Time to build

The effect of nature conservation laws on approval and construction time of housing in the Netherlands

A quantitative analysis

Master thesis Spatial Planning
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Abstract

The Netherlands faces a housing crisis. There is a housing shortage and new construction is undergoing delays. Reasons for the delay in scientific literature are mainly attributed to the amount of restrictive land-use regulations. In Dutch policy debate, it is often argued that, especially, projects close to Natura 2000 areas suffer from nature conservation regulation. In the Dutch context, for the last six years, nitrogen has played a significant role in the debate on nature conservation. This research aims to investigate whether nature conservation regulations cause a lengthier procedure in the approval and construction of plans. This led to the main question, "To what extent do nature conservation laws contribute to a delay in the permitting and construction process in the Netherlands?" The most important variables are plans before and after the introduction of regulation and their level of exposure to nitrogen. Quantitative analyses of data is done to test assumptions and the significance of data. (156 words)

Keywords: delay in new construction, nitrogen, land-use regulations, Natura 2000, nature conservation, permitting

Colophon

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Preface

This thesis is the final project of my Master's Programme in Spatial Planning at the Radboud University in Nijmegen. It is the result of research on the duration of approval and construction of houses in the Netherlands and the complex relationship this has with nature conservation laws.

The realisation of this research was met with challenges and educational moments. The nitrogen problem in the Netherlands had received significant attention in Dutch media and public debate, however, it was still a relatively new area of study for me. I was fond of deepening my understanding of this topic and relating it to housing in the Netherlands, and remained positive of the chosen topic throughout the entire research process. This was important to me personally and for finishing the research, as in my bachelor's thesis, the chosen topic quickly became uninteresting to me.

While my knowledge on the Dutch nitrogen problem and nature conservation laws was broadened in adequate fashion, my skills on quantitative research were put to the test. I had not worked with STATA before and I had used qualitative methods for my bachelor's thesis. Although I did not bail out on, and knew the magnitude of the challenge in advance, it did take more time to get acquainted to the matter, which resulted in a lengthier completion of this thesis, and loads of seeking assistance from my supervisor, fellow students and friends.

This is mainly why I want to express my deepest gratitude towards Huub Ploegmakers, my supervisor, who supplied me with a database, the right expertise, sources and examples, crucial patience, and valuable feedback throughout the entire process.

Furthermore, I would like to thank my fellow student Joris Buurman, who worked on a similar topic simultaneously. The times we worked together on our theses, especially the data analysis, and our discussions were valuable and inspiring.

This thesis was a challenging process, but at the same time an educative project for me. I hope that this research will contribute to the understanding of nature conservation in the Netherlands and its effect on housing construction in our country. Thank you for reading this master's thesis.

Summary

This master thesis analyses the Dutch housing market, which has been hindered by an immediate housing shortage. 900,000 houses need to be built by 2030 in order to reduce the housing shortage. This number has been met with scepticism, amongst others with regards to feasibility and affordability. In recent years, nitrogen has become another problem in Dutch construction. Nitrogen levels are too high and harm vulnerable nature, therefore the Dutch government had come up with the Programme for the Approach to Nitrogen (PAS). On 29 May 2019, the Council of State annulled the PAS, because it opposed the European Habitats Directive. All building projects in the Netherlands from 29 May 2019 onwards need an Aerius-calculation to map their nitrogen emission and prove no harm is done to nature. The newly imposed regulation influenced the building sector and public debate into thinking construction will face delays. Fears of a complete construction stop emerged. This led to the main question of this research:

"To what extent do nature conservation laws contribute to a delay in the permitting and construction process in the Netherlands?"

The literature review of this research aims to gain insights in several approaches in scientific literature to evaluate planning and regulations. Within economics there are several sub-sections, such as welfare economics, new institutional economics, and behavioural economics. In the academic literature studied in this research, it was stated that nature conservation laws influence market outcomes, such as increasing rents and housing prices. Nature conservation laws also negatively influence the permit approval and funding of plans.

This quantitative study uses secondary data from databases from three Dutch provinces – North Holland, South Holland and Limburg – and Natura 2000 areas. By applying statistical techniques, including Cox regression models and difference-in-difference analysis, it explores the relationship between nature conservation laws and development times, accounting for plan and environmental characteristics and market conditions. This research takes both the approval and construction phase of construction in the Netherlands into account. The analysis contains control variables which control for fixed effects for region and year of plan approval and other bias.

The analysis yields some interesting results. Besides many insignificant results, it can be concluded that plans after PAS take longer to be approved than before PAS. This is the case for all plans, not necessarily only the plans at risk of nature conservation. However, the findings of this result provide no reason to assume that the construction phase of the building process experiences delay. It could thus be concluded that there is a slight delay in approval for all plans after 2019, which can only be attributed to other factors outside those analysed in this research and not necessarily the newly imposed nature conservation laws. Construction does not experience delay, and the amount of permits granted also did not decrease.

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1. Introduction

1.1 Research problem statement

The Netherlands currently faces a severe housing shortage. It is difficult for many people to find affordable housing. This situation is exacerbated by the fact that the total number of households is expected to grow further in the coming years. According to a 2022 report, there was a demand of 405.000 houses, while 90.000 houses were available that year, resulting in a housing shortage of 315.000 houses in the Netherlands (BZK, 2022a). The peak in housing shortage is expected in 2024, when there will be an expected shortage of 326.000 houses. After 2024, the housing shortage is expected to reduce gradually. Nevertheless, 900.000 houses need to be built by 2030 (BZK, 2022b), around 100.000 each year, and of which two-thirds will be in the affordable segment. The national government aims to focus on large-scale inner-city locations for construction of houses (Novex), transformation of other – mostly tenantless – buildings such as offices into homes, and flexible living (Endhoven et al., 2022). However, according to figures of CBS (2023a), in 2019 only 71.500 houses were built. In 2020 this number dropped to 70.000. It rose to 71.200 in 2021 and 74.200 in 2022. Although the number for 2022 shows an increase and the highest in a decade, this constitutes the problem that the numbers of finalised new construction over the last few years has not reached the aim of 100.000 homes per year.

There are multiple factors that influence the planning process that should lead to new construction. The acquisition of land to build on approximately takes 7 years (Geuting & De Leve, 2018). In relation to that, scarcity of land can also be a cause of delay (Gerber et al., 2018). Due to a shortage of civil servants and a higher workload, plans in general might take longer to be approved. Due to problems regarding the capacity of builders, plans might take longer to be completed (CPB, 2019). Furthermore, obligations to research effects of the development concerning archaeology contribute to delay (CPB, 2019). Above all, building costs have risen (Albregts & Martens, 2019). Causes for that include scarcity of raw materials (Kets, 2022) and municipalities setting additional requirements on top of the statutory Building Decree ("wettelijk Bouwbesluit") in the field of sustainability, environment and energy efficiency, or regarding infrastructure and parking facilities (CPB, 2019).

One possible factor for delay in plan approval and construction that has received a significant amount of attention in the Netherlands in recent years is nitrogen. Technically, it is not nitrogen regulation but the Birds Directive and the Habitats Directive, also called European nature directives. These guidelines on nature conservation are thought to have contributed to delay in planning and building of houses in the Netherlands (EIB, 2019; Mouissie, 2019).

There is a legal distinction within nature conservation: area, and species protection. Species protection aims to preserve animal species and their habitats. It is based on the European nature directives and resulted in the Natura 2000 network.

Nitrogen emissions in the Netherlands are too high and cause problems to nature (Van Geersdaele, 2019) and therefore need to be reduced. As a result of this, the granting of building permits, plan approval and construction in general are thought to have experienced delay, because of the obligation to protect nature (Natura 2000 areas) through the Nature Protection Act. Natura 2000 areas in the Netherlands are sensitive to nitrogen and therefore any activity that emits nitrogen, and thus harms nature, is controlled and regulated.

1.1.1 Permits

According to article 2.7 of the Nature Protection Act, any activity that has a chance of having negative effects for the conservation objectives of a Natura 2000 area, even if this activity is outside of the boundaries of the Natura 2000 area, requires a permit (Van Buuren et al., 2017). This permit is called a nature conservation permit. Every activity is subject to a screening assessment ("voortoets"). If the results show that the activity potentially has a negative effect on Natura 2000 areas, an appropriate assessment ("passende beoordeling") is made. In this appropriate assessment, negative effects of the activity on nature have to be ruled out on a scientifically reliable basis. Taking mitigating measures is allowed. If no negative impact can be ruled out, an AIC-test is the last possible solution. This procedure will be further explained in the background chapter.

The construction of new houses might harm nature due to the emission and deposition of nitrogen, and housing projects therefore require a nature conservation permit. By this logic, it is necessary to look at the building permits that were granted in recent years to study the effect of nature conservation regulations on delay. The decisions by the Council of State regarding nature conservation have a direct influence on the granting of permits.

Koning & Kragt (2020) state that in 2018 in the Netherlands 70.000 building permits were given. The same report estimated the number of granted permits for the years 2020 (58.000), 2021 (77.000), and 2022 and 2023 (both years 80.000). CBS in 2023 presented the actual numbers. In 2019, the year in which the PAS was cancelled, the number of granted permits dropped to 58.100 (CBS, 2023b). In 2020, the amount of permits already came near the amount of 2018, as 67.200 applications were approved. In 2021, 75.800 permits were granted, more than before 2018 when PAS was still in effect. A reason for this rapid increase could be the building exemption explained below. In 2022, this number dropped again to 63.400 (CBS, 2023b).

1.1.2 Dutch court decisions and reactions

Already in 2008 the Dutch Council of State annulled a government initiative, called ‘Toetsingskader ammoniak en Natura 2000’, which gave permits to spatial developers if they could reliably show that their development would not harm nature, which was already in a tormented state. Nature in this case refers to the Natura 2000 areas in the Netherlands. The annulment of the ‘Toetsingskader’ resulted in delays in plan approval. As a consequence, several coalition parties of the reigning Dutch government at that time initiated the ‘Programma Aanpak Stikstof’ (PAS, programme for the approach to nitrogen) in 2015. The PAS aimed to diminish the deposition of nitrogen in nature. Because the PAS had foreseen a reduction of future nitrogen deposition, ongoing expansion of nitrogen emitters was deemed suitable and nature conservation permits were granted. In 2019, the PAS and pending permit applications were cancelled as well, because it was in opposition to the Habitats Directive. The Habitats Directive focuses on the current state of nature, instead of the Dutch PAS, which allowed permits based on (future) lowered emissions. The state of Dutch nature is threatened by the high deposition of nitrogen – the highest per acre in Europe (TNO, 2019, p.4).

After the cancellation of PAS, the construction industry loudly voiced fears of production loss and delay, loss of jobs and lengthier permit procedures (EIB, 2019). Developer organisations, like NEPROM, called on the national government to implement an emergency measure to prevent delay[1]. That emergency measure would turn out to be the building exemption, implemented in 2021. Koning & Kragt (2020) also warned that the increase in supply of houses will still lag behind the household growth in the Netherlands. The government worked on an improved version of Aerius to shorten procedures and minimise delay[2]. The advisors of the Ministry incentivised the construction industry to use low-emission production materials by including this in tender and permit conditions (Remkes et al., 2019). One of the advisors, Rudy Rabbinge, said the amount of Natura 2000 areas, 162 in total, needed to be reduced to create less, but larger natural areas of higher quality[3]. However, a Natura 2000 site “can only be delisted if it has lost its conservation value due to natural developments and cannot be restored by management measures” (European Commission, 2012). On the other hand, nature organisations were satisfied with the decision to cancel PAS.

