Investigate asymmetric effects of innovation index on business diversification index in selected listed companies in Iranian capital market: Fixed effects approach and Quantile regression

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Abstract

Currently, innovation in business models is considered corporate architecture. Innovation in business models shows how companies can take new approaches to develop their business. Companies can facilitate the entrepreneurship process by considering the innovations in their business model based on their capabilities. This will play a prominent role in designing and explaining the business model dynamics. This article investigates the effects of the innovation index on the business diversification index in selected listed companies in the Iranian capital market with the quantile regression approach from 2013 to 2019. The results of this study showed the positive and significant impact of the innovation index on business diversity in all three groups of competitive, concentrated, and semi-concentrated industries, but this effect was stronger among competitive industries. Also, the results of this study indicate the asymmetric effect of the innovation index in competitive and semi-centralized industries and the symmetrical effect of the innovation index in centralized industries.

Keywords: innovation, business diversification, quantile regression, stock market
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1 Statement of the problem

A business model explains how an organization creates, delivers, and captures values [10]. In other words, a business model is a framework for how a company creates value. Ultimately, it distils the potential of a business to its essence. A business model answers basic questions about the problems facing the organization, solutions, and growth opportunities in a given market. Creating a successful business model is essential, either when starting a new investment, when expanding to a new market, or when changing strategy [18]. A business model describes an architecture for how a company creates and delivers value to customers and the mechanisms used to obtain a share of

that value. This process is a matching set of elements that includes the flow of costs, revenues, and profits. Business success largely depends on the choice of technologies and the use of tangible assets and equipment, all of which depend on the design and implementation of the business model. With the introduction of a wide range of new technologies during the fourth industrial revolution, companies around the world have tried to increase their innovative activities, which include investing in new technology adoption, technical innovation factors, etc. technical and research and development (R&D). These activities are mainly to ensure the development, performance growth, sustainability, and business diversity of companies [32]. The business model provides a path through which innovation and technical knowledge, along with the use of tangible and intangible assets, turn into a flow of profit [17]. The resource-based view of the firm focuses on assembling concentrated assets that meet the four key criteria (valuable, scarce, inimitable, and non-substitutable) defined by [5] for resources and capabilities that can support sustainable competitive advantage. However, most successful business models are eventually imitated to some extent by other firms, and the assets associated with a model can provide minimal protection against competitor influence [7]. According to [38], what causes a change in the state of economic balance and progress toward the development process is the emergence of some innovations. From his point of view, opening new markets, creating new goods and services, discovering a new production or marketing method, using new technologies, or changing the structure of the existing market can be considered as the effects of innovation indicators.

The design and exploitation of business models depend on the capabilities of a company. dynamic capabilities are the firm's underlying organizational routines and managerial skills that provide grounds for the ability to integrate, create, and reconfigure internal competencies to address, or in some cases to create, changes in the business environment. The strength of a firm's dynamic capabilities is critical to its ability to sustain long-term profitability in many ways, including the ability to design and adjust business models [41].

Dynamic capabilities are easier to understand in the context of an organization's overall set of capabilities, which can be considered at two levels. At the basic level, there are operational and routine capabilities, routine activities, basic management, and governance that allow any organization to pursue a given production program, or set of defined activities, more or less efficiently. In the upper part of these, there is a layer of dynamic capabilities that can be divided into "Micro-foundations" and higher-level capabilities [43]. Micro-foundations involve the adjustment and recombination of a company's existing conventional capabilities as well as the development of new capabilities. They are second-order dynamic capabilities that include new product development, expansion into new sales territories, allocation of product tasks across departments in large firms, and other actions that constitute intelligent managerial decision-making under conditions of uncertainty. Driving these are high-level dynamic capabilities by which management, supported by organizational processes, senses possible future paths, invents business models to take advantage of new or changing opportunities, and determines the best configuration for the organization based on its existing shape and the existing conditions.

The occurrence of changes in human society is a promise that everyone is bound by. Nonetheless, thinkers in the field of system dynamics believe that these developments follow recognizable laws based on them and move the path of developments in the desired direction. Otherwise, entering into the field of work, management, and policy-making and generally making any kind of decision about the future without knowing the laws governing a phenomenon is an arrow shot in the dark. The approach of system dynamics is to provide the analyst with the necessary tools to discover these regularities, so he not only knows the regularities governing the evolution of phenomena, but with the simulation tool, it is possible to build a model of the phenomenon. It provides real events that are very similar to the phenomenon in the real world. Considering the importance of the concept of designing business models and the importance of the dynamic problem in explaining these models, this article is purposed to investigate the effects of the innovation index on the business diversification index in selected listed companies in the Iranian capital market with a Quantile Regression approach. and fixed effects from 2013-2019.

2 Theoretical literature and research background

This section is related to literature and research background. First, there will be a review of the innovation index for Iran and a comparison of the situation of other countries based on the 2021 Global Innovation Report. In the following, The Global Business Index (2021) and the situation in Iran will be examined. In the final part, the theoretical foundations and background of the research will be examined.
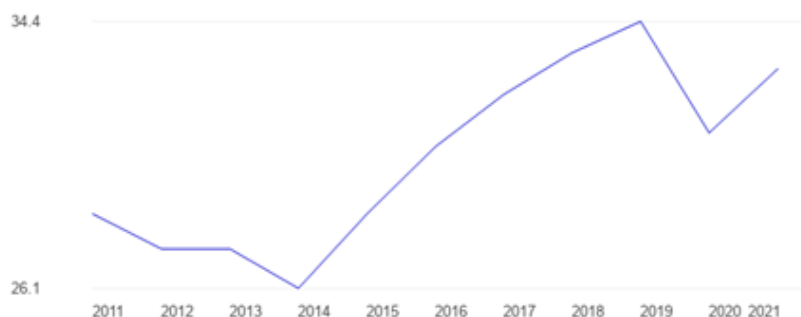
Figure 1:   The trend of the global innovation index during from 2011 to 2021

