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# The Impact of Regulatory Change on Hedge Fund Performance

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**Abstract:**
The paper investigates the effect of recent EU regulations on hedge fund performance. The expansion of hedge funds attracts the attention from authorities who are responsible for monitoring the market risks but the influence of the oversight has been argued for a long time. Prior studies usually focus on the US regulations and they provide controversial findings about the relationship of hedge fund performance and regulations. However, to our knowledge, no studies discuss the impact of the EU regulations-the Alternative Investment Fund Manager Directive (AIFMD). The analysis of the AIFMD and the comparison of the rules from the US and the EU show that the EU Directive has more extensive requirements, compliance cost, and wider scope of disclosure to the public. Considering the additional compliance cost and higher possibility to reveal managers' strategies, we expect the hedge fund performance is negatively influenced by the EU regulation. Based upon the common difference-in-difference method (DID), we utilize the characteristic that the scope of the AIFMD exempts some EU hedge funds and add the third factor to formulate the triple difference method to test the triple interaction relationship. This method allows us to mitigate the different influence from potential various sensitivities or development speed from control group and treatment group. Our results show that hedge funds domiciled or marketed in the EU had a drop of 0.2% in the alpha. The result has been further enhanced by comparing the matched control group and treatment group by using the propensity matching score, which ensures our research compares the changes of individual authorized hedge funds based on the specified authorization date.

**JEL:** G23, G28
**Keywords:** hedge fund, regulation, stock returns

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# 1. Introduction

After the financial crisis from 2007 to 2009, many experts called for tighter regulations on the hedge fund industry to address their tendency to aggressively take on the leverage to invest in risky financial products (Bianchi and Drew 2010; Buller and Lindstrom 2013; Kaal, Luppi, and Paterlini 2014). But it was not the first time that the industry of hedge funds came into people's view, raising doubts about its less-regulated nature. At the end of last century, US federal legislators and financial regulators started to question whether regulatory constraints are necessary to prevent financial market crises after the collapse of a massive hedge fund-Long-Term Capital Management L.P. (LTCM) in 1998, whose failure got many banks and pension funds involved and threatened the whole US financial system. Besides, in 2005, the EU commission's publication of a Green Paper about the enhancement of investment funds initiated the discussion of hedge fund regulation as the alternative investment fund industry expanded rapidly and the authority suggested preparing guidelines for the future actions (Moschella 2011). However, the regulatory proposal had been faced with many obstacles along with many arguments, resulting in a long-term existing debate on whether hedge funds should be constrained by strict regulations.

Hedge funds used to be mainly invested by sophisticated individuals or institutions who are treated differently from general public investors, and so they were less regulated compared with other investment vehicles (Engert 2010). But the situation became different during the recent decade as more retail investors became interested in investing in hedge funds. On one hand, if the industry is not required to disclose adequate information, some hedge fund managers might manipulate the report of returns to make their performance appear to be smooth and profitable. And misleading or incomplete information would particularly influence the decision-making of

small investors who highly rely on the released returns. On the other hand, even though the global financial crisis in 2008 resulted from the banking system instead of hedge funds, people are aware of the issue that the credit system incentivized investors and institutions to over-leverage and led to a severe situation. Similarly, hedge funds usually take advantage of high leverage to enhance their positions. It would sensitize the asset price and the failure of hedge funds would get many financial counterparties involved in their obligations (Johnston 2015). As a result, the authority is responsible for preventing hidden troubles of the hedge fund management for the overall financial market.

However, opponents indicate that regulations on hedge funds have more disadvantages than advantages. First, very few hedge funds have a size comparable to the LTCM to cause such a huge catastrophe. In fact, the failure rate of hedge funds is around 10 percent, but the high level of failure merely eliminated worse hedge funds rather than increasing the systematic risk. Many small entities in the hedge fund industry, on the contrary, increase the competition force and improve the industry liquidity since market function would be more efficient when more buyers and sellers exist in the industry (Bianchi and Drew 2010). Second, besides the aim to normalize the management of hedge funds and assure the qualification of managers, mandatory registration mainly contributes to the monitoring of hedge fund leverage, which is critical to the so-called "systematic risk". But such strict supervision would affect some arbitrage-type hedge fund strategies like convertible arbitrage, fixed income arbitrage and equity market neutral. To make the leverage more rational, radical advisors may choose some safe plans to alleviate their pressure towards the regulations. And thus may result in lower market liquidity and more price distortions because when less capital exists in the market, less price inefficiencies could be discovered (Bianchi and Drew 2010). Third, improvement on the transparency and disclosure conflicts with

protecting successful hedge fund strategies to a large extent. The most valuable intangible assets result from the nature of security selection and construction of investment portfolios. Once their secret strategies become public to investors and regulators, their competitors would obviously be able to get access to the central source of information and any imitation from peers makes the profit shared by other followers. Transparency and disclosure make competitive advantage hard to maintain in the industry and harm managers' incentives for innovation (Bianchi and Drew 2010). Fourth, tight rules could trigger regulatory arbitrage that encourages the hedge funds to leave Europe. Regulatory arbitrage arises when different jurisdictions have different requirements on a certain hedge fund activity. Hedge funds have considerable discretion in choosing the jurisdiction where they register. More demanding regulatory and disclosure requirements in the EU may thus incentivize some hedge funds to register in different jurisdictions where the regulation is laxer. This may compromise the EU's ability to attract hedge funds and it may render the European hedge fund market less competitive with all the corresponding adverse consequences for investors (Engert 2010). In such a case, the rules would reduce the investment opportunity in the EU and harm European financial markets. Finally, except leverage constraints and managers' specific strategies disclosed, hedge funds would be treated and supervised towards "normal funds" and be subject to certain compliance costs. Some costs can be considered as one-time consumption such as the cost of authorization requirements and relocation as needed while many costs are continuous spendings including the independent valuation, depository fee, and cost of violation of regulation. It is questionable whether hedge funds could sustain its performance and be a good choice for investments compared with other funds.

Even though the controversy remains unsolved, the trend of a series of regulations witnessed the same choice of different authorities. In the US, the Dodd-Frank Act was proposed

in June 2009. It became effective in March 2012 in the aftermath of the financial crisis. The Act extends the registration rule by requiring smaller advisors (with $25-$100 million AUM) to register with states instead of the SEC, which prevents small advisors from registration exemption. Also, it imposes several record-keeping and reporting requirements for sensitive and proprietary information including the types of investments managed, net asset values, investment strategies, performance and changes in performance, positions held through filing the SEC Form PF. Furthermore, the information of clients and employees and related practice to conflict of interest should be disclosed (Cumming, Dai, and Johan 2017). The European Union adopted the Directive 2011/61/EU on Alternative Investment Fund Managers, which aims to regulate all alternative fund managers that manage any alternative investment funds, such as private equity funds, hedge funds, real estate funds, and infrastructure funds (Kamal 2012). The Directive has extensive requirements about the hedge funds to obtain authorization from the competent authority of their home EU country, provide audited annual reports disclosing financial performance, risk measures, and investment policy, including investment strategies, techniques, descriptions of the types of assets and the use of leverage.

Compared with the US regulation, the EU Directive has similar requirements about registration and transparency but different scope of application, severities of risk control and forms of disclosure. For example, the EU Directive applies to even Non-EU hedge funds marketing in the EU regions while the US rules allow offshore hedge funds exempted from the registration in the SEC depending on the number of US clients and the AUM from these clients. Unlike US hedge funds, solely relying on the monitor from SEC or state government, the EU Directive also takes advantage of other institutions' force for the continuous attention and requires the hedge fund to appoint a depository for monitoring its asset safety. Independent valuation is mandatory and any

failure to perform the required independent valuation would result in sanctions. Besides, the EU rules pay special attention to the use of leverage, specifying the disclosure of maximum leverage, the extent of leverage and application in certain circumstances. It seems the EU hedge fund manager would be faced with greater pressure in operating their business with high leverage. With regard to the disclosure channel, the US hedge funds disclose main information about performance, net asset values and strategies through filing the Form PF, which is unavailable to the public. Instead, it is used by the authority to analyze, supervise and control risk. However, the EU Directive requires audited annual reports available to investors and authority on demand. The rule allows the public to easily get access to the relevant information they need. These differences indicate the EU regulation has more extensive and strict supervision.