[1] https://www.destentor.nl/wonen/stikstofprobleem-gijzelt-woningbouw-huizentekort-loopt-verder-op~af92623f/
[2] https://www.aanpakstikstof.nl/de-stikstofaanpak/tijdlijn
[3] https://www.ad.nl/binnenland/hoogleraar-over-stikstofcrisis-zet-mes-in-160-beschermde-natuurgebieden~a965edc0/

As a result of the cancellation of the PAS, it became clear that in order for projects to receive a permit, it had to be evident on a scientific basis, before the approval, that the project would not be harmful to nature. Due to this court decision, developments need nitrogen calculations prior to the approval of plans. This can result in a delay during the process – more administration – and a construction stop. The calculation for nitrogen deposition is called the Aerius-calculation. An Aerius-calculation is a legitimate screening assessment in the Netherlands. A deposition that exceeds the critical values and therefore is too high requires a permit. It is important to distinguish between the emission and actual deposition.

After 2019, the Dutch government has implemented several measures to re-enact construction. In July 2021, the building exemption ("bouwvrijstelling") came into effect. This is an example of such a measure taken by the Dutch government through a new law on nitrogen. It said that the temporary emissions of nitrogen during the demolition and building phase of a development did not have to be counted in the total nitrogen emission of that project. This meant that only a pre-approval nitrogen calculation had to be made and a permit had to be requested for the usage of the project once it was in operation. If the deposition limit in this phase exceeds 0.0, measures had to be taken to diminish the emission. This is mainly about the increase in traffic flows of large projects, residential use is of less influence, as all new Dutch houses have to be gasless, so without connection to gas infrastructure. The construction industry was positive about the building exemption, as it allegedly reduced procedure time and could therefore accelerate construction[4]. The government continued its call to the construction industry to use low-emission material in order to diminish the share in nitrogen emissions of the building sector and reserved more money for innovation in this domain[5]. Nature organisations have argued that a policy instrument like the building exemption slows down innovation and reduction of nitrogen emissions[6].

However, on 2 November 2022, the Council of State ruled that the building exemption could not continue to be used, because again it contrasted European nature conservation laws[7]. Just like in the period May 2019 through July 2021, new plans for housing now need project-specific calculations on all nitrogen emission and deposition in the demolition, building and usage phase and the effect of it on nature.

After the withdrawal of the building exemption, the trade union of builders (Bouwend Nederland) warned about more delay and higher costs[8]. The construction industry feared that the current goal of 900.000 houses by 2030 could not be reached with the ongoing nitrogen issues[9]. Chairman of Bouwend Nederland Maxime Verhagen stated that the share of nitrogen emissions that can be attributed to the construction industry is relatively small, compared to the share of the agricultural sector, and that the construction industry therefore was hit disproportionally because of the costs associated with new

[4] https://nos.nl/artikel/2360044-weerstand-tegen-kamermeerderheid-voor-stikstofwet-dweilen-met-kraan-open
[5] https://www.aanpakstikstof.nl/de-stikstofaanpak/nieuws/2021/06/18/stikstofwet-gaat-in-per-1-juli-2021
[6] https://www.greenpeace.org/static/planet4-netherlands-stateless/2023/02/59389d0f-2023-02-16-sommatiebrief.pdf
[7] The building exemption was declared invalid by the Council of State in November 2022, after a lawsuit filed by environmental organisations. The initiators of the Porthos project – filling large empty gas fields in the North Sea with CO_2 – were trying to obtain permits and start preparatory construction works without nitrogen calculations for the building phase. The Council of State argued that it could not be excluded that the critical deposition values of nitrogen were not exceeded in a project this size, so the building exemption as a measure was annulled. It was generally feared by the construction industry that the annulment would lead to more delay as more extensive nitrogen calculations were needed. It was estimated that this was the case in 91% of plans and 6% of plans needed further extensive ecological research, whereas 3% of plans had to be cancelled definitely (EIB, 2023). A full construction stop, however, was never a threat (RvS, 2022).

[8] https://www.omgevingsweb.nl/nieuws/einde-stikstofimpasse-bouw-en-infra-lijkt-in-zicht/
[9] https://www.bouwendnederland.nl/media/16271/bouwend-nhn-022022-5-def.pdf

calculations and permit applications. He called for a central approach to a solution[10]. NEPROM also stated that agriculture is to blame[1].

On the other hand, several reports refute the worries in the construction industry. According to Jaspers et al. (2019), only extreme cases – hundreds of homes within a kilometre of Natura 2000 – significantly exceed the critical deposition values. Been (2023) reported that there are multiple measures that can be taken to re-enact construction. Balancing, a procedure that will be described in chapter 3, is an important example of such measures. However, it is true that the construction industry is accountable for 0.6% of total emissions, whereas agriculture in the Netherlands accounts for 46% (RIVM, 2019a).

1.2 Research aim and questions

The aim of this research is to investigate whether restrictions due to the Birds and Habitats Directive since 2019 have resulted in a delay of plan approval or the building of homes in the Netherlands. In order to understand the core of the research aim, other factors that could cause delay are controlled for in this research. There are multiple factors that cause delay in plan approval and building the project. There is an implementation gap in new construction in the Netherlands, as the plan capacity is higher than the amount of approved plans. This shows that there is delay somewhere in the entire process of plan approval and eventually building. Although there are multiple reasons for delay, delay itself can only be measured if the lead times ("doorlooptijd") of construction projects are known. As a result of the increasing amount of regulations and different levels of government a plan passes, lead times of housing projects are long – approximately 7 years for plan initiative until construction (Van Randeraat et al., 2022), and 10 years in total, including construction (Geuting & De Leve, 2018) – and developers cannot react adequately if demand changes, resulting in the current shortage. This leads to the following main question:

"To what extent do nature conservation laws contribute to a delay in the permitting and construction process in the Netherlands?"

In answering the main question, the following sub questions were posed.

- What are the differences in lead times of plans before and after the PAS judgment?
- What are the differences in lead times of plans with minimal or low exposure and medium or high exposure?
- Have the differences in lead times after PAS become larger for plans that are potentially subject to nature conservation laws?

1.3 Scientific relevance

This research attempts to make a contribution to the scientific literature on the impact of nature conservation regulations on new construction. Not a lot of research is done on these topics.

Substantial research has been done on the effect of regulation on housing prices or property values (Pollakowski & Wachter, 1990; White & Allmendinger, 2003; Jaeger, 2006; Ihlanfeldt, 2007; Koster, 2016). One of the findings that seems to occur in this literature is that land-use regulations are of large, negative influence on prices, and through this, affordability for home buyers is reduced.

In some countries, mainly in the United States and the United Kingdom, extensive research has been done on the causes of stalled sites and planning delay, and the influence of land-use regulation. For example, in a 2009 report by Glaeser & Ward, consequences of land-use regulation were investigated in Greater Boston, Massachusetts. According to that research, the implementation of more land-use regulation leads to a reduction in new building permits and new construction, which means there is an implementation gap. They found that in Boston, each extra rule resulted in a reduction of new

[10] https://www.ewmagazine.nl/economie/achtergrond/2023/03/maxime-verhagen-kom-uit-de-loopgraven-41879w/

construction by 10 percent. In addition to Glaeser & Ward, Mayer and Somerville (2000) and Green, Malpezzi, & Mayo (2005) conducted research on the effects of land-use regulation on new construction and yielded similar results. They found that regulations that cause delay negatively influence the volume of new construction and the supply elasticity.

In England, Ball et al. (2009) investigated the process of development control (DC). The DC is the English equivalent of land-use regulation. The results of that research show “that DC is a lengthy process with a considerable degree of variability and uncertainty over how long it will take.” In China, taxes and fees are imposed to regulate real estate development and geographical constraints (Yu, 2021). That report investigated the Chinese housing market and similarly found that regulatory measures contributed to the fact that Chinese cities are “severely unaffordable” (Yu, 2021, pp. 221). This adds to the fact that there is evidence from the US, the UK and China, that more regulation therefore can lead to delay and higher costs – albeit subconsciously. This shows that a lot of research has been done on the consequences of land-use regulations on a particular part of the process. This research thus does not aim to repeatedly stress the effects of regulation in general on delay, however, as mentioned earlier, this research focuses on specific land-use regulations in the field of nature conservation, which is distinctive in scientific literature, and their effect on delay in plan approval and the supply of new houses.

Quigley and Swoboda (2007) have investigated the effect of nature conservation regulations on housing and rent prices in the US, also in areas that are not subject to that regulation. Although similar in terms of the focus on nature conservation regulations, the difference with this research is that Quigley and Swoboda investigate the effect on housing prices, while this research examines the effect on delay in plan approval and new construction. Furthermore, Quigley and Swoboda developed a simulation to conduct their research and yield results, whereas this research uses different methodology, and tests existing data empirically through survival and difference-in-difference analyses. All in all, not much research is done on the effect of nature conservation on the approval and construction of plans, reiterating why this research aims to do so.

1.4 Societal relevance

Besides a contribution to the existing literature, this research could also provide useful arguments to the societal debate. Governmental interference through land-use regulation and spatial planning is justified, because construction often has undesirable external effects: consequences for nature and the environment that could hurt actors that are not involved in the construction or usage of newly built homes (Schuur, 2010). However, at the current pace, the Netherlands is not going to reach the desired 900.000 new homes by 2030, and a long delay in approval or construction is therefore undesirable. This research will look into the effects of nature conservation on delay in plan approval and construction. The results could introduce some recommendations for reducing the delay. If the results show that nitrogen deposition through the building of houses does not significantly reduce the quality of Natura 2000 areas, this research could contribute to reducing the stigma on nitrogen emissions, deposition and policy regarding construction.

The Netherlands Bureau for Economic Policy Analysis (Centraal Planbureau, CPB) aims to investigate further the policies concerning the supply on the housing market in the Netherlands. It states that the construction of houses in the Netherlands is lagging behind due to conflicting interests of multiple actors (CPB, 2022). The research plan suggests that further research can be done on the effects of restrictions on the housing market. This research ought to make a contribution to this CPB suggestion.

This research aims to investigate whether regulations regarding nature conservation lead to a longer delay in plan approval and construction. Research on the nitrogen emissions and deposition caused by the building sector already exists. These studies were conducted by both public and private parties (for instance RIVM, EIB, Antea, Tauw, Cobouw). Therefore this research aims to contribute to existing literature on the effects of those emissions on Natura 2000 areas in the Netherlands. Not a lot of research in the Netherlands is done on delay of planning and construction as a result of nitrogen deposition or on the effect of planning on nature, hence this research aims to contribute to existing literature on this topic. For the Netherlands, specific research is needed, as the context differs and policies, rules and laws regarding planning may differ from country to country.

2. Literature review and theoretical framework

2.1 Introduction

As will be further explained in the methodology section, this research will have an evaluative nature, because its aim is to examine whether nature conservation restrictions result in a delay in plan approval and construction. There are several approaches in scientific literature to evaluate planning and regulations. There are also ways to evaluate planning and regulations in the field of economics. Within economics there are several sub-sections such as welfare economics, new institutional economics, and behavioural economics (Adams & Watkins, 2014); approaches that will be introduced below. The remaining body of this chapter will discuss the costs and benefits of planning and regulations, as introduced by Turner et al. (2014). Furthermore, nature conservation laws and their effect on market outcomes, responsiveness of developers and the delay in the construction process, are discussed. Finally, the control variables of this research will be introduced.

2.2 Evaluation of planning

This paragraph lists several criteria present in academic literature to evaluate spatial planning.

2.2.1 Fairness and democratic legitimacy

According to Hartmann & Needham (2012), spatial planning as an intervention by all levels of government needs to be democratically legitimized. Needham (2012) adds that this should be done from public interest. Scharpf (1999) distinguishes between input-legitimacy and output-legitimacy. Input-legitimacy refers to the way the public interest is represented in the institutional system of politics. On the other hand, output-legitimacy is the extent to which the realised result of spatial planning equals the collective goals of citizens.