3 An Overview of the innovation index for Iran in 2021

Every year, the World Intellectual Property Organization (WIPO) discusses the state of innovation in different countries in a report called the Global Innovation Index. In this section, there will be an overview of the latest global innovation index report. In this report, 132 countries have been evaluated in a balanced framework. The Global Innovation Index captures the elements of a national economy that enable innovative activities, including:

1. Institutions
2. Human capital and research
3. Infrastructure
4. Market complexity
5. Business complexity

Generally, the global innovation index includes two sub-indexes, the innovation input sub-index, and the innovation output sub-index. The first sub-index is based on five pillars, institutions, human capital and research, infrastructure, market complexity, and business complexity. The second sub-index is based on two foundations, knowledge and technology outputs, and creative outputs. In 2021, Iran was ranked 60th among 132 economies, holding a score of 32.9 out of 100. In this report, after India, Iran was ranked second among the ten countries in the Central and South Asian region. Also, among the sub-indices of innovation, it was ranked 41st among the 100 vibrant science and technology clusters, with a rise of 2 places.

According to the 2021 report, Iran ranked 60th, compared to 2020, it has risen to 7th rank, which is the highest position of Iran in the history of global innovation index calculations so far. Iran also ranked second among 10 countries in Central and South Asia. Also, among the global innovation index sub-indices, considering the 7 sub-indices comparison results compared to 2020, some indicators have experienced a multi-step improvement. The business complexity index in 2020 compared to 2019 experienced a one-step growth, but in 2021 compared to 2020, it experienced a 3-step decline. Also, according to the 2021 report, the growth of the eye-catching index shows a decrease. On the other hand, knowledge and technological outputs have reached the 46th global rank in 2021 with a significant increase. The market complexity index has also experienced significant growth with an increase of nearly 18 points [48]. The innovation index is scored between (0-100). The graph below shows the trend of the innovation index for Iran from 2011 to 2021.

The data of the innovation index for Iran from 2011 to 2021 has an average of 30.15, and its minimum and maximum points are 26.1 and 34.4, respectively. The score for 2021 was also about 32.9. The global average of the index in 2021 was approximately 34.30, which was higher than the value of the index for Iran this year.

4 An Overview of the business index for Iran in 2020

Every year, the World Bank examines the economic situation of countries in terms of the state of the business sector and its related indicators in all the countries and compares it with other countries in a report entitled "Business". According to the 2020 business report [47], Iran is ranked 127 among 185 countries, which has improved by one rank compared to 2019. Among the 25 countries of the development vision, Iran ranks 21st in terms of doing business, in the 2013 Business Report, which shows that it does not have a good status among the countries in development vision. Table 1 shows Iran's status in terms of business indicators and its dimensions.

Table 1: Iran's status in terms of business indicators and its dimensions

Indicators	Rank 2019	Rank 2020	Change in ranking compared to 2019
Overall Index	128	127	1 rank improvement
Start a business	173	178	5 ranks decline
Obtaining a construction permit	86	73	13 rank improvement
Access to electricity	108	113	5 ranks decline
Registration of ownership	90	70	20 rank improvement
Obtain credit	99	104	5 ranks decline
Small shareholder protection	173	128	45 rank improvement
Paying tax	149	144	5 rank improvement
Foreign business	121	123	2 rank decline
Execution of contracts	131	90	1 rank decline
Bankruptcy settlement	89	133	2 rank decline

Source: World Bank (2021)

According to Table 1, Iran experienced a one-rank improvement in the overall business index in 2020 compared to 2019. Iran's best performance in 2020 compared to 2019 was the result of support of small shareholders with a 45 rank improvement compared to 2019. And the biggest decline was for the indicators of starting a business, obtaining credit, and access to electricity with a 5 rank decrease compared to 2019.

5 A historical view on Innovation

In this section, we take a quick look at the history of economic thought on innovation, starting with Adam Smith. Not all of these contributions are made by people who are now known as economists, but all of them are the basic insights of innovation economics. The purpose of this section is to present several different perspectives on the economics of innovation historically.

5.1 Adam Smith (1723-1790) and John Ray (1796-1872)

A natural course to start with is Adam Smith, who is often referred to as the father and founder of economics. According to Smith, the invention and change of technology were important factors in creating the "wealth of nations". But Smith reckoned that the division of labor itself, instead of innovation, is the main driving force in creating the wealth of nations. Innovation itself arose from the division of labor [40]. It seems that the innovation and creation of all the machines with which the work is greatly facilitated and shortened was caused by the division of labor. Moreover, Ray had a different view from Smith about the relationship between invention and the division of labor (Ray, 1893). According to Smith, the division of labor is the great generator of invention and improvement, but in Ray's opinion, the previous developments came from the invention. Thus, as Ray observed, invention (not division of labor) is the mechanism that lies at the core of wealth creation.

5.2 John Stuart Mill (1806-1873)

The great philosopher and political economist John Stuart Mill also considers the centrality of wealth creation in innovation (Mill, 1929-1949: p. 80): "All things of present utility are the fruits of originality." But he was one of the first to paradoxically write that invention and innovation did not lead to the advancement of many ordinary people (Mill, 1848-1923: p. 751).

5.3 Karl Marx (1818-1883)

Karl Marx recognized the absolute centrality of innovation in economic development and had a special contribution to identifying the role of innovation in competitive struggles. In 1848, quoting Mill, he wrote: "The bourgeoisie cannot exist without a continuous revolution in the means of production and, as a result, the relations of production in society." This is a fundamental insight. Marx especially talked about the effects of innovation in the class struggle, but the point is much more general.

From the point of view of those who were brought up in the Schumpeterian school of innovation, this seems like a strange difference. Certainly, this innovation is different from the innovation intended by the Schumpeterian school;

however, this distinction is a difference in time and execution rather than a difference in type. In the Schumpeterian school, innovation is a basic precursor of innovation, and the latter can only be done commercially if previous innovations are used. But why did Ruskin find a kind of distinction? The answer is that Ruskin observed other channels for using innovation other than what we now call innovation and believed that these other channels are much more benign than innovation.

