Mandatory CSR disclosure and corporate innovation: Evidence from the European Union's CSR directive

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1. Introduction

In 2014, the E.U. passed a corporate social responsibility (CSR) directive, the Non-Financial Reporting Directive (hereafter: NFRD), that mandates large listed firms[1] to prepare annual CSR reports from 2018 onwards (Fiechter et al., 2018). The NFRD requires large listed firms to disclose information on the way they operate and manage CSR challenges. Firms prone to the mandate should include comprehensive details (i.e., policies, principal risks, and outcomes) related to environmental matters, social and employee factors, respect for human rights, anti-corruption issues, and board diversity (Fiechter et al., 2018).

This mandate can be seen as a response to the increasing demand for CSR reporting and related CSR activities[2] from listed companies by their stakeholders (Gamerschlag et al., 2011). These stakeholders want to understand how firms deal with ethical, environmental, and social issues. They want them to be accountable for their impact on the environment and society (Maas & Sampers, 2020).

Before this mandate, CSR reporting was done voluntarily. Voluntary CSR reporting may lead to information asymmetry between firms' managers and stakeholders. Firms with "good" social and environmental performance might use voluntary CSR reports as signals of their superior commitment to CSR. On the other hand, "bad" firms are more likely to use CSR reporting to "greenwash" themselves or report CSR to influence and enhance the stakeholders' perceptions of the firms' pro-social and environmental actions (Wang et al., 2017). Consequently, it will be impossible for stakeholders to determine whether managers are acting in their best interest or not. As a result, stakeholders might undervalue responsible actions and overvalue irresponsible actions (Jackson et al., 2020).

One of the goals of the NFRD is to increase the transparency of information to stakeholders, reducing the information asymmetries between the firm's managers and stakeholders (Jackson et al., 2020; Szabó & Sørensen, 2015).

Regarding prior literature, there seems to be a possible relation between CSR and innovation. Reverte et al. (2016) argue that CSR initiatives can lead to innovation through the use of social, environmental, or sustainability drivers to create new ways of working, new products, services, processes, and new market space (Reverte et al., 2016).

Therefore, the introduction of the NFRD might affect the amount of corporation innovation of companies that are subject to this mandate. For example, prior literature by Zhong (2018) states that innovative investments suffer from an underinvestment problem due to external financial constraints. Because of the high-risk nature of R&D,

[1] Firms are considered large when having more than 500 employees and total assets of more than EUR 20 million or sales of more than EUR 40 million. (Fiechter et al., 2018)

[2] CSR activities encompass corporate social and environmental behavior by firms that go beyond the regulatory requirements of the market (Chen et al., 2018).

innovative firms rely on costly equity capital as their primary source of financing (Zhong, 2018). Since the NFRD might improve transparency between firms and stakeholders, this could lower adverse selection costs (Zhong, 2018). Investors will be more confident in investing in companies, thereby reducing the cost of firms' capital and improving their access to external financing, which they need for innovative investments (Zhong, 2018).

To examine whether the NFRD might affect the amount of corporation innovation, I come up with the following research question:

Does mandatory CSR disclosure affect corporate innovation?

This paper exploits the introduction of the NFRD to test whether mandatory CSR disclosure affects the corporate innovation of firms measured by R&D spending. This is done by the use of a difference-in-difference (DiD) research design that compares the change in R&D spending among firms subject to the NFRD (treatment firms) and firms that are not subject to the NFRD (control firms). For this test, a sample period from 2011 to 2018 is used, defining 2015-2018 as the post-treatment period. To control for time-series trends in the treatment group that do not result from the treatment itself, a control group based on matched U.S. firms is used.

The results from the test show a decrease in innovation for firms subject to the NFRD. In addition, this paper concludes that larger firms, on average, innovate less than smaller firms after introducing the NFRD.

The remainder of this paper is structured as follows. First, this paper discusses prior literature on the relation between CSR and innovation, the NFRD, and the relationship between mandatory CSR reporting and innovation. Second, the main hypothesis is developed and explained according to prior literature. Third, the methodology is described followed up by the sample selection process and data. Next, this paper discusses the summary statistics, and the results of the DiD regression are presented, which are used to test H1 and H2. Lastly, the conclusion and limitations are presented.

2. Literature review

In this section, relevant literature is discussed regarding the relation between CSR and firms' innovative performance. It becomes clear that prior literature is based upon firms' voluntary CSR reporting, leading to the discussion of whether these results differ in a mandatory setting. Next, the European Union's (E.U.) CSR directive (Directive 2014/95) is introduced. The introduction of E.U. Directive 2014/95 is followed by prior literature examining the relation between mandatory CSR reporting and innovation based on an earlier Chinese mandate. Lastly, the main hypotheses of this research are stated and explained according to theories from prior literature.

Conceptualizing CSR

In prior literature, corporate social responsibility (CSR) and corporate sustainability (C.S.) are often used interchangeably. However, according to Bansal and Song (2017), these terms are inherently different. CSR emerged from expressed concern for social issues, while C.S. emerged from expressed concern about environmental matters (Bansal & Song, 2017). CSR initially focusses on social issues such as labor disputes, gender inequality, consumer issues, and fair trade. In a later stage, environmental matters were included since they affected society and, thereby, social issues.

On the other hand, C.S.'s focus is primarily on environmental/ecological management. Society is situated within the natural environment and is therefore treated as a part of the environmental system, but the focus is not on societal issues in the first place. Furthermore, C.S. focuses more on long-term value creation while CSR looks backward, reporting on what a business has done (Rezaee, 2016). CSR targets opinion formers such as politicians, pressure groups, and media, while C.S. targets the whole value chain (Rezaee, 2016).

Non-financial information reporting is a form of reporting that includes both C.S. and CSR (Fortuna et al., 2020). As stated by the NFRD, one of the main goals is to provide transparency about information not related to a company's finances (E.C., n.d.). For example, information on human rights. While the E.U. directive is stated as a Non-Financial Reporting Directive, they refer to non-financial reporting primarily in terms of CSR. The NFRD states that the non-financial information helps measure, monitor, and manage undertakings' performance and their impact on society (E.C., n.d.). Environmental matters are not the main focus of the NFRD but an element of the NFRD that affects society and social issues. In line with the NFRD, I will refer to non-financial information in terms of CSR.

Relation CSR and Innovation

Regarding prior literature, there seem to be mixed results about the connection between CSR and innovation. Borger and Kruglianskas (2006) found a strong relation between the adoption of CSR strategy and innovative performance. Moreover, Ubius and Alas (2012) found that CSR can predict innovation, but it is dependent on socio-demographic factors such as gender, age, and education level of employees. Reverte et al. (2016) examined whether CSR is a potential driver of organizational performance.

