“Impact of board characteristics and gender diversity on research and development spending in Jordan”

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IMPACT OF BOARD CHARACTERISTICS AND GENDER DIVERSITY ON RESEARCH AND DEVELOPMENT SPENDING IN JORDAN

Abstract

This study undertakes an investigation into the nexus between board characteristics and research and development (R&D) investments within the specific context of Jordan. Employing a dataset comprising 24 small and medium enterprises (SMEs) operating in the service and manufacturing sectors and enlisted on the Amman Stock Exchange (ASE) throughout the period from 2010 to 2023, the empirical findings substantiate that the dimensions of the board, mainly board size and independence, exert a positive influence on the intensity of R&D expenditures. However, gender diversity exerts an inverse impact on R&D spending. Consequently, organizations with a tendency toward sustaining innovation endeavors are encouraged to accord heightened consideration to fostering gender diversity during the board selection process. However, CEO duality reveals an insignificant influence on R&D expenditures. To conclude, the study's outcomes enrich the existing array of findings on the influence of women directors on board independence, particularly in R&D spending. Furthermore, the study offers policy recommendations, enhancing comprehension of the influence of women's representation on R&D spending.

Keywords board structure, women directors, R&D spending, Jordan, decision-making

JEL Classification G34, O32, J16, M14

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INTRODUCTION

Investments in R&D are pivotal in corporate decision-making processes, contributing to the development of novel products and the selection of highly profitable projects with a positive net present value (NPV), thus augmenting growth prospects for firms (Sarpong et al., 2023). However, scholarly discourse underscores the vital role played by boards of directors in modeling corporate policies, particularly concerning R&D expenditure (Rodrigues et al., 2020; Hernandez et al., 2010; Shubita et al., 2024a). Consequently, it is interesting to investigate the impact of board structure, including dimensions such as board size and independence, on R&D investments within the Jordanian setting.

Previous scholars have documented the significance of gender diversity in expanding R&D investment (Adams & Ferreira, 2009; Asad et al., 2023; Azzam, 2022; Gonzales-Bustos et al., 2020; Shubita et al., 2024b). These studies suggest that the existence of women directors can influence R&D expenditures through proficient oversight of women's knowledge and heightened managerial accountability. Additionally, women directors contribute unique perspectives, skills, and capabilities crucial for fostering innovation initiatives. Nevertheless, it is es-

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sential to note that the presence of women on the board does not necessarily translate into a more proactive board, as emphasized by Rose (2007).

Based on the above-mentioned argument, this study seeks to answer the following question: Do women directors donate to R&D spending in Jordan? With respect to board gender diversity, the Jordanian context is of particular interest, as gender diversity is still optional. In Jordan, women comprise 15.60% of the labor force. However, in publicly listed companies, where the average board size is eight members, only 3.54% of board members are women (World Bank Group, n.d).

The role of R&D spending in economic growth has become a heated debate issue in recent years, particularly following the success of high technology growth in Jordan since mid-2002. For instance, in 2016, R&D expenses, as a share of GDP for Jordan, were 0.7 %. Between 2002 and 2016, R&D expenses as a share of the GDP of Jordan rose considerably from 0.3 to 0.7 %, rising at an increasing annual rate that reached a maximum of 65.11% in 2016.

It is noticeable that factors influencing corporate governance also influence R&D spending. In other words, this study seeks to answer how corporate governance (board size, board independence, CEO duality, and gender diversity) affects R&D expenditures. In spite of the importance of board structure and gender diversity in shaping corporate strategies, their specific influence on R&D spending remains underexplored, particularly in emerging economies such as Jordan. The interplay between governance structures, inclusivity, and innovation investment is critical for sustainable economic growth, yet empirical evidence from Jordanian firms is limited.

1. LITERATURE REVIEW AND HYPOTHESES

Women directors bring diverse viewpoints, experiences, and expertise that positively influence R&D spending. Specifically, women directors play a role in safeguarding shareholders' interests by diligently overseeing R&D investment processes initiated by financial managers.

