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Do NEDs influence ESG corporate performance?

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Being uninvolved in day-to-day management of a company, Non-Executive Directors (NEDs) are arguably well-suited to oversee the drive for more sustainable business practices. Our study explores the correlation between the professional capital of NEDs and ESG performance for a sample of FTSE-350 listed companies spanning the years 2012 to 2022. Our findings reveal that board connectedness, particularly the simultaneous presence on boards of companies exhibiting superior ESG performance, significantly influences a company's overall ESG score. Our results highlight the relevance of board capital on corporate ESG performance, with practical implications for corporate governance.

Keywords: ESG; Corporate Governance; Boards: Non-executive directors; Network Centrality

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1. Introduction

Corporations are coming under increasing pressure from shareholders, regulators, customers and the court of public opinion to adopt more sustainable business practices and to integrate ESG considerations into their business practices. Empirical research has shown that companies with high ESG credentials often: outperform their peers in the stock market; are more likely to attract sustainable investment; and to enjoy reduced costs of capital (see Eccles, Ioannou, and Serafeim 2014; Flammer 2015; Fride et al. 2015; Alshehhi et al. 2018). These improvements in financial performance come through lower operational risks, higher corporate value, and via an improvement in the way that consumers, employees and policy-makers see the firm (Goto and Sueyoshi 2020). Companies can attain these tangible benefits by: engaging employees who in turn can become more productive and whose objectives can become better aligned with those of the company (Cao and Rees 2020); increasing customer loyalty and, therefore enhancing revenues (McDannold and Kwon 2023); and by accessing capital at a lower cost (Puggioni and Stefanou 2019). A survey of FTSE 350 board chairs conducted in 2022 reveals that ESG oversight ranks sixth in a board chair's priorities when selecting new directors (www.spencerstuart.com). While ESG disclosure requirements rank second board agendas, according to an EY corporate governance survey in 2022 (Ernst and Young 2022[1]). There is also evidence to suggest that investors may be willing to divert their capital away from companies that are not actively contributing to the economic, social, and environmental welfare of society (Shakil 2021; Tjahjadi et al. 2021).

To commit to longer-term responsible practices, companies require sound corporate governance mechanisms (Miras-Rodríguez et al. 2019; Amin et al. 2020). The board of directors is the key corporate governance mechanism, which has responsibility for monitoring,

[1]https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/attractiveness/ey-long-term-value-and-corporate-governance-survey-february-2022.pdf

controlling and supervising all aspects of the company (Adams et al. 2008). In this paper we investigate the influence that Non-Executive Directors (NEDs) may have on sustainable business practices.

Non-Executive Directors (NEDs) are an integral component of corporate governance. Unlike their executive counterparts, NEDs are not directly involved in the day-to-day management of the firm. Instead, their fiduciary duty lies with the company itself and its enduring interests, a role that emphasizes their independence from executive managers (Clarke 2015). In monitoring and challenging the performance of the top management team and enforcing good governance principles, NEDs act as independent advisors. They are appointed for their professional capital (also known as board capital), which they will have built up over the years and which usually comprises three main components: their human capital, that is their personal skills and abilities, (e.g. Haynes and Hillman 2010); their network of interactions, normally referred to as social capital (e.g., Dasgupta and Serageldin 2000; Pandey et al., 2023); and their accumulated expertise in taking decisions, that is, their decision capital.

The literature that explores the relationship between board-level governance and corporate social responsibility is increasing rapidly.[2] A number of studies have focused on the role of NEDs.[3] Hussain et al. (2018) study a sample of 100 US companies from the high-performance Global Fortune 2013 list adopting the framework provided by Global Reporting Initiative, which requires firms to disclose both positive and negative performance on economic, environmental, and social dimensions. Their results confirm that corporate governance characteristics play an important role in enhancing a firm's environmental and

[2] See Hussain et al. (2023) for a very recent survey using meta-analysis techniques, and Pandey et al. (2023) and Jain and Jamali (2016) for more traditional reviews of the literature about the relationship between board characteristics and corporate performance, including CSR accomplishments.

[3] Cheng et al. (2023) contend that there is still mixed evidence about whether investments on corporate social responsibility are exempt from agency problems.

social performance. In particular they find that: boards with a higher proportion of independent directors have a better environmental and social performance; and that board gender-diversity enhances the social dimension of sustainability, although it seems to have no effect upon environmental performance. Studying a sample of listed Italian companies between 2011 and 2014, Cucari et al. (2018) find a significant positive relationship between ESG disclosure and the presence of independent directors and a CSR committee. Haque and Ntim (2018) analyse data from 256 non-financial UK listed firms over the 2002-2014 period. They find that the positive effect of the Climate Change Act on carbon reduction initiatives is stronger in better-governed firms (e.g., with more independent directors) and that firms with a poor governance structure have lower actual carbon performance compared with their better-governed counterparts. Finally, a recent paper by Amin et al. (2020) studies the impact of NEDs' social capital on the ESG performance of a large sample of 3,000 publicly traded US companies between 2002 and 2013, confirming that board connectedness is positively associated with CSR performance.

We contribute to the literature by studying the relationship between NEDs and ESG corporate performance. To this end, we examine a sample of companies listed on the FTSE-350. In addition to considering many board characteristics that have been found to have an impact on a company's ESG performance, including measures derived from social network analysis, we introduce a new metric. Using data from BoardEx, a commercial provider that collects detailed information on board member attributes, including all present and past board positions, we build an index of the average ESG performance of all companies on which a NED serves. We refer to this metric as an ESG '*attentiveness*' index. This measure allows us to study the potential impact on a company's ESG performance of having on its board, NEDs that also serve on other boards that pay a great deal, or very little attention to sustainability issues.

The choice of board members, especially in the case of non-executives, may itself be

driven by a company's willingness to improve its ESG performance. For example, shareholders may decide to appoint NEDs with high ESG 'attentiveness' precisely because they wish to improve the board's professional capital on these issues. From an econometric perspective, this may give rise to an endogeneity problem in any estimation. To address this issue, we estimate the relationship using both standard fixed-effects panel regression techniques as well as the two-step Generalized Method of Moments (GMM) technique.