They concluded a significant and positive relation between CSR and innovation and found a mediating role of innovation between the CSR and organizational performance relation for manufacturing companies. It is argued that CSR initiatives can lead to innovation through the use of social, environmental, or sustainability drivers to create new ways of working, new products, services, processes, and new market space (Reverte et al., 2016).

On the other hand, it is argued that CSR information is more static than dynamic innovation information. This means that CSR primarily addresses present stakeholders while innovation information focuses more on the long-term stakeholder relationship. CSR information might therefore be contradictory to innovation information, indicating a negative relation between CSR and innovation. Furthermore, Gallego Alvarez et al. (2011) examined the bidirectional relation between CSR and innovation. They concluded a negative relation between CSR and innovation which may be because not all CSR practices create value for a specific company. For instance, innovative firms might focus more on innovation in their CSR strategy (Gallego-Álvarez et al., 2011).

In summary, prior studies show mixed results on the relation between CSR and innovation. These studies examined CSR and innovation in a voluntary disclosure setting. In this research, the effect of NFRD on corporate innovation will be examined. Until now, it is unclear whether mandatory CSR disclosure affects a firm's CSR behavior in such a way that it affects its innovative performance. This study is particularly of importance for standard setters to check whether a mandate such as NFRD leads to more CSR initiatives that can lead to more innovation or less innovation through more focus on the short-term stakeholder relationship instead of long-term stakeholder relationship.

Mandatory CSR disclosure

In 2014 the European Union (E.U.) passed Directive 2014/95, also called the Non-Financial Reporting Directive (NFRD), that mandates large firms listed on E.U. stock exchanges to prepare comprehensive non-financial reports on CSR (Fiechter et al., 2018). The target group of NFRD is large public companies with more than 500 employees and with more than 20 million euros of total assets or more than 40 million euros of sales (Fiechter et al., 2018). This group is totaling approximately 11700 large companies across the E.U. (European Commission, n.d.). The target group includes listed companies, banks, insurance companies, and other companies identified by national authorities as public companies (European Commission, n.d.). Starting from the fiscal year of 2018, the target group has to publish reports on the CSR policies that they implement as part of their annual reports. The European Parliament and Council indicated that the reported information from the target group must be "to the extent necessary for an understanding of the group's development, performance, position, and impact of its activity" (Szabó & Sørensen, 2015). However, the reported information is not bound to a lot of rules. The NFRD is a "minimum harmonization" directive, meaning that the CSR disclosures from target companies in member states are bound to minimum requirements only on the areas of concern which are

“environmental, social and employee matters, respect for human rights, anti-corruption and bribery matters” (Fiechter et al., 2018; Szabó & Sørensen, 2015). Member states can choose for themselves whether they go beyond the minimum requirements or not. Furthermore, the target group should also include a description of the policies, outcomes, and risks related to these areas of concern which should be included in the management report of the undertaking concerned (Szabó & Sørensen, 2015).

Transparency is one of the main objectives of the NFRD, reducing information asymmetries between companies and stakeholders (Jackson et al., 2020). According to prior research, R&D investments suffer from an underinvestment problem originating from an external financial constraint (Zhong, 2018). Because of the high-risk nature of R&D, innovative firms rely on costly equity capital as their primary source of financing (Zhong, 2018). Transparency will reduce information frictions between firms’ managers and stakeholders, thus lowering adverse selection costs (Zhong, 2018). Investors will be more confident in investing in companies, thereby reducing the cost of firms' capital and improving their access to external financing, which they need for innovative investments (Zhong, 2018). Next to transparency, comparability between firms is also one of the objectives of the directive. It will be easier for investors to distinguish ‘bad’ firms from ‘good’ firms in terms of investing (Jackson et al., 2020). The combination between transparency and comparability may prompt changes in the CSR activities of firms because they will compare themselves to their competitors (Jackson et al., 2020). This can be explained according to signaling theory. Signaling theory describes the relationship between the sender (firms’ managers) and receivers (stakeholders) of signals (Spence, 2002). Signaling theory focuses on signals and responses from the receiver’s feedback to the signals (Spence, 2002). Signaling theory is intended to avoid adverse selection and information asymmetry (Spence, 2002). Yu et al (2017) make use of signaling theory in order to examine whether CSR disclosure can boost a firm’s image and affect competitive advantage. They state that signaled CSR information that is easy to comprehend and compare is more likely to influence a firm’s competitive advantage. Thus firms will compare to their competitors in order to maintain their competitive advantage. In addition, signaling theory suggests that firms try to signal their type through disclosure (Ioannou & Serafeim, 2017). Firms that want to signal that they are “good corporate citizens” will further increase their disclosure since competitors are forced to increase their own disclosure by regulation (Ioannou & Serafeim, 2017).

Although the NFRD is mandatory, there are no hard rules regarding what extent firms have to elaborate on their CSR activities (Jackson et al., 2020). Firms are only bound to minimum requirements. Furthermore, firms that do not comply are not sanctioned, and their reports will be audited but not verified (Szabó & Sørensen, 2015). The high level of flexibility raises concerns on whether the mandate increases firms' CSR disclosure, leading to more transparency and comparability. This is also seen in prior studies regarding non-financial disclosure mandates, which indicate mixed results (Christofi et al., 2012; Fiechter et al., 2018; Ioannou & Serafeim, 2017; Wang et al., 2017).

Ioannou and Serafeim (2017) examined the effect of non-financial disclosure regulations on firms' disclosure practices and valuations. To test this, they collected data for four countries, China, Denmark, Malaysia, and South Africa, subject to mandated sustainability disclosures before 2011. Ioannou and Serafeim (2017) conducted a differences-in-differences analysis to estimate the impact of the regulation on treated firms compared to a control group based on firms from the rest of the world which were not subject to the mandates. Their research concluded that the ESG disclosure scores of the treatment group significantly increased after the non-financial disclosure mandate. Furthermore, their findings confirm that disclosure regulation may increase the transparency of firms because both firms that did and those that did not disclose ESG information before the regulation increased ESG disclosure once the regulation was adopted (Ioannou & Serafeim, 2017). Moreover, they concluded that firms, on average, are significantly likely to seek assurance on their ESG disclosures. Also, they are considerably more likely to adopt the Global Reporting Initiative (GRI) reporting guidelines. This indicates that treated firms increase their disclosure levels after a regulatory change and seek to improve their disclosure credibility and comparability (Ioannou & Serafeim, 2017).

Moreover, a study by Wang et al. (2017) examined the impact of mandatory CSR reporting on financial reporting quality. In particular, they assessed the mandate's effect on the likeliness of managers to engage in earnings management. They concluded that firms subject to the mandate had a significantly lower amount of discretionary accruals after the disclosure regulation than firms that were not subject to the mandate. Thus the financial reporting quality improved. According to Wang et al. (2018), this improvement for the treated firms is due to a reduction in information asymmetry between firms managers and the public. Mandatory CSR reporting tends to increase firms' exposure to public attention, which means that investors and media attention are drawn towards the firm. As a result, the misbehavior of managers is more likely to be detected and punished.

