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Managing Global Transitions (MGT) is a quarterly, scholarly journal that covers diverse aspects of transitions and welcomes research on change and innovation in increasingly digitalized and networked economic environments, from a societal, organizational, and technological perspective. MGT fosters the exchange of ideas, experience and knowledge among developed and developing countries with different cultural, organizational and technological traditions. MGT invites conceptual, theory-development, empirical and review papers and case-based studies advancing the field of transitions in societies, organizations and technologies.

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ACER's Success in Establishing and Ensuring the Functioning of the Internal Energy Market: Through the Eyes of NRAS and Traders

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The Agency for the Cooperation of Energy Regulators (ACER) was launched in 2011 to contribute to the establishment and functioning of the EU's internal energy market. This study aims to evaluate ACER's success in establishing and ensuring the functioning of the internal energy market, both from ACER's and its stakeholders' (energy regulators and energy traders in the EU member states) perspective. The paper includes the results of interviews with nine national regulatory authorities (NRAS) and ten energy traders from the EU member states. This research revealed that, based on their perception, ACER is actually crucial for the operation of the internal market. In addition, NRAS and energy traders mostly agree that the EU has a nearly functional internal energy market and that ACER is vitally important for the functioning of the internal market.

Key Words: regulator, internal energy market, EU, functioning, ACER

JEL Classification: K32, L43, F16, G14

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Introduction

Over the past few decades, as developing economies have struggled to pull their populations out of poverty, electricity sector restructuring has been regarded as a crucial facilitating factor for higher levels of economic development (Ebrahimian et al. 2018). However, although the international environment imposes constraints on countries, especially on the economically backward ones, it does not solely determine the dependency and developmental performance of a country (Rončević et al.

2010). According to Felder (2016), electricity markets are intertwined with engineering – perhaps even more so than other markets – meaning that power system engineering cannot be completely separated from microeconomics, neither in theory nor in practice. The restructuring of the electric power industry in the 1990s began with the key objective of establishing market-based decision-making in energy investment, despite the accompanying market risks. The aim was to have market forces, rather than bureaucrats, act as the drivers, and to have investors, rather than ratepayers, bear the risks, explained Léautier (2016). The reason for that is simple – such markets are presumed to be more efficient than the alternatives. In the world of perfect competition, the market's innate coordination mechanisms would allocate goods and services efficiently. They would reach the Pareto optimum (Arrow and Debreu 1954).

Electricity has characteristics of a public good as it spills over from producer to other players (consumers), who are only limited by their capabilities in utilising it. This results in an appropriability problem for producers of electricity. Electricity-producing companies cannot fully appropriate the returns on their investment and will hence under-invest in the production of electricity. This reasoning is based on the classical view that goes back to Smith (1845) and neoclassical economics. According to these views, the target for governments is to establish conditions for competition that will channel individual self-interest for the common good.

However, after long, wide trends toward freer and more integrated markets, peoples and ideas, reluctance to subordinate the ideals of globalization to state interests (Quirk 2008) and far from creating a perfect world, economic competition often encourages behaviours that not only cause enormous harm to the group but also provide no lasting advantages for individuals, since any gains tend to be relative and mutually offsetting (Frank 2012). Other theories, such as the evolutionary theory and institutional economic theories, for example, as well as the 'varieties-of-capitalism approach' (Hall and Soskice 2001) and national business system (Whitley 2000), though sometimes regarded as unorthodox, can better explain the organisation of markets. According to this view, various institutions are present in both contextual and transactional ecosystems and influence the organisation of markets. Players in such ecosystems try to fulfil their interests by seeking ways to position themselves in the institutional environment and by actively trying to use it to their advantage (Jaklič 2009). In an institutional environment, linkages among players and institutions are crucial for successful market organisation and a con-

dition for market efficiency. Lack of linkages present a systemic failure and can have crippling effects on market efficiency. To enable the creation of linkages, and with it the efficiency that market can bring, a uniform regulatory environment needs to be established.

The need for a new framework for regulatory cooperation was – and continues to be – the most critical in the case of wholesale markets and so-called horizontal networks (Agency for the Cooperation of Energy Regulators 2018). Namely, to a great extent the formed wholesale electricity market exhibits the features of a natural monopoly that does not contribute to competitive pricing as in other sectors of the economy (Abrahám et al. 2015). According to Lisin et al. (2017), integration of certain energy systems and energy markets results in the gradual equalisation of basic prices and a shift in the financial and economic policy of energy sector companies towards optimisation of the energy system.

The integration of wholesale markets relies on cross-border cooperation and it cannot be expected that development is effectively supported and controlled by NRAS whose cooperation is purely voluntary. The same consideration applies to the development of European energy networks. Consequently, to ensure the effective integration of energy markets and energy networks at an EU level, a regulatory framework was required – one that would be more effective than what could be achieved through voluntary NRA cooperation.

This paper will examine the process, goals and results of the establishment of the common EU energy market, which is now known as the internal energy market. One of the key elements of this process was the establishment of the common regulatory framework. Its key element was the establishment of the Agency for the Cooperation of Energy Regulators.

The Agency for the Cooperation of Energy Regulators and the Evolution of Its Role

As part of the institutional framework set out by the Third Energy Package, known as the Clean Energy Package (CEP), Regulation (EC) No 713/2009 (European Parliament and Council 2009a) brought about the establishment of the Agency for the Cooperation of Energy Regulators. Its purpose (set out in paragraph 2 of Article 1) was to assist the national regulatory authorities (NRAS) in exercising, at an EU level, the regulatory tasks performed in the member states and, where necessary, coordinate their action. The agency was therefore meant to fill the regulatory gap

in cross-border issues, which was created during the establishment of the internal energy market because NRAS had mostly national powers and competences. ACER was to play a key role in the liberalisation of European electricity and gas markets.

The reasons for establishing ACER, as summarised from the preambles of the ACER Regulation (European Parliament and Council 2009d), are as follows:

In the Commission's Communication of 10 January 2007 entitled 'An Energy Policy for Europe' (European Commission 2007), the EC stressed the importance of completing the internal electricity and natural gas markets. One of the key measures identified as being necessary to achieve this objective was improving the regulatory framework at the Community level. The EC established an independent advisory group on electricity and gas, called the European Regulators Group for Electricity and Gas (ERGEG) (European Commission 2003) to facilitate consultation, coordination, and cooperation between the regulatory bodies in member states, and between those bodies and the Commission, to consolidate the internal markets in electricity and natural gas. The group was composed of representatives of the NRAS established in line with Directive 2003/54/EC (European Parliament and Council 2003a) of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and Directive 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas (European Parliament and Council 2003b). As ERGEG's work since its establishment has made a positive contribution to the internal markets in electricity and natural gas, especially in terms of providing independent solutions to aid in the establishment of the EU's internal market, ERGEG proposed that voluntary cooperation between NRAS should take place within a Community structure with clear competences and with the power to adopt individual regulatory decisions in several specific cases. In March 2007 the European Council invited the Commission to propose measures to set up an independent mechanism for the cooperation of national regulators (NRAS).

The key areas of cooperation as outlined in the said regulation are (European Parliament and Council 2003a):

- regulating the internal market
- eliminating obstacles to cross-border electricity and natural gas exchange

- later (following the adoption of REMIT) monitoring and controlling the operation of the internal market (wholesale level)

The decision by the European Council and European Parliament to draw up a special regulation to outline ACER's operations (European Parliament and Council 2009a) was approved in the framework of the Third Energy Package of directives on the regulation of the internal electricity and gas market, which was followed by the regulation on conditions for access to the network for cross-border exchanges in electricity (European Parliament and Council 2009b) and the regulation on conditions for access to the natural gas transmission networks (European Parliament and Council 2009c), along with others (establishing ENTSO-E and ENTSOG) (European Parliament and Council 2009a).

To ensure adequate harmonisation of the applicable rules, the ACER Regulation states that ACER has an important role in developing framework guidelines with which network codes must be in line. It also highlights its role in reviewing network codes (both when created and upon modification) to ensure that they are in line with the framework guidelines (European Parliament and Council 2009a).

According to the European Commission, an essential factor in establishing single markets is a unified approach to monitoring the development and conditions in the market. ACER was therefore tasked with monitoring regional cooperation between transmission system operators (TSOs) in the electricity and gas sectors as well as executing the tasks of the European Network of Transmission System Operators for Electricity (ENTSO-E), and the European Network of Transmission System Operators for Gas (ENTSOG). ACER's involvement is essential to ensure that the cooperation between TSOs proceeds efficiently and transparently (Energy Agency 2019).

In line with the general EU guidelines for establishing an internal energy market and to ensure the security of energy supply, member states had to start cooperating closely and remove barriers to cross-border electricity and gas exchange. Based on an impact assessment of the resource requirements for a central entity, it was concluded that an independent central entity offers many long-term advantages over other options. A need, therefore, arose for the establishment of an agency for the cooperation of energy regulators, to fill the regulatory gap at the Community level and to contribute to the effective functioning of the internal electricity and natural gas markets (Energy Agency 2019). Agency for the

Cooperation of Energy Regulators (2018) itself has described the need for regulatory unification to assure the emergence of a common retail electricity market: ‘However, despite the ambition in the 1990s to set up a pan-European retail market, the markets supplying energy to end consumers are still mostly national in scope, as they must consider the different patterns of consumer behaviour, which are a result of historical and cultural differences. Although we need to do everything in our power to bring forth the liberalisation of national retail markets and ensure that competitive suppliers have non-discriminatory access, the implementation of provisions on retail markets and consumer protection are by nature national issues, so the agency was granted limited competences in these areas, mostly relating to monitoring.’

The increasing integration of wholesale energy markets and the resulting increase in cross-border trade volumes raised the question of how to ensure the integrity and transparency of these markets. Transparency is understood as timely, effective, and non-discriminatory access to the same important information relating to prices for all market participants. Transparency, therefore, gives all market participants confidence that they are trading based on the same information. Integrity, on the other hand, calls for the prevention of market abuse. In this sense, the integrity of energy markets gives consumers confidence that the prices at which they purchase electricity reflect a fair supply/demand ratio as well as, more generally, the market fundamentals, states the agency’s document.

ACER is therefore expected to provide an answer to the issue presented of the incomplete establishment and functioning of the EU’s internal energy market. In essence, a regulated energy market should bring greater:

- competitiveness, connected to the economic development within the EU,
- security of supply, relating to the EU’s social dimension,
- sustainability, which presents the answer to the climate and energy challenges.

In May 2011 the Commission also adopted a decision to repeal Decision 2003/796/EC on establishing the European Regulators Group for Electricity and Gas (European Commission 2003), through which ACER also took over the tasks that had until then been assigned to the European Regulators’ Group for Electricity and Gas.