Our results confirm that NED links, evaluated using social network analysis measures, have a significant impact on ESG performance, which is more pronounced on the aggregated ESG score and on the environmental and governance scores. Our findings also document that boards that comprise NEDs that serve on the boards of other firms with higher ESG credentials, exert a stronger impact on a company's environmental, social and governance performance. Finally, we also confirm the findings of Hussain et al. (2023) which is that boards with a higher proportion of women, or where women have a prominent role on the board (e.g., President or CEO) have a better ESG performance. The rest of the paper is organized as follows. In section 2 we provide a brief review of the relevant literature; in section 3 we present the hypotheses that we investigate, in 4 we describe our data sources, present some descriptive statistics, and discuss the empirical model, our results are presented in section 5, while section 6 concludes.

2. Brief literature review

The empirical evidence relating to board characteristics and firm value is vast. One of the first focuses of this literature was the role that board size plays. Yermack (1996) uses a sample of 452 large US corporations between 1984 and 1991, and uncovers a negative and statistically significant relationship between board size and corporate value, measured by Tobin's *Q*. As shown in the literature review by Jain and Jamali (2016), most authors have confirmed this finding, using samples of firms from different countries and periods. An original

perspective on this issue is provided by Coles et al. (2008), who argue that the relation between Tobin's *Q* and board size is U-shaped because complex firms have greater advising requirements than simple firms and thus have larger boards with more outside directors. As such, Tobin's *Q* increases in board size for complex firms and decreases for simple firms, and this relation is driven by the number of outside directors.

Other researchers have looked at the relationship between corporate performance and the independence of board members. Weisbach (1988) shows that independent directors increase firm value by removing bad management. Rosenstein and Wyatt (1990) find a positive wealth effect relating to the appointment of outside directors, although they do not find clear evidence that those with particular occupations are more or less valuable than others. Many other analyses have found that boards with stronger independence and more connections where the average level of social capital is higher, have a positive effect on firm value. Fang et al. (2012), for example, show that boards with more heterogeneous connections are associated with a higher Tobin's *Q*, more innovation, stronger internationalization and a better M&A performance. Joh and Yung (2018) study a sample of non-financial firms listed on the Korea Stock Exchange (KSE) between 1999 and 2006. They find that the presence of outside directors, especially those with stronger social connections, has a positive effect on firm value, but only for companies that are potentially subject to greater external pressure.

Of particular interest for our analysis is the strand of literature that has focused on the role of professional capital using social network measures. A professional network hinges on interactions that can develop from very different situations: from attending the same schools, to living in similar areas, to having or having had business relationships. In the case of NEDs, who can serve on boards of different companies, a very specific professional network is that of people serving on the same board over time. Several papers focus explicitly on this aspect of board connections, documenting the benefits of well-connected boards and recognizing that

"*social and professional networks are a central feature of virtually all economic activities"* (Larcker et al. 2013). Anderson et al. (2011) show that investors place valuation premiums on heterogeneous boards in complex firms, but discount heterogeneity in less complex firms. Akbas et al. (2016) find evidence that companies with more connected directors have more predictable outcomes of upcoming earnings surprises and firm-specific news sentiment. Chuluun et al. (2014) construct three measures of board connectedness based on social network analysis indices (e.g., degree, eigenvector and betweenness centrality). Studying all firms in the S&P 1500 Index between 1994 and 2005, they find that better connected firms have greater media coverage, more ties to financial firms and, likely as a consequence, pay statistically and economically significant lower spreads on their fixed income borrowing.

Using a sample of UK firms, Harjoto and Wang (2020) uncover a positive relationship between board network centrality and ESG performance.[4] And in a paper closely related to our analysis, Nandy et al. (2020) calculate a normalized index measuring degree, eigenvector and betweenness centrality among board members of all companies in their sample of about 2,000 publicly listed companies from 17 countries during the period from 2003 to 2018, to study the relationship between connectedness and corporate environmental and social performance. They find that firms with more connected directors have better corporate social responsibility performance.

3. Hypotheses

Our analysis focuses on the impact that NEDs may have on a company's ESG performance. NEDs should play a significant role in mitigating the agency problems caused by the misalignment between the choices of executive directors and the preferences of shareholders

[4] Harjoto and Wang (2020) take all interlocking directors regardless of where they sit – executive directors or non-executive directors alike.

and stakeholders (Cheng et al. 2023). In fact, agency theory suggests that NEDs, acting in the best interests of companies and their shareholders, should be the governance mechanism that mitigates the different motivations of shareholders and executive managers (Jensen and Meckling, 1976).[5] Our maintained assumption is that by being less involved in day-to-day decisions, NEDs are in a better position to have a positive influence on company's corporate culture and bring a sharper focus on ESG issues. The first hypothesis that we investigate therefore focuses on the number of NEDs on a board. We test whether a higher number of NEDs is associated with a better ESG performance.

H1: Companies with a higher share of NEDs on a board have a better ESG performance.

According to the resource dependency theory, since NEDs' professional networks constitute a channel for the diffusion of information, transmission of knowledge and forward-looking trends, well-connected NEDs can reduce information asymmetries leading to better informed board decisions (Amin et al. 2020). Harjoto and Wang (2020) use social network analysis on a sample of FTSE-350 companies from 2007 to 2018 and document a positive influence of directors' networks on all three main pillars of ESG performance, environment, social and governance. In addition, better connections can also provide channels for new business opportunities. These considerations give rise to our second hypothesis, which is that companies whose NEDs are more connected have superior ESG performance.

H2: Companies whose NEDs are better connected have a superior ESG performance.

[5] Contrary to our main assumption, it may also occur that NEDs limit the investments of companies on social responsibility in case these investments are less value creating in the long haul or even value-destroying ones (Amin et al., 2020; Cheng et al. 2023). Our empirical analysis will allow us to uncover which of the two opposing effects prevails.

In addition to broad measures of participation in professional networks, links capable of providing know-how that is specific to ESG practices are likely to exert a stronger effect on a company's ESG performance. NEDs that serve or who have served on boards of companies with strong ESG credentials, should be able to enhance effective ESG practices. We measure this relationship by constructing a new index of the '*attentiveness*' of each NED, based upon the average ESG performance of the corporations on which they serve. To the best of our knowledge, this is a new way of measuring whether NEDs can have an impact on corporate ESG performance.[6] Our third hypothesis then, posits that companies whose NEDs are more attuned to ESG issues have themselves a better ESG performance.[7]

H3: NEDs more attentive to ESG issues enhance a company's ESG performance.