On the other hand, Christofi et al. (2012) showed that investors have neither rewarded nor penalized organizations for misbehavior in their corporate decisions. The underlying reason for this is the comparability between the non-financial reports. Stakeholders need comparable information on others to punish wrongdoing. Still, the mandatory sustainability reporting requirements offer management-wide discretion concerning what kind of content and information they publish in these reports.

Regarding the effects of the NFRD, research is limited. Fiechter et al. (2018) are one of the first to examine the anticipation effect of treatment firms on the directive. They find that treated firms, on average, increase their CSR activities after introducing the mandate and that this effect increases with lower pre-directive CSR disclosure levels. This study will be the first to examine the impact of the mandate on a firm's corporate innovation. It will contribute to the stream of literature based on the relation between CSR and innovation, the effect of mandatory non-financial disclosure on firms, and the relation between mandatory CSR disclosure and innovation. Furthermore, this study

will be important for standard setters to see whether the mandate increases transparency and comparability across firms, thereby complying with the stakeholder demand of information availability.

Relation mandatory CSR disclosure and innovation

The effect of mandatory CSR disclosure on corporate innovation is relatively unexplored in prior literature. Hong et al. (2020) are one of the first to examine the impact of compulsory CSR disclosure on green innovation. They exploit China's mandate in 2008, which required firms to disclose CSR activities. Their results make it clear that firms that were subject to the mandate increased their green innovation compared to firms that were not subject to the mandate after the mandate. This is in line with Porter's hypothesis, which they used to explain the possible effect of mandatory CSR on green innovation. Porter's hypothesis states that environmental regulation can trigger the discovery and introduction of cleaner technologies and environmental improvements by firms, also called the innovation effect (Porter & Van der Linde, 1995). The innovation effect will make production processes and products more efficient. According to Porter & Van der Linde (1995), the cost savings achieved are sufficient to overcompensate for compliance costs attributed to the regulation and the innovation costs. The findings of Hong et al. (2020) support Porter's hypothesis since the mandatory CSR disclosure promotes corporate green innovation among firms subject to the mandate.

Regarding the European setting, this study will be one of the first to examine the effect of mandatory CSR disclosure on innovation. This study is particularly of importance for European standard setters to review the real effects of the NFRD. Prior research was done by Hong et al. (2020) on the Chinese mandate in 2008 is not generalizable to the European setting due to cultural differences between China and Europe. According to Hou & Li (2014), cultural differences between China and the E.U. lead to differences in the corporate culture, and these differences in corporate culture result in the development of CSR practices in various countries. To illustrate, China's culture is characterized by collectivism.

In contrast, the European culture is characterized by liberalism. China's collectivism stresses the sharing of profits while liberalism relates to independence and individual profit (Hou & Li, 2014). CSR practices in Europe build upon the influence of the freedom culture, while the CSR practices in China are primarily built upon governmental influences. Due to the freedom culture in Europe, there are a lot of non-governmental organizations (NGO's) that play an active role in CSR research and practice (Hou & Li, 2014). These NGOs have connected scholars, entrepreneurs, and others from all communities to make significant contributions to CSR and CSR guidelines in Europe. However, governmental influence in China lacks these NGOs, which could provide guidelines to the government on implementing CSR practices for firms (Hou & Li, 2014). The excess intervention of the government in China regarding CSR resulted in companies misconstruing CSR practices. Companies in China subject

to CSR mandates see CSR practices more as a duty, a burden, instead of a way to increase social welfare that might lead to more innovative practices (Hou & Li, 2014).

To operationalize green innovation, Hong et al. (2020) use green patent counts as a measure. In this paper, R&D expenditures are used as a way to operationalize innovation. R&D expenditures and patents capture different aspects of the innovation process. R&D expenditures can be seen as the measures of resources devoted to the innovation process, while patents reflect the results of the innovation process (Licht & Zoz, 1998). I refer to innovation inputs (R&D) in this study instead of innovation outputs (patents). The main reason for this is that the process of patenting innovations is lengthy, meaning that within the time frame of this study, it might not be possible to capture the real effects of the mandate on the corporate innovation of firms by using patents as a measure of innovation. Furthermore, patents can be seen as a biased measure of innovation because firms in a competitive industry might not patent innovations since this will diffuse knowledge to their competitors (Licht & Zoz, 1998).

Hypothesis development

According to the agency theory, agency problems arise when both the principal and the agent seek to maximize their interest, which is not aligned (Jensen & Meckling, 1976). One of the key factors leading to agency problems is information asymmetry. There is much demand from stakeholders (principals) for information on environmental, social, and governance issues for decision-making in the present economy. However, the firm's managers (agent) might have other interests instead of providing this information. This leads to information asymmetry between stakeholders and managers. According to the agency theory, companies that experience agency problems provide voluntary non-financial information (NFI) that allows investors to more accurately assess firms' financial prospects and risk profiles (Jensen & Meckling, 1976; Mio et al., 2020). This leads to positive outcomes such as avoiding the adverse selection of investments and a lower cost of capital.

The introduction of the NFRD might strengthen the role of agency theory beyond voluntary disclosure. The NFRD increases the reliability, trustworthiness, and objectiveness of the disclosed information since this information does not only rely on the manager's discretion (Mio et al., 2020). As a result, investors will be more confident in investing in firms, thereby lowering the cost of capital and improving their access to external financing, which these firms need for innovative investments (Zhong, 2018).

Overall, a firm's managers tend to focus on companies' short-term performance improvement (Hu et al., 2020). Managers often face high non-distributable employment risks, so they tend to show high-risk aversion in company decision-making and avoid risky investment projects, such as R&D and technology innovation projects (Hu et al., 2020). Moreover, a firm's short-term performance improvement affects a manager's salary, so managers have higher incentives to focus on short-term investment projects instead of risky innovation investment projects (He & Tian, 2013). The NFRD will increase the number of stakeholders to which managers' have to account to. As a

result, the number of monitors of managerial behavior increases, creating implicit contracts with an expanded set of stakeholders (Hu et al., 2020). The increased monitoring of managerial behavior and expanded implicit contract set mitigates agency conflicts between managers and shareholders. It will therefore be easier for shareholders to supervise managers to make the right decisions. The willingness of managers to reduce risk also decreases. Thus, the NFRD improves the information environment, leading to enhanced and expedited decision-making and greater capacity for innovation (Hu et al., 2020).