As two of the most popular hedge fund markets in the world, the EU and the US may "set the tone" for appropriate hedge fund regulation and they may become "notable examples to follow" for hedge fund regulators in the other parts of the world. And the other jurisdictions may feel obliged to follow suit and enact regulations similar to the one implemented in the EU and the US. Johnston (2015) suggest that the AIFMD itself creates some pressure for convergence since non-EU hedge funds can only obtain the EU-wide passport and operate investment management when the EU authority believes that there is no significant difference of investor protection, market disruption, and the monitoring of systematic risk between two jurisdictions. It is therefore important to study how regulatory changes impact on the hedge funds' decisions to register in jurisdictions, how hedge funds perform before and after the implementation of the EU Directive, and how certain aspects of major changes in special rules or their combinations influence the overall industry.

Prior studies provide conflicting results over the effect of changes of the US regulation on hedge fund performance. The enhanced oversight by the authority could possibly benefit the hedge funds and their investors by restricting managers from unethical and compensation-oriented actions (Frumkin and Vandegrift 2009). On the other hand, some rules, like disclosure of portfolio holdings, reveal hedge funds' competitive strategies and introduce free-riders which in turn lowers their competitive advantages and incentives of managers, ultimately reducing hedge fund performance (Cumming and Dai 2010; Shi 2017; Agarwal et al. 2013). Some studies concentrate on the overall effect of the Dodd-Frank Act combining the enhancement of registration and disclosure but still have opposite conclusions. For instance, Cumming, Dai, and Johan (2017) compare pre-Dodd-Frank period and after-Dodd-Frank period and find evidence that US funds have lower alpha after the effectiveness of Dodd-Frank Act. Oppositely, Kaal et al. (2014) find a positive relationship between the Dodd-Frank Act and hedge fund performance even though the effect is not persistent and is absorbed in the months following the effectiveness of the Act. Overall, a consistent conclusion can be drawn from prior studies that disclosure of portfolios negatively influences the performance of certain funds that have their special strategies. But it is still uncertain about the results of comparison of benefits (reducing managers' manipulation and increasing market efficiency) and costs (compliance costs and competitive strategies disclosed lowering incentives of managers) by the combination of several requirements. And we cannot obtain a clear conclusion about the relationship between the level of strictness of regulations and hedge fund performance.

On the contrary, there is no relevant information about the impact of the Directive on Alternative Investment Fund Managers on the overall hedge fund performance and investment assets. It is unreliable to speculate the influence of the EU Directive merely relying on the prior

results for the following two reasons: first, prior studies provide controversial evidence about the effect of the US Dodd-Frank Act, and so it would be difficult to identify the effect in the EU context based on the comparison of two sets of hedge fund rules. Second, the backgrounds of EU member states before the enactment of the EU Directive are various and so the changes are different in analyzing the effects. We plan to fill this gap and provide a systematic empirical analysis on the impact of this Directive on hedge funds in the EU context.

Prior literature mainly focuses on the testable change of hedge fund performance relative to the special rules while the extent of regulatory arbitrage is seldom detected because of the historically incomplete registration information and disclosure of hedge funds to the corresponding authority. In details, according to the report on the operation of AIFMD by KPMG (one of the big four accounting organizations), the size of total assets in AIFM almost doubled from the year 2011 and the cross-border distribution of AIFs grew from 3% in 2017 to 5.8% in 2019. The growth of distribution of hedge funds in the EU may come from the portion of hedge funds in offshore sites that used to focus on the EU market and choose to relocate after the AIFMD. But the other portion of hedge funds that decide to leave the EU market is not able to be assessed. And so our research will follow the stream of literature discussing the relationship of hedge fund performance and regulations but we specifically concentrate on the recent EU Directive.

Our research uses several approaches to investigate the impact of the EU Directive 2011/61/EU on alternative investment fund managers on hedge fund performance. First, we follow some prior studies to form the difference-in-difference (DID) method to compare: 1)the performance change of EU hedge funds and Non-EU hedge funds that do not meet exemption rules and 2)the performance change of EU hedge funds meeting exemption requirements and EU hedge

funds with no exemption rights. The results show a drop of performance (.21%) by alpha in the first comparison but there is no significant change in the second comparison. However, the method is limited in tracking the effect because a single comparison of two groups one time allows some noises existing in the two groups, like the different development speeds of the hedge funds in two markets, or a factor with different sensitivity to the macro environment, like the development difference of big hedge funds and small hedge funds.

Second, to further rule out the noise we formulate a difference-in-difference-in-difference (DDD) and compare the performance changes by AIFMD of constrained EU funds with unconstrained EU funds and corresponding two Non-EU fund groups. In this case, it is unlikely that the trend difference of different markets and sensitivity difference of different groups would be influential in our results. Third, we address the concerns that some funds classified as EU hedge funds in the database may not be authorized after the AIFMD possibly because hedge funds update information with delay in the financial database. Also, the date of registration of hedge funds may differ because the rules might become effective in different countries and the dates of funds applied for authorization varied. Hence, we focus on the fund name list collected from the European Securities and Market Authority (ESMA) and compare the performance changes of registered funds and unregistered funds by propensity score matching (PSM). In this way we are able to get more precise results about the performance changes around specific authorization time periods. Our results from the triple difference confirm that after the PSM, the funds experienced a 0.2% drop in hedge funds' performance change between control group and treated group after the authorization process and being imposed by the relevant rules.

Our research will provide several important contributions both to the academic area

regarding the effect of hedge fund regulation and the application in reality. First, as we discussed before, it is still a long path to investigate the effect of regulations on hedge funds since the trend of specific rules for hedge funds has just started. The prior literature provides some evidence but these are conflicted and not sufficient to give a strong conclusion about comparing the costs and benefits of the regulations. Our studies look into the different measurements of hedge fund performance used in prior studies and some limitations in the common method (difference-in-difference) to investigate the impact of regulations. We introduce the third confounding factor to form the triple interaction term to avoid the potential effect from other factors related to the performance change of control and treatment groups and allow for a more accurate result regarding the relationship of hedge fund performance and regulations.

Second, we add additional evidence from another set of data in the EU context. Most prior studies analyzing hedge fund regulation mainly focus on the effects of US rules (e.g. Aragon, Hertzel, and Shi 2013; Cumming, Dai, and Johan 2017; Shi 2017). The EU market is another major hedge fund market that represents the industry and can contribute to the related topics by providing data to further research. The EU Directive involves some similar modification of rules as the US, like registration and transparency, and some different rule changes, such as independent valuation and depositaries, but its impact on hedge fund performance remains unexplored. Our results will thus include the influence of compliance costs from other special rules not discussed in the prior literature.

Third, our results would be valuable for investors considering EU hedge funds in making their decision. Even though some professional investors have their judgment, retail investors still need some systematic and evidential results to help them in investments. It is mentioned that more

retail investors join the group of hedge fund investment nowadays and so the lack of evidence from the enforcement of the AIFMD would be obstacles for them to invest in a rational way.

More importantly, our study has practical applications for both EU regulators and regulators in other regions who want to follow. The AIFMD is still experiencing a long-term updating process for any amendments. It is critical to understand the past influence for any potential adjustments for optimal level of "tightness" of hedge fund regulation. And the trend of development of hedge funds may need the regulation to be popularized. The aim of the new EU legislation is to foster or develop alternative industry in Europe. That is the reason why the EU commissions invited various groups of industry experts for effective and efficient ways in improving the hedge fund activities in the markets. But whether the result is preferrable raises doubt among the groups of opponents. Other jurisdictions may need such information for understanding and developing hedge fund regulations.

The remainder of the paper is organized as follows. Section 2 reviews the literature on the relationship between US regulation and hedge fund performance, analysis of the difference of rules in the EU and the US. Section 3 makes the prediction about the relationship of the EU regulation and hedge fund performance. Section 4 describes the data and methodology. Section 5 presents the results. Finally, section 6 concludes and provides suggestions for future research of related topics.

