4,233	0.017	0.131	0	0	0	1

Central heating (dummy)	4,233	0.267	0.443	0	0	1	1
District heating (dummy)	4,233	0.509	0.500	0	0	1	1
Renovation in 1970s	4,233	0.084	0.278	0	0	0	1
Renovation in 1980s	4,233	0.044	0.206	0	0	0	1
Renovation in 1990s	4,233	0.052	0.223	0	0	0	1
Renovation in 2000s	4,233	0.051	0.220	0	0	0	1
Renovation in 2010s	4,233	0.034	0.182	0	0	0	1
Urban diversity (number of different services)	4,233	14.450	7.738	0	8	20	29
Nearness forest (0-1000 m)	4,233	769.563	158.054	131.369	669.156	895.097	993.584
Nearness lake (0-600 m)	4,233	209.600	163.381	0.000	47.219	340.537	584.929
Nearness wetland (0-600 m)	4,233	91.056	152.410	0.000	0.000	161.363	577.026

Nearness highway (0-1000 m)	4,233	6.296	46.417	0.000	0.000	0.000	593.900
Nearness large roads (0-500 m)	4,233	252.548	171.488	0.000	81.753	405.374	492.059
Nearness railway (0-500 m)	4,233	93.469	145.724	0	0	171.4	484
Nearness trainstation (0-5000 m)	4,233	2,872.713	1,845.730	0.000	0.000	4,344.342	4,974.838
Christiansfeld (dummy)	4,233	0.102	0.302	0	0	0	1
Vojens (dummy)	4,233	0.236	0.425	0	0	0	1
Lunderskov (dummy)	4,233	0.118	0.323	0	0	0	1
Vamdrup (dummy)	4,233	0.200	0.400	0	0	0	1
Gram (dummy)	4,233	0.093	0.290	0	0	0	1
Rødding (dummy)	4,233	0.062	0.241	0	0	0	1
Holsted (dummy, base)	4,233	0.089	0.284	0	0	0	1
Sales date (numerical)	4,233	14,227.130	1,828.852	11,323	12,756	15,788	17,674

2007-2011 (dummy)	4,233	0.296	0.457	0	0	1	1
2012-2015 (dummy)	4,233	0.162	0.369	0	0	0	1
2016-2018 (dummy)	4,233	0.133	0.340	0	0	0	1
Spatial-temporal lag	4,233	944,516.700	312,660.200	0	720,000	1,125,000	2,700,000

Descriptive Christiansfeld Model 3							
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Log(price)	3,980	13.731	0.465	11.918	13.430	14.047	15.103
Size (in m2)	3,980	140.339	39.772	53	112	161	438
Rooms	3,980	4.730	1.320	2	4	5	14
Car park	3,980	0.093	0.290	0	0	0	1
Outhouse (in m2)	3,980	2.906	7.901	0	0	0	100
Rowhouse (dummy)	3,980	0.109	0.312	0	0	0	1
Farmhouse (dummy)	3,980	0.007	0.081	0	0	0	1
Built before 1875 (dummy)	3,980	0.047	0.213	0	0	0	1

Built 1875-1894 (dummy)	3,980	0.019	0.135	0	0	0	1
Built 1895-1909 (dummy)	3,980	0.019	0.135	0	0	0	1
Built 1910-1944 (dummy)	3,980	0.048	0.214	0	0	0	1
Built 1945-1959 (dummy)	3,980	0.107	0.309	0	0	0	1
Built 1960 -1979 (dummy)	3,980	0.107	0.309	0	0	0	1
Built 1980-1994 (dummy)	3,980	0.424	0.494	0	0	1	1
Built 1995-2009 (dummy)	3,980	0.114	0.317	0	0	0	1
Built 2010-2018 (dummy)	3,980	0.132	0.338	0	0	0	1
Brick (dummy)	3,980	0.003	0.057	0	0	0	1
Concrete (dummy)	3,980	0.132	0.338	0	0	0	1
Flat roof (dummy)	3,980	0.867	0.339	0	1	1	1
Tile roof (dummy)	3,980	0.005	0.071	0	0	0	1
Thatched roof (dummy)	3,980	0.026	0.158	0	0	0	1

Woodburning stove (dummy)	3,980	0.165	0.372	0	0	0	1
Heatpump (dummy)	3,980	0.001	0.027	0	0	0	1
Electric heating	3,980	0.169	0.375	0	0	0	2
Central heating (dummy)	3,980	0.010	0.100	0	0	0	1
District heating (dummy)	3,980	0.017	0.131	0	0	0	1
Renovation in 1970s	3,980	0.265	0.441	0	0	1	1
Renovation in 1980s	3,980	0.514	0.500	0	0	1	1
Renovation in 1990s	3,980	0.086	0.281	0	0	0	1
Renovation in 2000s	3,980	0.044	0.206	0	0	0	1
Renovation in 2010s	3,980	0.053	0.224	0	0	0	1
Urban diversity (number of different services)	3,980	0.050	0.217	0	0	0	1
Nearness forest (0-1000 m)	3,980	0.033	0.178	0	0	0	1