On the other hand, CSR information disclosure may lead to the company's unique information being obtained by competitors (Hu et al., 2020). This will negatively impact their competitive position. As a result, the willingness of companies to perform risky innovation investments in the future will decline. However, related literature states the opposite (Ioannou & Serafeim, 2017; Jackson et al., 2020). CSR information disclosure can be seen as a way to increase competitive advantage, which is explained according to signaling theory. Furthermore, the NFRD will lead to increased transparency and therefore bring firms that maintain shallow levels of CSR engagement under greater scrutiny relative to competitor firms (Brunner & Ostermaier, 2019). This will negatively impact their competitive position; therefore, it is more likely that spotlighting the gap in their CSR activities will lead to an increased willingness to perform risky innovation investments in the future.

According to signaling theory, it can be explained that firms provide voluntary NFI to signal their type of firm towards stakeholders (Ioannou & Serafeim, 2017). Signaling theory describes the relationship between the sender (firms' managers) and receivers (stakeholders) of signals (Spence, 2002). Signaling theory focuses on signals and responses from the receiver's feedback to the signals (Spence, 2002). By providing stakeholders with voluntary NFI, firms' managers want to signal that they are a "good corporate firm" (Ioannou & Serafeim, 2017). Because of the introduction of the NFRD, firms that voluntarily provided NFI might fear losing their perceived benefits of signaling that they are "good corporate firms" since other firms that did not provide NFI now have to mandatory provide this (Ioannou & Serafeim, 2017). Therefore, they will further increase their activities and disclosure, given that competitors will also be forced to disclose by the regulation (Jackson et al., 2020).

Furthermore, Porter's hypothesis states that strict environmental regulation can induce efficiency and encourage innovation (Porter & Van der Linde, 1995). In other words, Porter's hypothesis states that environmental regulation will stimulate firms to improve the environmental efficiency of resource utilization. Because of this, innovation may occur, which helps improve production processes and product quality (Hong et al., 2020). The NFRD is an environmental regulation policy, so the NFRD will restrain firms from environmental pollution and foster innovation. Taking all argumentation together, the following hypothesis is proposed:

H1: Firms subject to the NFRD innovate more after the introduction of the NFRD

According to the stakeholder theory, firms should meet the demands of shareholders and fulfill the stakeholders' demands (Freeman, 1984). Stakeholder theory suggests that the firm's managers are expected to perform accountability towards its stakeholders by performing activities seen as important by its stakeholders and reporting information (Fernando & Lawrence, 2014). In line with stakeholder theory, firms engage in CSR activities and reporting to account to their stakeholders and fulfill their demands which might result in benefits for firms in the long run, such as improved image/reputation, attracting investors, lowering the cost of capital, attracting new employees and improving the relationship with stakeholders to gain support and approval (Fernando & Lawrence, 2014; Freeman, 1984). However, firms with different sizes face different stakeholders' pressure. Larger firms tend to face more stakeholder pressure since they are more visible and more likely to be socially responsive (Udayasankar, 2008). As a result, larger firms are more likely to engage in CSR activities which can lead to innovation through the use of social, environmental, or sustainability drivers to create new ways of working, new products, services, processes, and new market space (Reverte et al., 2016)..

In addition, the NFRD enhances this stakeholder pressure. The introduction of a mandatory CSR disclosure reduces information asymmetry between a firm's managers and stakeholders (Wang et al., 2017). Stakeholders will be able to distinguish firms with "good" social and environmental performance and "bad" firms that were likely to "greenwash" themselves through voluntary reporting (Wang et al., 2017). In other words, the implementation of the NFRD will provide more internal information to stakeholders. It will be easier for stakeholders to pressure managers to fulfill their demands.

Furthermore, larger firms are also more capable of complying with stakeholders' demands of innovation. Schumpeter's hypothesis states a close relationship between innovation and market structure (Schumpeter, 2003). Only large firms that have a lot of market power can support the costs related to innovation. This is because large firms have enough output to apply the results and spread the cost of innovation (Cohen & Klepper, 1996). In competitive environments, small firms will not have the ability to spend efficient resources on R&D because doing so would be too hazardous (Nicholas, 2003).

On the other hand, large firms have their market share that can act as a buffer of imitation whenever they innovate and try to stimulate technological change leading to a greater incentive to innovate. Therefore it is stated that "large firms are more than proportionately more innovative than small firms" (Kamien & Schwartz, 1982). This leads to the following hypothesis:

H2: Large firms subject to the NFRD innovate more than smaller firms subject to the NFRD after the introduction of the NFRD.

3. Methodology

In this section, the research design to test whether firms subject to the NFRD innovate more after the introduction of the NFRD is discussed. Furthermore, the treatment firms and control firms are defined. Lastly, variables of the model are described.

Research design

To test whether the firms subject to the NFRD innovate more after the introduction of the NFRD, this study bases its model on two econometric models used in prior literature by Fiechter et al. (2018) and Hong et al. (2020).

Fiechter et al. (2018) examine whether firms within the scope of the NFRD anticipate the disclosure mandate by increasing the CSR activities before the first mandatory disclosures. Fiechter et al. (2018) employ a difference-in-difference (DiD) analysis, which compares the impact of the introduction of the CSR directive on CSR activities across E.U. firms within the scope of the CSR directive and a sample of matched U.S. control firms. They state their DiD model as follows:

$$CSR_{it} = \beta_0 + \beta_1 POST_t \times EU_i + \beta_2 Controls_{it} + \beta_3 YearFE_t + \beta_4 FirmFE_i + \varepsilon_{it}$$

In this DiD model, the dependent variable, CSR, is a score that measures firms' social and environmental CSR activities. The score is directly related to the firm's actual CSR activities. The coefficient of interest in this model is β_1 which shows whether firms within the scope of the regulation (E.U. firms) on average increase/decrease their CSR activities relative to the U.S. control firms.

Hong et al. (2020) examine whether firms within the scope of China's CSR mandate increase their green innovation after the CSR mandate. To test this, Hong et al. (2020) perform a DiD analysis, which compares the impact of the CSR mandate on the green innovation of firms across firms within the scope of the mandate (treatment firms) relative to the control firms. Hong et al. (2020) state their DiD model as follows:

$$\begin{aligned} greeninnovation_{it} \\ &= \alpha + \beta \times treat_i + \gamma \times post_t + \delta \times treat_i \times post_t \\ &+ \theta \times controlvariables_{it} \times \varepsilon_{it} \end{aligned}$$

This paper combines the models mentioned above accordingly to result in the following main model to perform the main analyses:

$$\begin{aligned} INNOV_{it} = \beta_0 + \beta_1 POST_t + \beta_2 EU_i + \beta_3 POST_t \times EU_i + \beta_4 SIZE + \beta_5 POST_t \times SIZE \\ + \beta_6 POST_t \times SIZE \times EU_i + \beta_7 CONTROLS_{it} + \varepsilon_{it} \end{aligned}$$

This main model will provide results for H1 and H2. Table 1 provides the variable definitions for this model. The key explanatory variables are the interaction variables $POST_t$ x EU_i, $POST_t$ x SIZE, and $POST_t$ x SIZE x EU_i. The coefficients of interest are β_3 and β_6.In addition, to control for both general time trends in innovation and time-

invariant unobservable differences in industry characteristics, industry- and year fixed effects are included.