The last of four criteria is fairness, or justice, which relates to the distribution of goods (Davy, 1997). Three concepts of justice can be distinguished: libertarian, social, and utilitarian justice. Libertarian justice is achieved when market forces lead to fair outcomes, and the involvement of government is limited to correcting market failures. Social justice covers the subject of ethics, promoting the less fortunate and recommends the instalment of a welfare state (Rawls, 2005). Utilitarian justice aims to "maximize happiness" (Sandel, 2010). The state should defend and benefit the happiness of the majority, at minimum costs of minorities (Davy, 1997).

2.2.2 Neo-classical economics and welfare theory

This paragraph evaluates the value of planning by focusing on several economic perspectives that are discussed. One of them is welfare theory, which is treated as a bifurcation of the neo-classical economic mainstream, because both approaches orbit around self-interested and rational economic agents. Neo-classical economics and welfare theory are evaluated on whether individual preferences are satisfied, and the overall economy is efficient, regardless of (social) equity (Adams & Watkins, 2014).

The distinction between welfare theory, and neo-classical economy, regarding spatial planning, centres around market failure. Market failure in neo-classical economy is a result of agents acting out of self-interesting, thereby endangering the efficiency (Krugman & Wells, 2006). According to welfare theory, market failure could arise as a result of external causes, even in theoretically perfectly competitive markets. In that case, resources are not assigned in accordance with Pareto optimality. Pareto optimality is the situation in which the existing resources cannot be reallocated in such a way that one agent benefits, without disadvantaging another agent (Debreu, 1954). The central question concerning welfare theory and planning is how planning can prevent market failure or vanquish it when it happens regardless.

According to Adams & Watkins (2014), the real estate market is more prone to failure than other types of markets. Reasons listed in their study include externalities, underprovision of public goods and lost opportunities (p. 72). Planning can be considered successful if these circumstances are prevented. In welfare theory, government intervention is therefore in most cases necessary (Adams & Watkins, 2014) and justified to obtain efficiency and improve welfare.

2.2.3 New institutional economics and transaction costs

Another economic perspective is new institutional economics. New institutional economics refer to an addition and new approach to the economic mainstream, in which institutions – 'rules of the game' – over time should lead to a reduction of transaction costs (Coase, 1960). Transaction costs as a theoretical concept were first introduced by Coase in 1937 and were applied to planning by Alexander in 1992. Hence, transaction costs can be used to evaluate planning. Transaction costs refer to costs made exchanging and trading in the market, and they are acknowledged as hidden costs (Alexander, 1992). This neoclassical definition of transaction costs is mostly prevalent in present-day literature. However, transaction cost theory is not widely used in literature on planning, especially compared to other theoretical disciplines.

High transaction costs hamper development. Transaction costs can be lowered by planners by reducing uncertainties and preventing asymmetrical information (Alexander, 1992). This can be realized through public engagement. It is important to note that public engagement in decision-making processes does have its own costs, takes time, and could increase uncertainties; all contributing to higher transaction costs. To summarise, delay in planning approval also leads to higher transaction costs (Dawkins, 2000). However, although transaction costs may be higher in the initial stages of the development process, they might be cancelled out further on as uncertainties and asymmetric information are prevented in the later stages of the development (Shahab, 2022). It is also possible for planners after the initial stages of development to choose the development that has the least transaction costs in the last stages.

2.2.4 Behavioural economics

Another economic perspective that has been introduced, and on its turn is an addition to institutional economics, is behavioural economics. Behavioural economics stem from psychology and focus on presenting people with certain financial choices and investigating which decisions people take regarding those choices. Are people rational decision-makers, as was assumed in neo-classical economics (Simon, 1987)? Are they choosing the most optimal choice for themselves, individually, through cost-benefit calculations? Are they for instance risk averse? Such questions can be answered by examining behavioural economics and have resulted in a new way of economic thinking and new visions on the market forces in practice (Simon, 1987). This new way of thinking led to the concept of bounded rationality. Adams & Watkins (2014) define bounded rationality as "limits […] to the information people can access and take in before making any decision" (p. 73). As a consequence, bias could emerge into the decision-making process, as economic agents decide upon what choices to make based on previous decisions or habits. This thus is in contrast to the mainstream economics (Ferrari et al., 2011).

According to Ferrari et al. (2011) better information results in better decision-making in both neo-classical and behavioural economics. This means acquiring insights in the emotions, habits, norms and 'rules of thumb' is important in planning decision-making (Claydon, 1998). Understanding the behaviour of agents thus helps to improve the implementation stage and the assessment of planning applications (Ferrari et al., 2011). Successful planning adheres to this criterium.

2.3 Costs and benefits of land-use regulation

Land-use regulations entail implications about welfare: costs and benefits. They will be discussed in this paragraph. Whether a particular land-use regulation should be desired in a certain area ought to be determined by net social benefits (Beatley, 1994).

Cheshire and Sheppard (2002) describe multiple benefits of land-use planning in the UK. They distinguished between gross and net benefits. The gross benefit was measured by comparing, as they call it, "consumption of amenities" in areas with a land-use planning system, with consumption in areas without land-use planning. According to Cheshire and Sheppard (2002), gross benefits of spatial planning and regulations are the containment of open space (compared to the value of inaccessible open space) and the limitation of industrial land use. Although the authors have described two gross benefits of regulations, the results surprisingly show that welfare would instead be improved by loosening regulation. This is a result of the reduction in housing prices outweighing the loss of amenities. The net benefits – gross benefits minus net costs – are thus absent. A significant reduction of regulations would result in an average increase in income of approximately 4% (Gyourko & Molloy, 2015).

A loss of welfare is considered an economic cost. Relevant concepts that have been introduced and discussed in literature are the own-lot and supply effects. According to Turner et al. (2014), the own-lot effect "reflects the cost of regulatory constraints on how land is used". Own-lot effects are also called internal effects. Furthermore, Turner et al. (2014) introduce supply effects, which reflect the effect of regulation on the supply of developable land. Turner et al. (2014) have studied the impact of these effects by focusing on bordering municipalities where the restrictiveness of regulations significantly differs. The own-lot effects as introduced in Turner et al. (2014) show that land prices are lower in areas with more regulation.

Land-use regulations can also influence the supply of new construction, for instance by declining pending permit applications. A lower supply of new housing results in higher housing prices, as demand exceeds supply.

Besides the costs of regulation, land-use regulation also has benefits, otherwise there would be no point in regulating. Turner et al. (2014) introduce external effects as the benefits of regulation. The external effect "reflects the value of regulatory constraints on the use of nearby land". These effects are often called 'external', because they are often not paid for directly or otherwise caused by residents who do benefit from them. Some external effects are the presence of cultural heritage, open spaces, retail, provision of services, industry and wind turbines. Cultural heritage, open spaces, retail and services are thought to have a positive local external effect, whereas industry and wind turbines have a negative effect.

Since this research aims to detect delay in plan approval and new construction as a result of a specific group of land-use regulations, namely nature conservation regulations, it is important to know how to evaluate regulations. The authors mentioned in the previous paragraphs have all cited arguments and evaluations about land-use regulations (in general) within welfare theory, through costs and benefits. Turner et al. (2014) have looked at the housing market. Cheshire and Sheppard (2002) have examined land prices. They will be elaborated on below.

According to Turner et al. (2014) own-lot effects might "decrease land values by constraining how a landowner develops his land". The results on the external effects as described by Turner et al. (2014) show that there are negative external effects in areas with more regulation. Cheshire & Sheppard (2002) have also evaluated the costs and benefits of land-use regulation and have come to the conclusion that benefits of land-use planning are for the largest part attributed to those who already have higher incomes, increasing inequality. However, the benefits have been realised by making costs. They have been paid for by increases in land prices, which diminish supply of houses. These are economic costs. "The net effect is a system of valuable benefits, and very high costs, that combines for a net effect that is almost distributionally neutral" (Cheshire & Sheppard, 2002).

2.4 Nature conservation

Nature conservation focuses on protecting natural areas and animals, increasing biodiversity and designating habitats. As described earlier, in the European Union, the Habitats and the Birds Directive are examples of sets of guidelines on which nature conservation regulations are based in each member state.

Examples of nature conservation acts in the United States are the Endangered Species Act (ESA) and the Wetlands Protection Act (WPA). The Endangered Species Act is being discussed in Quigley and

Swoboda (2007). Just like in the European Union, the ESA in the US obliges the designation of habitats for endangered animal species and thus is an example of a regulation in the field of nature conservation. Therefore it is interesting to look at how this regulation might affect market outcomes. Quigley and Swoboda (2007) analyse the economic effects of designating land as such a critical habitat, and thereby restricting its use. If the critical habitat comprises land that would otherwise have been used to construct new houses, the nature conservation regulations influence the equilibrium of local land and housing markets. New land, which initially was not planned to be developed, and on which construction can actually take place is sought and finally developed. Furthermore, projects will now be developed with much higher densities, thereby increasing land values. This results in increasing rents and housing prices and reducing the well-being of residents (Quigley & Swoboda, 2007). Nature conservation thus can have its effect on the housing market.

Stokstad (2005), Owley (2015) and Arnold (1991) discuss the effects of nature conservation regulations on the responsiveness of developers and the delay in the construction process. Stokstad (2005) states that conservation laws do not always benefit the subject that is ought to be conserved, yet it could restrict land owners, delay projects and decrease property values. Owley (2015) studied the processes in obtaining permits for the ESA and WPA, and states that especially the permitting of nature conservation laws takes up the most time out of all phases in the construction process. Permit approval, funding and participation are among the first things that experience delay or trouble when conservation laws are in force (Arnold, 1991).

The Wetlands Protection Act is discussed in Glaeser & Ward (2009). The Wetlands Protection Act, unlike the Endangered Species Act, is not a federal act, but a law imposed by the State of Massachusetts. Still, it is useful to look at this form of regulation, because aforementioned research examines the effect of this nature conservation regulation on the supply of houses through new construction. Glaeser & Ward (2009) also introduce septic regulations in their report. Septic tanks ensure that polluted water, from homes in areas without sewage, is purified for hygiene and health concerns. However, there are regulations that control this procedure, often so that polluted water cannot be in contact with ground water or nature (wetlands and floodplains). This shows that there can be regulations that in itself cannot be categorised under 'nature conservation', but in combination with other regulations still impose rules that benefit nature conservation. Pollakowski & Wachter (1990) conclude "land-use constraints collectively have larger effects than individually".

2.5 Control variables

This paragraph enumerates several control variables that have been taken into account in this research to account for bias or external factors that influence the variables studied.

The amount of dwellings is included to check whether plans with larger capacity are approved or completed more quickly or more slowly, in an attempt to reveal whether larger plans get priority in planning or on the contrary, could need more time to be thoroughly checked before approval. The percentage of owner-occupied homes surrounding a certain plan also provides insights into the construction of new houses in multiple different ways. For instance, areas with a high percentage of owner-occupied homes are attractive for developers, because of the revenue potential. It also indicates a stable housing market with a demand that is high enough, in other words lower (financial) risks for developers (Follain & Velz, 1993). Areas with a lower percentage of owner-occupied homes can denote stricter regulations for social housing, thus rental properties. These homes are usually smaller in size and therefore usually have a lower emission, and could face less nature conservation regulations. Besides, a low percentage of owner-occupied homes can also be a result of low affordability of houses (Haffner & Boumeester, 2015).

The previous land use of new plans is taken into account as well. The previous land use of new construction plans in the Netherlands is limited to the three largest sources of previous land use, namely housing land, industrial land and unbuilt land. This means that other previous land uses, such as leisure or agriculture, are not explored in this research. The previous land use of new construction could be an important factor to consider when researching delay in approval or completion of plans. If the previous land use was industry, for instance soil contamination and the costs associated with that or a necessary change of zoning plans could explain longer approval times. For unbuilt land, the lack of infrastructure or the costs of site preparation are important factors (Wallace, 1988). In case the previous land use is housing, less delay is expected in the aspect of previous land use, as it might even have a positive effect (Glaeser & Ward, 2009).