Although the agency was founded as a driving force of greater cooperation between NRAS, its role concerning the regulators continued to

evolve and the ratio between the role of the agency and that of the NRAs gradually changed, for example in the case of implementing Regulation (EU) No 1227/2011 of the European Parliament and the Council on Wholesale Energy Market Integrity and Transparency (European Parliament and the Council 2011). This aspect of the agency's operations, along with other aspects that have complemented its initial mandate, are recognised in the recast ACER Regulation, which is part of the Clean Energy for All Europeans package of legislative proposals. The regulation (Agency for the Cooperation of Energy Regulators 2018) states that 'ACER shall also contribute to the establishment of high-quality common regulatory and supervisory practices, thus contributing to the consistent, efficient and effective application of Union law to achieve the Union's climate and energy goals.'

According to one of the very prolific authors in the field of energy, Erkan Erdogdu (2011), one of the main objectives of any economic reform is to bring changes in the institutional arrangement so that economic activities can be performed more efficiently. In addition, reforming any sector in an economy requires changing the institutional environment, changing the organisational structure and modifying the governance mechanism. Since the late 1980s, power market reform has become the standard prescription of the multilateral donor agencies such as the International Monetary Fund (IMF) and the World Bank, and reform programmes have been implemented vigorously for about three decades now. Although the content of each reform programme has differed from one country to the next, the policy of functional disintegration, the establishment of regulatory authorities, the formation of wholesale and retail power markets and the privatisation of the electricity industry have been generally regarded as the natural components of a reform programme without paying much attention to the institutional environment of the country (Erdogdu 2013). The author also claims that 'despite the different approaches in the design of regulatory institutions, a separate agency from the government with reasonable levels of autonomy and technical expertise has emerged as the preferred model for a regulatory institution,' which could also be applied to ACER and its role in the development of the EU energy market.

Erdogdu (2016) also reminds us that the most important step in European power market integration took place on 4 February 2014, when price coupling in North Western Europe (NWE) went live. 'Since the launch of NWE, two extensions have taken place. Spain and Portugal joined in May

2014, while Italy coupled with France, Austria and Slovenia in February 2015. As a result, the coupled area was named the Multi-Regional Coupling (MRC), which now covers 19 countries and represents about 85% of European power consumption,' writes Erdogdu (2016). In an article published in 2011 entitled 'What happened to efficiency in electricity industries after reforms?' he claims: 'The true value of electricity reform is a matter of empirical testing rather than theoretical debate.'

In practical situations, it is often the case that regulatory policy is pursued both locally and globally. For example, each state has its own regulatory policies and regulatory institutions, but there are common policies and institutions that seek to produce additional social benefits by coordinating regulatory policies and promoting the common interests of the Union, writes Sabolić (2016), adding that in this case, this 'supranational' regulator faces the same problems of limited rationality that local regulators face at their local level (for the purpose of this paper, the chair of the ACER's administrative board argued that naming ACER as a 'European Energy Regulator' would be wrong, since the agency's full name – Agency for Coordination of Energy Regulators – clearly states what its role is). In this case the joint regulator formulates its regulatory policy tools partly based on input from local regulators and partly at its discretion. This time, as local regulators belong to sovereign states and there is no possibility of absolute control by the joint regulator, individual local regulatory policies will not be mapped unchanged to supranational policy, but local regulators will reject the extent to which they filter information by the joint regulator, and by doing so try to achieve or maintain their own local interests. In general, the variance of local regulatory policies, as viewed by an incompletely informed joint regulator, to which the national regulators are "lying" to some extent, may be greater than the variance of the same policies when viewed by local regulators. On the other hand, due to the uncertainty further compounded by the regulatory moves of the joint regulator, the variance of local policies may also become larger for local regulators. While they only serve the common regulator of local politics as a source of information (somewhat corrupted by deliberate filtering), local regulators are the primary tool of action. In any case, a situation involving a joint regulator, which does not have full authority over the local authorities, may lead to an increase in information asymmetry and therefore to a deterioration in the regulatory policy portfolio at the local level, or to a deterioration in the quality of information received by the regulator at a global level (Sabolić 2016).

According to Sabolić (2016), the global regulator may seek to 'improve' its own portfolio through synergies and policies of common interest. To what extent it will succeed in this is difficult to assess in the general case. In this situation, the global regulator and local regulators enter into a strategic competition, at least in part, an uncooperative strategic game of information filtering. The outcomes of such games may be better, equal or worse than the ordinary sum of the effects of local regulatory policies, which depends on many factors, but, first and foremost, on the success of formulating a common regulatory policy in circumstances where it cannot be firmly imposed, whilst it also depends on the will of the individual participants in the game, not just the will of the central regulator. However, they can never be better than the outcome of a regulatory process in which a policy is formulated by only one regulator, common to all jurisdictions. Namely, the 'unitary regulator' is not confronted with the additionally introduced asymmetry of information, and it can fully extract the benefit of all local policies, and add to its overall policy mix its own policies, hoping for an increase in shared well-being (Sabolić 2016).

The first of the key roles assigned to the agency by the Third Energy Package, which has kept it busy during its initial years of operation, was to contribute to the development of framework guidelines and network codes, which, in line with their purpose, set out a consistent set of rules for the internal energy market. *It is, therefore, necessary to assess whether these rules were adequately implemented and whether they had the intended effects and benefits – mainly relating to energy consumers – with the latter being the ultimate aim of the entire market integration project.* This will be the main hypothesis of this research.

For this purpose, exactly ten years after the establishment of ACER, the authors of this paper set out to check its effectiveness in establishing and ensuring the operation of the internal energy market in the EU. The paper was drafted as a case study of the EU's internal energy market, exploring the role of the principal player – ACER – the only European agency of its kind in the field of energy. It must be stressed that the focus of this study is to paint a general perception of national regulators, whose cooperation the agency is in charge of, and energy traders (companies that retail electricity to final consumers) as market players.

Methodology

Although the authors are aware that ACER's success could be measured differently – through more econometric and therefore quantitative re-

search methods – the qualitative research method was used in order to get the information directly from the market participants, since they are active market players. The purpose of this research is to determine the level of satisfaction among NRAS and energy traders with the work done by ACER, whose main task is to establish the internal energy market and to make sure that it functions. The authors wanted to not only check the perception of NRAS and traders of ACER's functionality but also to examine their expectations regarding the future of this unique institution in the energy market, that is, the future of ACER and what kind of importance the regulators attach to this institution today.

The authors began by carrying out in-depth interviews with the first director of ACER and the director of the Slovenian NRA, and then moved on to examining the issues by using a questionnaire to conduct a survey among NRAS and energy traders in the EU.

The interview with the first director of ACER, Alberto Pototschnig, took place in April 2019. The conversation was recorded on a mobile phone, it took 43 minutes and was conducted in English.

The interview with the director of the Slovenian NRA, Duška Godina, took place in May 2019. The conversation was recorded on a mobile phone, it took 40 minutes and was conducted in Slovenian.

After carrying out the first part of research with the implementation of interviews, a survey questionnaire was prepared (see the Appendix), which was sent via email to all the NRAS in the 28 EU member states (Brexit had not yet taken place at the time of the survey) and 30 energy traders operating in the EU (individual traders are present in more than one state).

The authors were able to secure a representative sample for quantitative research: nine representatives of NRAS operating in European energy markets – a third of all possible respondents among regulators (some NRAS responded that they did not wish to take part in the survey) and ten representatives of energy traders – a third of all the possible respondents among traders (some traders responded that they did not have time to take part in the survey).

Results and Recommendations

This research has shown that the NRAS and energy traders who participated in the survey mostly agree on the fact that the EU has a nearly functional internal energy market.

Their answers are shown in table 1. Based on these results, it can be

TABLE 1 Responses to the questions

Response	Does the EU Have a Well-Functioning Internal Energy Market?		Has the Agency for the Cooperation of Energy Regulators Been Key to the Functioning of the Internal Energy Market?	
	NRAS	Energy traders	NRAS	Energy traders
Disagree	0	0	0	0
Somewhat disagree	1	2	1	2
Neutral/don't know	0	0	0	0
Somewhat agree	8	6	8	6
Agree	0	2	0	2

concluded that NRAS and energy traders mostly agree on the fact that the EU has a nearly functional internal energy market.

Nevertheless, the comments of two NRAS who replied to the question about what still needs to be done for a well-functioning internal energy market should not be overlooked. One of the comments was that instead of striving towards the lowest possible energy prices for consumers, work should be done on lowering CO₂ emissions. This should, therefore, act as a governing strategy for the internal energy market. The second comment, on the other hand, mentioned Nominated Electricity Market Operators (NEMOS), suggesting that a single operator should be established for the entire internal energy market for successive periods of 5 to 10 years.

Not all respondents answered the authors' question about whether ACER has been effective in establishing an internal energy market, however those that did, believe that the agency has been effective in this regard. The question about whether ACER has been effective in ensuring the functioning of the internal energy market was also not answered by all the respondents, however those that did, believe that it has. Most of the respondents – both NRAS and energy traders – agree that ACER has been key to the functioning of the internal energy market. The answers are shown in table 1.

However, it should be stressed that the research is based on the perception of the selected target group (e.g., NRAS and energy traders) and that the results do not necessarily represent the 'absolute truth.' Moreover, the authors suggest that further research needs to be conducted – such that a quantitative research method would also be used.

Meanwhile, the responses to the question about whether ACER's effectiveness depends mostly on its director were quite mixed, with a large number of the respondents replying that it does not. Nevertheless, the answers to the follow-up question should not be dismissed: If it does not depend on the director, what does it depend on? One of the responding NRAS stated that 'the effectiveness of ACER is dependent upon good cooperation between the director and the Board of Regulators (BoR).' Another NRA replied: 'the effectiveness of ACER depends mostly, perhaps solely, on the disciplining of TSOs and regulators through the interplay between the decision-making procedures [...] set in the European network codes and the European network guidelines.' A separate NRA said that 'a sufficient number of employees and financial resources are indispensable for the effectiveness of ACER,' while another emphasised the importance of 'well-trained and competent staff.' Well-trained staff, professionalism, the right competencies, and the ability to work in a team were also mentioned in the energy traders' answers to the follow-up question. Their responses also reveal that energy traders are aware of the fact that a broader support environment – encompassing everything from the legislative framework to the NRAS – is required to ensure ACER's efficiency.

It can, therefore, be concluded that, when asked about whether ACER's efficiency depends on its independence, although the respondents (both NRAS and energy traders) chose nearly all of the possible answers (except the first one, 'disagree'), most of them agreed that the efficiency of the agency does ultimately depend on its independence. There were also two noteworthy answers to the follow-up question: If ACER's efficiency does not depend on its independence, what does it depend on? One of the NRAS reiterated its answer to the previous question: 'The effectiveness of ACER depends mostly, perhaps solely, on the disciplining of TSOs and regulators through the interplay between the decision-making procedures [...] set in the European network codes and the European network guidelines,' while another said that 'independence is a precondition, but not a guarantee for success. Successful operation necessitates the right competencies and a sufficient budget.'

It can, therefore, be concluded that, when asked about whether ACER's independence depends on its management, although the respondents (both NRAS and energy traders) chose all of the possible answers, most of them agreed that it does.