In the following, we will test the three hypotheses described above.

4. The empirical framework

4.1. The data

Our analysis is based upon FTSE-350 companies. The sample period is 2012 to 2022, a period comparable to extant studies (e.g., Amin et al. 2020; Adhikari 2026).[8] Data on the composition of boards and on the characteristics of board members were extracted from BoardEx, a global leadership database used for academic research. Unlike other studies (e.g.

[6] A related strand of literature has studied human capital formed by experience and expertise, underpinned by the concept of social capital linked to resource dependence theory (Pfeffer and Salancik, 1978; Pfeffer, 2005).

[7] Following a similar logic, in a set of robustness checks we have also verified that price-to-book ratio and the return on equity are not significantly different for those corporations whose NEDs also sit in the boards of companies with higher price-to-earnings ratio or higher returns on equity. We interpret this result as confirming that the attention to ESG issues is more likely to be transferred through the expertise of NEDs.

[8] Besides, social relationships don't last forever and might decay along time, making it difficult to rekindle to people who have been contacted more than 10 years before.

Fracassi, 2016), we exclude top management positions from our analysis, because managers are focused on day-to-day operations which are only tangential to decision-making with impact on ESG performance at the firm level, and their access to strategic information and decision processes differs from those of directors.

Using BoardEx data, we build a map of the connections of each NED with all other members that served in the same board of a FTSE 350 listed company during the period of analysis. This map allows us to use social network analysis to build centrality measures such as degree centrality, betweenness, closeness, and Katz and eigenvector centrality. Each one of these measures allows us to capture specific features of a NED's role within their professional network. Specifically, following the standard representation used in social network analysis, we consider each NED as a node. When they sit on the same board as another NED then there is a link between the two NEDs (i.e., the two nodes).[9] In other words, two NEDS sitting on the same board are adjacent in the network (i.e., the entry in the adjacency matrix describing the network takes the value of one). From this representation, different centrality measures for each NED can be built. The simplest measure is degree centrality, which is the sum of all connections of a node normalized by the total number of possible connections:

$$Degree\ (i) = \frac{\sum_{i \neq j} d(i,j)}{N-1} \qquad (1)$$

where *d(i,j)* is an indicator function taking the value of one if there is a link between node *i* and node *j* and *N* is the is the total number of nodes in the graph.

[9] In a set of robustness checks we have considered only NEDs that have been sitting in the same board for at least one year or more, to control for the possibility that sharing only a few board meetings might have little or no effect. In addition, we have also considered the alternative hypothesis that each corporation is a node and that two corporations are linked if they share at least one NED. In both cases, the results confirm the findings of the baseline specification.

Related to degree centrality is *closeness centrality*, which is the inverse of the average distance between each node and any other node in the network.[10] The main difference between the two is that degree centrality measures the links at one unit of distance, closeness centrality accounts for the possibility that a node is connected to all other nodes in the network through just one or very few links. For example, if one NED who is connected to just one other NED, who in turn sits on all boards, means that the first NED is just two steps away from all other NEDs. Formally, closeness can be defined as follows:

$$Closeness\ (i) = \frac{\sum_{i \neq j} l(i,j)}{N-1} \qquad (2)$$

where $l(k,j)$ is the length of the shortest path linking *i* and *j* (i.e., the smallest number of successive links that are necessary to go from *i* to *j*).

The NED from the example above that is connected with all other NEDs, would have a very central position, acting as a pivot for many possible connections. This characteristic is captured by *betweenness centrality*, which assigns a higher weight to nodes that help form links with other sets of nodes. A typical example is that of a NED who sits on a board that connects NEDs from many distinct groups of companies, that otherwise would have no contact with one another. Such a NED would have a high betweenness centrality because they help put two groups in touch that would otherwise be separated or linked weakly. Formally, betweenness centrality is defined as:

$$Betweenness\ (i) = \sum_{k \neq j, i \neq k, i \neq j} \frac{\sigma_i(k,j)/\sigma(k,j)}{(N-1)(N-2)/2} \qquad (3)$$

where $\sigma_i(k,j)$ is the number of shortest paths between nodes *k* and *j* that go through *i*, $\sigma(k,j)$ is the number of shortest paths between nodes *k* and *j*, and *N* is the total number of nodes in the graph.

[10] While different conventions are used to address the problem of unconnected nodes, in our analysis we simply exclude them from the computation.

Two more refined centrality measures account not only for the number of links of a node, but also for the centrality of the nodes with which one node is linked. The first such measure is *Katz centrality* (or prestige), which is formally defined as:

$$Katz\ (i) = P_i = \sum_{j \neq i} I_{ij} \frac{P_j}{d_j} \quad (4)$$

where I_{ij} is an indicator function that takes the value of one if nodes *i* and *j* are linked, and d_j is the degree of node *j*. Since this definition is self-referential, because the Katz centrality of each node is a function of the Katz centrality of the other nodes linked to it, the solution is obtained recursively.

Finally, and similar to Katz centrality, is *eigenvector centrality*, which does not normalize each node's prestige by its degree:

$$eigenvector\ (i) = eig_i = \sum_{j \neq i} I_{ij} eig_j \quad (5)$$

Once we have calculated each NED's centrality measure, we aggregate the information at the company level so that we can calculate the average and the maximum centrality of its NEDs. Centrality measures capture different but interrelated aspects of connectedness. To address this issue, we calculate the principal components of the set of centrality measures described above to reduce the number of possibly correlated control variables.[11] The first principal component has positive factor loadings on all variables,[12] except for closeness (unsurprisingly, since a higher closeness index implies a larger average distance from other nodes in the network). It explains about 30% of total variability, suggesting that each component provides a substantial share of independent information.

[11] Principal components are uncorrelated linear combinations of the original variables that, combined, contain the same information as the original variables. Each component is orthogonal to the other components; they can then be ranked so that earlier components contain more information than later ones. The advantage of using principal components is that of reducing the number of, possibly collinear, explanatory variables, while retaining a large share of their information (see Afifi et al., 2020, for an introduction).

[12] That is, the weight associated to each variable in the construction of the linear combination is positive.

