Corporate Cash Holdings in the Oil and Gas Industry: The Role of Energy Directives

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1 Introduction

The phenomenon of globalization, which started in the early 1990s has led to significant economic changes in the past 25 years and increased the uncertainty in the global economic conditions (Prasad et al. 2007). The global growth period in early 2000s followed by the 2008 crisis as well as monetary easing and tapering periods created uncertainty by affecting all countries, companies, and financial markets. As a result of these changes in the global market and corporate environment, almost all the corporate financial policies such as cash holding, capital structure, and investment policies of the firms have been reinvestigated by the scholars to provide additional insights on how firms react to major shifts in the global economy.

Apart from the changes in the macroeconomic conditions such as the financial crisis, the energy industry has experienced significant changes due to the implementations of the new regulations related to the generation, transmission, and distribution of electricity and gas. To ensure free trade and increase the competition among energy suppliers, the First Energy Directive has been ratified in 1992 by the member states of the European Union and put into force in 1996. The directive aims at establishing general rules about the internal electricity markets.[1] It undertook several steps to create a new energy market by unbundling the monopolistic

[1] Directive 96/92/EC of the European Parliament and of the Council.

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corporations and increasing the competition among the energy distributors by giving the option to the consumers to select their energy distributor (Jakovac 2012). Following these regulative changes, the Second and Third Energy Directives have, respectively, been issued in 2003 and 2009 by the European Commission to strengthen the functionality of the internal markets, as well as to enhance the efficiency of the energy supply, market integration and consumer protection.[2,3] Passed in June 2003, the Second Energy Directive aims at overcoming the deficiencies in the First Directive in terms of transparent energy distribution, consumer protection, and also efficiency in energy supply (Jakovac 2012). As an additional step, the purpose of The Third Energy Directive, put into force in 2009, was to improve the liberalization process in energy markets by eliminating the current problems in energy distribution, integrating the energy markets, and clarifying the common rules in energy generation and distribution. Moreover, renewable energy sources have gained significant attention due to environmental concerns such as climate change and environmental pollution. Overall, energy directives in electricity and gas industry aimed to liberalize energy production and distribution via implementing common rules and regulations for energy companies. Not surprisingly, energy companies face more competitive market conditions and increasing uncertainty, which in turn force them to take necessary actions in terms of corporate policies and to adopt their financial positions to the new macro environment. Therefore, it becomes even more important to investigate how energy companies react to these reforms in the market in terms of major corporate financial decisions.

In this chapter, we investigate the cash holding decisions of oil and gas companies in Europe. Specifically, we examine both the firm-specific determinants of cash holdings in different country-groups and the impact of regulative changes on the cash holding decisions. In addition, we also provide evidence on the adjustment process toward the target cash position. As being one of the important corporate strategies, motives of cash holdings are significantly related with the uncertainty and future cash flow volatility. Firms with uncertain operational and macroeconomic environment tend to hold significant amount of cash in order to hedge against the future cash shortages, which is also called as the precautionary motive of cash holdings. According to this motive, firms tend to accumulate cash to meet the future investment opportunities, as well as the future unexpected cash requirements, which arise from the rapidly changing economic conditions if the cost of other resources are expected to be larger in the future (Ferreira and Vilela 2004; Ozkan and Ozkan 2004). Therefore, due to increasing uncertainty and competition with the implementation of energy directives, energy firms are expected to change their strategies in terms of the cash holding decisions to hedge against the future cash flow uncertainty.

Including 244 firms and 2670 firm-year observations from 24 countries, our results suggest that there are significant differences among countries in terms of the corporate cash holding policies and speed of adjustments toward the target cash position. More importantly, the role of energy directives on corporate cash holding decisions also differs among countries. The implementation of European Energy

[2]Directive 2003/54/EC of the European Parliament of the Council.

[3]Directive 2009/72/EC of the European Parliament of the Council.

Directives increases the cash accumulation in the energy firms in Nordic and Western European countries, which is an evidence of the precautionary motive of cash holdings, but other country-groups are insensitive to the regulative changes. Regarding the target adjustment behavior, our results suggest that Nordic and Western European energy firms tend to adjust their cash positions toward the target level faster than the firms in the UK and Eastern Europe. The adjustment speed toward target cash position is approximately 64% in Nordic countries, 56% in Western European countries, and 52% in the UK. The slowest adjustment speed (about 20%) is observed in Eastern European countries. These findings indicate that country-specific factors have a strong impact not only on determinants of cash holdings, but also on the speed of adjustment toward the target cash level. Moreover, speed of adjustment in Eastern European (Nordic) energy firms decreases (increases) with the implementation of the directives but firms in the UK and Western Europe are less sensitive to the policy changes in terms of the speed of adjustment toward the target cash position. Overall, the findings of this study reveal that directives and regulations in the energy industry has a considerable impact on the cash holding decisions of the Nordic, Western, and Eastern European firms in terms of both cash accumulation and speed of adjustment.

This study has several contributions to the growing "cash" literature. First, to the best of our knowledge, it is the first study that investigates the cash holding decisions in oil and gas industry using a large sample of firms from Europe. As discussed before, industry-specific factors such as the regulations, directives, and increasing competition have a strong influence on the corporate policies. Since oil and gas industry significantly differ from other industries in terms of regulative changes in the recent history, the findings of this study provide important insights on the cash holding dynamics in this industry. Second, by employing a comparative perspective, we show that the impact of policy changes on corporate policies is not same for all firms. Country-specific factors have a strong influence on the magnitude of the impact of these policy changes. Overall, the findings of this study extend the issue beyond the country-specific or institutional context by focusing on a specific industry through a comparative perspective.

In the next section, we discuss the main developments in the energy industry and relevance of energy directives with the motives of cash holdings. Section 3 describes the data with a brief literature about the variables used in the study and methods of estimations including robustness checks. In Sect. 4, we discuss the main findings. Section 5 concludes the chapter.

2 Developments in the Energy Industry and Cash Holdings

Since the seminal paper of Opler et al. (1999), there is a growing interest in providing explanation for the motives and determinants of cash holdings. One of the main reasons of this growing attention is that firms tend to increase their cash holdings over years. For example, Bates et al. (2009) suggest that firm-level cash holdings are almost doubled from 1980 to 2006 for the US setting. Dittmar and Mahrt-Smith

(2007) find that about 13% of the US firms' total assets are held as cash or cash equivalents. Several other studies extended the issue by providing additional evidence on the markets other than the USA. These papers include Ozkan and Ozkan (2004) for the UK, Ferreira and Vilela (2004) for EMU context, and García-Teruel and Martínez-Solano (2008) for Spain. Moreover, several other researchers provide international evidence on the determinants and value of cash holdings by incorporating both macroeconomic, governance related, and national characteristics of the countries into their analytical framework. The main conclusion of these studies is that in addition to the firm-specific factors such as agency costs, information asymmetries, or financial constraints, institutional and macroeconomic factors have a strong influence on the firm-level cash holdings. For example, Dittmar et al. (2003) find that governance characteristics of the countries play a significant role in cash holding decisions. In a similar vein, Kalcheva and Lins (2007) show that firm values are lower in the countries with weak investor protection if managers hold too much cash. Chang and Noorbakhsh (2009) and Chen et al. (2015) extend the issue by incorporating the impact of national culture on the cash holding decisions. Overall, these studies show that not only firm-specific factors but also country- and industry-specific factors have a strong influence on the corporate cash holding policies.