It can also be concluded that the respondents (both NRAS and energy traders) have differing opinions on whether ACER's independence de-

depends on its budget, as they chose nearly all of the possible answers to this question (except the first one, 'disagree').

There were also quite interesting responses to the question about whether the taking away of some of the director's powers and increasing those of the Board of Regulators, as set out in the recast ACER Regulation, was a positive development. While most of the NRAS support the modification, not all of the energy traders see it as a truly positive development. One of the traders explained that the development was not positive due to the 'collective perpetuation of the status quo.' Another energy trader stated that 'this approach will further increase the influence of local regulators and local interests,' whereas one said that 'considering the Board's composition, the risk of "bland compromises" is even greater.' The NRAS that saw this as a positive development mostly supported their decisions by saying that this will also increase the influence and power of NRAS – something energy traders are certainly not too pleased about. However, the energy traders that did see this as a positive development explained that the NRAS which will thus gain more power are also more acquainted with the local content and the specifics of certain environments. They added that this will ensure that ACER's position on relevant topics is the most neutral and professional. One of the energy traders also emphasised that although it is a good idea to take away power from a particular person and give it to several people, it is necessary to ensure that not too many people take part in the decision-making process.

ACER should take into consideration, on a professional basis, all the comments and opinions submitted both by the NRAS and the energy traders, since these players form an integral part of the internal energy market and ensuring the best possible operation of the internal energy market will depend on the cooperation of all the players.

Conclusion

It can be concluded that the expectations of the respondents (both NRAS and energy traders) regarding the effectiveness of ACER in establishing the EU's internal energy market have so far mostly been met. However, the neutral responses of some of the traders and the negative responses from a small number of respondents should not be overlooked, especially one very clear comment made by one of the NRAS: 'The formal procedures and the substantial reasoning in respect of ACER's Decision No. 04/2019 of 1 April 2019 on the determination of CCRS etc. had the character of a 'coup d'état.' Notably, the proceedings leading to the wording

of Article 6 on Future Amendments within Annex I on the decision in question failed to meet the requirements for ‘good administration,’ transparency, the right to be heard etc. set in Article 41(1) to (2), ref. to Article 51(1), in the Charter of Fundamental Rights of the European Union.’

Additionally, it can be concluded that when it comes to the expectations regarding the effectiveness of ACER in ensuring the functioning of the EU’s internal energy market, only a few respondents, including NRAS and energy traders, said that their expectations have been met. However, it is worth noting that several respondents chose the neutral response, while one of the traders wrote in the email reply: ‘For us traders, ACER means greater transparency, and consequently fewer opportunities. On the other hand, investments in non-transparent markets are better valued.’ NRAS were in the majority among the respondents whose expectations were mostly met.

When replying to the question about their specific expectations regarding ACER’s future activity, one of the NRAS mentioned ‘the continued solidification of ACER’s reputation as a professional European institution which promotes cooperation between EU NRAS, making professional and transparent choices that support both the implementation of the Clean Energy Package (CEP) and the functioning and control of the EU’s internal energy market.’ Another NRA said that ‘the importance of ACER will grow further as the internal energy market develops.’ A different NRA stated: ‘We are very concerned about the reduction of financial resources allocated to ACER and we are afraid that in the future ACER will not be able to fulfil all the tasks assigned to it, especially those related to REMIT.’ A separate NRA said that ‘ACER could have more say in solving the problems of third countries,’ while another regulator stated that it expects ‘increased emphasis on ACER’s role as an advisor for NRAS on issues related to the implementation of regulatory requirements and transposition of the directives and improved energy market data quality and exchange.’ A separate NRA noted that ‘the Clean Energy Package, notably the recast ACER Regulation, seems likely to improve the effectiveness of ACER’s future activity, as the regulators of member states, in respect of their collective decision-making via the Board, are likely to be more involved in the preparation for the Board’s decision-making, and in the following implementation within each of the member states of the decisions having previously been adopted by the Board.’ The final NRA said that ‘we expect ACER’s workload to increase especially in terms of the decision on cross-border cases (as per art. 6(10) New ACER regula-

tion) as the internal market becomes increasingly interconnected and integrated. We expect ACER to improve its decision-making in terms of a fair process, evidence and regard to the complexities of interconnected grids. The new ACER rules of procedure and resource availability will be key to this.'

Turning now to the expectations of energy traders. One of them noted that it expects 'faster implementation and operation of adopted regulations,' whereas another pointed out 'the establishment of a market where the countries are interconnected at all levels and which features clear, easily accessible and presented connections for approved flows between bidding zones.' Another trader mentioned 'supporting the further integration of the EU internal energy market based on the now approved EU Clean Energy Package legislation and enabling market-based regulation for applying new technologies in demand flexibility, energy storage, sector coupling, hydrogen energy, etc.,' whereas a separate trader emphasised 'establishing a competitive environment in all segments of the energy market, focusing on advanced solutions and enabling their application in consumer services.' One of the traders also noted 'a focus on further harmonisation of the EU's internal energy market and closer monitoring of national markets' activities, regarding the implementation and execution of EU regulations (which should be "independent" from local/national politics).' A separate trader expects to see 'greater trust in the trans-European market, especially in the markets where the risks are higher, as well as boosting investment of western companies in eastern and Balkan markets,' whereas the final energy trader said that 'ACER should continue to monitor the internal market, but it should be more open towards the market participants. [...] Their guidelines [ACER's guidelines on REMIT; authors' note] is rough and too general. There is simply no way of getting in direct contact with them. It makes the market participants' situation more difficult, when all they would like to do is to fully comply with ACER regulation.'

Even though the authors initially tried to answer the question of how successful ACER has been in promoting the internal energy market, which led them to investigate how successful traders and regulators believe ACER has been and how successful traders and regulators claim ACER has been in response to a survey, the authors are well aware that a survey alone will not provide answers to the first question. However, the research did produce an interesting view of how the most active market participants feel and perceive the main institution's contribution to mar-

ket development. The authors also acknowledge that interviewees might not say what they believe in response to a certain question. For example, traders might have no particular interest in how well the internal market operates; their interest is in how profitable the market is to them and if it is highly profitable to them but the market is functioning poorly, they are unlikely to criticise arrangements that are highly advantageous to them. Regulators could also have their own reasons for giving answers that are strategically favourable to them. Nevertheless, the authors strongly believe that the conducted research brings a particular social desirability of the answers for the sector. In order to overcome the possible obstacles, such as insincere answers, the research assured the anonymity of the survey participants.

‘Science explores, technology executes, man, conforms,’ said Rifkin (2007), commenting on the necessary adjustments. Fittingly, the ultimate conclusion of this study, which examined the establishment and functioning of the EU’s internal electricity market through the prism of the effectiveness of ACER – strictly through the eyes of NRAS and traders –, is that the agency, along with the entire ecosystem that supports its operation, must be ready to make certain adjustments, necessitated by future energy trends. Nevertheless, we can confirm the hypothesis of this paper: *ACER was able to set out a consistent set of rules for the internal energy market and these rules were adequately implemented.* Whether they had the intended effects and benefits – mainly relating to providing benefits to energy consumers and to bringing market mechanisms to the decision-making process in the industry – further, quantitative, research would be required.

As Felder (2016) notes, it is necessary to understand that more time is still needed for the development and reform of electricity markets and that it is still ongoing. At the same time, it is necessary to consider that no matter how a system or market is structured, organisations or other players will always act in their interest, as is the case in any other market.

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Survey Questionnaire

Scale: ① disagree, ② somewhat disagree, ③ neutral/don't know, ④ somewhat agree, ⑤ agree.

Part 1

Does the EU have a well-functioning internal energy market?

① ② ③ ④ ⑤

If you have answered 'disagree' (1) or 'somewhat disagree' (2) to question 1: In your opinion, is the process of establishing the internal energy market still underway?

① ② ③ ④ ⑤

If you have answered 'disagree' (1) or 'somewhat disagree' (2) to the previous question: What would you say still needs to be done for a well-functioning internal energy market?

If you have answered 'agree' to question 1: Has the Agency for the Cooperation of Energy Regulators (ACER) been effective in establishing the EU's internal energy market?

① ② ③ ④ ⑤

If you have answered 'agree' to question 1: Has ACER been effective in ensuring the functioning of the EU's internal energy market?

① ② ③ ④ ⑤

Has the Agency for the Cooperation of Energy Regulators been key to the functioning of the internal energy market?

① ② ③ ④ ⑤

Part 2

In your opinion, does the effectiveness of the Agency for the Cooperation of Energy Regulators depend mostly on its director?

① ② ③ ④ ⑤

If you have answered 'disagree' (1) or 'somewhat disagree' (2) to the previous question: What would you say the effectiveness of ACER depends on if not the Agency's director?

In your opinion, does the effectiveness of the Agency for the Cooperation of Energy Regulators depend mostly on its independence?

① ② ③ ④ ⑤

If you have answered 'disagree' (1) or 'somewhat disagree' (2) to the previous question: What would you say the effectiveness of ACER depends on if not the Agency's independence?

Would you say that the independence of the Agency depends on the Agency's management?

① ② ③ ④ ⑤

Would you say that the independence of the Agency depends on the Agency's budget?

① ② ③ ④ ⑤

The recast ACER regulation that is part of the Clean Energy Package adapts the role of the Agency's director by taking away some of the director's powers in making decisions on substantive issues. The division of responsibility in decision making between the Board of Regulators and the director has been redefined in favour of the board. Would you say this is a positive development?

① ② ③ ④ ⑤

If you have answered 'disagree' (1) or 'somewhat disagree' (2) to the previous question: Why not?

If you have answered 'agree' (5): Why is this a positive development?

Part 3

Have the expectations of your organisation regarding the effectiveness of ACER in establishing the EU's internal energy market so far been met?

① ② ③ ④ ⑤

If you have answered 'disagree' (1) or 'somewhat disagree' (2) to the previous question: Why not?

Have the expectations of your organisation regarding the effectiveness of ACER in ensuring the functioning of the EU's internal energy market so far been met?

① ② ③ ④ ⑤

If you have answered 'disagree' (1) or 'somewhat disagree' (2) to the previous question: Why not?

What are your expectations regarding ACER's future activity? Please specify.

Thank you for participating in the survey.

Women in Top Management and Corporate Share Price: The Mediating Role of Management Learning


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The objective of this paper is to evaluate the relationship between the number of females in corporate top management and share value. Given the inconsistencies in previous research, this paper contributes a new model to existing literature by mediating the number of women in top management with the 'management learning' variable, which is absent in previous research models. The paper applied a panel data regression approach. Findings from the first analysis (without management learning) indicate a positive relationship (though not significant). Findings from the second analysis (with management learning into the model) show that women in top management are positively and significantly related to share value. The paper concludes that the inclusion and supporting of women in top management through management learning can create a competitive value for the organisation. The paper recommends extension of this new model in future research with more time series and more cross sectional units.