A substantial body of scholarly literature emphasizes the crucial role that board characteristics play in shaping the connection between board structure and investment decisions. However, there remains a scarcity of empirical examinations into how board structure relates to firms' innovative activities (Balsmeier et al., 2014). Notably, Baysinger et al. (1991) examined the link between board size and R&D expenditure, noting a positive link. Consequently, different studies have explored this relation (e.g., Shubita, 2019; Brunninge et al., 2007; Driver & Guedes, 2012; Lacetera, 2001). While acknowledging the potential for larger boards to enhance a company's ability to navigate environmental uncertainties and foster partnerships, these studies have produced mixed findings concerning the influence of board size on R&D disbursements.

This study creates notable contributions to the corporate governance literature on several fronts. Firstly, it extends existing inquiries into the impact of boards of directors on R&D spending by delving into the pivotal characteristics of these boards. While Asad et al. (2023) and Azzam (2022) explore this matter within developed markets and propose a positive link between board size and R&D spending, this study focuses on Jordanian companies, formulated by concentrated ownership and limited minority shareholder protection. It offers a distinctive setting for examining these dynamics. Secondly, this study incorporates gender diversity as a board characteristic and evaluates its link to R&D spending.

Taking a resource theory perspective and drawing from Pfeffer's (1985) insights, a larger board size could facilitate diversified knowledge, expertise, and networking opportunities, potentially bolstering R&D activities (e.g., Ashwin et al., 2016). Regarding independent directors, prior research suggests they may improve R&D decision-making processes. Yet, Rodrigues et al. (2020) reported a negative influence of board size on R&D expenditure, documenting that large boards may exhibit sluggish decision-making processes that affect

R&D spending. The conflicting findings in the literature show the complexity of the association between board size and R&D.

However, according to Kosnik's (1987) theoretical framework, the presence of independent directors is believed to positively influence R&D activities, as their external oversight role positions them well to supervise management effectively. Consequently, previous studies have explored the impact of board independence on R&D investment (Ashwin et al., 2016; Brunninge et al., 2007; Dong & Gou, 2010; Lu & Wang, 2015). These studies have highlighted how independent directors can mitigate agency issues, potentially leading to increased R&D spending. For instance, Lu and Wang (2015) observed a positive linkage between independent directors and R&D expenditure.

Nevertheless, another body of literature has outlined a negative link between R&D spending and independent directors (e.g., Dalziel et al., 2011; Kor, 2006; Yoo & Sung, 2015). These studies suggest that independent directors might curtail R&D spending due to their perceived lack of expertise and skills.

In corporate governance, the inclusion of gender diversity on boards is instrumental in acquiring and sustaining vital resources and skills, thereby fostering enhanced decision-making processes and moderating risk-taking by the firm. This diversity contributes to the augmentation of available information and knowledge in decision-making through the incorporation of a multitude of perspectives. Empirical evidence suggests that gender diversity is associated with expanded viewpoints, heightened creativity and innovation, and enhanced risk management (Koren & Tenreyro, 2013).

Torchia et al. (2011) posit that the presence of women directors enhances the quality of board decision-making and fosters the development of more innovative solutions. García-Sánchez et al. (2021) contended that women directors exhibit greater rigor, increased engagement in monitoring activities, and greater circumspection in decision-making processes. These diverse perspectives have the potential to stimulate innovation activities and positively impact a firm's (R&D) investments. Some studies have revealed a positive association between gender diversity and both R&D investment and innovation. Torchia et al. (2011) conducted a study on Norwegian firms, discerning the role of women on boards as a shift from tokenism to critical mass. Their findings highlight that achieving a critical mass, defined as the transition from one or two women directors to at least three, facilitates innovation. Chen et al. (2018) demonstrated a positive association between women directors and both R&D investment and innovation output.

From a French perspective, Messai and Jouini (2025) examined the influence of board traits on R&D spending. By conducting different methods of estimation on a sample of 102 companies over the period (2010–2021), the scholars noted a positive linkage between gender diversity, smaller board size, and more frequent board meetings and R&D spending.

However, a stream of literature has emerged to document the nexus between the board of directors demographic data and R&D. From the Chinese context, Azzam and Alhababsah (2022) gauged the effects of age and tenure of the chair of the board of directors on R&D intensity. Applying an OLS on a sample of 9,997 observations over the years (2009–2018), the study noted an inverse linkage between chair length of appointment and R&D intensity. Nevertheless, a non-significant linkage was noted between chair age and R&D spending.

