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The Influence of Exam Timing on Academic Performance.

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Economics of Markets and Organisations

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Abstract

In recent years, exams at the Erasmus School of Economics have been scheduled on Saturdays, and moreover there were also exams scheduled at Saturday-evening. This has led to an ongoing discourse about the scheduling of exams and the effect it has on students. Therefore, it is important to research whether the scheduling of exams is influencing students and their performance on exams. This thesis aims to provide an answer on the question whether the time of day and the day of the week on which an exam is scheduled have an influence on the performance of students. The thesis begins by evaluating and discussing the current literature that is available on this topic. This literature review forms the basis of several hypothesis. These hypotheses were tested by using 20 different regression models, including both *random-effects generalized least squares-regressions* (GLS-regressions) and *individual fixed effects-regressions* (FE-regressions). Anonymized data from the Erasmus School of Economics on exam results and schedules for the academic years 2020-2021, 2021-2022 and 2022-2023 was used for these regressions. Combining the outcome of all regressions, there is a strong indication that there is an effect of exam timing on students and their performance on exams. More specifically, students tend to perform the best on exams scheduled during midday exams, while morning exams result in the poorest performance. Evening exams show performance levels between these two time-slots. Moreover, there is an indication that the effect of scheduling is even weakened because of an selection bias that occurs by more students not showing up for exams on times that result in a worse performance. This suggest that optimizing exam schedules could lead to a higher average grade on exams.

Keywords: *Exam timing; Circadian rhythms; Grades; Student performance; Cognitive tasks*

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1. Introduction

From the moment we wake up until we go to sleep, we are constantly making decisions, performing tasks and processing information. These cognitive functions are essential for navigating daily life and functioning effectively in society. Whether performing cognitive tasks such as grocery shopping, cleaning or executing tasks in the workplace, cognitive tasks appear in every aspect of life. However, some of these tasks have a bigger impact on our lives than others. For example, a job interview can have a significant impact on one's career, while a one-time decision to order take-out or to cook is not expected to have such a big impact. This underscores the importance of understanding the effect of timing on important cognitive tasks, especially if the effect differs among people. If individuals perform better at different times of the day, it could lead to an unfair advantage for certain people. Therefore, the scheduling effect of important tasks should be considered in this case.

The impact of schedules on performance is recognized in the field of chronobiology, which studies how biological rhythms influence human behaviour and physiology. In various domains, ranging from corporate environments to sports, the timing of activities has already been shown to significantly impact performance and outcomes differently among people. For instance, Facer-Child, Boiling & Balanos (2018) found that evening-orientated people are compromised in sport activities in the morning compared to morning types. Furthermore, Schmidt, Collette, Cajochen & Peigneux (2007) produced an overview of studies researching the influence of time-of-day on cognitive functions. They stated that cognitive performance differs throughout the day and that the optimal time varies among people. This variation implies that workplace productivity fluctuates because of circadian rhythms, and that for some people the schedule of society fits better than for others.

Given the variation in optimal performance times in other fields, it can be expected that similar differences exist for students. This suggest that some students may perform better or worse on exams depending on the time of day they are scheduled, potentially leading to unfair advantages as it is only due to differences in morningness-eveningness characteristics. Since it is plausible that there are individual differences among students, it is interesting to investigate whether students tend to have similar preferences regarding exam times. Understanding the impact of exam timing on the average student could provide valuable insight into how exam schedules can be optimized to suit the student population.

However, in academic evaluation, exam timing is often a factor that is overlooked. This is especially surprising given that exam performance is an objective measure, which is hard to gather outside academic contexts. In educational settings, many people perform similar tasks that are observed in the same objective way. Therefore, exam results could be a good measure of cognitive performance

differences between people. Furthermore, it is likely that the student population has similar characteristics to the workforce, suggesting that findings in academic setting could also be relevant later in life.

Hartley & Nicholis (2008) however note that there is little research on the effect of timing in higher education, whereas these studies are conducted for primary education. Exam timing however holds the potential to influence student performance in higher education based on the evident importance of timing in the areas mentioned previously. Therefore the aim of this thesis is to address this knowledge gap and contribute to a better understanding of the impact of exam timing on academic performance in higher education. To address this topic, the scope of this thesis will particularly be on the influence of the time of day and the day of the week on which the exam takes place.

Conducting this study allows for a contribution to the ongoing discourse surrounding educational equity, excellence and success as it is possible to examine whether the average student performs better at certain time-slots.[1] Understanding the relationship between the exam timing and performance is essential for educators striving to create fair assessment environments, but is also important for policymakers seeking to optimize educational outcomes and for students aiming to maximize their results. Therefore this research could potentially lead to changing and optimizing university policies, and moreover, it could also lead to a better understanding of the timing-effect on cognitive tasks in other fields.

To research the effect of exam timing, and more specifically the time of day and the day of the week, on academic performance a broad range of potential variables and considerations that could be the mechanism behind the effect of exam timing on performance should be taken into account. Regarding the time of the day, factors such as circadian rhythms, study habits, individual differences in sleep quality, and stress levels must be considered. When examining the weekday on which the exam takes place, it involves taking into account the dimensions for students related to the weekly schedule, social dynamics and influence of an extended workweek. Furthermore, it could be the case that certain groups of students are disproportionally influenced by preferences in exam timing compared to other groups of students.

The data on which this thesis is based is provided by the Erasmus School of Economics. It contains data on students from this faculty for study years 2020-2021, 2021-2022 and 2022-2023. Figure 1.1

[1] See also for example Hanemaaier et al. (2023) and Landsman & Lewis (2023) for a small insight into to ongoing discourse and the different topics involved.

shows the distribution of exams per study year and time of day. Morning, midday, and evening exam respectively start at 09:30, 13:30, and 18:30.

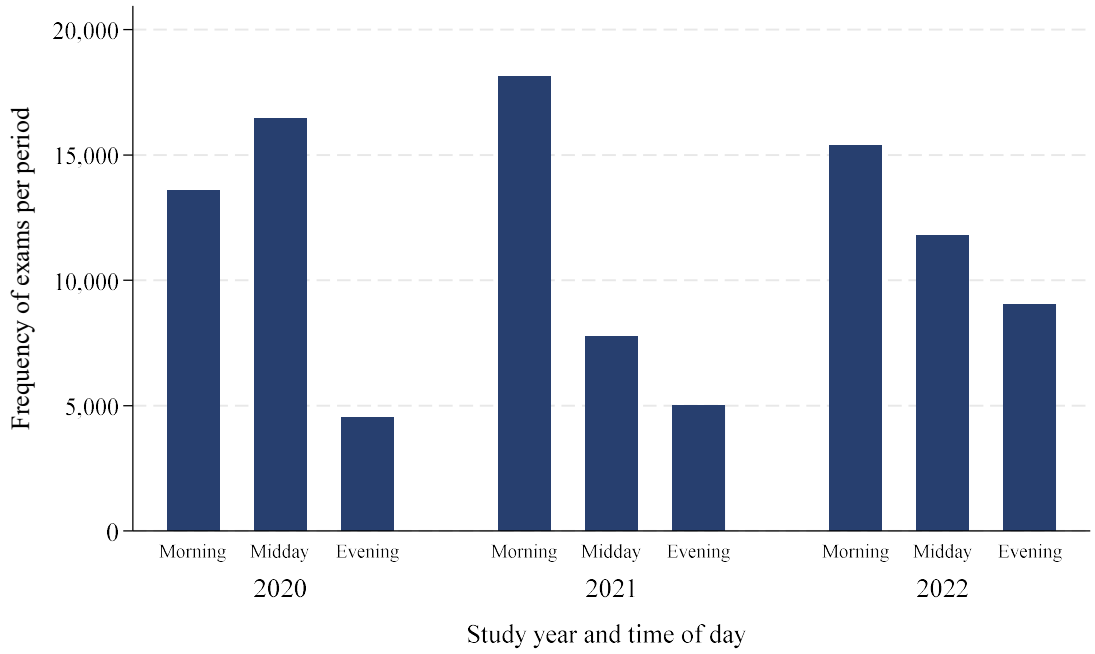

Figure 1.1 Overview of amount of exams per study year and time of day.

If the results of this thesis are deemed externally valid, then the findings could also be of importance for other universities. Universities around the world have to schedule exams and therefore it is interesting to know what role the time of day and the day of the week play on the academic performance of students. Obviously, in most universities there are capacity constraints for physical exams, and therefore it could be hard to give everyone an optimal time. This issue could however potentially be solved in the future by online exam taking. This adds to the importance of understanding the relation between timing and performance.

Another aspect of exam timing is its burden on student well-being. This makes the topic even more relevant at the Erasmus University Rotterdam (from here: EUR). Students of the EUR have to take certain exams in the evening or in weekends. According to the Universiteitsraad of the EUR, exams that take place on the weekend put a burden on mental welfare of students. Therefore the Universiteitsraad has tried in the past to get a ban on these exam slots.[2] However, the EUR has not implemented a ban and students still take exams in weekends, which makes the thesis topic still relevant today. The debate around exam times underscores the broader importance of exam timing,

[2] See Uraad wil verbod op tentamens en deadlines in het weekend en op feestdagen - Erasmus Magazine

especially when combined with the existing knowledge gap of the effect of exam timing on academic performance for Dutch university students.

To research the effect of exam timing on academic performance, I will perform different steps to be able to draw a conclusion. First, I will summarize a part of the current literature on this topic, and some literature related to the topic. From the literature I will abstract some hypotheses that will be tested on the data provided by the Erasmus School of Economics. Before running the regressions, I will present the data, specifying the available variables and elaborating what information is captured. As the data is student-specific, it is possible to track the students and use data from different courses. The panel-structure of the data also allows to control for certain characteristics of the students. Furthermore, there will be multiple statistical analyses included such that the conclusion is more solid. One of the variations is to use a general least square (GLS) regression and a fixed effect (FE) regression. The FE-regression allows to check for individual fixed effects. With the results of these analysis, I will draw a conclusion. At the end of this thesis there will be a critical discussion of the findings, and some recommendations on further research will be presented.

2. Literature review

In this literature review, I will explore the relationship between circadian rhythms, sleep patterns and academic performance. First, the biological basis and influence of circadian rhythms on psychological and behavioural processes will be discussed, including the effects of disrupting these rhythms. Subsequently, I will explain the difference between morning-orientated and evening-orientated people and explain the most used method to classify people. The review will then cover differences in circadian rhythms between people from various climates and how these rhythms change with age. Following this, the impact of school start times on the circadian rhythm for primary education and its influence on academic performance will be analysed. This discussion will highlight the existing knowledge gap between primary and higher education. After addressing this gap, the review will continue with an examination of existing literature on higher education. Finally, I will address broader aspects of exam scheduling, the importance of sleep for academic success and the influence of psychological factors.

2.1. Explanation of the Circadian Rhythm

The circadian rhythm, governed by a biological clock with a cycle of approximately 24 hours, influences various physiological and behavioural processes. This biological clock can be influenced by external signals, but also persist in the absence of these signals. Humans, compared to animals, have the unique ability to cognitively override the circadian rhythm. Because the circadian rhythm regulates psychological and behavioural processes, overriding and thus disrupting the circadian

rhythm can impair health, as highlighted by Vitaterna., Takahashi & Turek (2001). This underscores the importance of aligning external schedules, such as school start times, with individuals' natural biological rhythms to support optimal functioning.

Vitaterna et al. (2001) also compare the circadian rhythm to diurnal preferences. Strictly speaking, diurnal rhythms and circadian rhythms are not the same. The circadian rhythm has a self-sustained nature and diurnal preferences do not. This means that circadian rhythms also persist in absence of light, while diurnal rhythms do not. However, almost all diurnal preferences are influenced by circadian rhythms. Only in the case that the diurnal preference is not persistent with a constant environment, it is not a circadian rhythm. Because, as stated by Vitaterna et al. (2001), this does not occur often, I will for the purpose of this thesis treat both rhythms as the same.

2.2. Morningness-eveningness questionaire and circadian rhythm

From the definition of the circadian rhythm it follows that every person has one, but not every person has the same circadian rhythm. Horne & Ostberg (1976) developed a questionnaire to classify people into a more morning-orientated or evening oriented person. The different type of circadian rhythm a person has, is also called the chronotype of that person. The Morningness-Eveningness Questionnaire (MEQ) they developed is used widely in the academic field because of the many translations into foreign languages.

The questionnaire developed by Horne & Ostberg (1976) determines the morningness-eveningness type of a person in the following way. The respondent answers 19 questions and each question has 5 possible answers. The different answers have been given points that correspond to being either more of a morning or evening chronotype. The total amount of points at the end of the questionnaire indicate if the respondent is more of a morning or evening chronotype. A lower score for the questionnaire indicates being more of an evening chronotype. If the score is higher, the more of a morning chronotype the respondent is. Morning chronotypes are more active in the morning, have little or no trouble getting out of bed early and become tired earlier in the evening. In contrast, evening types are more active in the evening, have trouble getting out of bed early and are more tired in the morning. A person can also be neither a morning or evening chronotype, these persons then are classified as neither chronotype.

The possible end scores in the original questionnaire of Horne & Ostberg (1976) are between 16 and 86 points. Therefore it is possible to be more or less of a morning or evening chronotype. Someone can also have a neither chronotype if the score is between 59 and 69. Students thus can have different chronotypes, and also more or less extreme variants of the chronotype. In a sample of 423 students from an Italian University, Montaruli et al. (2019) found that the MEQ resulted in the

following distribution of chronotypes. There were 277 students that qualified as neither types, 103 students that were evening types and 43 students were morning types. From this it follows that, at least for this sample, the student population mostly is neither morning- or evening-orientated, but that there are more evening-orientated students than morning-oriented students. The type of circadian rhythm is also referred to as the chronotype of that person.

2.3. Changes and differences of the circadian rhythm

As follows from the previous Section, the circadian rhythm differs between people. But Randler (2008) also found that students from around the world were different in the distribution of chronotypes. Using a MEQ, Randler (2008) researched the morningness-eveningness of adolescents from different countries. For his study he used a sample of students from German-schools around the world. He found that students from more temperate countries were more likely to be more morning-orientated. This conclusion is also in line with Smith et al. (2002). They compared the morningness of students from six countries with different climates. Based on these findings it is hard to compare students from different climates and countries, as also will be discussed in Section 2.6.

Not only do people have different circadian rhythms, the circadian rhythm is also not constant through one's life. Using a method based on the MEQ, Randler and Frech (2006) found that adolescents tend to shift towards an evening-oriented chronotype around the age of puberty. This shift in circadian rhythm can result in difficulties with early school start times, potentially leading to negative impacts on academic performance. This also means that students from before and after puberty are not comparable. This is important, as existing literature has mainly researched the effects of schedules and timing of exams for elementary or secondary education.

A similar finding was made by Cardinali (2008), who also found that the rhythm of being awake and asleep changes with becoming older. In his study he discovered that adolescents change towards a more evening-orientated rhythm. These adolescents have external signals, such as the school-schedule, that are not aligned with their circadian rhythm. This effect is enlarged because of the fact that it is easier to delay the circadian rhythm than to move it earlier. Therefore it is easier to sleep late during the weekends than to sleep earlier during the week.

Crowley, Acebo & Carskadon (2007) also reviewed the rhythm of being awake and asleep for students between 11 and 18 years old. They also include the Delayed Phase Syndrome (DPS). The DPS is a disorder of the circadian rhythm and results in sleep-wake rhythm that is not in line with daytime. Therefore people with DPS will dysfunction at daytime, and this could mean that DPS is an extreme symptom of changing circadian rhythms. Crowley et al. (2007) however did not find enough

evidence to support this. The conclusion still remains the same as the findings of Cardinali (2008); most people delay their circadian rhythm as they age.

2.4. School start times and circadian rhythm at lower education

There are several studies that are similar to Cardinali (2008) and research the effect of the school schedule on sleeping habits of students at the primary education level. Research conducted by Minges & Redeker (2016) at the primary education level shows that delaying start times can be beneficial for students. Later start times not only led to improvements in academic performance, but also improved overall well-being among students. Minges & Redeker (2016) found that this was due to the fact that the school time better aligned with the circadian rhythm. In line with Vitaterna et al. (2001), reducing the discrepancy between the external signal, school time, and the circadian rhythm, improved health.

Appleman, Gilbert & Au (2015), also perform an analysis of school starting times for elementary school students. They used sleep patterns after a district-wide change in school starting times. They found that third and fourth graders did not sleep less after earlier school times, fifth graders however reported more sleepiness. These finding are in line with the findings of Randler & Frech (2006), Cardinali (2008) and Crowley et al. (2007), that people become more evening-orientated when they get older and that for optimal sleep, the school schedule should align with the circadian rhythm.

Edwards (2012) used a sample of middle school students to research the effect of start times on academic performance. He found that students of grade six to eight performed better after delaying start times. In a similar way, Bowers & Moyer (2017) performed a meta-analysis in which they aggregated the results of 20 different studies. As these 20 studies aimed at different stages of education, the meta-analysis of Bowers & Moyer (2017) covered a broad range of different students, reaching from primary education to university.

With this meta-analysis, Bowers & Moyer (2017) found that later school times were better for students. Later start times improved performance and it also led to more sleep for students. The latter is especially important, because as Bowers & Moyer (2017) state, many students do not meet the current recommended sleep duration. Changing the school start times could therefore not only be beneficial to the academic performance, but also improve general health of students. The importance of sleep will be discussed more in-depth in Section 2.10.

Another study performed by Hahn et al. (2012) used a sample of participants between 11 and 14 years old to research the relationship between circadian rhythms and the time of day of executive functions. When the time-of-day on which the participants were tested on their executive function was aligned with their optimal time the performance was better. The findings suggest that aligning

academic tasks with students' optimal cognitive periods can enhance executive functioning and academic outcomes.

From the conclusion that cognitive performance changes throughout the day and that students perform better when the school schedule aligns with circadian rhythms, Pope (2016) performed a study on the effect of the order of the school schedule on performance. He used a panel data structure of almost 2 million students from grades six to eleven. The school schedule had a significant effect on test outcomes, and rearranging important or more difficult subjects to the morning increased the result. Therefore rearranging school schedules could be an efficient method to improve academic performance.

Combining the different studies, it follows that there is an indication that school schedules can have an impact on the performance of students. As follows from the discussion of the literature in this Section, the average student benefits from later start times such that the circadian rhythm better aligns with the school schedule. But could it be that for example students with a morning chronotype are benefitting from the current school times, or that exam timing does not have influence on performance?

2.5. Cognitive function and time of day outside of educational settings

The effect of time-of-day on performance has also been studies outside of the educational setting. As stated in the introduction, the time-of-day influences performance between individuals differently and Facer-Child et al. (2018) performed research on the effect of time-of-day on physical performance. Using a sample of 52 participants, they found that there were differences in performance between chronotypes, and that evening-orientated people performed worse in physical activities in the morning compared to morning-orientated individuals.

Not only in physical activities there is a difference between individuals with a different chronotype. Schmidt et al. (2007) performed a meta-analysis on the influence of the circadian rhythm on cognitive skills. From this meta-analysis it follows that cognitive performance for various tasks fluctuates, and that this fluctuation is especially important when considering the differences between individuals. Because cognitive performance differs based on the time-of-day it implies that the level of various tasks in daily life differ. This could mean that for example workplace productivity fluctuates because of circadian rhythms, and that for some people the schedule of society fits better than for others.

The effect of circadian rhythms in the workplace has been mainly studied in the setting of shift-work. Because of the timing element of shift work, it has the potential to disturb the circadian rhythm. Chellappa, Morris & Scheer (2018) found that there was indeed a misalignment between shiftwork

and circadian rhythms. Because of this misalignment, they found that nightshifts could be less productive and have a higher risk of accidents. This is due to the fact that people showed less attention and cognitive skills during these shifts.

2.6. Knowledge gap between higher and lower education

As stated in the introduction, there is a knowledge gap between higher and lower education. For primary education there is a lot of research examining the influence of exam timing and school schedules on academic performance. However, the literature remains sparse in the context of higher education. This gap in knowledge was mentioned by Smith et al. (2002) and later corroborated by Hartley & Nicholls (2008). Since then there has been some additional research, but especially in the contexts of exam timing the literature remains sparse. From Section 2.4 and Section 2.5 it follows that in the workplace and in primary education there is an effect of time-of-day on performance. This emphasizes the need for further investigation into the effects of exam scheduling on student outcomes at higher educational level, at least for Dutch University students.

As discussed before, Smith et al. (2002) found that people from more temperate climates were more likely to be morning persons. This finding also underscores the importance of this thesis as the literature covering the importance of exam timing on academic performance in higher education mostly uses student samples from warmer countries then the Netherlands. This will be discussed more in depth in Section 2.7.

These studies also focus on the difference in performance between more morning-orientated and more evening-orientated people. From Section 2.2. it follows that a lot of research uses the questionnaire developed by Horne & Ostberg (1976) to define if someone is more morning-oriented or evening-orientated. This thesis however focusses on the question whether there is a structural difference in overall grades, implicitly stating whether the student population is more morning-orientated or more evening-orientated.

2.7. Chronotype and academic performance

To answer the question as stated in Section 2.4., whether certain students benefit from the current schedule, I will first summarize the different types of students in terms of morningness-eveningness as developed by Horne & Ostberg (1976). As follows from Section 2.2., students can be either morning-orientated, evening-orientated or neither. Because of this difference in chronotype it is possible to research if there are differences in academic performance between students with different types of chronotype. This is what Beşoluk, Önder & Deveci (2011); Tonetti, Natale & Randler (2015); Montarulli et al (2019) and Escribano, Díaz-Morales, Delgado & Collado (2012) have done.

Beşoluk et al. (2011) had students from the Sakarya University Faculty of education in Turkey perform the morningness-eveningness questionnaire. With this information they classified the students into three different chronotypes; larks (morning), owls (evening) and intermediate (neither). Students could choose to have class either from 08:00 till 14:50 or from 15:00 till 21:50. The final exam all students had to take was scheduled at 9:30. The authors found that students that were larks, performed better than intermediate and owl types. Furthermore, the authors stated that because the student's academic performance differed between the different teaching period's, the teaching period influenced academic performance. In my opinion this is not necessarily true, as all exams were in the morning. Evening and intermediate types thus had a disadvantage at the exam time compared to morning types. Therefore I believe that the research would have benefitted from an analysis with also later test times included.

Escribano et al (2012) also researched the academic performance of different chronotypes. They found that for students of age 12 till 14, morning and neither chronotypes outperformed evening types. And for students of age 15 and 16 they found that only neither types outperformed evening types. The effect of having a different chronotype is thus not equal for all ages. This difference and changing of the chronotype is also described by Tonetti et al (2015).

Tonetti et al. (2015) performed a meta-analysis in which they used 31 studies, with a total sample size of 27,309. They found that the relationship between chronotype and academic performance changes over time. The relationship was stronger for school pupils compared to university students. This finding seems logical to me, as to my perspective there are 2 options. Evening types have been either conditioned to function during school hours or they have not reached university. Combining both options result in less difference in performance between different chronotypes at higher education level compared to lower education.