Key Words: share price, gender equity, women in top management, corporate governance, market value, management learning

JEL Classification: G1, G11, G12, G13

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Introduction

Within the twenty first century, businesses around the world have grown in profit accumulation occasioned by improvements in manufacturing technology and computerised business processes. Despite growing profits and multinational expansions, businesses are confronted with a contemporary issue of ensuring that businesses' processes align with sustainable development ideals. One of the sustainable and responsible business expectations is the inclusion of women in corporate top-level management to enhance gender equity.

Accordingly, the interconnection between sustainable development and globalisation of business has witnessed an incessant growth in the campaign for gender equality (Johnsson-Latham 2007). This has become important as part of worldwide effort for effacing gender and other forms of discrimination in business and organisational management (Kates, Parris, and Leiserowitz 2005; Grosser 2009; Roberts 2015). It is believed that global human wellbeing and economic development will be better if there is a pragmatic transition to gender inclusiveness in all spheres of human activity including corporate management (Kabeer 2016). Within the corporate sector, women have been found to occupy a smaller number of seats in top management positions than men (Johnsson-Latham 2007). This phenomenon is anti-developmental given huge talents that are endowed in women, which are suppressed by relegating women's leadership and decision making opportunities.

This research problem is inclined on continuous exclusion of women in top management, particularly in South Africa. Despite global advocacy for transition to gender equity, as of 2018, research shows that only one woman CEO appear in the top listed companies in South Africa (Mabuza 2018). Globally, as of May 2018, only 4.8% women are CEOs in the global Fortune 500 companies (Mejia 2018). Why gender discrimination against women continues in the work place is seen simply as a matter of archaic perception and stereotype with the erroneous belief that masculinity is better associated with leadership achievement (Heeraman 2016).

It is unfortunate that some organisations fail to appreciate the myriad of talent endowed in women, which are absent in entities dominated by men. For instance, research based on practical evidence shows how women are endowed with talent and wisdom to navigate and balance the world of corporate career with a successful family responsibility (Stromberg 2017). However, despite the excellent talents in women, there is a persistence of reservations in some quarters that inclusion of women in leadership might affect firm performance negatively (Shrader, Blackburn, and Iles 1997). Yet other researchers dispute the acclaimed negative effect of women leadership on firm performance and suggest that women leadership might rather improve firm performance (Carter, Simkins, and Simpson 2003; Post and Byron 2015; Glass, Cook, and Ingersoll 2016). These divergent views connote ambiguity and inconsistency in current research findings about this relationship (Shrader, Blackburn, and Iles 1997). Such inconsistencies in opinion may arise either from different methods of research and from cultural settings given existence of some

cultural stereotypes against women (Post and Byron 2015). Accordingly, academics and scholars have a role to play in helping businesses to appreciate the urgent need to accommodate and capacitate women in business leadership positions. One avenue to play this gender advocacy role is through research that identifies relationship between women leaders and business performance; this research contributes to this role.

Research on managers' performance management have highlighted the important role of management learning in enhancing performance (Den, Boselie, and Pauwe 2004; Hayes, Rose-Quirie, and Allinson 2000). However, research on women in management and firm performance has been silent about the mediating role of management learning with women in top management on share price performance. Based on this gap in research, this paper adopts a slightly different model from previous research and makes a contribution to previous studies on women in management and firm performance by including 'management learning' variable in the regression model. Therefore, the objective of this paper is to evaluate the relationship between women in top management and share price performance before and after mediating the regression model with management learning. Hence the research question is whether a relationship exists between women in top management and share price performance when mediated by management learning.

The paper is organised in four main sections. After this introductory section, the following section presents the theoretical background and a review of the related literature. This is followed by the method and results section. Thereafter, the final section presents the conclusion.

Theoretical Background: The Resource Based Theory and Women in Management

The main trust of resource based theory is that organisations, which possess strategic resources will use such resource to develop a unique competitive advantage to be ahead of its competitors (Nason and Wiklund 2018). This view believes that every organisation is endowed with a bunch of unique resources that makes them unique and competitive amongst organisations (Conner and Prahalad 1996). Hence, the organisation brings together a diverse genre of resources (Barnat 2014). Strategic management experts argue that organisations should first look inwards to see the wealth of resources that lie embedded within the company and such should be developed and utilised to a fullest extent before looking outwards (Dollinger 1999). In Barnat (2014), human resource is placed first

in the list of organisational resources, which thus indicates the vital importance of human resource in the organisation. Other resources of the firm then follow, which are the tools used by human resource to achieve the goal of the firm, these include finance, information and physical resources. These resources must be managed efficiently and effectively by an organisation manager using the four pillars of management, which are planning, organising, leading and controlling (Samson, Donnet, and Daft 2018). The human resources of the organisation are endowed with knowledge resource, which has to be tapped by managers to achieve the goal of management. The management of this knowledge is an essential part of innovation management (Roblek et al. 2014). Accordingly, the more sophisticated the pool of managers, the more the profit goal of the firm is achievable (Kavcic et al. 2015). The promotion of gender equity in the organisational management ladder helps to infuse management sophistication needed to achieve organisation goals (Subrahmanian 2004). This is because talented management is gender blind. The talent is endowed by nature and can be found in the male or female gender. This is also how diverse human resource talents are distributed equitably amongst different genders such that when gender equity is embraced in the organisation, this gives way for a better pool of talented managers with diverse characteristics to fortify the resources of the organisation and improve its competitiveness (Koyuncu, Burke, and Fiksenbaum 2006). Aside from other acclaimed unique managerial talents in women managers, research has highlighted that women managers perform outstandingly in international settings, and women managers possess appreciable interpersonal skills that often are not very common in male managers (Jelinek and Adler 1988). An empirical research confirm that women managers appear to be more collaborative and transformative (Rosener 2011), this is an important managerial leadership style needed in the transition to the 4th industrial revolution. Collaboration and synergy of smart ideas is one of the desired management qualities needed in the smart industrial age, such ideas as possessed by humans irrespective of gender, race or colour, hence the development and usage of such resources do not require discrimination of any type, hence the resource synergy theory, which highlights complementarity of skill and knowledge to achieve corporate goals (Zhu 2014).

The resource based theory is thus fundamental in this research, reason being that organisations with strategic resource apply this to create competitive advantage over competitors. Contrary to some discrimina-

tion against women leaders, empirical research has found that women are strategic resource to the organisation, because women managers possess unique skills that improve overall organisational value (Zhu 2014). But strategic resource in women can be utilised best when organisations take a bold equity step and increase the number of women managers in management positions because it is contended that when more women are involved in management, this gives way to bolstering of diverse resource synergy in the organisation (Zhu 2014). A low number of women managers in the organisation may dampen their morale and overall resource capacity given their perception of inequality in the organisation. However, if the organisation embraces the unique potential in women leaders despite their small representation, such organisations will unleash the best out of women managers and be able to see the strategic and competitive resource inherent in women managers (Zhu 2014).

Literature Review

Human capital capabilities are seen in many researches as the core behind innovative corporate economic and unique competitive growth opportunities (Nason and Wiklund 2018). This is because human capital constitutes one of the salient invaluable corporate resource (which is knowledge). Current research about the value of human capital and firm performance has advanced toward gender diversity for enhanced value creation through amalgamation of capabilities implicit in different genders (Nason and Wiklund 2018). Such value accruable from merging of different genders cannot be achievable by discriminating against women as corporate leaders, because such discrimination limits versatility and synergy of resources derivable from implicit talent endowed in different genders. This is why the resource based theory regards firms as possessing distinctive resources, which is pivotal for service and product innovations (Nason and Wiklund 2018; Barney, Ketchen, and Wright 2011; Barney 1991). Therefore, corporate internal resources such as human resources are a vital tool for improvement of overall firm performance if human resource is properly mixed (Hitt, Carnes, and Xu 2016). Accordingly, women leaders in the corporate world have been empirically proven to contribute to the overall resource wealth of companies through their unique resource skills (Terjesen, Couto, and Francisco 2016). There should be no justification for discriminating against women managers because some empirical research have found that women leaders possess managerial psychology traits on par with their male counterparts and in some cases, women

managers are found to outperform men in managerial competences and skills (Linde et al. 2013).

Hence, given the burgeoning research on firms' human resources, many scholars have thus focused on what researchers regard as the most neglected, which is allowing more women access to the top management position. Therefore, extant research has dwelt on various sub-issues pertaining to women in management and how this impacts corporate competitiveness and performance; some examined women in top management via CEO attributes (Peni 2014) and diverse financial performance implication of women in top management (Cook and Glass 2014; Ming and Hock 2016; Lückérath-Rovers 2013; Christiansen et al. 2016; Liu, Wei, and Xie 2014). These prior researches have come up with diverse methods and findings, which deserve mentioning.

Cook and Glass (2014) find a negative relationship between corporate performance and women in top management. Ming and Hock (2016) find that the number of women in the director position is what matters for firm performance, for instance, they found no evidence of relationship between females in director positions and financial value, but that a relationship becomes noticeable only when more than fifteen women are appointed to the board. The reason is that men's dominance beclouds the voice of one or few women, hence the more women there are in top management the better their impact can be felt since they support each other in solidarity to push women's strategic views to be heard and implemented (Mavin 2008).

Some other research studies on how female managers contribute to the financial growth of the firm have found that the presence of women in the companies' board of directors facilitates the financial value of the firm better than companies that exclude women from their boards (Lückérath-Rovers 2013; Peni 2014). For instance, higher female gender mix in top management of firms in Europe were found to be correlated with better return on assets (Christiansen et al. 2016). A related study in China found that inclusion of more women on the corporate board contributes to better financial success of Chinese firms, but that this performance is more pronounced for females in executive positions than independent positions (Liu, Wei, and Xie 2014). Research has also found that aside from direct relationship between women in the board on firm performance, there are also indirect benefits, for instance, it has been found that women directly increase the value of sales turnover, asset returns and ethical responsibility and that these in turn have indirect positive effects on

firm share value in the market (Isidro and Sobral 2015). Another research applied regression and event study to examine the long and short-run implication of women directors on corporate boards in Spain. Results indicate that when females are appointed to the corporate board the stock market price improves positively as participants have confidence on the performance of women directors (Campbell and Vera 2010).

This research adds to the previous existing research in a unique way; none of the previous research have integrated management learning into the model equation about role of women in top management on firm performance. The following section provides details of the method used and the findings.

Method and Results

This research analysis utilised a quantitative method because the data that were used are numerical in nature, and this is amenable to the positivist paradigm approach. Hence, this research applied the positivist paradigm wherein a relationship was sought between two independent variables, which are number of women in companies' top management, number of women with management learning and one dependent variable, which is the share price of companies. Experts believe that a positivist paradigm is used to discover the relationships amongst two or more variables in an empirical analysis (Antwi and Hamza 2015).

The research data were collected through a secondary data process from the financial statements of selected companies from the FTSE/JSE Responsible Investment Index (RI) for the period 2010/2011–2014/2015 financial years. Hence the population of study were the entire 30 top companies listed in the FTSE/JSE RI companies. Applying a purposive sampling approach, 25 companies (that had complete data on the variables of study) were selected from the 30 FTSE/JSE Responsible Investment Index. Purposive sampling is suitable when the researcher applies judgement regarding what to sample and the characteristics that best serve the purpose of the research (Barratt, Ferris, and Lenton 2015).