Alhaj-Ismail et al. (2025) demonstrated the effect of shared tenure between directors and CEOs on R&D spending using a sample of companies traded in the UK FTSE350 index over 2010–2019. The authors found a positive linkage between directors/CEO shared tenure and R&D intensity. From a cross-country analysis, Ginesti et al. (2025) tested the influences of the board of directors' knowledge, chief financial officer (CFO) board membership, and audit committee attributes on R&D intensity by applying a multivariate regression model on 16 European countries (2014–2020). The findings noted an inverse nexus between CFO board membership, independence of audit committee, and R&D intensity, whereas improved board knowledge has an inverse influence. Similarly to that,

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audit committee financial knowledge is positively linked with the level of R&D intensity.

The existing literature emphasizes the crucial role of board characteristics and gender diversity in shaping corporate governance and strategic decision-making. Studies from various regions have demonstrated that diverse boards can enhance innovation, improve firm performance, and foster long-term growth. However, the relationship between board attributes and research and development (R&D) spending remains underexplored in emerging economies, particularly in Jordan, where cultural and institutional factors may shape these dynamics uniquely.

This research is aimed to investigate the influence of board characteristics and gender diversity on R&D spending in Jordanian firms. By exploring this relationship, the analysis seeks to provide empirical evidence on how governance structures and inclusivity influence innovation investments in the context of an emerging market.

Thus, this study proposes the following hypotheses:

H1: Board size has a positive and substantial influence on R&D investment.

H2: Board independence has a positive and substantial effect on R&D investment.

H3: CEO duality has a positive and substantial influence on R&D investment.

H4: Women directors have a positive and substantial influence on R&D investment.

2. METHODS

This study employs a quantitative research design to examine the relationship between board characteristics, gender diversity, and research and development (R&D) spending in Jordanian firms.

The data for this study were obtained from multiple reliable sources:

- Annual reports of companies, specifically the governance and financial sections, for board composition and R&D spending data.
- The Amman Stock Exchange database for firm-specific details.
- Secondary data from publicly available economic reports and databases for industry and macroeconomic context.

The data analysis involves descriptive statistics to summarize the variables, correlation analysis to examine the relationships between variables, and multicollinearity tests to ensure the robustness of the results. The analysis is conducted using statistical software such as Stata or SPSS to ensure accurate and efficient computation of results. This methodological approach supports a systematic investigation into the influence of board characteristics and gender diversity on R&D spending, providing insights into the governance practices of Jordanian firms.

The research sample contains Jordanian firms listed on the Amman Stock Exchange (ASE) from 2010 to 2023. The initial sample is 74. Nevertheless, only 24 firms meet the definition of small and medium-sized corporations (Appendix A). Importantly, this study classifies the corporation according to the number of people employed. SMEs employ less than 250 individuals. SMEs are further classified as micro businesses (less than ten workers), small enterprises (10 to 49 employees), and medium-sized firms (50 to 249 people). Large companies employ 250 or more individuals.

Companies with incomplete or missing data for the variables under investigation were excluded to ensure data consistency and reliability. The final sample comprises firms with available information on the study variables.

To test the study's hypotheses, the following model was developed:

$$\begin{aligned} R\&D_{it} &= \beta_0 + \beta_1 BZ_{it} + \beta_2 CEO \cdot Duality_{it} \\ &+ \beta_3 Board \cdot Independence_{it} \\ &+ \beta_4 Gender \cdot Diversity_{it} \\ &+ \mathrm{B}_5 Company \cdot Size_{it} + \beta_6 Leverage_{it} \\ &+ \beta_7 Growth \cdot Opportunities_{it} + \varepsilon_{it}, \end{aligned} \quad (1)$$

where $R\&D_{it}$ – Research and Development intensity for firm i at time t, typically measured as R&D