Nearness lake (0-600 m)	3,980	14.542	7.710	0	8	20	29
Nearness wetland (0-600 m)	3,980	771.504	156.653	131.369	672.207	895.506	993.584
Nearness highway (0-1000 m)	3,980	208.050	162.229	0	46.7	337.4	583
Nearness large roads (0-500 m)	3,980	90.280	151.686	0.000	0.000	159.095	577.026
Nearness railway (0-500 m)	3,980	4.921	38.407	0	0	0	552
Nearness trainstation (0-5000 m)	3,980	251.714	171.159	0	81.9	404.5	492
Christiansfeld (dummy)	3,980	93.698	145.605	0.000	0.000	173.543	483.516
Vojens (dummy)	3,980	2,883.937	1,848.037	0.000	0.000	4,348.102	4,974.838
Lunderskov (dummy)	3,980	0.099	0.299	0	0	0	1
Vamdrup (dummy)	3,980	0.242	0.428	0	0	0	1
Gram (dummy)	3,980	0.119	0.324	0	0	0	1
Rødding (dummy)	3,980	0.200	0.400	0	0	0	1

Holsted (dummy, base)	3,980	0.096	0.294	0	0	0	1
Sales date (numerical)	3,980	0.061	0.240	0	0	0	1
2007-2011 (dummy)	3,980	0.086	0.280	0	0	0	1
2012-2015 (dummy)	3,980	14,210.120	1,822.148	11,323	12,737	15,743.8	17,674
2016-2018 (dummy)	3,980	0.298	0.457	0	0	1	1
Log(price)	3,980	0.162	0.368	0	0	0	1
Size (in m2)	3,980	0.130	0.337	0	0	0	1
Spatial-temporal lag	3,980	943,629.800	311,236.100	0	720,000	1,125,000	2,700,000

A2 Descriptive statistics of Godsbane survey areas

Descriptive Godsbanen: Municipality							
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Log(price)	20,702	14.231	0.541	9.914	13.911	14.557	16.523
Size (in m^2)	20,702	74.391	28.518	21	56	87	395
Rooms	20,702	2.537	0.96	1	2	3	9
Number of floors building	20,702	4.166	2.244	1	3	5	19
Floor level	20,702	1.799	1.809	-1	0	3	17
Bussiness size (m^2)	20,702	0.06	2.098	0	0	0	183
Age 1885-1922 (dummy)	20,702	0.247	0.432	0	0	0	1
Age 1923-1941 (dummy)	20,702	0.232	0.422	0	0	0	1
Age 1942-1963 (dummy)	20,702	0.11	0.312	0	0	0	1
Age 1964-1971 (dummy)	20,702	0.148	0.356	0	0	0	1
Age 1972-1991 (dummy)	20,702	0.082	0.274	0	0	0	1
Age 1992- (dummy)	20,702	0.152	0.359	0	0	0	1
Brick (dummy)	20,702	0.844	0.363	0	1	1	1
Concrete (dummy)	20,702	0.11	0.313	0	0	0	1
Tile roof (dummy)	20,702	0.462	0.499	0	0	1	1
Electric heating (dummy)	20,702	0.001	0.035	0	0	0	1
Central heating (dummy)	20,702	0.002	0.048	0	0	0	1

District heating (dummy)	20,702	0.986	0.119	0	1	1	1
Renovation in 1970s (dummy)	20,702	0.034	0.182	0	0	0	1
Renovation in 1980s (dummy)	20,702	0.094	0.292	0	0	0	1
Renovation in 1990s (dummy)	20,702	0.03	0.17	0	0	0	1
Renovation in 2000s (dummy)	20,702	0.041	0.199	0	0	0	1
Renovation in 2010s (dummy)	20,702	0.06	0.237	0	0	0	1
Renovation after sale (dummy)	20,702	0.061	0.239	0	0	0	1
Nearness forest (0-600m)	20,702	186.272	196.921	0	0	364.132	581.684
Nearness coastline (0-1000m)	20,702	252.844	301.849	0	0	507.2	975
Harbor (dummy)	20,702	0.69	0.463	0	0	1	1
Nearness park (0-600m)	20,702	220.45	203.664	0	0	402.9	595
Nature density Ha within 1000 m	20,702	102.214	212.079	0	0	78.456	1,085.93
Nearness nature (0-600m)	20,702	118.863	189.829	0	0	211.029	592.924
Park density Ha within 1000 m	20,702	20.488	17.668	0	5.304	32.307	52.044
Nearness lake (0-600m)	20,702	93.615	130.932	0	0	165.569	580.601
Urban diversity (number of different services)	20,702	40.901	14.412	0	31	55	59