The data collected over the five years' period from the 25 sample of companies were arranged according to the panel data approach. Since the analysis involved data collected from different cross section units over different time series, the panel data regression became a suitable data analysis approach for this study (Hsiao 2014; Arellano 2003).

Therefore, research data were analysed using the two regression models as follows.

TABLE 1 Regression Result on the Relationship between Number of Women in Top Management and Share Price: Model 1

Item	Coefficient	Std. Error	<i>t</i> -ratio	<i>p</i> -value
const	306.011	50.6996	6.0358	<0.00001***
WINTM	26.7885	15.0103	1.7847	0.1576
<i>R</i> ²	0.406	Observations		150
Adjusted <i>R</i> ²	0.369	Cross-sectional units		25
<i>F</i> (25, 124)	9.914	Time-series length		6
<i>P</i> -value(<i>F</i>)	0.477	Dependent variable		SharePr
Schwarz criterion	2070			
Rho	0.191			
Akaike criterion	1992			
Hannan-Quinn	2023			
Durbin-Watson	2.95			

Model 1 (without management learning)

$$\gamma = \beta_0 + \beta_1\chi_1 + \varepsilon. \quad (1)$$

Model 2 (with management learning)

$$\gamma = \beta_0 + \beta_1\chi_1 + \beta_2\chi_2 + \varepsilon. \quad (2)$$

Where γ is share price, β_0 is intercept, $\beta_1 - \beta_2$ are coefficients, χ_1 is the number of women in top management, χ_2 is the number of women with management education, and ε is error.

Discussion of Findings

This analysis made use of two different models; the first model examined the relationship between the number of women in top management and share price of 25 companies in FTSE/JSE responsible investing companies. Since no previous research has considered the role of management education, the second model contributes a nuance to existing research by considering the moderating role of management learning proxied by the number of women managers holding management education. The comparative examination of the two different models in table 1 with single independent variable (number of women in top management) and table 2 which added a moderating variable (management learning) show different results worthy of noting. A closer view on values of Akaike, Hannan-Quinn and Schwarz criterion between table 1 and table 2 indicates that

TABLE 2 Regression Results of Women in Top Management and Share Price (Moderated by Management Learning): Model 2

Item	Coefficient	Std. Error	t-ratio	p-value
const	301.386	52.4709	5.7439	<0.00001***
WINTM	34.077	25.2137	1.3515	0.03901**
MgtLearn	11.5933	32.1619	0.3605	0.17912
R^2	0.666	Observations		150
Adjusted R^2	0.599	Cross-sectional units		25
$F(25, 124)$	65.91	Time-series length		6
P -value(F)	0.0041	Dependent variable		SharePr
Schwarz criterion	1000			
Rho	0.720			
Akaike criterion	802.0			
Hannan-Quinn	970.0			
Durbin-Watson	1.862			

model 2 results in a much lower statistics for Akaike, Hannan-Quinn and Schwarz criterion. Since these three statistics are used to detect a better model, it becomes clear that model 2, which has lower values for Akaike, Hannan-Quinn and Schwarz criterion than model 1 is a preferred model; this is because these statistics are widely used to decide an alternative model that provides a better linear fit (Iida, Miyata, and Shiohama 2018; Davidian and Gallant 1993). Additionally, a comparison of Durbin Watson statistics value in the two models shows which model is autocorrelation free. Model 1 has a Durbin Watson statistics value of more than 2, indicating presence of autocorrelation, but model 2 has a Durbin Watson statistics value of less than 2, which shows absence of autocorrelation, indicating independence of residuals (King 2018). In model two, the correlation test, which is represented by the rank correlation (rho) show a positive value of 0.72, indicating that more women in top management and more women with management learning do play a positive role on the value of share price. The total significance of model 2 (with two independent variables) is indicated by the F -test. The values comprise the F -critical value of 65.9 and P -value (F) of 0.004, which is lower than the research alpha value of 5% (0.05). The low p -value of the F indicates that the introduction of management learning in model two makes the model (number of women in top management and management learning) to

be significantly and positively related to share price; it can be seen that this significance of p -value is absent in model 1, hence the introduction of management learning can play a helpful role in enhancing better performance of women managers in top management. This adds to previous allusions that there is indeed a business value case for women managers (Hoobler et al. 2018).

The analysis and results in table 1 and table 2 were conducted at an alpha (α) of 0.05. A two stage analysis was therefore conducted, the first stage in table 1 excludes the management learning variable, but the second stage analysis in table 2 includes the management learning variable in the regression analysis (see also models 1 and 2). From the results in table 1, the $NOWTM$ (number of women in top management) indicates a p -value of 0.15, which is higher than the research alpha level of 0.05. This shows that the relationship is not significant. However the R^2 of 46% does show that a relationship exists between women in top management and share price (although not significant). Important to note is that the regression coefficient for women in top management shows a positive number of 26.788, which means that the women in top management is positively related to share price performance. This means that increase in the number of women in top management can increase the value of share price. The second stage analysis introduced management learning variable into the regression model to test the mediating role of management learning, whether management learning might improve the role of women in top management. The result in the second test (table 2) shows that women in top management is positively and significantly related to share value with a p -value of 0.039, which is less than the research alpha of 0.05. It can also be seen in table 2, that with the introduction of management learning variable, the R^2 (which is the coefficient of determination) value increased to 66%, indicating a stronger association with the introduction of management learning. This analysis is different from previous research as this is the first introduction of management learning in analysing the role of women in top management on corporate share price performance. It should be noted that other factors, which affect share price were held constant in order to isolate the role of women in top management and these other factors were represented by the error term in the regression model (in model 1 and model 2).

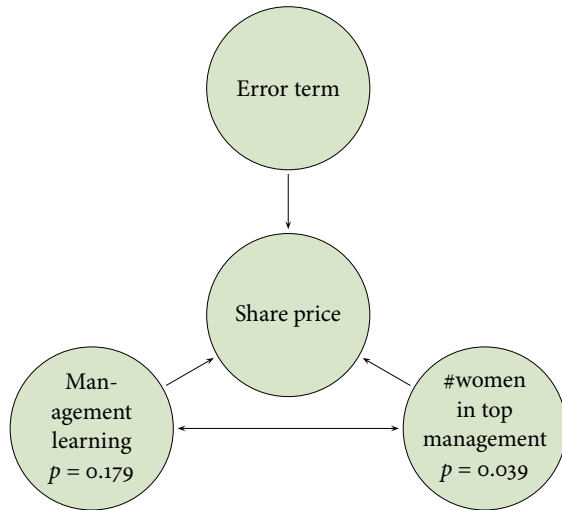
Findings from the foregoing analysis are important in motivating for gender equity in top management. At least from the share price argument, the result implies that allowing women in top management posi-

tion would not necessarily affect companies' share price negatively, rather there is the potential that the effect of women in top management might have a positive effect on share price value given the positive sign on the regression coefficients in table 1 and table 2 analysis. The result of this research corroborates the findings of Paustian-Underdahl, Walker and Woehr (2014) who found similar results that firms with more women in senior anagement are more profitable and have higher share prices. Similarly, findings from Christiansen et al. (2016) suggest that the stock market has the likelihood to react positively with improved share price on new appointments of women on the corporate board of directors. Other studies have equally opined the positive market value, returns on equity and high payout ratios associated with women on the corporate board (Ahern and Dittmar 2012). However, this result differs from a previous research that found a somewhat negative relationship between women leadership and firm performance such as Cook and Glass (2014); this might be due to methodological differences. The result of this study is limited within the number of years used and within the 25 companies studied. This research therefore serves as a first investigation using this new model with management learning and thus providing an agenda for future research to expand this research using this model. Figure 1 presents a summary framework of the model used in this analysis for theoretical and research application. Drawing from these research findings, the figure framework is that a combination of women in top management and management learning (developing the managerial skill of women through management education) can lead to improved share price. Other factors which can influence share price are represented by the error term and the error term function (for other missing variables) is allowed in statistical research (Plonsky and Ghanbar 2018). This framework can be tested and expanded by future researchers.

Conclusion

This research explored the relationship between the number of females as top managers and companies' share price by using selected corporates from the FTSE/JSE Responsible Investment Index. This paper was pertinent given existing low number of females in corporate top management in South Africa, hence this research was meant to provide empirical information for company policy makers that there is no share value disadvantage, which may arise by involving female leaders in companies' management. This paper adds to the existing literature to South African

FIGURE 1
Women in Top
Management Link with
Share Price (Moderated
by Management Learning)



studies on the value accruable from the appointment of women to top management positions, but it has differed slightly from previous research as this research focused only on stock price implication of women on top management and by adding management learning as mediating variable, which has largely not been present in previous women managers' value analyses. Hence the important contribution of this research is that it adds to existing literature by introducing management learning into the regression model, which is absent in previous research models.

A two stage analysis disclosed two different results; results from the first stage regression analysis indicate a positive relationship between the number of women in top management and corporate share value; but at this stage, the relationship is not significant in the first examination without management learning. The second test introduced management learning into the regression model to visualise the mediating role of management learning. The result in the second test shows that women in top management are positively and significantly related to share value with a p -value less than 0.05. This findings suggests that, within the sample of companies used in this research, management learning is an important factor that can enhance the role of women in top management on firm performance. It therefore means that supporting women in top management through management learning can create a competitive value for the organisation, which supports the resource based theory that human resource can produce a competitive advantage for the organisation. This

new finding makes a practical and theoretical contribution to business and the literature. The practical implication to business is that organisations can enhance their strategic value by not only including more women in top management, but also by capacitating women's managerial skills through management learning. Further, it should extend this new research model by adding more time series and by expanding the number of companies in future research. Given the current low position of women CEOs in South Africa, which stands at about only three percent (Tsako 2017), this paper recommends that the corporate world could contribute to the global transition to gender equity by appointing more women in top management positions such as in the CEO positions. There should be no fear of possibility of financial loss because previous studies and this research have confirmed that the stock market believes in the value potential inherent in women managers.

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Sources of Business Growth at Different Levels of Innovativeness: Case of Firms in EU Countries

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The purpose of this research is to explore how investment in R&D, training of employees, branding and reputation, design and acquisition of technology affect business performance measured in terms of turnover growth in firms operating in EU countries at different levels of innovation performance. This study contributes to the literature by identifying activities that lead to business growth of firms in less innovative countries for which R&D is less relevant. Empirical part of the paper relies on survey data from Flash Eurobarometer 433 (European Commission 2016). Research findings reveal rather complex story behind business growth of firms across EU countries. Impact of R&D on business growth indeed varies across EU countries at different levels of innovativeness. In countries at lower level of innovativeness business growth relies on training of employees, branding and reputation as well as acquisition of new technologies.