expenditure scaled by total assets or sales, BZ_{it}, *Board Size* – the total number of directors on the board of firm *i* at time *t*, $CEO\_Duality_{it}$ – A dummy variable that takes the value of 1 if the CEO is also the Chairperson of the Board (i.e., dual role), and 0 otherwise, $Board\_Independence_{it}$ – The proportion of independent (non-executive) directors to total board members for firm *i* at time *t*, $Gender\_Diversity_{it}$ – The percentage or proportion of female directors on the board of firm *i* at time *t*, $Company\_Size_{it}$ – Firm size, typically measured as the natural logarithm of total assets for firm *i* at time *t*, $Leverage_{it}$ – The financial leverage of firm *i* at time *t*, commonly calculated as the ratio of total debt to total assets, $Growth\_Opportunities_{it}$ – A proxy for the firm's growth prospects, such as the market-to-book ratio or percentage growth in sales for firm *i* at time *t*, β_0 – Intercept term, β_1 to β_7 –Coefficients estimating the impact of each explanatory variable on *R&D* investment, ε_{it} – Error term capturing unobserved influences for firm *i* at time *t*.

Drawing on Limanlı (2015), R&D was defined as a dummy variable, taking the value of one if the firm invests in R&D and zero otherwise. The examination relied on three measurements to assess board composition:

1) the level of gender diversity within the board, calculated as the percentage of women directors among the board members for firm *i* at time *t*;

2) board independence, determined by the proportion of non-executive directors for firm *i* at time *t*; and

3) board size, indicating the total count of board members in firm *i* at time *t*.

The model incorporates firm- and time-specific effects, with *i* and *t* denoting the firm and time dimensions, correspondingly. Descriptions of the variables employed can be found in Table 2. Additionally, the study used control variables recognized in prior research to influence R&D activities: firm size, growth potential, operational risk, and cash flow (Asad et al., 2023). To address the potential impact of outliers, winsorization was applied to all continuous variables at the upper and lower percentiles.

3. RESULTS AND DISCUSSION

Table 1 provides an overview of the descriptive statistics for the study variables spanning the period from 2010 to 2023. The average R&D is observed to be 17%, indicating that listed Jordanian manufacturing SMEs generally allocate a lower proportion of their resources to R&D investments. Regarding board size, the mean is approximately eight members, with the maximum reaching 13. The average number of independent directors is nearly seven, indicating a substantial presence of external directors relative to executive directors on the boards. As per gender diversity, the mean proportion of women on boards is 4.7%, suggesting a relatively low level of women representation among ASE-listed firms. Furthermore, the average firm size is estimated at 33,442,165 JD.

Table 1. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
R&D	.17	.376	0	1
Board Size	7.521	2.414	4	13
CEO Duality	.229	.421	0	1
Board Independence	6.851	2.376	3	13
Gender Diversity	.047	.132	0	.8
Leverage	.302	.202	.016	.7
Growth Opportunity	.898	.324	.407	1.666
Total Assets	33442165	50399895	469848	2.799e+08

Table 2. Variable definitions

Variables	Definitions
R&D	A binary variable, which equals 1 if the firm invests in R&D and zero if the firm does not invest in R&D.
Board Size	The total number of members on the board.
CEO duality	The dummy variable takes 1 if the CEO and the chair are the same and 0 if otherwise.
Board Independence	The proportion of independent directors over total board directors.
Gender Diversity	The percentage of female directors to the total number of board members.
Firm Size	The natural logarithm of the total assets of a company.
Growth Opportunities	The ratio of liabilities plus market capitalization to total assets.
Leverage	The ratio of total liabilities to total assets.

Table 3 displays the pairwise correlation coefficients among the variables under investigation. Remarkably, none of the correlation coefficients in Table 3 reached levels indicative of multicollinear-

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Table 3. Correlation matrix

Variable	1	2	3	4	5	6	7	8
R&D	1.000							
Board size	0.184*	1.000						
CEO duality	0.018	–0.073	1.000					
Board Independence	0.132*	0.085	–0.425*	1.000				
Gender Diversity	–0.156*	–0.222*	–0.076	0.160*	1.000			
Leverage	0.201*	–0.050	–0.223*	0.178*	–0.227*	1.000		
Growth Opportunity	0.251*	–0.229*	0.287*	–0.190*	–0.129*	0.052	1.000	
Total Assets	0.107	0.422*	–0.221*	0.099	–0.119*	0.275*	–0.211*	1.000

Note: * statistical significance for 0.05 level.

ity concerns. Moreover, the variance inflation factor (VIF) presented in Table 4 demonstrates that all figures fall below the cut-off point of 10, pinpointing further assurance regarding the absence of multicollinearity problems.