There are however also studies that indicate that there is still a difference in performance for different chronotypes at higher education. Montaruli et al. (2019) explore the effects of chronotype on academic achievement for practical and theoretical exams in a sample of Italian university students. They found that morning types performed better than evening or neither types. This difference was enlarged for practical exams. However Montaruli et al. only used 429 students, and grades of three theoretical and three practical exams. They also did not control for exam times, and have not specified the school schedule.

The research conducted by Beşoluk et al. (2011), Tonetti et al. (2015), Escribano et al. (2012), Montaruli et al. (2019) and Horne & Ostberg (1976) seems to indicate that there is difference in academic performance between certain chronotypes. The studies however did not focus on specific

exam times, but they examined the overall academic performance. As I am interested in the influence of exam timing on academic performance, it is important to understand the difference between the overall academic performance and chronotypes. This relationship also provides an indication for the expected outcome of the main analysis, the relationship between exam timing and academic performance.

2.8. Exam timing and performance

There is also research, such as that conducted by Van der Vinne et al. (2015), that analyses the relationship between exam timing and chronotypes more specifically. The research performed by Van der Vinne et al. (2015) indicates that the timing of examinations can affect students differently based on their chronotype. The authors used Dutch students from the age of 11 till 18 years old that took exams at three different times. Either from 08:15 till 09:45, 10:00 till 12:15 or 12:45 till 15:00. They found that evening types performed significantly worse during the first two time frames, and that during the third there was no significant difference. Therefore they recommended scheduling all exams in the afternoon, to give all students an equal opportunity.

This finding is also in line with potentially having more evening types dropping out of the education system, which results in less difference between chronotypes in later education, as I have discussed before. If students tend to have one similar chronotype, then it could be the case that certain exam times result in better overall academic performance. If this is however not the case, some students could have a disadvantage. However, it is essential to note that the applicability of findings from primary education to higher education may be limited due to differences in developmental stages, educational environments, and the nature of academic assessments. This also follows from the previously discussed literature, which indicates that the circadian rhythm changes over time. As such, there remains a need for research specifically focused on understanding how exam timing influences academic performance in higher education contexts.

Houston, Nichols & Edmondson (2018) performed research on the effects of exam group timing on academic performance for higher education. They used a sample of first year college students that had to perform lab experiments at different times of the day. Housten et al. (2018) did not control for chronotype and found no difference in overall results between different lab times. This is in line with previously discussed literature that the difference in performance between different chronotypes disappears, or at least becomes smaller.

It is however in contrast with Gaggero & Tommasi (2020), they initially did a research on, and found an effect of exam timing on academic performance for a sample of university students from the United Kingdom. They kept working on this research and eventually published a more detailed

version of the same research in 2023 (Gaggero & Tommasi, 2023). The authors used data of more than 500,000 exam results from different students. The exams were taken at either 09:00, 13:30 or 16:30, and exams that took place at midday had, on average, the best result. On both morning and late-afternoon exams, students performed worse. This effect was even larger for seasons with less daylight. In line with other literature, as previously described, the effect was smaller for younger students. The authors furthermore found that the effect was not the same for all subjects, and that for STEM exams the effect was larger.

Gaggero & Tomassi (2023) also controlled for background, age, number of exams per year and the total credits per year. They did however not control for the day of the week on which the exam was scheduled. Something that was also not controlled for by Van der Vinne et al. (2015) and Houston et al. (2018). As will be discussed in Section 2.9, the timing during a exam week can also matter. Therefore it could be the case that on certain days students perform better then on other days.

2.9. Other aspects of exam timing

While this thesis focuses specifically on the influence of exam times and weekdays on academic performance in higher education, it's crucial to acknowledge related research that sheds light on other facets of exam timing. Studies exploring topics such as the timing of exams within the academic year or the overall structure of exam schedules within a given period have revealed valuable insights into the potential impact of exam timing on academic performance.

Di Pietro (2013) for example found that switching from exams at the end of the semester to exams at the end of the year resulted in worse performance. Therefore the rescheduling of exams should not only be based on financial, administrative or ideology, but also should take into account the effect of exam timing on academic performance.

In another research on the effect of exam timing on performance, Hanemaaijer, Marie & Musumeci (2023) examined the effects of Ramadan timing on academic performance. This revealed systematic declines in academic achievement among students who are likely to follow Ramadan rules during this period. This research highlights the importance of considering broader cultural and religious factors when studying the influence of exam timing on student success. They also found that the effect was larger for the second exam of the day if a person had one, this could be for example due to the fact that fatigue enlarges the effect of timing on cognitive performance.

Goulas & Megalokonomou (2020) researched the preferences of students regarding the scheduling of exams within an exam period, including preferences for exam difficulty sequencing and the overall duration of the exam schedule. Their findings indicated variations in academic performance associated with different exam scheduling preferences, underscoring the importance of considering

the preferences of students when designing exam schedules. They also distinguished between the warm-up and fatigue effect of exam weeks.

A similar research to that of Goulas & Megalokonomou (2020) has been conducted by Pope & Fillmore (2015). They researched the difference in schedule of and performance in advanced placement exams. In this research they found that results were higher when students had more time between exams. If a student has more then ten days in between exams, he is 6-8% more likely to pass both when compared to the situation that there is only one day in-between. This finding is in line with the conclusion of Hanemaaijer et al. (2023) that there is difference between the effects for first and second exam of the day.

In a research on the effect of a Sunday break on academic performance on exams Glaser and Insler (2022) found that grades are significantly higher the day after the break compared to the day before. They used over 19,000 exam grades from over 5,000 first year U.S. Naval Academy students. In the panel data exam schedules differ across years and students cannot choose their schedule or courses. Glaser & Insler (2022) also found that performance on afternoon exams was better compared to morning exams. This research therefore highlights the importance of considering the timing of exams to minimize fatigue and optimize performance.

2.10. Importance of sleep

As previously stated in Section 2.4., students often do not meet their recommended sleep duration and changing school schedules could result in better sleep patterns for students. Leak, Weiner, Chandwani & Rhodes (2020) found that especially for men; poor sleep hygiene resulted in worse performance, both physical and mental performance. They however based their study on survey-data and also discussed that they were not able to gather causal effect. From the findings and previous literature they recommend schools to adapt the school schedule to circadian rhythms of students. The same conclusion is drawn by Estevan, Sardi, Tejera, Silva & Tassino (2021), who found that test scores improved when students slept longer. Therefore they recommended to schedule exams later on the day such that students could sleep longer.

In a systematic review on the relationship between sleep and academic performance, Curcio, Ferrara & De Gennaro (2006) first discussed the importance of sleep. First, they described the mechanisms of sleep, which is an active behaviour that is repetitive and reversible with various functions linked to it. From the review it follows that sleep is among others the key aspect in different psychological and neurocognitive processes and Sleep deprivation thus also results in a less optimal cycle of the processes linked to sleep. In their systematic review Curcio et al. (2006) also drew the same conclusion that students do not meet recommended sleep durations. This means that students

experience non-optimal processes in their sleep and this negatively affects cognitive functions such as memory, attention, and executive functioning. As these functions are critical for academic success, this research underscores the importance of adequate sleep for academic performance.

2.11. Social and psychological factors

As discussed in this literature review, exam timing and school schedules hold the power to influence circadian rhythms and result in a lack of sleep for students. From Section 2.10. it follows that this can have an impact on various biological and neurocognitive processes. Therefore it is also important to discuss the influence of certain social and psychological factors on exam performance, and how these factors can be influenced by time-of-day.

One of the factors predicting exam performance is self-efficacy. A study performed by Vrugt, Langereis & Hoogstraten (1997) found that higher self-efficacy and stronger beliefs in high-intelligent individuals predicted better results, and that lower self-efficacy and weaker beliefs resulted in worse outcomes. In order to come to this conclusion they used an Academic Self Efficacy Questionnaire that indicates the personal goals of an individual. Furthermore, Vrugt et al. (1997) found that individuals with stronger beliefs and higher self-efficacy viewed failure differently compared to people with weaker beliefs and lower self-efficacy. Participants with lower self-efficacy and weaker beliefs saw failure more as a lack of talent, whereas people with higher self-efficacy and stronger beliefs viewed it more as lack of commitment or lack of performance on that moment. Their findings thus show that students who believe in their ability to succeed tend to perform better academically, highlighting the importance of psychological factors in educational performance.

Another psychological factor that can influence exam performance is test anxiety. Trifoni & Shahini (2011) studied the impact of test anxiety before and during tests on performance by testing a sample of undergraduate students. They found that quite a large group of students was affected by anxiety and that test anxiety influences motivation, concentration and performance. Furthermore, they found that various factors can influence the anxiety level. This can be factors such as the kind of test or number of questions, but also time and the attitude of teachers. Therefore this study, and that of Vrugt et al. (1997), underscore the importance of taking into account psychological factors, and how these factors can change throughout the day.

3. Data Description

The data for this study is provided by the Erasmus School of Economics and covers the academic years 2020 to 2023. It contains anonymized data on 7,122 different students that participated in exams from 117 different courses at the Erasmus School of Economics during these academic years. In this chapter I will explain which observations I decided to drop. First of all I dropped all observations for which there was no information on the exam timing. Afterwards, I dropped observations that were not informative. In the end, the dataset contained information on 6,874 students in 87 different courses.

In total the dataset consists of 101,695 observations on test results, with 90,726 of these being numerical results. The process of anonymisation has been conducted by the Erasmus School of Economics. Anonymising has been done by giving each student that took an exam, a number between 1 and 7,122. This anonymised student number is stored in the variable "Number" and therefore it is possible to link multiple results to the same student. The dataset captures a wide range of variables, including academic performance metrics, course characteristics, and demographic details. Now a more in-depth analysis of the dataset and the setting at the EUR will follow.

3.1. Educational setting at the EUR

The dataset contains information on first and second year courses of the Erasmus School of Economics, which is a faculty of the EUR. The Erasmus School of Economics has five different 'tracks' that students can choose. These different bachelor 'tracks' are: Economie en Bedrijfseconomie, International Bachelor Economics and Business Economics, Econometrie en operationele research, International Bachelor Econometrics and Operations Research and Fiscale Economie.

Each bachelor consists of 60 study points per year, and a bachelor is three years. The academic year is divided into five block, each lasting eight weeks. Typically a block consists of two or three courses. Additionally, there is a resit period at the end of the academic year in which all resits take place. Especially at the EUR this can be an important period as the EUR uses a Binding Study Advice (BSA) of 60 points for first-year students. This means that a student is only allowed to continue with their study if all 60 points are obtained. It should however be noted that there is a compensation rule for courses within the same cluster. The compensation rule allows one grade of 5 to be compensated within the same cluster, meaning not all courses require a passing grade to meet the 60-points requirement. Clusters are based on the topics and specific skills required for the courses.

The study load of a course indicates the amount of study points that can be obtained by passing it. A course can consists of lectures, tutorials and question sessions. All students participating in the course take the exam simultaneously, usually in the same exam hall. However, some courses were

taught during the corona-crisis, and therefore some of the exams in the dataset were taken online. As stated before in the introduction, exams have fixed start times, exams start either at 9:30, 13:30 or 18:30. Students cannot choose at which time they take an exam, the schedule is determined by the scheduler of the EUR.

The EUR has limited space for examinations and therefore not all exams can be at a favourable moment. To divide the different time-slots between faculties, the faculties trade for the time-slots. This happens in the following way. First, all faculties will draft a exam schedule and these schedules are compared. All scheduling-issues will be negotiated and his means that faculty's can have a preferred time-slot one period, and the following period they have to take the less optimal time-slot. It therefore follows that the scheduling of exams is not completely random, but there are no other considerations for allocating exams. Thus it is for example not the case that certain type of exams are always scheduled at the same time-slot. This means that although I cannot guarantee that the schedule is randomized, I will treat the timing of exams as exogenous as there are no substantive considerations with respect to exam timing.

Furthermore, the data-set provides the final grade of each course. This is mostly not equal to the result obtained in the final exam. This is due to the fact that although each course ends with a final exam, the result of this exam only contributes to the final grade for a certain percentage. In first and second year courses the final grade of a course should be determined for at least 60% by the exam at the end of the course. The remainder of the final grade comes from mid-terms or assignments. This means that the final grade, as depicted in the data, mostly consists of multiple grades that each contribute to the final grade for a certain percentage.

3.2. Variables on Exam Results

The summary statistics of all variables that are related to information about the courses can be found in Table 3.1. In the dataset, the result of the exam is distributed on a range from 0 to 10, and is stored without no shows, insufficient grades or exemptions, in the variable "ResultNumerical". The average score is 6.376 and there is a standard deviation of 1.765. Figure 3.1 provides an overview of the distribution of the grades and it can be seen that it nicely follows a normal distribution, although a small part of the distribution is cut-off at the 10-mark. Because this is such a small part of the distribution it is expected that it does not have an influence on the results.

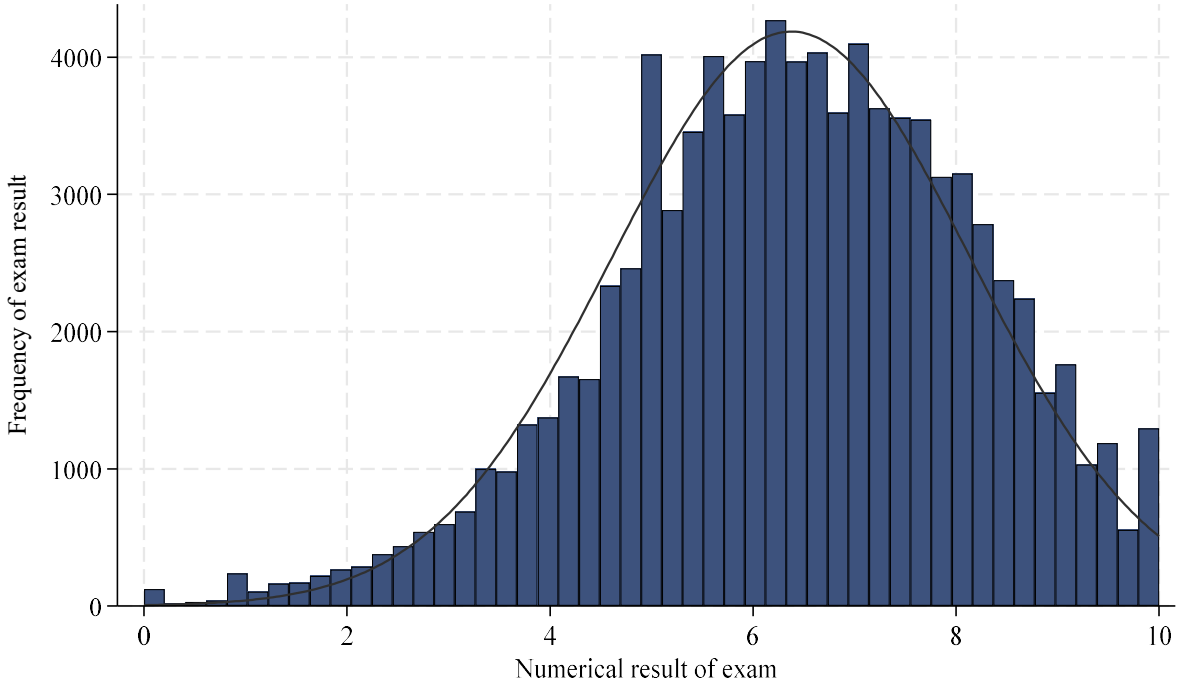

Figure 3.1 Overview of grade distribution for all courses in study years 2020-2021, 2021-2022 and 2022-2023.

Based on the grades it follows if a student passed or failed their course, with a passing grade being 5.5 or higher. From the grade it follows if a student has either passed, scoring 5,5 or above, or failed their course. The variable "DumPassMark" shows whether a student passed (1) or failed (0) their course based on the numerical result, and thus does not include the results from no shows, insufficient grades or exemptions. “DumPassMark” has a mean of 0.723 and a standard deviation of 0.448. This indicates that on average 72.3% of the students pass their course based on their marks. The variable “DumPass” is similar to the variable “DumPassMark”, but also includes the results from no shows. Therefore, it has a mean of 0.645 and a standard deviation of 0.479. Indicating that on average 64.5% of students pass their course.

In the original dataset there were also non-numerical results stored. These non-numerical results included; NO, GGR, VR, FR and NVD. As the aim of this thesis is to focus on the effect of timing on exam performance, the only important variable is the NO result. This NO means that the student did not show up for an exam that he was scheduled to take. The variable “DumNO” has a value of 1 if the student did not show up and has a value of 0 otherwise. It has a mean of 0.108 with a standard deviation of 0.310. This indicated that 10.8% of the time a student does not show up for an exam he is scheduled to take.

The results GGR, VR and NVD, respectively meaning “Geen Geldig Resultaat”, “Vrijstelling” and “Niet Voldaan”, have been dropped as they are not directly related to the exam timing. GGR can also be due to different circumstances, VR will be granted before exams and NVD is mostly related to assignments. Furthermore, FR seemed like an error as there were only 4 observations in the data-set in total and they were all from the same course.

3.3. Variables on Course information

The course information consist of the variables “Coursecode_cat”, “Block” and “TestKind”. "Coursecode_cat," is a categorical variable representing the different courses. There are 87 different courses for which exam results are provided. These are sored in number between 1 and 106, this also means that of 19 courses the observations have been dropped, this will be explained in Section 3.6. An overview of the observations per study year per exam can be found in Appendix A, Table A.1. The observations per study year per exam are also used to provide a kernel density graph with bandwidth of 26.397, which can be seen in Figure 3.2. From this graph it follows that the number of observations somewhat follows a normal distribution. As courses have more or less equal observations for the final grade throughout the years it is logical that it does not exactly follow a normal distribution. However, from this figure, Table A.1 and Table 1.1 it follows that the observations of exam results per course are nicely distributed across study year, time of day and day of the week.

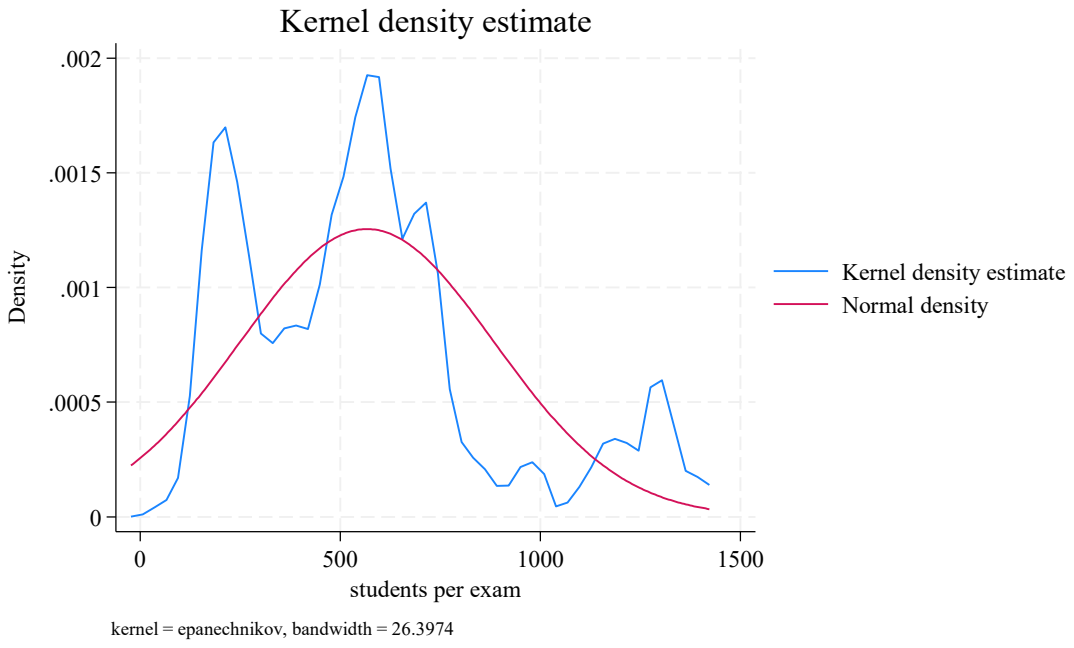

Figure 3.2 Kernel distribution of coursecode for all courses in study years 2020-2021, 2021-2022 and 2022-2023.

The variable “Block” is a categorical variable that shows in which block a course took place. Values 1 to 5 refer to Block 1 to 5, while 6 means that the exam was in the resit period, and 7 indicates an extra attempt. As an extra attempt is not usual and information on it is scarce, I decided to drop these observations. The type of test, whether written, oral, project or assignment, is captured in the variable “TestKind”. As there were only oral exams in the extra attempts, these observations were dropped. Furthermore, there was no information on exam schedule of projects, thus these observations have also been dropped.

The last variable that contains information on the course, is the dummy variable “Online”. This variable indicates if the exam took place online with a value of 1, and has a value of 0 if the exam took place on location. It has a mean of 0.276, indicating that 27.6% of the exams took place online.

3.4. Variables on the timing of exams

The information on the timing of the exam is captured in the variables “StudyYear”, “Week”, “Day” and “TimeOfDay_cat”. “StudyYear” corresponds to the study year in which the exam took place. The value 2020 corresponds to the 2020-2021 academic year, while values 2021 and 2022 respectively correspond to the academic years 2021-2022 and 2022-2023. The variable “Week” indicates the week of the year in which the exam took place. The value of “Week” ranges from 1 to 52. The day of the week on which the exam took place is represented by the variable “Day”. It has values from 1 (Monday) to 6 (Saturday). The last variable on the timing of the exam is the variable “TimeOfDay_cat”, this variable categorizes the time of day the exam took place into morning (1), midday (2), and evening (3). As stated in the introduction, morning exams start at 9:30, midday exams start at 13:30, and evening exams start at 18:30. An overview of the distribution of exams throughout the week is given in Figure 3.3.

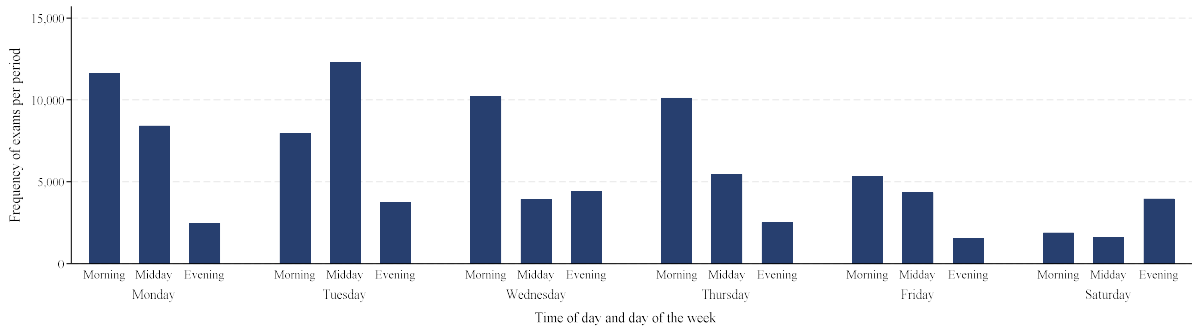

Figure 3.3 an overview of the distribution of exams throughout the week for study years 2020-2021, 2021-2022 and 2022-2023.