Key Words: R&D, training, branding, acquisition of technology, design

JEL Classification: M20, O30

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Introduction

When it comes to achieving and maintaining good business performance and business growth, R&D remains one of the most important and widely recognized activities. Literature on innovation provides rich evidence on benefits of investing in R&D. EU countries are still at different levels of innovation performance ranging from modest to lead innovators (see European Innovation Scoreboard). For several years consecutively EU countries ranked among modest and moderate innovators in the European Innovation Scoreboard (indicating rather low overall innovation performance) show rather sluggish progress insufficient for catching up with other countries. Technology gap between new and old EU member states, although somewhat reduced, remains rather considerable (Filippetti and Peyrache 2013). The progress has been slowed down during the latest eco-

conomic crisis that affected more strongly innovation investment in catch-up EU countries (Archibugi and Filippetti 2011; Makrevska Disoska et al. 2018). In addition to overall lack of R&D, East European countries are, in general, inefficient when it comes to converting R&D into productivity (Kravtsova and Radošević 2012).

Although R&D is generally considered a prerequisite to business growth, evidence shows it is more important for leader firms, i.e. firms closer to technology frontier¹ (Coad 2008) that are, in general, more prone to innovation (Gombau and Segarra-Blasco 2011). Interaction of innovation, competition and technology on firm level is affected by development of economy and the level of technology of the country (Alder 2010). Growth in emerging economies where R&D expenditures as well as returns on R&D are low is generated by high number of imitators who create competition and supply (Minniti and Lévesque 2010).

Considering these findings, R&D in technologically less advanced economies is not necessarily a generator of business growth. It is, therefore, hypothesized that firms in countries at lower level of innovativeness lack pressure to invest in R&D and consequently seek other paths to business growth. Acemoglu, Aghion, and Ziliboti (2006) show that importance of innovation relative to copying and adoption of existing technologies for productivity growth is higher for firms in countries closer to world technology frontier. However, Autant-Bernard et al. (2010) found that EU countries with low innovation capacity demonstrate weak adoption capacity as well.

Both academic literature and business practice recognize concepts and mechanisms other than R&D, that contribute to achieving superior business performance such as firm reputation and branding, quality of human capital, and design of products and services. We still lack evidence on other activities that potentially can help firms in these countries to improve their business results. This research connects literature on business performance determinants and distance to frontier theory and aims to contribute to the literature by identifying activities that lead to business growth of firms in less innovative EU countries in comparison to firms in EU countries at higher levels of innovation performance. 28 EU countries² are grouped according to innovativeness as defined by European Innovation Scoreboard 2017.³

The rest of the paper is organized as follows. Succeeding introductory section, in the second section a background literature is provided. The third section explains methodology and descriptive statistics. The fourth

section covers results and discussion while the fifth section provides concluding remarks.

Background Literature

The importance of R&D for achieving outstanding business results is well emphasized in the literature. Research findings show that R&D is crucial for long term survival and growth (Siepel, Cowling, and Coad 2015) and it has positive effects on future cash flows and market value (Chauvin and Hirschey 1993). Relationship between R&D expenditures and firm performance is somewhat more pronounced in manufacturing than in service sector (Ehie and Olibe 2010). Chen et al. (2016) show that manufacturing firms, especially those in electronics sector, benefit more from R&D investment in terms of business performance than service firms.

Wakelin (2001) argue that returns to R&D are influenced by innovation history of the firm as well as innovation history of the sector. Better-performing firms are likely to invest more in R&D (Cainelli, Evangelista, and Savona 2006; Mansury and Love 2008). They can afford continuous R&D engagement and sufficient funding for these activities that surely helps them to continue their growth. According to García-Quevedo, Pellegrino, and Vivarelli (2014) investment in R&D shows high level of persistence over time, especially in mature, well established firms.

Relationship between R&D and productivity has attracted great attention (for extensive review see Hall, Mairesse, and Mohnen (2010) and Mohnen and Hall (2013)). Productivity growth is especially evident in firms with long history of R&D investment (Hall and Mairesse 1995). Bond and Guceri (2017) found that productivity in enterprises that invest in R&D is on average 14 percent higher than in those with no R&D. When it comes to returns to R&D investment, they are generally positive and higher than returns to ordinary capital (Hall, Mairesse, and Mohnen 2010). In-house R&D contributes greatly to productivity in firms with low productivity level (Segarra Blasco and Teruel Carrizosa 2008). In young firms, R&D is more important in terms of sales growth, while in large firms it leads to the labour productivity growth (Coad, Segarra, and Teruel 2016).

R&D is also important in terms of learning and technology adoption. In Cohen and Leventhal's (1990) model, investment in R&D strengthens absorptive capacity and enables organizational learning. In countries further from technology frontier R&D investment improves ability to apply and exploit technologies developed at the frontier (Madsen, Islam, and

Ang 2010). Firms that rely on adoption of new technologies are more likely to grow but are not more productive (Koellinger 2008). Research results indicate that large investments in equipment lead to decline in productivity growth on a plant level (Huggett and Ospina 2001). New technology adoption often generates high costs as a result of lost output due to installation, replacement of complementary equipment and training of employees (Hall and Khan 2003).

Firms' effort to improve their business performance (in general or by R&D and acquisition of new technologies) is often accompanied by improving employees' skills through various training programmes. Research findings show that some firms never invest in R&D due to lack of knowledge inside the firm (Cuervo-Cazurra and Un 2010). Modifications of technologies, their adoption from external sources or even imitations are less demanding in terms of necessary skills and capabilities than development of radically new innovations and technologies.

Existing literature also suggests positive effects of human capital that occur through enabling innovation and R&D. Human capital has positive effects on innovation development (Vivarelli 2014; Dakhli and De Clercq 2004) and enables firms to overcome innovation barriers (D'Este, Rentocchini, and Vega-Jurado 2014). Skills of the employees in firm are important for profiting from R&D investment (Leiponen 2005). Moreover, adoption of new technologies also requires adequate skills. It is often accompanied by training of employees that increases probability of improving firm productivity (Boothby, Dufour, and Tang 2010). Bartel and Lichtenberg (1987) argue that government programmes designed to encourage education will stimulate adoption and implementation of new technologies in firms. Improvement of employee skills through adequate education and training is likely to increase R&D investment (Piva and Vivarelli 2009).

Apart from its importance for both innovation and adoption of new technologies, human capital is one of the most important factors that enable business growth (Haber and Reichel 2007). In fact, in Central and East European countries human capital, unlike R&D, contributes to productivity growth (Kutan and Yigit 2009). Outcomes of investment in human capital are highly important for achieving success (Unger et al. 2011). According to Goldin and Katz (2008), higher level of education is related to labour productivity increase.⁴ Technological and scientific progresses, as well as social and business changes nowadays impose need for continuous training and education in order to develop and improve knowledge,

skills and competences gained through formal education. Therefore, it is expected that investment in training of employees will contribute to achieving better business results.

From the perspective of marketing literature, one of the most important resources a firm can have is brand equity (Keller 1993; Aaker 1992). Brand equity positively affects market performance and profitability (Baldauf, Cravens, and Binder 2003). Firms that have strong brands show higher profitability (Yeung and Ramasamy 2008). Branding is imperative for business-to-consumer firms, but research results show that investment in brand development pays off for business-to-business (B2B) firms as well. Brand awareness is associated with market performance of firms operating on B2B market (Homburg, Klarmann, and Schmitt 2010) and strong brands contribute to business growth of B2B small and medium sized enterprises (Hirvonen, Laukkanen, and Salo 2016). Positive effects of strong brand on business performance are found by Wong and Merilees (2008). Even though brand represents important component of intangible assets, firms rarely develop brand metric systems that would enable them to assess contribution of brand to their business performance (Munoz and Kumar 2004).

Investment in design and design management has positive contribution to firm performance (Chiva and Alegre 2009). It leads to higher labour productivity and total factor productivity (Cereda et al. 2005). Design is recognized as driver of market success due to its potential to attract customers' attention and provide additional value to the entire experience of product use (Bloch 1995). Unique features of products (including design) are one of the most important success factors (Cooper and Kleinschmidt 1987). Moreover, design can be used as strategic tool for achieving sustainable competitive advantage in the market (Kotler and Rath 1984).

Livesey and Moultrie (2009) distinguish between design in the creation of products and services and design in promoting products or the company. Design in the creation of products and services refers to technical aspects and design of the user experience. Design in promoting products or the company incorporate design of advertising and promotional activities for specific products and services and design as part of developing, promoting, and communicating the corporate identity. The role of design has changed over time and nowadays it has different roles in new product development (Perks, Cooper, and Jones 2005). It is worth to distinguish design activities that are incorporated in new product de-

velopment (and related to product innovation) from changes in design of existing products (that are often characterized as marketing innovations). Regardless of the type, design has potential to improve overall business results. Design contributes to higher sale of new products and product innovation especially in large firms that use it throughout the development process (Roper et al. 2016). It is estimated that firms who rely on design throughout idea development, production as well as marketing and commercialization achieve the highest turnover growth rates in comparison to those who use it in one or two stages (Nevado, Barata, and Almendra 2016).

The above-cited literature testifies benefits generated by R&D, acquisition of technology, but also training, branding and design for various aspects of business performance. The remainder of the paper explores how these activities affect business growth at different levels of innovativeness. Considering extant findings from distance to frontier literature, it is expected that gains will depend on the overall innovation performance of the countries.

Methodology and Descriptive Statistics

METHODOLOGY

The empirical research relies on survey data from Flash Eurobarometer 433 (European Commission 2016) survey available in GESIS Data Archive. This survey covers responses of micro, SMEs, and large firms in manufacturing, services (including retail) and industry in EU countries.

Dependent variable in all models is turnover growth in three-year period (from 2013 to 2015). Respondents reported if their turnover in the analysed period have fallen by more than 25 percent, fallen by between 5 and 25 percent, remained approximately the same, risen by between 5 and 25 percent or risen by more than 25 percent. Considering the type of dependent variable, empirical analysis relies on ordered probit model.

Independent variables take value 1 if firms invested in R&D, acquisition of technology, training, branding and/or design from 2013 to 2015, and 0 otherwise. Apart from these variables, models control for size and sector. Relevance of R&D or any of the other five investments for business growth can depend on characteristics of industry. In order to control for sector specific factors all four models include binary variables manufacturing (NACE category C), services (NACE categories H, I, J, K, L, M, N, R) and industry (NACE categories D, E, F). Reference sector is retail.

Models also control for firm size measured in terms of number of employees. Binary variable *SMES* takes value 1 if firm employs from 10 to 249 employees while large takes values 1 if firm has 250 and more employees. Reference size is micro firms, i.e. those employing less than 10 employees.

Overall sample includes responses from 11,434 micro, *SMES*, and large firms operating in EU countries grouped in four categories according EIS methodology (For definitions see footnote iii). Firms who did not provide required information as well as those who did not know are excluded from ordered probit models. After clearing the dataset, model for modest innovators refers to 851 firms operating in Bulgaria and Romania. Sample of moderate innovators countries includes 5,639 firms from Croatia, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia and Spain. 2,756 firms from Austria, Belgium, France, Ireland, Luxembourg and Slovenia are included in the model for strong innovators. And finally, model for lead innovators covers responses of 2,188 firms from Denmark, Finland, Germany, the Netherlands, Sweden and the United Kingdom.