Although there is extensive evidence on the determinants of cash holdings both in single country or international studies, industry-level differences in cash holding decisions are often neglected. Specifically, cash holding policies are expected to differ according to industry-specific factors such as the cash flow uncertainty, industry-specific regulations, and sensitivity of industries to the macroeconomic shocks. The energy or oil and gas industry is significantly different from the other industries for several reasons. First, due to their special conditions, the 1990–2015 period has been more complicated for energy companies. The energy sector has not only shifted from a monopolistic market to a competitive market in the globalization period, but also obliged to solve two major problems, such as energy security and climate change. The situation of the European Union market, which leads the other countries by organizing and planning the reform of energy markets, is much more specific. The energy sector in Europe has undergone major changes in the last two decades, which is rarely seen in any business environment. The European energy companies are simultaneously faced with market reforms including organizational setting, market structure, regulatory framework, ownership arrangement, and innovational challenge, which arises from environmental concerns and technological advancements. Since the early 1990s, the traditional vertically integrated structure of the energy sector has unbundled into four segments of generation, transmission, distribution, and retail. Competition accelerated with the entry of many companies into generation, transmission, distribution, and sale stages of energy sector. New national authorities and a common regulatory mechanism are established in Europe. Most of the energy companies entered the privatization process following the EU Directives (Capece et al. 2013). Still, the new structure of European energy markets has been developing with discovery and involving continuous interactions between the market players and the regulatory agencies. Over the years, many other pieces of

the energy market legislation have been adopted and the energy market experienced a remarkable change (Karan and Kazdagli 2011). Inevitably, the new energy paradigm created problems in energy markets. Since, most of the European countries and companies had energy plans or policy statements, the shift in policy objectives and priorities had not yet been matched immediately (Helm 2014). The new paradigm simply does not get replaced by another and created significant uncertainties for companies.

Second, the great shift in the energy technology is mostly in the field of renewable energy, and traditional energy sources are starting to change rapidly. Since renewable energy is crucial to any move toward a low carbon economy, the promotion of renewable energy became an essential part of EU energy policy. Currently, the electricity sector has seen the fastest growth in renewable share, which currently reaches 28.3% of total electricity production. Also, it is achieved a 16% share of renewable energy in 2014 and it is estimated to be greater in the near future.[4] Wind energy and solar photovoltaic development has been uneven, and together, other renewables constitute 12% of the EU gross electricity production. Most of the EU countries are well on track to reach their targets for renewable energy (EU renewable energy progress report 2015-16). This transition phase has not been easy for the energy sector companies. It is an expensive and risky process, as stated by the European Commission.[5] Europe is trying to develop this policy by considering three main concerns that are conflicting among themselves: energy security problems, concerns about climate change, and economic realities (Johnson and Boersma 2015). Undoubtedly, this complexity also increases the risks of energy companies.

The market reform in Europe has been initiated by the British experience and further developments have been observed in the rest of the Europe. The energy market in the UK is well established and competitive relative to the other markets. The annual switching rate is about 18% and consumers are well informed about the competition in the market and they know that they can switch their supplier if they want (Karan and Kazdagli 2011). On the other hand, Nordic countries distinguishes from the other countries in terms of the market dynamics such as the competition among the market players and the challenges, which are waiting to be addressed. The adoption of integrated energy market is much more challenging for the Nordic firms since the success of the system depends on some country-specific factors such as the supply of the alternative energy, capacity of the energy production units, and also deregulation of the market (Amundsen and Bergman 2006). The liberalization process of the energy market in the Continental Europe has been initiated by Germany in the 1990s and followed by the France, Netherlands, and Belgium. With the substantial progress of the Spain and Portugal in terms of the supply of alternative energy and market efficiency, Continental Europe has been adopted a

[4]The web link for the following report: https://ec.europa.eu/energy/en/topics/renewable-energy/progress-reports

[5]The web link for the following report: https://ec.europa.eu/energy/en/topics/technology-and-innovation

well-functioning integration strategy, but further developments required to improve the efficiency and overcome the significant challenges such as the energy security and political instability. Different than the other countries, the liberalization process of the energy market in Eastern Europe is relatively slow and needs further improvements. The competition among the market players are generally low in these countries, which hinders the diversification and integration. Therefore, energy directives and regulations have a delayed impact on the overall market as well as the energy firms (Karan and Kazdagli 2011).

With the increasing uncertainty as a result of market reform, energy directives, and regulations, energy firms are facing with a more challenging environment than in the past. Thus, firms in the energy industry are expected to face some difficulties in accessing external funds. As confirmed by the precautionary motive of cash holdings, firms tend to increase their cash levels to cope with the risky cash flows and uncertainty arising from the more competitive markets (Bates et al. 2009; Chen et al. 2015). Therefore, energy firms are expected to increase their cash holdings due to increasing competition among the market players as an outcome of the energy directives and regulations. In other words, increasing market and industry-specific risks as discussed above are expected to force energy firms to accumulate cash as a buffer against the uncertain future cash flows. Several studies in the literature provide support for the precautionary motive of cash holdings in uncertain market environments. The main finding of these studies is that firms tend to hoard cash as a cushion against the uncertainty. For example, Al-Najjar (2013) investigate the cash holdings in emerging markets and provide support for the precautionary motive of cash holdings due to greater market imperfections, uncertainty, and bankruptcy risk in these markets. In a similar vein, Song and Lee (2012) investigate the cash holding decisions of Asian firms during the Asian crisis (1997–2998) and provide strong evidence of precautionary motive due to increasing uncertainty in that time period. Also, the findings of Duchin (2010) and Ramirez and Tadesse (2009) support the precautionary motive for the firms operate in volatile markets and industries. Similarly, the oil and gas industry is one of the most volatile sectors due to its strong dependency to external factors such as specific regulations and directives. Therefore, we predict that energy firms in Europe will increase their cash holdings with the implementation of the energy directives.

3 Data and Methodology

3.1 Overview of Data

Our sample includes a total of 244 firms operate in oil and gas industry and 2670 firm-year observations from 24 European countries for the period 2000–2016. Specifically, our sample includes 25 (298) firms (observations) form Eastern European countries, 58 (640) firms (observations) from Nordic countries, 107 (1117) firms (observations) from the UK and Ireland, and 54 (615) firms

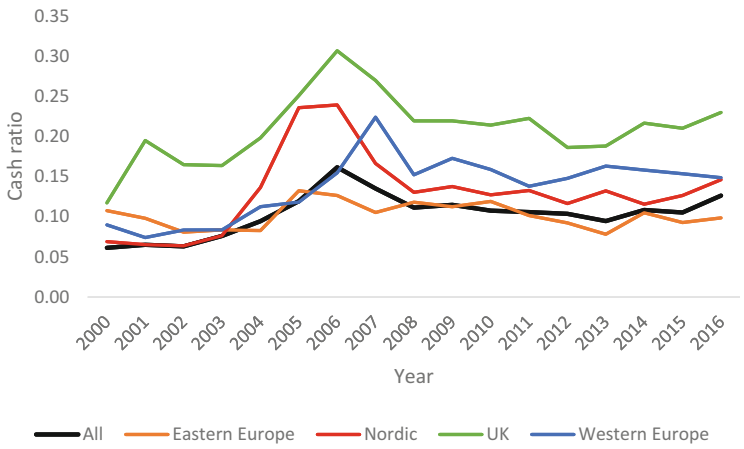

Fig. 1 Cash ratios over years

(observations) from Western Europe. We only include firms with at least 5 years of consecutive observations and without any missing data.[6] The data for the dependent and explanatory variables is obtained from the Datastream.