5.4 Henry George (1839-1897)

Henry George's book "Progress and Poverty" is very famous in the field of innovation; because this book has made an important contribution to understanding what was considered to be the conflicting aspect of innovation. Like John Stuart Mill, George thought that innovation does not necessarily improve the condition of ordinary people; Although his reasoning was slightly different ([16], pp. 177-176). Any progress or innovation that leads to an increase in the labor force creates more wealth, causing an increase in the demand for land and its direct products, such as the telegraph, an improvement in the ore smelting process, a printing press, or a weaving machine, and an increase in rents. George also stated that many people still hold the simplistic view that material progress will eventually eliminate poverty. But the fallacy of these views has already been sufficiently demonstrated. Although several later authors disputed the theoretical logic and empirical validity of this claim, it is still worth considering. Despite the arguments that claim that in many areas cheap communication and transportation lead to the dispersion of economic activity and the equalization of property prices, today we find that property prices in strong commercial clusters also continue to be higher than the price in internal areas. The relationship that George established between innovation and real estate prices was correct; although, the current mechanism was slightly different from his mechanism. Henry George's insight is important because he observed one of several paradoxes about innovation. Innovation does not necessarily do what you expect or it may have unexpected side effects.

5.5 Alfred Marshall (1842-1924)

Alfred Marshall's specific phrase quoted below [28] is based on a fundamental insight from McCulloch (1864-1965, p. 23). Fulfilling a desire or a need is just a step to achieve a new goal. At every stage of development, it is destined for him to devise and invent and start new businesses, and when this is done, he enters into others with new energy.

Marshall's [28] intended consumer is, in a sense, an innovator, and this type of consumer behavior has an interesting difference compared to other types of consumer behavior. In today's language, this idea means that innovation is not only the right of the producer, but it can be an action on the part of the consumer. Until recently, many economists and policymakers had serious problems with this idea. But with the recent works of Von Hippel [45] in which the customer (and even the consumer) plays a role in innovation, it does not seem so strange.

5.6 Thorstein Veblen (1857-1929)

Thorstein Veblen is the next economist on our list that can be classified as an economist and sociologist. Thorstein Veblen had a fundamental insight into the issue of conspicuous Consumption (the desire to consume so that the consumer can attract the attention of others to his consumption). By now, Veblen's basic insight was considered by some to be mischief. He took the old saying "necessity is the mother of invention" and turned it ([44], p. 315) into "Invention is the mother of necessity." While the original version of the proverb suggests that invention is done because of a user's need, Veblen suggested that after invention, this invention itself will lead to another need (the inventor's need to create competitive differentiation). An innovation that creates competitive differentiation cannot necessarily be certain that its competitively differentiated product meets a consumer need. But with the right consumers (what we read below, Veblen consumers), there is always a distinction. Therefore, Veblen stated that there is a demand for inventions that do not have a primary consumer need.

5.7 Joseph Schumpeter (1883-1895)

Schumpeter is one of the most important (probably the most important) economists in the history of economic innovation. Perhaps better than anyone before him, Joseph Schumpeter captured and described the dual role of innovation in economics [39]. The process of the industrial revolution, which continuously transforms the economic structure from within, destroys the old structure continuously and creates a new structure without interruption. This process of creative destruction is a fundamental reality in the capitalist world. And he added: Each part of the business strategy acquires its real importance only against the root of that process and in the conditions created by itself. This should be seen in its role in perpetuating the process of creative destruction [39].

The concept of creative destruction is one of the most important issues in the innovation economy. An innovator creates something (probably a competitive advantage with wealth). But with this work, it destroys something else (often the competitive position of a rival company). Therefore, innovation simultaneously creates and destroys; but fortunately, the value of creation will exceed the value of destruction. Schumpeter also emphasized a very important point that contradicts the conventional view in neoclassical economics. He insisted that this creative destruction is a much more important force for competition and that is the traditional concept of price competition [39].

6 Business innovation and diversification

The relationship between the innovative activities of companies and changes in the economic situation is relatively strong and at the same time uncertain [23]. The global financial crisis proved that innovative companies have little resistance to external negative shocks. Considering the innovation strategies of the companies during the economic crisis, we can come across the view that the continuation of the innovation activity helps to increase the survival of an economic enterprise and its competitive capacity in the last stages of the economic recession. This case will be stronger if innovation helps to diversify business activities to reduce the risk of continuity of activities [2]. The issue of innovation in companies plays a central role in their development plans. The basic priorities of companies' strategies mainly include smart, sustainable, and inclusive growth. The first is related to the development of the economy based on knowledge and innovation, increasing the potential of the digital economy due to higher investment costs for research and development and improving the quality of education [15]. The issues of innovation, economic growth and development, and prosperity are closely related to entrepreneurship [9]. It seems that innovative entrepreneurs, which are measured by the level of innovation in the initial stage of their entrepreneurial activity, have the highest growth rate. This is largely due to the impact of innovative activities on the diversification of business activities. Companies that have more diversity in business, in crisis conditions, suffer less damage than other companies that have less diversity [7]. Studies have shown that from the point of view of companies' innovation, their possession of a set of unique resources or assets and the ability to operate in a socio-economic environment compatible with innovation is of vital importance. It seems that the factors affecting the possibility of innovation include four characteristics related to the company and two characteristics of a regional nature. The most important characteristics of companies in the literature include company size, industrial sector, availability of R&D staff, and R&D work with their financing; while the environmental characteristics are related to the size and quality of the area. It has been shown in many studies that the most important factor affecting the possibility of innovation is the size of the company. Larger firms are more innovative than smaller firms [49]. This observation is consistent with basic economics because large companies can devote much larger resources or assets to their innovative activities than smaller companies and have more business diversity [24]. A more diverse and inclusive business team is likely to draw inspiration from different places to create something new. The stock section is often overlooked. Teams that operate in a fair environment, including fair wages, are more likely to feel respect and trust. These factors create better knowledge sharing and collaboration that fuel innovation, which in turn affects diversity in business [12].