The variables price index, price index change and building costs have been taken into account as well. Price index and price index change are important to make assumptions about current market value. Indices can also be used to forecast future developments, demand and competition (Mark & Goldberg, 1984). Building costs hint at the feasibility of the project.

3. Background

This chapter aims to sketch background and context and elaborates on the introduction chapter.

3.1 Nature Directives

The significance of laws on nature conservation in spatial planning is difficult to understand without interpreting the Habitats and Birds Directive (Van Buuren et al., 2017). The Habitats Directive finds its origin in 1992 and aims to create a European network of protected natural areas where plants and animals can flourish and be preserved for future generations.

The Birds Directive is older than the Habitats Directive and was introduced in as early as 1979. The Birds Directive obliges the designation of areas of importance for the protection of bird species (Van Buuren et al., 2017). Furthermore, the Birds Directive regulates the protection of birds outside these areas. After 1992, the protection of birds was also arranged under article 6 of the Habitats Directive. The Habitat and Birds Directive regulate a great deal, in order to reach its aim. Several concrete plans, measures and laws have been cancelled because they were in opposition to the directives. Such cases in the Netherlands were described in the introduction.

3.2 Natura 2000

The Habitats and Birds Directive obliges the designation of Natura 2000 areas. Those are nature areas throughout the entire European Union in which nature is preserved by law, biodiversity is restored, and animal species (including birds) and their habitats are protected. The Natura 2000 network comprises 18% of the European Union's land area and 8% of its marine territory. The Netherlands has a total of 162 Natura 2000 areas of which 130 are vulnerable to excessive nitrogen (RIVM, 2020).

Natural areas in the Netherlands were designated as Natura 2000 by the Dutch government in 2003, and in 2019, all but two of the 162 were legally designated. The process of assignment included a design phase, and opinions and objections of stakeholders before it could be designated. A single nature area that has been designated in the Natura 2000 network is also called a Special Protection Zone. Every Natura 2000 area has specific conservation objectives that are legally binding through the decision to designate it as such. A Natura 2000 area is anchored in one or multiple municipal zoning plans, and thereby also its conservation is legally secured.

The European guidelines have a legal basis in every country. In the Netherlands this is the Nature Protection Act ("Wet Natuurbescherming, Wnb"), which came into effect in 2017 and is a codification of the European Directives. Since 1 January 2024 this act is part of the Environment and Planning Act ("Omgevingswet"). The Nature Protection Act categorises multiple kinds of nature areas. Besides the aforementioned Natura 2000 areas, the Netherlands has NNN-areas (Nature Network Netherlands) and 'special provincial landscapes' (Van Buuren et al., 2017). In both cases, the provinces carry the responsibility. They have no basis of European guidelines, and therefore, for this research, solely the Natura 2000 areas are taken into consideration.

3.3 Introduction to nitrogen

Nitrogen is thought to have impact on the state of Dutch nature and hinders the obligation to conserve Natura 2000 areas (Van Geersdaele, 2019).

Nitrogen is a colour- and odourless gas that comprises 78% of all air. Nitrogen on its own is not harmful for humans and the environment, however there are chemical connections of the gas that are. The first group of such connections is nitrogen oxides (NOx) that are mainly released through traffic and industry. A second harmful chemical connection of nitrogen is ammonia (NH3) which is mainly a result of agriculture, through manure and fertiliser. Manure and fertilisers cause eutrophication, a process in which the soil is enriched by nutrients, causing certain ordinary species to grow more quickly than rare species, thereby reducing biodiversity (Jaspers et al., 2011). A monotonous biodiversity frustrates insects that are needed in the pollination of crops.

The concentration of nitrogen is the amount of nitrogen that is in the air. The emission of nitrogen describes how the (chemical connections of) nitrogen are released in the air and is calculated in kilograms per year. The deposition of nitrogen is the sum of how much nitrogen descends on or settles in the earth's surface and is calculated in moles per year. Ammonia and ammonium ($NH4+$; connection of ammonia with air or water) account for two-thirds of the total deposition, whereas nitrogen oxides thus account for roughly one-third (CBS, 2020). By calculating the deposition, one can determine the critical deposition value (CDV). The CDV for nitrogen is defined as the limit, beyond which the risk cannot be excluded that the quality of the habitat type is significantly affected as a result of the acidifying and/or fertilising influence of the atmospheric nitrogen deposition (Van Dobben et al., 2012, p. 13). The CDV results in a nitrogen deposition limit. A large and lengthy exceedance of the CDV likely results in a loss of quality of nature (Vink et al., 2021).

3.4 Nitrogen and projects for construction

Nitrogen oxides are emitted during all phases of construction of houses: demolition, building, and eventual usage of a house. The construction industry is thought to have an impact on the emissions and deposition of nitrogen in the Netherlands. However it is of much smaller influence than for instance agriculture, nitrogen from abroad or traffic (Vink et al., 2021). In 2018, the construction industry was categorised under 'Trade, services, government & construction' and was accountable for 0.6% of all nitrogen deposition in the Netherlands. In comparison, 46% came as a result of agriculture, and 32% came from abroad (RIVM, 2019a). In the neighbouring countries, nitrogen deposition is also for the largest part derived from agriculture (CLO, 2023). According to the Dutch National Institute for Health and Environment (RIVM), the construction of a single house on average emits 3 kilograms of nitrogen oxides per year (RIVM, 2019b). However, this is largely dependent on the project size and is related to the amount of work that has to be done. Evidently, if the site is ready for construction, the total emission of the building phase is less than when demolition or piling are necessary to prepare the site before construction starts. The amount of traffic that is needed for construction is also taken into account. Furthermore, prefabricated houses have a smaller emission and deposition than 'traditional' building projects, where everything is built brick by brick on-site. Prefabricated houses could also accelerate the building process and thus prevent delay (CPB, 2019).

Private parties Antea and Tauw, in addition to RIVM, have also made calculations of the nitrogen oxide emissions of Dutch construction. Both came to similar results as the RIVM: it is fair to say that on average building a house emits between 2.7 and 3 kilograms of nitrogen oxide per year with normal material (table 1). The findings for clean material are further apart, however it does indicate that using clean, low-emission material reduces the nitrogen oxide emissions. Emissions of material and machinery are measured through, for instance, the Emma-model (Hulskotte & Verbeek, 2009).

Table 1: Nitrogen oxide emission in kg per year and type of material used in Dutch construction

Source, year	NO_x per home	Type of material
RIVM, 2019	3	Normal
Antea, 2021	1.54	Normal
Antea, 2022	2.7	Normal
Antea, 2022	0.23	Clean
Tauw, 2020	2.9	Normal
Tauw, 2020	1.52	Clean

Source: Cobouw (De Leeuw et al., 2022)

As stated earlier, new development projects need calculations on nitrogen deposition in order to be approved. De Leeuw et al. (2022) state that especially projects close to Natura 2000 areas and that are relatively large in size exceed the critical values of nitrogen deposition. In smaller projects and projects that are further away from nature, nitrogen deposition does not cause problems.

If a development plan after an Aerius-calculation exceeds the critical values of nitrogen deposition, it does not mean the plan is immediately postponed. Mitigations can be made to the plan in order to stay under the deposition limit. One of those mitigations is balancing ("saldering"). Balancing is a term referring to any measure taken to reduce the nitrogen emissions and deposition. Balancing can be divided into internal balancing and external balancing. Internal balancing happens when the surplus of nitrogen emissions is solved within a given project. Internal balancing does not require a nature conservation permit and a development can then go through as planned. External balancing implies acquiring emission rights of other projects or companies, for instance agricultural companies that have closed their doors. In 2011, external balancing was deemed legally promising by Jaspers et al. In years onwards, external balancing has been subject of discussion on whether it is a legal practice (Mendelts, 2020).

As a matter of fact, external balancing does lead to additional legal requirements, like the appropriate assessment to maintain the conservation objectives in all cases and, additionally, an AIC-test in some cases. An AIC-test examines whether the development lacks suitable alternative solutions, and whether there are imperative reasons of overriding public interest to proceed, and whether enough compensatory measures of nitrogen emissions have been achieved (Kamphorst et al., 2020). Compensation in this case does not mean payments, but compensation through the designation of more natural areas. In some cases, these tests and additional requirements can still lead to building permits and approved plans all the same, even without additional measures taken. However, a plan for the construction of new houses will likely not pass AIC-testing, because alternative solutions are at hand; construction can take place on another site. AIC-testing has proven to be more successful when human health, public safety, and the environment were at risk (Van Buuren et al., 2017). In essence, this shows that in the short-term, development is only realisable when it does not cause harm to nature as proven through Aerius-calculations (Bastmeijer, 2019).

4. Methodology

In this chapter, the methods used for conducting this research and answering the research questions are elaborated on, including assumptions related to the research philosophy and design.

4.1 Research strategy

This paragraph contains assumptions related to research philosophy and research design.

This research carries out a post-positive approach. Quantitative analysis will be used to describe and investigate large numbers of data from all projects from several provinces. The data is secondary, of an existing dataset. Primary data, for instance through interviews and other qualitative methods, is difficult to collect and not suitable for this research, because to test any statistical significance, large numbers of data are desired. This results in quasi-experimental research, because variables are controlled and manipulated to establish causal relations in nature conservation regulation. Due to the fact that the analysis contains a control group, but one that can impossibly be randomised, this research is quasi-experimental (Rossi et al., 2004). Van Thiel (2014) argues that research on European regulations is per definition quasi-experimental, as the rules apply to all member states, so a control group in this context is lacking. The main part of this research, to find out whether nature conservation regulations cause extra delay in approval and construction of houses, is explanatory of nature. Because the potential outcomes of this analysis are plausible, measurable and implemented adequately, and elaborate on previous evaluation, this research can be classified as an impact evaluation (Rossi et al., 2004).

4.2 Data collection

In this paragraph, it is described how data was collected, and used in the research. For this research, an existing dataset containing data about the status of 1,553 individual plans in the Netherlands, sorted by municipality and province, was used. The dataset for this research was completed with the most recent available data, provided by the provinces. This means that data until the year 2021 is used for North Holland, South Holland and Limburg. The status of the plans was analysed to see whether the plan was finalised or whether the plan was still not approved or under construction, which is possible thanks to the date of approval or completion that is included in the dataset. This is necessary to induct the lead times of plans and to conclude whether any delay throughout the approval or completion phase of the building process had occurred. Furthermore, the dataset yielded the data on the size of the project, which is necessary to predict the harm the project might cause to nature. The distance of a project to a Natura 2000 area is retrieved through ArcGIS. As a base, the map of all Natura 2000 areas in the Netherlands is used from its official website. Although the number of vulnerable Natura 2000 areas in the Netherlands is large, not every area is vulnerable to excessive nitrogen. To check which Natura 2000 areas are, a look is taken at their hexagons. Natura 2000 areas are divided into hexagons in order to optimally calculate, for instance, nitrogen deposition. Buffer zones around Natura 2000 areas are also included in these hexagons. If the calculated value of the nitrogen exceeds the critical deposition values, an area is considered vulnerable. The critical deposition values differ per Natura 2000 area, depending on among others, soil and vegetation type (Van Dobben et al., 2012).

Using secondary data has some advantages. It does not take up as much time as acquiring primary data, and still a large number of samples can be analysed. Larger samples are evidently more useful to give more reliable and more precise results. For this research, a larger sample is useful to draw subgroups from. If the total sample size is larger, the subgroup size will be larger as well, generating more reliable analyses. A second advantage is the possibility for longitudinal research (over different periods in time). The existing data set contains information from multiple provinces in the Netherlands over a long period of time, giving insights into the status of plans, which would be useful to track down delay in the process.