We present the distribution of cash ratio[7] over years for each country-group in Fig. 1. The firms in our sample hold cash approximately 10.6% of their total assets, however, cash ratio is not stable over time. Regarding the entire sample, median cash ratio is highest in 2006 as approximately 16% and lowest in 2000 as 6.1%. Moreover, the median cash ratio decreases to 13.5% in 2007 after a considerable increase in 2006 and it stays at 10–11% level afterwards. Moreover, we observe that the oil and gas firms in the UK hold relatively larger cash balances (14.6%) compared to the Western European (10.4%), Nordic (9.3%), and Eastern European (5.9%) firms. When we review prior studies, we observe significant differences in terms of average cash positions among countries. For example, Al-Najjar and Belghitar (2011), Al-Najjar (2013), and Dittmar et al. (2003) report 9%, 10% and 8% for the UK, respectively. In addition, in their comprehensive study about the cash holding decisions of multinational firms, Fernandes and Gonenc (2016) report approximately 20% for the UK, 14% for France, 15% for Germany, and 14% for Finland. The difference between the cash ratios reported in this study with previous studies arise from several reasons. Most importantly, there is no other study that focuses on oil and gas industry in the prior literature. Abovementioned studies include all available industries except financing sector. As it is discussed before, cash holding decisions in oil and gas industry can be significantly different from

[6]Eastern Europe countries are Croatia, Cyprus, Czech Republic, Greece, Hungary, Poland, Romania, Slovenia, and Turkey. Nordic countries are Denmark, Finland, Norway, and Sweden. Countries in the UK group are United Kingdom and Ireland. Western Europe countries are Austria, Belgium, France, Germany, Italy, Netherlands, Portugal, and Spain.

[7]The ratio of cash and equivalents to the total assets.

Table 1 Variable definitions

Variable	Definition
CASH	The ratio of cash and equivalents to the total assets
NET CASH	The ratio of cash and equivalents to the total assets minus cash and equivalents
SIZE	Natural logarithm of total assets in dollars
CAPEX	The ratio of capital expenditures to the total assets
CFLOW	The ratio of pre-tax income plus depreciation to the total assets
LEV	The ratio of total debt to the total assets
MB	The ratio of book value of total assets minus the book value of equity plus the market value of equity to book value of total assets
NWC	The ratio of current assets minus cash and current liabilities to the total assets
DIV	Dividend dummy equals to 1 if firm pays dividend and 0, otherwise
RD	R&D dummy equals to 1 if firm makes R&D investments and 0, otherwise
Second Directive	Includes the years from 2004 to 2009
Third Directive	Includes the years from 2010 to 2016
E. Europe	Equals to 1 if the firm is in Eastern Europe
Nordic	Equals to 1 if the firm is a Nordic country
UK	Equals to 1 if the firm is in the UK
W. Europe	Equals to 1 if the firm is in Western Europe

This table presents the variables used in this study

other industries due to industrial dynamics such as industry-specific regulations/directives and so on. The difference in the sample period is also another reason of the reported cash ratio. As it is evident in Fig. 1, the cash ratio is not stable over time, which leads significant differences on the reported statistics in the prior literature.

We use two measures of cash holdings, namely the ratio of cash and equivalents to the total assets (CASH) and the ratio of cash and equivalents to the net assets, which is measured as total assets minus cash and equivalents (NET CASH). Table 1 provides the definitions of each variable used in this study. We discuss the operationalization of these variables as follows:

ENERGY DIRECTIVES Our main variable interest is the Energy Directives. As discussed before, The Second and The Third Energy Directives were put into force in 2004 and 2009, respectively. We use dummy variable equal to 1 if the year belongs to the 2004–2009 period, and 0 otherwise (*Second Directive*). In other words, 2004–2009 period is the period when the Second Energy Directive was in force. Moreover, we also use another dummy variable for the years from 2010 to 2016 to indicate the period in which the Third Energy Directive is effective (*Third Directive*). Finally, 2000–2003 period is our base period and denotes the period that the First Energy Directive was enforced.

In addition to the dummy variables for the Energy Directives, we also use several explanatory variables to explore the firm-specific determinants of cash holdings in

European oil and gas industry. In the following, we briefly explain the relevance of each variable on the cash holding decisions.

SIZE Firm size is one of the important determinants of cash holdings for several reasons. First, smaller firms are expected to hold greater amount of cash since they are more prone to information asymmetries, bankruptcy costs and, they have less access to the external funds (Al-Najjar and Belghitar 2011; Opler et al. 1999). On the other hand, given that small firms experience more financial distress than the large firms (Titman and Wessels 1988), one may expect that they hold larger amount of cash balances than large firms. Therefore, we expect a negative relationship between firm size and cash holdings. Our proxy for the firm size (*SIZE*) is the natural logarithm of total assets in dollar terms.

CAPEX The relationship between investments or capital expenditures are not straightforward since two theories about cash holdings propose opposing views about the impact of investments on cash accumulation. According to the Pecking Order Theory,[8] firms with greater investments should hold less cash due to usage of internal resources (Opler et al. 1999). On the other hand, Trade-off Theory[9] predicts a positive relationship between capital expenditures and cash holdings. Our measure (*CAPEX*) is the ratio of capital expenditures to the total assets.

CFLOW According to the Pecking Order Theory, firms prefer internal finance over external finance, which implies a positive relationship between cash flow and cash holdings. Moreover, cash flow is also considered as proxy of growth opportunities (Ozkan and Ozkan 2004), firms with greater cash flows are expected to have larger amount of cash according to the predictions of the Trade-off theory. Our measure (*CFLOW*) is the ratio of earnings before extraordinary items plus depreciation to the total assets.

LEV Baskin (1987) argues that cost of liquid assets is greater as the leverage increases, which induce a negative relationship between leverage and cash holdings. This argument is in line with the Pecking Order Theory, which suggests that profitable firms pay their debt, make their investments, and accumulate the remaining as cash. In other words, any increase in cash amount also indicates a reduction in the leverage. On the other hand, increasing financial distress with the

[8]The Pecking Order Theory suggests that firms first use internal funds, then safe debt, and equity as a last resort to finance their investments. If the cash flows are enough to finance the new projects, firms repay their debt and accumulate the remaining as cash. Therefore, firms do not have any target cash balances, instead they use cash as a buffer against the future shortages in internal funds (Myers 1984).

[9]The Trade-off Theory postulates that firms set their target/optimal cash balances by weighing the marginal costs and marginal benefits of cash holdings. Marginal benefits of cash accumulation are the cushion against the future uncertainty in the cash flows and marginal costs of cash holding is the opportunity costs, which arise from the lower returns of cash and cash equivalents (Ferreira and Vilela 2004).

leverage may motivate firms to hoard larger amount of cash balances. Our measure of leverage (*LEV*) is the ratio of total debt to total assets.

MB Another important determinant of firm-level cash holding is the firms' growth opportunities. It is suggested that the problem of information asymmetry is more severe for the firms with greater growth options (Myers and Majluf 1984). In addition, firms with greater growth opportunities tend to hold excess cash to meet future cash requirements when they can invest in positive NPV projects (Ozkan and Ozkan 2004). Moreover, bankruptcy costs are higher if the firm has greater growth options since the proportion of intangible assets is greater in these firms (Shleifer and Vishny 1992). Thus, we predict a positive relationship between growth opportunities and cash holdings. Our proxy of growth opportunities is the market-to-book ratio (*MB*), which is measured as the ratio of book value of total assets minus the book value of equity plus the market value of equity to book value of total assets.