Coefficient β_3 from the interaction term $POST_t$ x EU_i indicates whether there is a difference in innovation between firm-year observations in the post-period for E.U. firms compared to U.S. firms. In other words, this coefficient indicates the difference in innovation between U.S. firms that do not have to comply with the NFRD and E.U. firms that have to comply after the mandate. For H1 β_3 is expected to be positive.

Coefficient β_5 from the interaction term $POST_t$ x SIZE indicates a difference in innovation between firm-year observations in the period after the mandate for firms that differ in size.

Coefficient β_6 from the interaction term $POST_t$ x SIZE x EU_i. indicates whether there is a difference in innovation between firm-year observations in the post-period for firms that differ in size. This difference is different for E.U. firms compared to U.S. firms. In other words, a coefficient of > 0 would mean that larger firms subject to the NFRD compared to smaller firms subject to the NFRD innovate more after the introduction of the NFRD. For H2, β_6 is therefore expected to be positive.

Definition of treatment firms and control firms

The NFRD has a broad scope and applies to all large listed firms in the E.U. Therefore, like most disclosure regulations, this setting falls short of the experimental ideal where the treatment is randomly assigned (Fiechter et al., 2018). Furthermore, the NFRD applies to large firms above a certain size threshold (see Section 2). The number of firms below this size threshold is not enough to use as a control group. Therefore, this analysis uses a comparable control group based on U.S. firms that are matched to the E.U. firms. Fiechter et al. (2018) use a propensity score matching (PSM), where they match E.U. firms within the scope of the NFRD with U.S. control firms based on pre-directive values of CSR performance, CSR reporting, industry membership, as well as other covariates that they use in their DiD model. In this analysis, similar propensity score matching will be applied to match E.U. firms within the scope of the mandate with U.S control firms based on pre-directive values of the covariates: ROA, Tobin's Q, Leverage, Firm size, Tangibility, Capital expenditures, and Cash flow.

Measures

Hong et al. (2020) define innovation by green patent counts. In this study, innovation is measured by R&D expenditures scaled by total assets. The main reason for this is that the process of patenting inventions is lengthy. Within the time frame of this study, it might not be possible to capture the real effects of the mandate on the corporate innovation of firms by using green patents as a measure of innovation. Furthermore, green patent data is a noisy measure of innovation because most innovations are not patented, and many patents are not valuable (Roach & Cohen, 2013). In addition, the NFRD does not focus only on environmental matters (see section 2). The scope of the NFRD also includes social and governance matters which green patent counts do not

capture. This is also the reason why the indicator for environmental R&D spending in the ASSET4[3] database is not used as a measure for innovation. This indicator does not cover the social and governance-related topics in the NFRD.

Following Fiechter et al. (2018), Chen et al. (2018), and Hong et al. (2020), this paper controls for firm size (SIZE), leverage (LEV), cash flow (CASH), return on assets (ROA), Tobin's Q (T.Q.). In addition, this paper controls for tangibility and capital expenditures. Firms with a higher ratio of asset tangibility are expected to be less innovative, and capital expenditures are expected to positively affect innovation (Chkir et al., 2021).

Table 1. Definitions of variables

Variable Name	Symbol	Definition	Source
Corporate innovation	INNOV	R&D expense to total assets	Compustat
Post	POST	Dummy variable = 1 if a firm-year observation falls in post-period (i.e., 2015-2018), and 0 otherwise	Compustat
Treatment firms	E.U.	Dummy variable = 1 if the listed firm is subject to the NFRD starting from 2015 and 0 otherwise	Compustat
Firm size	SIZE	Natural logarithm of total assets of firm i in year t	Compustat
Leverage	LEV	Total liabilities to total assets of firm i in year t	Compustat
Cash flow	CASH	The ratio of cash to total assets of firm i in year t	Compustat
Return on Assets	ROA	Net income available to common shareholders deflated by total assets	Compustat
Tobin's Q	TQ	Market value scaled by total assets	Datastream
Tangibility	TANG	PPE to total assets	Compustat
Capital expenditures	CAPIT	Capital expenditures to total assets	Compustat

Table 1 presents the variables for the main model of this paper. Variable name, symbol and definitions of the variables are presented. Furthermore, the database source where the variable is gathered is given.

[3] The ASSET4 database contains data on firms' environmental, social and governance activities. Data from the ASSET4 database comes from a variety of sources, including company reports, company filings, company and non-governmental websites, CSR reports and media sources (Fiechter et al., 2018).

4. Sample and data

In this section, the databases used to gather data for this research are discussed. Furthermore, this section will elaborate on the sample selection process of this research and explain the usage of propensity score matching to match the treatment group with the control group.

This study gathers European data from the Compustat Global database for the sample period 2011-2018. This database includes coverage of almost 100% of the European market capitalization. Unfortunately, this database does not have annual share prices of European companies needed to calculate the market value of the companies used in Tobin's Q control variable. Therefore Datastream database is used. This database is a global financial and macroeconomic platform, providing data on equities, stock market indices, currencies, company fundamentals, fixed income securities, and key economic indicators for 175 countries and 60 markets. To obtain U.S. firm data, Compustat North America is used.

For the E.U. sample, 4,906 firm-year observations are obtained from Compustat Global and Datastream. The E.U. sample contains listed firms from all European exchanges. After merging the Compustat Global and Datastream databases and eliminating observations with missing data, 1,064 firm-year observations are left, totaling 133 EU firms. Regarding the U.S. sample, 20,415 firm-year observations are obtained from Compustat North America. After eliminating the observations with missing data, 4,584 firm-year observations are left, totaling 573 US firms. Table 2 shows the complete sample selection procedure.

Since the NFRD has a broad scope and applies to all large listed firms in the E.U., this regulation falls short of an ideal situation where the treatment sample is randomly selected. This paper uses a propensity score matching (PSM) approach to match comparable U.S. firms with E.U. firms to mitigate the concern that the treatment sample is not randomly selected. Two tests (balance and common support assumptions) are required before a PSM method (Hong et al., 2020).

The balance assumption requires two groups in observables should be as similar as possible so that the possibility of firms entering the control group was similar to the treatment group (Hong et al., 2020). The first step to PSM is using a logit regression to estimate the probability of being a treatment firm, using the pre-mandate period data. In this logit regression, all the covariates from the main model are used. Table 5 of the Appendix shows that the likelihood of being a treatment firm is positively associated with capital expenditures (CAPIT) and negatively associated with Tobin's Q (T.Q.), leverage (LEV), and tangibility (TANG). After the logit regression, the treatment and control groups are matched using the nearest neighbor matching technique. For this technique, one-to-one matching is applied, meaning that one treatment group is matched with one control group.