In addition to calculating the centrality measures described above, we also build a new index. This index captures the average '*attentiveness*' to ESG issues of the NED of each company. To this purpose, we proceed as follows: for each NED in the board of a company, we first calculate the average ESG score of the scores of all other companies in which they are a board member (thus excluding the score of the company under analysis), and next take the average of the scores of all NEDs in the company's board. We replicate this procedure for each measure of ESG performance: environment, social, governance, and composite.

Finally, we also control for more standard characteristics of the board, such as: the number of members; the share of females; and the number and share of NEDs. More complex firms have larger boards, bringing in more experience. However, larger boards might also be less effective than smaller boards (Jensen 1993). Board diversity, and in particular the presence of female directors, has been studied extensively (see, for example, Cambrea et al. 2023, and Pandey et al. 2023), also with respect to its impact on ESG performance. Finally, a larger share of NEDs performing their duties of monitoring and advising, might have an impact on the company's performance and also on ESG matters (Amin et al., 2020).

Company's ESG ratings are obtained from Refinitiv, which builds these measures based on public data. Among the many produced by Refinitiv, we focus on four scores:

> (1) the *environmental score*, which measures a company's impact on living and non-living natural systems, including the air, land and water, as well as complete ecosystems;
>
> (2) the *social score*, which measures a company's capacity to generate trust and loyalty with its workforce, customers and society, through its use of best management practices;
>
> (3) the *corporate governance score*, which measures a company's systems and processes, which ensure that its board members and executives act in the best interests of its long-term shareholders; and
>
> (4) the *composite ESG score*, that is a weighted average of the previous. Each score is the percentile ranking of the company, based on equally weighted sums of all the indicators used to create it. As shown in Table 1, aspects that are considered more relevant have a larger number of indicators, which leads automatically to assigning them a higher weight.

In addition to board characteristics, our econometric analysis also controls for some indices of corporate characteristics and performance, on the basis that they may also influence ESG performance in a way that is independent from, but correlated with board characteristics.[13] Drawing from the extant literature (Coles et al. 2008; Dhaliwal et al. 2011) we control for size (proxied by market capitalization), as larger firms may, on the one hand, be more ESG aware because they are subject to more external scrutiny and, on the other hand, be more prone to face ESG issues because of internal agency and management problems. Second, we control for profitability (proxied by return on equity). A large number of studies document a positive relationship between ESG and company financial performance (Velte 2017). Next, we control for the price-to-book ratio, which is a valuation multiple also used in extant studies (e.g., Gavrilakis and Floros 2023). Finally, we also control for leverage (debt-to-equity) because highly leveraged firms rely more on external financing, making them more prone to evaluation by external investors and advisors (Coles et al., 2008; Pfeffer, 2005).[14]

Table 2 reports the descriptive statistics of the variables considered in our analysis It shows that the FTSE-350 companies included in our sample have on average a slightly better ESG score than average on all ESG indices, except for the environmental score.[15] The latter might result from high levels of carbon emissions and lower climate transition preparedness form the largest UK companies. The coefficient of variation of all scores is rather limited (0.3-0.5). The median number of board members is 9, the median share of NEDs is 50%, and the

[13] For example, larger and more profitable companies may aim at a better ESG performance because they are under stronger scrutiny from independent advisors and the press. Since these companies also have larger boards, because they are more complex organizations, if we did not control for company size, its effect would be erroneously captured by board size, giving a biased estimate. A similar reason can be applied to more leveraged companies, that are likely to be under stronger scrutiny from external investors.

[14] In the robustness checks we use an additional measure of ESG performance, based upon each company's exposure to environmental, social and governance controversies. The score, that ranges from 0 to 100 (with less than 50 regarded as poor and more than 70 considered excellent) is produced by Refinitiv from media disclosures pertaining to negative events reflected in global media (Aouadi and Marsat 2018; Bang et al. 2023).

[15] The total number of companies in our sample is slightly larger than 350, due to the entry and exit of companies into and from the FTSE 350 index.

median share of female NEDs over total NEDs is 30%. NEDs' centrality measures have a rather high dispersion, as shown by the coefficient of variation that are in most cases above 1. Attentiveness, that is the average ESG performance of all companies where each NED sits, also shows a high variability within our sample. Table 3 shows that the higher scoring ESG companies have slightly larger boards, a slightly larger share of NEDs, have NEDs that are better connected and have higher levels of ESG attentiveness. Finally, Table 4 presents the matrix of the bilateral correlations between our variables. As expected, ESG scores are positively correlated, but less so in the case of the governance score. Interestingly, each ESG score is also strongly positively correlated with the attentiveness of its NEDs with respect to the associated score. Centrality measures are positively correlated, but not strongly.

Descriptive statistics provide some preliminary evidence that companies with better ESG scores have more connected and more attentive NEDs. In the following, we present the results of a more rigorous econometric analysis aimed at verifying the robustness of the descriptive evidence.

4.2. The empirical model

Since a company's ESG performance is likely to be rather persistent through time, we exploit our data on FTSE 350 companies between 2012 and 2022 to estimate a dynamic panel, including the lagged dependent variable:

$$ESG_{it} = \alpha_0 + \beta_1 ESG_{it-1} + \beta_2 Board\ characteristics_{i,t-1} + \beta_3\ Other\ company\ characteristics_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (6)$$

where ESG is our dependent variable, describing either the overall ESG score or one of its single components. Since the inclusion of the lagged dependent variable among the regressors introduces the well-known Nickel's bias, we estimate the model using the system GMM estimator suggested by Arellano and Bond (1991). Moreover, to account for the potential

endogeneity of the choice of board members with respect to ESG performance, board characteristics are instrumented using their lagged values. In the robustness checks, we present some additional results obtained by: (1) considering only the average ESG 'attentiveness' of new board members; (2) including only observations on companies that did not have new NED members; (3) splitting the sample for companies with ESG scores above and below the sample median; and (4) by estimating the model with the bootstrap-based bias correction for dynamic panels proposed by Everaert and Pozzi (2007).