# 2. Literature Review

*2.1 The effect of regulations on performance*

In theory, the relationship between hedge fund regulation and hedge fund performance is ambiguous (Cumming and Dai 2010). The enhanced regulation could improve the quality of hedge funds, reduce information asymmetry between the managers and investors or authorities, restrict managers from unethical and compensation-oriented actions and possibly improve the performance of the hedge funds (Cumming and Dai 2010, Frumkin and Vandegrift 2009). The lack of regulatory oversight makes it possible for managers to merely chase high compensation and disguise investment schemes, which is a part of the agency problem. One example in Cumming and Dai (2010) is that two funds under the control of the same managers could have strategies of shorting the S&P index and going long on S&P separately. The result would be one wins and one loses but managers still have high compensation from fixed management fees and carried interest performance fees. Neither investors nor regulatory authorities would know the true nature of these hedge funds. Given the improved regulation and oversight, hedge fund structure and performance may be enhanced by preventing managers from such behavior. However, the regulations and rules may hamper hedge fund performance because managers lose freedom to contract and organize resources in the most efficient way. Under the pressure of regulations, managers may behave in some conservative ways to form strategies and would not get some "bold" rewards. The common regulations such as registration, restrictions on minimum hedge fund size, restrictions on the location of key service providers, and market channels for hedge fund distributions not only set barriers to entry or participate and to choose efficient human resources but also impose high compliance costs on hedge funds and influence their instant and continuous performance. And so the regulations may lead to worse performance and less efficient hedge fund structures (Cumming and Dai 2010).

To have a clear understanding of the relationship between regulations and hedge fund performance. Cumming and Dai (2010) collectively investigate 29 countries' hedge fund data. Some countries, such as the United Kingdom, have minimum capital requirements to operate as hedge fund managers, restrictions on marketing channels (banks, fund distribution companies, other financial service institutions, ect.). Besides above related regulations, countries like Canada and Germany, have restrictions on location of key service providers. The results show that the requirements like locational restrictions of key service providers give rise to lower performance. But minimum capital requirements and locational restrictions of key service providers are associated with lower standard deviations of returns. Therefore, the requirements could lower risks in the market.

Other than international differences in hedge fund regulations, several papers focus on regulations of hedge funds in the United States. Section 13(f) of the Exchange Act (adopted by the SEC in 1978) requires hedge fund managers who exercise investment discretion over accounts holding at least $100 million in publicly traded company, convertible bonds or options to make quarterly disclosures of portfolio holding in these securities to SEC on Form 13F within 45 days of the quarter end. However, managers could request confidential treatment to delay public disclosure of some or all of the holdings reported on Form 13F. Then Form 13F "add new holdings" Amendment should be filed within six days of the end of the confidential treatment period (Aragon, Hertzel, and Shi 2013). More transparency is beneficial for investors' decision making, but it may reduce the incentives of hedge fund managers since revealed information makes competitors identify their strategies or free-ride on their efforts. Shi (2017) uses TASS data from

1994 to 2010 and finds that the drop in alpha is concentrated among funds that disclose a greater fraction of their assets. The return correlations between the disclosing funds and other hedge funds that have the same investment style increase after the disclosure. That implies that after a fund discloses, other funds take similar positions. Aragon, Hertzel, and Shi (2013) find that managers are more likely to seek confidential treatment for positions if they perform well in the past. And securities that are kept confidential earn significantly positive abnormal returns over the post-filing confidential period while securities disclosed originally do not have abnormal stock price performance over the same period. Agarwal et al. (2013) also compare confidential holdings and original holdings and find the confidential holdings have higher benchmark-adjusted returns than the original holdings up to 12 months. All these studies suggest that Form 13F and complete public disclosure may encourage free-riding activities and negatively influence fund performance.

In 2006, the amendment of the Investment Advisers Act of 1940 by the SEC was enforced and it required hedge fund advisors to register with the SEC except those that have less than $25 million undermanagement or with a lockup longer than 2 years. And the net worth requirement for accredited investors was raised to $1.5 million. Before the new rule, only limited managers from large hedge funds had registered in the SEC. The new regulations also require the investment advisors to file the Form ADV to disclose publicly several information about fund characteristics such as potential conflicts of interest and past legal problems (Brown et al. 2008). Even though the new amendment of hedge fund regulation has a short life and was revoked soon, some studies utilize the short term to test the influence of the registration and disclosure on hedge fund performance. Frumkin and Vandegrift (2009) expect the rule would reduce fraudulent or unethical behavior of advisors and improve the average quality of investors. They assume that the registration rule will improve the performance of hedge funds. By using a regression of excess

monthly returns over S&P 500 returns on size, age, volatility, and registration rule, they find registration increases hedge fund returns by 11.6 percent comparing before the registration period and registration in-effect period. Brown et al. (2008) focus on the prior performance of two types of opposite attitudes of hedge funds towards the rule and find that hedge funds that were willing to apply for registration had better past performance, suggesting a potential signal from registration in 2006 for investors to make their decision. The study also finds a negative relationship of disclosed past legal issues and existing leverage and a nonsignificant relationship of inflows and legal issues. Their results show that some market participants, such as equity fund investors and prime brokers extending credit already know the information before the rule while retail investors do not have a relevant source to know such information. Therefore, limited evidence shows that a combination of registration and disclosure of general information without details would improve the hedge fund returns.

The Dodd-Frank Act (effective in 2012) requires smaller advisors (with $25-$100 million AUM) register with states instead of SEC, which prevents small advisors from registration exemption. Compared with the 2006 rule of hedge funds, it imposes several more extensive disclosure requirements including the types of investments managed, net asset values, investment strategies, financing information, products used by advisors, risk metrics, performance and changes in performance, positions held though filing the Form PF hedge fund returns (Cumming, Dai, and Johan 2017; Kaal et al. 2014). Because the Dodd-Frank Act improves the oversight, Cumming, Dai, and Johan (2017) expect some risk-averse managers would change their activities for meeting requirements. And the cost of compliance expenditure may lower the returns. They compare pre-Dodd-Frank period and after-Dodd-Frank period and find evidence that US funds have lower alpha after the effectiveness of Dodd-Frank Act. Nonetheless, Kaal et al. (2014) discuss

a similar topic but they find no evidence about the negative relationship of hedge fund performance and the Dodd-Frank Act. Moreover, they find a temporary but positive relationship of monthly return and the coefficient of treated interaction term. These studies have conflicted results regarding the influence of hedge fund registration and transparency on performance.

*2.2 How does AIFMD differ from the Dodd-Frank Act?*

The European Union adopted the Directive 2011/61/EU on Alternative Investment Fund Managers (AIFMD) that authorizes, supervises and regulates the managers of a range of alternative investment funds, such as hedge funds and private funds. The Directive applies to all EU alternative fund managers managing EU or non-EU funds, and to non-EU alternative investment managers who manage EU funds or markets in the EU. (*Directive 2011/61/EU,* Ferran 2011). The following main aspects are summarized and compared to analyze the potential effects caused by the AIFMD.

### 2.2.1 Authorization requirements

The AIFMD has some conditions for the qualification of hedge funds by requiring that funds which apply for the authorization need to meet the requirements such as sufficient initial capital, at least two qualified and experienced managers who have the ability to conduct the investment strategies and office registered in a member state (*Directive 2011/61/EU*). Most hedge funds in the regions without capital requirements in the past only hold the capital required for managing the investment (Kamel 2012). The funds that do not fulfill the capital requirements may attempt to solicit more investments or to be eliminated. And so the rule may screen out the undesirable funds which are not expected to perform well without sufficient assets and competent

managers while reducing the number of small hedge funds without the ability to raise adequate capital for the operation.

Unlike the US laws allowing for the existence of offshore hedge funds marketing in the US but not subjected to the US requirements, the AIFMD has constraints on all hedge funds which market in the EU. Then non-EU funds domiciled in the third country which considers EU investors would be faced with two choices. First, non-EU funds overcome hurdles that are required for outside fund marketing in the EU. Such hurdles involve cooperation arrangements between the third country and EU member states and agreements about effective exchange of tax information. Therefore, the hurdles put the non-EU hedge fund at an inferior position. Reaching such requirements highly depends on relevant local government policy and system instead of hedge funds themselves. Some hedge funds domiciled in popular hedge fund offshore locations such as Cayman Islands, British Virgin Islands, Guernsey would be excluded from the EU market due to not being able to comply with the tax model (Kamal 2012).

Second, hedge funds may re-domicile in one of the member states in the EU. The advantage is that the relocation makes it possible to have the largest pool of investors including EU investors and global investors. Moving funds from offshore countries to onshore Europe contributes to the dynamic market in the EU. However, the funds that choose to relocate have to bear double costs involving the cost of relocation and the cost of meeting the requirements of AIFMD. The cost of restructuring hedge funds to meet the current needs of investors is estimated to be significant (around €1.4 billion) (Kamal 2012).