Table 3.1: Summary Statistics of variables on examinations at the Erasmus School of Economics from 2020 till 2023

Variable	Obs	Mean	Std. Dev.	Min	Max
ResultNum	90,726	6.376	1.765	0	10
DumPass	101,695	.645	.479	0	1
DumPassMark	90,726	.723	.448	0	1
DumNO	101,695	.108	.310	0	1
Online	101,695	.270	.444	0	1
Day					
Monday	101,695	.221	.415	0	1
Tuesday	101,695	.236	.424	0	1
Wednesday	101,695	.182	.386	0	1
Thursday	101,695	.178	.382	0	1
Friday	101,695	.110	.313	0	1
Saturday	101,695	.073	.260	0	1
TimeOfDay					
Morning	101,695	.463	.499	0	1
Midday	101,695	.354	.478	0	1
Evening	101,695	.183	.387	0	1
StudyYear					
2020-2021	101,695	.340	.474	0	1
2021-2022	101,695	.304	.460	0	1
2022-2023	101,695	.356	.479	0	1
Block					
Block-1	101,695	.195	.396	0	1
Block-2	101,695	.165	.371	0	1
Block-3	101,695	.164	.370	0	1
Block-4	101,695	.225	.418	0	1
Block-5	101,695	.120	.325	0	1
Block-RE	101,695	.131	.337	0	1

Note: The data used is provided by the Erasmus School of Economics, specifically for this thesis. The Erasmus School of Economics anonymized the data such that individual students can not be identified. The dataset contains information on all students that took exams for the subjects provided, therefore it is representative for the students studying at the Erasmus School of Economics. Table 3.1 provides the total observations, mean, standard deviation and the extreme values of all course related variables.

3.5. Variables on Student Background

The summary statistics of the background variables on students can be found in table 3.2 and include the variables "Male", “PreviousEdu”, “Nationality”, and “CountryOfBirth”. The variable “Male” indicates the gender of the students , with value 0 for female and value 1 for male. It has a mean of 0.676 with a standard deviation of 0.468. This indicates that 67.6% of the sample is male. The variable “PreviousEdu” captures the previous type of education of the student, with 8 different options available. The variable "Nationality" is a categorical variable that indicates the nationality of a person and in total there are 96 different countries. The variable "CountryOfBirth," indicates the country of birth from a student and there are 122 different countries of birth in the sample. These

countries of birth have been used to create a variable "Continent", which indicates if a person is either from Europe, Oceania, Africa, Middle East, North America or South America.

As stated in Section 2.6., research found that climate can influence the morningness-eveningness of a person. Therefore my intention was to divide people into different groups based on climate and country of birth. I however came to the conclusion that it was not possible to assign people to a certain climate based on only their country of birth. In Appendix B, Figure B.1, the updated version of the world map of Köppen-Geiger climate classification can be seen. The Köppen-Geiger climate classification is used around the world to classify climates, and the updated map is from Peel, Finlayson & McMahon (2007). The system behind the updated map has 5 main climates that are further subdivided to correct for local differences. From this graph it follows that one country can have many different climates. Spain has for example all 5 main climates. Therefore it would not be correct to assign people to a certain climate solely based on their country of birth. It would have been possible to assign people to a certain climate if the place of birth was known. As I don't have this information, I decided to classify people based on the continent they were born.

Table 3.2: Summary Statistics of variables on students of the Erasmus School of Economics from study years 2020-2021, 2021-2022 and 2022-2023

Variable	Obs	Mean	Std. Dev.	Min	Max
Male	101,695	.676	.468	0	1
PreviousEducation					
VWO	101,695	.552	.497	0	1
BUITENL SL	101,695	.349	.477	0	1
HAVO	101,695	.019	.137	0	1
HBO	101,695	.004	.066	0	1
MBO	101,695	.001	.023	0	1
OVERIG	101,695	.035	.184	0	1
WO	101,695	.040	.196	0	1
CD	101,695	.007	.084	0	1
Baccalaureate	101,695	.028	.165	0	1
Continent					
Africa	98,160	.014	.116	0	1
Asia	98,160	.107	.310	0	1
Australia/Oceania	98,160	.003	.051	0	1
Europe	98,160	.812	.391	0	1
Middle East	98,160	.024	.153	0	1
North America	98,160	.019	.137	0	1
South America	98,160	.022	.146	0	1

Note: The data used is provided by the Erasmus School of Economics, specifically for this thesis. The Erasmus School of Economics anonymized the data such that individual students can not be identified. The dataset contains information on all students that took exams for the subjects provided, therefore it is representative for the students studying at the Erasmus School of Economics. Table 3.2 provides the total observations, mean, standard deviation and the extreme values of the variables that contain information of students.

4. Hypotheses

The literature review and the data Sections provide some insight in possible outcomes. With these outcomes in mind, some hypotheses on the effect of exam timing will be formed. The first hypothesis is that exams starting on midday will result in higher average grades than exams starting in the morning. The second hypothesis is that exams starting in the evening on average result in better performance than exams starting in the morning. This follows from Section 2.8., in which the influence of exam timing on performance is analysed. Both effects could be due to the fact that there are more neither types then morning- or evening-orientated students.

The third hypothesis is that exams closer to the middle of the week on average result in higher grades. This is based on the warm-up and fatigue aspects as described in Section 2.9. The warm-up effect is on average expected to lead to lower grades in the beginning of the week, and the fatigue effect is on average expected to result in worse performances of students at the end of the week.

Furthermore, it is important to discuss the potential effect of a selection bias due to students not showing up for an exam they are scheduled to take. I expect that students tend to show up less for time-slots they do not prefer. If this is true, I assume that students make the decision of showing up or not based on their expected mark. This means that students will have a threshold mark, which will determine if a student is participating in the exam or not. Students will probably have a higher threshold for less favourable times. Therefore, it is expected that the students that are participating in exams scheduled at unfavourable times, on average expect a higher result than for exams at favourable times. Therefore, it would mean that the selection-bias effect, if anything, reduces the findings on the effect of timing on the result of students.

Besides investigating the differences on the average student with regards to exam timing, it is also interesting to investigate whether there are differences between certain type of students. As described in Section 2.10., there were stronger effects of sleep deprivation on performance for male students. Therefore, I also expect to see a stronger effect for exam timing on performance for male students.

5. Method

The hypotheses described above need to be tested before being able to draw any conclusions. This method needs to align with the data-set and therefore I will use the methods as described in this Section. First, I will describe the main analysis, and afterwards I will explain some alternative methods that I want to explore to check whether the findings of the main analysis are robust.

5.1. Main analysis

This study employs two different types of panel-regression analyses: a Generalized Least Squares (GLS) regression and a Fixed Effects (FE) regression. Both regressions are conducted with robust standard errors. Using both types of regression equations allows for a comparison of results. The FE-regression accounts for all time-invariant individual characteristics through the individual constant, meaning these variables do not need to be measured or known. An example of such a time-invariant variable is gender, which, except in rare cases, remains constant for respondents.

To investigate whether the timing of an exam, determined by both the time of day and the day of the week, influences exam performance, the dependent variable used is the numerical result for the exam. For this dependent variable, both the GLS-regression and the FE-regression are executed. The independent variables of interest are "Day" and "TimeOfDay_cat". Additionally, several control variables are included to account for respondent characteristics. These control variables include "Gender", "PreviousEdu", "CountryOfBirth", "Online", "Block", and "StudyYear". The panel data is structured such that it tracks individual students, therefore the 'i' in the regressions presented refer to the individual student. As the individual students have observations for certain exams, the 'e' subscript will refer to the exam from which the result is from.

From this it follows that the complete equation of the GLS-regression will look as shown in Equation 1. Besides running this regression, I will also run a regression with only the variables of interest. This means that the regression only includes "Day", TimeOfDay_cat" and "Coursecode". This will show what happens to the coefficients of the variables of interest by adding the control variables.

1. $\text{ResultNumerical}_{i,e} = \beta_1 \cdot \text{Day}_e + \beta_2 \cdot \text{TimeOfDay\_cat}_e + \beta_3 \cdot \text{Coursecode}_e + \beta_4 \cdot \text{Male}_i + \beta_5 \cdot \text{PreviousEdu}_i + \beta_6 \cdot \text{CountryOfBirth}_i + \beta_7 \cdot \text{Online}_e + \beta_8 \cdot \text{Block}_e + \beta_9 \cdot \text{StudyYear}_e + \epsilon_{i,e}$

The FE-regression will look a bit different due to the fact that *time fixed* effects cannot be taken into account, as described before in this Section. This means that the equation of the FE-regression will have the form as shown in Equation 2.

2. $\text{ResultNumerical}_{i,e} = \beta_1 \cdot \text{Day}_e + \beta_2 \cdot \text{TimeOfDay\_cat}_e + \beta_3 \cdot \text{Coursecode}_e + \beta_4 \cdot \text{Online}_e + \beta_5 \cdot \text{Block}_e + \beta_6 \cdot \text{StudyYear}_e + FE_i + \epsilon_{i,e}$

The FE-regression will also be run once with only the variables of interest as this shows how the coefficients of these variables change by adding the control variables.

5.2. Alternative analyses on no shows and passing rate

Besides the described regressions above, I will run some robustness checks on the influence of timing on academic performance. These regressions will have different dependent variables. The first analyse I want to do is on no shows. If the timing of exams has influence on whether people decide to not show up, there could be a self-selection bias in the results for the people that do show up.

Not showing up could be a short notice decision, which could be influenced by timing of the exam. This means that I will run the regression with "DumNO" as a dependent variable. Both regression have respectively the same form as Equation 1 and Equation 2, and only differ in the dependent variable. Also for "DumNO" both regressions will also be ran once without control variables.

The second analysis has as a goal to see if the passing rate of students is influenced by the timing of the exam. Therefore the dependent variable will be "DumPassMark". The GLS-regression and FE-regression will again both have respectively the same form as in Equation 1 and Equation 2. Similar to previous analyses, both regressions will also be run once without control variables.

Furthermore, I want to research if the overall pass rate of students is influenced by the timing of the exam. This will be done by having "DumPass" as the dependent variable. Again, the GLS and FE-regression will be respectively as shown in Equation 1 and Equation 2, respectively. These regressions are also run once without control variables, to see the influence on the coefficients of the variables of interest.

5.3. Regressions with interaction effect of male

Because men and women are different in their biological processes, it is possible that the effect of timing of exams on performance is different. In order to investigate whether there is indeed a difference, I will use a interaction-effect of "TimeOfDay" and "Male". From this it follows that the GLS-regression and FE-regression will have the form as shown in equation 3 and 4, respectively. In the same way as before, these regressions will also be ran without control variables.

3. $ResultNumerical_{i,e} = \beta_1 \cdot Day_e + \beta_2 \cdot TimeOfDay\_cat_e + \beta_3 \cdot Coursecode_e + \beta_4 \cdot Male_i + \beta_5 \cdot PreviousEdu_i + \beta_6 \cdot CountryOfBirth_i + \beta_7 \cdot Online_e + \beta_8 \cdot Block_e + \beta_9 \cdot StudyYear_e + \beta_{10} \cdot Male\#i.TimeOfDay\_cat + \epsilon_{i,e}$

4. $ResultNumerical_{i,e} = \beta_1 \cdot Day_e + \beta_2 \cdot TimeOfDay\_cat_e + \beta_3 \cdot Coursecode_e + \beta_4 \cdot Online_e + \beta_5 \cdot Block_e + \beta_6 \cdot StudyYear_e + \beta_7 \cdot Male\#i.TimeOfDay\_cat + FE_i + \epsilon_{i,e}$

6. Analysis

In this chapter I will discuss the results of the regressions as described in Chapter 5. The main text only includes tables that show the results of the variables of interest. The tables with the complete overview of all coefficients will be placed in the appendix due to the size of these tables. I will first cover the main analysis and afterwards I will discuss the alternative analysis with “DumNO” as the dependent variable. I decided to discuss the results of the equation with “DumNO” before going over the analysis with “DumPass” and “DumPassMark” as dependent variables due to the fact that there could be a selection bias in the numerical results if there are significant results for timing of the exam on “DumNO”. The last analysis I will discuss is almost equal to the main analysis, but also includes an interaction-effect.

6.1. Main analysis

Table 6.1 shows the main coefficients of the GLS-regressions and the FE-regression with “ResultNumerical” as the dependent variable. The complete results can be found in Table D.1, in Appendix D. Both tables show the same regressions. In Column 1 the GLS-regression with only the variables “TimeOfDay_cat”, “Day” and “Coursecode” is shown. While Column 2 depicts the GLS-regression with all control variables. Column 3 shows the FE-regression with only “TimeOfDay_cat”, “Day” and “Coursecode” included and Column 4 shows the FE-regression with all control variables taken into account. For all four regressions, the null hypothesis that “TimeofDay_cat” does not have an effect on “ResultNumerical” should be rejected. The null hypothesis that there is no influence of the day of the week on “ResultNumerical” can however not be completely rejected. Some days have a significant effect, while for others there is no significant effect.

I will first discuss the GLS-regressions and afterwards I will address the FE-regressions. In Column 1, of Table 6.1, the coefficients of Midday and Saturday are respectively 0.216 and -0.112. This means that an exam starting at 13:30 results on average in a 0.216 higher grade compared to an exam starting at 9:30 and that an exam taken on Saturday results on average in a 0.112 lower grade compared to a Monday. In the case that an exam has 100 questions of 1 point, making the exam at 13:30 on Monday instead of a Saturday morning has on average the same effect as answering 3 extra questions right.

From the coefficients it follows that it is not only a statistical significant effect, but that the size of the effect is also significant. The standard deviation is 1.765 and therefore the percentage of change in the average numerical grade of students that can be achieved by scheduling an exam with regard to the standard deviation of the numerical result is around 12.2%.

Table 6.1 Overview of main coefficients of GLS-regressions and FE-regressions for the relation between the numerical result of exams and exam timing

ResultNumerical	**GLS(1)**		**GLS(2)**		**FE(1)**		**FE(2)**	
TimeOfDay								
Midday	0.216	***	0.202	***	0.214	***	0.204	***
	(0.015)		(0.016)		(0.015)		(0.016)	
Evening	0.118	***	0.081	***	0.152	***	0.105	***
	(0.019)		(0.019)		(0.019)		(0.019)	
Day								
Tuesday	0.031	*	0.049	***	0.023		0.039	**
	(0.018)		(0.018)		(0.018)		(0.018)	
Wednesday	0.040	*	0.081	***	0.046	**	0.079	***
	(0.022)		(0.022)		(0.022)		(0.022)	
Thursday	0.012		0.014		0.017		0.012	
	(0.022)		(0.023)		(0.022)		(0.023)	
Friday	-0.031		-0.009		-0.028		-0.014	
	(0.027)		(0.028)		(0.028)		(0.028)	
Saturday	-0.112	***	-0.072	**	-0.103	***	-0.085	***
	(0.031)		(0.032)		(0.031)		(0.032)	
Male			-0.018					
			(0.036)					
Online			0.183	***			0.170	***
			(0.027)				(0.027)	
Intercept	6.321	***	6.335	***	7.267	***	7.191	***
	(0.045)		(0.075)		(0.076)		(0.092)	
PrevEdu-FE	NO		YES		NO		NO	
Continent-FE	NO		YES		NO		NO	
Study year-FE	NO		YES		NO		YES	
Block-FE	NO		YES		NO		YES	
Course-FE	YES		YES		YES		YES	
Individual-FE	NO		NO		YES		YES	
Number of observations	90,726		87,432		90,726		87,432	
Individuals	6,572		6,364		6,572		6,364	
R^2	0.084		0.101		0.021		0.022	

Note: This table contains the main coefficients of the result of two GLS-regressions and two FE-regressions with ResultNumerical as dependent variable. The complete overview of the regression results can be found in Table D.1 in Appendix D. Column 1 and 2 show the GLS-regressions and give the average effect of the variable in the corresponding model on the dependent variable ResultNumerical. Column 3 and 4 show the FE-regressions and give the average effect of the variable in the corresponding model on the dependent variable ResultNumerical. The omitted categories are; Morning for TimeOfDay, Monday for Day, FEB11001 for Coursecode, VWO for TypePrevEdu, Europe for Continent, 2020-2021 for StudyYear and Block1 for Block. Standard errors are shown between round brackets. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

In Column 2 of Table 6.1 it can be seen that adding the control variables results in a change in the coefficients of the variables of interest. This is due to the fact that the added control variables remove a part of the bias from the independent variables. It is noticeable that the effect of time of day becomes less strong, although the coefficients remain statistically significant. Furthermore, it is interesting that the intercept drops just below a 6. Moreover it is important to note that on average the performance of students is worse in the resit period, which can be expected as most of the students taking an exam in this period already failed their first attempt.

Now I will continue with discussing the FE-regressions with "ResultNumerical" as dependent variable. As stated before, the regressions can be found in Column 3 and Column 4 of both Table 6.1 and Table D.1. Column 1 shows the results for the equation with only "TimeOfDay_cat", "Day" and "Coursecode" and Column 2 includes all control variables.

From the equations it follows that although there is some difference in the size of the coefficients for the variables of interest, the sign is the same in all four equations. Also for the FE-regressions the null hypothesis that time of day does not have an effect on "ResultNumerical" should be rejected. The null hypothesis that day of the week does not have an effect on "ResultNumerical" can again not be completely rejected. Some days show a significant effect while others do not. It is interesting to see that Saturday's show the strongest effect in all four regressions, both in terms of size and statistical significance. Furthermore, it follows from both the FE-regression and GLS-regression that online exams on average result in a higher grade. It should however be noted that the R^2 is low in all four regressions, only ranging between 0.021 and 0.101.

6.2. Analysis with DumNO as dependent variable

The complete overview of the results of the regressions with "DumNO" as dependent variable can be found in Table E.1 in Appendix E, and Table 6.2 shows the coefficients of the variables of interest. Both tables use the same structure for the columns. Column 1 gives the GLS-equation with only the variables of interest and Column 2 also includes all control variables. Column 3 and 4 show the FE-regressions with no control variables and all control variables, respectively.

Again I will first discuss the GLS-regression and afterwards I will elaborate on the FE-regression. But first it is important to note that in this case the dependent variable is "DumNO", which is a dummy variable. Therefore the interpretation is different than for the equations with "ResultNumerical" as the dependent variable. The coefficients in the regression with "DumNO" depict the change of the average chance of not showing up for an exam. From Table E.1 it follows that all null hypotheses stating that exam timing has no effect on not showing up should be rejected for the equation with all control variables. It is however important to note that the sign of the coefficients for time of day

switches when adding control variables. This can be explained by the fact that control variables remove some of the bias that is captured in the coefficients of the independent variable. It is interesting to see that the chance that a student does not show up for their exam is higher on Saturdays compared to all other weekdays. Furthermore, it is interesting to see that the average chance that a student does not show up is higher in the morning.

Table 6.2 Overview of main coefficients of GLS-regressions and FE-regressions for the relation between not showing up for an exam and exam timing

DumNO	**GLS(3)**		**GLS(4)**		**FE(3)**		**FE(4)**	
TimeOfDay								
Midday	0.010	***	-0.022	***	0.005		-0.023	***
	(0.003)		(0.003)		(0.003)		(0.003)	
Evening	0.026	***	-0.014	***	0.020	***	-0.019	***
	(0.004)		(0.004)		(0.004)		(0.004)	
Day								
Tuesday	-0.005		0.025	***	-0.007	**	0.020	***
	(0.004)		(0.004)		(0.004)		(0.004)	
Wednesday	0.038	***	0.031	***	0.037	***	0.028	***
	(0.005)		(0.005)		(0.005)		(0.005)	
Thursday	0.004		0.021	***	0.004		0.021	***
	(0.005)		(0.005)		(0.005)		(0.005)	
Friday	0.032	***	0.025	***	0.030	***	0.022	***
	(0.007)		(0.006)		(0.007)		(0.007)	
Saturday	0.021	***	0.044	***	0.023	***	0.034	***
	(0.006)		(0.006)		(0.007)		(0.007)	
Male			0.005					
			(0.005)					
Online			-0.027	***			-0.033	***
			(0.006)				(0.006)	
Intercept	0.100	***	0.156	***	0.031		0.071	***
	(0.010)		(0.016)		(0.023)		(0.025)	
PrevEdu-FE	NO		YES		NO		NO	
Continent-FE	NO		YES		NO		NO	
Study year-FE	NO		YES		NO		YES	
Block-FE	NO		YES		NO		YES	
Course-FE	YES		YES		YES		YES	
Individual-FE	NO		NO		YES		YES	
Number of observations	101,695		87,432		101,695		87,432	
Individuals	6,872		6,657		6,872		6,657	
R^2	0.036		0.097		0.025		0.058	

Note: This table contains the main coefficients of the result of two GLS-regressions and two FE-regressions with DumNO as dependent variable. The complete overview of the regression results can be found in Table E.1 in Appendix E. Column 1 and 2 show the GLS-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumNO. Column 3 and 4 show the FE-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumNO. The omitted categories are; Morning for TimeOfDay, Monday for Day, FEB11001 for Coursecode, VWO for TypePrevEdu, Europe for Continent, 2020-2021 for StudyYear and Block1 for Block. Standard errors are shown between round brackets. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

As the interpretation of the coefficients of the equations with “DumNO” as dependent variable differs compared to equations with “ResultNumerical”, I will discuss the meaning a bit more in-depth. As follows from Table 6.2, the average chance of not showing up is 0.022 higher in the morning than in the middle of the day and 0.014 higher in the morning than in the evening. The interpretation of this coefficient is important, it means that for an exam that takes place in the morning instead of the evening there are on average 2.8 students extra if the total number of students that take the test is 200, and all else is kept equal.

As discussed above, the GLS-regressions show that there are some significant effects. Consequently, it is interesting to analyse if the coefficients for the FE-regressions also show some statistical significance. Therefore, I will now continue with the discussion of the results of the FE-regressions, which, as stated before, can be found in Column 3 and 4 of Table 6.2 or Table E.1.

In this case the FE-regression with control variables has the same statistical significance of the coefficients as the GLS-regression with control variables. All null hypotheses of there being no effect of exam timing on the chance of not showing up should be rejected. Again it is important to note that the sign of Midday and Evening switches when adding control variables. Furthermore, the coefficient of Saturday is still the largest and the chance of not showing up is on average still the biggest for morning exams compared to evening exams and midday exams. Besides, it is interesting to see that on average people tend to show up more often for online exams. Moreover, it should be noted that the R^2 for all four regressions is only between 0.025 and 0.097 for all four regressions and I will discuss the importance of the findings in these analyses more in-depth in Chapter 7 as it could have some consequences in terms of selection bias.

6.3. Analysis with DumPass as dependent variable

The variable “DumPass” is also a dummy variable, therefore the way of interpreting the coefficients is the same as for the regressions with “DumNO” as the dependent variable. The coefficients corresponding to the independent variables depict the average change in the chance of passing a course. The complete results of the GLS-regressions and FE-regressions can be found in Table F.1 in Appendix F and the overview of the results for the main coefficients is shown in Table 6.3. Again both tables have the same structure regarding the columns. Column 1 and Column 2 show the GLS-regressions without and with control variables, respectfully. Column 3 and Column 4 do the same, but then for the FE-regressions.