NWC Firms can use substitutes of cash holdings rather than using external financing when they face shortfalls in their cash positions. In other words, converting liquid assets into cash is much easier than converting non-liquid assets (Ferreira and Vilela 2004). Thus, a negative relationship is expected between the proportion of liquid assets and cash holdings due to the substitution effect of liquid assets. We use the ratio of current assets minus current liabilities to the total assets (*NWC*) as a measure of liquidity.

DIV The relationship between dividend payments and cash holding policy is twofold. In one hand, firms that pay dividend have a greater flexibility as they can cut their dividend payments when they face a cash shortage (Opler et al. 1999). As a result, a positive relationship between dividend payments and cash balances is expected. On the other hand, dividend cuts may not be favorable for firms since it may be perceived by shareholders negatively. Therefore, firms that persistently pay dividends may hoard cash to meet the future dividend payments in case of cash shortage (Ozkan and Ozkan 2004). Our measure of dividend payments (*DIV*) is a dummy variable equals to 1 if the firm pays dividend and 0, otherwise.

RD As a final determinant of cash holdings employed in this study, R&D expenditures exerts a negative influence on the cash holdings. Like the arguments in the relevance of market-to-book ratio, Trade-off Theory predicts that firms with greater R&D expenditures should accumulate more cash since they have greater information asymmetry problems. Our measure of R&D expenditures (*RD*) is a dummy variable equals to 1 if the firm make any R&D investments and 0, otherwise.[10]

Table 2 presents the descriptive statistics of the variables employed in this study by country-groups as Western Europe, Nordic, the UK, and Eastern Europe. When we compare the summary statistics among the country-groups, we observe that oil and gas firms in the UK significantly differ from the firms in other countries.

[10]We treat an observation as zero if the information about the R&D expenditures is missing.

Table 2 Descriptive statistics

Country	No. of firms	No. of observations	CASH	NET CASH	SIZE	CAPEX	CFLOW	LEV	MB	NWC	DIV	RD
Eastern Europe—Total number of firms (observations) = 25 (298)												
Croatia	1	8	0.017	0.018	15.099	0.086	0.096	0.265	1.591	−0.342	1.000	0.000
Cyprus	1	11	0.039	0.041	12.026	0.055	0.093	0.290	0.834	0.034	1.000	0.000
Czech Republic	1	14	0.048	0.051	14.619	0.048	0.061	0.071	0.924	1.026	0.000	0.000
Greece	2	32	0.060	0.064	14.758	0.055	0.110	0.376	1.170	−0.022	1.000	0.500
Hungary	1	17	0.055	0.058	16.065	0.082	0.105	0.254	1.043	−1.308	1.000	0.000
Poland	6	65	0.060	0.064	15.110	0.055	0.089	0.168	0.991	0.112	0.000	0.000
Romania	8	73	0.041	0.043	11.486	0.062	0.085	0.024	0.829	0.086	0.000	0.000
Slovenia	1	14	0.025	0.026	13.951	0.049	0.077	0.370	1.142	−0.057	0.000	0.000
Turkey	4	64	0.143	0.167	14.982	0.036	0.085	0.284	1.080	−0.083	1.000	0.000
Median			0.059	0.062	14.503	0.055	0.089	0.202	1.015	−0.017	1.000	0.000
Nordic—Total number of firms (observations) = 58 (640)												
Denmark	3	36	0.050	0.053	12.403	0.072	0.078	0.187	1.294	−0.171	0.000	0.000
Finland	1	11	0.061	0.064	15.678	0.073	0.090	0.279	1.169	0.030	1.000	1.000
Norway	42	478	0.096	0.107	13.270	0.081	0.064	0.410	1.129	−0.363	0.000	0.000
Sweden	12	115	0.099	0.109	9.705	0.058	−0.030	0.077	1.472	−0.184	0.000	0.000
Median			0.093	0.103	12.985	0.076	0.059	0.316	1.180	−0.307	0.000	0.000
UK—Total number of firms (observations) = 107 (1117)												
UK	101	1042	0.149	0.175	11.229	0.043	−0.023	0.047	1.384	−0.016	0.000	0.000
Ireland	6	75	0.114	0.128	11.295	0.064	−0.035	0.035	1.003	−0.043	0.000	0.000
Median			0.146	0.171	11.239	0.043	−0.024	0.045	1.355	−0.017	0.000	0.000
Western Europe—Total number of firms (observations) = 54 (615)												
Austria	2	30	0.096	0.106	15.547	0.084	0.146	0.209	1.206	0.017	1.000	1.000
Belgium	2	17	0.163	0.195	14.557	0.039	0.092	0.324	0.687	−0.039	1.000	0.000
France	11	146	0.104	0.116	14.476	0.047	0.091	0.174	1.218	0.008	1.000	0.000

(continued)

Table 2 (continued)

Country	No. of firms	No. of observations	CASH	NET CASH	SIZE	CAPEX	CFLOW	LEV	MB	NWC	DIV	RD
Germany	24	224	0.134	0.154	11.765	0.046	0.046	0.193	1.200	0.050	0.000	1.000
Italy	6	68	0.083	0.091	15.134	0.049	0.096	0.204	1.232	−0.038	1.000	0.000
Netherlands	3	51	0.051	0.054	15.091	0.101	0.154	0.305	1.354	−0.003	1.000	1.000
Portugal	1	10	0.061	0.066	16.060	0.075	0.085	0.287	1.539	0.032	1.000	0.000
Spain	5	69	0.131	0.151	15.255	0.030	0.064	0.309	1.173	−0.095	1.000	0.000
Median			0.104	0.116	13.995	0.054	0.081	0.081	1.200	0.008	1.000	0.000

All numbers except number of firms and number of observations are country medians of the variables. *Median* indicate the median of the variables for the overall country-group. Definitions of variables are presented in Table 1

Regarding the investment level of oil and gas firms in Europe, UK firms have the lowest capital expenditures (0.043) over the sample period. In addition, the leverage ratio of UK firms is considerably lower (0.045) than those of other country-groups. Interestingly the median cash flow ratio is negative for UK firms. Overall, oil and gas firms in the UK have considerably lower investments, leverage, and most importantly negative cash flows. On the other hand, Nordic firms differ from the other oil and gas firms in the Europe by their high leverage. Median debt ratio in Nordic firms is almost 32%, which is considerably higher than those of other firms (second highest is for the Eastern European firms as 20%).

3.2 Model Formulation

We employ several estimations to investigate the impact of energy directives on the cash holdings. In addition to the estimation for the whole sample, we run separate estimations for the country-groups to observe how the impact conventional firm-specific variables as well as the energy directives differ by countries. As discussed before, the dependent variable of our model is CASH, which is defined as the ratio of cash and equivalents to the total assets. We also use NET CASH, which is defined as the ratio of cash and equivalents to the net total assets (total assets minus cash and equivalents) for robustness purposes. Our baseline model is as follows:

$$\begin{aligned} CASH_{i,t} = {} & \beta_0 + \beta_1 SIZE_{i,t-1} + \beta_2 CAPEX_{i,t-1} + \beta_2 CFLOW_{i,t-1} + \beta_3 LEV_{i,t-1} \\ & + \beta_4 MB_{i,t-1} + \beta_5 NWC_{i,t-1} + \beta_6 DIV_{i,t-1} + \beta_7 RD_{i,t-1} \\ & + \beta_8 Second\ Directive + \beta_9 Third\ Directive + \varepsilon_{i,t} \end{aligned} \quad (1)$$

In Eq. (1), $CASH_{i,\ t}$ denotes the ratio of cash and cash equivalents to the total assets. The definitions of the explanatory variables are defined in Table 2. $\beta_{1\_}\beta_9$ denote the coefficients of explanatory variables. Finally, $\varepsilon_{i,\ t}$ is the error term of the equation. It should be noted that we use lagged values of the independent variables to mitigate the simultaneity and endogeneity concerns. We report robust standard errors, which are clustered at the firm level to account for the heterogeneity in the standard errors. In the second stage of this chapter, we also run GMM estimations to account for the dynamic nature of the panel data and weighted least square estimations and least absolute deviation regressions, which will be discussed later.