Table 6 of the Appendix shows the effectiveness of the matching procedure. The results suggest that the matching process reduced differences between the treatment

and control groups before the mandate. This can be seen according to the reduced standardized mean differences (SMD) between the covariates of the control and treatment group pre-matching and post-matching. An SMD above 0.1 indicates that there is an imbalance between the control and treatment groups. For example, the SMD of ROA in the pre-match is 0,357 > 0,1, meaning that there is an imbalance between the control and treatment groups for this variable. After the matching procedure, most variables are balanced between the control and treatment groups satisfying the balance hypothesis.

The common support hypothesis requires the propensity scores of the treatment group and control group to have common support (Hong et al., 2020). Figure 1 of the Appendix shows that before matching, the kernel density of the control and treatment groups are significantly different. However, after the matching procedure (Figure 2, Appendix), the kernel density of the two groups is very close, indicating that the two groups have common support and, therefore, meet the common support hypothesis.

After the matching procedure, the total sample consists of 133 U.S. and 133 E.U. firms totaling 2128 firm-year observations (See table 2 on sample selection). Table 7 of the Appendix shows the industry distribution between treatment and control groups after matching. This panel makes it clear that the PSM made the industry composition comparable between treatment and control groups. Finally, Table 8 in the Appendix presents the Pearson correlation coefficients among firm-level variables. From Table 8, it becomes clear that there is a high correlation (0.68) between variables CAPIT and TANG and a medium correlation (0.34) between T.Q. and ROA.

Table 2. Sample selection

Selection criteria	**E.U. sample**	**U.S. sample**
Start: EU listed firms between 2011-2018 (based on ISIN)	1,761	7,999
Less observations of firms:		
without number of employees >499 (or missing employee data)	(1,148)	(5,447)
without Compustat data	(480)	(1,978)
without Datastream data	-	(1)
Final sample before matching:	133	573
Final sample after matching:	**133**	**133**

Table 2 presents the sample selection procedure. The selection criteria are presented in firm-year observations except for the final sample given in the total number of firms.

Table 3. Summary statistics

	EU firms N = 133				U.S. firms N = 133			
	Mean	**StDev**	**Min**	**Max**	**Mean**	**StDev**	**Min**	**Max**
INNOV	0.036	0.018	0.000	0.346	0.026	0.016	0.000	0.211
ROA	0.038	0.039	-0.659	0.678	0.037	0.042	-1.141	0.326
TQ	1.503	1.276	0.513	7.733	1.484	1.336	0.219	8.500
LEV	1.930	1.757	0.979	16.270	1.897	1.682	0.643	7.324
SIZE	8.282	8.197	3.781	13.035	8.310	8.015	3.977	13.483
TANG	0.206	0.181	0.010	0.726	0.208	0.169	0.000	0.876
CAPIT	0.041	0.034	0.001	0.308	0.044	0.033	0.000	0.258
CASH	0.107	0.080	0.007	0.661	0.095	0.077	0.000	0.562

Table 3 presents the summary statistics between the treatment and control groups after matching.

5. Empirical results

In this section, the summary statistics between the treatment and control groups are described. Furthermore, the empirical results from the DiD research design are presented. These results are then used to test hypothesis 1 and hypothesis 2.

Table 3 presents the summary statistics between E.U. firms and U.S. firms. As stated in the previous section, the E.U. firms and U.S. firms are matched on the covariates resulting in 133 EU firms matched with 133 US firms. Imbalances are treated, which can be seen from the summary statistics since means of the covariates between E.U. firms and U.S. firms are close to each other. Furthermore, the variable INNOV has a higher mean (0.036) for E.U. firms than U.S. firms (0.026) which indicates that, on average, E.U. firms are more innovative compared to U.S. firms.

Table 4 reports the DID results of the NFRD on corporate innovation. Column 1 is the main model without including control variables, year, and industry fixed effects. Column 2 includes control variables and excludes year and industry fixed effects, and column 3 includes control variables, year, and industry fixed effects.

Column 3 shows an insignificant coefficient on POST, indicating that, on average, U.S. firms do not experience any change in innovation (INNOV) after the disclosure shock. By contrast, the coefficient on E.U. is significantly positive, indicating that, on average, E.U. firms innovate more before the disclosure shock. Notably, the coefficient on the interaction term (POST* E.U.) is significantly negative. This result suggests that, relative to U.S. firms that do not comply with the NFRD, E.U. firms that have to comply according to the NFRD, on average, experience a decrease in innovation (INNOV) after the mandate. This result leads to a rejection of H1, which stated that firms subject to the NFRD innovate more after the introduction of the NFRD.

H2 stated that large firms innovate more compared to smaller firms after the introduction of the NFRD. Column 3 of the table shows a coefficient on SIZE*POST that is negative. This indicates that larger firms, on average, innovate less than smaller firms after the mandate. However, this coefficient is insignificant, so this can not be concluded. Furthermore, the coefficient on SIZE*POST* E.U. is positive. This indicates that larger firms subject to the NFRD compared to smaller firms subject to the NFRD innovate more after the introduction of the NFRD. However, this coefficient is also not significant. So this cannot be concluded. Due to the insignificance of this coefficient, this outcome indicates that differences in firm size in the post-period that are different for E.U. firms compared to U.S. firms do not affect innovation. H2 is therefore rejected.

Table 4. The impact of the NFRD on corporate innovation

	(1)	(2)	(3)
Dependent variable:	INNOV	INNOV	INNOV
POST * EU	-0,002	-0,008**	-0,007*
	(0,004)	(0,003)	(0,003)
POST	0,000	0,001	0,001
	(0,003)	(0,002)	(0,002)
EU	0,010***	0,014***	0,014***
	(0,003)	(0,002)	(0,002)
POST * SIZE		-0,001	-0,001
		(0,001)	(0,001)
POST * SIZE * EU		0,002	0,001
		(0,002)	(0,002)
ROA		-0,037***	-0,066***
		(0,010)	(0,015)
TQ		0,014***	0,007***
		(0,002)	(0,001)
LEV		0,004***	0,003***
		(0,002)	(0,002)
SIZE		-0,003**	-0,003**
		(0,000)	(0,001)
TANG		--0,058***	-0,077***
		(0,008)	(0,008)
CAPIT		0,211***	0,221***
		(0,034)	(0,032)
CASH		0,073***	0,053***
		(0,012)	(0,011)
Industry-fixed effects	Excluded	Excluded	Included
Year-fixed effects	Excluded	Excluded	Included
Adj. R^2	0.016	0.178	0.256
N	2128	2128	2128

Table 4 presents the DID results of the NFRD on corporate innovation. (1) is the main model without including control variables, year, and industry fixed effects. (2) includes control variables and excludes year and industry fixed effects. (3) includes control variables, year, and industry fixed effects. ***, **, * denote significance at the 1%, 5%, and 10% level. The standard deviations are given in parentheses.