Table 6.3 Overview of main coefficients of GLS-regressions and FE-regressions for the relation between passing an exam and the timing of exams

DumPass	GLS(5)		GLS(6)		FE(5)		FE(6)	
TimeOfDay								
Midday	0.032	***	0.049	***	0.037	***	0.051	***
	(0.005)		(0.005)		(0.005)		(0.005)	
Evening	0.001		0.025	***	0.013	**	0.033	***
	(0.006)		(0.006)		(0.006)		(0.006)	
Day								
Tuesday	0.010	*	-0.005		0.011	*	-0.002	
	(0.006)		(0.006)		(0.006)		(0.006)	
Wednesday	-0.023	***	-0.006		-0.016	**	0.001	
	(0.007)		(0.007)		(0.007)		(0.007)	
Thursday	-0.012		-0.012	*	-0.008		-0.011	
	(0.007)		(0.007)		(0.007)		(0.007)	
Friday	-0.021	**	-0.009		-0.016	*	-0.005	
	(0.009)		(0.009)		(0.009)		(0.009)	
Saturday	-0.038	***	-0.044	***	-0.034	***	-0.036	***
	(0.009)		(0.009)		(0.009)		(0.009)	
Male			-0.006					
			(0.008)					
Online			0.056	***			0.055	***
			(0.008)				(0.008)	
Intercept	0.631	***	0.609	***	0.810	***	0.801	***
	(0.013)		(0.022)		(0.021)		(0.027)	
PrevEdu-FE	NO		YES		NO		NO	
Continent-FE	NO		YES		NO		NO	
Study year-FE	NO		YES		NO		YES	
Block-FE	NO		YES		NO		YES	
Course-FE	YES		YES		YES		YES	
Individual-FE	NO		NO		YES		YES	
Number of observations	101,695		88,160		101,695		98,160	
Individuals	6,872		6,657		6,872		6,657	
R^2	0.048		0.073		0.018		0.024	

Note: This table contains the main coefficients of the result of two GLS-regressions and two FE-regressions with DumPass as dependent variable. The complete overview of the regression results can be found in Table F.1 in Appendix F. Column 1 and 2 show the GLS-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumPass. Column 3 and 4 show the FE-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumPass. The omitted categories are; Morning for TimeOfDay, Monday for Day, FEB11001 for Coursecode, VWO for TypePrevEdu, Europe for Continent, 2020-2021 for StudyYear and Block1 for Block. Standard errors are shown between round brackets. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

I will first go over the results for the GLS-regressions, and afterwards I will discuss the FE-regression results. For the GLS regression with all control variables, the null hypothesis of no effect of time of day on the average chance of passing a course should be rejected. While for day of the week only the null hypothesis of no effect for Saturday on the average chance of passing a course should be rejected. Furthermore, it is interesting to note that the size of the coefficients for Midday and Evening becomes bigger after adding control variables, while for all days of the week except Saturday, the average effect becomes smaller.

To elaborate a bit further on the meaning of the coefficients, I will use the following explanation. In this example I will compare an exam taken in the morning on Monday to an exam taken during midday on Saturday. The chance of passing a course is on average 4.9% higher during midday than in the morning, but the chance of passing is on average 4.4% lower on a Saturday compared to a Monday. Therefore the overall average effect between the two different time slots, if all else equal, is 0.5%. In a course with 400 students, this means that on average there are two extra students who pass the course.

The GLS-regression thus indicates that there is some effect of exam timing on the chance of passing the course. Now I will discuss whether a similar effect is noticeable for the FE-regressions. From Column 4 in Table 6.2 it also follows that the null hypothesis of no effect of time of day on the chance of passing a course should be rejected and that the null hypothesis for no effect of day of the week can only be rejected for Saturday. This is thus similar to the rejections of the GLS-regressions. Furthermore, it can be noticed that again the coefficients for time of day become larger when adding control variables and that the coefficients for day of the week become smaller, except for Saturday. Besides, it is interesting to note that in both the FE-regression and GLS-regression taking an exam online improves the average chance of passing that exam. It should however be noted that the R^2 is only between 0.018 and 0.073 for all 4 regressions.

6.4. Analysis with DumPassMark as dependent variable

The previous Section discussed the regressions with “DumPass” as the dependent variable. As stated before in the Methodology section, this dummy variable also includes the students that did not show up for their exam. It is however also interesting to analyse if there are different coefficients for the chance of passing a course when only the students that did receive a numerical result are taken into account. Therefore I will now discuss the regressions with “DumPassMark”. In a similar way as before, the complete overview of results can be found in Table G.1 in Appendix G, while Table 6.4 shows the coefficients of the variables of interest. Column 1 and Column 3, respectively, show the

GLS-regression and FE-regression without control variables, and Column 2 and Column 4, respectively, show the GLS-regression and FE-regression with control variables.

Table 6.4 Overview of main coefficients of GLS-regressions and FE-regressions for the relation between passing an exam based on numerical grades and the timing of exams

DumPassMark	**GLS(7)**		**GLS(8)**		**FE(7)**		**FE(8)**	
TimeOfDay								
Midday	0.049	***	0.043	***	0.049	***	0.045	***
	(0.005)		(0.005)		(0.005)		(0.005)	
Evening	0.022	***	0.015	**	0.034	***	0.022	***
	(0.006)		(0.006)		(0.006)		(0.006)	
Day								
Tuesday	0.010	*	0.016	***	0.006		0.012	**
	(0.006)		(0.006)		(0.006)		(0.006)	
Wednesday	0.007		0.021	***	0.012	*	0.022	***
	(0.007)		(0.007)		(0.007)		(0.007)	
Thursday	-0.004		0.004		0.001		0.005	
	(0.007)		(0.008)		(0.008)		(0.008)	
Friday	-0.003		0.004		-0.000		0.004	
	(0.009)		(0.009)		(0.009)		(0.009)	
Saturday	-0.028	***	-0.014		-0.020	**	-0.015	
	(0.009)		(0.009)		(0.009)		(0.009)	
Male			-0.005					
			(0.007)					
Online			0.053	***			0.045	***
			(0.008)				(0.008)	
Intercept	0.687	***	0.706	***	0.930	***	0.931	***
	(0.013)		(0.022)		(0.020)		(0.027)	
PrevEdu-FE	NO		YES		NO		NO	
Continent-FE	NO		YES		NO		NO	
Study year-FE	NO		YES		NO		YES	
Block-FE	NO		YES		NO		YES	
Course-FE	YES		YES		YES		YES	
Individual-FE	NO		NO		YES		YES	
Number of observations	90,726		87,432		90,726		87,432	
Individuals	6,572		6,364		6,572		6,364	
R^2	0.056		0.070		0.007		0.008	

Note: This table contains the main coefficients of the result of two GLS-regressions and two FE-regressions with DumPassMark as dependent variable. The complete overview of the regression results can be found in Table G.1 in Appendix G. Column 1 and 2 show the GLS-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumPassMark. Column 3 and 4 show the FE-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumPassMark. The omitted categories are; Morning for TimeOfDay, Monday for Day, FEB11001 for Coursecode, VWO for TypePrevEdu, Europe for Continent, 2020-2021 for StudyYear and Block1 for Block. Standard errors are shown between round brackets. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

From Column 2 in Table 6.4, it follows that the rejection of the null hypotheses is as follows for the GLS-regression with control variables. The null hypotheses of no effect of time of day should be rejected and the null hypotheses of no effect of day of the week can only be rejected for Tuesday and Wednesday. The effect of adding control variables on the coefficients of the variables of interest is different from that of "DumPass". For both midday and evening exams the effect becomes smaller after adding control variables.

This result indicates that the timing of exams has, for example, the following impact on the chance of passing a course for students who receive a numerical result. If an exam takes place during midday the average chance of passing that course is 4.3% higher compared to an exam in the morning if all else is kept equal. This means that for an exam with 200 participants there are on average 8.6 more students who pass the course.

As there seems to be an effect of exam timing on the chance of passing an exam, it is important to analyse if this outcome is the same for the FE-regressions. Therefore I will now discuss the outcome of the FE-regressions. For these regressions, the rejection of null hypotheses follows the same pattern as for the GLS-regression. Therefore it follows from Column 4 of Table 6.4 that the null hypothesis of no effect of time of day on the chance of passing when receiving a numerical grade should be rejected. This is also the case for the null hypothesis that Tuesday and Wednesday have no effect on the chance of passing when receiving a numerical grade. Furthermore, it is interesting to note that online exams seem to improve the average chance of passing a course when a numerical grade is received. This effect can be seen in both the FE-regression and in the GLS-regression. Moreover, it is important to note that the size of the coefficients for time of day, day of the week and online are similar in both the GLS and FE-regression. It should however also be noted that the R^2 of all four regressions is low, and that it lies between 0.007 and 0.070.

6.5. Analysis with interaction-effect of male and TimeOfDay

From the main analysis it followed that the null hypotheses for no effect of timing on performance was, at least partly, rejected. In this analysis I will run similar regressions, but now I will also include a interaction effect of "Male" and "TimeOfDay_cat". This will allow us to conclude if, on average, the timing of exam influences men and women differently. Table 6.5 shows the coefficients of the variables of interest, while the complete overview of the results can be found in Table H.1 in Appendix H. The GLS regressions with and without control variables can, respectively, be seen in Column 1 and Column 2. Column 3 and Column 4, respectively, show the FE-regressions with and without control variables.

Table 6.5 Overview of main coefficients of GLS-regressions and FE-regressions for the relation between the numerical result of exams and exam timing, including an interaction-effect.

ResultNumerical	GLS(9)		GLS(10)		FE(9)		FE(10)	
TimeOfDay								
Midday	0.181	***	0.167	***	0.180	***	0.169	***
	(0.021)		(0.022)		(0.021)		(0.022)	
Evening	0.146	***	0.105	***	0.178	***	0.127	***
	(0.026)		(0.027)		(0.026)		(0.027)	
Male	-0.009		-0.029					
	(0.038)		(0.038)					
TimeOfDay # Male								
Midday # Male	0.052	**	0.052	**	0.051	**	0.052	**
	(0.021)		(0.022)		(0.021)		(0.022)	
Evening # Male	-0.042		-0.036		-0.040		-0.033	
	(0.027)		(0.027)		(0.027)		(0.027)	
Day								
Tuesday	0.030	*	0.049	***	0.022		0.039	**
	(0.018)		(0.018)		(0.018)		(0.018)	
Wednesday	0.040	*	0.081	***	0.046	**	0.078	***
	(0.022)		(0.022)		(0.022)		(0.022)	
Thursday	0.012		0.013		0.016		0.012	
	(0.022)		(0.023)		(0.022)		(0.023)	
Friday	-0.032		-0.009		-0.028		-0.014	
	(0.027)		(0.028)		(0.028)		(0.028)	
Saturday	-0.112	***	-0.073	**	-0.103	***	-0.086	***
	(0.031)		(0.032)		(0.031)		(0.032)	
Online			0.182	***			0.169	***
			(0.027)				(0.027)	
Intercept	6.327	***	6.342	***	7.267	***	7.190	***
	(0.053)		(0.076)		(0.076)		(0.092)	
PrevEdu-FE	NO		YES		NO		NO	
Continent-FE	NO		YES		NO		NO	
Study year-FE	NO		YES		NO		YES	
Block-FE	NO		YES		NO		YES	
Course-FE	YES		YES		YES		YES	
Individual-FE	NO		NO		YES		YES	
Number of observations	90,726		87,432		90,726		87,432	
Individuals	6,572		6,364		6,572		6,364	
R^2	0.084		0.101		0.021		0.022	

Note: This table contains the main coefficients of the result of two GLS-regressions and two FE-regressions with ResultNumerical as dependent variable, and including an interaction-effect of Male and TimeOfDay_cat. The complete overview of the regression results can be found in Table H.1 in Appendix H. Column 1 and 2 show the GLS-regressions and give the average effect of the variable in the corresponding model on the dependent variable ResultNumerical. Column 3 and 4 show the FE-regressions and give the average effect of the variable in the corresponding model on the dependent variable ResultNumerical. The omitted categories are; Morning for TimeOfDay, Monday for Day, FEB11001 for Coursecode, VWO for TypePrevEdu, Europe for Continent, 2020-2021 for StudyYear and Block1 for Block. Standard errors are shown between round brackets. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

The rejection of the null hypothesis follows the same pattern as for the main analysis. This is not strange as the only difference between the analyses is the interaction-term. This means that for all four regressions, the null hypothesis that "TimeofDay_cat" does not have an effect on "ResultNumerical" should be rejected. Furthermore, the null hypothesis of no influence of the day of the week on "ResultNumerical" cannot be completely rejected. Some days have a significant effect, while for others there is no significant effect.

To analyse the results a bit more in depth, I will start with discussing the GLS-regressions. From these regressions it follows that the effect of time of day becomes smaller compared to the GLS-regressions without interaction-effect. This change in coefficients is due to the fact that the interaction-effect of "Male" and "TimeOfDay_cat" now captures a part of the average effect on the numerical result. This interaction-effect is statisitical significant for exams that take place during midday. From this coefficient it follows that male students on average benefit more from scheduling exams during midday compared the female students.

Besides, it is interesting to note that the coefficients for day of the week almost completely stay the same compared to the regression without the interaction term. When the coefficients do change, they only change by 0.001. This is interesting due to the fact that adding other control variables do results in a different coefficient for day of the week, as can be seen in Column 2. Furthermore, It is interesting to note that the coefficient of the interaction term for "Midday" and "Male" is not influenced by adding the control variables and that there is only a small change for the interaction-effect for "Evening" and "Male".

Now I will compare the FE-regressions with interaction-term to the GLS-regressions. As stated before, the coefficients for the variables of interest can be seen in Column 3 and Column 4 in Table 6.5. It follows that there is a small change in the coefficients of the variables of interest, but the sign is the same in all four regressions. Furthermore, the rejection of the null hypotheses follows the same pattern as for the GLS-regressions. The null hypothesis of no effect of time of day on "ResultNumerical" should be rejected, and the null hypothesis of no effect of day of the week can not be completely rejected. Some days have significant coefficients, and some days do not.

It is interesting to note that the size and significance of the interaction term between "Midday" and "Male" is almost completely the same for the FE-regressions. Moreover, it can be seen that Saturday's show the strongest effect in all four regressions, both in terms of size and statistical significance. Furthermore, it follows from both the FE-regression and GLS-regression that online exams on average result in a higher grade. However, it should be noted that the R^2 is only between 0.021 and 0.101 for all four regressions.

7. Conclusion and discussion

In this thesis, I have researched the influence of exam timing on academic performance. From both the GLS-regression and FE-regression of the main analysis, as discussed in Section 6.1, it follows that there seems to be an effect of exam timing. Therefore, there is an indication that time of day and day of the week have an influence on performance. This follows from the fact that both the null hypothesis for no effect of Midday and Evening on the numeric result were rejected, while also the null hypotheses of no effect of Tuesday, Wednesday and Saturday on academic performance were rejected. But how should we interpret these results?

The conclusion for the regressions with "ResultNumerical" as dependent variable are the following. All four regression give a significant effect of the time of day on academic performance. All models also indicate that exams during midday result on average in higher grades compared to exams in the morning, and it follows that exams in the evening on average result in a better grade than exams in the morning, but worse compared to exams during midday. This is a similar effect to that found in the literature as discussed in Section 2.8.

Furthermore, the effect of the time of day can interact with the effect of the day of the week on which the exam takes place. Exams that take place on Tuesday's or Wednesday's instead of Monday's on average result in better performance of students, while exams on Saturday's result in lower grades compared to Monday's. This means that if we combine the average effects of "TimeOfDay_cat" and "Day" we will get the overall scheduling effect. Thus for example in comparison with a Monday morning exam, an exam on Saturday evening exam results on average in only a 0.020 higher grade while an exam during midday on Wednesday on average results in a 0.283 higher grade compared to Monday morning.

As these results indicate that there could be an effect of exam timing on academic performance, it is important to investigate whether this could be due to self-selection bias. This bias could be due to differences in certain students not showing up for time-slots. From the regressions with "DumNO" as the dependent variable, it seems that there could be an effect. This follows from the fact that in both regressions with control variables the null hypotheses of there being no effect of midday and evening on the chance of not showing up were rejected and that the null hypotheses of there being no effect of the day of the week were rejected for all days. But what does this mean exactly for the interpretation of the other analyses?

The conclusion of the analyses with DumNO as dependent variable should be interpreted in the following way for the regressions with control variables. I use these models as the R^2 of the models with control variables is higher than the corresponding regression without control variables. From

these models it follows that the chance of not showing up on average decreases during midday with 2.3% and in the evening with 1.9%, compared to the morning. This means that more students actually show up during these times compared to the morning. There could be several explanations for this. A possible explanation could be for example that students oversleep in the morning and miss their exam, or that students feel better prepared after studying in the morning and afternoon. If we however take the position that students do not show up because they expect to fail, it could be the case that students that take exams in the morning have more belief in passing the course. However, from the main-analysis it follows that students perform on average worse in exams that take place in the morning compared to other time-slots. This would mean that the effect of the main analysis is even underestimated.

A similar approach in interpreting follows for the day of the week. On Saturday's compared to Monday's, students are 4.4% more likely to not show up for exams they are scheduled to take. If people do not show up because they do not believe that they will get a good grade, it would mean that on Saturday there is a higher percentage of people that believe they will pass the course. This would mean that it is expected that the average grade of exams that take place on Saturday is higher. This is however not the case, as from the main analysis it follows that exams on Saturday on average result in lower grades. This also indicates that the effect of the main analysis is, if anything, underestimated for the coefficient of Saturday.

Thus, it means that at least for the main analysis, the findings are not compromised due to the conclusion of there being an effect of exam timing on the average chance of not showing up for an exam. Therefore, I will now continue with the conclusions of the other analysis, and see whether there is an impact of the findings on no shows on the outcome of the following analyses.

The effect of exam timing on the numerical result is important, but maybe the most important question related to the performance on an exam is whether a student passed the course or not. Therefore, I will now discuss the conclusions of the regressions with "DumPass" and "DumPassMark". From the regressions with control variables, that had "DumPass" as the dependent variable, it follows that there seems to be an effect of exam timing on the average chance of passing a course. This follows from the fact that the null hypotheses for no effect of midday and evening were rejected. Furthermore, the null hypothesis of there being no effect for Saturday on the chance of passing a course was also rejected. I choose to use the regressions with control variables as the R^2 was higher for these regressions, compared to the corresponding regression without control variables. But what does this conclusion mean exactly, and how should we interpret it with the conclusion of the analysis of not showing up for an exam in mind?

The results of “DumPass” follow a similar pattern as the results for “ResultNumerical”. The average chance of passing is higher in the evening compared to the morning, but the average chance of passing is even higher for exams during midday compared to mornings and evenings. This also means that the interpretation of the results of the analysis with “DumNo”, if anything, only leads to an underestimation of the regression results for “DumPass”. This is also the case for the average chance of passing an exam on Saturday compared to Monday. On average the exam on Saturday results in a lower chance of passing the course compared to a Monday.

From the regression with “DumPassMark” as the dependent variable, it follows that there seems to be an effect of exam timing on the chance of passing a course when only considering numerical results. As in previous conclusions, I will base my conclusion on the regressions with control variables as the R^2 is higher than the corresponding regressions without control variables. From the regressions with control variables it follows that the null hypotheses of no effect of midday and evening on the chance of passing a course based on numerical results were rejected. The null hypotheses of no effect of Tuesday and Wednesday on the average chance of passing a course based on numerical results were also rejected. It is interesting to see that in this case Saturday does not have a statistical significant effect. But as discussed before, the results of the analysis with “DumNO” could indicate that the coefficient of Saturday is underestimated. But how should we interpret these results?

From the GLS-regression it follows that on average the chance of passing a course based on numerical results is 4.3% higher for exams during midday and 1.5% higher during the evening, compared to the morning. This is also in line with the analysis of the numerical results, as the average grade was expected to be higher during these time-slots. When the average grade is expected to be higher, it is also to be expected that more people actually pass the course. Furthermore, from the results it follows that respectively for exams during midday and the evening, on average 8.6 and 3 students extra pass the course based on the numerical result. This scheduling effect can on average be increased by scheduling an exam on Tuesday or Wednesday, which is also in line with previous results as the average grade is expected to be higher on those days.

The conclusions above indicate that there is some effect of exam timing on performance. This result is based on the average student, but what happens when we differentiate between students? In the last analysis I investigated whether there is a different effect for men and women. In a similar way as before I will draw my conclusions based on the GLS-regression and FE-regression with control variables as the R^2 is higher. From these regressions it follows that the null hypothesis of there being no differences between men and women in terms of the timing effect on performance should

be rejected. This is because the interaction-term of “Midday and “Male” has a significant coefficient. Thus there is an indication that exam timing influences men and women differently. This is in line with the literature, as described in Section 2.10. The other coefficients of the regressions with control variables and interaction-term are completely in line with the main analysis. This is quite logical as the regression is exactly the same apart from the interaction effect.

There is, however, one important thing to note. Namely, that on average the numerical result is higher for online courses than for offline courses. Not only in this analysis with interaction-effect, taking an exam online instead of offline results in more positive results, but also in all other analysis this effect can be seen. This follows from the fact that in all regressions the null hypothesis of there being no effect of taking an exam online on performance or showing up should be rejected. This means that on average online exams; result in higher grades; have fewer students that do not show up for their exam; and these exams have higher passing rates.

All things considered, there seems to be an effect of exam timing on performance, this effect is found for bot the time of day and for the day of the week. However it should be noted that due to the structure of the data and the chosen methods, only courses that differentiate between time-slots have an influence on the effect of exam timing on performance. Furthermore, it is important to realize that in this thesis only data from the Erasmus School of Economics was used. This could mean that the results only apply to this specific faculty. It can however be expected that other economic faculties have similarities in their student population, which would make the results at least somewhat externally valid.

Moreover, it would be interesting to investigate a bit more in-depth what the reasons behind poorer performance and more no-shows could be on certain time-slots. Is it only the difference in biological rhythms and the corresponding optimal times for performing cognitive tasks that leads to the effect of exam scheduling on performance? Or are there other reasons for this relationship? This is both interesting for the effect of exams in the morning, as for the effect of exams on Saturday. It could be for example the case that students have to rush in order to be on time for a morning exam, which creates extra stress. Or that there is another potential reason such as that students prefer to overlook the course-material one more time before entering an exam, and that this is not really possible when taking an exam in the morning.