Table 4. VIF figures

Variable	VIF	1/VIF
Board size	1.449	0.690
CEO Duality	1.391	0.719
Board Independence	1.314	0.761
Gender Diversity	1.24	0.807
Leverage	1.312	0.762
Growth Opportunities	1.230	0.813
Firm Size	1.434	0.697
Mean VIF	1.696	

The main research aspect revolved around the examination of how board characteristics influence R&D activities. Using a panel data approach, it sought to explore the link between various board characteristics features and R&D investment. However, Table 3 reveal that the outcomes regarding the impact of board structure on R&D spending are insignificant. Therefore, the 2SLS approach was employed to address endogeneity concerns between board characteristics and R&D spending utilizing instrumental variables used in the 2SLS procedure. The outcomes presented in Table 4 corroborate a positive association between board size and R&D. Additionally, the study affirms a negative link between board gender diversity and R&D expenditure.

According to these results, board size demonstrates a positive and statistically significant influence on R&D investments, thereby validating hypothesis H1. This finding echoes existing literature, which suggests that a larger board size can contribute to the firm's reservoir of knowledge, skill set, and overall experience (Goodstein et al., 1994; Haynes & Hillman, 2010). Additionally, a large board can facilitate access to diverse technological and financial resources crucial for R&D investment (Shapiro et al., 2015), thereby enhancing the firm's resilience in navigating environmental uncertainties and fostering stakeholder relationships (Pfeffer & Salancik, 2015). However, it is pertinent to note that some scholars have observed a negative association between R&D expenditure and board size (Chen et al., 2018), whereas others have documented no notable correlation (Driver & Guedes, 2012; Shapiro et al., 2015).

Moreover, the outcomes establish a positive link between board independence and R&D investments, confirming hypothesis H2. Board independence exerts a positive and statistically significant effect on R&D activities, confirming hypothesis H3. These findings align with prior research (Liang et al., 2024), which has similarly observed that a large proportion of independent directors' status led to a more effective monitoring process and positively enhanced R&D spending. However, findings note an insignificant association between CEO duality and R&D intensity.

The findings showed that female directors had a negative and significant impact on R&D activities; hence, hypothesis H4b was accepted. This result is consistent with those of other studies noting that board gender diversity may be negatively related to R&D activities. This stems from previous scholarly investigations indicating that women executives are more risk-averse and careful in handling financial activities and R&D spending (Mao et al., 2023). The outcomes depicted in Table 5 indicate a significantly positive association between leverage, growth opportunities, and R&D spending.

Table 5. Regression of the association between board characteristics and R&D investment using 2SLS

Variable	1	2
Board Size	0.661*** (3.97)	0.402*** (2.61)
CEO duality	0.049 (0.95)	0.084 (1.62)
Board Independence	0.597*** (3.02)	0.639*** (3.09)
Gender Diversity	–0.138 (–0.88)	–0.419*** (–2.66)
Firm Size	0.124 (0.31)	
Leverage	0.301*** (2.87)	
Growth Opportunities	0.360*** (5.69)	
Constant	–1.446*** (–4.37)	–0.756*** (–3.36)
R^2	0.18	0.07

Note: ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.10 levels (two-tailed), respectively.

The findings reveal a significant relationship between board characteristics, gender diversity, and research and development (R&D) spending in Jordanian firms. Specifically, board size and the proportion of independent directors were positively associated with R&D investment, suggesting that larger and more independent boards foster strategic decisions aimed at innovation. However, gender diversity was found to have a negative impact, suggesting that greater female representation on boards may reduce creativity and innovation-focused decision-making. The inverse linkage between gender diversity and R&D spending may stem from the lower fraction of female representation on the board of directors. Nevertheless, the role of independent directors as effective monitors and advisors supports the allocation of resources toward high-impact investments such as R&D. The significant influence of board size on R&D spending could be linked to the availability of a broader pool of expertise and ideas, enabling better strategic planning. However, excessively large boards might dilute decision-making efficiency, a potential limitation worth exploring further. Nevertheless, CEO duality noted an insignificant impact on R&D spending.