4 Multivariate Results

4.1 Determinants of Cash Holdings

In the first stage of our analysis, we estimate the cash holdings (CASH and NET CASH) for the whole sample without including the Second and Third Directives to see the impact of conventional firm-specific factors on the corporate cash holdings decisions of the energy firms. We employ two separate estimations one including the country dummies and other with the country-group dummies to account for the country-specific factors. We also run each estimation by using NET CASH as our dependent variable. Finally, we also run Fama-Macbeth regressions as an alternative to the OLS estimations. Table 3 presents our results.

First, the coefficient of SIZE is negative and significant at 1%, which suggests that small firms hold more cash than large firms, which is consistent with the prior literature (Al-Najjar and Belghitar 2011; Opler et al. 1999; Ozkan and Ozkan 2004). Small firms are more prone to information asymmetries and have less access to the external funds. Therefore, they tend to hold a larger amount of cash in order to mitigate the adverse effects of financial distress. The impact of capital expenditures (CAPEX) on cash holdings is negative as expected. Interestingly, our results suggest a negative impact of cash flows (CFLOW) on cash holdings. Specifically, firms with greater cash flows tend to hold less cash, which is contrast to the theory, but in line with some of the prior findings (Ozkan and Ozkan 2004). We also find a negative relationship between leverage (LEV) and cash holdings as expected. The coefficient of market-to-book ratio (MB) is positive and significant at 1%, which suggests that firms with greater growth opportunities hold less cash. As discussed earlier, firms with greater growth opportunities are more exposed to asymmetric information problem and their future cash need is expected to be larger than the firms with less growth opportunities, especially in case of a cash shortage. The relationship between net working capital (NWC) and cash holdings is negative, but the significance level is low. Moreover, we find a negative relationship between cash holdings and R&D expenditures (RD) similar to the coefficient of market-to-book ratio. Finally, dividend payments do not exert any significance on the cash holding decisions. Overall, our baseline results are generally in line with the predictions of the theory and with the prior findings. The results are also insensitive to the model selection (country fixed effects vs. country-group-fixed effects), different methods of estimations (fixed OLS vs. Fama-Macbeth estimations) and different operationalization of the dependent variable (CASH vs. NET CASH) with the only exception of CFLOW and RD, which are not significant in Fama-Macbeth regressions when we use NET CASH as our proxy for the cash holdings.

In the second stage of our analysis, we employ separate estimations for each country-group and incorporate the impact of the Second and the Third Directives on the cash holding decisions. As it is presented in Table 4, there are significant differences across the determinants of cash holdings by country-groups, especially regarding the impact of energy directives on the cash holding decisions. First of all,

Table 3 Determinants of cash holdings

	Dep. variable = $CASH_t$			Dep. Variable = NET $CASH_t$		
	(1) OLS	(2) OLS	(3)F-M	(4) OLS	(5) OLS	(6) F-M
$SIZE_{t-1}$	-0.012^{***} (0.003)	-0.011^{***} (0.003)	-0.012^{***} (0.002)	-0.013^{***} (0.004)	-0.012^{***} (0.004)	-0.012^{***} (0.002)
$CAPEX_{t-1}$	-0.104^{**} (0.043)	-0.134^{***} (0.044)	-0.131^{***} (0.035)	-0.116^{**} (0.051)	-0.150^{***} (0.051)	-0.155^{***} (0.042)
$CFLOW_{t-1}$	-0.105^{***} (0.038)	-0.114^{***} (0.040)	$-0.077*$ (0.038)	$-0.086**$ (0.036)	-0.093^{**} (0.038)	-0.051 (0.038)
LEV_{t-1}	-0.186^{***} (0.031)	-0.162^{***} (0.031)	-0.132^{***} (0.017)	-0.213^{***} (0.032)	-0.184^{***} (0.033)	-0.153^{***} (0.020)
MB_{t-1}	0.014^{***} (0.004)	0.014^{***} (0.004)	0.012^{***} (0.003)	0.012^{***} (0.003)	0.012^{***} (0.003)	0.012^{***} (0.004)
NWC_{t-1}	-0.005 (0.010)	-0.008 (0.009)	-0.009 (0.008)	-0.008 (0.011)	-0.012 (0.011)	-0.014 (0.009)
DIV_{t-1}	-0.006 (0.012)	-0.004 (0.012)	0.004 (0.006)	-0.007 (0.013)	-0.006 (0.013)	-0.000 (0.006)
RD_{t-1}	0.050^{***} (0.019)	0.046^{**} (0.018)	0.027^{**} (0.011)	0.043^{**} (0.017)	0.040^{**} (0.017)	0.017 (0.012)
Nordic		0.024 (0.024)	0.022^{**} (0.009)		0.041^{*} (0.024)	0.039^{**} (0.013)
UK		0.044^{*} (0.026)	0.046^{***} (0.006)		0.066^{**} (0.025)	0.069^{***} (0.006)
W. Europe		0.032 (0.023)	0.026^{***} (0.008)		0.052^{**} (0.024)	0.045^{***} (0.010)
Constant	0.247^{***} (0.055)	0.234^{***} (0.052)	0.282^{***} (0.026)	0.287^{***} (0.070)	0.267^{***} (0.057)	0.315^{***} (0.024)
Year fixed	Yes	Yes	No	Yes	Yes	No
Country fixed	Yes	No	No	Yes	No	No

(continued)

Table 3 (continued)

	Dep. variable = $CASH_t$			Dep. Variable = NET $CASH_t$		
	(1) OLS	(2) OLS	(3)F-M	(4) OLS	(5) OLS	(6) F-M
R^2	0.277	0.256	0.282	0.260	0.238	0.270
N	2670	2670	2670	2670	2670	2670

This table presents the OLS and Fama-Macbeth (F-M) estimation results of CASH and NET CASH. Variable definitions are presented in Table 1. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively. Standard errors (in parenthesis) are clustered at the firm level