8. Recommendations

From the conclusion it follows that it would be interesting if other faculties and universities show a similar result. Therefore, I would recommend using a broader student sample in further research. Additionally, it would be interesting to look at the influence of different types of exams. As follows from the literature, there could be a difference in the effect of different types of exams. In line with this, it could also be interesting to research whether the exam duration plays a role in the effect of exam timing on academic performance, especially because from the literature it follows that fatigue can increase the effect of exam timing. This, however, would mean that there should be exams of different length in the data-set. Besides, it would be interesting to research why online exams result in more positive outcomes. It could be, for example, due to the difficulty of exams, that it is more easy to cheat or that people prefer online exams over big exam halls. To be able to research this more in-depth, there should be a better distribution of online and offline exams. As Graph 8.1 namely shows, there were only online exams during study year 2020-2021

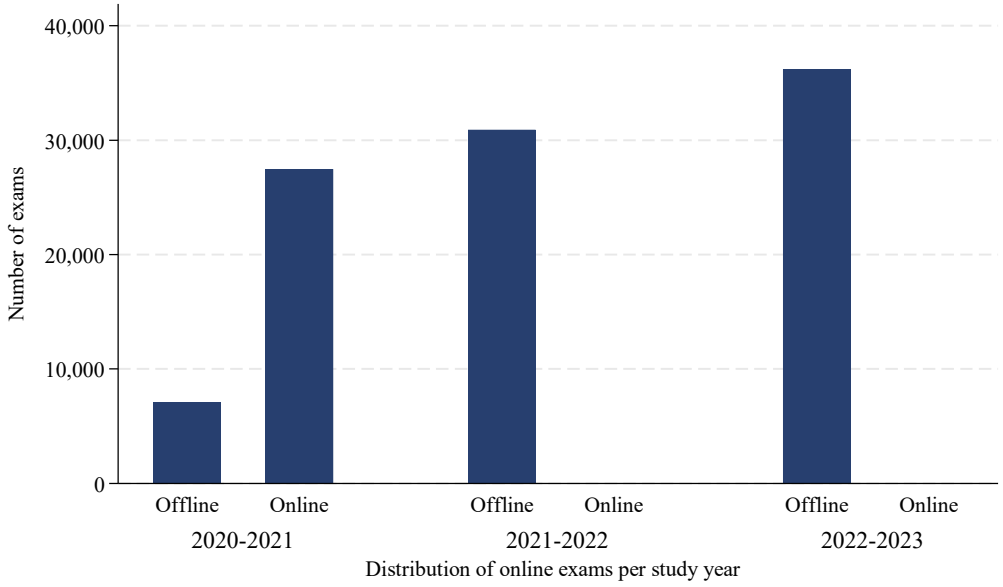

Figure 8.1 Overview of the distribution of online and offline exams during study year 2020-2021, 2021-2022 and 2022-2023.

Furthermore, it would be interesting to research more student specific effects. It follows for example from the literature that people from different climates differ in their morningness-eveningness characteristics. This could have an influence on exam performance during the day. However, to be able to research this effect, it would be important to know the place or city of birth rather than the country of birth. Besides it would be interesting to study the reasons why students do actually not show up for exams they are scheduled to take. This could have an impact on the interpretation of the results. Moreover, it could be important to drop observations of students who do repeatedly not

show up, because then their could be another reason for their absence. For example because they stopped with their studies, they are ill, or that they have other issues that are not related to exam timing.

Before drawing any conclusions on the changes that the Erasmus School of Economics should make in their policies regarding exam schedules, it is important to research the above mentioned recommendations first. This will ensure that changing the policy happens in the most effective way possible, and this will make sure that the policy leads to the most equal exam-environment for all students. Because, as described before, there could be an unfair advantage for certain students regarding specific exam times. This difference between students however also holds the potential to create inequality when all exams are scheduled at the same time-slot, although this time-slot may on average result in the best performance. Therefore it is important to research more in-depth how different groups are influenced in a specific way by the timing of exams.

Furthermore, the EUR should address this scheduling effect in other faculties. This will allow them to take into account the potential effect of exam schedules on performance and on the number of students showing up for an exam. Moreover, it could be that the findings of this thesis are of importance for other universities in the Netherlands, and perhaps even outside of the Netherlands. This is due to the fact that all the findings of this thesis point in the same direction, namely that there is a strong indication that there is an effect of exam timing on performance.

Also outside of the academic field, the findings of this thesis can be of importance, and maybe they even have a bigger impact in other fields. This is due to the fact that in the academic field it is mostly the case that multiple people have to take a certain exam or test at the same time. As described above, the difference between students could lead to there being no perfect time, as there is always a student negatively influenced by the timing of an exam. However, outside of the academic field there are a lot of important cognitive tasks that are individually scheduled. From this thesis it follows that the timing of cognitive tasks, in this case exams, is influenced by the timing. Therefore, it could be of importance to give everyone their optimal time-slot as this could lead to a more fairer assessment and comparison between individuals.

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10. Appendix A

Table A.1 Overview of number of observations per Course per study year for study years 2020-2021, 2021-2022 and 2022-2023.

Coursecode	StudyYear			
	2020-2021	2021-2022	2022-2023	Total
FEB11001	773	578	587	1938
FEB11001X	498	638	596	1732
FEB11002	719	524	595	1838
FEB11002X	420	608	581	1609
FEB11003	740	619	725	2084
FEB11003X	441	644	727	1812
FEB11004	713	517	554	1784
FEB11004X	421	613	536	1570
FEB11005	624	467	523	1614
FEB11005X	391	565	522	1478
FEB11006	626	443	502	1571
FEB11006X	906	1112	1272	3290
FEB11013	599	498	554	1651
FEB11013X	375	560	544	1479
FEB11018	826	690	693	2209
FEB11018X	1178	1396	1312	3886
FEB11020	685	491	586	1762
FEB11020X	972	1304	1312	3588
FEB12001	740	578	647	1965
FEB12001X	391	395	693	1479
FEB12003	641	585	747	1973
FEB12003X	479	453	715	1647
FEB12004	652	687	704	2043
FEB12004X	514	505	729	1748
FEB12005	589	504	565	1658
FEB12005X	346	362	576	1284
FEB12006	448	412	450	1310
FEB12006X	358	343	545	1246
FEB12007	591	539	724	1854
FEB12007X	493	509	792	1794

FEB12010	648	562	606	1816
FEB12012	585	503	694	1782
FEB12012X	375	372	664	1411
FEB12015	841	540	557	1938
FEB12015X	992	1234	1176	3402
FEB12018	483	456	557	1496
FEB12018X	363	345	617	1325
FEB21005	371	193	245	809
FEB21005X	164	159	192	515
FEB21007	357	197	309	863
FEB21007X	170	177	219	566
FEB21009	482	219	351	1052
FEB21009X	209	169	249	627
FEB21010	355	194	304	853
FEB21010X	165	167	235	567
FEB21011	410	175	280	865
FEB21011X	176	147	212	535
FEB21017	458	255	275	988
FEB21017X	202	195	214	611
FEB21018	372	245	268	885
FEB21018X	162	193	208	563
FEB21019	436	242	292	970
FEB21019X	198	192	246	636
FEB21020	347	248	258	853
FEB21020X	161	186	206	553
FEB21021	462	224	303	989
FEB21021X	229	184	248	661
FEB21022	297	188	200	685
FEB21022X	143	175	171	489
FEB21023	466	190	277	933
FEB21023X	200	165	218	583
FEB22002	272	211	231	714
FEB22002X	163	124	157	444
FEB22003	258	220	212	690
FEB22003X	169	209	188	566

FEB22004	282	259	256	797
FEB22004X	186	165	240	591
FEB22005	292	243	193	728
FEB22005X	179	144	165	488
FEB22006	284	245	264	793
FEB22006X	162	136	201	499
FEB22008	326	291	275	892
FEB22008X	218	170	214	602
FEB22012	221	0	149	370
FEB22012X	142	3	136	281
FEB22013	228	170	183	581
FEB22013X	136	122	149	407
FEB22016	262	228	181	671
FEB22016X	77	119	151	347
FEB22017	214	187	191	592
FEB22017X	54	55	83	192
FEB22018	192	179	167	538
FEB22018X	45	51	65	161
FEB23001	273	230	253	756
FEB23001X	178	147	181	506
FEB42001	173	96	147	416
FEB42002	159	85	124	368
Total	34573	30919	36215	101707

Note: Table 10.1 provides an overview of the number of observations of each course in study years 2020-2021, 2021-2022 and 2022-2023. The table shows the number of observations of each course in the corresponding study year. Furthermore, the table also includes the total number of observations of each course combined over the three study years.

11. Appendix B

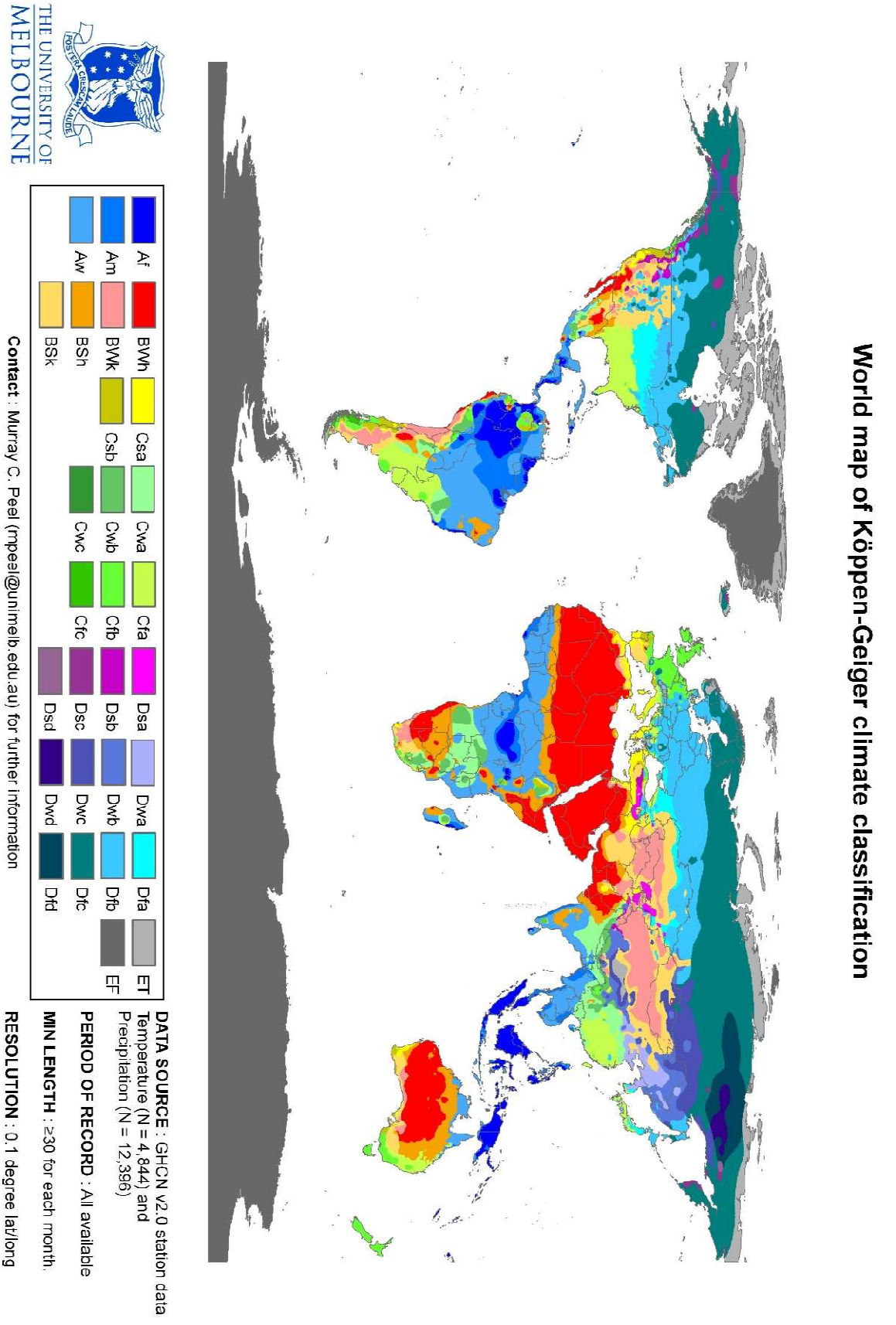

Figure B.1 Overview of updated world map of Köppen-Geiger Climate classification (Peel et al. , 2007)

12. Appendix C

Table C.1 overview of the distribution of the categorical variable Coursecode with corresponding numbers and labels.

Coursecode

1 FEB11001	52 FEB21005X	103 FEB23017
2 FEB11001X	53 FEB21007	104 FEB23018
3 FEB11002	54 FEB21007S	105 FEB42001
4 FEB11002X	55 FEB21007X	106 FEB42002
5 FEB11003	56 FEB21009	107 FEB43004
6 FEB11003X	57 FEB21009X	108 FEB43007
7 FEB11004	58 FEB21010	109 FEB43008
8 FEB11004X	59 FEB21010X	110 FEB43013
9 FEB11005	60 FEB21011	111 FEB43015
10 FEB11005X	61 FEB21011S	112 FEB43018
11 FEB11006	62 FEB21011X	113 FEM11037
12 FEB11006X	63 FEB21017	114 FEM11038
13 FEB11013	64 FEB21017X	115 FEM11056
14 FEB11013X	65 FEB21018	116 FEM11090
15 FEB11018	66 FEB21018X	117 FEM11186
16 FEB11018X	67 FEB21019	
17 FEB11020	68 FEB21019X	
18 FEB11020X	69 FEB21020	
19 FEB12001	70 FEB21020X	
20 FEB12001X	71 FEB21021	
21 FEB12002	72 FEB21021X	
22 FEB12002X	73 FEB21022	
23 FEB12003	74 FEB21022X	
24 FEB12003X	75 FEB21023	
25 FEB12004	76 FEB21023X	
26 FEB12004X	77 FEB22002	
27 FEB12005	78 FEB22002X	
28 FEB12005X	79 FEB22003	
29 FEB12006	80 FEB22003X	
30 FEB12006X	81 FEB22004	
31 FEB12007	82 FEB22004X	
32 FEB12007X	83 FEB22005	
33 FEB12010	84 FEB22005X	
34 FEB12012	85 FEB22006	
35 FEB12012X	86 FEB22006X	
36 FEB12013	87 FEB22008	
37 FEB12013X	88 FEB22008X	
38 FEB12015	89 FEB22009	
39 FEB12015X	90 FEB22009X	
40 FEB12017X	91 FEB22012	
41 FEB12018	92 FEB22012X	
42 FEB12018X	93 FEB22013	
43 FEB13020	94 FEB22013X	
44 FEB13023	95 FEB22016	
45 FEB13035	96 FEB22016X	
46 FEB13036	97 FEB22017	
47 FEB13050	98 FEB22017X	
48 FEB13066	99 FEB22018	
49 FEB13105	100 FEB22018X	
50 FEB21005	101 FEB23001	
51 FEB21005S	102 FEB23001X	

13. Appendix D

Table D.1 Results of GLS-regressions and FE-regressions for the relation between the numerical result of exams and exam timing

ResultNumerical	GLS(1)		GLS(2)		FE(1)		FE(2)	
TimeOfDay								
Midday	0.216	***	0.202	***	0.214	***	0.204	***
	(0.015)		(0.016)		(0.015)		(0.016)	
Evening	0.118	***	0.081	***	0.152	***	0.105	***
	(0.019)		(0.019)		(0.019)		(0.019)	
Day								
Tuesday	0.031	*	0.049	***	0.023		0.039	**
	(0.018)		(0.018)		(0.018)		(0.018)	
Wednesday	0.040	*	0.081	***	0.046	**	0.079	***
	(0.022)		(0.022)		(0.022)		(0.022)	
Thursday	0.012		0.014		0.017		0.012	
	(0.022)		(0.023)		(0.022)		(0.023)	
Friday	-0.031		-0.009		-0.028		-0.014	
	(0.027)		(0.028)		(0.028)		(0.028)	
Saturday	-0.112	***	-0.072	**	-0.103	***	-0.085	***
	(0.031)		(0.032)		(0.031)		(0.032)	
Course								
FEB11001X	0.058		0.437	***	-1.090	***	-1.110	***
	(0.060)		(0.080)		(0.134)		(0.134)	
FEB11002	-0.120	***	-0.373	***	-0.170	***	-0.429	***
	(0.039)		(0.063)		(0.038)		(0.063)	
FEB11002X	-0.255	***	-0.129		-1.420	***	-1.683	***
	(0.059)		(0.093)		(0.134)		(0.142)	
FEB11003	-0.569	***	-0.762	***	-0.535	***	-0.764	***
	(0.042)		(0.061)		(0.041)		(0.061)	
FEB11003X	-0.095		0.126		-1.243	***	-1.463	***
	(0.063)		(0.096)		(0.136)		(0.145)	
FEB11004	-0.171	***	-0.105		-0.247	***	-0.202	***
	(0.046)		(0.064)		(0.045)		(0.064)	
FEB11004X	0.158	**	0.602	***	-1.018	***	-0.975	***
	(0.067)		(0.096)		(0.137)		(0.145)	
FEB11005	0.313	***	0.072		0.264	***	0.017	
	(0.041)		(0.065)		(0.040)		(0.065)	
FEB11005X	0.400	***	0.522	***	-0.755	***	-1.027	***
	(0.062)		(0.097)		(0.135)		(0.145)	
FEB11006	0.678	***	0.652	***	0.600	***	0.566	***
	(0.042)		(0.063)		(0.042)		(0.063)	
FEB11006X	0.815	***	1.134	***	-0.369	***	-0.450	***
	(0.057)		(0.091)		(0.133)		(0.142)	
FEB11013	1.059	***	1.106	***	1.029	***	1.083	***
	(0.045)		(0.046)		(0.045)		(0.046)	
FEB11013X	1.091	***	1.471	***	-0.062		-0.070	
	(0.062)		(0.083)		(0.137)		(0.137)	
FEB11018	-0.418	***	-0.587	***	-0.374	***	-0.607	***
	(0.038)		(0.058)		(0.038)		(0.059)	
FEB11018X	-0.256	***	-0.044		-1.402	***	-1.647	***
	(0.057)		(0.091)		(0.133)		(0.141)	
FEB11020	-0.390	***	-0.295	***	-0.421	***	-0.354	***
	(0.047)		(0.066)		(0.046)		(0.066)	
FEB11020X	-0.072		0.388	***	-1.252	***	-1.208	***
	(0.057)		(0.093)		(0.133)		(0.143)	
FEB12001	-0.911	***	-1.083	***	-1.078	***	-1.500	***

	(0.045)		(0.063)		(0.045)		(0.065)	
FEB12001X	-0.708	***	-0.544	***	-1.941	***	-2.381	***
	(0.063)		(0.094)		(0.135)		(0.144)	
FEB12003	-0.211	***	-0.486	***	-0.327	***	-0.788	***
	(0.053)		(0.072)		(0.052)		(0.073)	
FEB12003X	0.206	***	0.283	***	-0.998	***	-1.447	***
	(0.065)		(0.098)		(0.136)		(0.145)	
FEB12004	-0.706	***	-0.722	***	-0.872	***	-1.082	***
	(0.051)		(0.052)		(0.050)		(0.054)	
FEB12004X	0.114	*	0.428	***	-1.135	***	-1.336	***
	(0.066)		(0.085)		(0.135)		(0.137)	
FEB12005	0.029		-0.145	**	-0.139	***	-0.535	***
	(0.053)		(0.072)		(0.052)		(0.072)	
FEB12005X	0.683	***	0.842	***	-0.532	***	-0.940	***
	(0.069)		(0.100)		(0.137)		(0.147)	
FEB12006	0.659	***	0.386	***	0.523	***	0.073	
	(0.052)		(0.073)		(0.052)		(0.075)	
FEB12006X	1.045	***	1.110	***	-0.200		-0.685	***
	(0.062)		(0.096)		(0.135)		(0.146)	
FEB12007	-0.717	***	-0.858	***	-0.858	***	-1.199	***
	(0.045)		(0.065)		(0.045)		(0.066)	
FEB12007X	-0.671	***	-0.448	***	-1.893	***	-2.200	***
	(0.060)		(0.092)		(0.134)		(0.142)	
FEB12010	-1.032	***	-1.032	***	-1.172	***	-1.373	***
	(0.046)		(0.048)		(0.047)		(0.052)	
FEB12012	-0.683	***	-0.660	***	-0.818	***	-0.989	***
	(0.046)		(0.067)		(0.046)		(0.068)	
FEB12012X	-0.361	***	0.008		-1.562	***	-1.732	***
	(0.064)		(0.096)		(0.136)		(0.146)	
FEB12015	0.585	***	0.642	***	0.521	***	0.569	***
	(0.044)		(0.064)		(0.043)		(0.064)	
FEB12015X	1.031	***	1.434	***	-0.161		-0.156	
	(0.062)		(0.094)		(0.133)		(0.142)	
FEB12018	0.151	***	0.216	***	0.016		-0.094	
	(0.044)		(0.066)		(0.045)		(0.067)	
FEB12018X	0.407	***	0.812	***	-0.798	***	-0.922	***
	(0.060)		(0.095)		(0.135)		(0.145)	
FEB21005	-1.136	***	-0.943	***	-2.256	***	-2.095	***
	(0.084)		(0.093)		(0.098)		(0.105)	
FEB21005X	-0.767	***	-0.285	**	-2.110	***	-1.934	***
	(0.093)		(0.118)		(0.147)		(0.153)	
FEB21007	-0.681	***	-0.596	***	-1.833	***	-1.786	***
	(0.092)		(0.102)		(0.105)		(0.113)	
FEB21007X	-0.215	**	0.104		-1.573	***	-1.563	***
	(0.106)		(0.125)		(0.153)		(0.159)	
FEB21009	-0.513	***	-0.500	***	-1.703	***	-1.751	***
	(0.080)		(0.089)		(0.095)		(0.103)	
FEB21009X	0.071		0.371	***	-1.308	***	-1.330	***
	(0.088)		(0.111)		(0.144)		(0.150)	
FEB21010	-1.546	***	-1.471	***	-2.707	***	-2.665	***
	(0.078)		(0.090)		(0.096)		(0.106)	
FEB21010X	-1.280	***	-0.929	***	-2.646	***	-2.597	***
	(0.082)		(0.106)		(0.143)		(0.150)	
FEB21011	-0.075		0.118		-1.192	***	-1.027	***
	(0.084)		(0.096)		(0.099)		(0.109)	
FEB21011X	0.169	*	0.643	***	-1.195	***	-1.024	***
	(0.098)		(0.121)		(0.151)		(0.159)	
FEB21017	-0.905	***	-0.976	***	-1.861	***	-1.975	***
	(0.077)		(0.089)		(0.091)		(0.100)	
FEB21017X	-0.439	***	-0.208	*	-1.738	***	-1.839	***
	(0.084)		(0.109)		(0.142)		(0.149)	