7 Experiments

The literature was reviewed to examine the research background, considering accounting and financial management topics, including magazines and research publications, stock exchange publications, articles, and academic theses. Below is a summary of the literature reviewed:

7.1 Foreign research

Authors in [37] addressed the issue of dynamic capital structure under the changing conditions of the market in the oil industry. They examined the dynamics of the capital structure in the oil sector, which has witnessed significant changes in market conditions, such as significant changes in oil prices, fundamental reforms in laws, and reduced access to credit over the past decade. Their analysis focuses on testing the main trading predictions, pecking order, and market condition models under a variable market condition. Our main contribution is to explore the heterogeneity of firms regarding debt level, equity issues, and long-term and short-term debt in the analysis of capital structure through the use of quantitative regression and also consider time dynamics. We identify general patterns in the sector, such as the preference in the oil industry to finance investment changes through the issuance of new debt (mainly long-term debt). In general, they stated in their research that in recent years, we are changing the capital structure over time and the characteristics of corporate debt. For example, they stated that oil companies with a relatively high growth rate in new debt issuance are much more sensitive to changes in investment than companies with a relatively

lower rate of new debt issuance in a given year. Their results emphasize the importance of considering temporal and cross-sectional asymmetry when explaining the budgetary mechanisms adopted by a firm. Their study emphasizes the importance of time-varying aggregate factors in the choice of capital structure by energy firms and therefore the importance of policies that affect the funds available to energy firms, regardless of the specific characteristics of their capital structure decisions. Also, they clarified the importance of policies such as creating anti-cyclical buffers in the energy industry.

The research [46], modeled the technology cooperation of several profit-oriented business units in the framework of system dynamics. They stated that The competitive Original Design Manufacturing (ODM) continues to strengthen its technological capabilities to maintain competition. They continue in the market. Technology collaboration among the profit-driven business units of several companies in an (ODM) industry is becoming an important issue. This study presents a new system dynamics model to investigate system performance over time for multiple profit-oriented business units (BUs), a firm characterized by strategic capital deployment and technology collaboration. A case study for an industry-leading company with an original manufacturing (ODM) competition plan, in the electronics industry, is investigated. Our simulation results confirm that the proposed model can effectively determine profit changes under different capital deployment policies and technology cooperation protocols. In addition, the experimental design has examined the effect of key parameters from two perspectives: at the level of the business unit (BU) as well as multiple profit-oriented business units (BUs). Therefore, they expect that the results of the study improve quality decision-making for effective capital deployment and mutually beneficial technological cooperation between business units of a company.

Authors in [13] investigated the specific technology shocks of investment and the dynamics of the emerging business cycle. His study examines the role that investment-specific technology (IST) shocks play in business cycle fluctuations in emerging markets. The analysis is motivated by two main empirical facts. The presence of investment-specific technology (IST) changes in the postwar US economy, along with the importance of US investment goods in emerging market imports. The objective is to quantify the contribution of US investment-specific technological change (IST) to the business cycles of an emerging country in the context of a two-country, two-sector real international trade cycle framework with investment and consumer goods sectors. Specifically, they estimate the model using Mexican and US data and find that a permanent investment-specific technology shock (IST), originating in the US, is important in explaining the dynamics of the Mexican business cycle. The technology impact of the investment sector explains about 60% of investment, 44% of consumption, and 52% of production variation. In addition, they argued that both the shock from financial frictions and the permanent investment-specific technology (IST) shock, with the origin of its creation considering the role of the United States, are necessary to account for the main features of the business cycle in the data. [46] examined the subject of the study of the bull market effect (BWE) in the supply chain (SC). Their study produced two system dynamics (SD) models based on the AR(1) (autoregressive process) model developed in [3]. In this research, they analyzed the effect of the demand correlation coefficient, lead time, demand smoothing time, and information on the bull market effect (BWE) using Vensim Simulation Software, and then made suggestions on how to reduce the bull market effect (BWE). Also, in the end, they compared the simulation results of their system dynamics model(s) with the AR(1) models, which have the validity in [3], that is, the AR(1) model from the simulation point of view, and based on that, the results of their research was also approved. They also show that the system dynamics model along with the AR model (1) can reliably and powerfully analyze the bull market effect (BWE) in the supply chain (SC).

The research [30] examined the issue of presenting a financial accounting model from the perspective of system dynamics. In this project, he examined the basis of the financial accounting model. He investigated the features of the accounting equation as the main algorithm for designing and developing a system dynamics model. A key perspective is the basic requirement that resolves the time conflict inherent in a stock and flow model. Through formal analysis, the accounting equation is defined as a cybernetic model by expressing the temporal and dynamic characteristics of its conditions. The expressed form of the accounting equation is defined as a dynamic flow and flow model that represents two dimensions of the two-way accounting system. With this formal basis, it is claimed that the accounting model is capable of simulating financial dynamics as well as integrating with models that represent global operational dynamics. Therefore, they proved that it is possible to design and build a dynamic business model that can meet the requirements of management accounting (before the fact) as well as financial accounting (ex-post, after the fact). Moreover, they concluded that the dynamic accounting model can be relevant for strategic planning and control purposes and be integrated into a system dynamic model designed for such purposes.

7.2 Domestic literature

Authors in [1] studied the design of a sustainable business model using soft systems methodology and the value triangle business model as a case study in Farasan Industrial Manufacturing Company. In this research, by using the methodology of soft systems, and using the new business model of the value triangle, it was possible to design a comprehensive model for Farasan Industrial Manufacturing Company, one of the companies active in the pipe industry. This research is trying to achieve two main goals, i.e.: identifying key components and factors that make up the sustainable business model of Farasan Company and also designing it to help create value for key stakeholders. The achievement of the research, from a practical point of view, is to achieve a suitable business model for this company, and from a theoretical point of view, to present a new approach to designing sustainable business models. This research, as a practical case in the real world, can be a basis for helping the country's organizations and industries in creating value for key stakeholders such as shareholders, customers, employees, society, and the environment, and improve the possibility of achieving sustainable development.