Nearness trainstation (0-1000m)	20,702	120.736	196.23	0	0	183.3	746
Nearness highway (0-1000m)	20,702	11.02	67.182	0	0	0	948.127
Nearness large roads (0-500m)	20,702	339.968	140.836	0	260.998	453.348	492.484
Nearness Railway (0-500m)	20,702	119.11	155.188	0	0	244.6	485
Distance to city center	20,702	2,436.88	2,124.17	72.214	1,120.43	3,206.95	16,308.29
Sales date (numeric)	20,702	3,612.88	1,918.90	366	1,892	5,433	6,730
2008-2011 (dummy)	20,702	0.179	0.384	0	0	0	1
2012-2018 (dummy)	20,702	0.403	0.49	0	0	1	1
Spatial lag	20,702	1.615	0.594	0.171	1.167	1.962	6.35
Godsbanen area (dummy)	20,702	0.068	0.251	0	0	0	1

Descriptive Godsbanen: Outer ring							
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Log(price)	15,739	14.278	0.522	9.914	13.998	14.59	16.523
Size (in m2)	15,739	73.106	27.474	21	55	85	395
Rooms	15,739	2.524	0.965	1	2	3	9
Number of floors building	15,739	4.316	2.171	1	3	5	19
Floor level	15,739	1.948	1.86	-1	1	3	17
Business size (m2)	15,739	0.046	1.488	0	0	0	72

Age 1885-1922 (dummy)	15,739	0.314	0.464	0	0	1	1
Age 1923-1941 (dummy)	15,739	0.281	0.45	0	0	1	1
Age 1942-1963 (dummy)	15,739	0.129	0.335	0	0	0	1
Age 1964-1971 (dummy)	15,739	0.105	0.306	0	0	0	1
Age 1972-1991 (dummy)	15,739	0.024	0.153	0	0	0	1
Age 1992- (dummy)	15,739	0.11	0.313	0	0	0	1
Brick (dummy)	15,739	0.886	0.318	0	1	1	1
Concrete (dummy)	15,739	0.079	0.27	0	0	0	1
Tile roof (dummy)	15,739	0.545	0.498	0	0	1	1
Electric heating (dummy)	15,739	0.001	0.025	0	0	0	1
Central heating (dummy)	15,739	0.001	0.038	0	0	0	1
District heating (dummy)	15,739	0.985	0.12	0	1	1	1
Renovation in 1970s (dummy)	15,739	0.043	0.203	0	0	0	1
Renovation in 1980s (dummy)	15,739	0.109	0.311	0	0	0	1
Renovation in 1990s (dummy)	15,739	0.03	0.171	0	0	0	1
Renovation in 2000s (dummy)	15,739	0.046	0.21	0	0	0	1
Renovation in 2010s (dummy)	15,739	0.072	0.258	0	0	0	1
Renovation after sale (dummy)	15,739	0.074	0.262	0	0	0	1

Nearness forest (0-600m)	15,739	150.659	183.446	0	0	290.685	577.819
Nearness coastline (0-1000m)	15,739	294.119	291.805	0	0	550.3	926
Harbor (dummy)	15,739	0.812	0.391	0	1	1	1
Nearness park (0-600m)	15,739	269.584	195.639	0	41.2	437.7	595
Nature density Ha within 1000 m	15,739	41.552	94.301	0	0	78.456	828.414
Nearness nature (0-600m)	15,739	65.358	141.171	0	0	0	576.597
Park density Ha within 1000 m	15,739	25.272	17.08	0	8.2	46.7	52
Nearness lake (0-600m)	15,739	69.701	104.946	0	0	128.037	557.558
Urban diversity (number of different services)	15,739	46.837	10.06	19	37	56	59
Nearness trainstation (0-1000m)	15,739	125.918	196.429	0	0	205.6	746
Nearness highway (0-1000m)	15,739	0	0	0	0	0	0
Nearness large roads (0-500m)	15,739	379.707	99.191	0	317.664	461.44	492.484
Nearness Railway (0-500m)	15,739	124.505	152.033	0	0	249.5	477
Distance to city center	15,739	1,556.20	831.377	72.214	965.612	1,944.17	4,158.30
Sales date (numeric)	15,739	3,596.16	1,914.41	366	1,878	5,395.50	6,730
2008-2011 (dummy)	15,739	0.184	0.387	0	0	0	1