4.3 Research methods and data analysis

4.3.1 Survival analysis

To test a significant difference between multiple groups of variables with regards to timing, a survival time analysis was conducted. Survival analysis analyses the expected time until an event occurs. This time-to-event method stems from medicine and biology, but it can also be used in other fields, such as planning. Survival analysis can also observe and analyse multiple different groups of variables, of which not every group has to be subject to the given event (Buis, 2006). For this research, this means that the events of approval and completion can be analysed for plans that have and have not been exposed to excessive nitrogen, and plans that are initiated before and after PAS.

Survival analysis encompasses different concepts that are associated with it. Only the ones used in this research are elaborated on below: hazard function, Kaplan-Meier and Cox Proportional Hazards model.

A survival time analysis yields hazard ratios. A hazard ratio indicates the likelihood (hazard) of an event happening, taking a given variable into account, for instance time (Spruance et al., 2004). A hazard ratio of 1 indicates no difference between the two groups compared, whereas a hazard ratio lower than 1 indicates a decrease in hazard in the variable that is studied. A hazard ratio above 1 suggest a higher likelihood in the variable that is being compared to the reference variable.

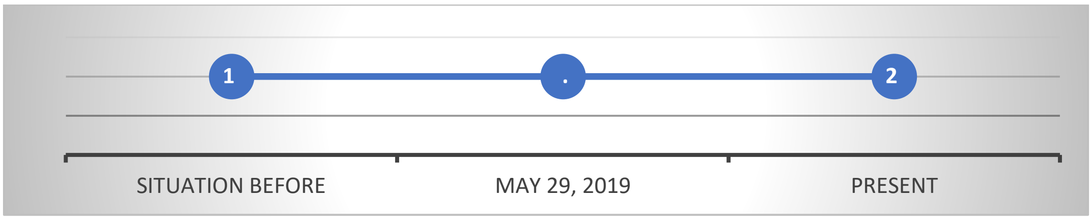
With Kaplan Meier curves, the time it takes for plans to be either approved or completed is displayed graphically. This research incorporates four Kaplan Meiers, two for approval and two for completion. Furthermore, per phase in the building process, the Kaplan Meier shows the estimates for plans before and after PAS, and the estimates for plans with minimal or low exposure and medium or high exposure. The Kaplan-Meier estimates provide a handy first look into the analysis of the variables, but do not include the interaction between these variables, as it is non-parametric. The regression models that were also included in the research enhance the understanding of in the building process.

The Cox Proportional Hazards Model is a semi-parametric model used to assess the effect of several variables on survival time simultaneously (Fox & Weisberg, 2002). It assumes that the hazard ratios for the event are a constant proportion over time, which simplifies the analysis of covariates in relation to survival (Fox & Weisberg, 2002). With a Cox regression, it could be tested whether different parameters influence the approval or completion of plans, in this case especially deposition of nitrogen and the control variables. With a log rank test, two or more independent variables were analysed to test a significant difference between multiple groups with the help of hypotheses.

4.3.1 Difference-in-difference analysis

To test the data over multiple periods of time, the difference-in-difference analysis is used. A difference-in-difference analysis uses a treatment group – who are exposed to the treatment – and a control group – who are not – and is useful if the control group cannot be randomised (Rossi et al., 2004). The main motivation to use a difference-in-difference analysis is to compare the discrepancies in outcomes over time between the treatment group and the control group (Wing et al., 2018). The analysis is made to test whether plans that are subject to nature conservation regulation and are initiated after PAS (treatment group) yield different results than plans without regulation and before PAS (control group). It is tested whether the treatment is effective, in which case it is expected that the situation after PAS differs significantly, compared to the period before PAS. This is the treatment effect.

Figure 1: Timeline



There is one important moment in time in recent years that has influenced decision-making regarding construction in the Netherlands, so roughly two significant periods can be distinguished (see figure 1). The first period is everything before May 29 in 2019, the moment the Dutch Council of State annulled measures taken by the Dutch government, and from that moment on (the second period), all plans for construction needed a calculation that proved no harm would be done to nature.

4.4 Validity

The quality of a research can be determined among others by determining its validity and reliability. This way, it becomes clear whether the methods used in this research have been conducted well, in order to gain insights in the research problem, and whether the research aim was achieved. The reliability of this research will be discussed in paragraph 4.5. Validity focuses on the accuracy of the methodology used in a research (Punch, 1998). This way, it can be established if results are correct and correspond to the actuality or the physical world. Validity can be subdivided in two types of validity: internal and external.

4.4.1 Internal validity

Internal validity refers to whether the methods used in the research are accurate, therefore it is also called methodological validity.

This research uses longitudinal data collection to ensure internal validity. This way, the process until approval and construction can be studied accurately and it shows differences in time at which plans were in fact approved or finalised. In addition to that, different methods were used to yield results. The survival time analysis test differences between multiple groups over time, whereas the difference-in-difference analysis enhances the understanding about the interaction between those variables. Furthermore, internal validity is increased by using control variables and fixed effects that control for bias and unwanted manipulation of other variables on the outcomes of the analysis. This enhancement of validity will become clear in the results chapter of this research, as the outcomes and hazard ratios of the variables have become substantially different when these control variables and fixed effects are included across the different models. The statistical analyses for this research have been set up using the same procedure for analysing plans until approval and until completion, another element which ensures internal validity. An important factor that limits the internal validity of this research is the absence of a possibility to randomising the variables. Randomising also reduces systematic bias, but this is impossible in this research, because the variables are from three provinces only and need to be categorised and thus separated by year of plan approval and level of exposure.

4.4.2 External validity

In academic research, external validity is ensured when results can be generalised, which means that results and conclusions drawn from a research can also be applicable for a larger group, a different or more common setting or time, etc.

External validity for this specific research is slightly more difficult to achieve than internal validity. This research is detailed and specified to the effect of nature conservation laws on approval and construction in the Netherlands. Results of this research can, for instance, not be generalised to the effect of nature conservation laws on other settings, such as the intended improved quality of nature, and it also does not measure the effect of other laws and regulation, such as the Spatial Planning Act (Wro) or General

Provisions on Environmental Law Act (Wabo) – which as of 2024 are also part of the Environment and Planning Act (Ow) –, on approval and construction.

However, the external validity is guaranteed by the fact that nature conservation laws are impeded on a national level, and do not differ between the several different provinces in the Netherlands, and can therefore be generalised to a national level. Besides that, every EU country has its own codification of the same laws, and therefore this research could also be useful in different EU countries (Van Thiel, 2014). Further research could ascertain this. Furthermore, the longitudinal nature of the analysis ensures external validity, because the results and conclusions are not limited to a single year, but can be generalised to a longer period of time.

4.5 Reliability

Reliability refers to the trustworthiness and consistency of the methodological procedures and the data generated (Stiles, 1993). Roberts and Priest (2006) distinguish between inter-rater reliability and test-retest reliability. Inter-rater reliability according to Roberts and Priest (2006) should provide the same information if used by different people. In this research, this is ensured by clear operational definitions of the (control) variables introduced in the theory chapter, the addition of a background chapter to enhance understanding of the complex context, and transparency in the analysis process, in an attempt to be as detailed in explaining the different steps. Test-retest reliability refers to whether the analysis would yield the same results, when conducted at a different moment in time (Roberts & Priest, 2006). This is ensured by the longitudinal data.

Furthermore, the research can be reproduced, so reliability is ensured, by the large sample that is used (1,553 plans). However, triangulation is difficult to achieve, because this research does not consult mixed methods, no qualitative data was used in this research.

5. Results

The results chapter of this research presents the research and data analysis conducted to address the questions outlined in the study, and lists its main findings. Three provinces have been thoroughly studied for this research: North Holland, South Holland and Limburg. This research examines the process of residential construction in the Netherlands in the permitting and construction phases, with the main focus on housing projects with, as well as without, exposure to excessive deposition of nitrogen. This is measured by categorising the levels of deposition; minimal, low, medium and high. Furthermore, the periods before and after 29 May 2019 – the annulment of PAS – are compared. The most important part of the data analysis is evaluation of data from a Cox survival regression analysis.

5.1 Descriptives

In total, there are 1,553 plans in the database used for this research. All those plans can be marked by year and quarter (yq) in which the first building permits are granted. 29 May 2019, the date on which the Dutch Council of State annulled the PAS, falls in yq 237. This way, it can be decided that all the plans before yq 237 or yq 237 itself, could be judged by municipalities for approval and implemented without any measures regarding nature conservation. Every plan initiated after yq 237 is supposed to face extensive nature conservation measures[11]. This resulted in the variable 'After PAS'. Out of all the plans gathered in the database, 1,435 or 92,4% of plans are approved before or on yq 237 (After PAS = 0) and 118 or 7.6% of plans are approved after that yq (After PAS = 1).

Furthermore, every plan has been assigned a category to indicate whether it is exposed to nature conservation laws (Natura 2000 legislation), depending on the projected amount of deposition of nitrogen caused by the development. Four categories have been distinguished, namely minimal, low, medium and high. See table 2. Plans with minimal exposure emit a maximum of 0.005 moles of nitrogen per hectare per year ('max. moles p.ha. p.y.' in table 2) in all hexagons of a Natura 2000 area. In Aerius-calculations, a number lower than 0.005 is rounded to 0. Low and medium exposure plans emit a maximum of 0.1 and 0.5 moles per hectare per year respectively. Plans which are considered to have a high exposure emit more than 0.5 moles. The third column in table 2 refers to whether plans with a certain deposition category are subject to nature conservation laws or not. This resulted in the variable 'Medium or high exposure'. 1,285 or 82,7% of plans have been assigned to categories minimal or low (Medium or high exposure = 0) and 268 or 17,3% of plans are medium or high (Medium or high exposure = 1).

Table 2: Categories of deposition (Koning & Endhoven, 2023)

Deposition category	Max. moles p.ha. p.y.	Conservation laws?	Medium or high exp. =
Minimal	0.005	No	0
Low	0.1	No	0
Medium	0.5	Yes	1
High	Above 0.5	Yes	1

The interaction between these variables is also studied so that there are four main groups of plans analysed.

5.2 Models

The Cox survival regression analyses used in this research consist of four models. The first model compares the plans after PAS to before PAS and the plans with medium or high exposure to minimal and low exposure. The second model comprises the control variables. Finally, the third and fourth model of the analyses include fixed effects for region and year of plan approval.

[11] It is important to note that the actual quarter would have finished on 31 May 2019, but this difference of two days is considered negligible for this research.

This research includes these fixed effects on top of the control variables to repeatedly control for unobserved and time-invariant bias or heterogeneity. This is done to acquire more accurate estimates of the time-varying variables, in an attempt to increase the robustness of findings and the validity of the model. Fixed effects are included in the analysis using dummy variables. The fixed effects in this research are region effects and the effect of the year of plan approval. The region effect controls for differences in the plans between the three provinces studied: North Holland, South Holland and Limburg. The year of plan approval effect controls for the statistic trends and bias for the year in which the plan was approved.

5.3 Approval time

A central part of this research is to investigate whether differences in approval time occur between the plans analysed in this research. This is important, in order to identify whether nature conservations laws form a threat to the continuity of the process of homebuilding in the Netherlands. The primary emphasis is directed towards all plans collected in the database, thus initially no regional distinction by province is made. It deviates from assumptions that there will be significant differences between the provinces, as the nature conservation legislation applies to the entire country. Nevertheless, as mentioned in paragraph 5.2, the third and fourth models control for this assumption and other regional bias.

The Kaplan-Meier survival estimates curves in figures 1 and 2 are visual representations of the time it takes for building permits to be granted in the three examined provinces. The x-axis represents the analysis time in months. The y-axis represents the percentage of building permits granted within the range of 1–0, given that 0 in this case indicates that all of the building permits have been granted.