In authors [11] examined the dynamic analysis (dynamics) of the ordering system in the supply chain with the systems dynamics approach. They stated that the supply chain is a dynamic system that includes all activities related to product creation and delivery, from the raw material stage to reaching the final customer. Sapco's supply chain management requires forward-looking decisions and the design of new capacities with a comprehensive and connected approach. Moreover, the science of system dynamics is one of the management tools based on this attitude. This science can simulate various supply chains, and with the help of this simulation, the uncertain consequences of decisions are revealed. Analyzing the fluctuations in the behavior of customers' orders can provide a key role in predicting the level of meeting the demand of customers, sales, on-time delivery, adjustment of sales personnel, and other factors. In this article, the dynamic analysis of the ordering system in the supply chain was investigated with the system dynamics approach. In this article, based on the principles of the system dynamics method, the dynamic hypotheses that give rise to the problem in question were explained after stating the problem of the ordering system in the supply chain; then, the dynamic model related to fluctuations in the ordering system was presented. In this regard, first, the main variables were identified, with formulated their relationships in the form of causal loops. Then the main model was designed in the form of a flow accumulation diagram and then simulated in the software. Validation tests and sensitivity analysis were performed on the model after the final model design and simulation, which showed the validity of the model.

In authors [35] examined system dynamics and addressed a new approach to modeling accounting events and financial decisions. In this paper, the system dynamics method was used as a new approach for modeling accounting events. For this purpose, first, by defining financial accounts in the form of state and rate variables, the effect of accounting events on each other was modeled based on cause and effect relationships and in the form of a dynamic model, then the key variables in 2021 was simulated by using the real data of a manufacturing company. The results of the study showed that the proposed method while modeling financial operations based on a dynamic approach, by simulating the trend of variables in future periods, helps managers to analyze the effectiveness of variables based on behavioral patterns, and by simulating the behavior of financial variables in the future, it provides useful information for managers to make decisions. Based on the results, the variable behavioral pattern of doubtful receivables is not only instantaneous and simultaneous, but also has an exponential distribution function with a time delay, and its changes have a significant relationship with the variables of sales rate, capital return rate, and accounts receivable. So that by receiving feedback from the change process of receiving claims, the sales behavior pattern will also change in the future.

The research [22] examined green information technology maturity modeling with a systems dynamics approach. Since information technology can have a destructive effect on the environment, protecting the environment against these threats has been added to the concerns of organizations, and for this reason, the discussion of green information technology has become a topic of the day. Various models and methods have explained the various dimensions of green information technology maturity, a dynamic system model has been presented in this research to examine the relationships of components and determine the appropriate strategy to reduce energy consumption and, as a result, increase the maturity level of green information technology in the organization. Since the banking industry has a close relationship with information technology, Iran's banks were considered in this research. Various components affecting the maturity of green information technology were identified and the initial dynamic hypothesis was formed, then cause and effect diagrams and rate and mode diagrams were drawn to explain their relationships. In the end, after testing and simulating the dynamic model, various scenarios were proposed to improve the situation in the banking industry and reach the highest level of green information technology maturity.

In authors [50] investigated accounting positioning in the managerial decision-making process. They stated that deciding on the organization's future without proper and logical analysis and evaluation of various solutions will

have no consequences other than wasting time and bearing heavy losses. Emphasis on the principles of financial accounting and the existence of limitations governing the qualitative characteristics of financial information cause that the information of financial statements, despite being reliable, alone is not useful for planning. The necessity of using reports based on management accounting is more evident in such cases. In this article, the identification and ranking of factors influencing the manager's decision-making in management accounting, to answer the question, "What are the factors influencing the decision-making of managers in the field of management accounting?" has been followed. For this purpose, first, the statements and main barriers to decision-making in management accounting were extracted and analyzed based on literature and theoretical foundations followed by determined key features relying on the results obtained from the statistical population and data analysis using SPSS software to provide criteria as good theoretical basis for ranking the factors affecting managers' decision-making in management accounting. Finally, the previous stage extracted factors were ranked according to the experts' opinions, using the AHP method and Expert choice software.

In authors [22] examined simulation with the systems dynamics approach to create and integrate knowledge management strategy and knowledge strategy. They stated that organizations are forced to develop a knowledge management strategy and develop a knowledge strategy to face the issue of knowledge management. Various models and methods were presented for formulating these strategies. In their research, a dynamic system model was presented to select and combine these two strategy types. In this model, organizational factors such as the general business strategy of the organization, organizational structure, cultural factors, human resources, and information technology infrastructure were considered influential variables. On the other hand, in the dynamic approach to creating knowledge strategies and knowledge management, the state of knowledge creation and dissemination processes, as well as the level of open and hidden knowledge, have a direct impact on the chosen strategies. In this paper, first, the studied organization knowledge variables were identified, followed by determining their initial level and the factors affecting their increase or decrease, then the cause and effect diagrams and their rates and conditions were drawn. In the end, different scenarios and policies were proposed for the studied sample after testing and simulating the dynamic model. The results of the selected scenarios of their research show improvement in the variables related to both types of knowledge strategy and knowledge management strategy.

On the demand side, foreign companies may need higher quality or asset-specific products that can be provided by new companies more effectively than existing companies [6]. On the other hand, some studies state that the relationship between FDI and entrepreneurship is a U-shaped relationship. That is, initially, with the entry of foreign companies that have superior technology, the entry barriers for domestic companies increase; but, gradually with the acquisition of skills and the transfer of knowledge, local entrepreneurial companies are placed in the upward part of the U curve [42]. On the other hand, bank credits (especially micro credits) are the main source of entrepreneurial financing. Bank credits as a strategy in economic development to give people access to credit resources, to create job opportunities to improve their economic and social status, and as a tool for earning and investing. The effects of microfinance on economic growth are investigated in direct and indirect ways. The direct ways of effects of microfinance on economic growth are based on reducing poverty, increasing welfare, and adding value to products through the entrepreneurial activities of the poor. Therefore, economic growth is directly related to microfinance. Microfinance is directly affected by the products created by small entrepreneurs, the improvement of human development indicators (health, nutrition, education), and poverty reduction on economic growth. Microfinance also indirectly contributes to economic growth through interaction with financial markets. Microfinance institutions increase the poor's involvement in financial affairs, better recognize the poor's financial needs, and most importantly, create formal financial intermediation. The second way of transferring microfinance is that it increases the money cycle and expands entrepreneurship in the economy [26]. Foreign trade is also a channel for transferring thoughts, ideas, knowledge, and advanced technologies. Acceptance, adaptation, and adherence to these technologies strongly depend on the human capital in the receiving country. The human capital's role in the growth and development of business is a tool that facilitates technology adoption across borders. The richer the country is in terms of human capital, the more profit it will benefit from trade, and in fact, the growth resulting from trade is more effective when there is enough human capital to absorb transferred thoughts, ideas, and technologies [20]. The increase in the number of documents for registering imports and exports is one of the reasons for that increase in the costs of official business, which harms innovative and productive activities.