Assuming the undernourished hedge funds decrease due to the strict rule, the overall industry performance is expected to grow (Frumkin and Vandegrift 2009). The EU Directive

requires minimum capital amounts and qualified managers to assure the quality of the industry, which seems positively influential on hedge fund performance. However, the minimum capital requirement also raises the capital costs for some small funds. As to the hedge funds located in third countries but plan to market in the EU, it is expected to have an additional one-time cost for relocating in a member state of the EU and the cost of authorization and restriction is probably greater than the benefits from the improvement of the overall hedge fund quality.

### 2.2.2 Independent Valuation and depositaries

Unlike the US which depends mainly on the authority to monitor the risk, the EU also utilizes third parties such as credit institutions or external valuers. The fund should ensure independent valuation of assets at least once a year and need a single depositary for the safekeeping of the assets and monitoring cash flows (*Directive 2011/61/EU*). The depository is responsible for assuring cash flows and verifying the ownership of all other assets by the AIF. And it is liable for the loss if the financial assets are held in custody unless due to some external events beyond the control. The depository could increase investors' confidence by reducing asymmetric information between the manager and investors (Kamal 2012). But failing to correctly value the assets of hedge funds may lead to sanctions by the authority for the valuation shortcomings. It is effective in controlling risk in a continuous way while hedge funds would unavoidably distract the attention and invest more in its operation and management in case of any violation of the AIFMD. The compliance cost from the valuation and depository is continuous and constitutes an important part of total cost.

### 2.2.3 Transparency and disclosure

Similar to the Dodd-Frank Act, the funds need to disclose relevant information about the investment strategies, performance, and assets. According to the AIFMD, the fund needs to prepare an annual report for investors on request and the competent authorities of the home Member State and the accounting information given in the annual report shall be audited. Investors have the right to know the investment strategy and objectives of the AIF, a description of the types of assets in which the AIF may invest, the techniques it may employ and all associated risks, any applicable investment restrictions, the extent of leverage, the maximum level of leverage, the circumstances in which the AIF may use leverage, etc (*Directive 2011/61/EU*). The difference is that the US intends to disclose this information to the authorities instead of the investors to analyze and monitor the risk while the EU requires not only initial disclosure of relevant information but also the annual reports which are available to both the investors and the authority. And the EU regulators pay special attention to imposing pressure to use high leverage. Therefore, it is easier for competitors to identify their techniques in investment and managers may lose the incentive to explore aggressive tactics by high leverages. From the perspective of scope of information disclosed, the AIFMD makes hedge fund transparent approaching to general fund status and would weaken hedge fund performance especially for some "secret" strategies.

### *2.3 Comparison of EU regulations before AIFMD among countries*

Hedge funds are mostly managed in the US, which accounts for 68% of the hedge fund industry in late 2009, and the EU is in second place and accounts for 23%. Within the EU, the UK plays a dominant role as the hedge fund management with other individual members having less than 10% distributions. However, the location of management could differ from the authority of registration (Woll 2012). Some regions, such as Cayman Islands, British Virgin Islands, Delaware

(US), Bermuda and Guernsey, have relatively lax regulations with lowest tax rates and so attract hedge funds as offshore domiciles. These offshore locations usually have no corporate taxes, lax regulations and further help avoid personal tax in corresponding onshore locations. One example is that non-US investors are exempted from tax obligation if the hedge fund is not domiciled in the US (Kamal 2012). Hedge funds set offshore sites to lower their tax obligation, simplify their operation and management, and thus allow for higher returns for investors.

The centers of hedge fund management, UK and US, used to allow the variation of domicile and management. Even two regions have distinction in their regulation models and executions before 2010, for instance, US hedge fund managers could use the legal exemption and avoid the registration as managers with SEC while the UK managers should be accredited by the Financial Services Authority, hedge funds themselves did not see the coerciveness to be registered in nether regions (Fioretos 2010). In 2009, around 78% hedge funds were incorporated in offshore tax havens. Other than those offshore countries or regions, main domiciles in the EU are Ireland and Luxembourg (Woll 2012).

It is expected that domiciles in some traditional choices, like Ireland and Luxembourg would increase after the implementation of the AIFMD when some non-EU hedge funds do not want to give up the EU market and consider to redomicile. In fact, the proportion of hedge fund domicile in the Caymans has already dropped by 7.5% (from 40% to 37%) while the proportion of Ireland and Luxembourg has increased by 60% (from 4.5% to 7.3%) from 2008 to early 2010s. It seems that after the effectiveness of the directive, it is hard for hedge funds seeking global investors including the EU investors to register in the offshore sites and escape from hedge fund regulations (Kamal 2012).

Hedge funds were not regulated at the EU level before the adoption of the EU Directive. But hedge fund managers might be regulated in member states by a combination of financial and company law regulations, accompanied by industry-developed standards in some sectors (Moschella 2011). In continental Europe, there were regulations about registration, disclosure, and reporting requirements (Woll 2013). Some countries, such as France, Italy, Spain and Germany, regulate the fund as an onshore vehicle (Quaglia 2011). But most countries accounted for only a small part of hedge fund business in the EU. We focus on the analysis of regulation changes of three countries as examples including the United Kingdom, Ireland, and Luxembourg. These countries, together with France, account for over 50% managers authorized in the EU (ESMA 2019 Report).

The UK, as the most popular financial market in the EU, hosted four-fifths hedge funds in the EU (Quaglia 2011). It mostly relied on indirect regulations that were imposed on the counterparts instead of hedge funds (Woll 2013). The Financial Services Authority (FSA) has a principle-based approach to regulation. But the principles are very broad that allows the FSA to change the approach without enacting any legislation. The UK requires authorization of persons if relevant hedge funds products and services are to be traded in the public, it also needs information about investment strategies. However, most hedge funds were not authorized because they did not want to release their strategies (Sami 2009). Other relevant regulations in the UK were too general and not specific to hedge funds. And so it may cause problems in implementing the rules.

In Ireland, several forms- the Unit Trusts, Investment Limited Partnerships, Common Contractual Funds, and Variable or Fixed Asset Company can be used as the legal structures of AIFs and different rules were evolved for the different legal structures. For example, the

Investment Limited Partnerships Act 1994 regulates investment limited partnerships and the Investment Funds, Companies, and Miscellaneous Provisions Act 2005 regulates Common Contractual Funds. Commonly it requires an authorization process for the AIF itself and the authorization process for its promoter and service providers. In addition, adequate information on the expertise and the reputation of the proposed directors of the management company must be provided and the minimum capital of the management company is specified. There is no limit on the leverage, but prospectus disclosure is necessary. Annual audited financial statements are required. And the monthly report should provide information about net asset value and net subscription and redemptions in the fund units/shares during the month and the method of valuation of assets should be disclosed in the fund's constitutive document and prospectus.

Luxembourg has various regulatory frameworks that can be applied by hedge funds that are distinguished by the strictness of regulations. The vast majority of hedge funds before the AIFMD are set up as the Specialized Investment Funds that are subject to a lighter regulation. However, even the lighter set of rules needs the demonstration of managers' qualification and reputation for approval of launch of entities. There is no minimum capital requirement, but the minimum must be reached within a period of twelve months following its authorization. Depositories and annual audited financial statements are required but the publication of net asset value is not necessary (ALFI 2014).

Overall, these countries have their own regulations before the AIFMD while they either did not have the strong force for hedge funds to register such as the UK or had different sets of regulations varying in the strictness for a certain scope of hedge funds such as Luxembourg or Ireland. Differences exist in the force of implementation, the specification or the strictness of

authorization, operation, valuation, and disclosure requirements but they have some similar rules in these aspects. Luxembourg has the rule about depository while other two countries do not have relevant requirements. After the AIFMD, the hedge funds would be subjected to the same standard rules and it is convenient for hedge fund managers to market in the EU region. It seems the AIFMD is much more tight and more comprehensive in the regulated activities and execution (Kim 2014) and the scope of the new regulation covers more entities and avoids most of the off-shore funds to operate in the EU markets.