Figure 2: Kaplan-Meier survival estimates for After PAS (approval)

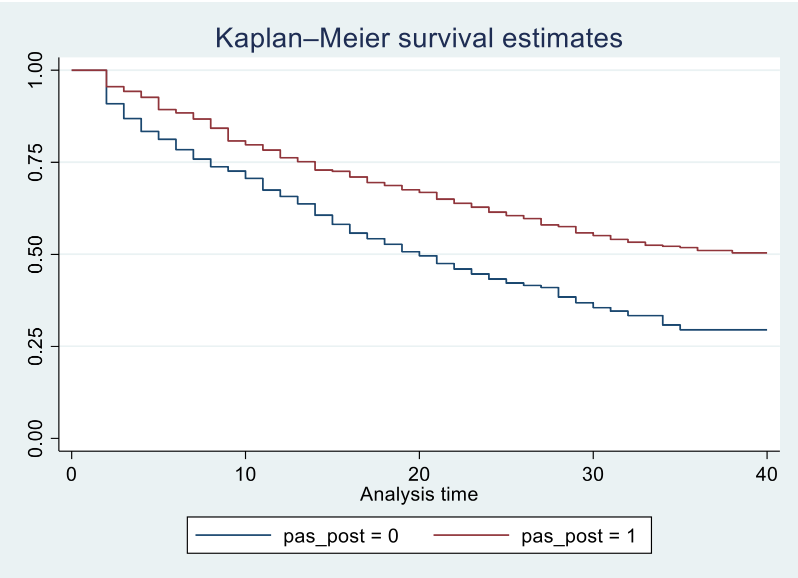
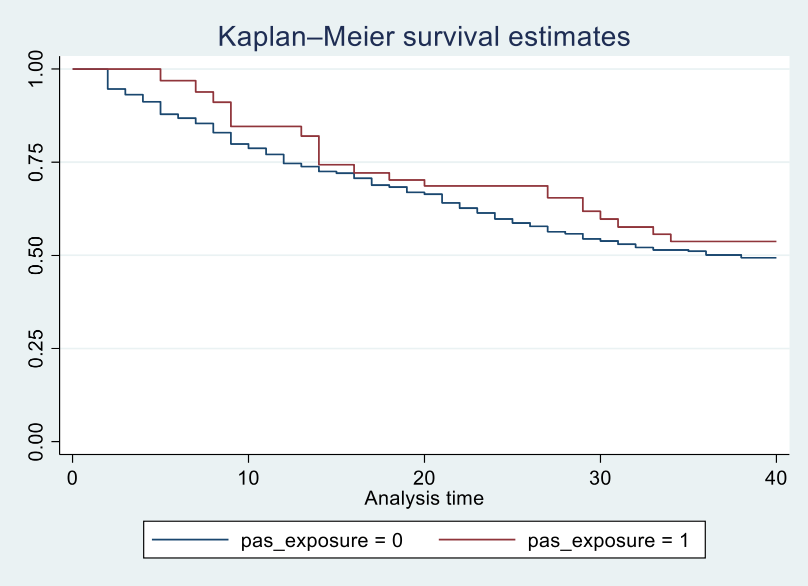


Figure 2 shows that plans approved after 29 May 2019 (After PAS = 1) are permitted after a longer period of time than plans before that date (After PAS = 0), as can be induced by the higher red curve. For instance, 50% of plans before the PAS annulment were permitted within 20 months, whereas after it took around 38 months for plans to be permitted. This graph also shows that in the first months the difference is apparent, but not quite this large, given that 25% of plans before PAS annulment were approved within 9 months, and around 13 months for plans after that. The difference between the two curves thus only grows as more months pass. However, it is important to note the uncommon difference in distribution of plans – 92% compared to 8% – for this graph analysed in this research.

Figure 3: Kaplan-Meier survival estimates for Medium or high exposure (approval)



This graph shows that plans with a maximum of 0.1 moles per hectare per year (Medium or high exposure = 0) are approved at almost the same rate as the rest of the plans (Medium or high exposure = 1). The lower blue curve hints at a slightly quicker rate for minimal or low exposure plans, however, all in all not much difference is observed. It takes plans with minimal or low exposure around 35 months to reach 50% of plans approved and plans with medium or high exposure more than 40. It cannot be induced from this graph where exactly the 50% mark for Medium or high exposure = 1 is, as the graph is maxed out to 40 months. Therefore a look can be taken at the 25% mark to see the difference. It takes 12 months to reach 25% plans approved and Medium or high exposure = 1 around 14 months. Again, it is important to note the difference in distribution of plans – 83% compared to 17% – for this graph, which also resulted in the choppy nature of the red line. The percentages for this graph are closer than the first graph, and also both curves in the graph seem closer, leading to a question of further discussion whether the appeared difference would still be the same if the variables in the groups were of the same size.

The Kaplan-Meier estimates serve as a helpful introduction to the analysis of the variables, but lack the interaction between them. The regression models analysed below provide more detail to comprehending variations in the permit approval process.

5.3.1 Analysis of the influence of nature conservation laws on permit approval

This paragraph examines the results of the Cox regressions shown in tables 3 and 4. A hazard ratio indicates the likelihood of an event occurring, taking a certain variable into consideration (Spruance et al., 2004). A hazard ratio of 1 indicates no effect. A hazard ratio lower than 1 indicates a lower likelihood, and a hazard ratio above 1 suggest an increase in likelihood of the variable that is being compared to the reference variable.

Table 3: Results of the Cox survival regression (approval)

	Model 1	**Model 2**	**Model 3**	**Model 4**
_t	Haz. ratio (z)	Haz. ratio (z)	Haz. ratio (z)	Haz. ratio (z)
Nature conservation regulation				
After PAS	0.6030***	0.4343***	0.4499***	0.5710***
	(-4.58)	(-5.47)	(-5.25)	(-3.55)
Medium or high exposure	1.0010	1.0954	1.0953	1.0869

	(0.01)	(0.89)	(0.89)	(0.81)
After PAS X Medium or high exposure	0.8865	0.8740	0.8865	0.8775
	(-0.46)	(-0.51)	(-0.46)	(-0.50)
Plan and Environment				
Plan capacity		0.9981***	0.9980***	0.9980***
		(-5.16)	(-5.38)	(-5.40)
Previous use: share of housing land		1.0057***	1.0049**	1.0051**
		(2.68)	(2.33)	(2.37)
Previous use: share of industrial land		1.0105**	1.0060	1.0074
		(2.05)	(1.14)	(1.39)
Previous use: share of unbuilt land		1.0117***	1.0070	1.0061
		(2.78)	(1.60)	(1.36)
Percentage of owner-occupied homes		1.0022	1.0013	1.0008
		(0.86)	(0.49)	(0.30)
Market conditions				
Price index homes		0.9930	0.9836***	0.9866**
		(-1.38)	(-2.88)	(-2.10)
Price index change		0.9875	0.9772	0.9732
		(-0.49)	(-0.90)	(-1.01)
Building costs index		1.0412***	1.0666***	1.0165
		(3.06)	(4.30)	(0.53)
Region fixed effects	No	No	Yes	Yes
Year plan approval effect	No	No	No	Yes
Number of plans	1,553	1,516	1,516	1,516
Plan quarters at risk	27,034	26,020	26,020	26,020

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

The hazard ratios of the plans after PAS is under 1 across all four models. In the first model, the hazard ratio is 0.6030, which means that plans initiated after 29 May 2019 have around 40% less chance to be approved than before that date for each quarter they are observed in the dataset. That percentage becomes even higher when the control variables and the region effects are included. It returns to roughly 40% again when the year of plan approval effect is included. These results are statistically significant. In the same model, the plans that are exposed to higher values of nitrogen (medium and high), have a hazard ratio close to, but above 1. The hazard ratio of the first model indicates no effect, however in the other three models the results do indicate a slight positive effect of around 9%. This is surprising at first, however, the results are insignificant, which means that there is not enough evidence to back this slight positive effect and it is assumed that medium or high exposure to nitrogen does not influence approval times. When the interaction between plans after PAS and medium and high plans is studied – the difference-in-difference estimate –, a hazard ratio of 0.8865 occurs, which indicates that plans with medium and high exposure after 29 May 2019 have 11.3% less chance of being approved compared to plans with minimal or low exposure before the annulment of PAS. However, the results are insignificant, which means no effect can be established.

Regarding the control variables incorporated in the analysis, the percentage of owner-occupied homes can be considered to have no effect, as its hazard ratio is close to 1 across all three models. This means that whether or not the area surrounding the development has a lot of homeownership does not influence permit approval. The plan capacity has a hazard ratio of 0.9980, which means that every extra building in a plan leads to a 0.002% less chance of a permit for each quarter they are observed in the dataset. This is of course negligible for plans with a limited plan capacity, but if a plan anticipates on 5000 dwellings, there is already a 10% lower chance of approval.

Table 4: Results of the Cox survival regression (deposition; approval)

	Model 1	**Model 2**	**Model 3**	**Model 4**
_t	Haz. ratio (z)	Haz. ratio (z)	Haz. ratio (z)	Haz. ratio (z)
Level of deposition				
After PAS	0.5336***	0.3726***	0.3884***	0.5150***
	(-4.00)	(-5.15)	(-4.94)	(-3.36)
Deposition category - low exposure	0.7317***	0.8302**	0.8808	0.8777
	(-3.68)	(-2.15)	(-1.45)	(-1.48)
- medium exposure	0.7407**	0.8540	0.8967	0.8863
	(-2.07)	(-1.08)	(-0.74)	(-0.81)
- high exposure	0.9774	1.1689	1.1819	1.1694
	(-0.17)	(1.10)	(1.16)	(1.09)
After PAS X Deposition category - low exposure	1.2613	1.3246	1.3080	1.2145
	(1.12)	(1.35)	(1.29)	(0.93)
- medium exposure	1.2991	1.3151	1.3363	1.3141
	(0.76)	(0.80)	(0.84)	(0.79)
- high exposure	0.7096	0.7238	0.7197	0.6569
	(-0.80)	(-0.76)	(-0.77)	(-0.98)
Plan and Environment				
Plan capacity		0.9982***	0.9980***	0.9981***
		(-4.87)	(-5.16)	(-5.16)
Previous use: share of housing land		1.0062***	1.0054**	1.0056***
		(2.91)	(2.53)	(2.58)
Previous use: share of industrial land		1.0103**	1.0063	1.0076
		(2.00)	(1.19)	(1.43)
Previous use: share of unbuilt land		1.0109**	1.0068	1.0058
		(2.54)	(1.54)	(1.28)
Percentage of owner-occupied homes		1.0023	1.0014	1.0009
		(0.88)	(0.54)	(0.34)
Market conditions				
Price index homes		0.9928	0.9838***	0.9870**
		(-1.43)	(-2.84)	(-2.03)
Price index change		0.9873	0.9775	0.9731

		(-0.50)	(-0.88)	(-1.01)
Building costs index		1.0426***	1.0665***	1.0140
		(3.14)	(4.29)	(0.44)
Region fixed effects	No	No	Yes	Yes
Year plan approval effect	No	No	No	Yes
Number of plans	1,553	1,516	1,516	1,516
Plan quarters at risk	27,034	26,020	26,020	26,020

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

In table 4, the different levels of deposition are included in the analysis. This was done in order to check if plans that have a higher exposure, and consequently are subject to nature conservation regulation laws, have a lower chance of permitting than plans that are not subject to those laws. This analysis does not yield drastically different results for the control variables, and all significant results of table 3 retain the same level of significance in table 4.

Across all four models, the variable 'after PAS' yields significant results between 63% and 48%. It can be interpreted that this variable represents minimal exposure, which means that plans with minimal exposure after PAS have a 48% less chance of being approved, if all variables and fixed effects are included. If no control variables or fixed effects are taken into account, plans with low and medium exposure encounter a 27% and 26% less chance to be approved respectively for each quarter they are observed in the dataset. However, these results become smaller and insignificant if all variables are considered. This once more underlines that the categorisation of variables into low, medium, or high exposure to nitrogen does not result in explaining differences in approval times with significant outcomes.