2012-2018 (dummy)	15,739	0.398	0.49	0	0	1	1
Spatial lag	15,739	1.685	0.569	0.171	1.269	2.025	5.15
Godsbanen area (dummy)	15,739	0.089	0.284	0	0	0	1

Descriptive Godsbanen: Inner ring							
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Log(price)	11,388	14.366	0.499	9.914	14.097	14.653	16.49
Size (in m^2)	11,388	76.241	28.822	21	57	87	395
Rooms	11,388	2.645	0.992	1	2	3	9
Number of floors building	11,388	4.62	2.294	1	3	5	19
Floor level	11,388	2.149	1.969	-1	1	3	17
Bussiness size (m^2)	11,388	0.06	1.704	0	0	0	112
Age 1885-1922 (dummy)	11,388	0.411	0.492	0	0	1	1
Age 1923-1941 (dummy)	11,388	0.242	0.428	0	0	0	1
Age 1942-1963 (dummy)	11,388	0.077	0.267	0	0	0	1
Age 1964-1971 (dummy)	11,388	0.08	0.271	0	0	0	1
Age 1972-1991 (dummy)	11,388	0.028	0.165	0	0	0	1
Age 1992- (dummy)	11,388	0.111	0.314	0	0	0	1
Brick (dummy)	11,388	0.878	0.328	0	1	1	1
Concrete (dummy)	11,388	0.09	0.286	0	0	0	1
Tile roof (dummy)	11,388	0.541	0.498	0	0	1	1

Electric heating (dummy)	11,388	0.001	0.03	0	0	0	1
Central heating (dummy)	11,388	0.001	0.025	0	0	0	1
District heating (dummy)	11,388	0.983	0.131	0	1	1	1
Renovation in 1970s (dummy)	11,388	0.053	0.224	0	0	0	1
Renovation in 1980s (dummy)	11,388	0.128	0.334	0	0	0	1
Renovation in 1990s (dummy)	11,388	0.031	0.174	0	0	0	1
Renovation in 2000s (dummy)	11,388	0.045	0.207	0	0	0	1
Renovation in 2010s (dummy)	11,388	0.091	0.288	0	0	0	1
Renovation after sale (dummy)	11,388	0.089	0.285	0	0	0	1
Nearness forest (0-600m)	11,388	118.208	169.666	0	0	193.89	576.164
Nearness coastline (0-1000m)	11,388	398.371	268.503	0	170.5	622.1	926
Harbor (dummy)	11,388	0.863	0.344	0	1	1	1
Nearness park (0-600m)	11,388	293.787	187.012	0	127.1	448.7	595
Nature density Ha within 1000 m	11,388	25.239	33.39	0	0	55.3	112
Nearness nature (0-600m)	11,388	51.985	125.629	0	0	0	577
Park density Ha within 1000 m	11,388	29.452	16.381	3.203	14.132	47.672	52.044
Nearness lake (0-600m)	11,388	69.884	109.399	0	0	125.1	462

Urban diversity (number of different services)	11,388	51.124	7.661	34	47	57	59
Nearness trainstation (0-1000m)	11,388	170.096	213.918	0	0	332.8	746
Nearness highway (0-1000m)	11,388	0	0	0	0	0	0
Nearness large roads (0-500m)	11,388	364.891	104.207	95.74	293.238	452.874	492.484
Nearness Railway (0-500m)	11,388	151.428	157.552	0	0	276.6	477
Distance to city center	11,388	1,176.91	464.363	72.214	823.632	1,568.97	1,998.90
Sales date (numeric)	11,388	3,632.74	1,916.51	366	1,886	5,422	6,730
2008-2011 (dummy)	11,388	0.182	0.386	0	0	0	1
2012-2018 (dummy)	11,388	0.41	0.492	0	0	1	1
Spatial lag	11,388	1.778	0.579	0.171	1.38	2.124	5.15
Godsbanen area (dummy)	11,388	0.123	0.328	0	0	0	1

Appendix B

Three models for Christiansfeld were estimated. The first model contains all sales data and no spatial temporal innovation. The second model contains all data and include a spatial- temporal lag term and the third model is estimated using a reduced dataset where outliers have been removed. Model three still have a spatial-temporal lag term. A test for normality of the data indicates that neither of the samples are normally distributed population, however comparing QQ-plots for the different datasets indicate, that the reduced dataset has a distribution closer to being normal. Especially lower values of the datasets are not following a normal distribution. We estimate the models with robust standard errors as we reject the null-hypothesis of homoscedasticity using a Breuch-Pegan test.

Housing characteristics

The structural variables all have the expected signs. The value of the houses increases with the size, but decreases for very large houses. Moreover, there is a premium for farmhouses, houses with thatched roof and tile roof and houses made of brick. The significance level and size of the parameter estimates are stable across model types and size of the datasets.