6. Conclusion

The NFRD is an E.U. directive that mandates large firms listed on the E.U. stock exchange to prepare comprehensive non-financial reports on CSR (Fiechter et al., 2018). Prior research by Fiechter et al. (2018) finds an increase in CSR activities after the introduction of the NFRD. This result is in line with the fact that the introduction of the NFRD might strengthen the role of agency theory. One of the critical factors driving agency theory is information asymmetry. Due to the NFRD, firms' exposure to public attention increases which means that investors and media attention are drawn towards the firm. As a result, the misbehavior of managers is more likely to be detected and punished. In addition, it is easier for investors to compare firms based on their CSR practices after the introduction of the NFRD, which leads to an incentive to increase CSR activities.

From prior literature, there seems to be inconclusive evidence of a relation between CSR and innovation (Borger & Kruglianskas, 2006; Gallego-Alvarez et al., 2011). These results are based on voluntary disclosure settings. In this paper, the effect of the NFRD on corporate innovation is examined. This paper adds to the relatively new literature on the impact of mandatory CSR disclosure on innovation.

Hong et al. (2020) examined the impact of mandatory CSR disclosure on green innovation based on a Chinese mandate. From their results, it becomes clear that firms that were subject to the mandate increased green innovation after the mandate compared to firms not subject to the mandate. This is in line with Porters' hypothesis, which states that environmental regulation can trigger the discovery and introduction of cleaner technologies and environmental improvements by firms, also called the innovation effect (Porter & Van der Linde, 1995). However, these results are not generalizable to the E.U. setting due to cultural differences between China and the E.U.

Therefore this paper examines the effect of the NFRD on corporate innovation. To investigate this, the following research question is researched:

Does mandatory CSR disclosure affect corporate innovation?

The DID results show that mandatory CSR disclose does affect corporate innovation. However, this is not in line with the expectation that mandatory CSR disclosure increases innovation for firms subject to the mandate. The DiD results show a decrease in innovation for firms subject to the mandate. Furthermore, the DiD results show that firm size does not affect firms' innovation subject to the NFRD.

A possible reason for the decrease in innovation for firms subject to the mandate is that this could be that the NFRD is a "minimum harmonization" directive. The E.U. firms subject to the mandate are bound to minimum requirements regarding their CSR reports (Fiechter et al., 2018; Szabó & Sorensen, 2015). Thus, this NFRD offers wide discretion to management concerning what kind of content and information they

publish in their reports. This is not in line with one of the main objectives of this NFRD, namely transparency, reducing information asymmetries between firms and stakeholders. Prior literature from Zhong (2018) states that R&D investments suffer from an external financing constraint. Because of the high-risk nature of R&D, innovative firms rely on costly equity capital as their primary source of financing. Transparency should lead to more confident investors investing in companies, thereby lowering the cost of capital of firms and improving their access to external funding, which they need for innovative investments. However, it can be argued that due to the “minimum harmonization” profile of the mandate, the transparency between both parties did not improve or even worsened and consequently led to no change in innovative investments or a decrease in innovative investments.

In short, the findings of this paper show a decrease in innovation for firms subject to the NFRD. Furthermore, this paper concludes that firm size does not affect firms' innovation after the introduction of the NFRD.

7. Limitations

Although this paper suggests a negative impact of the NFRD on the corporate innovation of the firms subject to this mandate, some limitations should be taken into account. First of all, omitted-variable bias could be an issue. Prior literature by Chen et al. (2018), Fiechter et al. (2018), and Hong et al. (2020) include control variables that control for the corporate governance and ownership nature of firms. In this paper, these variables are not included due to data availability. However, they could influence the effect of the NFRD on corporate innovation.

Similar to the limitation stated in the paper of Fiechter et al. (2018), this paper cannot entirely rule out that the results may be influenced by omitted factors such as concurrent events to the extent that these events correlate with the treatment effect and concurrent changes in corporate innovation.

Furthermore, some of the results of this paper contain statistical significance. However, the economic significance of the results is debatable. The coefficients of the main model used in this paper have low magnitude; therefore, this paper's economic and policy relevance should be interpreted with caution.

Lastly, from Table 9 in the Appendix on the sample distribution per country, it becomes clear that the treatment group consists of a large amount out of French firms (26,60%). Before the NFRD, France already had a similar CSR directive for listed companies, namely the New Economic Regulations, operative since 2003 (Wolniak & Hąbek, 2013). Thus, it is possible that the NFRD did not significantly impact these firms since they already report CSR on a mandatory basis. Therefore this did not impact their corporate innovation.

Regarding future research ideas, it would be interesting to specify the dependent variable, innovation, more. R&D spending is a broad measure that captures all forms of innovation. It would be interesting to research to what extent a CSR directive impacts certain forms of innovation. For example, firms might innovate more in terms of environmental matters or social matters. The environmental matters could, for instance, be measured by the environmental R&D spending indicator from the ASSET4 database. Moreover, I recommend testing the effect of NFRD on green innovation at the country level and industry level.

8. Appendix

Table 5. Logit model used to find propensity scores

Variable	Dep. var. = Indicator variable (1=EU sample, 0=US sample)
	1,714*
	(0,755)
ROA	2,780
	(2,545)
TQ	-1,698***
	(0.277)
LEV	-0.475***
	(0,143)
SIZE	0,072
	(0,061)
TANG	-3,432**
	(1,114)
CAPIT	15,676**
	(5,473)
CASH	-0,516
	(1,487)
Pseudo R2	0,160
N	707

Table 5 presents the logit model used to find the propensity scores for the PSM procedure. ***, **, * denote significance at the 1%, 5% and 10% level. Standard deviations are given in parenthesis.

Table 6. Test of the effectiveness of the propensity score matches

Variable		Mean value, treatment (1)	Mean value, control (2)	Diff. (1)-(2)	SMD
ROA	Pre-match	0,04	0,06	-0,02	0,357
	Post-match	0,04	0,04	0	0,071
TQ	Pre-match	1,38	2,08	-0,7	0,695
	Post-match	1,38	1,44	-0,06	0,116
LEV	Pre-match	1,90	2,66	-0,76	0,496
	Post-match	1,90	1,90	0	0,004
SIZE	Pre-match	8,17	7,67	0,5	0,262
	Post-match	8,17	8,28	-0,11	0,055
TANG	Pre-match	0,21	0,21	0	0,015
	Post-match	0,21	0,21	0	0,029
CAPIT	Pre-match	0,04	0,04	0	0,067
	Post-match	0,04	0,04	0	0,074
CASH	Pre-match	0,10	0,13	-0,03	0,319
	Post-match	0,10	0,10	0	0,083

Table 6 presents the effectiveness of the PSM procedure. This table shows the differences in the mean values of the treatment and control groups pre-matching and post-matching. Standardized Mean Differences (SMD) > 0.1 indicates an imbalance in the dataset; therefore, PSM is needed.