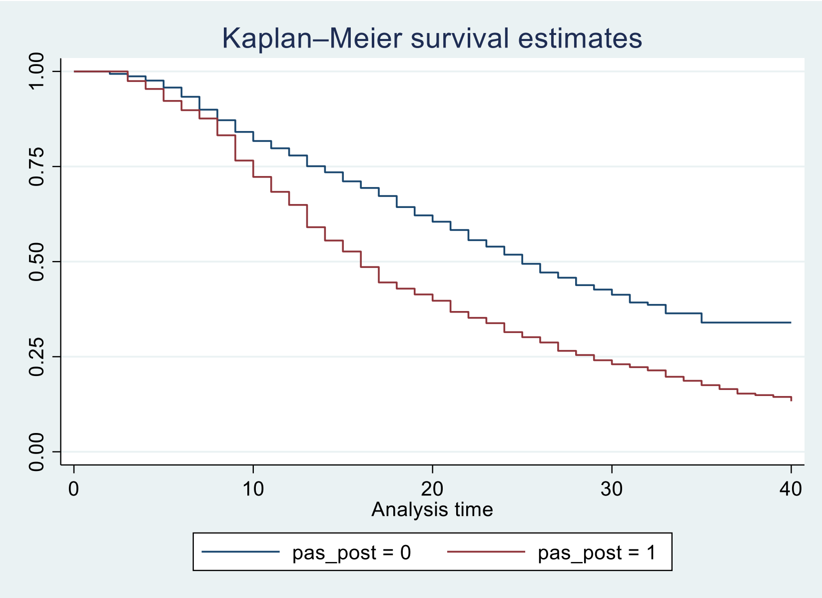
It can be noted that there is almost no difference in approval between medium and low exposure. The results are only significant at 5% in model 1, but the size of the differences does not change across all models. This is striking, because measures can be expected when the critical exposure is exceeded as compared to when it is not. There might be underlying factors as to why the medium plans are approved at the same rate as the low plans, such as compensation, described in the background chapter.

5.4 Event completion

Besides the time it takes for the approval of plans, it is also useful to delve into the time needed until the plan is completed. A plan is considered 'completed' (event_completion = 1) if 90% of all dwellings are finalised. It is interesting to investigate whether this analysis will yield different results as the analysis on approval of plans. The two outcomes will be compared in paragraph 5.6.

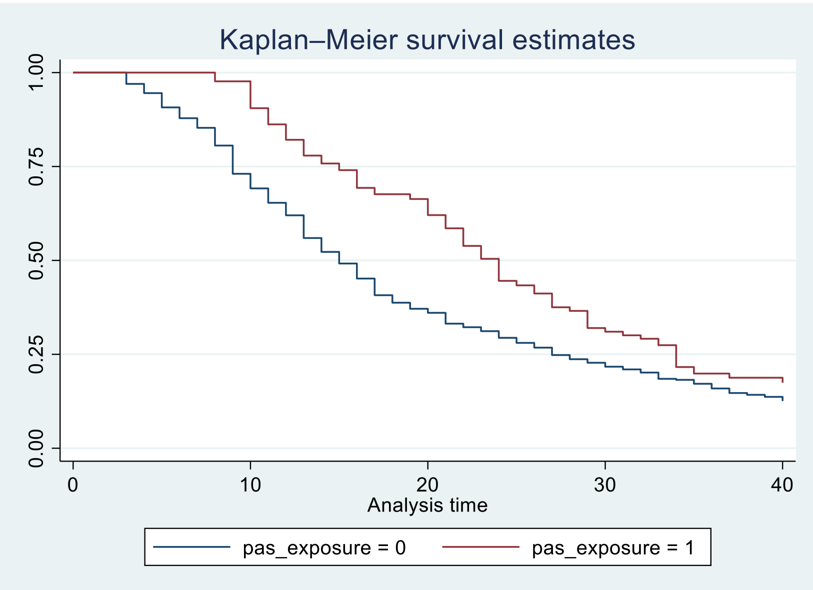
The Kaplan-Meier survival estimates curves in figures 3 and 4 are visual representations of the time it takes for plans to be completed in the three provinces. Similarly, the x-axis represents the analysis time in months. The y-axis in this case represents the percentage of plans completed within a range of 1–0, where 0 indicates that all of the plans have been completed.

Figure 4: Kaplan-Meier survival estimates for After PAS



It becomes clear from figure 4 that plans after 29 May 2019 (After PAS = 1) are completed more quickly than plans before that date (After PAS = 0), as can be induced by the lower red curve. For instance, 50% of plans before the PAS annulment were completed within 25 months after the start of construction, though after PAS only around 16 months had passed to reach the 50% mark. This is the only of four curves used in this research with a lower red curve. However, it is still difficult to draw conclusions from this observation, because the difference was only around 4 months at the 25% mark. This can be explained by the fact that this graph applies to all plans, regardless of the level of exposure.

Figure 5: Kaplan-Meier survival estimates for Medium or high exposure (completion)



After a lower red curve in figure 5 for After PAS, this graph on exposure depicts a lower blue curve again. This means that plans that have not been exposed to excessive nitrogen levels are completed earlier than plans that have. With regards to the 50% mark, the difference is approximately 8 months; 15 months (Medium or high exposure = 0) compared to 23 months (Medium or high exposure = 1). However, it can be noted that the difference between the two curves does not seem to exponentially grow, because at both the 25% and 75% marks the disparity is approximately 4-5 months. The red curve thus catches up on the blue curve. The survival regression in the next paragraph explores the interaction between the variables and its effect on plan completion.

5.4.1 Analysis of the influence of nature conservation laws on completion

Similar to paragraph 5.4.1, this paragraph aims to investigate the results of the Cox regressions displayed in tables 5 and 6. Without any extra variables, it can be induced from the first model, that plans after 29 May 2019 had a 67% higher chance of being completed than those before that date. When the control variables and fixed effects are included, the hazard ratios came under 1, consequently meaning that the buildings were completed with a 5 to 8% lower chance. Plans that are exposed to medium or high levels of deposition had 21% less chance to be completed, a number that dropped to 16% if all variables were included. However, insignificant results for the models 2, 3 and 4 mean that the effects cannot be proven with certainty. The interaction between these variables yields insignificant results close to 1, which means that there is no effect of nitrogen exposure and nature conservation laws on completion times.

Table 5: Results of the Cox survival regression (completion)

	Model 1	**Model 2**	**Model 3**	**Model 4**
_t	Haz. ratio (z)	Haz. ratio (z)	Haz. ratio (z)	Haz. ratio (z)
Nature conservation regulation				
After PAS	1.6740***	0.9206	0.9225	0.9528
	(6.59)	(-0.67)	(-0.66)	(-0.39)
Medium or high exposure	0.7903**	0.8533	0.8489	0.8447
	(-1.97)	(-1.31)	(-1.35)	(-1.39)
After PAS X Medium or high exposure	1.0877	1.0198	1.0267	1.0191
	(0.47)	(0.11)	(0.15)	(0.10)
Plan and Environment				
Plan capacity		0.9982***	0.9981***	0.9981***
		(-5.75)	(-5.89)	(-5.93)
Previous use: share of housing land		1.0091***	1.0088***	1.0086***
		(4.64)	(4.49)	(4.32)
Previous use: share of industrial land		1.0045	1.0036	1.0037
		(0.92)	(0.72)	(0.73)
Previous use: share of unbuilt land		1.0062	1.0051	1.0065
		(1.56)	(1.25)	(1.52)
Percentage of owner-occupied homes		1.0005	0.9998	0.9997
		(0.22)	(-0.07)	(-0.11)
Market conditions				
Price index homes		1.0135***	1.0051	1.0061
		(3.06)	(0.95)	(1.05)
Price index change		0.9135***	0.9091***	0.9160***
		(-3.67)	(-3.86)	(-3.51)
Building costs index		1.0173	1.0400***	1.0318
		(1.28)	(2.48)	(1.17)
Region fixed effects	No	No	Yes	Yes
Year plan approval effect	No	No	No	Yes

Number of plans	1,553	1,516	1,516	1,516
Year quarters at risk	30,108	29,094	29,094	29,094

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

Like in plan approval, the percentage of owner-occupied homes does not influence the completion times of plans. Furthermore, the 0.002% lower chance for every extra building in the plan capacity has not changed for completion. If a look is taken at the previous use of the land, there are insignificant results for industry and unbuilt land, which means no conclusions can be drawn with certainty about these previous land uses. If housing was the previous function of a plan, a very minimal, but significant effect can be established: a plan is completed with a 0.009% slower rate for each quarter they are observed in the dataset.

The market conditions in this analysis yield some interesting results. The price index change indicates a 8% less chance of completion, if the price index changed in the last year. This could be a result of market uncertainty or conservative behaviour of developers. Besides that, the results for building costs indicate that if buildings costs rise, buildings are completed with a 3% higher chance. This is counter-intuitive, but the insignificant results show that not much value should be attached to these findings.

Table 6: Results of the Cox survival regression (deposition; completion)

	Model 1	**Model 2**	**Model 3**	**Model 4**
_t	Haz. ratio (z)	Haz. ratio (z)	Haz. ratio (z)	Haz. ratio (z)
Level of deposition				
After PAS	1.7708***	0.9635	0.9692	1.0064
	(5.34)	(-0.26)	(-0.22)	(0.04)
Deposition category - low exposure	0.8355*	0.9476	0.9677	0.9563
	(-1.91)	(-0.56)	(-0.34)	(-0.46)
- medium exposure	0.6474**	0.7349*	0.7479*	0.7371*
	(-2.51)	(-1.76)	(-1.66)	(-1.73)
- high exposure	0.7966	0.9353	0.9258	0.9174
	(-1.38)	(-0.40)	(-0.46)	(-0.51)
After PAS X Deposition category - low exposure	0.9039	0.9151	0.9085	0.8976
	(-0.70)	(-0.61)	(-0.66)	(-0.74)
- medium exposure	1.1993	1.1638	1.1667	1.1621
	(0.73)	(0.61)	(0.61)	(0.60)
- high exposure	0.8678	0.8033	0.8059	0.7866
	(-0.54)	(-0.84)	(-0.83)	(-0.92)
Plan and Environment				
Plan capacity		0.9983***	0.9982***	0.9982***
		(-5.53)	(-5.70)	(-5.72)
Previous use: share of housing land		1.0093***	1.0090***	1.0088***
		(4.73)	(4.57)	(4.40)
Previous use: share of industrial land		1.0041	1.0035	1.0038

		(0.84)	(0.70)	(0.74)
Previous use: share of unbuilt land		1.0055	1.0048	1.0062
		(1.38)	(1.16)	(1.44)
Percentage of owner-occupied homes		1.0005	0.9998	0.9997
		(0.21)	(-0.07)	(-0.12)
Market conditions				
Price index homes		1.0132***	1.0051	1.0060
		(2.98)	(0.94)	(1.04)
Price index change		0.9125***	0.9085***	0.9158***
		(-3.71)	(-3.88)	(-3.52)
Building costs index		1.0183	1.0402**	1.0323
		(1.35)	(2.49)	(1.19)
Region fixed effects	No	No	Yes	Yes
Year plan approval effect	No	No	No	Yes
Number of plans	1,553	1,516	1,516	1,516
Year quarters at risk	30,108	29,094	29,094	29,094

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

In table 6, when splitting the deposition into the four different levels, one significant result (at 10%) emerges in model 4. Plans with medium exposure have a 26% less chance of being completed for each quarter they are observed in the dataset. Also for low and high exposure lower chances of completion are found and expected. Minimal exposure does not have an effect on completion and are completed at the same pace as before 29 May 2019. Although the results are insignificant and thus it cannot be concluded with certainty, it could hint at delay in completion as a result of nature conservation laws.