# 3. Hypothesis

Reasons for both negative and positive relationship of hedge fund performance and the AIFMD hold based on the prior conflicted study results. The requirement of authorization in AIFMD ensures managers with qualification and experience. The regulation also requires a process of monitoring conflicts of interests and risk management. These aspects should improve the operation of hedge funds and alleviate the risk of misreporting. However, the process of valuation, the appointment of depositories would evidently increase the operational costs. The leverage constraints and disclosure requirements restrict managers from potential investment opportunities or specific strategies that may benefit free riders.

We expect the AIFMD would have oversights and influence on hedge funds of two sources. The first source is the hedge funds existing in the EU supervised by local authority or industry standards most probably with less strict regulations. Another source is hedge funds coming from offshore sites with lax regulations. The influence for hedge funds in third countries would be greater since they would be subject to both the relocation cost and other compliance costs. And

their previous rules are laxer compared to the rules of other hedge fund EU member states. Even jurisdictions in different areas had different regulations in terms of authorization and transparency before the EU directive, in general, the enforcement of AIFMD, as minimum requirements, would influence the funds that domiciled in regions that had lax regulations, such as offshore sites. If a country had stricter regulations, the new rule would not be that influential when the country has its special considerations and chooses not to downgrade its requirements. Prior studies suggest that public disclosure is negatively related to hedge fund performance, and the EU AIFMD involves a large amount of relocation cost. Considering the extra continuous costs of appointment of depositories, independent valuation, and violation of independent valuation, it seems the costs will outweigh the benefits from the improvement of the hedge fund industry.

In addition, Kehoe (2013) points out that the rigid approach of AIFMD seems to make hedge funds behave like mutual funds. But prior studies show some evidence that hedge funds provide more risk-adjusted return than mutual funds (e.g. Eling and Faust 2010). If the authorities make efforts to regulate hedge funds towards mutual funds and abandon characteristics such as the freedom to use high leverage, less transparency to hide special strategies, it is reasonable to rethink the earning ability of hedge funds. Based upon all above reasons, we have our hypothesis as follows:

**H1:** Hedge funds marketing in the EU have lower risk-adjusted performance after the AIFMD was transposed into EU countries' national laws.

# 4. Research Design

*4.1 Data Collection*

We obtain data from the Eurekahedge database and European Securities and Markets Authority database. Eurekahedge is a commercial hedge fund database that provides a comprehensive and global data of hedge funds including monthly returns and main characteristics of funds such as country focus, domicile, leverage, management fee, performance fee, hurdle rate, main strategies, management company. By the end of November 2021, the database has 26,862 global hedge funds. We exclude 8,864 US hedge funds because relevant hedge fund regulations (Dodd–Frank Act) became effective in 2012. And Cumming et al. (2020) has provided evidence that the rule has an effect on the US hedge fund regulations.

We did the following procedures to mitigate the survivorship bias and backfilling bias. We checked all data involved and found our data are less likely to suffer from survivorship bias because they are all post 1994, when the database includes both live and dead hedge funds. Backfilling bias occurs when a new hedge fund enters a database, it has an incubation period to record past performance. If the past performance is good, the record is backfilled. If the past performance is bad, the hedge fund will probably cease the operation. This situation makes average returns in databases biased upward (Fung and Hsieh 2004). We only include the observations that post the initial date of adding the information of hedge funds to mitigate the backfilling bias.

To further test the authorized entities' performance, we need the monthly return of entities listed on the official website of the European Securities and Markets Authority. Using the list has two advantages: 1) We can identify the exact time when each entity started to comply with the

AIFMD and have the comparison within each entity instead of utilizing the uniform date of effectiveness of the rule; 2) the information of the database is based on the provided information from hedge funds, we could not rule out the possibility that some hedge funds that used to specialize in the EU market shifted their focuses and leave the EU market after the enactment of EU hedge fund regulations but did not update the relevant regional information. The survey conducted by Open Europe indicated that 27% had a preference to give up the EU market if the Directive became effective (Kamal 2012). Nonetheless, the information could be inaccurately updated or reflected on the website since some key words of "country focus" in the database involve multiple regions and the EU is in their list of regions. The fact is we did find in the database some hedge fund domiciling in the offshore sites (e.g., Cayman Island) show their European "country focus". As we discussed the potential choice of hedge funds in the third countries, theoretically, it is possible but hard for hedge funds to operate in offshore locations and so it is reasonable to question that some geographical information of hedge funds was not correctly updated.

Since the entities include funds of funds, real estate funds, hedge funds, and private equity funds, it is necessary to identify the hedge funds by searching for the relevant information from a commercial hedge fund database. We downloaded the AIFM list, which involves 3,696 entities by the end of 2021. We identify the authorized hedge funds by searching the entity name on the platform of Eurekahedge corresponding to the management company. If the entity name is close to the management company but not the same, we confirm whether the address is the same to include the fund. For the management companies that have multiple funds located globally, we only include the funds that are either domiciled or marketed in the EU in case our list involves other funds that are less likely to apply for the authorization. Moreover, we do not include the

funds managed by the EU managers but not marketed or domiciled in the EU since they are exempt from strict rules such as the requirements in respect of depositary and fund annual reports.

**Table 1 Summary statistics on hedge fund characteristics**

Panel A reports the hedge fund returns, flows, and AUM divided by the pre- AIFMD / post- AIFMD period and EU / NonEU region. NonEU region excludes the US because the Dodd-Frank Act became effective in 2012. Panel B shows other fund characteristics provided by the Eurekahedge. Hurdlerate, watermark, leverage, lockup are dummy variables that indicate whether the hedge fund uses hurdlerate, watermark, leverage, lockup in the operation. Panel C & D list the distribution of authorization and withdrawal in each year according to the ESMA (European Securities and Markets Authority).

Panel A Hedge Fund Returns, Flows, and AUM

| | EU | | | NonEU | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Before AIFMD | Post AIFMD | Totals | Before AIFMD | Post AIFMD | Totals | Before AIFMD | Post AIFMD | Totals |
| Frequency | 1,991,952 | 850,014 | 2,841,966 | 1,247,000 | 532,125 | 1,779,125 | 3,238,952 | 1,382,139 | 4,621,091 |
| Percent | 43.11% | 18.39% | 61.50% | 26.98% | 11.52% | 38.50% | 70.09% | 29.91% | 100.00% |
| AUM (millions) | | | | | | | | | |
| Mean | 365.02 | 620.55 | 535.45 | 155.9 | 263.91 | 191.92 | 250.84 | 538.16 | 406.51 |
| Median | 89 | 147 | 123 | 38 | 53 | 43 | 56 | 117 | 84 |
| St.d. | 906.93 | 1444.81 | 1296.43 | 529.79 | 1137.76 | 788.26 | 733.16 | 1388.12 | 1144.89 |
| Returns (%) | | | | | | | | | |
| Mean | 0.48 | 0.31 | 0.37 | 0.73 | 0.57 | 0.68 | 0.61 | 0.37 | 0.49 |
| Median | 0.44 | 0.26 | 0.32 | 0.68 | 0.51 | 0.63 | 0.56 | 0.31 | 0.42 |
| St.d. | 4.45 | 3.64 | 3.98 | 5.3 | 5.87 | 5.48 | 4.92 | 4.29 | 4.62 |
| Flows (millions) | | | | | | | | | |
| Mean | 3.09 | -0.02 | 1.01 | 0.67 | -0.69 | 0.22 | 1.77 | -0.17 | 0.71 |
| Median | 0.01 | -0.08 | -0.02 | 0.00 | -0.04 | 0.00 | 0.00 | -0.07 | 0.00 |
| St.d. | 61.39 | 86.44 | 79.07 | 48.3 | 36.6 | 44.71 | 54.63 | 77.79 | 68.23 |

Panel B Fund Characteristics

| | Mean | St.D. | First quartile | Second quartile | Third quartile |
|---|---|---|---|---|---|
| Hurdlerate | 0.28 | 0.45 | 0 | 0 | 1 |
| Watermark | 0.77 | 0.42 | 1 | 1 | 1 |
| Leverage | 0.82 | 2.01 | 0 | 0 | 0.5 |
| Lockup | 0.11 | 0.32 | 0 | 0 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| PerformanceFee (percent) | 15.85 | 7.69 | 15 | 20 | 20 |
| ManagementFee (percent) | 1.43 | 0.63 | 1 | 1.5 | 2 |
| UCITS | 0.38 | 0.48 | 0 | 0 | 1 |
| SharpeRatio | 0.84 | 26.02 | -0.02 | 0.39 | 0.82 |
| SortinoRatio | 1.73 | 17.86 | -0.04 | 0.58 | 1.33 |
| AnnualisedReturn | 4.42 | 24.34 | -0.14 | 3.4 | 7.63 |