8 Data analysis model and method

The model used in this article is defined in the following way in the normal panel:

$$HH_{it} = \beta_{it} + \beta_1 INV_{it} + \beta_2 Size_{it} + \beta_3 LEV_{it} + \beta_4 SG_{it} + \beta_5 ROA_{it} + \beta_6 PRO_{it} + \varepsilon_{it}.$$

Also, the study model is specified with quantile regression as follows:

$$q\left(\frac{\text{HH}_{2it}}{\Omega_t}\right) = \theta_{0t} + \theta_{1t}\text{INV}_{it} + \theta_{2t}\text{SIZE}_{it} + \theta_{3t}\text{LEV}_{it} + \theta_{4t}\text{SG}_{it} + \theta_{5t}\text{ROA}_{it} + \theta_{5t}\text{ROA}_{it}\theta_{5t} + \text{PRO}_{it} + \mu_{it}.$$

In the above equations, HH is the business diversification index, which is measured using the Herfindahl-Hirschman index. This index gives weight to each company's share in the market

$$\text{HH} = \sum S_i^2.$$

In the above relationship, S_i^2 is the square of the market share of the ith company. This index is between zero and one. Also, in the quantile regression equation $q\left(\frac{\text{HH}_{2it}}{\Omega_t}\right)$, the conditional quantile is the index of business diversification. In the above equations, INV is also the innovation index; LEV, leverage, Size, company size, SG, company sales growth compared to the previous year, PRO, gross operating profit and ROA are also the return on the company's total assets. All research data, except the innovation index, were extracted from the Tehran Stock Exchange website and Rahavard Novin software. The innovation index data was also collected from the website of the World Intellectual Property Organization (WIPO) from 2012 to 2018. This article adopted the fixed effects panel approach and quantile regression to analyze the model. Quantile regression provides the possibility of many effects of independent variables on the dependent variable in different quantiles of the dependent variable, which is not possible in normal regression. In other words, in normal regression, a coefficient is provided for each independent variable, while in quantile regression, the coefficient is provided according to the number of quantiles under investigation, and it is widely used in providing policy strategies. In the following, these two approaches will be briefly described.

In case of panel data adoption, various tests should be performed to identify the appropriate estimation method. The most common tests are Chow Test and Hausman Test. Chow's test is used to test between Ordinary Least Squares method and the fixed effects model. In this test, the null hypothesis indicates that the coefficients and width from the origin are the same in the studied data. Therefore, the rejection of the null hypothesis indicates the use of panel data and the failure to reject the null hypothesis indicates the use of the ordinary least squares method. If it is determined in Chow's test that it is possible to consider widths from separate origins for all stages or times in the study, then the test of choice between estimation with group or time random effects should also be used. The main assumption in the fixed effects model is that the error component can be correlated with the explanatory variables, while in the random effects model, it is assumed that there is no correlation between the error component and the explanatory variables. The Hausman test also uses the chi-square test if the probability of the test statistic is more than 5., thus, random effects can be preferred to fixed effects at a significant level of 95%. Otherwise, fixed effects are selected. The above process can be briefly shown as follows [4].

This article adopts the quantile regression method due to its advantages, which will be described below, as well as the possibility of examining the effects in the high and low quantiles of the human development index. The estimation of parameters in quantile regression is based on a symmetric and asymmetric loss function and is calculated similarly to the estimation of parameters in the least squares regression. Quantile regression, without the limitations of normal regression assumptions, allows the involvement of independent variables in all parts of the distribution, especially in the beginning and end sequences, and this regression when the error distribution is non-normal and in distributions with a sequence long and asymmetric, and also despite the heterogeneity of the regression, it deals with the estimation of the parameters. This model was introduced by [24] and gradually became a comprehensive method for analyzing the statistical analysis of linear and non-linear models of the response variable in different fields. The main motive for using quantile regression is to provide a model with a detailed and comprehensive look at the evaluation of the response variable, so that the involvement of independent variables is possible, not only in the center of gravity of the data but also in all parts of the distribution, especially in the initial and final sequences, without the limitations of normal regression assumptions, heterogeneity variance and the effective presence of outlying data in the estimation of coefficients. In quantile regression, unlike normal regression, minimizing the sum of the absolute value of the weighted residuals is used to estimate the model parameter, which is called the Least Absolute Deviations (LAD) method [24].

9 Research findings

This section presents the main research findings. In this section, based on the Herfindahl-Hirschman index, stock market industries will be classified into three competitive, concentrated, and semi- concentrated categories. Table 2 shows the results of the Herfindahl-Hirschman index.

Considering Table 2 calculations, different industries will be classified based on table 3.