DESCRIPTIVE STATISTICS

Descriptive statistics shows that presence of R&D investment varies between groups of countries (see table 1). As expected, it is the lowest in modest innovators (29.38 percent). Strong and lead innovators report similar level of engagement in R&D, approximately 44 percent of firms in the sample.

The most prevalent in all groups of countries is investment in acquisition of technology. It is followed by investment in training and investment in branding. Design is more present in firms operating in lead and strong innovators countries. Descriptive statistics also shows that operating in modest innovators implies somewhat lower engagement in design activities. Investment in R&D appears to be the least implemented activity regardless of group of countries.

Cursory overview of descriptive statistics reveals that firms in analysed groups report different levels of involvement in these activities. It can be pointed out that presence of all five activities increases with the level of innovation performance (from modest to strong innovators). Descriptive statistics for lead innovators countries derogates this pattern. Compared to strong innovators countries, firms in lead innovators countries engage somewhat less in training, branding and R&D activities, but considering

TABLE 1 Descriptive Statistics: Percent of Firms that Report Investments in Three-Year Period

Item	(1)	(2)	(3)	(4)
Training	66.63	72.55	79.93	78.38
Branding	59.46	61.66	73.40	72.25
R&D	29.38	33.97	44.09	44.05
Design	45.48	47.26	54.43	61.38
Acquisition of technology	77.32	77.78	80.26	83.41

NOTES Column headings are as follows: (1) modest innovators, (2) moderate innovators, (3) strong innovators, (4) lead innovators. Based on Eurobarometer data.

these differences are small we can conclude these are rather similar. They, however, do not follow different patterns. In all four groups of countries the highest percentage of firms reports investment in acquisition of technology, that is followed by investment in training, branding, design and R&D in that exact order.

Descriptive statistics on turnover change indicate that firms operating in countries that are strong and lead innovators have performed somewhat better from 2013 to 2015 (table 2). First, percentages of firms that faced turnover fall in analysed time-period are smaller. This is especially evident in percent of firms who experienced severe decline in their turnover (i.e. more than 25 percent). In those operating in countries with strong innovation performance as well as in those that lead in innovation performance less than 3 and less than 4 percent respectively report having turnover over 25 percent lower. According to data presented in table 2, percentage of firms whose turnover has fallen by more than 25 percent in moderate and modest innovators is over 7 percent. Furthermore, in EU countries that are leader in innovation performance nearly one half of firms in the sample has higher turnover than prior year 2013.

In general, firms in countries with better innovation performance are more engaged in all five activities and perform better. However, relying on descriptive statistics only we cannot conclude on importance of analysed activities for turnover change. These results show only the presence of these activities in firms across EU countries at different levels of innovation performance. The next step of the analysis focuses on exploring if engagement in these activities contributes to business performance. To do so, ordered probit is employed for four groups of countries (modest, moderate, strong and lead innovators).

TABLE 2 Descriptive Statistics: Turnover Trends in Three-Year Period

Item	(1)	(2)	(3)	(4)
Fallen more than 25%	7.29	7.28	2.86	3.68
Fallen between 5% and 25%	15.23	15.98	14.11	11.63
Remained approximately the same	37.11	35.80	37.44	34.86
Risen between 5% and 25%	30.03	31.31	35.77	34.14
Risen more than 25%	10.34	9.62	9.82	15.69

NOTES Column headings are as follows: (1) modest innovators, (2) moderate innovators, (3) strong innovators, (4) lead innovators. Based on Eurobarometer data.

Results and Discussion

Results of the ordered probit for modest, moderate, strong and lead innovators are presented in table 3. According to these results, firms in countries whose innovativeness is at modest level can improve their business performance only through engagement in training and acquisition of technology. Results of the ordered probit indicate that firms investing in these two activities are significantly more likely to achieve better business results. Not just investment in R&D but also investment in branding and design in these countries are not associated to improved business performance. This is somewhat expected considering lower level of innovativeness in these countries. It furthermore confirms importance of enhancing employees' knowledge and skills and need for catching-up with more developed economies by adopting state-of-the art technologies developed elsewhere.

According to the results of ordered probit, only firms operating in countries of strong innovativeness benefit from R&D investment. Firms with R&D investment in these countries are more likely to have higher turnover in the short-run. Furthermore, in this case other analysed activities are significant sources of business growth. One possible explanation for this finding is in their continuous dedication to R&D and other activities. Deschryvere (2014) shows that R&D growth and sales growth are possible only for firms that innovate continuously. Adequate balance and continuous dedication to these activities including R&D is likely to lead to success in strong innovators countries.

Surprisingly, in lead innovators countries having invested in R&D activities do not affect probability of turnover growth. The same is found for moderate innovators. Firms operating in these two groups of countries improve their business performance following the same pattern. Their

TABLE 3 Results of Ordered Probit for Modest, Moderate, Strong and Lead Innovators

Item	(1)	(2)	(3)	(4)
Training	0.232 (0.087)***	0.202 (0.036)***	0.167 (0.056)***	0.212 (0.062)***
Branding	0.043 (0.089)	0.182 (0.033)***	0.149 (0.050)***	0.239 (0.057)***
R&D	0.045 (0.092)	0.001 (0.034)	0.115 (0.047)**	0.035 (0.052)
Design	0.138 (0.086)	0.081 (0.033)**	0.145 (0.047)***	0.129 (0.054)**
Acquisition of technology	0.313 (0.095)***	0.306 (0.037)***	0.180 (0.054)***	0.137 (0.064)**
Manufacturing	0.290 (0.118)**	0.038 (0.045)	0.115 (0.071)	-0.126 (0.084)
Services	0.128 (0.086)	0.055 (0.033)*	0.128 (0.048)***	0.053 (0.055)
Industry	-0.033 (0.127)	-0.048 (0.045)	0.070 (0.066)	0.036 (0.075)
SME	0.201 (0.082)**	0.200 (0.031)***	0.122 (0.045)***	-0.006 (0.050)
Large	0.264 (0.176)	0.326 (0.066)***	0.131 (0.088)	-0.059 (0.099)
Number of analysed observations	851	5639	2756	2188
LR χ^2	78.96	446.31	201.07	97.15
Prob > χ^2	0.0000	0.000	0.000	0.000
Pseudo R^2	0.0320	0.0274	0.0209	0.0158

NOTES Column headings are as follows: (1) modest innovators, (2) moderate innovators, (3) strong innovators, (4) lead innovators. Based on Eurobarometer data.

turnover growth is enabled by investment in improving employees' skills, branding and acquisition of technology. While it is relatively easy to explain no relationship between R&D and business performance in countries whose innovativeness is at lower level, this finding for lead innovators model is more difficult to comprehend from the perspective of distance to frontier approach. One possible explanation is that most of the firms in lead innovators countries invest high amounts of money in complex R&D projects and radical innovation development whose positive effects are not likely to occur in short-run. This can be also relevant for young firms who started their R&D project in recent years. Improved

business performance can be more evident in innovators with continuous engagement in R&D, especially if their innovation portfolio consists of radical and incremental innovation projects. Extant findings show that the best effects are achieved by continuous involvement in both radical and incremental innovation projects (Sandvik and Sandvik 2003). Lack of significant relationship between R&D investment and business performance in lead innovators can be also related to their R&D management and R&D strategy, as well as various characteristics of their R&D projects. Unfortunately, available data do not allow more detail analysis. At this point it can be concluded that the results clearly point to the nature of R&D projects for generating business growth.

As for investments in training, branding, design and acquisition of technology in firms operating in moderate, strong and lead innovators countries, they are all significant predictors of turnover growth. Firms that report investments in these activities in the three-year period are significantly more likely to report turnover growth. The findings testify that training and acquisition of new technologies are associated to turnover growth regardless of overall innovation performance of the country.

Research findings support the hypothesis on importance of R&D for business success at different levels of innovativeness. As expected, and in accordance with previous research findings, R&D is not found relevant for turnover growth in firms operating in less innovative countries. The contribution of this analysis is in identifying other activities that lead to higher turnover growth. For firms in the countries at moderate level of innovation performance those include investment in training of employees, branding and reputation as well as acquisition of new technologies. Investment in design is found relevant for improving business growth at higher levels of innovativeness as well. The most puzzling finding that opens a venue for future research is the same pattern of growth in moderate and lead innovators.

As for the sector, models show that turnover growth is more likely in manufacturing firms in modest innovators and service sector in moderate and strong innovators. SMES in all groups except in lead innovators were more prone to improve business performance. The same is relevant for large firms in countries that are moderate innovators. In other cases, sector and size variables are not significant.

The results in general show that R&D is not significant driver of business growth at lower levels of innovation development. Findings for lead innovators clearly reveal that relationship between R&D and business

growth is rather complex and depends on the nature of the projects. As the available data did not enable us to explore this in more detail, this remains beyond the research scope. However, better insight into R&D potential to induce business growth can be provided by analysing marginal effects after ordered probit. Marginal effects indicate how the decision to invest in R&D (and other analysed activities) affects probability of turnover growth (or fall) in each category. For that purpose, focus is first on strong innovator as only in these countries R&D is significantly related to better business performance.

Marginal effects after probit for strong innovators models show that investment in R&D increases chances of having turnover growth between 5 and 25 percent by 2.6 percent. (Marginal affects after ordered probit available from the author on request). Turnover growth over 25 percent is 1.9 percent more likely if firm invests in R&D. In comparison to other activities included in the analysis, R&D investment contributes less to turnover growth. For instance, acquisition of new technology is associated with being 4.3 percent more likely to have turnover growth between 5 and 25 percent and 2.8 percent more likely of having an increase higher than 25 percent.

In fact, acquisition of technology, the only variable that is significant in all four models, is the most important contributor to turnover growth in modest, moderate and strong innovators countries. For modest innovators investment in acquisition of new technology increases likelihood of 5 to 25 percent turnover growth by 7 percent. It also increases chances of turnover growth over 25 by 4.3 percent. Firms in moderate innovators countries that acquire new technologies are 7.2 percent more likely to experience 5 to 25 percent turnover growth and 4.3 percent more likely of turnover growth higher than 25 percent.

Situation is somewhat different when it comes to lead innovators. Firms in these countries benefit the most (in terms of turnover growth) from investment in branding. It is associated with 4.2 percent of being more likely to grow 5 to 25 percent and 5.4 percent to grow more than 25 percent. Acquisition of technology contributes to turnover growth 2.4 percent and 3.1 percent, respectively.