5. Empirical results

5.1. The overall ESG performance

Table 5 presents the results of the estimation of different specifications of equation (6) for the overall ESG score. In column 1 the explanatory variables are the lagged dependent variable, a set of board characteristics: the number of board members, the share of female board members, the proportion of NEDs to the total number of board members – and a set of company characteristics: market capitalization, price-to-book ratio, leverage and returns on equity.[16] The results are broadly in line with the previous literature: ESG performance has a significant degree of persistence, as shown by the coefficient of the lagged dependent variable of 0.739, that is also statistically significant at the 1 per cent level. Consistent with the theory that emphasise the role of human and professional capital, our findings show that companies with larger boards, and which therefore probably benefit from more diverse expertise, also have a better ESG performance, even controlling for the size of the company by including its total market capitalization. The coefficient of the logarithm of the number of board members is 6.281 (and statistically significant at the 5 per cent level), suggesting that a one percent increase

[16] The Hansen test of overidentifying restrictions and the Difference-in-Hansen tests of exogeneity of instrument subsets all have p-values of one, suggesting that our specification is sound.

in the number of board members increases the ESG index by about 6 points. Considering that the average (and median) number of board members in our sample is about 9 and the average (and median) ESG score is 52, the effect of adding one more member is not only statistically but also economically significant. The positive and statistically significant coefficient of the percentage of female directors confirms the previous findings of the literature that shows that female directors have a bigger impact on ESG performance than their male counterparts. The coefficient value of 0.11 on this variable implies that substituting one man for one woman in a board of average size (9) and with the average number of women (2) increases the ESG index by about one point. Consistent with our expectations about the ability of NEDs to have an impact on longer term corporate objectives, such as the ESG performance, the coefficient of the share of NEDs in the board is positive. However, the effect is not statistically significant, and the economic impact is also rather small: for the average company, substituting one executive director with one non-executive director increases the ESG performance by less than one point. Finally, among corporate characteristics, only price-to-book ratio has a statistically significant effect on total ESG performance. Higher price-to-book is associated with a worse ESG performance.

Column 2 of Table 5 presents the results of a specification where we have also included a measure of the average centrality of the NEDs in the board of each company. The measure adopted in this specification is the principal component of the five measures of centrality described in Section 4.1 above. Also, in this case, the Hansen test of overidentifying restrictions and the Difference-in-Hansen tests of exogeneity of instrument subsets all suggest that our specification is again sound. Interestingly, our measure of centrality has a positive and statistically significant impact on ESG performance, with a coefficient of 1.290 that is statistically significant at the 10 per cent level. However, the economic impact is not very large: even a large change of the average centrality of the NEDs in the board, from the value at the

25th percentile to that at the 75th percentile of the sample distribution, is associated with an increase in the ESG performance of just slightly more than one point. What is more noteworthy is that with the inclusion of the measure of average centrality, the coefficients of the size of the board, and of the share of females and NEDs drop to about 10 to 20% of the value estimated in the previous specification. Both these coefficients maintain the statistically significance, although the coefficient of the share of females is now significant at the 10 per cent level, instead of the 5 per cent on the previous specification, as its standard error remains almost unchanged. This is a remarkable result, because it implies that the effect on a company's ESG performance of larger boards and of the presence of women and NEDs is mostly due to the higher number of connections that these two features entail.[17] In other words, size and the presence of NEDs do not matter per se, but they allow a company to benefit from stronger connections, which in turn provide the board with an improvement in human, social, and professional capital. The coefficient of the lagged dependent variable and of the corporate characteristics are broadly unchanged with respect to the previous specification.

Column 3 presents the results of a specification that does not include the centrality index but includes the measure of NED average ESG 'attentiveness' as described in Section 3.1. As in the previous cases, the Hansen test of overidentifying restrictions and the Difference-in-Hansen tests of exogeneity of instrument subsets all suggest that our specification is sound. The inclusion of the average ESG 'attentiveness' variable causes the coefficients of the size of the board and of the share of NEDs to decline and to lose their statistical significance compared with the specification presented in Column 1. The economic impact of ESG 'attentiveness' is about half the size of that of centrality: the coefficient of 0.681 implies that a change from the value at the 25th percentile to that at the 75th percentile of the sample distribution causes an

[17] In our sample, women NEDs are on average slightly more connected than men NEDs.

increase in the index of ESG performance of nearly 3 points. On the contrary, the coefficient of the share of females becomes larger and remains highly statistically significant. These results seem to suggest that it is not only connections that matter, but also the ESG-specific knowledge acquired through such connections.

Finally, Column 4 presents our preferred specification, that includes both the centrality index and the measure of average ESG 'attentiveness' of the NEDs in the board. Also, as in the previous cases, the Hansen test of overidentifying restrictions and the Difference-in-Hansen tests of exogeneity of instrument subsets all suggest that our specification is sound. The inclusion of both additional measures of board characteristics does not alter the picture emerging from the previous specifications. The coefficient of the measure of average ESG 'attentiveness' is comparable to that estimated with the specifications presented in Columns 2 and 3. The standard error of the centrality index remains almost unchanged and with the drop of the coefficient estimate this measure loses statistical significance. The coefficient of the percentage of female directors is positive and statistically significant.

Overall, the results reported in Table 5 suggest that the presence of NEDs on a board has a positive impact on a company's ESG performance, but only to the extent that they are well connected, and they bring better knowledge about ESG issues.

5.2. E, S and G

Having uncovered the impact of board characteristics on the overall ESG performance, we now estimate the model shown in column 4 of Table 5 for the three main ESG components: environmental, social and governance. Table 6 present the results of these estimates Column 4 simply replicates the results of the regression for the aggregate ESG score, for comparison).[18]

[18] For brevity, we have only reported the results of the richer specification from Table 5. Complete results are available from the authors upon request.

The overall picture that emerges from these results broadly confirms the findings that we reported for the composite index. Aside from the size of the effect on the different indices, the most noticeable difference is that the total size of the board has no statistically significant impact on the single indices, and it has a negative and insignificant effect on the environmental score. Reassuringly, the average ESG 'attentiveness' of the NEDs in the board has a positive and statistically significant effect on all individual ESG dimensions.