Table 2:   Herfindahl-Hirschman index results in selected groups

Industry	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
Food	0.218	0.223	0.231	0.238	0.236	0.240	0.241
Pharmaceutical	0.179	0.198	0.214	0.234	0.273	0.243	0.224
Chemical	0.145	0.175	0.165	0.142	0.153	0.187	0.169
Metal	0.135	0.145	0.154	0.147	0.152	0.139	0.143
Ceramic/ Tile	0.0587	0.0678	0.078	0.0712	0.0687	0.085	0.086
Automobile manufacturing	0.245	0.264	0.247	0.236	0.241	0.218	0.241

Source: Research calculations

Table 3: Classification of different industries based on the HH index

index HH	Market type	Industry
HH < 0.10	Competitive	Ceramic/ Tile
0.10 < HH < 0.18	Concentrated	Metal/chemical
HH > 0.18	Semi-concentrated	Food/automotive/pharmaceutical

Source: Research calculations

10 Stationarity test

Before estimating the model, the significance of the investigated model variables should be tested. In panel data, it is generally assumed that the number of fixed sections and the number of periods tend to infinity. Considering this issue, it is necessary to choose the appropriate unit root test. Stationarity tests in panel data were presented by Quah [34]. These studies were completed in [25] and [19]. Authors in [25] (LLC) state that in panel data, the use of these data stationarity tests has more test power than the use of the unit root test for each section separately. Considering the asymptotic characteristics of the LLC test, in this article, this test is used to check the validity, the results of which are presented in Table 4.

Table 4: Stationarity test results by LLC method in different industries

Symbol	Variable	Competitive	Concentrated	Semi-concentrated
		Probability	Probability	Probability
HH	HH index	0.002	0.000	0.001
INV	Innovation index	0.001	0.000	0.000
SIZE	Size of the company	0.000	0.002	0.004
LEV	Leverage	0.000	0.001	0.001
ROA	Return on company assets	0.014	0.021	0.000
SG	Company sales growth	0.000	0.000	0.031
PRO	Gross operating profit	0.001	0.003	0.002

Source: Research calculations

Table 2 shows that the null hypothesis of non-stationarity in the studied variables can be rejected in all three groups, and therefore the study variables were at the stationarity level. After confirming the stationarity of the studied variables, the need to use panel data will be checked using the Chow test. In Chow's test, the null hypothesis indicates that the width of the origins is equal (the need to use pooled data) and the opposite hypothesis indicates that the width of the origins is different (the need to use panel data).

H_0: Pooled Model

H_1: Fixed Effects Model

The test results are summarized in table 5.

Table 5 shows the value of the F statistic is in the zone of rejecting the zero hypothesis, which means confirming the panel data against the pooled data. Next, to determine the use of a fixed effects model against random effects, the Hausman test will be performed. In other words, the most common test to determine the type of pooled data model is the Hausman test. The Hausman test is based on the presence or absence of a relationship between the estimated

Table 5: Chow test result

F-test	Statistics F	Probability	Result
Competitive industries	24.2	0.00	Verification of panel data
Concentrated industries	376.1	0.00	Verification of panel data
Semi-concentrated industries	310.5	0.00	Verification of panel data

Source: Research results

regression error and the independent variables of the model. Hypothesis H_0 indicates the lack of correlation between independent variables and estimation error, and hypothesis H_1 indicates the presence of correlation.

Table 6: Hausman test to distinguish fixed or random effects method

F-test	Chi-squared test	Probability	Result
Competitive industries	47.03	0.000	Verification of fixed effects
Concentrated industries	56.11	0.000	Verification of fixed effects
Semi-concentrated industries	40.96	0.000	Verification of fixed effects

Source: Research results

The results of the Hausman test in Table 6 show that the fixed effects were confirmed against the random effects. Table 7 shows the estimation results of the model with fixed effects in the 3 investigated groups.

Table 7: Model estimation results in 3 groups examined with fixed effects panel

Variable	Competitive industries		Concentrated industries		Semi-concentrated industries	
	Factor	T statistic	Factor	T statistic	Factor	T statistic
INV	0.175	2.11	0.0542	3.71	0.0712	1.92
SIZE	0.214	1.99	0.213	1.97	0.0242	2.636
LEV	-0.078	-1.42	-0.035	-1.28	-0.048	-0.841
ROA	0.172	2.06	0.0267	1.89	0.0075	0.841
SG	0.129	2.04	0.154	2.43	0.148	1.789
PRO	0.318	2.72	0.182	2.33	0.146	1.95
C	0.33	2.16	0.465	3.19	0.198	3.27
Model evaluation	$R^2 = 0.81$ Prob (F-statistic) = 0.0000		$R^2 = 0.89$ Prob (F-statistic) = 0.0000		$R^2 = 0.86$ Prob (F-statistic) = 0.0000	

Source: Research results

In the following, the results of quantile regression will be presented and then the estimated results will be discussed.

The findings show that the estimated model is in good statistical condition in terms of statistical criteria. The F statistic indicates the significance of the whole regression. In other words, the hypothesis that the model-independent variable's coefficients can be zero was rejected, with the significance of the whole regression.

The main point in modeling the factors affecting the diversification of the business index in the investigated companies is that about 15 variables were examined, and the model combining the above variables is the best model among about 40 models with different states of variables. The best model title was chosen for the significance and consistency of the signs of the variables with theoretical foundations.

Based on the estimated results, among the research variables, in all three groups, company size variables, innovation index, profitability, and company sales had the greatest impact on the business diversification index.

In both fixed effects and quantile regression, the impact of the innovation index on the diversified business index was positive and significant. Also, the quantile results analyzed in all three groups show that the estimated coefficient is larger in the high quantiles of the business diversification index than in the low quantiles of the business diversification index. This shows that simultaneously with the increase of the business diversification index in the investigated companies, the impact of the innovation index on the business diversification index also increases. This is the reason why in developed countries, the effects of innovation on business diversity are stronger than in developing countries;

Table 8: Model estimation results in the 3 groups examined with quantile regression