FEB21018	-0.810	***	-0.904	***	-1.786	***	-1.915	***
	(0.080)		(0.091)		(0.091)		(0.100)	
FEB21018X	-0.421	***	-0.207	*	-1.731	***	-1.842	***
	(0.088)		(0.110)		(0.143)		(0.149)	
FEB21019	-0.589	***	-0.490	***	-1.568	***	-1.482	***
	(0.076)		(0.076)		(0.089)		(0.088)	
FEB21019X	-0.219	***	0.160		-1.524	***	-1.447	***
	(0.085)		(0.099)		(0.142)		(0.143)	
FEB21020	-0.039		0.065		-1.030	***	-0.934	***
	(0.081)		(0.081)		(0.093)		(0.091)	
FEB21020X	0.453	***	0.848	***	-0.861	***	-0.765	***
	(0.085)		(0.099)		(0.141)		(0.141)	
FEB21021	-1.777	***	-1.904	***	-2.864	***	-3.007	***
	(0.084)		(0.096)		(0.097)		(0.107)	
FEB21021X	-1.226	***	-1.102	***	-2.560	***	-2.729	***
	(0.097)		(0.124)		(0.148)		(0.156)	
FEB21022	-0.402	***	-0.573	***	-1.483	***	-1.653	***
	(0.074)		(0.089)		(0.090)		(0.103)	
FEB21022X	-0.251	***	-0.140		-1.585	***	-1.756	***
	(0.082)		(0.109)		(0.139)		(0.147)	
FEB21023	-0.729	***	-0.512	***	-1.855	***	-1.667	***
	(0.090)		(0.101)		(0.101)		(0.111)	
FEB21023X	-0.315	***	0.209		-1.679	***	-1.459	***
	(0.106)		(0.131)		(0.159)		(0.167)	
FEB22002	-1.486	***	-1.552	***	-2.795	***	-3.126	***
	(0.080)		(0.091)		(0.101)		(0.109)	
FEB22002X	-0.800	***	-0.621	***	-2.233	***	-2.613	***
	(0.086)		(0.113)		(0.144)		(0.153)	
FEB22003	-0.060		-0.122		-1.363	***	-1.661	***
	(0.088)		(0.097)		(0.108)		(0.115)	
FEB22003X	0.249	***	0.406	***	-1.228	***	-1.557	***
	(0.088)		(0.111)		(0.146)		(0.154)	
FEB22004	-1.526	***	-1.681	***	-2.838	***	-3.184	***
	(0.081)		(0.092)		(0.102)		(0.111)	
FEB22004X	-1.442	***	-1.325	***	-2.836	***	-3.159	***
	(0.082)		(0.111)		(0.141)		(0.151)	
FEB22005	-1.145	***	-0.932	***	-2.470	***	-2.470	***
	(0.080)		(0.091)		(0.102)		(0.110)	
FEB22005X	-0.487	***	-0.032		-1.889	***	-1.889	***
	(0.080)		(0.106)		(0.140)		(0.149)	
FEB22006	-1.102	***	-1.025	***	-2.392	***	-2.522	***
	(0.073)		(0.073)		(0.097)		(0.096)	
FEB22006X	-0.369	***	-0.052		-1.740	***	-1.866	***
	(0.085)		(0.102)		(0.141)		(0.143)	
FEB22008	-1.714	***	-1.611	***	-3.026	***	-3.140	***
	(0.081)		(0.081)		(0.101)		(0.101)	
FEB22008X	-1.195	***	-0.848	***	-2.627	***	-2.786	***
	(0.085)		(0.102)		(0.143)		(0.146)	
FEB22012	0.461	***	0.313	***	-0.847	***	-1.227	***
	(0.093)		(0.103)		(0.111)		(0.119)	
FEB22012X	0.926	***	1.034	***	-0.465	***	-0.830	***
	(0.082)		(0.107)		(0.141)		(0.150)	
FEB22013	0.045		-0.096		-1.291	***	-1.646	***
	(0.077)		(0.092)		(0.100)		(0.112)	
FEB22013X	0.184	**	0.276	***	-1.275	***	-1.686	***
	(0.075)		(0.105)		(0.138)		(0.150)	
FEB22016	-1.060	***	-0.976	***	-2.325	***	-2.464	***
	(0.105)		(0.106)		(0.121)		(0.121)	
FEB22016X	-0.293	**	0.017		-1.696	***	-1.922	***
	(0.130)		(0.147)		(0.174)		(0.178)	
FEB22017	-0.959	***	-1.146	***	-2.222	***	-2.601	***

	(0.084)		(0.096)		(0.105)		(0.115)	
FEB22017X	-0.262	**	-0.191		-1.679	***	-2.062	***
	(0.112)		(0.134)		(0.163)		(0.171)	
FEB22018	-0.449	***	-0.219	**	-1.725	***	-1.706	***
	(0.080)		(0.091)		(0.099)		(0.108)	
FEB22018X	0.450	***	0.951	***	-0.978	***	-0.949	***
	(0.114)		(0.140)		(0.166)		(0.179)	
FEB23001	-0.789	***	-0.752	***	-2.098	***	-2.272	***
	(0.078)		(0.092)		(0.102)		(0.113)	
FEB23001X	-0.148	**	0.147		-1.588	***	-1.793	***
	(0.075)		(0.104)		(0.138)		(0.149)	
FEB42001	-1.166	***	-1.421	***	-1.348	***	-1.789	***
	(0.081)		(0.094)		(0.083)		(0.097)	
FEB42002	-0.882	***	-0.972	***	-1.060	***	-1.353	***
	(0.091)		(0.101)		(0.095)		(0.107)	
Male			-0.018					
			(0.036)					
Online			0.183	***			0.170	***
			(0.027)				(0.027)	
Previous Education								
BUITENL_SL			-0.390	***				
			(0.067)					
HAVO			-0.210	**				
			(0.103)					
HBO			-0.032					
			(0.181)					
MBO			-0.192					
			(0.383)					
WO			-0.022					
			(0.080)					
CD			-0.788	***				
			(0.220)					
Baccalaureate			-0.406	***				
			(0.144)					
Continent								
Africa			-0.339	**				
			(0.148)					
Asia			-0.109	*				
			(0.065)					
Oceania			-0.367					
			(0.409)					
Middle East			-0.437	***				
			(0.119)					
North America			-0.063					
			(0.133)					
South America			-0.536	***				
			(0.135)					
Study year								
2021			0.140	***			0.309	***
			(0.030)				(0.032)	
2022			0.283	***			0.606	***
			(0.035)				(0.044)	
Block								
Block2			-0.189	***			-0.236	***
			(0.049)				(0.049)	

Block3			0.097	**			0.036	
			(0.048)				(0.048)	
Block4			-0.275	***			-0.321	***
			(0.046)				(0.047)	
Block5			-0.062				-0.118	**
			(0.047)				(0.048)	
Block-RE			-0.074	**			-0.085	***
			(0.033)				(0.033)	
Intercept	6.321	***	6.335	***	7.267	***	7.191	***
	(0.045)		(0.075)		(0.076)		(0.092)	
Number of observations	90726		87432		90726		87432	
Individuals	6,572		6,364		6,572		6,364	
R^2	0.081		0.101		0.021		0.022	

Note: This table contains the complete overview of the result of two GLS-regressions and two FE-regressions with ResultNumerical as dependent variable. Column 1 and 2 show the GLS-regressions and give the average effect of the variable in the corresponding model on the dependent variable ResultNumerical. Column 3 and 4 show the FE-regressions and give the average effect of the variable in the corresponding model on the dependent variable ResultNumerical. The omitted categories are; Morning for TimeOfDay, Monday for Day, FEB11001 for Coursecode, VWO for TypePrevEdu, Europe for Continent, 2020-2021 for StudyYear and Block1 for Block. Standard errors are shown between round brackets. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

14. Appendix E

Table E.1 Results of GLS-regressions and FE-regressions for the relation between not showing up for an exam and exam timing

DumNO	GLS(3)		GLS(4)		FE(3)		FE(4)	
TimeOfDay								
Midday	0.010	***	-0.022	***	0.005		-0.023	***
	(0.003)		(0.003)		(0.003)		(0.003)	
Evening	0.026	***	-0.014	***	0.020	***	-0.019	***
	(0.004)		(0.004)		(0.004)		(0.004)	
Day								
Tuesday	-0.005		0.025	***	-0.007	**	0.020	***
	(0.004)		(0.004)		(0.004)		(0.004)	
Wednesday	0.038	***	0.031	***	0.037	***	0.028	***
	(0.005)		(0.005)		(0.005)		(0.005)	
Thursday	0.004		0.021	***	0.004		0.021	***
	(0.005)		(0.005)		(0.005)		(0.005)	
Friday	0.032	***	0.025	***	0.030	***	0.022	***
	(0.007)		(0.006)		(0.007)		(0.007)	
Saturday	0.021	***	0.044	***	0.023	***	0.034	***
	(0.006)		(0.006)		(0.007)		(0.007)	
Course								
FEB11001X	-0.043	***	-0.022		0.013		0.031	
	(0.012)		(0.017)		(0.042)		(0.040)	
FEB11002	-0.013		-0.036	***	-0.012		-0.037	***
	(0.009)		(0.014)		(0.009)		(0.013)	
FEB11002X	-0.032	***	-0.045	**	0.024		0.008	
	(0.012)		(0.020)		(0.042)		(0.041)	
FEB11003	-0.066	***	-0.086	***	-0.064	***	-0.076	***
	(0.008)		(0.012)		(0.008)		(0.012)	
FEB11003X	-0.083	***	-0.084	***	-0.026		-0.023	
	(0.012)		(0.019)		(0.042)		(0.041)	
FEB11004	-0.025	**	-0.042	***	-0.017	*	-0.036	***
	(0.010)		(0.013)		(0.010)		(0.013)	
FEB11004X	-0.053	***	-0.048	**	0.004		0.006	
	(0.013)		(0.020)		(0.043)		(0.041)	
FEB11005	-0.002		-0.016		0.008		-0.009	
	(0.009)		(0.013)		(0.009)		(0.013)	
FEB11005X	-0.028	**	-0.026		0.034		0.031	
	(0.013)		(0.020)		(0.042)		(0.041)	
FEB11006	0.015		0.124	***	0.022	**	0.137	***
	(0.010)		(0.016)		(0.010)		(0.016)	
FEB11006X	-0.003		0.121	***	0.049		0.176	***
	(0.013)		(0.022)		(0.042)		(0.042)	
FEB11013	-0.057	***	-0.045	***	-0.052	***	-0.042	***
	(0.009)		(0.009)		(0.009)		(0.009)	
FEB11013X	-0.072	***	-0.055	***	-0.014		0.001	
	(0.013)		(0.018)		(0.042)		(0.040)	
FEB11018	-0.062	***	-0.093	***	-0.060	***	-0.091	***
	(0.009)		(0.012)		(0.009)		(0.013)	
FEB11018X	-0.038	***	-0.053	***	0.020		0.004	
	(0.012)		(0.019)		(0.042)		(0.041)	
FEB11020	-0.043	***	-0.059	***	-0.036	***	-0.056	***
	(0.009)		(0.013)		(0.009)		(0.013)	
FEB11020X	-0.050	***	-0.046	**	0.008		0.005	
	(0.012)		(0.019)		(0.042)		(0.041)	
FEB12001	-0.017		-0.027	*	-0.006		-0.049	***

	(0.012)		(0.015)		(0.012)		(0.016)	
FEB12001X	-0.061	***	-0.075	***	-0.004		-0.050	
	(0.014)		(0.021)		(0.043)		(0.042)	
FEB12003	0.054	***	-0.023		0.055	***	-0.053	***
	(0.012)		(0.016)		(0.012)		(0.017)	
FEB12003X	-0.004		-0.079	***	0.048		-0.054	
	(0.013)		(0.020)		(0.042)		(0.042)	
FEB12004	-0.050	***	-0.085	***	-0.038	***	-0.103	***
	(0.010)		(0.010)		(0.011)		(0.012)	
FEB12004X	-0.064	***	-0.097	***	-0.007		-0.063	
	(0.013)		(0.017)		(0.042)		(0.040)	
FEB12005	-0.029	**	-0.056	***	-0.021	*	-0.071	***
	(0.012)		(0.015)		(0.012)		(0.016)	
FEB12005X	-0.073	***	-0.102	***	-0.017		-0.066	
	(0.014)		(0.020)		(0.043)		(0.042)	
FEB12006	-0.001		-0.041	***	0.003		-0.070	***
	(0.012)		(0.015)		(0.012)		(0.016)	
FEB12006X	-0.042	***	-0.085	***	0.012		-0.068	
	(0.013)		(0.020)		(0.043)		(0.042)	
FEB12007	0.031	***	0.080	***	0.035	***	0.055	***
	(0.012)		(0.017)		(0.012)		(0.017)	
FEB12007X	0.001		0.045	**	0.053		0.074	*
	(0.013)		(0.021)		(0.042)		(0.042)	
FEB12010	-0.016		-0.034	***	-0.008		-0.064	***
	(0.011)		(0.011)		(0.011)		(0.012)	
FEB12012	0.001		-0.052	***	0.005		-0.078	***
	(0.011)		(0.014)		(0.012)		(0.015)	
FEB12012X	-0.049	***	-0.102	***	0.000		-0.079	*
	(0.014)		(0.020)		(0.043)		(0.041)	
FEB12015	-0.024	***	-0.034	***	-0.023	***	-0.031	**
	(0.009)		(0.012)		(0.009)		(0.012)	
FEB12015X	-0.057	***	-0.050	***	-0.002		0.004	
	(0.012)		(0.019)		(0.042)		(0.041)	
FEB12018	0.019		-0.025	*	0.023	**	-0.052	***
	(0.012)		(0.015)		(0.012)		(0.015)	
FEB12018X	-0.015		-0.058	***	0.032		-0.040	
	(0.014)		(0.020)		(0.043)		(0.042)	
FEB21005	0.184	***	0.150	***	0.288	***	0.264	***
	(0.020)		(0.021)		(0.030)		(0.029)	
FEB21005X	0.083	***	0.083	***	0.143	***	0.159	***
	(0.019)		(0.024)		(0.045)		(0.044)	
FEB21007	0.302	***	0.354	***	0.407	***	0.473	***
	(0.021)		(0.022)		(0.031)		(0.030)	
FEB21007X	0.166	***	0.265	***	0.224	***	0.342	***
	(0.021)		(0.026)		(0.045)		(0.045)	
FEB21009	0.207	***	0.297	***	0.308	***	0.407	***
	(0.021)		(0.021)		(0.031)		(0.029)	
FEB21009X	0.121	***	0.252	***	0.173	***	0.321	***
	(0.021)		(0.025)		(0.045)		(0.045)	
FEB21010	0.241	***	0.325	***	0.349	***	0.444	***
	(0.021)		(0.022)		(0.031)		(0.030)	
FEB21010X	0.133	***	0.243	***	0.194	***	0.323	***
	(0.020)		(0.025)		(0.045)		(0.045)	
FEB21011	0.173	***	0.166	***	0.260	***	0.259	***
	(0.022)		(0.021)		(0.031)		(0.028)	
FEB21011X	0.096	***	0.116	***	0.140	***	0.174	***
	(0.022)		(0.025)		(0.046)		(0.044)	
FEB21017	0.085	***	0.053	***	0.170	***	0.151	***
	(0.018)		(0.019)		(0.028)		(0.026)	
FEB21017X	0.015		0.020		0.061		0.085	**
	(0.018)		(0.023)		(0.044)		(0.043)	

FEB21018	0.024		0.007		0.117	***	0.117	***
	(0.016)		(0.018)		(0.027)		(0.026)	
FEB21018X	-0.028	*	-0.015		0.025		0.061	
	(0.017)		(0.022)		(0.044)		(0.043)	
FEB21019	0.099	***	0.077	***	0.182	***	0.169	***
	(0.018)		(0.017)		(0.028)		(0.025)	
FEB21019X	0.030		0.039	*	0.072		0.096	**
	(0.020)		(0.022)		(0.045)		(0.043)	
FEB21020	0.043	***	0.021		0.143	***	0.128	***
	(0.016)		(0.015)		(0.027)		(0.024)	
FEB21020X	0.005		0.010		0.062		0.081	*
	(0.017)		(0.021)		(0.044)		(0.042)	
FEB21021	0.137	***	0.128	***	0.226	***	0.223	***
	(0.021)		(0.021)		(0.031)		(0.028)	
FEB21021X	0.101	***	0.122	***	0.148	***	0.181	***
	(0.022)		(0.025)		(0.046)		(0.045)	
FEB21022	0.064	***	0.054	***	0.165	***	0.165	***
	(0.018)		(0.020)		(0.029)		(0.027)	
FEB21022X	-0.007		0.008		0.050		0.082	*
	(0.018)		(0.023)		(0.044)		(0.043)	
FEB21023	0.176	***	0.162	***	0.264	***	0.254	***
	(0.021)		(0.022)		(0.031)		(0.028)	
FEB21023X	0.082	***	0.101	***	0.127	***	0.156	***
	(0.022)		(0.026)		(0.046)		(0.045)	
FEB22002	0.134	***	0.103	***	0.256	***	0.201	***
	(0.019)		(0.020)		(0.031)		(0.030)	
FEB22002X	0.002		-0.014		0.063		0.022	
	(0.018)		(0.023)		(0.044)		(0.043)	
FEB22003	0.109	***	0.077	***	0.231	***	0.182	***
	(0.019)		(0.020)		(0.030)		(0.029)	
FEB22003X	-0.011		-0.024		0.061		0.029	
	(0.015)		(0.020)		(0.042)		(0.041)	
FEB22004	0.094	***	0.062	***	0.218	***	0.163	***
	(0.018)		(0.020)		(0.030)		(0.029)	
FEB22004X	0.019		-0.006		0.082	*	0.041	
	(0.017)		(0.022)		(0.044)		(0.043)	
FEB22005	0.050	***	0.035	*	0.177	***	0.134	***
	(0.017)		(0.018)		(0.030)		(0.028)	
FEB22005X	-0.011		-0.022		0.052		0.024	
	(0.017)		(0.022)		(0.043)		(0.042)	
FEB22006	0.123	***	0.078	***	0.243	***	0.174	***
	(0.019)		(0.017)		(0.030)		(0.027)	
FEB22006X	0.042	**	0.008		0.104	**	0.055	
	(0.017)		(0.020)		(0.043)		(0.041)	
FEB22008	0.112	***	0.082	***	0.236	***	0.179	***
	(0.018)		(0.017)		(0.030)		(0.028)	
FEB22008X	0.033	*	0.009		0.097	**	0.047	
	(0.018)		(0.020)		(0.044)		(0.042)	
FEB22012	0.212	***	0.141	***	0.329	***	0.248	***
	(0.026)		(0.027)		(0.035)		(0.034)	
FEB22012X	0.069	***	0.012		0.127	***	0.070	
	(0.025)		(0.028)		(0.047)		(0.046)	
FEB22013	0.158	***	0.150	***	0.285	***	0.247	***
	(0.021)		(0.022)		(0.032)		(0.030)	
FEB22013X	0.037	*	0.041	*	0.101	**	0.075	*
	(0.020)		(0.024)		(0.045)		(0.044)	
FEB22016	0.171	***	0.187	***	0.286	***	0.270	***
	(0.021)		(0.020)		(0.032)		(0.029)	
FEB22016X	0.049	**	0.071	***	0.107	**	0.095	**
	(0.023)		(0.025)		(0.046)		(0.044)	
FEB22017	0.130	***	0.093	***	0.253	***	0.192	***

	(0.019)		(0.021)		(0.031)		(0.030)	
FEB22017X	0.124	***	0.101	***	0.188	***	0.146	***
	(0.030)		(0.033)		(0.051)		(0.050)	
FEB22018	0.137	***	0.093	***	0.260	***	0.188	***
	(0.019)		(0.020)		(0.031)		(0.029)	
FEB22018X	0.065	***	0.034		0.127	***	0.075	
	(0.024)		(0.029)		(0.047)		(0.046)	
FEB23001	0.173	***	0.249	***	0.297	***	0.351	***
	(0.020)		(0.021)		(0.031)		(0.031)	
FEB23001X	0.069	***	0.157	***	0.136	***	0.201	***
	(0.020)		(0.025)		(0.045)		(0.045)	
FEB42001	0.109	***	0.078	***	0.116	***	0.049	**
	(0.021)		(0.023)		(0.021)		(0.023)	
FEB42002	0.085	***	0.142	***	0.089	***	0.118	***
	(0.021)		(0.024)		(0.021)		(0.025)	
Male			0.005					
			(0.005)					
Online			-0.027	***			-0.033	***
			(0.006)				(0.006)	
Previous Education								
BUITENL_SL			-0.018					
			(0.013)					
HAVO			0.073	***				
			(0.022)					
HBO			0.054					
			(0.037)					
MBO			0.044					
			(0.099)					
WO			0.066	***				
			(0.015)					
CD			0.017					
			(0.038)					
Baccalaureate			0.009					
			(0.019)					
Continent								
Africa			0.032					
			(0.021)					
Asia			0.009					
			(0.009)					
Oceania			0.017					
			(0.031)					
Middle East			0.006					
			(0.014)					
North America			0.028					
			(0.019)					
South America			0.027					
			(0.017)					
Study year								
2021			-0.128	***			-0.092	***
			(0.007)				(0.009)	
2022			0.031	***			0.093	***
			(0.009)				(0.013)	
Block								
Block2			-0.018	*			-0.012	
			(0.010)				(0.010)	

Block3			-0.008			-0.001	
			(0.011)			(0.011)	
Block4			-0.018	*		-0.011	
			(0.009)			(0.009)	
Block5			-0.145	***		-0.146	***
			(0.013)			(0.014)	
Block-RE			0.070	***		0.068	***
			(0.007)			(0.008)	
Intercept	0.100	***	0.156	***	0.031	0.071	***
	(0.010)		(0.016)		(0.023)	(0.025)	
Number of observations	101,695		87,432		101,695	87,432	
Individuals	6,872		6,657		6,872	6,657	
R^2	0.036		0.097		0.025	0.058	

Note: This table contains the complete overview of the result of two GLS-regressions and two FE-regressions with DumNO as dependent variable. Column 1 and 2 show the GLS-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumNO. Column 3 and 4 show the FE-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumNO. The omitted categories are; Morning for TimeOfDay, Monday for Day, FEB11001 for Coursecode, VWO for TypePrevEdu, Europe for Continent, 2020-2021 for StudyYear and Block1 for Block. Standard errors are shown between round brackets. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

15. Appendix F

Table F.1 Results of GLS-regressions and FE-regressions for the relation between passing an exam and the timing of exams