Table 4 Determinants of cash holdings: The role of energy directives

	Dep. variable = $CASH_t$				
	(1) All	(2) E. Europe	(3) Nordic	(4) UK	(5) W. Europe
$SIZE_{t-1}$	-0.012^{***} (0.003)	-0.011 (0.010)	-0.024^{***} (0.008)	-0.005 (0.005)	-0.012^{**} (0.005)
$CAPEX_{t-1}$	-0.099^{**} (0.042)	0.120 (0.125)	-0.131^{**} (0.051)	-0.099 (0.072)	-0.200 (0.120)
$CFLOW_{t-1}$	-0.105^{***} (0.038)	-0.178 (0.112)	-0.099 (0.068)	-0.080 (0.054)	-0.124^{*} (0.064)
LEV_{t-1}	-0.188^{***} (0.030)	-0.239^{**} (0.102)	-0.086^{*} (0.044)	-0.267^{***} (0.057)	-0.149^{**} (0.067)
MB_{t-1}	0.014^{***} (0.004)	0.027^{*} (0.014)	0.006 (0.005)	0.018^{***} (0.004)	0.040^{***} (0.012)
NWC_{t-1}	-0.006 (0.010)	0.004 (0.017)	-0.002 (0.011)	0.042 (0.057)	-0.157^{**} (0.063)
DIV_{t-1}	-0.006 (0.012)	-0.051 (0.031)	0.030 (0.019)	-0.062^{**} (0.024)	0.032 (0.023)
RD_{t-1}	0.050^{***} (0.019)	0.026 (0.029)	0.044^{**} (0.021)	0.074^{*} (0.043)	0.050^{***} (0.018)
Second Directive	0.050^{***} (0.014)	0.034 (0.020)	0.085^{***} (0.024)	0.034 (0.030)	0.039^{**} (0.019)
Third Directive	0.036^{***} (0.013)	0.038 (0.023)	0.045^{**} (0.018)	0.024 (0.029)	0.053^{***} (0.018)
Constant	0.262^{***} (0.054)	0.213 (0.175)	0.371^{***} (0.100)	0.233^{***} (0.070)	0.183^{**} (0.083)
Year fixed	No	No	No	No	No
Country fixed	Yes	Yes	Yes	Yes	Yes
R^2	0.271	0.266	0.325	0.219	0.343
N	2670	298	640	1117	615

This table presents the OLS estimation results of cash for different country-groups controlling for energy directives. Variable definitions are presented in Table 1. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively. Standard errors (in parenthesis) are clustered at the firm level

the energy directives have an impact on the cash holding decisions only for the Nordic and Western European firms. More specifically, oil and gas firms in Nordic and Western European countries tend to increase their cash holdings with the implementation of energy directives. As discussed earlier, energy directives significantly changed the rules of the game in energy sector. Through the unbundling process and greater focus on the renewable energy, firms encounter with a more competitive and uncertain financial environment. Positive coefficient of directives suggests that firms may consider the cash holdings as an alternative tool to hedge against the future uncertainty (precautionary purpose). In other words, changing market dynamics force firms to be more cautious about their future well-being and in turn take corrective actions in terms of enhancing their flexibility by increasing their cash balances especially for the Nordic and Western European firms. However,

energy firms in the UK and Eastern European countries are insensitive to the energy directives in terms of the cash holding decisions.

Considering the impact of firm-specific factors, the only significant variables are the leverage (LEV) which has a negative impact and market-to-book ratio (MB) has a positive impact on the cash holding decisions for the energy firms in Eastern Europe. Cash holding policies in these firms are insensitive to the other factors. Nordic case shows that majority of the variables have a significant influence on the cash holdings. Specifically, SIZE, CAPEX, and LEV have a negative, RD has a positive impact on cash hoarding. Regarding the UK firms, LEV, and DIV have a negative; MB and RD have a positive impact on the cash holdings as in line the predictions. Finally, all the predicted determinants except CAPEX and DIV are significant for the Western Europe case. Specifically, SIZE, CFLOW, LEV, and NWC have a negative, MB, and RD have a positive impact on cash accumulation. Overall, the determinants of cash holdings are significantly different by country-groups. Majority of the determinants are insignificant for the Eastern European firms. On the other hand, the results for UK, Nordic, and Western European firms are generally in line with our predictions. Moreover, when we compare the predictive power of the estimated models, we observe the smallest R^2 for UK case. Finally, the determinants of cash holdings are generally in line with the Western European firms evident by the highly significant coefficients of the determinants and largest predictive power of the model (R^2 is 34%).

4.2 Adjustment Toward Target Cash Holdings

In addition to the estimations regarding the impact of energy directives on the cash holding decisions, we also investigate the adjustment speed toward target cash balances. As it is discussed before, Trade-off Theory suggests that there are marginal benefits and costs of holding cash. Therefore, rather than immediate, a partial adjustment process to target cash holdings takes place due to transaction costs (Ozkan and Ozkan 2004). To this aim, we include the lagged dependent variable into our model to account for the dynamic process. However, employing conventional OLS regressions yields biased results since lagged dependent variable is correlated with the unobservable firm-fixed effects. To mitigate this concern, several alternative approaches are discussed in the literature. We employ dynamic system-GMM (Blundell and Bond 1998) estimations to observe the adjustment speed toward the target cash position, which enables us to instrument the endogenous variables such as lagged dependent variable with the past realizations. Moreover, GMM estimations also allow us to mitigate the endogeneity concerns by treating the explanatory variables as predetermined or endogenous. We use NET CASH instead of CASH to mitigate the autocorrelation on the CASH variable. We also report post-estimation statistics such as AR (1) and AR (2), which indicate the first- and second-order correlations in the residuals under the null hypothesis of no serial correlation

and Hansen value, which tests the over-identification of instruments under the null hypothesis of instruments are valid. Our dynamic GMM model is as follows:

$$NET\ CASH_{i,t} = \beta_0 + \beta_1 NET\ CASH_{i,t-1} + \beta_{2-9} \sum W_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

In our dynamic system-GMM estimation (Eq. 2) we employ the lagged dependent variable ($NET\ CASH_{i,\ t\ -\ 1}$) as endogeneous and used second to third lags as instruments. $W_{i,\ t\ -\ 1}$ denote the vector of explanatory variables including the Second and the Third Directives which are discussed before and demonstrated in Eq. (1). $\beta_{2\ -\ 9}$ are the coefficients of the explanatory variables and $\varepsilon_{i,\ t}$ is the error term.

Table 5 presents the dynamic panel estimations (system-GMM) of cash holdings. The coefficient of the lagged dependent variable ($NET\ CASH_{i,\ t\ -\ 1}$) for the whole sample (Column 1) is 0.48, which indicates a 52% (1–0.48) adjustment speed toward the target cash positions. In other words, it takes approximately two years to reach the target cash level for the oil and gas firms in Europe. In addition, we also compare the target adjustment behavior of oil and gas firms separately for the country-groups. As it is expected, there are significant differences in the adjustment speeds among country-subgroups. The highest adjustment speed is observed in Nordic firms as it is approximately 64% (1–0.36). Larger adjustment speeds toward the optimal level indicates that adjustment costs are significantly lower for Nordic firms. On the other hand, the lowest adjustment speed is observed for the Eastern European firms as approximately 20%. In other words, it takes almost 5 years for these firms to reach the target cash level. The adjustment speed is about 56% for the firms in Western Europe, and 52% for the firms in the UK. Overall, the results exert some important implications about the cash holding policies of the European energy firms. As having the first and second largest adjustment speed, energy firms in Nordic and Western European countries do not face with significant adjustment costs and reach their target level relatively faster. Put differently, the marginal cost of being suboptimal in terms of the cash position exerts larger costs than the adjustment costs. This finding supports our earlier results. Nordic and Western European firms are very sensitive to the changes in the market dynamics such as the implementation of the energy directives. As a result, they tend to stay close to the target cash level to hedge against the unexpected losses due to the increasing competition and uncertainty. Finally, energy firms in the UK has a moderate level of adjustment speed compared to the other country-groups. Overall, our findings suggest that country-specific factors have a significant influence not only on the cash holdings decisions but also on the adjustment behavior. Firms in Nordic and Western Europe tend to stay close to the optimum cash levels. On the other hand, Eastern European oil and gas firms struggle to stay at the optimal levels due to their dependencies to the other countries in terms of energy supply and market development. Eastern European countries are generally developing countries, and they may face additional financial constraints to adjust their cash positions quickly.