Nature and infrastructure characteristics

Proximity to forest has the largest and most significant impact on the house prices of the three nature variables. The cut-off distance is set to 1 km. Within this distance, the forest is visible from the house and is within walking distance for recreational purposes. Proximity to lakes seems to have a small negative impact whereas proximity to wetlands has a positive effect. However, the estimates are only significant for model 1 and 2.

Proximity to highway, larger roads and railways have a significant negative effect, which is as we expected. The cut-off distance to train station is set to 5 km, thus the parameter reflects the presence of a train station in the town or not. The parameter estimate for train station is significant and positive in model 3, but not significant in model 1 and 2.

Results Christiansfeld

	Dependent variable:		
	logprice		
	Model 1	Model 2	Model 3
size	0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)
$size^2$	-0.00001*** (0.00000)	-0.00001*** (0.00000)	-0.00001*** (0.00000)
rooms	-0.008 (0.007)	-0.007 (0.008)	-0.001 (0.005)
car park	-0.039 (0.027)	-0.035 (0.028)	0.086*** (0.020)
outhouse	0.0002 (0.001)	-0.0001 (0.001)	0.001 (0.001)
rowhouse	-0.023 (0.024)	-0.021 (0.025)	-0.067*** (0.018)
farmhouse	0.298*** (0.066)	0.318*** (0.069)	0.380*** (0.060)
Built 1875-1894	-0.145*** (0.055)	-0.160*** (0.058)	-0.201*** (0.042)
Built_1895-1909	-0.097** (0.045)	-0.120** (0.047)	-0.175*** (0.034)
Built_1910-1944	-0.028 (0.040)	-0.041 (0.041)	-0.057* (0.029)
Built_1945-1959	0.044 (0.040)	0.029 (0.041)	0.009 (0.029)
Built_1960-1979	0.173*** (0.035)	0.152*** (0.037)	0.117*** (0.026)
Built_1980-1994	0.290*** (0.038)	0.262*** (0.040)	0.257*** (0.028)
Built_1995-2009	0.318*** (0.040)	0.292*** (0.041)	0.412*** (0.029)
Built_2010-2018	-0.031 (0.072)	-0.073 (0.073)	0.314*** (0.087)
brick	0.055** (0.024)	0.055** (0.025)	0.073*** (0.018)
concrete	-0.052 (0.081)	-0.056 (0.084)	-0.012 (0.067)
flet_roof	0.144*** (0.041)	0.143*** (0.042)	0.031 (0.031)
tile_roof	0.060*** (0.019)	0.057*** (0.019)	0.071*** (0.014)
thatch_roof	0.319 (0.196)	0.349* (0.196)	0.418** (0.210)
woodburningstove_heating	0.071*** (0.019)	0.069*** (0.019)	0.047*** (0.014)
Heat pump	-0.161*** (0.059)	-0.166*** (0.061)	-0.167*** (0.049)
electric heating	-0.042 (0.052)	-0.052 (0.054)	-0.032 (0.038)

Central heating	-0.030 (0.025)	-0.034 (0.025)	-0.022 (0.018)
District heating	-0.026 (0.023)	-0.035 (0.024)	-0.013 (0.017)
Renovation70s	-0.058** (0.025)	-0.047* (0.026)	-0.036** (0.018)
Renovation80s	0.030 (0.033)	0.018 (0.034)	0.024 (0.024)
Renovation90s	0.119*** (0.030)	0.112*** (0.031)	0.105*** (0.022)
Renovation00s	-0.025 (0.030)	0.011 (0.032)	0.003 (0.023)
Renovation10s	-0.180*** (0.037)	-0.182*** (0.038)	-0.167*** (0.027)
urban_diversity	-0.0002 (0.001)	-0.0001 (0.001)	-0.0004 (0.001)
cforest_distance	0.0002*** (0.00005)	0.0002*** (0.00005)	0.0001*** (0.00004)
clake_distance	-0.0001* (0.00005)	-0.0001** (0.00005)	-0.00003 (0.00004)
cwetland_distance	0.0002*** (0.0001)	0.0001** (0.0001)	0.00002 (0.00004)
chighway_distance	-0.0004** (0.0002)	-0.0004** (0.0002)	-0.0001 (0.0001)
clargeroad_distance	-0.0002*** (0.00005)	-0.0001*** (0.00005)	-0.0001*** (0.00003)
crailway_distance	-0.0003*** (0.0001)	-0.0003*** (0.0001)	-0.0003*** (0.00004)
ctrainstation_distance	0.00001 (0.00001)	0.00001 (0.00001)	0.00002** (0.00001)
christiansfeld	0.183*** (0.070)	0.127* (0.073)	0.226*** (0.052)
vojens	-0.004 (0.028)	-0.013 (0.029)	0.005 (0.021)
lunderskov	0.146*** (0.035)	0.109*** (0.037)	0.132*** (0.027)
vamdrup	0.200*** (0.027)	0.176*** (0.029)	0.171*** (0.020)
gram	-0.237*** (0.064)	-0.210*** (0.066)	-0.147*** (0.047)
rødding	-0.027 (0.068)	-0.021 (0.070)	-0.004 (0.050)
holsted	-0.246*** (0.035)	-0.199*** (0.036)	-0.163*** (0.026)
lag_st_dependent_median		0.00000*** (0.00000)	0.00000*** (0.00000)
sales_date_numerical	0.003*** (0.001)	0.005*** (0.001)	0.006*** (0.001)
I(sales_date_numerical^2)	-0.00000*** (0.00000)	-0.00000*** (0.00000)	-0.00000*** (0.00000)
I(sales_date_numerical^2)	0.000** (0.000)	0.000*** (0.000)	0.000*** (0.000)
y2007_2011	0.240*** (0.032)	0.198*** (0.033)	0.174*** (0.023)
y2012_2015	0.124** (0.060)	0.125** (0.061)	0.068 (0.043)