Like with tables 3 and 4, the results of the control variables and fixed effects for table 6 do not dramatically differ from table 5 when the different levels of deposition are incorporated into the analysis. All significant values retain the same level of significance throughout both models, except for the significant value of building costs in model 3, which in table 6 is significant at 5% instead of 1%.

5.5 Comparison

This paragraph aims to compare the outcomes of the analyses on approval and completion of plans. This is important to gain understanding of the matter, to validate findings, and possibly to identify similar patterns or inconsistencies.

The very first outcome that catches the eye, is the difference in hazard ratios of the plans after PAS and plans with exposure across the four tables. Plans after 29 May 2019 have a 40% lower chance of being approved, however, they have a 67% higher chance of being completed. The former observation is likely attributed to an increase in nature conservation regulation it has faced. This could mean that plans that have passed this extensive regulation – which can be considered to have a substantial slowing effect on the process – in the approval phase, have less potential factors for delay in the completion phase, and are in fact completed quicker, leading to the latter observation. This could by all means show that the most time that passes, whether it be called ‘delay’ or not, has shifted from the building phase to the approval phase of the entire process, or has increased mostly in the approval phase. Moreover, plans that experience exposure have a 21% lower chance of being completed, compared to no effect in approval.

When the interaction between plans after PAS and with medium or high exposure is studied and compared between the tables, it is striking that plans with these conditions have 12% lower chance of being approved, whereas there is no effect on completion. However, the results are insignificant.

The different categories of deposition also result in different outcomes for approval and completion. However, there are very few significant results in these groups of smaller sample sizes, which means that not many variables influence the approval or completion time. Therefore it comes with great caution to draw the conclusions that minimal exposure has a negative influence on approval, and has no effect on completion, whereas low, medium and high have a negative influence on both.

The study by Koning & Endhoven (2023) states that plans with high exposure can by no means get a permit. However, this research has proven that plans with high exposure were in fact able to obtain a permit and continue the building process. Future research could also delve into the factors as to why these plans did get approved. Rouwendal (2023) found that developers have shifted their attention to municipalities at the outskirts of Natura 2000 areas, instead of municipalities with more than 40% of its area designated as Natura 2000. Benjamin (2022) states that more room for nitrogen emissions was created as a result of buying out agricultural companies. Both authors provide a possible explanation as to why these permits were granted nonetheless, but further research could be conducted on this topic.

5.5.1 Comparison of the control variables

The plan capacity has a negative, but significant influence on both approval and completion. This variable adjusts for scale, and demonstrates that larger projects take longer to be approved and completed. However, the hazard ratios are bordering on 1, so the influence is extremely small and negligible.

The percentage of owner-occupied homes yield insignificant results that are not of influence as they all have a hazard ratio of 1. Market conditions such as the price indices and building costs are of limited influence. Across all four tables, some values for the several price indices are insignificant, which could possibly hint at the absence of economical influence on the longer term. However, the changes in price index yield significant negative results on completion in the short-term. On the other hand, the building costs index has a slight positive influence on both approval and completion, when the year of plan approval effect is not considered. This could imply that the likelihood of more expensive plans to be approved is slightly higher, counter-intuitively. When the building costs are corrected for year effects, the result becomes even slightly higher, but insignificant, meaning that the year in which the building costs were made is in fact of influence, and that bias is then removed.

6. Conclusion

This research was conducted with the main question being: “To what extent do nature conservation laws contribute to a delay in the permitting and construction process in the Netherlands?” The conclusion of this research and answer to this question are formulated with the results of the analysed data, and in a stepwise manner with the help of the sub questions in this research.

6.1 Sub question 1

The first sub question posed in this research is, “What are the differences in lead times of plans before and after the PAS judgment?” Firstly, it can be established that after the annulment of PAS on 29 May 2019, new projects for homebuilding in the Netherlands are subject to more regulation and nature conservation laws. This led to the question whether plans after PAS had different lead times than before, with the assumption of these differing lead times being longer after PAS than before. This was assumed for this research, following the initial reaction of the building sector, which was driven by panic. The PAS annulment triggered a conservative mindset, foreseeing only problems instead of chances, as construction in the Netherlands was deemed impracticable by the building industry. From the findings of this research, in the first two years after PAS, a 43% reduction in permit approval became apparent for each quarter they are observed in the dataset. This percentage represents all plans in the dataset. If a look is taken at the completion of plans after PAS, no statistically significant effect can be found when the control variables are included. This means that, using this dataset, there is no reason to assume that completion rates after PAS have changed, compared to the situation before. In conclusion, the permitting phase of the building process has become longer, possibly resulting in more delay. However, the building phase until which a plan is completed, does not result in more delay after PAS. Furthermore, the delay in the permitting process, could also hint at a shift of delay from other parts of the entire process to the permitting phase, and thus do not necessarily have to result in more total delay.

6.2 Sub question 2

The second sub question to which an answer will be formulated is, “What are the differences in lead times of plans with minimal or low exposure and medium or high exposure?” In order to find an answer to this sub question, the analysis of data was conducted in a way that separated the different levels of exposure. Due to a small dataset, not much significant results were found, when including the fixed effects and control variables. This means that this research cannot prove with certainty that plans with medium or high exposure experience different lead times than plans with minimal or low exposure, neither in the approval nor completion phase. However, there are two significant results. Firstly, plans with minimal exposure have a 48% lower chance of being permitted. This being the only significant results, means there is no reason to assume that other levels of exposure experience a lower chance of approval. It does hint at the possibility of longer approval times after PAS, but for all plans, not only plans at risk of nature conservation. Secondly, plans with medium exposure have a 26% lower chance of being completed. This is the only result that proves why it could have been useful to conduct the research in a way that analyses the different levels of exposure separately. Larger datasets, with especially plans with medium or high exposure, could yield more significant results.

6.3 Sub question 3

At last, the third and final sub question of this research will be answered: “Have the differences in lead times after PAS become larger for plans that are potentially subject to nature conservation laws?” In answering this question, a difference-in-difference analysis was used. Across all models, the values for the interaction between plans after PAS and plans with medium or high exposure – which would be subject to nature conservation laws – are not found to be statistically significant. This means that the differences in lead times after PAS cannot be proven to have become larger for plans potentially subject to nature conservation laws. The analysis did not reveal any substantial variation in lead times when comparing plans subject to nature conservation regulations with those that are not, indicating that nature conservation laws do not significantly impact the processing time of buildings in the Netherlands.

6.4 Answering the research question

The Nature Protection Act in the Netherlands became a central part of debate in Dutch construction after the cancellation of PAS on 29 May 2019. After this date, every new plan for construction in the Netherlands needed extensive research on emission of nitrogen and its effect on nature. The building sector feared delays as a result of this. This led to the main question of this research, "To what extent do nature conservation laws contribute to a delay in the permitting and construction process in the Netherlands?"

It cannot be denied that Dutch developers face more regulation after PAS – every plan now needs at least an Aerius-calculation –, and so this research aimed to analyse if more regulation leads to more delay in approval or construction of new plans in the Netherlands. The findings of the data analysis suggest that the consternation that emerged in the construction industry was slightly premature. Plans after PAS did take slightly longer until approval for each quarter they are observed in the dataset, however, this finding does not provide reason to assume that the time until completion after has changed, compared to before 29 May 2019. It is important to note that this accounts for all plans, therefore also plans that are not subject to extra regulation. These findings were then elaborated on, by categorising the different levels of exposure and analysing them separately. The aim of this was to find whether significant results could be proven again per each level of exposure. In both the approval and construction phases, insignificant results mean that it could not be proven with certainty that plans with medium or high exposure experience longer lead times than plans with minimal or low exposure.

The interaction between plans after PAS and plans with medium or high exposure was also studied. Likewise, no effect was found when analysing these plans, reiterating that plans after PAS and with medium or high exposure did not have differing lead times, compared to before PAS and with minimal or low exposure. In short, plans of all exposure categories after PAS did experience slower approval than before PAS, whereas completion rates did not significantly differ compared to before PAS. No significant results were found between the different categories of exposure.

The initial reaction of the building sector was comprehensible, however it turned out to be premature. It can be concluded that there is a slight delay in approval for all plans after 2019, but this is only due to factors outside those analysed in this research and not necessarily the nature conservation laws. Construction was and will continue to be possible for the vast majority of plans in the Netherlands without much delay. This was also one of the findings of other studies and articles such as Been (2023) and Rouwendal (2023). Been (2023) reported that various measures can be implemented to continue construction, such as balancing and AIC-testing as introduced in the background chapter of this research. Rouwendal (2023), like this research, investigated the effect of the new nitrogen laws on permit approval in the Netherlands, and states that the total amount of permits granted after 29 May 2019 has not decreased as was assumed by the building sector. As a matter of fact, there was an ongoing decrease in granted permits prior to the annulment of PAS, whereas after PAS, the permitting experienced a slight increase.

Furthermore, this research roughly gathers the same outcomes as Owley (2015) and Arnold (1991), studies which were introduced in the literature chapter. Owley (2015) and Arnold (1991) both state that especially the approval of nature conservation laws takes up the most time out of all phases in the construction process and experience delay first. This research has likewise proven that in the Netherlands, the approval phase experiences delay and the construction phase does not.

6.5 Critical reflection and recommendations

6.5.1 Recommendations for further research

This results of this research could be a base for further research. To refine these results, further research could investigate several additional factors that could influence permit approval and completion of homes in the Netherlands. First of all, to continuously keep adapting to changes in the housing market and the field of nitrogen and nature conservation law, or other political developments is an important step to investigate this complex matter. Exploring the role of other regulations, economic aspects, and local governance practices could provide a more comprehensive understanding of the approval phase. Furthermore, comparative studies incorporating other countries in the European Union with similar nature conservation laws could offer interesting insights into how these laws work in different contexts, for instance in countries with fewer areas assigned as Natura 2000 that need to be protected. It could also be helpful to conduct studies over longer periods of time to assess the longitudinal effects of nature conservation laws on construction. Moreover, more attention could be given to other stages of the development process, for instance the approval phase until a plan becomes irrevocable, or the plan process as a whole. Finally, it could be an idea to conduct qualitative research, and use methods such as interviews and case studies of specific construction projects. Utilizing a combination of qualitative and quantitative methods, or exploring alternative statistical techniques could also be helpful to yield specific insights into the challenges that come with nature conservation laws in the Netherlands.

For future research on this subject, using a larger dataset is recommended to improve the robustness and reliability of the findings. A future dataset can incorporate more Dutch provinces, gather information on more plans from all different categories of exposure, especially medium and high, and use data from the most recent years. A larger dataset would improve the statistical potential of the analyses, creating more precise estimates and the chance of more significant results. This would also initiate a more comprehensive analysis. The data already analysed in this research and its results back this recommendation. In table 4, the hazard ratios for the different levels of exposure and previous land uses, for instance, become smaller when the control variables and fixed effects are taken into account as well. Furthermore, the already significant results at 10% for medium exposure in table 6 give the impression that significant conclusions (at 5 or 1%) could be drawn with more data of this specific exposure level, and for more plans in the research.

6.5.2 Limitations

While this research attempts to broaden the understanding of delay in approval and construction of new houses in the Netherlands, its limitations underline the necessity for further research. One of the main limitations is the spatial coverage of this research. Only three of the twelve Dutch provinces are being monitored, and the geographical diversity is not sufficient. To sufficiently make conclusions about and correct for regional differences, widening the spatial coverage by including more provinces could be interesting in further research. Furthermore, if data from 2022 and 2023 were used, this would have improved the findings of this research in an attempt to yield more significant results, as more plans would have been completed. This also contributes to the fact that the test-retest reliability of this research is low, if more years would be added. Besides that, it is difficult to compare the time it takes for the total building process to be completed in the Netherlands before and after PAS, as the current average time for approval and construction of a house is 10 years (Geuting & De Leve, 2018), and 10 years have not passed since the annulment of PAS in 2019.

7. References

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