Future research should expand the sample to include firms from other emerging markets to validate and generalize these findings. Additionally, qualitative studies could provide deeper insights into the mechanisms through which board characteristics influence R&D decisions. Longitudinal studies that track changes in governance practices and their impact on innovation over time would also be valuable. Finally, policymakers and corporate leaders should consider these findings when developing governance structures and diversity initiatives, as fostering inclusive and well-composed boards can be a catalyst for innovation and competitiveness in Jordanian firms.

CONCLUSION

This paper examines the impact of board characteristics and gender diversity on R&D, using a sample of 24 service and manufacturing SMEs spanning the period from 2010 to 2023. The findings document a positive nexus between R&D and board size. Moreover, the study reports that board independence positively affects R&D spending. Nevertheless, the study notes an insignificant effect of CEO duality on R&D, while gender diversity has a negative impact. Thus, the outcomes show the important influence of board structure on R&D. Moreover, the findings furnish valuable guidance for Jordanian regulatory bodies, informing future governance guidelines and practices. Additionally, the findings carry important suggestions for the independence of public company boards. Companies committed to continual innovation should prioritize board independence in the director selection process.

The study contributes valuable insights to the existing literature and holds implications for scholars and policymakers interested in R&D spending and corporate governance. Notably, it contributes to resolving the inconsistent findings in prior research regarding the impact of board composition, particularly gender diversity, on R&D spending. These outcomes underscore the importance for regulators to consider such factors when devising future governance reforms, especially in jurisdictions where women's representation on boards remains optional. Furthermore, the outcomes offer important implications for

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manufacturing firms seeking to manage cash reserves effectively. Additionally, this analysis highlights the potential for enhancing corporate governance by increasing women's representation in Jordanian companies, where such representation is currently low.

However, the study has its limitations. Firstly, its focus on Jordan may restrict the generalizability of the findings to underdeveloped countries, where cultural norms often limit women's participation in corporate roles. Including developed countries could provide insights into diverse policy decisions across various corporate governance landscapes. Secondly, the study's reliance solely on board characteristics as an independent variable leaves room for future research to explore additional board diversity data, such as nationality, as well as macroeconomic factors like inflation and unemployment rates, to offer a more inclusive understanding of the drivers of R&D spending.

AUTHOR CONTRIBUTIONS

Conceptualization: Dua'a Shubita, Majd Iskandrani, Hadeel Boshmaf, Hadeel Yaseen.
Data curation: Dua'a Shubita.
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Funding acquisition: Dua'a Shubita.
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Writing – original draft: Dua'a Shubita, Majd Iskandrani.
Writing – review & editing: Hadeel Boshmaf, Hadeel Yaseen, Mohammad Fawzi Shubita.

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APPENDIX A

Table A1. Sampled companies

No.	Company	Establishment year
1	Al-Dawliyah for Hotels and Malls	1995
2	Al-Sharq Investments Projects (Holding)	1994
3	Al-Zarqa Educational and Investment	1991
4	Injaz for Development and Projects	1999
5	International Company for Medical Investment	2017
6	Jordan Industrial Resources	1991
7	Jordan National Shipping Lines	1976
8	Nopar for Trading and Investment	2005
9	Premier Business and Projects Co. Ltd	1973
10	Salam International Transport and Trading	1952
11	Specialized Trading and Investment	1994
12	Al-Quds Ready Mix	1996
13	Al-Rakaez Investment Co.	2006
14	Bindar Trading and Investment Co. plc	2000
15	Comprehensive Leasing Company plc	2004
16	Intermediate Petrochemicals Industries Co. plc	1980
17	Jordan International Trading Center	1999
18	Jordan Trade Fac	2001
19	Jordan Vegetable Oil Industries	1953
20	National Steel Industry	1979
21	Rum Group for Transportation and Tourism Investment	2006
22	The Jordan Pipes Manufacturing	1969
23	Universal Modern Industries	1989
24	Zara Investment Holding	1994

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