Variable/ Quantile	Competitive industries			Concentrated industries			Semi-concentrated industries		
	Q33	Q50	Q67	Q33	Q50	Q67	Q33	Q50	Q67
INV	0.089 (2.38)	0.088 (1.98)	0.097 (1.97)	0.101 (1.78)	0.102 (1.89)	0.117 (1.93)	0.114 (2.08)	0.119 (2.14)	0.129 (2.31)
SIZE	0.023 (1.66)	0.028 (1.43)	0.014 (1.71)	0.029 (1.99)	0.035 (1.67)	0.041 (1.65)	0.047 (1.88)	0.046 (1.87)	0.051 (1.67)
LEV	-0.125 (-1.11)	-0.118 (-1.27)	-0.123 (-1.53)	-0.109 (-0.97)	-0.108 (-0.88)	-0.098 (-0.79)	-0.092 (-1.56)	-0.089 (-1.22)	-0.086 (-1.61)
ROA	0.043 (1.11)	0.023 (1.56)	0.035 (1.45)	0.054 (1.43)	0.087 (1.54)	0.086 (1.87)	0.087 (1.78)	0.087 (2.06)	0.098 (1.98)
SG	0.186 (1.97)	0.179 (1.99)	0.167 (2.96)	0.172 (2.52)	0.162 (2.19)	0.159 (2.29)	0.167 (2.67)	0.154 (2.44)	0.149 (2.01)
PRO	0.186 (1.97)	0.179 (1.99)	0.167 (2.96)	0.172 (2.52)	0.162 (2.19)	0.159 (2.29)	0.167 (2.67)	0.154 (2.44)	0.149 (2.01)
C	0.186 (1.97)	0.179 (1.99)	0.167 (2.96)	0.172 (2.52)	0.162 (2.19)	0.159 (2.29)	0.167 (2.67)	0.154 (2.44)	0.149 (2.01)

Source: Research results

because the index of business diversification is stronger in developing countries than in developed countries, and accordingly, the effects of innovation on it will be stronger based on the estimated results. However, the effects of innovation in companies with relatively low business diversification index will be insignificant for the potential of using this innovation in such companies is weak. Furthermore, considering the positive effect of the innovation index on business diversification concluded that by improving the innovation index companies can also benefit from this knowledge in different aspects both in production, marketing, and sales to increase their profitability. This, in turn, adds to the diversification of business and increases the scope of the company's activities. Additionally, this effect has been stronger in competitive industries than in the other two industries.

Today, to stay in the competitive environment, companies must always be creative and innovative, so that they can diversify their activities and continue to survive in the domestic and international markets. Therefore, if organizations do not have creativity and innovation in their products, they will be downgraded and removed from the competition cycle. In globally competitive markets, putting innovation strategies in the organization's plans is the key to improving performance and expanding the business and its dynamics. Product innovation strategy is the invention of innovative methods of products and services, which has always been important for the survival of groups in competitive environments. Input materials, business features, workflow, and information include the main innovation process feature inside the organization that occurred in the production line and cannot be discovered by people outside the organization. This feature is unique and it is not imitated by competitors, because it is inside the organization. Competition means trying to employ a wide range of competitors in an industry to undermine each other, and in this way, each competitor maximizes their ability to survive in the field and achieve future growth and development of the business. Therefore, business dynamism and growth owe a great deal to innovative approaches that companies, especially in a competitive environment, desperately need to expand their business.

Following the quantile regression estimation, the final step is to determine whether the effects are symmetric or asymmetric through the Newey and Powel (1987) test. The results of the symmetry test for the investigated quantiles are calculated in Table 9.

Considering the calculation probability value, the null hypothesis based on the symmetry of the results in most of the studied quantiles was rejected in the studied quantiles regarding the impact of the innovation index variable on business diversification in the group of competitive and semi-concentrated industries. In other words, the effect of innovation on the business diversification index has been asymmetric, but this effect has been mostly symmetrical in concentrated industries.

11 Conclusion and suggestions

Diversification in business is a broad and complex issue. Diversification is caused by the difference in existing human characteristics and interferes with the dynamics of the workforce resulting in competitiveness affecting organizations

Table 9: Symmetry results for the examined quantiles

Variable	Symmetry between quantiles	Probability
Competitive industries	0.1- 0.9	0.00
	0.2-0.8	0.00
	0.3-0.7	0.04
	0.4-0.6	0.076
Concentrated industries	0.1-0.9	0.092
	0.2-0.8	0.21
	0.3-0.7	0.27
	0.4-0.6	0.19
Semi-concentrated industries	0.1-0.9	0.00
	0.2-0.8	0.014
	0.3-0.7	0.00
	0.4-0.6	0.098

Source: Research results

and countries' innovations. Business diversification is a pillar to stay in the global competition in today's world. Without diversifying businesses and products, many companies will lag behind other companies. Currently, innovation in business models is considered in the form of corporate architecture. Innovation in business models shows how companies can take new approaches to develop their business. According to the innovations in their business model, companies can facilitate the entrepreneurship process in the company according to their capabilities. This will play a prominent role in designing and explaining the model of business dynamics. This paper purposed to investigate the effects of the innovation index on the business diversification index in selected listed companies in the Iranian capital market with a dynamic panel data approach from 2012 to 2018. The results of this study showed that in all three groups of competitive, concentrated, and semi-concentrated industries, the impact of the innovation index on business diversity was positive and significant, but this effect was stronger among competitive industries. These results show that governments can, like many developed countries, due to the high costs of research and development for various companies, while creating research and development centers in different sectors provide domestic industries with new innovative technologies and findings in different sectors. In other words, considering the role of innovation in business diversification with a vital role in growth sustainability especially in production companies, and attention to the fact that the creation of research and development units requires a lot of expenses and can only be afforded by large companies, governments should take serious steps by creating research and development centers and introducing innovations, especially in the agricultural sector, which leads to the diversification of products as well as the increase of production efficiency. Governments can help increase the level of production and incomes in the society, and also increase the government's income from taxes that contributes to the stability of their incomes. Companies should also devote considerable effort to building competencies and networks to take advantage of knowledge developed by government, universities, and other research institutions. On the policy side, the evidence presented shows that environmental policy innovations can sustain the growth processes of smaller and less-growing firms, but they fail to further expand production and diversify production, which is the main source of job creation. These findings are also particularly relevant to the current situation in Iran, where environmental innovations are considered a major tool to overcome the current unemployment crisis caused by the Covid-19 pandemic.

Future research can help to further study the identified relationships. In particular, longer time series allow for more sophisticated and robust econometric analyses, while the availability of comparable firm-level data for other economies in the region and similar economies in Iran allows for the exploration of relevant heterogeneities at the country level.

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