5.3. Robustness checks

To investigate the robustness of our results in Tables 5 and 6, Table 7 presents the results of a set of additional regressions.[19] First, we focus on the issue of the potential endogeneity of the composition of the board with respect to the ESG corporate performance. Column 1 presents the results of the estimates of equation (6) disentangling the impact of new NEDs. The rationale for this specification is as follows: if a corporation is willing to increase its ESG performance, it may hire NEDs with a higher 'attentiveness' to ESG issues. If this were the case, the positive impact on the ESG performance of a board with higher ESG 'attentiveness' could be affected by reverse causation. That is, any observed positive impact of having a more ESG-focused board on a company's ESG performance might be the result of the company's prior decision to enhance its ESG score, for example, by bringing in more ESG-focused board members. The positive coefficient on the average 'attentiveness' coefficient could then be due to the new members that are appointed. When we disentangle this effect, the average 'attentiveness' of existing NEDs should be insignificant. The results in Column 1 show that this is not the case: the coefficient of the average 'attentiveness' of new NEDs is statistically insignificant, while

[19] For brevity, we have only reported the results for the aggregate ESG measure. Complete results are available from the authors upon request.

that of the average 'attentiveness' remains positive and highly statistically significant. In fact, the dummy for boards that have hired new NEDs is also statistically insignificant.

Columns 2 and 3 present the results obtained by estimating the baseline specification on the two sub-samples for which the level of the ESG score in the previous year was below or above the year-specific median value. Remarkably, board characteristics only matter for corporations with an initial level of ESG performance below the median. Interestingly, for this sub-sample, in addition to the impact of the average 'attentiveness' of NEDs, the principal component of the average of their network connection measures also has a positive and statistically significant effect on ESG performance.

Columns 4-6 of Table 7 present the findings obtained by estimating the baseline specification on the entire sample but using different estimation techniques. The results in Column 4 are obtained by following the approach suggested by Everaert and Pozzi (2007) to correct for bias correction in dynamic panels.[20] Reassuringly, all results are broadly consistent with those obtained using system-GMM estimation. Columns 5 and 6 present estimates of a static panel data specification, respectively with industry and firm fixed effects. Also, in this case, the results are broadly consistent with those of our baseline specification using system-GMM estimation, providing strong support for our empirical specification.

Finally, Table 8 presents the results of a specification that includes all alternative measures of network connectivity. The results show that only the *average between* and *closeness centrality* of the NEDS in the board have a positive and statistically significant effect on corporate ESG performance. Reassuringly, also in these cases, average 'attentiveness' retains a positive and statistically significant impact on the ESG score.

[20] See also De Vos et al. (2015) for the description of the Stata command used in the estimation.

6. Conclusions

As boards of directors increasingly seek to embed sustainable business practices into their operations and their governance structures, the characteristics of board members will matter. In this paper we have focused on NEDs. Because they are an important control mechanism on corporate boards. They have the power to advise and influence and, at the same time, to monitor and challenge the executive board members in their decision-making process (Amin et al. 2020).

Based on a sample that comprised all FTSE 350 UK companies over the period 2012-2022 for which ESG data are available, we test several hypotheses advanced in the literature about the impact of board characteristics on corporate ESG performance. Using different econometric techniques and different ESG measures, we find robust evidence to suggest that boards whose members are more connected with our corporations are associated with better ESG performance. In addition, we introduce a new measure, the average 'attentiveness' of NED members of the board to ESG issues and find that it has a strong positive relationship with a corporation's ESG performance. We do not, however, find evidence that the proportion of NEDs on a board, or the size of the board have any statistically significant effect on ESG performance.

Our results provide support to theories that emphasize the importance of human, social and decisional capital of board members, with special reference to the role of NEDs (Dasgupta and Serageldin 2000; Haynes and Hillman 2010; and Pandey et al. 2023). Our results also have important implications for any governments or regulators wishing to promote the cause of sustainable business practices.

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Table 1 – Refinitiv, Eikon ESG performance scores

The table provides detailed counts and weights for each category consisting of a different number of measures that make up a category in comparison to all indicators used in the ESG Score framework. The source is Refinitiv.

Pillar	Category	Nr. indicators in scoring	Weights (%)
Environmental	Resource use	20	11
	Emissions	22	12
	Innovation	19	11
Social	Workforce	29	16
	Human rights	8	4.5
	Community	14	8
	Product responsibility	12	7
Governance	Management	34	19
	Shareholders	12	7
	CSR strategy	8	4.5
Total		178	100

Table 2 - Descriptive statistics for the whole sample

Variable	Mean	Median	Coeff. of var.	Min	Max	No. obs.
CSR variables						
Environmental score	49.6	48.9	0.5	0.0	97.1	1,441
Social score	55.5	56.0	0.4	2.1	97.1	1,440
Governance score	59.5	62.8	0.4	3.0	97.6	1,441
ESG score	52.2	51.9	0.3	9.6	93.5	1,441
NEDs' network measures						
Average degree centrality	3.3	2.4	1.0	0.0	13.0	1,235
Average betweenness	102.8	0.0	4.6	0.0	9,171.2	1,235
Average closeness	0.1	0.1	0.3	0.1	0.2	1,235
Average weighted centrality	28.5	8.6	1.6	0.0	312.6	1,235
Average ESG 'attentiveness'	1.4	0.0	5.4	-29.5	36.9	1,091
Average environment 'attentiveness'	2.6	0.0	4.9	-48.6	61.5	1,091
Average social 'attentiveness'	1.4	0.0	6.2	-33.1	37.5	1,090
Average governance 'attentiveness'	0.9	0.0	10.4	-38.0	39.9	1,091
Board variables						
Number of board members	9.1	9.0	0.3	3.0	21.0	1,442
Number of NED board members	4.1	4.0	0.5	0.0	12.0	1,249
Share of NED board members	0.5	0.4	0.5	0.0	2.0	1,109
Share of female NEDs	0.3	0.3	0.8	0.0	1.0	1,235
Firm-specific variables						
Total assets (billions)	39,400	1,699	4.9	32.0	2,180,000	1,769
Price to book ratio	3.0	1.9	1.1	0.0	29.2	1,769
Leverage	69.2	39.1	1.4	0.0	917.0	1,769
Returns on equity	15.4	13.7	1.4	-77.5	162.5	1,769

Table 3 – Descriptive Statistics - Low vs. high ESG performing companies

The table reports the average values of the corporate characteristics included in the empirical analysis, calculated within the samples of companies above and below the mean and the median values of the aggregate ESG indicator.