Panel C Distribution of the Number of Authorization of the Entity

| | Authorization | Percent |
|---|---|---|
| 2013 | 9 | 2.53 |
| 2014 | 177 | 49.72 |
| 2015 | 65 | 18.26 |
| 2016 | 34 | 9.55 |
| 2017 | 31 | 8.71 |
| 2018 | 14 | 3.93 |
| 2019 | 16 | 4.49 |
| 2020 | 8 | 2.25 |
| 2021 | 2 | 0.56 |
| Total | 356 | 100 |

Panel D Distribution of the Number of Withdrawal of the Entity

| | Withdrawal | Percent |
|---|---|---|
| 2017 | 6 | 3.35 |
| 2018 | 3 | 1.68 |
| 2019 | 4 | 2.23 |
| 2020 | 162 | 90.50 |
| 2021 | 4 | 2.23 |
| Total | 179 | 100.00 |

Table 1 shows the descriptive characteristics of hedge funds. Panel A reports the hedge fund returns, flows, and AUM divided by the pre- AIFMD / post- AIFMD period and EU / NonEU region. The returns are net of fees. The inflows are measured by $AUM_{t+1} - AUM_t * (1+Return\%)$. The dataset excludes the US because the Dodd-Frank Act became effective in 2012. Panel B shows other fund characteristics provided by the Eurekahedge. Hurdlerate, watermark, leverage, lockup are dummy variables that indicate whether the hedge fund uses hurdlerate, watermark, leverage, lockup in the operation. Panel C & D list the distribution of authorization and withdrawal in each year according to the ESMA (European Securities and Markets Authority).

*4.2 Methodology*

### 4.2.1 Measurement of hedge fund performance

Prior studies utilized different methods to measure hedge fund performance in the relevant literature. Frumkin and Vandegrift (2009) use the monthly returns in excess of S&P 500 returns to represent the hedge fund performance possibly due to the short effectiveness of the period of the 2006 amendment of the Investment Advisers Act by the SEC. And Kaal et al. (2014) simply use the monthly return to compare the instant or short-term influence of performance. Both studies lead to a positive relationship of hedge fund performance and enforcement of regulations. However, most studies use the alphas through the linear aggression of hedge fund returns on risk factors to evaluate the performance and they provide evidence that the regulation negatively influences the hedge fund performance.

The conflicted results from prior research may come from the different measurements of the hedge fund performance. Using monthly returns to reflect the hedge fund performance could be inaccurate because the returns include some risk-factor returns that are not representative of hedge fund earning ability. The increase of the returns may come from the increase of the general market returns. To avoid invalid comparison, we use the Fung & Hsieh (2004) seven factor model with the emerging market factor(MSCI Emerging Market index monthly total return) (Fung & Hsieh 2006). The model involves bond, currency, and commodity trend-following risk factors, equity market factor (Standard & Poors 500 index monthly total return), the size spread factor (the difference between Russell 2000 index monthly total return and Standard & Poors 500 monthly total return), the bond market factor (monthly change in the 10-year treasury constant maturity yield), the credit spread factor (difference between monthly change in the Moody's Baa yield and

10-year treasury constant maturity yield). These factors can explain above 50% of hedge funds (Fung & Hsieh 2004). Many hedge fund studies use these factors to measure the performance (e.g. Bali et al. 2013; Kosowski et al. 2007; Teo 2009). Following Shi (2017), we use the non-overlap two-year window of individual hedge funds as the periodical performance and regress the monthly return over the two-year window on the eight factors. The unexplained return observed by the intercept (or alpha) represents the abnormal return obtained by managers' particular skills.

### 4.2.2 Difference-in-difference method (DID)

To evaluate the impact of AIFMD on hedge funds, we use the difference-in-difference method commonly utilized by prior studies that want to evaluate the influence by a certain hedge fund regulation (e.g. Shi 2017, Cumming et al. 2017, Kaal et al.2014). First, we compare the change in performance before and after the AIFMD was imposed into national laws within the European Union between funds with no exemptions and funds with exemptions. According to the Directive, the Directive should apply to AIFMs managing funds that are not covered by UCITS. In addition, the smaller funds that assets under management (AUM) do not exceed 100 million euros or the funds that have AUM between 100 million euros and 500 million euros and at the same time, are unlevered and have lockup requirements of at least 5 years are exempted from strict regulations. They are only required to register and provide information on strategies and instruments. We exclude these groups in the treated group, our control group are exempted funds within European Union:

$$\textbf{Performance}_{i,t} = \gamma_i + \gamma_t + \beta 1\textbf{nonexemption} + \beta 2\textbf{post} + \beta 3\textbf{nonexemption\_post}_{i,t} + \textbf{Controls}_{i,t} + \varepsilon_{i,t} \quad (1)$$

where dependent variable is eight factor alpha obtained from evenly divided period t of 24 months of fund i. The nonexemption_post is a dummy variable that equals to 1 if the manager of fund i is subject to AIFMD in period t post July 2013 when the AIFMD is transposed into national laws and 0 otherwise. If a period covers July 2013, we treat it as before the AIFMD. Similar to Shi (2017), control variables are lagged log fund size or the linear and quadratic terms of lagged fund size. We assume each fund has its own characteristics such as management fee, lockup requirements, incentive fee, and regional focus that affect its influence and the time trend would cause overall influence by worldwide markets or other time trends. The $\gamma_i$ represents fund fixed effects and $\gamma_t$ reflects time fixed effects, and $\varepsilon_{i,t}$ is an idiosyncratic error.

Second, we compare the change of performance funds that do not meet relevant exemption rules before and after the AIFMD was imposed into national laws between the European Union and other regions (we exclude the US funds because the Dodd–Frank Act became effective for US funds in March 2012). The control group are large funds that do not meet relevant exemption rules in other regions:

$$\textbf{Performance}_{i,t} = \gamma_i + \gamma_t + \beta 1\textbf{eu} + \beta 2\textbf{post} + \beta 3\textbf{eu\_post}_{i,t} + \textbf{Controls}_{i,t} + \varepsilon_{i,t} \quad \textbf{(2)}$$

Where eu_post equals 1 if the fund i is a European fund in period t post AIFMD is transposed into national laws and 0 otherwise. As in equation (1), β3 is the key indicator of the interaction term that reflects the influence.

However, limitations remain within the DID method in exploring the effect of the regulations. Cumming et al. (2017) use the April 2012 to divide the pre-regulation and post-regulation periods and regress alpha on the interaction of post period and US hedge fund. The

negative coefficient can show the US hedge funds experience a negative change or less development relative to other areas. But it is still possible to explain the result by other reasons than the regulations. For instance, the US market is saturated and has fewer marginal returns (suppose the asset inflows are similar for the treatment and control groups). Or hedge funds in other regions are more sensitive to the development of the financial market after the global crisis. These factors can influence the DID result and cause a similar effect as the regulations. It would be better to introduce a third confounding factor that allows us to compare not only the EU hedge funds with other global hedge funds but also a subgroup of EU hedge funds subjected to the AIFMD with another group of the EU hedge funds not subjected to the AIFMD. And so we use the difference-in-difference-in difference method (DDD).

### 4.2.3 Difference-in-difference-in-difference method

We combine the two Difference-in-Difference (DD)s and form DDD to investigate the impact of AIFMD on hedge funds. It allows evaluation of differences before and after AIFMD comparing relevant funds from EU and other regions, at the same time, it accounts for differences before and after AIFMD between funds with exemption and no exemption:

$$\textbf{Performance}_{i,t} = \gamma_i + \gamma_t + \beta 1\textbf{eu} + \beta 2\textbf{post} + \beta 3\textbf{nonexemption} + \beta 4\textbf{eu\_post}_{i,t} + \beta 5\textbf{nonexemption\_post}_{i,t} + \beta 6\textbf{eu\_nonexemption\_post}_{i,t} + \textbf{Controls}_{i,t} + \varepsilon_{i,t} \quad (3)$$

In equation (3), β6 measures the double-interaction influence among the EU, post, and funds with no exemption. The results show the value of the difference of performance changes from before-AIFMD to post-AIFMD between funds with exemption and non-exemption in the EU minus the difference of performance changes from before-AIFMD to post-AIFMD between funds

with exemption in other regions.