Table 5 Speed of adjustment

	Dep. variable = NET $CASH_t$				
Variable	(1) All	(2) E. Europe	(3) Nordic	(4) UK	(5) W. Europe
$NET\ CASH_{t-1}$	0.483^{***}	0.804^{***}	0.360^{***}	0.478^{***}	0.439^{***}
	(0.046)	(0.102)	(0.073)	(0.059)	(0.121)
$SIZE_{t-1}$	-0.008^{***}	0.004	-0.013^{**}	-0.009^{**}	-0.010^{**}
	(0.002)	(0.003)	(0.007)	(0.003)	(0.004)
$CAPEX_{t-1}$	0.073	0.068	−0.049	0.139^{*}	−0.081
	(0.048)	(0.148)	(0.048)	(0.082)	(0.092)
$CFLOW_{t-1}$	-0.066^{***}	-0.178^{***}	−0.059	−0.031	−0.094
	(0.025)	(0.068)	(0.053)	(0.036)	(0.063)
LEV_{t-1}	-0.051^{**}	0.003	−0.011	-0.088^{*}	−0.041
	(0.022)	(0.031)	(0.037)	(0.045)	(0.047)
MB_{t-1}	0.003	0.002	−0.002	0.005	0.008
	(0.003)	(0.012)	(0.005)	(0.003)	(0.011)
NWC_{t-1}	0.023^{**}	0.043^{**}	0.017	0.013	−0.004
	(0.010)	(0.019)	(0.012)	(0.040)	(0.057)
DIV_{t-1}	−0.006	−0.005	0.006	−0.017	0.020
	(0.008)	(0.011)	(0.015)	(0.015)	(0.014)
RD_{t-1}	0.019^{**}	−0.019	0.026	0.017	0.040^{***}
	(0.009)	(0.013)	(0.017)	(0.020)	(0.015)
Second Directive	0.019^{*}	0.007	0.071^{***}	0.004	0.024^{*}
	(0.011)	(0.018)	(0.024)	(0.022)	(0.013)
Third Directive	0.018^{*}	−0.010	0.045^{***}	0.000	0.040^{***}
	(0.009)	(0.012)	(0.014)	(0.020)	(0.015)
Constant	0.185^{***}	−0.013	0.234^{***}	0.213^{***}	0.179^{***}
	(0.033)	(0.039)	(0.088)	(0.048)	(0.066)
AR (1)	0.000	0.024	0.000	0.000	0.000
AR (2)	0.128	0.239	0.353	0.328	0.272
Hansen	0.403	1.000	0.237	0.305	0.709
N	2425	272	581	1010	562

This table presents the GMM-BB estimation results of NET CASH for different country-groups. Variable definitions are presented in Table 1. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively. Robust standard errors are in parenthesis. Second to third lags of NET CASH are used as instruments. AR (1) and AR (2) test the first- and second-order correlation among residuals under the null hypothesis of no serial correlation. Hansen is a test of instrument validity under the null hypothesis of instruments are valid

4.3 Adjustment Toward Target Cash Holdings: The Role of Energy Directives

Although the estimation results of Eq. (2) show how energy directives impact the cash holding decisions in a dynamic framework, they do not reveal the impact of the directives on the adjustment speed toward the target cash balances. Following

Guariglia and Yang (2018), we estimate the speed of adjustment in different time periods by employing the following equation:

$$\begin{aligned} NET\ CASH_{i,t} = {} & \beta_0 + \beta_1 NET\ CASH_{i,t-1} * First\ Directive \\ & + \beta_2 NET\ CASH_{i,t-1} * Second\ Directive \\ & + \beta_3 NET\ CASH_{i,t-1} * Third\ Directive + \beta_{4-11} \sum W_{i,t-1} \\ & + \varepsilon_{i,t} \end{aligned} \tag{3}$$

In Eq. (3), we interact $NET\ CASH_{i,\ t\ -\ 1}$ with the First, Second, and Third Directives (dummy variables) to observe how adjustment speed changes with the implementation of the energy directives. Specifically, $1 - \beta_1$, $1 - \beta_2$, and $1 - \beta_3$ in Eq. (3) shows the adjustment speeds during the periods where the First, Second, and the Third Energy Directives are in force.

The results in Table 6 show that energy directives have a significant impact not only on the cash accumulation decisions but also on the adjustment speed toward the target level. However, the impact is not the same for all country-groups. First of all, energy firms in Eastern Europe have a significantly lower speed of adjustment with the implementation of the Second and the Third Energy Directives. After the implementation of the Second Energy Directive speed of adjustment in the Eastern European energy firms drop to 10% (1–0.90) from 47.5% (1–0.525) and it stays at 16.2% (1–0.838) during the period when the Third Energy Directive is in force. This finding implies that adjustment costs for the Eastern European energy firms are significantly greater than the costs of being away from the target level. In other words, Eastern European firms experience some difficulties to stay at the optimum cash level with the increasing uncertainty arising from the implementation of energy directives. In contrast to Eastern European firms, Nordic firms increase their speed of adjustment with the implementation of energy directives, particularly with the Second Energy Directive. The speed of adjustment for Nordic firms increases from 20% (1–0.804) to 58% (1–0.423) with the implementation of the Second Energy Directive and it stays about 40% (1–0.397) during the Third Energy Directive period. Although there are some changes in the speed of adjustment toward the target cash level for the firms in the UK and Western Europe, the changes are not statistically significant. Overall, the findings suggest that the implementation of energy directives has a negative influence on particularly Eastern European firms with a lower adjustment speed after the implementation of the regulations. On the other hand, Nordic firms react to the new environment by staying close to the optimum level in terms of their cash position, which also shows their ability or willingness to stay at the optimum level.

Table 6 Speed of adjustment: The role of energy directives

	Dep. variable = NET $CASH_t$				
Variable	(1) All	(2) E. Europe	(3) Nordic	(4) UK	(5) W. Europe
NET $CASH_{t-1}$*First Directive	0.626***	0.525***	0.804***	0.571***	0.524***
	(0.072)	(0.127)	(0.181)	(0.095)	(0.068)
NET $CASH_{t-1}$*Second Directive	0.506***	0.900***	0.423***	0.433***	0.538***
	(0.052)	(0.045)	(0.102)	(0.076)	(0.122)
NET $CASH_{t-1}$*Third Directive	0.595***	0.838***	0.397***	0.591***	0.662***
	(0.044)	(0.066)	(0.091)	(0.058)	(0.081)
$SIZE_{t-1}$	−0.007***	0.005	−0.012*	−0.008**	−0.006*
	(0.002)	(0.003)	(0.006)	(0.003)	(0.004)
$CAPEX_{t-1}$	0.092*	0.111	−0.038	0.154*	−0.033
	(0.049)	(0.133)	(0.047)	(0.084)	(0.091)
$CFLOW_{t-1}$	−0.064**	−0.184***	−0.062	−0.027	−0.088
	(0.025)	(0.065)	(0.052)	(0.037)	(0.063)
LEV_{t-1}	−0.030	0.012	−0.011	−0.063	0.004
	(0.021)	(0.031)	(0.036)	(0.044)	(0.038)
MB_{t-1}	0.003	−0.000	−0.002	0.005	0.000
	(0.003)	(0.012)	(0.005)	(0.003)	(0.010)
NWC_{t-1}	0.027***	0.046***	0.018	0.012	0.041
	(0.010)	(0.018)	(0.012)	(0.040)	(0.053)
DIV_{t-1}	−0.005	−0.006	0.006	−0.014	0.019
	(0.008)	(0.011)	(0.015)	(0.014)	(0.013)
RD_{t-1}	0.015*	−0.019	0.025	0.010	0.035**
	(0.009)	(0.015)	(0.017)	(0.018)	(0.014)
Second Directive	0.038***	−0.034*	0.095***	0.039	0.022
	(0.015)	(0.020)	(0.030)	(0.031)	(0.020)