y2016_2018	0.228*** (0.083)	0.193** (0.083)	0.094 (0.059)
I(christiansfeld * y2007_2011)	-0.007 (0.053)	-0.009 (0.055)	-0.003 (0.039)
I(christiansfeld * y2012_2015)	0.057 (0.061)	0.061 (0.063)	0.047 (0.045)
I(christiansfeld * y2016_2018)	0.128* (0.066)	0.123* (0.068)	0.049 (0.049)
Constant	-3.736 (4.759)	-11.375** (5.741)	-15.280*** (4.044)
Observations	4,496	4,233	3,976
R^2	0.369	0.378	0.603
Adjusted R^2	0.361	0.370	0.597
Residual Std. Error	0.432 (df = 4441)	0.432 (df = 4177)	0.295 (df = 3920)
F Statistic	48.117*** (df = 54; 4441)	46.238*** (df = 55; 4177)	108.251*** (df = 55; 3920)

Note: *p<0.1; **p<0.05; ***p<0.01

Results Christiansfeld

	Model 1	Model 2	Model 3
size	0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)
I(size2)	-0.00001*** (0.00000)	-0.00001*** (0.00000)	-0.00001*** (0.00000)
rooms	-0.008 (0.007)	-0.007 (0.008)	-0.001 (0.005)

car_park	-0.039 (0.027)	-0.035 (0.028)	0.086*** (0.020)
outhouse	0.0002 (0.001)	-0.0001 (0.001)	0.001 (0.001)
rowhouse	-0.023 (0.024)	-0.021 (0.025)	-0.067*** (0.018)
farmhouse	0.298*** (0.066)	0.318*** (0.069)	0.380*** (0.060)
opfort_1875_1894	-0.145*** (0.055)	-0.160*** (0.058)	-0.201*** (0.042)
opfort_1895_1909	-0.097** (0.045)	-0.120** (0.047)	-0.175*** (0.034)
opfort_1910_1944	-0.028 (0.040)	-0.041 (0.041)	-0.001653
opfort_1945_1959	0.044 (0.040)	0.029 (0.041)	0.009 (0.029)
opfort_1960_1979	0.173*** (0.035)	0.152*** (0.037)	0.117*** (0.026)
opfort_1980_1994	0.290*** (0.038)	0.262*** (0.040)	0.257*** (0.028)
opfort_1995_2009	0.318*** (0.040)	0.292*** (0.041)	0.412*** (0.029)

opfort_2010_2018	-0.031 (0.072)	-0.073 (0.073)	0.314*** (0.087)
brick	0.055** (0.024)	0.055** (0.025)	0.073*** (0.018)
concrete	-0.052 (0.081)	-0.056 (0.084)	-0.012 (0.067)
flet_roof	0.144*** (0.041)	0.143*** (0.042)	0.031 (0.031)
tile_roof	0.060*** (0.019)	0.057*** (0.019)	0.071*** (0.014)
thatch_roof	0.319 (0.196)	0.349* (0.196)	0.418** (0.210)
woodburningstove_heating	0.071*** (0.019)	0.069*** (0.019)	0.047*** (0.014)
heat_pump	-0.161*** (0.059)	-0.166*** (0.061)	-0.167*** (0.049)
heat_electric	-0.042 (0.052)	-0.052 (0.054)	-0.032 (0.038)
central_heating	-0.030 (0.025)	-0.034 (0.025)	-0.022 (0.018)
district_heating	-0.026 (0.023)	-0.035 (0.024)	-0.013 (0.017)