### 4.2.4 Propensity score matching

We use the propensity score matching to make sure our control group includes only hedge funds that have been authorized by the EU authority since some information of country focus or location in the commercial database may not be updated in time. In this way, we can also address the concern that the dates of authorization of different entities differ because of the time difference of effectiveness of AIFMD in national laws and the application date. Following Shi (2017), we exactly match the investment strategies and the time variable. The hedge funds are commonly analyzed by investment strategies in prior studies and different strategies have been shown to differ in their performance (Aggarwal and Jorion 2010; Bali, Brown, and Demirtas 2013). And the time variables affect the general hedge fund returns especially when the market has fluctuations (Agarwal, Arisoy, and Naik 2017).

We include other variables that are both likely to affect the performance and the authorization. Prior studies provide evidence that size is related with the hedge fund performance even though their results are inconsistent. In our context, the size of a hedge fund directly also relates to the obligation of authorization. The flows with the prior assets under management are correlated with size, and hence the flows are included in our variables for selecting appropriate control observation.

Considering the scope of the AIFMD, we add the EU/NonEU and UCITS/NonUCITS for the nearest match. The UCITS hedge funds are not required to apply to be AIFMD hedge funds, but some UCITS hedge funds still register as AIFMD hedge funds. These funds are convenient in

the application since the two sets of rules share some similarities and authorized managers of a UCITS are entitled to request to be authorized as AIFM subject only to complying with any relevant additional requirements for the new authorization. It is necessary to match based on close groups for consistent comparison. We expect the EU hedge funds and NonUCITS funds are more likely to apply for the authorization and the different groups may differ in their performance. Furthermore, we have other fund characteristics that are possible to influence the performance, such as leverage, lockup, high watermark, hurdle rate, management fee and incentive fee, and further influence their size and possibility to be under the control of AIFMD.

After the matching, we use the difference-in-difference method to test the influence of authorization based on the propensity matching results:

$$\mathbf{Performance}_{i,t} = \gamma_i + \gamma_t + \beta\mathbf{treated\_post}_{i,t} + \mathbf{Controls}_{i,t} + \varepsilon_{i,t} \quad \mathbf{(4)}$$

# 5. Results

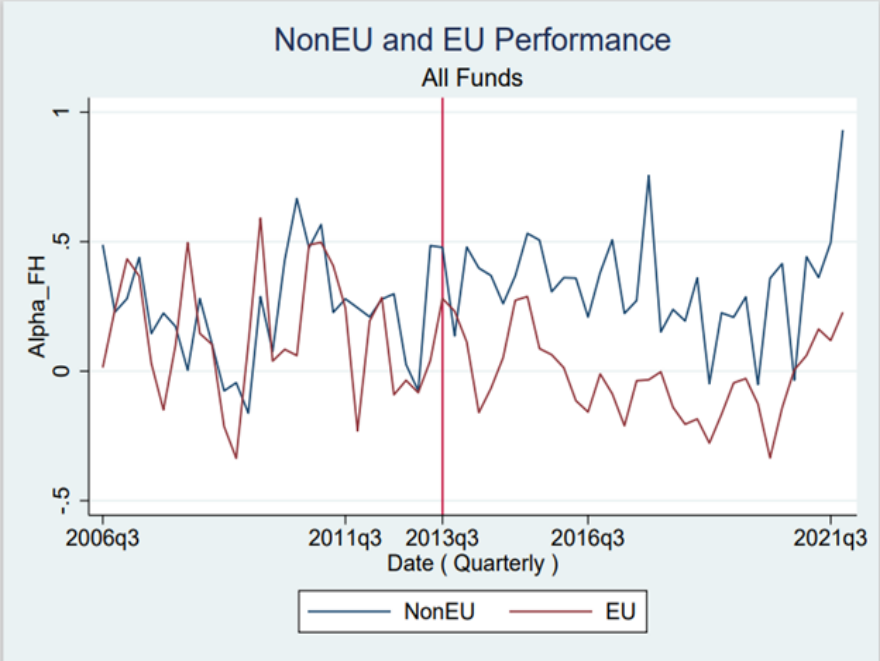


**Figure1. NonEU and EU Performance**

Figure 1 describes overall EU and NonEU hedge fund performance from 2006 to 2021. The x-axis represents the timeline that ends the two-year window of individual hedge funds. The figure shows that before the AIFMD was imposed, there was not much difference between EU and NonEU alphas. Instead, they overlapped to a large extent in their performance. However, the EU funds performed worse than the after-2013 period while the NonEU funds seem better than the pre-2013 period. And so EU hedge funds were .5% lower in alpha than NonEU hedge funds on average after 2013.

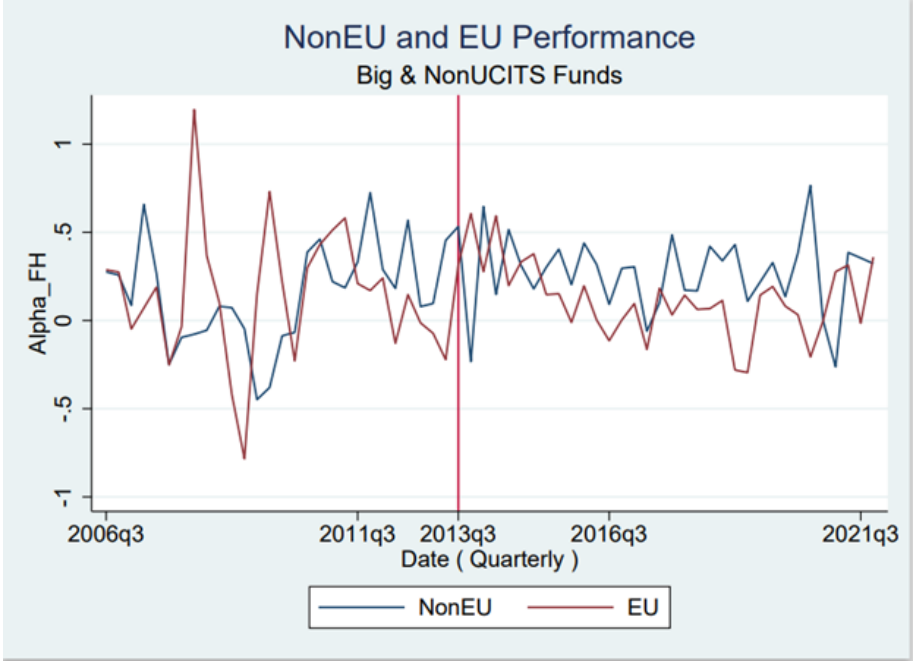


**Figure 2. Performance of EU and NonEU Funds without Exemption**

Figure 2 also presents the performance of EU and NonEU groups, but the hedge funds are those constrained by the AIFMD according to the size and NonUCITS identity. The results show that before 2013, they were still similar but differed in fluctuations. Neither EU nor NonEU hedge funds outperformed the other group all the time before the AIFMD became effective. After 2013, EU funds' alpha became lower than NonEU funds' alpha. However, the difference is not huge.