Variable	Mean		Median	
	Low ESG	High ESG	Low ESG	High ESG
ESG variables				
Environmental score	41.2	66.2	36.6	68.3
Social score	48.9	70.3	46.5	70.8
Governance score	56.4	71.0	59.2	72.6
ESG score	43.0	68.5	45.1	66.8
NEDs' network measures				
Average degree centrality	2.8	4.8	2.0	5.0
Average betweenness	74.3	172.9	0.0	0.3
Average closeness	0.1	0.1	0.1	0.1
Average weighted centrality	17.0	47.5	5.9	26.0
Average ESG 'attentiveness'	-1.6	4.7	0.0	1.5
Average environment 'attentiveness'	0.2	5.5	0.0	0.0
Average social 'attentiveness'	-0.3	3.9	0.0	0.0
Average governance 'attentiveness'	-0.7	3.3	0.0	0.0
Board variables				
Number of board members	8.9	9.9	9.0	10.0
Number of NED board members	4.0	5.0	4.0	5.0
Share of NED board members	0.5	0.5	0.4	0.5
Share of female NEDs	0.3	0.3	0.3	0.3
Firm-specific variables				
Total assets (billions)	67,600	41,600	2,448,527	5,141,800
Price to book ratio	279.3	3.5	2.5	2.2
Leverage	69.9	101.4	49.2	59.2
Return on equity	17.2	20.9	14.5	14.3

Table 4 - Correlation matrix

The table reports the pairwise correlation coefficients among the corporate characteristics included in the empirical analysis.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 Environmental score																			
2 Social score	0.68																		
3 Governance score	0.25	0.24																	
4 ESG score	0.67	0.71	0.52																
5 Total assets (billions)	0.26	0.19	0.17	-0.02															
6 Price to book ratio	-0.02	-0.03	-0.08	-0.05	-0.01														
7 Leverage	0.14	0.07	0.07	0.08	0.21	-0.01													
8 Return on equity	0.03	0.01	-0.05	0.02	-0.03	0.01	0.15												
9 Number of board members	0.42	0.37	0.24	0.27	0.41	-0.02	0.12	0.01											
10 Number of NED board members	0.36	0.40	0.28	0.31	0.23	-0.01	0.16	-0.00	0.38										
11 Share of NED board members	0.21	0.24	0.17	0.21	0.03	0.00	0.11	-0.01	-0.11	0.84									
12 Share of female NEDs	0.11	0.13	0.06	0.12	0.01	-0.01	0.02	0.00	-0.05	0.12	0.15								
13 Average degree centrality of NEDs	0.37	0.32	0.21	0.40	0.13	-0.02	0.07	0.02	0.24	0.42	0.33	0.08							
14 Average betweenness of NEDs	0.08	0.05	0.07	0.11	-0.02	-0.01	0.02	0.01	-0.03	0.06	0.08	0.02	0.33						
15 Average closeness of NEDs	0.03	-0.00	0.01	0.04	-0.03	-0.03	0.05	0.04	-0.02	0.00	0.01	0.01	0.02	-0.12					
16 Average weighted centrality of NEDs	0.32	0.29	0.15	0.39	0.04	-0.02	0.11	0.12	0.10	0.24	0.21	0.09	0.59	0.25	0.04				
17 Average ESG ‘attentiveness’ of NEDs	0.38	0.38	0.23	0.53	0.01	-0.01	0.07	0.08	0.13	0.13	0.10	-0.02	0.45	0.05	0.07	0.68			
18 Average environment ‘attentiveness’ of NEDs	0.60	0.34	0.06	0.29	0.26	-0.01	0.08	0.06	0.23	0.20	0.13	0.00	0.38	0.04	0.05	0.48	0.65		
19 Average social ‘attentiveness’ of NEDs	0.39	0.53	0.06	0.33	0.14	-0.01	0.00	0.06	0.19	0.18	0.09	-0.01	0.38	0.02	0.05	0.53	0.73	0.69	
20 Average governance ‘attentiveness’ of NEDs	0.18	0.18	0.53	0.31	0.26	-0.00	0.05	0.02	0.12	0.13	0.07	-0.02	0.26	0.02	0.05	0.41	0.62	0.34	0.41

Table 5 - Baseline estimates

The dependent variable is the value of the ESG score. Estimates are conducted using the GMM estimator of Arellano and Bond (1991). In all specifications, the Hansen test for overidentifying restrictions has a p-value of 1. Standard errors, reported in parentheses, are clustered at the company level. Time dummies, unreported, are included in all specifications. * indicates statistical significance at the 10 per cent level or less, ** at the 5 per cent, *** at the 1 per cent.

	(1)	(2)	(3)	(4)
Lagged ESG	0.739***	0.704***	0.498***	0.508***
	(0.043)	(0.050)	(0.062)	(0.061)
Number of board members (log)	6.281**	5.721**	2.902	4.973*
	(2.890)	(2.746)	(3.440)	(2.860)
Female directors (share)	0.110**	0.089*	0.149***	0.140***
	(0.051)	(0.050)	(0.051)	(0.050)
Share of NEDs over board members	0.044	0.050**	0.011	0.027
	(0.029)	(0.025)	(0.029)	(0.027)
Market cap. (log)	-0.223	-0.038	0.086	-0.262
	(0.393)	(0.499)	(0.446)	(0.428)
Price to book ratio (/100)	-0.006***	-0.006***	-0.009***	-0.009***
	(0.001)	(0.001)	(0.001)	(0.001)
Leverage (/100)	0.202	0.193	0.169	0.133
	(0.150)	(0.139)	(0.139)	(0.123)
Return on Equity	0.001	0.001	-0.001	-0.001
	(0.004)	(0.005)	(0.004)	(0.004)
Average connections (principal component)		1.290*		0.782
		(0.659)		(0.512)
Average ESG score of NEDs			0.681***	0.649***
			(0.115)	(0.101)
Observations	957	948	948	948

Table 6 – Robustness checks: environmental, social and governance indicators

The dependent variable is the value of the ESG score indicated at the head of each column (Column 4 is identical to Column 4 of Table 5). Estimates are conducted using the GMM estimator of Arellano and Bond (1991). In all specifications, the Hansen test for overidentifying restrictions has a p-value of 1. Standard errors, reported in parentheses, are clustered at the company level. Time dummies, unreported, are included in all specifications. * indicates statistical significance at the 10 per cent level or less, ** at the 5 per cent, *** at the 1 per cent.