Renovation70s	-0.058^{**} (0.025)	-0.001222	-0.036^{**} (0.018)
Renovation80s	0.030 (0.033)	0.018 (0.034)	0.024 (0.024)
Renovation90s	0.119^{***} (0.030)	0.112^{***} (0.031)	0.105^{***} (0.022)
Renovation00s	-0.025 (0.030)	0.011 (0.032)	0.003 (0.023)
Renovation10s	-0.180^{***} (0.037)	-0.182^{***} (0.038)	-0.167^{***} (0.027)
urban_diversity	-0.0002 (0.001)	-0.0001 (0.001)	-0.0004 (0.001)
cforest_distance	0.0002^{***} (0.00005)	0.0002^{***} (0.00005)	0.0001^{***} (0.00004)
clake_distance	-5E-09	-0.0001^{**} (0.00005)	-0.00003 (0.00004)
cwetland_distance	0.0002^{***} (0.0001)	0.0001^{**} (0.0001)	0.00002 (0.00004)
chighway_distance	-0.0004^{**} (0.0002)	-0.0004^{**} (0.0002)	-0.0001 (0.0001)
clargeroad_distance	-0.0002^{***} (0.00005)	-0.0001^{***} (0.00005)	-0.0001^{***} (0.00003)

crailway_distance	-0.0003^{***} (0.0001)	-0.0003^{***} (0.0001)	-0.0003^{***} (0.00004)
ctrainstation_distance	0.00001 (0.00001)	0.00001 (0.00001)	0.00002^{**} (0.00001)
christiansfeld	0.183^{***} (0.070)	0.127^{*} (0.073)	0.226^{***} (0.052)
vojens	-0.004 (0.028)	-0.013 (0.029)	0.005 (0.021)
lunderskov	0.146^{***} (0.035)	0.109^{***} (0.037)	0.132^{***} (0.027)
vamdrup	0.200^{***} (0.027)	0.176^{***} (0.029)	0.171^{***} (0.020)
gram	-0.237^{***} (0.064)	-0.210^{***} (0.066)	-0.147^{***} (0.047)
rødding	-0.027 (0.068)	-0.021 (0.070)	-0.004 (0.050)
holsted	-0.246^{***} (0.035)	-0.199^{***} (0.036)	-0.163^{***} (0.026)
lag_st_dependent_median		0.00000^{***} (0.00000)	0.00000^{***} (0.00000)
sales_date_numerical	0.003^{***} (0.001)	0.005^{***} (0.001)	0.006^{***} (0.001)

I(sales_date_numerical2)	-0.00000*** (0.00000)	-0.00000*** (0.00000)	-0.00000*** (0.00000)
I(sales_date_numerical3)	0.000** (0.000)	0.000*** (0.000)	0.000*** (0.000)
y2007_2011	0.240*** (0.032)	0.198*** (0.033)	0.174*** (0.023)
y2012_2015	0.124** (0.060)	0.125** (0.061)	0.068 (0.043)
y2016_2018	0.228*** (0.083)	0.193** (0.083)	0.094 (0.059)
I(christiansfeld * y2007_2011)	-0.007 (0.053)	-0.009 (0.055)	-0.003 (0.039)
I(christiansfeld * y2012_2015)	0.057 (0.061)	0.061 (0.063)	0.047 (0.045)
I(christiansfeld * y2016_2018)	0.128* (0.066)	0.123* (0.068)	0.049 (0.049)
Constant	-3.736 (4.759)	-11.375** (5.741)	-15.280*** (4.044)
Observations	4,496	4,233	3,976
R^2	0.369	0.378	0.603

Adjusted R^2	0.361	0.37	0.597
Residual Std. Error	0.432 (df = 4441)	0.432 (df = 4177)	0.295 (df = 3920)
F Statistic	48.117*** (df = 54; 4441)	46.238*** (df = 55; 4177)	108.251*** (df = 55; 3920)