Third Directive	0.018	−0.043**	0.071***	−0.009	0.012
	(0.014)	(0.022)	(0.021)	(0.030)	(0.020)
Constant	0.142***	0.004	0.185**	0.184***	0.115**
	(0.032)	(0.040)	(0.078)	(0.053)	(0.049)
AR (1)	0.000	0.022	0.000	0.000	0.000
AR (2)	0.084	0.466	0.341	0.297	0.224
Hansen	0.347	1.000	0.257	0.265	0.783
Diff (First vs Second Directive)	0.151	0.007***	0.093*	0.215	0.918
Diff (First vs Third Directive)	0.706	0.044**	0.070*	0.852	0.160
Diff (Second vs Third Directive)	0.132	0.226	0.831	0.072*	0.288
N	2425	272	581	1010	562

This table presents the GMM-BB estimation results of NET CASH for different country-groups. Variable definitions are presented in Table 1. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively. Robust standard errors are in parenthesis. Second to third lags of NET CASH are used as instruments. AR (1) and AR (2) test the first- and second-order correlation among residuals under the null hypothesis of no serial correlation. Hansen is a test of instrument validity under the null hypothesis of instruments are valid

Table 7 Additional tests: Weighted least squares and least absoule deviations regressions

	Dep. variable = $CASH_t$		
Variable	(1) WLS 1	(2) WLS 2	(3) LAD
$SIZE_{t-1}$	-0.013^{***}	-0.013^{***}	-0.008^{***}
	(0.003)	(0.004)	(0.002)
$CAPEX_{t-1}$	-0.095^{**}	-0.105^{**}	-0.114^{***}
	(0.040)	(0.042)	(0.042)
$CFLOW_{t-1}$	-0.108^{***}	-0.080^{**}	-0.083^{***}
	(0.037)	(0.040)	(0.024)
LEV_{t-1}	-0.179^{***}	-0.163^{***}	-0.098^{***}
	(0.030)	(0.030)	(0.021)
MB_{t-1}	0.014^{***}	0.014^{***}	0.020^{***}
	(0.003)	(0.003)	(0.002)
NWC_{t-1}	−0.006	−0.006	0.003
	(0.010)	(0.010)	(0.010)
DIV_{t-1}	−0.003	−0.005	0.006
	(0.012)	(0.012)	(0.010)
RD_{t-1}	0.047^{***}	0.044^{***}	0.028^{***}
	(0.016)	(0.013)	(0.009)
Second Directive	0.050^{***}	0.042^{***}	$0.026*$
	(0.013)	(0.014)	(0.014)
Third Directive	0.037^{***}	0.040^{***}	$0.030**$
	(0.012)	(0.014)	(0.013)
Constant	0.272^{***}	0.275^{***}	0.180^{***}
	(0.056)	(0.061)	(0.046)
Country fixed	Yes	Yes	Yes
R^2	0.279	0.288	0.115
N	2670	2670	2670

This table presents the weighted OLS and least absolute deviations regression estimation results of cash for the whole sample. Variable definitions are presented in Table 2. In Panels 1 and 2, we weigh the standard errors using inverse of the square root of the number of observations per country (WLS 1) and country-group (WLS 2), respectively (weighted least square estimation). In Panel 3, we employ least absolute deviation (LAD) regression instead of standard OLS estimation. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively. Standard errors (in parenthesis) are clustered at the firm level

4.4 Additional Tests

Our main results about the impact of energy directives on cash holding accumulation could be driven by our model specification or sample heterogeneity. It is therefore necessary to conduct a series of robustness tests to validate our conclusions.

One of the potential concerns about the analysis is the heterogeneity in the number of observations per country and country-group. To control for the differences in the sample size across the countries and country-groups, we perform

Weighted Least Squares regression. Specifically, we use the inverse of the square root of the number of observations per country and country-group in calculating the standard errors to eliminate the impact of sample size heterogeneity across countries. According to the results presented in Table 7 and Panel 1–2, our main findings are not sensitive to the sample size heterogeneity. The coefficients of the Second and Third Directives are positive and significant at the 1% level, which imply that with the implementation of the further directives, European energy firms increase their cash level. Moreover, the impacts of firm-specific variables are quite similar when we undertake Weighted Least Squares regression.

The standard linear regression models estimate the relationship between the dependent and explanatory variables conditional on the mean function. However, with the presence of outliers and concerns about the assumptions of the parametric estimation, median regression, or least absolute deviations (LAD) provide more robust results. To account for this, we also employ LAD regression to test the impact of energy directives on the cash holdings (Table 6 and Panel 3). Our results are similar when we employ LAD regression instead of OLS regression.

As a final robustness check, we follow Kalcheva and Lins (2007) and control for country-level anti-self-dealing index as a proxy for investor protection and gross domestic product (GDP) as a proxy for economic development in addition to the other variables used in the empirical model. Untabulated results show that our findings are robust even after controlling for investor protection and GDP level. In other words, the energy directives have a significant impact on the cash holding policies of the energy firms even after controlling for other factors such as GDP and investor protection level of the country.

5 Conclusion

In this chapter, we investigate the impact of energy directives on corporate cash holding policies of the energy firms in Europe. The energy industry has substantially different institutional and macroeconomic settings than other industries. The energy sector has experienced radical changes in terms of the unbundling process, developments in the energy security, and concerns about the climate change as well as the increasing importance on the usage of renewable energy all over the world. Moreover, energy directives have significantly changed the business environment for energy firms by increasing the uncertainty in generation, transmission, and distribution of energy. Although the energy industry has some unique characteristics in terms of the business dynamics and regulative issues, corporate financial policies of the energy firms is often neglected in the energy economics literature. Therefore, understanding the cash holding decisions of these firms will enhance our understanding about the corporate policies of the firms operating in the energy industry. Moreover, we expect to bridge the gap between corporate finance and energy economics by focusing on the one of the most important field of corporate finance, cash holdings.

We adopt a similar methodological approach to prior research by including several firm-specific and macroeconomic variables and by employing both static and dynamic regressions. As expected, the determinants of cash holdings are significantly different among countries and country-groups. More importantly, the implementation of energy directives has a different influence on cash holding policies. Oil and gas firms in Nordic and Western European firms significantly increase their cash holdings after the implementation of the Second and Third Directives, however, firms in other countries are insensitive to the changes in the energy industry. Moreover, target adjustment behavior also differs among country-groups. The firms in Nordic and Western European countries have a relatively quick adjustment processes to reach the desired cash levels. Therefore, it may be implied that firms in these countries face lower adjustment costs or greater costs of being suboptimal and as a result they tend to operate close to their target cash position. On the other hand, greatest adjustment costs are observed in Eastern European firms as they have the considerably slower adjustment processes. Moreover, implementation of the energy directives increases (decreases) the speed of adjustment in Nordic (Eastern Europe) firms. Therefore, it can be inferred that implementation of the energy directives has a considerable impact not only on the cash accumulation but also on the speed of adjustment to the desired cash level.

Overall, the findings of this study are expected to enhance the understanding of the cash holding policies in a unique industry in terms of the different micro and macro environmental and financial settings. Further studies can extend the issue by incorporating other countries outside of Europe. There is still enough room for investigating other corporate policies such as investment, capital structure, or dividend policies in this industry to gain better understanding of corporate decisions of these firms. This awaits further research.

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