	(1) environment	(2) social	(3) governance	(4) ESG
Lagged indicator	0.732***	0.673***	0.470***	0.508***
	(0.041)	(0.047)	(0.054)	(0.061)
Number of board members (log)	-4.126	2.878	5.718	4.973*
	(3.555)	(3.698)	(5.119)	(2.860)
Female directors (share)	0.102**	0.075*	0.198**	0.140***
	(0.048)	(0.043)	(0.078)	(0.050)
Share of NEDs over board members	-0.023	0.039*	0.053	0.027
	(0.027)	(0.022)	(0.038)	(0.027)
Market cap. (log)	1.241**	1.016*	0.076	-0.262
	(0.595)	(0.528)	(0.694)	(0.428)
Price to book ratio (/100)	-0.004***	-0.004***	-0.018***	-0.009***
	(0.001)	(0.001)	(0.002)	(0.001)
Leverage (/100)	0.096	-0.036	-0.037	0.133
	(0.084)	(0.087)	(0.126)	(0.123)
Return on Equity	0.001	-0.002**	-0.008**	-0.001
	(0.002)	(0.001)	(0.004)	(0.004)
Average connections (principal component)	0.042	0.038	0.608	0.782
	(0.345)	(0.276)	(0.778)	(0.512)
Average ESG score of NEDs	0.397***	0.381***	0.790***	0.649***
	(0.071)	(0.061)	(0.080)	(0.101)
Observations	948	947	948	948

Table 7 – Robustness checks: alternative estimation techniques

The dependent variable is the value of the aggregate ESG score, on the sample indicated in the head of each column. Estimates are conducted using the GMM estimator of Arellano and Bond (1991), unless indicated otherwise. In all specifications, the Hansen test for overidentifying restrictions has a p-value of 1. Standard errors, reported in parentheses, are clustered at the company level. Time dummies, unreported, are included in all specifications. * indicates statistical significance at the 10 per cent level or less, ** at the 5 per cent, *** at the 1 per cent.

	(1) New members	(2) Initial ESG performance below median	(3) Initial ESG performance above median	(4) Everaert and Pozzi (2007) estimator	(5) OLS with industry fixed-effects	(6) OLS with corporation fixed-effects
Lagged ESG	0.532***	0.225	0.279	0.311***		
	(0.060)	(0.198)	(0.216)	(0.044)		
Number of board members (log)	5.409	-2.434	3.414	0.143	0.874	3.027
	(3.313)	(17.049)	(14.662)	(2.733)	(3.894)	(2.654)
Female directors (share)	0.104**	0.459***	0.092	0.109**	0.120**	0.140***
	(0.048)	(0.178)	(0.454)	(0.047)	(0.049)	(0.047)
Share of NEDs over board members	0.045*	0.099	-0.018	-0.038	0.014	-0.013
	(0.026)	(0.114)	(0.118)	(0.027)	(0.037)	(0.029)
Average connections (principal component)	1.105**	3.207**	1.871	0.884***	0.975***	0.926***
	(0.432)	(1.438)	(1.146)	(0.299)	(0.309)	(0.303)
Average ESG score of NEDs	0.488***	0.837***	0.569	0.787***	1.134***	0.885***
	(0.094)	(0.281)	(0.495)	(0.098)	(0.086)	(0.086)
Average ESG score of new NEDs	0.274					
	(0.200)					
Number of new members	0.228					
	(1.552)					
Market cap. (log)	-0.167	1.885	1.251	-0.405	0.133	1.427**
	(0.532)	(3.117)	(2.434)	(1.313)	(0.868)	(0.622)
Price to book ratio (/100)	-0.009***	-0.014**	62.184**	-0.011	-0.017***	-0.012***
	(0.001)	(0.007)	(28.522)	(5.605)	(0.001)	(0.001)
Leverage (/100)	0.074	-0.349	-0.677	-0.101	0.081	-0.011
	(0.133)	(0.768)	(0.539)	(0.265)	(0.317)	(0.112)
Return on Equity	-0.002	-0.000	-0.003	0.005	-0.008	0.004***
	(0.005)	(0.007)	(0.026)	(0.009)	(0.012)	(0.001)
Observations	948	384	564	926	889	1043

Table 8 – Robustness checks: alternative centrality measures

The dependent variable is the value of the aggregate ESG score. Estimates are conducted using the GMM estimator of Arellano and Bond (1991). In all specifications, the Hansen test for overidentifying restrictions has a p-value of 1. Standard errors, reported in parentheses, are clustered at the company level. Time dummies, unreported, are included in all specifications. * indicates statistical significance at the 10 per cent level or less, ** at the 5 per cent, *** at the 1 per cent.

	(1)	(2)	(3)	(4)	(5)	(6)
Lagged ESG	0.520***	0.540***	0.550***	0.497***	0.534***	0.543***
	(0.060)	(0.052)	(0.057)	(0.049)	(0.057)	(0.059)
Number of board members (log)	3.665	4.104	3.782	5.497	5.520	4.846
	(3.862)	(3.227)	(3.950)	(4.245)	(3.896)	(3.552)
Female directors (share)	0.150***	0.153***	0.172***	0.183***	0.131**	0.134**
	(0.053)	(0.054)	(0.056)	(0.054)	(0.057)	(0.058)
Share of NEDs over board members	0.033	0.031	0.029	0.042*	0.049*	0.041
	(0.027)	(0.027)	(0.026)	(0.025)	(0.027)	(0.026)
Average degree centrality of NEDs	0.459**					
	(0.187)					
Average betweenness centrality of NEDs		0.001**				
		(0.001)				
Average closeness centrality of NEDS			233.938*			
			(137.397)			
Average Katz centrality of NEDs				-0.010		
				(0.011)		
Average eigenvector centrality of NEDs					19.276	
					(23.226)	
Average connections (principal component)						1.012**
						(0.437)
Average ESG score of NEDs	0.645***	0.740***	0.705***	0.695***	0.704***	0.641***
	(0.082)	(0.095)	(0.103)	(0.103)	(0.096)	(0.111)
Price to book ratio (/100)	-0.009***	-0.009***	-0.009***	-0.009***	-0.009***	-0.009***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
Leverage (/100)	0.182	0.178	0.160	0.043	0.266*	0.375**
	(0.165)	(0.231)	(0.157)	(0.183)	(0.147)	(0.184)
Return on Equity	-0.001	-0.003	-0.002	-0.001	-0.001	-0.003
	(0.003)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	948	948	948	948	948	948