Note: *p**p***p<0.01

Appendix C

Results Godsbanen

	large model	Outer ring model	Inner Ring model
size	0.015*** (0.0003)	0.014*** (0.0003)	0.012*** (0.0004)
I(size2)	-0.00003*** (0.00000)	-0.00003*** (0.00000)	-0.00002*** (0.00000)
rooms	0.029*** (0.004)	0.030*** (0.005)	0.027*** (0.006)
building_floor	-0.008*** (0.002)	-0.006*** (0.002)	-0.010*** (0.002)
floor	0.012*** (0.001)	0.013*** (0.002)	0.013*** (0.002)
I((bussiness_size + 1)/building_size)	0.418*** (0.128)	0.456** (0.224)	0.814*** (0.303)
age_1885_1922	-0.047*** (0.014)	-0.055*** (0.014)	-0.062*** (0.015)
age_1923_1941	-0.00039	-0.035** (0.016)	-0.036** (0.017)
age_1942_1963	-0.064*** (0.016)	-0.081*** (0.017)	-0.075*** (0.021)
age_1964_1971	-0.120*** (0.018)	-0.084*** (0.021)	0.016 (0.026)
age_1972_1991	-0.022 (0.019)	0.022 (0.023)	0.023 (0.025)
age_after_1992	0.102*** (0.017)	0.044** (0.018)	0.011 (0.020)
brick	-0.014 (0.013)	0.002 (0.017)	0.080*** (0.027)

concrete	0.012 (0.014)	0.043** (0.018)	0.057** (0.024)
tile_roof	0.011* (0.006)	0.010 (0.006)	0.026*** (0.008)
electric_heating	-0.067 (0.067)	-0.054 (0.102)	-0.092 (0.107)
central_heating	0.076 (0.050)	-0.143** (0.071)	-0.002 (0.125)
district_heating	-0.034 (0.022)	-0.031 (0.025)	0.015 (0.028)
Renovation70s	-0.001 (0.012)	-0.001 (0.013)	0.00000 (0.014)
Renovation80s	-0.002 (0.008)	0.007 (0.009)	0.015 (0.010)
Renovation90s	0.064*** (0.013)	0.076*** (0.015)	0.047** (0.018)
Renovation00s	0.095*** (0.012)	0.058*** (0.014)	0.049*** (0.016)
Renovation10s	0.078*** (0.017)	0.066*** (0.019)	0.081*** (0.021)
Renovation_after	-0.075*** (0.017)	-0.059*** (0.018)	-0.084*** (0.021)
cforest_distance	-0.00004** (0.00002)	-0.0001*** (0.00003)	0.0001 (0.00004)
ccoastline_distance	0.0001*** (0.00002)	0.00001 (0.00003)	0.0002*** (0.00004)
I(ccoastline_distance * harbour)	-0.0001*** (0.00002)	-0.00002 (0.00003)	0.0001 (0.00003)

cpark_distance	-0.00003 (0.00002)	-0.00001 (0.00002)	-0.0001*** (0.00003)
nature_density	0.0001*** (0.00002)	0.00004 (0.00003)	-0.0005** (0.0002)
cnature_distance	-0.0001*** (0.00003)	-0.0001** (0.00004)	-0.0001** (0.0001)
park_density	-0.0002 (0.0002)	-0.001*** (0.0003)	0.002*** (0.001)
clake_distance	0.0002*** (0.00002)	0.0001*** (0.00004)	0.0001* (0.00005)
urban_diversity	0.0001 (0.0004)	-0.002*** (0.001)	0.004*** (0.001)
ctrainstation_distance	-0.0001*** (0.00002)	-0.0001*** (0.00003)	0.0001* (0.00004)
chighway_distance	-0.0002*** (0.00005)		
clargeroad_distance	-0.0001*** (0.00002)	-0.0002*** (0.00003)	-0.0004*** (0.00004)
crailway_distance	0.0002*** (0.00003)	0.0001*** (0.00003)	0.0001 (0.00004)
Aarhus_centrum	-0.00005*** (0.00001)	-0.0001*** (0.00002)	0.0002*** (0.00003)

sales_day	0.0003*** (0.00001)	0.0004*** (0.00001)	0.0004*** (0.00001)
I(sales_day2)	- 0.00000*** (0.000)	- 0.00000*** (0.000)	- 0.00000*** (0.000)
y2008_2011	-0.288*** (0.010)	-0.304*** (0.012)	-0.296*** (0.015)
y2012_2018	-0.409*** (0.016)	-0.413*** (0.018)	-0.399*** (0.023)
lag_st_dependent_median	0.157*** (0.007)	0.148*** (0.009)	0.150*** (0.010)
area_restrict	-0.070*** (0.017)	-0.0007	-0.099*** (0.021)
I(area_restrict * y2008_2011)	-0.00132	-0.055** (0.028)	-0.072** (0.029)
I(area_restrict * y2012_2018)	0.118*** (0.020)	0.085*** (0.020)	0.069*** (0.022)
Constant	12.668*** (0.042)	12.905*** (0.062)	12.178*** (0.133)
Observations	20,702	15,739	11,388
R^2	0.682	0.653	0.59
Adjusted R^2	0.682	0.652	0.588
Residual Std. Error (df = 20640)	0.305	0.308	0.32
F Statistic (df = 61; 20640)	727.199***	590.836***	354.117***