Table 7. Sample distribution per industry

	E.U. firms		U.S. firms	
	Firm-years	Percent	Firm-years	Percent
(1) Agriculture, Forestry and Fishing	0	0,00%	0	0,00%
(2) Mining	48	4,51%	24	2,26%
(3) Construction	24	2,26%	0	0,00%
(4) Manufacturing	712	66,92%	752	70,68%
(5) Transportation, Communications, Electric, Gas and Sanitary service	80	7,52%	8	0,75%
(6) Wholesale Trade	16	1,50%	80	7,52%
(7) Retail Trade	16	1,50%	64	6,02%
(8) Finance, Insurance and Real Estate	0	0,00%	0	0,00%
(9) Services	128	12,03%	128	12,03%
(10) Public Administration	0	0,00%	0	0,00%
(11) Other	40	3,76%	8	0,75%
Total	*1,064*	*100,00%*	*1,064*	100,00%

Table 7 presents the sample distribution of the treatment group (E.U. firms) and control group (U.S. firms) per industry.

Table 8. Pearson correlation coefficients among firm-level variables (Maximum N = 2128 firm-years)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		INNOV	ROA	TQ	LEV	SIZE	TANG	CAPIT	CASH
(1)	INNOV	1							
(2)	ROA	0.01	1						
(3)	TQ	0.20***	0.34***	1					
(4)	LEV	0.15***	0.18***	0.10***	1				
(5)	SIZE	-0.24***	0.05***	-0.06***	-0.22***	1			
(6)	TANG	-0.24***	-0.04*	-0.11***	-0.07***	0.26***	1		
(7)	CAPIT	-0.05**	0.06***	0.04*	-0.03	0.09***	0.68***	1	
(8)	CASH	0.25***	0.05**	0.18***	0.21***	-0.26***	-0.18***	-0.04*	1

Table 8 presents the Pearson correlation matrix among firm-level variables. ***,**,* denotes significance at the 1%, 5% and 10% level.

Table 9. Sample distribution per country

	E.U. firms		U.S. firms	
Countries	Firm-years	Percent	Firm-years	Percent
Belgium	104	9,77%	0	0,00%
Czech Rep.	8	0,75%	0	0,00%
Finland	16	1,50%	0	0,00%
France	283	26,60%	0	0,00%
Germany	164	15,41%	0	0,00%
Ireland	48	4,51%	0	0,00%
Italy	16	1,50%	0	0,00%
Luxembourg	8	0,75%	0	0,00%
Netherlands	136	12,78%	0	0,00%
Norway	72	6,77%	0	0,00%
Spain	8	0,75%	0	0,00%
UK	201	18,89%	0	0,00%
U.S.	0	0,00%	1,064	100,00%

Table 9 presents the sample distribution of the treatment group (E.U. firms) and control group (U.S. firms).

Figure 1. Kernel density before matching between treatment and control group

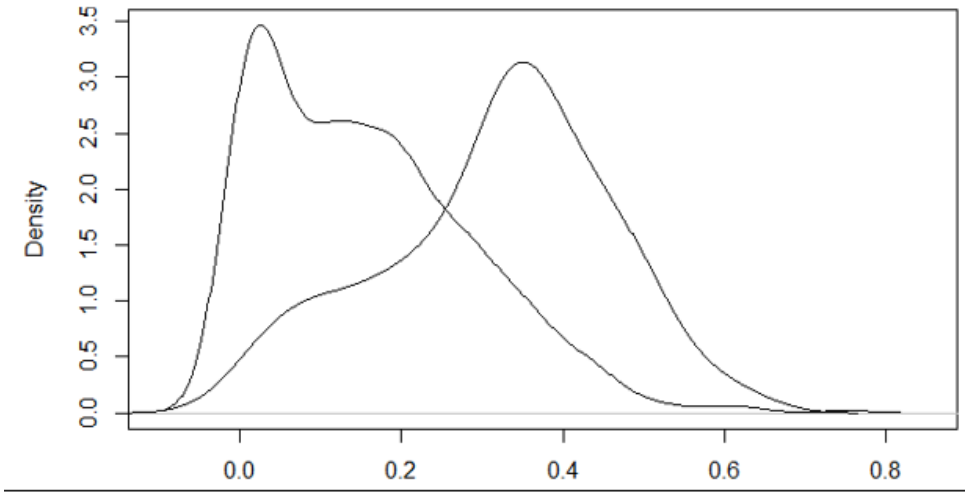
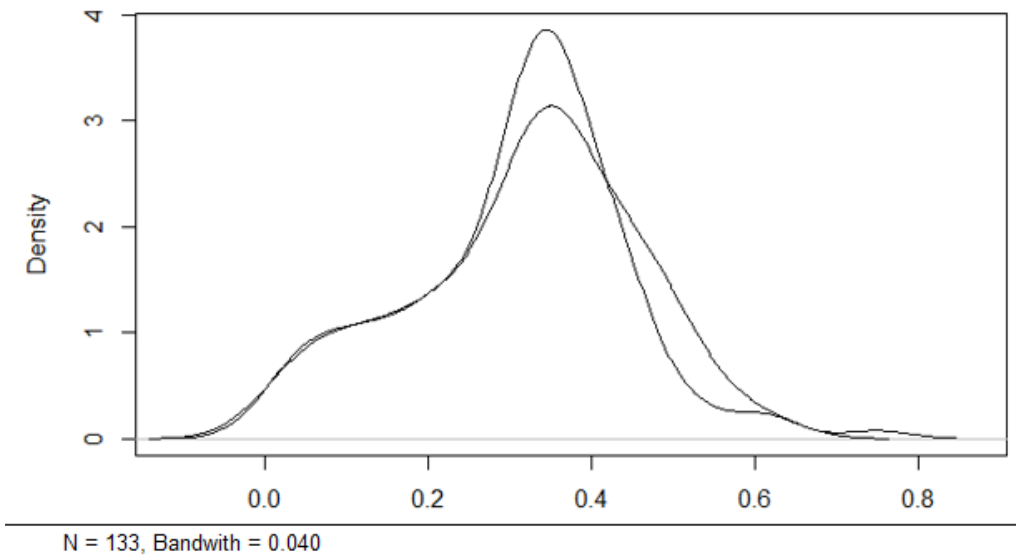


Figure 2. Kernel density after matching between treatment and control group



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