DumPass	GLS(5)		GLS(6)		FE(5)		FE(6)	
TimeOfDay								
Midday	0.032	***	0.049	***	0.037	***	0.051	***
	(0.005)		(0.005)		(0.005)		(0.005)	
Evening	0.001		0.025	***	0.013	**	0.033	***
	(0.006)		(0.006)		(0.006)		(0.006)	
Day								
Tuesday	0.010	*	-0.005		0.011	*	-0.002	
	(0.006)		(0.006)		(0.006)		(0.006)	
Wednesday	-0.023	***	-0.006		-0.016	**	0.001	
	(0.007)		(0.007)		(0.007)		(0.007)	
Thursday	-0.012		-0.012	*	-0.008		-0.011	
	(0.007)		(0.007)		(0.007)		(0.007)	
Friday	-0.021	**	-0.009		-0.016	*	-0.005	
	(0.009)		(0.009)		(0.009)		(0.009)	
Saturday	-0.038	***	-0.044	***	-0.034	***	-0.036	***
	(0.009)		(0.009)		(0.009)		(0.009)	
Course								
FEB11001X	0.058	***	0.125	***	-0.118	***	-0.134	***
	(0.016)		(0.019)		(0.038)		(0.038)	
FEB11002	0.015		-0.028		-0.003		-0.043	**
	(0.014)		(0.019)		(0.014)		(0.019)	
FEB11002X	-0.034	**	-0.005		-0.217	***	-0.270	***
	(0.017)		(0.024)		(0.039)		(0.041)	
FEB11003	-0.072	***	-0.108	***	-0.070	***	-0.123	***
	(0.013)		(0.019)		(0.013)		(0.019)	
FEB11003X	0.021		0.057	**	-0.156	***	-0.221	***
	(0.016)		(0.024)		(0.039)		(0.041)	
FEB11004	-0.004		-0.012		-0.034	**	-0.044	**
	(0.015)		(0.019)		(0.015)		(0.019)	
FEB11004X	0.096	***	0.153	***	-0.090	**	-0.117	***
	(0.017)		(0.023)		(0.039)		(0.041)	
FEB11005	0.050	***	0.011		0.029	**	-0.009	
	(0.013)		(0.019)		(0.013)		(0.019)	
FEB11005X	0.083	***	0.111	***	-0.100	**	-0.153	***
	(0.016)		(0.024)		(0.039)		(0.041)	
FEB11006	0.172	***	0.055	***	0.145	***	0.014	
	(0.013)		(0.020)		(0.013)		(0.020)	
FEB11006X	0.182	***	0.128	***	-0.000		-0.151	***
	(0.016)		(0.024)		(0.038)		(0.041)	
FEB11013	0.226	***	0.219	***	0.217	***	0.215	***
	(0.013)		(0.013)		(0.013)		(0.014)	
FEB11013X	0.239	***	0.309	***	0.063		0.051	
	(0.016)		(0.019)		(0.039)		(0.038)	
FEB11018	-0.068	***	-0.089	***	-0.060	***	-0.096	***
	(0.013)		(0.019)		(0.014)		(0.019)	
FEB11018X	-0.046	***	0.002		-0.223	***	-0.276	***
	(0.016)		(0.024)		(0.038)		(0.041)	
FEB11020	0.026	*	0.023		0.000		-0.003	
	(0.014)		(0.019)		(0.014)		(0.020)	
FEB11020X	0.118	***	0.177	***	-0.071	*	-0.094	**
	(0.016)		(0.023)		(0.038)		(0.040)	
FEB12001	-0.137	***	-0.171	***	-0.203	***	-0.262	***

	(0.016)		(0.020)		(0.016)		(0.021)	
FEB12001X	-0.063	***	-0.033		-0.268	***	-0.343	***
	(0.019)		(0.025)		(0.039)		(0.042)	
FEB12003	-0.086	***	-0.088	***	-0.126	***	-0.138	***
	(0.014)		(0.020)		(0.014)		(0.020)	
FEB12003X	0.036	**	0.101	***	-0.157	***	-0.182	***
	(0.016)		(0.023)		(0.039)		(0.041)	
FEB12004	-0.136	***	-0.112	***	-0.196	***	-0.187	***
	(0.015)		(0.016)		(0.016)		(0.017)	
FEB12004X	0.049	***	0.140	***	-0.160	***	-0.161	***
	(0.017)		(0.020)		(0.038)		(0.039)	
FEB12005	0.034	**	0.009		-0.027	*	-0.080	***
	(0.015)		(0.020)		(0.015)		(0.021)	
FEB12005X	0.162	***	0.206	***	-0.038		-0.102	**
	(0.017)		(0.025)		(0.039)		(0.041)	
FEB12006	0.122	***	0.097	***	0.074	***	0.040	*
	(0.015)		(0.020)		(0.015)		(0.021)	
FEB12006X	0.194	***	0.240	***	-0.009		-0.048	
	(0.016)		(0.023)		(0.039)		(0.041)	
FEB12007	-0.147	***	-0.250	***	-0.197	***	-0.320	***
	(0.016)		(0.021)		(0.016)		(0.022)	
FEB12007X	-0.121	***	-0.146	***	-0.320	***	-0.442	***
	(0.017)		(0.024)		(0.039)		(0.041)	
FEB12010	-0.162	***	-0.146	***	-0.217	***	-0.210	***
	(0.015)		(0.015)		(0.015)		(0.016)	
FEB12012	-0.109	***	-0.098	***	-0.158	***	-0.158	***
	(0.015)		(0.020)		(0.015)		(0.021)	
FEB12012X	-0.018		0.062	**	-0.210	***	-0.220	***
	(0.018)		(0.025)		(0.039)		(0.041)	
FEB12015	0.115	***	0.094	***	0.091	***	0.070	***
	(0.013)		(0.018)		(0.013)		(0.018)	
FEB12015X	0.203	***	0.245	***	0.011		-0.029	
	(0.015)		(0.022)		(0.038)		(0.040)	
FEB12018	0.088	***	0.094	***	0.042	***	0.043	**
	(0.015)		(0.020)		(0.014)		(0.020)	
FEB12018X	0.147	***	0.219	***	-0.044		-0.057	
	(0.016)		(0.023)		(0.038)		(0.041)	
FEB21005	-0.247	***	-0.219	***	-0.507	***	-0.506	***
	(0.021)		(0.024)		(0.026)		(0.029)	
FEB21005X	-0.135	***	-0.067	**	-0.370	***	-0.385	***
	(0.024)		(0.028)		(0.041)		(0.043)	
FEB21007	-0.285	***	-0.336	***	-0.555	***	-0.648	***
	(0.020)		(0.023)		(0.026)		(0.028)	
FEB21007X	-0.197	***	-0.233	***	-0.433	***	-0.566	***
	(0.023)		(0.027)		(0.041)		(0.043)	
FEB21009	-0.162	***	-0.259	***	-0.433	***	-0.569	***
	(0.020)		(0.022)		(0.025)		(0.028)	
FEB21009X	-0.077	***	-0.142	***	-0.314	***	-0.472	***
	(0.022)		(0.026)		(0.041)		(0.043)	
FEB21010	-0.325	***	-0.405	***	-0.603	***	-0.721	***
	(0.022)		(0.025)		(0.027)		(0.030)	
FEB21010X	-0.225	***	-0.262	***	-0.470	***	-0.603	***
	(0.024)		(0.028)		(0.043)		(0.045)	
FEB21011	-0.113	***	-0.113	***	-0.355	***	-0.376	***
	(0.021)		(0.024)		(0.026)		(0.028)	
FEB21011X	-0.043	*	0.001		-0.266	***	-0.302	***
	(0.024)		(0.028)		(0.042)		(0.044)	
FEB21017	-0.147	***	-0.158	***	-0.364	***	-0.409	***
	(0.021)		(0.024)		(0.025)		(0.028)	
FEB21017X	-0.031		-0.003		-0.245	***	-0.311	***
	(0.023)		(0.028)		(0.042)		(0.043)	

FEB21018	-0.104	***	-0.126	***	-0.333	***	-0.392	***
	(0.020)		(0.024)		(0.025)		(0.028)	
FEB21018X	-0.027		-0.001		-0.254	***	-0.326	***
	(0.023)		(0.028)		(0.042)		(0.044)	
FEB21019	-0.121	***	-0.089	***	-0.338	***	-0.329	***
	(0.020)		(0.020)		(0.025)		(0.025)	
FEB21019X	-0.029		0.039		-0.238	***	-0.254	***
	(0.024)		(0.025)		(0.042)		(0.041)	
FEB21020	0.023		0.057	***	-0.215	***	-0.202	***
	(0.019)		(0.019)		(0.024)		(0.024)	
FEB21020X	0.090	***	0.165	***	-0.136	***	-0.142	***
	(0.021)		(0.023)		(0.041)		(0.040)	
FEB21021	-0.324	***	-0.345	***	-0.567	***	-0.610	***
	(0.021)		(0.023)		(0.025)		(0.028)	
FEB21021X	-0.224	***	-0.212	***	-0.443	***	-0.511	***
	(0.024)		(0.028)		(0.042)		(0.043)	
FEB21022	-0.040	*	-0.074	***	-0.300	***	-0.355	***
	(0.022)		(0.026)		(0.027)		(0.030)	
FEB21022X	0.014		0.023		-0.220	***	-0.291	***
	(0.024)		(0.029)		(0.042)		(0.044)	
FEB21023	-0.187	***	-0.181	***	-0.433	***	-0.445	***
	(0.021)		(0.024)		(0.025)		(0.028)	
FEB21023X	-0.087	***	-0.041		-0.313	***	-0.342	***
	(0.024)		(0.028)		(0.042)		(0.044)	
FEB22002	-0.243	***	-0.242	***	-0.572	***	-0.624	***
	(0.022)		(0.025)		(0.028)		(0.031)	
FEB22002X	-0.064	***	-0.031		-0.324	***	-0.389	***
	(0.023)		(0.028)		(0.042)		(0.044)	
FEB22003	-0.027		-0.025		-0.352	***	-0.403	***
	(0.020)		(0.024)		(0.027)		(0.030)	
FEB22003X	0.077	***	0.109	***	-0.201	***	-0.264	***
	(0.021)		(0.026)		(0.040)		(0.042)	
FEB22004	-0.165	***	-0.179	***	-0.496	***	-0.543	***
	(0.022)		(0.025)		(0.028)		(0.031)	
FEB22004X	-0.157	***	-0.125	***	-0.411	***	-0.461	***
	(0.023)		(0.028)		(0.041)		(0.043)	
FEB22005	-0.118	***	-0.094	***	-0.456	***	-0.466	***
	(0.021)		(0.024)		(0.028)		(0.031)	
FEB22005X	-0.006		0.060	**	-0.263	***	-0.280	***
	(0.021)		(0.026)		(0.041)		(0.043)	
FEB22006	-0.160	***	-0.108	***	-0.481	***	-0.469	***
	(0.022)		(0.021)		(0.028)		(0.028)	
FEB22006X	-0.033		0.055	**	-0.280	***	-0.277	***
	(0.023)		(0.025)		(0.042)		(0.041)	
FEB22008	-0.250	***	-0.206	***	-0.579	***	-0.572	***
	(0.021)		(0.021)		(0.028)		(0.028)	
FEB22008X	-0.159	***	-0.076	***	-0.419	***	-0.420	***
	(0.023)		(0.025)		(0.042)		(0.042)	
FEB22012	-0.060	**	-0.049		-0.384	***	-0.430	***
	(0.027)		(0.031)		(0.033)		(0.036)	
FEB22012X	0.067	***	0.116	***	-0.183	***	-0.240	***
	(0.025)		(0.030)		(0.042)		(0.045)	
FEB22013	-0.023		-0.046	*	-0.359	***	-0.413	***
	(0.021)		(0.024)		(0.028)		(0.031)	
FEB22013X	0.074	***	0.085	***	-0.191	***	-0.258	***
	(0.022)		(0.027)		(0.041)		(0.043)	
FEB22016	-0.238	***	-0.227	***	-0.560	***	-0.581	***
	(0.021)		(0.021)		(0.028)		(0.028)	
FEB22016X	-0.070	***	-0.023		-0.325	***	-0.359	***
	(0.025)		(0.027)		(0.043)		(0.043)	
FEB22017	-0.160	***	-0.171	***	-0.483	***	-0.527	***

	(0.023)		(0.026)		(0.029)		(0.032)	
FEB22017X	-0.086	***	-0.059		-0.348	***	-0.399	***
	(0.033)		(0.037)		(0.048)		(0.050)	
FEB22018	-0.071	***	-0.026		-0.394	***	-0.382	***
	(0.022)		(0.025)		(0.028)		(0.031)	
FEB22018X	0.048		0.135	***	-0.214	***	-0.211	***
	(0.030)		(0.034)		(0.047)		(0.049)	
FEB23001	-0.140	***	-0.218	***	-0.469	***	-0.594	***
	(0.021)		(0.024)		(0.028)		(0.031)	
FEB23001X	-0.008		-0.045	*	-0.273	***	-0.403	***
	(0.022)		(0.027)		(0.041)		(0.043)	
FEB42001	-0.218	***	-0.252	***	-0.281	***	-0.323	***
	(0.025)		(0.029)		(0.026)		(0.030)	
FEB42002	-0.136	***	-0.222	***	-0.197	***	-0.309	***
	(0.026)		(0.029)		(0.027)		(0.031)	
Male			-0.006					
			(0.008)					
Online			0.056	***			0.055	***
			(0.008)				(0.008)	
Previous Education								
BUITENL_SL			-0.069	***				
			(0.013)					
HAVO			-0.085	***				
			(0.024)					
HBO			-0.039					
			(0.046)					
MBO			-0.020					
			(0.119)					
WO			-0.051	***				
			(0.018)					
CD			-0.168	***				
			(0.048)					
Baccalaureate			-0.092	***				
			(0.029)					
Continent								
Africa			-0.061	*				
			(0.032)					
Asia			-0.033	**				
			(0.014)					
Oceania			-0.068					
			(0.071)					
Middle East			-0.081	***				
			(0.026)					
North America			-0.027					
			(0.028)					
South America			-0.100	***				
			(0.027)					
Study year								
2021			0.093	***			0.092	***
			(0.008)				(0.010)	
2022			0.032	***			0.040	***
			(0.009)				(0.013)	
Block								
Block2			-0.039	***			-0.058	***
			(0.015)				(0.015)	

Block3			0.017				-0.006	
			(0.015)				(0.015)	
Block4			-0.014				-0.038	***
			(0.015)				(0.015)	
Block5			0.120	***			0.111	***
			(0.017)				(0.017)	
Block-RE			-0.068	***			-0.067	***
			(0.011)				(0.011)	
Intercept	0.631	***	0.609	***	0.810	***	0.801	***
	(0.013)		(0.022)		(0.021)		(0.027)	
Number of observations	101,695		88,160		101,695		98,160	
Individuals	6,872		6,657		6,872		6,657	
R^2	0.048		0.073		0.018		0.024	

Note: This table contains the complete overview of the result of two GLS-regressions and two FE-regressions with DumPass as dependent variable. Column 1 and 2 show the GLS-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumPass. Column 3 and 4 show the FE-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumPass. The omitted categories are; Morning for TimeOfDay, Monday for Day, FEB11001 for Coursecode, VWO for TypePrevEdu, Europe for Continent, 2020-2021 for StudyYear and Block1 for Block. Standard errors are shown between round brackets. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

16. Appendix G

Table G.1 Results of GLS-regressions and FE-regressions for the relation between passing an exam based on numerical grades and the timing of exams

DumPassMark	GLS(7)		GLS(8)		FE(7)		FE(8)	
TimeOfDay								
Midday	0.049	***	0.043	***	0.049	***	0.045	***
	(0.005)		(0.005)		(0.005)		(0.005)	
Evening	0.022	***	0.015	**	0.034	***	0.022	***
	(0.006)		(0.006)		(0.006)		(0.006)	
Day								
Tuesday	0.010	*	0.016	***	0.006		0.012	**
	(0.006)		(0.006)		(0.006)		(0.006)	
Wednesday	0.007		0.021	***	0.012	*	0.022	***
	(0.007)		(0.007)		(0.007)		(0.007)	
Thursday	-0.004		0.004		0.001		0.005	
	(0.007)		(0.008)		(0.008)		(0.008)	
Friday	-0.003		0.004		-0.000		0.004	
	(0.009)		(0.009)		(0.009)		(0.009)	
Saturday	-0.028	***	-0.014		-0.020	**	-0.015	
	(0.009)		(0.009)		(0.009)		(0.009)	
Course								
FEB11001X	0.032	**	0.136	***	-0.248	***	-0.252	***
	(0.016)		(0.018)		(0.034)		(0.035)	
FEB11002	0.006		-0.067	***	-0.014		-0.088	***
	(0.014)		(0.021)		(0.014)		(0.021)	
FEB11002X	-0.058	***	-0.029		-0.348	***	-0.424	***
	(0.017)		(0.024)		(0.035)		(0.039)	
FEB11003	-0.122	***	-0.184	***	-0.111	***	-0.186	***
	(0.013)		(0.020)		(0.013)		(0.020)	
FEB11003X	-0.032	**	0.017		-0.312	***	-0.386	***
	(0.016)		(0.024)		(0.035)		(0.039)	
FEB11004	-0.014		-0.019		-0.044	***	-0.054	***
	(0.015)		(0.021)		(0.015)		(0.021)	
FEB11004X	0.075	***	0.172	***	-0.219	***	-0.229	***
	(0.017)		(0.024)		(0.035)		(0.039)	
FEB11005	0.051	***	-0.014		0.032	**	-0.035	*
	(0.013)		(0.020)		(0.013)		(0.020)	
FEB11005X	0.064	***	0.100	***	-0.219	***	-0.291	***
	(0.016)		(0.024)		(0.034)		(0.039)	
FEB11006	0.204	***	0.187	***	0.173	***	0.154	***
	(0.013)		(0.020)		(0.012)		(0.020)	
FEB11006X	0.199	***	0.275	***	-0.099	***	-0.130	***
	(0.014)		(0.022)		(0.034)		(0.038)	
FEB11013	0.200	***	0.205	***	0.188	***	0.197	***
	(0.014)		(0.014)		(0.014)		(0.014)	
FEB11013X	0.208	***	0.312	***	-0.073	**	-0.073	**
	(0.015)		(0.018)		(0.034)		(0.035)	
FEB11018	-0.114	***	-0.164	***	-0.096	***	-0.170	***
	(0.014)		(0.020)		(0.014)		(0.020)	
FEB11018X	-0.074	***	-0.022		-0.352	***	-0.431	***
	(0.016)		(0.023)		(0.034)		(0.038)	
FEB11020	0.008		0.009		-0.008		-0.014	
	(0.014)		(0.021)		(0.014)		(0.021)	
FEB11020X	0.092	***	0.191	***	-0.202	***	-0.214	***
	(0.015)		(0.023)		(0.034)		(0.039)	
FEB12001	-0.166	***	-0.203	***	-0.239	***	-0.360	***

	(0.016)		(0.021)		(0.016)		(0.022)	
FEB12001X	-0.108	***	-0.063	**	-0.429	***	-0.564	***
	(0.019)		(0.025)		(0.035)		(0.040)	
FEB12003	-0.056	***	-0.117	***	-0.107	***	-0.230	***
	(0.015)		(0.021)		(0.014)		(0.021)	
FEB12003X	0.043	***	0.069	***	-0.265	***	-0.391	***
	(0.016)		(0.023)		(0.034)		(0.039)	
FEB12004	-0.174	***	-0.166	***	-0.244	***	-0.299	***
	(0.015)		(0.016)		(0.015)		(0.016)	
FEB12004X	0.015		0.111	***	-0.311	***	-0.362	***
	(0.017)		(0.019)		(0.034)		(0.036)	
FEB12005	0.022		-0.021		-0.052	***	-0.169	***
	(0.015)		(0.021)		(0.015)		(0.021)	
FEB12005X	0.128	***	0.173	***	-0.189	***	-0.310	***
	(0.017)		(0.024)		(0.034)		(0.039)	
FEB12006	0.139	***	0.077	***	0.079	***	-0.041	*
	(0.014)		(0.021)		(0.014)		(0.021)	
FEB12006X	0.185	***	0.213	***	-0.136	***	-0.264	***
	(0.015)		(0.023)		(0.034)		(0.039)	
FEB12007	-0.149	***	-0.189	***	-0.212	***	-0.314	***
	(0.016)		(0.022)		(0.016)		(0.023)	
FEB12007X	-0.132	***	-0.077	***	-0.448	***	-0.543	***
	(0.017)		(0.024)		(0.034)		(0.039)	
FEB12010	-0.192	***	-0.177	***	-0.254	***	-0.306	***
	(0.015)		(0.016)		(0.015)		(0.017)	
FEB12012	-0.120	***	-0.123	***	-0.181	***	-0.245	***
	(0.016)		(0.021)		(0.015)		(0.022)	
FEB12012X	-0.047	***	0.039		-0.358	***	-0.426	***
	(0.018)		(0.025)		(0.035)		(0.040)	
FEB12015	0.116	***	0.102	***	0.089	***	0.077	***
	(0.013)		(0.019)		(0.013)		(0.019)	
FEB12015X	0.173	***	0.256	***	-0.127	***	-0.148	***
	(0.014)		(0.022)		(0.034)		(0.038)	
FEB12018	0.112	***	0.115	***	0.052	***	-0.001	
	(0.014)		(0.020)		(0.013)		(0.020)	
FEB12018X	0.154	***	0.243	***	-0.158	***	-0.219	***
	(0.015)		(0.023)		(0.034)		(0.039)	
FEB21005	-0.170	***	-0.148	***	-0.516	***	-0.497	***
	(0.022)		(0.026)		(0.027)		(0.030)	
FEB21005X	-0.091	***	0.014		-0.447	***	-0.420	***
	(0.023)		(0.029)		(0.037)		(0.041)	
FEB21007	-0.112	***	-0.103	***	-0.471	***	-0.468	***
	(0.022)		(0.026)		(0.028)		(0.031)	
FEB21007X	-0.092	***	-0.020		-0.455	***	-0.462	***
	(0.024)		(0.028)		(0.037)		(0.041)	
FEB21009	-0.028		-0.038	*	-0.404	***	-0.425	***
	(0.018)		(0.023)		(0.025)		(0.028)	
FEB21009X	0.024		0.093	***	-0.348	***	-0.360	***
	(0.019)		(0.025)		(0.035)		(0.039)	
FEB21010	-0.228	***	-0.223	***	-0.594	***	-0.592	***
	(0.025)		(0.029)		(0.029)		(0.033)	
FEB21010X	-0.150	***	-0.068	**	-0.518	***	-0.513	***
	(0.025)		(0.030)		(0.039)		(0.043)	
FEB21011	0.004		0.023		-0.343	***	-0.323	***
	(0.020)		(0.025)		(0.026)		(0.029)	
FEB21011X	0.039	*	0.136	***	-0.327	***	-0.303	***
	(0.022)		(0.027)		(0.037)		(0.041)	
FEB21017	-0.104	***	-0.145	***	-0.389	***	-0.438	***
	(0.021)		(0.026)		(0.026)		(0.029)	
FEB21017X	-0.018		0.025		-0.357	***	-0.402	***
	(0.023)		(0.028)		(0.037)		(0.041)	