**Table 2 Difference-in-Difference and Triple Difference estimations**

| | (1) DDD | (2) DD_eu_post | (3) DD_nonexemption_post |
|---|---|---|---|
| eu | 0 | 0 | |
| | (.) | (.) | |
| post | -1.586* | 0.0000287 | 0.406 |
| | (0.899) | (0.158) | (0.639) |
| nonexemption | -0.228*** | | -0.120* |
| | (0.0586) | | (0.0677) |
| eu_post | 0.0279 | -0.211*** | |
| | (0.0636) | (0.0706) | |
| nonexemption_post | 0.137** | | -0.0998 |
| | (0.0687) | | (0.0616) |
| eu_nonexemption | 0.11 | | |
| | (0.0746) | | |
| eu_nonexemption_post | -0.236*** | | |
| | (0.0869) | | |
| aum_euros | -0.0000953*** | 0.0000696 | -0.0000691** |
| | (0.0000209) | (0.0000474) | (0.0000303) |
| lnaum | -0.0622*** | -0.341*** | -0.0624*** |
| | (0.0154) | (0.0409) | (0.023) |
| aumsq | 4.78e-09*** | 1.47E-09 | 3.58e-09** |
| | (9.73E-10) | (1.08E-09) | (1.52E-09) |

| | | | |
|---|---|---|---|
| _cons | 2.676*** | 6.676*** | 0.716 |
| | 0.903 | 0.792 | 0.484 |
| *N* | 22395 | 5371 | 14246 |
| *R2* | 0.08 | 0.155 | 0.131 |

Standard errors in parentheses

** p < 0.1, ** p < 0.05, *** p < 0.01*

Table 2 shows the results of DDD and two DDs of the effect on the performance. Column 2 presents the results of equation (2), the coefficient of eu_post captures the influence of AIFMD before and after the rule comparing the EU and other regions. It shows, on average, the EU funds under AIFMD experienced a 0.21% drop in performance change after the rule compared with the corresponding funds of other areas. The result is significant at 1%. However, we cannot rule out the possibility that EU funds and nonEU funds have different sensitivity to the market situation or time trend around the year 2013. If the macro factors cause different influences between the treated and control groups, we could also obtain similar significant results.

Column (3) shows that within the EU, the managers of larger funds and nonUCITS funds that are subject to AIFMD experienced an insignificantly negative influence (0.09%) compared with performance change of funds with exemption. The difference is minor but it also shows the negative influence of AIFMD on funds' performance. Relying solely on the coefficient of interaction in equation (2), the regulation did not cause significant influence on the hedge fund performance. However, unless we are certain that the trend speeds of two groups are the same, we are not able to prove that our hypothesis is rejected.

Column (1) shows the results of triple differences after we include all factors. The estimates of eu_nonexemption_post provides relatively strong evidence that a decline of 0.24% in relevant hedge funds' performance change between treated group and control group within the EU comparing the corresponding difference outside the EU. The coefficient of eu_post denotes the insignificant reverse effect of DD interpreted as the difference in performance change of funds with exemption between the EU and nonEU regions. The coefficient of eu_nonexemption represents the indifference of two groups within each EU or NonEU region prior to the enforcement of the AIFMD. The coefficient of nonexemption_post reflects the positive difference in performance change of funds between funds qualified for exemption and not qualified for exemption in nonEU regions, which is the only significant result among the reverse effects in the DDD. All these results show that the AIFMD constrains the development of EU qualified funds, causing these hedge funds cannot reach the high improvements as the control group in the other region while the hedge funds that do not meet exemption requirements remain the similar trend of development, and so lead to a difference between the developments of qualified and unqualified hedge funds within each EU and NonEU region.

**Table 3 Logit regression in the propensity score matching**

| Variables | authotization |
|---|---|
| lnaum | 0.0807*** |
| | (6.57) |
| flow_period | 0.000116** |
| | (2.51) |
| hurdlerate_dummy | -0.265*** |

| | |
|---|---|
| | (-4.94) |
| watermark_dummy | 0.0635 |
| | (0.96) |
| lev_numer | 0.0738*** |
| | (5.46) |
| managementFee | 0.00602 |
| | (0.14) |
| performanceFee | -0.0241*** |
| | (-6.42) |
| DummyLockup | -0.581*** |
| | (-5.57) |
| eu | 1.763*** |
| | (22.09) |
| nonucits | -0.506*** |
| | (-8.62) |
| _cons | -3.314*** |
| | (-13.01) |
| *N* | 12107 |

*t statistics in parentheses*

** p < 0.1, ** p < 0.05, *** p < 0.01*

Table 3 shows the logit regression for propensity score matching. As we expected, the size and the flows are significantly positive with the hedge fund possibility to apply for authorization. And EU funds have a high possibility to apply for the authorization. The lockup is negatively

related with the authorization probably due to the rule that smaller funds, which have AUM between 100 million euros and 500 million euros with lockup greater than 5 years, are exempted from strict regulations. The rule allows smaller funds with longer lockups not constrained by the authorization of AIFMD. Unlike our expectation, the NonUCITS group which is exempted from the authorization has a higher possibility to apply for AIFMD hedge funds. The potential reason could be the convenience of application as UCITS hedge funds due to the similarity of the sets of regulations.

**Table 4 Characteristics of control group and treatment group**

| | (1) Control Group | | (2) Treated Group | | (3) Difference | |
|---|---|---|---|---|---|---|
| | mean | sd | mean | sd | mean | t |
| lnaum | 18.114 | 2.294 | 18.105 | 2.542 | 0.009 | (0.059) |
| flow_period | -26.883 | 340.723 | -18.99 | 375.857 | -7.893 | (-0.331) |
| Hurdlerate | 0.254 | 0.436 | 0.199 | 0.399 | 0.055** | (1.987) |
| Watermark | 0.72 | 0.45 | 0.775 | 0.418 | -0.055* | (-1.913) |
| leverage | 0.71 | 1.633 | 0.573 | 1.244 | 0.137 | (1.415) |
| managementfee | 1.416 | 0.59 | 1.378 | 0.806 | 0.038 | (0.810) |
| performancefee | 14.475 | 7.801 | 14.15 | 7.493 | 0.325 | (0.640) |
| DummyLockup | 0.026 | 0.161 | 0.057 | 0.233 | -0.207** | (-2.325) |
| eu | 0.64 | 0.48 | 0.642 | 0.48 | -0.002 | (-0.069) |
| nonucits | 0.545 | 0.498 | 0.541 | 0.499 | 0.004 | (0.133) |
| N | 454 | | 454 | | 908 | |

Table 4 compares the original group and the matched control group after the PSM. The results show that the two groups have similar characteristics. Even though the hurdle rate and lockup show a difference at 5% significance, the hurdle rate and lockup are measured as dummy

variables, the hedge fund with hurdle rate and lockups represents a rather small portion both in the treated group and control group. Thus, the matching has relatively high quality.

**Table 5 DID Regression using the matched group**

| Variables | alpha_FH |
|---|---|
| post | -0.208*** |
| | (-2.75) |
| aum_euros | -0.000215** |
| | (-2.04) |
| lnaum | -0.00558 |
| | (-0.31) |
| aumsq | 5.74e-08** |
| | (2.45) |
| _cons | 0.185 |
| | (0.61) |
| *N* | 908 |
| *R2* | 0.261 |

In table 5, the DD results after PSM provide strong evidence that funds experienced a 2% drop in alpha after the authorization process and being imposed by the relevant rules. The drop is lower compared to our DDD results but these two results are very close. The regression provides further evidence for the negative relationship between the AIFMD and hedge fund performance. We conclude that hedge funds' alpha is around 2% lower compared to the performance without the AIFMD.

# 6. Conclusion

In this article, we investigated the effect of the EU AIFMD on the hedge fund performance. Through analyzing the main aspects of change in the regulations compared with the US regulations, we find the EU regulation has more extensive constraints, compliance costs and wider scope of disclosure to the public. Combining the analysis of prior findings and the fact that the EU regulation is stricter than the US rules, we expect the hedge fund performance is negatively related with the EU regulation.

We develop based on the common DID method and introduce the third factor to formulate the DDD interaction term and avoid the limitation involved in the DID method for a more accurate result. Besides, we use the PSM approach to test further through comparing the change of performance using the effective date of the AIFMD of individual hedge funds. Our hypothesis is supported by empirical evidence. The coefficient of triple interaction is significant and negative and shows that hedge fund performance is negatively affected by the AIFMD. Our PSM analysis has similar results to reflect a negative change in performance by 0.2% in alpha. Our research provides additional evidence from another dataset and contributes to the understanding of current conflicted findings in the area, the improvement the judgment of retail investors of hedge funds. It is also valuable for authorities in making or amending relevant hedge fund rules.

Nonetheless, our study has some limitations. First, our data may be subject to self-selection bias since we use a single commercial database that may miss some hedge fund data due to voluntary reporting. Second, the sample of some member states is limited to match the treatment group through the factor of country in PSM while the country could be an important conditional variable to simulate the trend of performance and compare the changes. Future studies may use

more comprehensive data for identifying the impact of regulations. They could further test the influence of specific rules by comparing changes of regulations in separate countries with different backgrounds within the EU. That would be useful to investigate the effect of special rules.

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