FEB21018	-0.096	***	-0.142	***	-0.386	***	-0.436	***
	(0.020)		(0.025)		(0.025)		(0.028)	
FEB21018X	-0.035		0.009		-0.378	***	-0.420	***
	(0.022)		(0.027)		(0.036)		(0.040)	
FEB21019	-0.057	***	-0.037	*	-0.350	***	-0.326	***
	(0.021)		(0.021)		(0.025)		(0.025)	
FEB21019X	0.009		0.104	***	-0.330	***	-0.311	***
	(0.022)		(0.023)		(0.036)		(0.038)	
FEB21020	0.052	***	0.068	***	-0.245	***	-0.222	***
	(0.019)		(0.019)		(0.024)		(0.024)	
FEB21020X	0.103	***	0.200	***	-0.243	***	-0.221	***
	(0.019)		(0.020)		(0.035)		(0.036)	
FEB21021	-0.293	***	-0.334	***	-0.628	***	-0.667	***
	(0.022)		(0.027)		(0.027)		(0.030)	
FEB21021X	-0.186	***	-0.157	***	-0.540	***	-0.585	***
	(0.026)		(0.031)		(0.039)		(0.042)	
FEB21022	-0.005		-0.064	**	-0.338	***	-0.388	***
	(0.021)		(0.026)		(0.027)		(0.031)	
FEB21022X	0.014		0.033		-0.340	***	-0.390	***
	(0.023)		(0.028)		(0.037)		(0.041)	
FEB21023	-0.098	***	-0.076	***	-0.449	***	-0.427	***
	(0.021)		(0.026)		(0.026)		(0.030)	
FEB21023X	-0.030		0.073	***	-0.397	***	-0.369	***
	(0.022)		(0.028)		(0.037)		(0.041)	
FEB22002	-0.178	***	-0.195	***	-0.596	***	-0.695	***
	(0.022)		(0.026)		(0.028)		(0.031)	
FEB22002X	-0.059	***	-0.017		-0.448	***	-0.563	***
	(0.022)		(0.028)		(0.037)		(0.041)	
FEB22003	0.050	***	0.032		-0.361	***	-0.452	***
	(0.018)		(0.023)		(0.026)		(0.029)	
FEB22003X	0.086	***	0.125	***	-0.314	***	-0.413	***
	(0.019)		(0.025)		(0.035)		(0.039)	
FEB22004	-0.122	***	-0.162	***	-0.539	***	-0.633	***
	(0.021)		(0.026)		(0.028)		(0.031)	
FEB22004X	-0.153	***	-0.125	***	-0.532	***	-0.624	***
	(0.023)		(0.029)		(0.037)		(0.042)	
FEB22005	-0.102	***	-0.060	**	-0.523	***	-0.541	***
	(0.020)		(0.025)		(0.027)		(0.031)	
FEB22005X	-0.010		0.092	***	-0.392	***	-0.413	***
	(0.020)		(0.026)		(0.036)		(0.040)	
FEB22006	-0.093	***	-0.063	***	-0.500	***	-0.533	***
	(0.020)		(0.020)		(0.027)		(0.027)	
FEB22006X	0.003		0.091	***	-0.366	***	-0.402	***
	(0.022)		(0.023)		(0.037)		(0.038)	
FEB22008	-0.207	***	-0.171	***	-0.625	***	-0.653	***
	(0.021)		(0.021)		(0.028)		(0.027)	
FEB22008X	-0.147	***	-0.050	**	-0.535	***	-0.578	***
	(0.022)		(0.024)		(0.037)		(0.038)	
FEB22012	0.120	***	0.078	***	-0.304	***	-0.417	***
	(0.021)		(0.025)		(0.028)		(0.031)	
FEB22012X	0.145	***	0.166	***	-0.237	***	-0.350	***
	(0.017)		(0.024)		(0.034)		(0.038)	
FEB22013	0.100	***	0.068	***	-0.323	***	-0.417	***
	(0.016)		(0.022)		(0.025)		(0.029)	
FEB22013X	0.128	***	0.154	***	-0.268	***	-0.379	***
	(0.016)		(0.023)		(0.034)		(0.039)	
FEB22016	-0.143	***	-0.109	***	-0.546	***	-0.579	***
	(0.024)		(0.024)		(0.030)		(0.030)	
FEB22016X	-0.021		0.073	***	-0.404	***	-0.461	***
	(0.024)		(0.027)		(0.039)		(0.040)	
FEB22017	-0.081	***	-0.125	***	-0.483	***	-0.582	***

	(0.023)		(0.027)		(0.029)		(0.032)	
FEB22017X	0.026		0.052		-0.359	***	-0.458	***
	(0.030)		(0.034)		(0.042)		(0.045)	
FEB22018	0.015		0.060	**	-0.390	***	-0.406	***
	(0.020)		(0.025)		(0.027)		(0.030)	
FEB22018X	0.104	***	0.216	***	-0.286	***	-0.304	***
	(0.025)		(0.030)		(0.040)		(0.044)	
FEB23001	-0.024		-0.016		-0.439	***	-0.491	***
	(0.020)		(0.026)		(0.027)		(0.031)	
FEB23001X	0.059	***	0.134	***	-0.332	***	-0.393	***
	(0.020)		(0.026)		(0.035)		(0.040)	
FEB42001	-0.180	***	-0.237	***	-0.261	***	-0.379	***
	(0.028)		(0.032)		(0.028)		(0.033)	
FEB42002	-0.077	***	-0.095	***	-0.155	***	-0.239	***
	(0.029)		(0.033)		(0.030)		(0.034)	
Male			-0.005					
			(0.007)					
Online			0.053	***			0.045	***
			(0.008)				(0.008)	
Previous Education								
BUITENL_SL			-0.101	***				
			(0.012)					
HAVO			-0.046	**				
			(0.023)					
HBO			0.003					
			(0.041)					
MBO			-0.029					
			(0.104)					
WO			-0.017					
			(0.016)					
CD			-0.195	***				
			(0.050)					
Baccalaureate			-0.105	***				
			(0.027)					
Continent								
Africa			-0.059	*				
			(0.030)					
Asia			-0.033	**				
			(0.013)					
Oceania			-0.076					
			(0.071)					
Middle East			-0.090	***				
			(0.025)					
North America			-0.011					
			(0.026)					
South America			-0.098	***				
			(0.026)					
Study year								
2021			0.012				0.065	***
			(0.009)				(0.009)	
2022			0.051	***			0.155	***
			(0.009)				(0.012)	
Block								
Block2			-0.061	***			-0.079	***
			(0.016)				(0.016)	

Block3			0.020				-0.003	
			(0.016)				(0.016)	
Block4			-0.054	***			-0.075	***
			(0.016)				(0.016)	
Block5			-0.012				-0.036	**
			(0.017)				(0.017)	
Block-RE			-0.028	**			-0.027	**
			(0.012)				(0.012)	
Intercept	0.687	***	0.706	***	0.930	***	0.931	***
	(0.013)		(0.022)		(0.020)		(0.027)	
Number of observations	90,726		87,432		90,726		87,432	
Individuals	6,572		6,364		6,572		6,364	
R^2	0.056		0.070		0.007		0.008	

Note: This table contains the complete overview of the result of two GLS-regressions and two FE-regressions with DumPassMark as dependent variable. Column 1 and 2 show the GLS-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumPassMark. Column 3 and 4 show the FE-regressions and give the average effect of the variable in the corresponding model on the dependent variable DumPassMark. The omitted categories are; Morning for TimeOfDay, Monday for Day, FEB11001 for Coursecode, VWO for TypePrevEdu, Europe for Continent, 2020-2021 for StudyYear and Block1 for Block. Standard errors are shown between round brackets. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.

17. Appendix H

Table H.1 Results of GLS-regressions and FE-regressions for the relation between passing an exam based on numerical grades and the timing of exams, including an interaction effect

ResultNumerical	GLS(9)		GLS(10)		FE(9)		FE(10)	
TimeOfDay								
Midday	0.181	***	0.167	***	0.180	***	0.169	***
	(0.021)		(0.022)		(0.021)		(0.022)	
Evening	0.146	***	0.105	***	0.178	***	0.127	***
	(0.026)		(0.027)		(0.026)		(0.027)	
Male	-0.009		-0.029					
	(0.038)		(0.038)					
TimeOfDay # Male								
Midday # Male	0.052	**	0.052	**	0.051	**	0.052	**
	(0.021)		(0.022)		(0.021)		(0.022)	
Evening # Male	-0.042		-0.036		-0.040		-0.033	
	(0.027)		(0.027)		(0.027)		(0.027)	
Day								
Tuesday	0.030	*	0.049	***	0.022		0.039	**
	(0.018)		(0.018)		(0.018)		(0.018)	
Wednesday	0.040	*	0.081	***	0.046	**	0.078	***
	(0.022)		(0.022)		(0.022)		(0.022)	
Thursday	0.012		0.013		0.016		0.012	
	(0.022)		(0.023)		(0.022)		(0.023)	
Friday	-0.032		-0.009		-0.028		-0.014	
	(0.027)		(0.028)		(0.028)		(0.028)	
Saturday	-0.112	***	-0.073	**	-0.103	***	-0.086	***
	(0.031)		(0.032)		(0.031)		(0.032)	
Course								
FEB11001X	0.059		0.437	***	-1.090	***	-1.109	***
	(0.060)		(0.080)		(0.134)		(0.134)	
FEB11002	-0.120	***	-0.372	***	-0.170	***	-0.428	***
	(0.039)		(0.063)		(0.038)		(0.063)	
FEB11002X	-0.254	***	-0.127		-1.419	***	-1.682	***
	(0.059)		(0.093)		(0.134)		(0.142)	
FEB11003	-0.569	***	-0.761	***	-0.535	***	-0.763	***
	(0.042)		(0.061)		(0.041)		(0.061)	
FEB11003X	-0.097		0.125		-1.245	***	-1.464	***
	(0.063)		(0.096)		(0.136)		(0.145)	
FEB11004	-0.170	***	-0.104		-0.246	***	-0.201	***
	(0.046)		(0.064)		(0.045)		(0.064)	
FEB11004X	0.157	**	0.601	***	-1.019	***	-0.976	***
	(0.067)		(0.096)		(0.137)		(0.145)	
FEB11005	0.311	***	0.072		0.262	***	0.016	
	(0.041)		(0.065)		(0.040)		(0.065)	
FEB11005X	0.403	***	0.526	***	-0.752	***	-1.023	***
	(0.063)		(0.097)		(0.135)		(0.145)	
FEB11006	0.677	***	0.650	***	0.600	***	0.564	***
	(0.042)		(0.063)		(0.042)		(0.063)	
FEB11006X	0.815	***	1.133	***	-0.369	***	-0.451	***
	(0.057)		(0.091)		(0.133)		(0.142)	
FEB11013	1.063	***	1.109	***	1.033	***	1.086	***
	(0.045)		(0.046)		(0.045)		(0.046)	
FEB11013X	1.090	***	1.469	***	-0.063		-0.071	
	(0.063)		(0.083)		(0.137)		(0.137)	

FEB11018	-0.420	***	-0.587	***	-0.376	***	-0.607	***
	(0.038)		(0.058)		(0.038)		(0.059)	
FEB11018X	-0.253	***	-0.040		-1.399	***	-1.642	***
	(0.057)		(0.091)		(0.133)		(0.141)	
FEB11020	-0.390	***	-0.295	***	-0.421	***	-0.355	***
	(0.047)		(0.066)		(0.046)		(0.066)	
FEB11020X	-0.070		0.390	***	-1.250	***	-1.205	***
	(0.058)		(0.093)		(0.133)		(0.143)	
FEB12001	-0.911	***	-1.083	***	-1.078	***	-1.499	***
	(0.045)		(0.063)		(0.045)		(0.065)	
FEB12001X	-0.708	***	-0.543	***	-1.940	***	-2.380	***
	(0.063)		(0.094)		(0.135)		(0.144)	
FEB12003	-0.210	***	-0.484	***	-0.326	***	-0.786	***
	(0.053)		(0.072)		(0.052)		(0.073)	
FEB12003X	0.206	***	0.283	***	-0.998	***	-1.446	***
	(0.066)		(0.098)		(0.136)		(0.145)	
FEB12004	-0.703	***	-0.720	***	-0.869	***	-1.080	***
	(0.051)		(0.053)		(0.050)		(0.054)	
FEB12004X	0.112	*	0.426	***	-1.136	***	-1.338	***
	(0.067)		(0.085)		(0.135)		(0.137)	
FEB12005	0.033		-0.140	*	-0.135	***	-0.530	***
	(0.053)		(0.072)		(0.052)		(0.072)	
FEB12005X	0.680	***	0.840	***	-0.535	***	-0.941	***
	(0.069)		(0.101)		(0.137)		(0.147)	
FEB12006	0.659	***	0.387	***	0.524	***	0.075	
	(0.052)		(0.073)		(0.052)		(0.075)	
FEB12006X	1.044	***	1.110	***	-0.201		-0.685	***
	(0.062)		(0.096)		(0.134)		(0.146)	
FEB12007	-0.715	***	-0.858	***	-0.857	***	-1.198	***
	(0.045)		(0.065)		(0.045)		(0.067)	
FEB12007X	-0.672	***	-0.450	***	-1.894	***	-2.202	***
	(0.060)		(0.092)		(0.134)		(0.142)	
FEB12010	-1.035	***	-1.035	***	-1.175	***	-1.376	***
	(0.046)		(0.048)		(0.047)		(0.052)	
FEB12012	-0.684	***	-0.660	***	-0.818	***	-0.989	***
	(0.046)		(0.067)		(0.046)		(0.068)	
FEB12012X	-0.361	***	0.009		-1.561	***	-1.730	***
	(0.064)		(0.096)		(0.136)		(0.146)	
FEB12015	0.586	***	0.643	***	0.522	***	0.570	***
	(0.044)		(0.064)		(0.043)		(0.064)	
FEB12015X	1.031	***	1.434	***	-0.161		-0.156	
	(0.062)		(0.094)		(0.133)		(0.142)	
FEB12018	0.152	***	0.217	***	0.017		-0.093	
	(0.045)		(0.066)		(0.045)		(0.067)	
FEB12018X	0.406	***	0.811	***	-0.799	***	-0.923	***
	(0.061)		(0.095)		(0.134)		(0.145)	
FEB21005	-1.138	***	-0.944	***	-2.257	***	-2.096	***
	(0.084)		(0.093)		(0.098)		(0.105)	
FEB21005X	-0.765	***	-0.283	**	-2.107	***	-1.931	***
	(0.093)		(0.118)		(0.147)		(0.153)	
FEB21007	-0.682	***	-0.598	***	-1.835	***	-1.788	***
	(0.092)		(0.102)		(0.105)		(0.113)	
FEB21007X	-0.217	**	0.101		-1.573	***	-1.565	***
	(0.107)		(0.125)		(0.153)		(0.159)	
FEB21009	-0.515	***	-0.503	***	-1.706	***	-1.753	***
	(0.080)		(0.089)		(0.095)		(0.103)	
FEB21009X	0.071		0.371	***	-1.307	***	-1.330	***
	(0.088)		(0.111)		(0.144)		(0.150)	
FEB21010	-1.549	***	-1.474	***	-2.709	***	-2.667	***
	(0.078)		(0.090)		(0.096)		(0.106)	
FEB21010X	-1.277	***	-0.927	***	-2.643	***	-2.594	***

	(0.082)		(0.106)		(0.143)		(0.150)	
FEB21011	-0.075		0.118		-1.192	***	-1.026	***
	(0.084)		(0.096)		(0.099)		(0.109)	
FEB21011X	0.170	*	0.645	***	-1.193	***	-1.022	***
	(0.098)		(0.121)		(0.151)		(0.159)	
FEB21017	-0.907	***	-0.976	***	-1.863	***	-1.975	***
	(0.077)		(0.089)		(0.091)		(0.100)	
FEB21017X	-0.438	***	-0.206	*	-1.736	***	-1.836	***
	(0.084)		(0.109)		(0.142)		(0.149)	
FEB21018	-0.810	***	-0.902	***	-1.786	***	-1.913	***
	(0.080)		(0.091)		(0.091)		(0.100)	
FEB21018X	-0.420	***	-0.205	*	-1.730	***	-1.839	***
	(0.088)		(0.110)		(0.143)		(0.149)	
FEB21019	-0.589	***	-0.490	***	-1.568	***	-1.482	***
	(0.076)		(0.076)		(0.089)		(0.088)	
FEB21019X	-0.219	***	0.160		-1.524	***	-1.446	***
	(0.085)		(0.099)		(0.142)		(0.143)	
FEB21020	-0.040		0.065		-1.030	***	-0.934	***
	(0.081)		(0.081)		(0.093)		(0.091)	
FEB21020X	0.453	***	0.847	***	-0.860	***	-0.765	***
	(0.085)		(0.099)		(0.141)		(0.141)	
FEB21021	-1.780	***	-1.905	***	-2.866	***	-3.008	***
	(0.084)		(0.096)		(0.097)		(0.107)	
FEB21021X	-1.223	***	-1.098	***	-2.557	***	-2.725	***
	(0.098)		(0.124)		(0.148)		(0.156)	
FEB21022	-0.402	***	-0.572	***	-1.482	***	-1.651	***
	(0.074)		(0.089)		(0.090)		(0.103)	
FEB21022X	-0.249	***	-0.138		-1.583	***	-1.753	***
	(0.082)		(0.109)		(0.139)		(0.147)	
FEB21023	-0.732	***	-0.514	***	-1.858	***	-1.669	***
	(0.090)		(0.101)		(0.101)		(0.111)	
FEB21023X	-0.314	***	0.210		-1.677	***	-1.457	***
	(0.106)		(0.131)		(0.159)		(0.167)	
FEB22002	-1.485	***	-1.550	***	-2.794	***	-3.124	***
	(0.081)		(0.091)		(0.101)		(0.109)	
FEB22002X	-0.802	***	-0.622	***	-2.235	***	-2.613	***
	(0.087)		(0.113)		(0.144)		(0.153)	
FEB22003	-0.057		-0.118		-1.360	***	-1.658	***
	(0.088)		(0.097)		(0.108)		(0.115)	
FEB22003X	0.247	***	0.405	***	-1.228	***	-1.556	***
	(0.088)		(0.111)		(0.145)		(0.154)	
FEB22004	-1.524	***	-1.678	***	-2.835	***	-3.180	***
	(0.081)		(0.092)		(0.102)		(0.111)	
FEB22004X	-1.442	***	-1.325	***	-2.836	***	-3.158	***
	(0.082)		(0.111)		(0.141)		(0.151)	
FEB22005	-1.143	***	-0.930	***	-2.468	***	-2.468	***
	(0.080)		(0.091)		(0.102)		(0.110)	
FEB22005X	-0.488	***	-0.034		-1.890	***	-1.890	***
	(0.080)		(0.106)		(0.140)		(0.149)	
FEB22006	-1.102	***	-1.025	***	-2.391	***	-2.522	***
	(0.073)		(0.073)		(0.097)		(0.096)	
FEB22006X	-0.369	***	-0.053		-1.740	***	-1.867	***
	(0.085)		(0.102)		(0.141)		(0.143)	
FEB22008	-1.712	***	-1.610	***	-3.024	***	-3.139	***
	(0.081)		(0.082)		(0.101)		(0.101)	
FEB22008X	-1.195	***	-0.850	***	-2.627	***	-2.787	***
	(0.085)		(0.102)		(0.143)		(0.146)	
FEB22012	0.460	***	0.314	***	-0.848	***	-1.226	***
	(0.093)		(0.103)		(0.111)		(0.119)	
FEB22012X	0.927	***	1.036	***	-0.463	***	-0.828	***
	(0.082)		(0.107)		(0.141)		(0.150)	

FEB22013	0.046		-0.095		-1.290	***	-1.645	***
	(0.077)		(0.092)		(0.100)		(0.112)	
FEB22013X	0.182	**	0.275	***	-1.276	***	-1.686	***
	(0.075)		(0.105)		(0.138)		(0.149)	
FEB22016	-1.061	***	-0.977	***	-2.325	***	-2.465	***
	(0.105)		(0.106)		(0.121)		(0.121)	
FEB22016X	-0.291	**	0.019		-1.694	***	-1.919	***
	(0.131)		(0.147)		(0.174)		(0.178)	
FEB22017	-0.959	***	-1.145	***	-2.221	***	-2.600	***
	(0.084)		(0.096)		(0.105)		(0.115)	
FEB22017X	-0.261	**	-0.190		-1.678	***	-2.060	***
	(0.112)		(0.133)		(0.163)		(0.171)	
FEB22018	-0.449	***	-0.219	**	-1.724	***	-1.705	***
	(0.080)		(0.091)		(0.099)		(0.108)	
FEB22018X	0.449	***	0.950	***	-0.978	***	-0.950	***
	(0.114)		(0.140)		(0.166)		(0.179)	
FEB23001	-0.787	***	-0.751	***	-2.095	***	-2.272	***
	(0.079)		(0.092)		(0.102)		(0.113)	
FEB23001X	-0.149	**	0.145		-1.588	***	-1.794	***
	(0.075)		(0.103)		(0.138)		(0.149)	
FEB42001	-1.164	***	-1.419	***	-1.346	***	-1.787	***
	(0.081)		(0.094)		(0.083)		(0.097)	
FEB42002	-0.880	***	-0.972	***	-1.058	***	-1.353	***
	(0.091)		(0.101)		(0.095)		(0.107)	
Online			0.182	***			0.169	***
			(0.027)				(0.027)	
Previous Education								
BUITENL_SL			-0.390	***				
			(0.067)					
HAVO			-0.210	**				
			(0.103)					
HBO			-0.034					
			(0.181)					
MBO			-0.189					
			(0.382)					
WO			-0.022					
			(0.080)					
CD			-0.788	***				
			(0.220)					
Baccalaureate			-0.405	***				
			(0.144)					
Continent								
Africa			-0.339	**				
			(0.148)					
Asia			-0.109	*				
			(0.065)					
Oceania			-0.368					
			(0.410)					
Middle East			-0.437	***				
			(0.119)					
North			-0.063					
			(0.133)					
South			-0.536	***				
			(0.135)					
Study year								
2021			0.139	***			0.308	***
			(0.030)				(0.032)	

2022			0.283	***			0.606	***
			(0.035)				(0.044)	
Block								
Block2			-0.187	***			-0.235	***
			(0.049)				(0.049)	
Block3			0.097	**			0.036	
			(0.048)				(0.048)	
Block4			-0.274	***			-0.320	***
			(0.046)				(0.047)	
Block5			-0.060				-0.116	**
			(0.047)				(0.048)	
Block-RE			-0.073	**			-0.084	**
			(0.033)				(0.033)	
Intercept	6.327	***	6.342	***	7.267	***	7.190	***
	(0.053)		(0.076)		(0.076)		(0.092)	
Number of observations	90,726		87,432		90,726		87,432	
Individuals	6,572		6,364		6,572		6,364	
R^2	0.084		0.101		0.021		0.022	

Note: This table contains the complete overview of the result of two GLS-regressions and two FE-regressions with ResultNumerical as dependent variable, and including an interaction-effect of Male and TimeOfDay. Column 1 and 2 show the GLS-regressions and give the average effect of the variable in the corresponding model on the dependent variable ResultNumerical. Column 3 and 4 show the FE-regressions and give the average effect of the variable in the corresponding model on the dependent variable ResultNumerical. The omitted categories are; Morning for TimeOfDay, Monday for Day, FEB11001 for Coursecode, VWO for TypePrevEdu, Europe for Continent, 2020-2021 for StudyYear and Block1 for Block. Standard errors are shown between round brackets. Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.