Concluding Remarks

Results of this research confirm some of the previous empirical findings on importance of R&D for improving business performance at different levels of innovation performance and technological development. Firms

in less innovative countries (countries further from technology frontier), but surprisingly also those at the top of innovation performance, will not benefit from R&D. They are likely to improve their performance by investing in adoption of existing technology instead of investing in R&D and development of new technologies. Extant findings indicate that investment in R&D as well as its importance for generating growth will improve as the overall performance improves. The main point is how to improve overall development level to the point when investment in R&D starts generating growth. The findings in this paper contribute to the literature by identifying other activities (besides adoption of existing technology) that can help firms to improve their business results and build adequate innovation capabilities. This raises issue of not just quantity but also the quality of R&D in firms in less innovative countries. If these activities are sporadic, not well-organized and adequately supported they will fail to contribute to business performance.

Depending on the level of innovativeness of the country, firms will benefit if they focus more effort and funds on other activities. Lower level of overall innovativeness in these countries indicates also lower pressure for firms to invest in R&D, develop innovation and grow. For firms in countries at the lowest level on innovation performance investment in training and acquisition of technology is likely to give good impulse. Somewhat improved overall level of innovation performance makes also branding beneficial for generating higher turnover. Design investment becomes important for business growth at higher level of innovation performance. This is important finding for both managers of firms operating in respective countries as well as policy makers especially for those in countries aiming to improve innovation and overall performance. Too much effort on R&D investment evidently will not pay in the environment that lags in terms of technological development and innovation performance. The focus should be on empowering growth by training and acquisition of technology as well as branding.

These findings reveal rather complex story behind innovation across EU countries. Building truly innovative society that rests on creativity and development of new technologies requires more than R&D. For managers as well as policy makers in EU countries these findings provide useful input for innovation strategies and policies. Stronger emphasis should be on activities that ensure growth at the particular stage of innovation performance. This, however, does not mean that R&D should be completely neglected and abandoned by firm operating in countries at lower

level of innovation performance. It just indicates that gains from R&D in most of the cases will not be as high as expected. Investment in R&D is part of broader picture of growth (both business and economic) and has potential to contribute to success in other aspects.

These research results are also useful for understanding why innovation performance of some EU countries still lags despite efforts and measures designed to improve it. Measures that focus on R&D only help firms to finance and carry on their innovative projects. However, these project in given circumstances will not result in improved business performance nor they will empower firms to continue their R&D activities. Therefore, efforts should be made to support not just R&D but also other activities relevant for generating higher turnover at given level of innovation performance.

One of the limitations of the study refers to the fact that data on investments in analysed activities and turnover growth refers to the same time-period. As in many studies on R&D and firm performance, the problem of establishing temporal sequencing (Boulding and Staelin 1995) is present in this case. Concerning there is no time lag between investment and turnover, the results show immediate effects.

Models in this research include only binary variables (i.e. if firms invested in analysed activities or not). Likar, Kopač, and Fatur's (2014) research result show significant differences in R&D expenditures and business performance between innovation leaders and innovation followers. Therefore, interesting venue for future research is how the amounts of investment in any of the analysed activities influence business growth. It would be interesting to see if those that invest more in R&D and other activities are able to grow more or even faster.

Notes

- 1 Distance from technology frontier has been first introduced in studies on innovation and productivity growth on country level (e.g. Acemoglu, Aghion, and Ziliboti 2006). However, the concept is equally applicable and often used in studies on firm level (e.g. Alder 2010; Gombau and Segarra, 2011).
- 2 UK included as the data refer to the time period when UK was EU member state.
- 3 The European Innovation Scoreboard (EIS) assess research and innovation performance of the EU Member States and selected countries. The analysis in this paper relies on 2017 edition of EIS. Indicators used in EIS 2017 refer to data for years 2014 to 2016. In EIS 2017 countries were grouped as

- follows: Modest Innovators – performance below 50% of the EU average (Bulgaria and Romania), Moderate Innovators – performance between 50% and 90% of the EU average (Croatia, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia and Spain), Strong Innovators – performance between 90% and 120% of the EU average (Austria, Belgium, France, Ireland, Luxembourg and Slovenia) and Innovation Leaders – performance is more than 20% above the EU average (Denmark, Finland, Germany, the Netherlands, Sweden and the United Kingdom). More information on EIS methodology and innovation performance of EU member states is available on http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en.
- 4 Human capital defined as the stock of skills and knowledge possessed by an individual (Burgess 2016) is often associated to education level, namely formal education.

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Data Mining Based Classifiers for Credit Risk Analysis

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In order to pay back the principal borrowed from the depositary bank, the interest collected by principal creditors will be collected. In this paper, we have presented the main classifiers which are used in credit evaluation. From the research, we have noticed that there are some classifiers who find application in the credit allocation decision. Credit risk assessment is becoming a critical field of financial risk management. Many approaches are used for the credit risk evaluation of client data sets. The evaluation of credit risk data sets leads to an option of cancelling the loan or refusing the request of the borrower, which requires a detailed examination of the data set or of the customer's data. This paper discusses various automatic methods of credit risk analysis used for the estimation of credit risk. The data mining method was defined with the emphasis on different algorithms, such as neural network, and as the most widely employed approach for credit risk analysis.

Key Words: banking loan analysis, classifiers, credit risk analysis, machine learning, data mining

JEL Classification: E51, G21, G32, H81

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Introduction

One of the most important and crucial procedures for banks is the loan allocation mechanism for approving requests for loans. This vital process consists of the compilation, review, and final credit evaluation of the different factors used to determine credit applications from sources such as credit application forms, interbank data exchange, credit office information, and the relevant in-bank information (Brown and Zehnder 2007).

In the conventional assessment approach, banks accept or decline applications from commercial and/or retail customers, typically discretionary judgments of credit allocation specialists. The 'credit scoring

technique' or more generally referred to as the 'Scorecard' is also an approach for evaluating requests for loans. The scorecards would estimate the probability that the borrower will repay the credit he/she requested and address the issue of whether or not the loan fails at any time. An application scorecard is generated in terms of credit risk based on previous statistics, by classifying it as either good or bad. Applications for past loans are analyzed to classify characteristics that have a substantial effect on the discrimination of good and bad credit risk applications (Anderson 2007). The advantages of using credit allocation scorecards can be summarized as better decisions, quicker and easier, more logical loan choices, observable risk management and decreased transaction costs.

Data mining is a major area of research, aiming at the collection and analysis of large amounts of data with machine learning. Data mining is currently popular in the banking sector, as there are successful analytical techniques for identifying knowledge related to credit scores. The primary goal is to exploit a huge amount of information available in databases to make key decisions (Hamid and Ahmed 2016; Sudhakar and Reddy 2014).

Decision making is an important element in the selection of lenders with a lot of information and experience. Identifying less risky borrowers is key to good credit scores. The financial sector is not only unpredictable, but it is also very competitive (Altman 1968). The possibility of failure to provide the desired results is significant for lenders, and lenders must take adequate measures to remedy the situation and mitigate the risks in order to obtain favorable debt payment (Akkoc 2012). The selection procedure for lenders can contribute to the identification of good lenders who have the willingness and capacity to repay debt during the fixed payback period. Any of the credit scores approaches currently in operation are criticized for failing to address the lender's ability to repay the debt at reduced risk within a specified time (Chen et al. 2012).

The debtor is obliged to pay the principal and additional interest if a loan has been issued by a bank or a financial institution. The most significant factor is the amount borrowed and the interest rate of the bank. Loans are typically secured or not secured. A loan secured requires a loan obligation for an estate, such as a car, home, etc. If the borrower makes an error or fails to repay the loan, the lender is entitled to the estate. The unsecured credit option is not preferred, nor is it common. If the creditor fails to repay the unsecured loan, the lender has no right to withdraw anything.

When a customer loan is accepted, the bank first reviews the customer profile and documents. Each bank has a credit score for each customer, represented as numbers based on the borrower's credit file (Chopde et al. 2012). Credit scoring is a compilation of a variety of functions, mechanisms, and requests which must be considered in full (Hájek 2011). Accordingly, credit funding decisions in such situations are challenging and complex (Malhotra and Malhotra 2003). Systems are therefore important to describe such complex scenarios. The findings show that the implementation of certain decision-making parameters will make it easier to answer these questions (Louzada, Ara, and Fernandes 2016). Some models such as furrowed logic, deep neural networks, and decision tree models specifically consider and identify the underlying connections, such as operational risks. Additional techniques such as fuzzy sets or computational models are increasingly being used in credit score, alongside the multi-criterion approaches. These instruments were included in the decision-making of the lender to deal with the financial risk aspects. The ability of these instruments to resolve ambiguity makes it possible for the lender to address the issues in a manner not protected by traditional approaches (Zurada 2010). This method is referred to as a loan assessment that takes time but is typically a binary decision resulting in approval or refusal. The credit process fails under the circumstances that are at the core of the bank. The two main reasons for the need for an expert support system are the absence of accurate methods of measuring the lack of public credit risk system and credit risk in many banks (Sudhakar and Reddy 2014).

There are many risks associated with bank loans, for the bank and for those who get loans. The risk assessment of bank loans should be understood as the nature of the risk (Sudhakar and Reddy 2014). Credit risk is the risk that the loan will not be repaid on time or at all; liquidity risk is the risk that too many deposits will be withdrawn too soon, leaving the bank short of immediate cash; and interest rate risk, the risk that interest rates on bank loans will be too low to earn the bank significant funds (Hamid and Ahmed 2016).

In ranking candidates in both good and bad grades, the banking system tests the reliability of the data sets. Applicants in the good groups are more likely to repay the cashback to the bank. Applicants in the bad class seem unable to return cash to the bank and are thus defaulting on loans. Various forms of credit risk management approaches are used to minimize the defaulter rate of credit data (Bask et al. 2011). Even with a slight

improvement in the accuracy of the loan assessment, major losses may often be minimized. The benefits of a reliable credit risk dataset are that the cost of credit ratings is minimized, excellent decision-making takes less time, and the risk of borrowing is avoided. Since credit risk assessment plays a key role in the banking sector and is very important and a major challenge facing banks, the correct classification of credit information in order to avoid economic losses plays a significant role. The decreased default rate in the non-reliable credit risk data set gives inspiration to this sector (Pandey et al. 2013).

In the following, in the second chapter are presented algorithms for credit risk analysis, divided in categories: Classification Algorithms, Grouping Algorithms, Neural Networks and The combinations of Classifiers. In the third part is presented the utilization of data mining algorithms for credit risk analysis also divided in categories like the second chapter. In the fourth part are presented Discussion, Implication, and Conclusion.

Algorithms for Credit Risk Analysis

For the better and more reliably analyzed credit risk, different kinds of methods are used for the evaluation of credit datasets.

CLASSIFICATION ALGORITHMS

Bayesian Classifier. The Bayesian network is referred to as the belief network. Bayesian is an acyclic direct graphic or Directed Acyclic Graph statistical model (Pandey et al. 2013). Each graph node displays a random variable in which the edges reflect the respective variable's functions. This is based upon the presupposition that the decision problem is formulated in probability terms, and that all applicable probability values are generated by the decision theory.

The Bayesian model is one of the most common test methods used in data mining. Coined by Thomas Bayes (1763) and complemented by Pierre-Simon Laplace (1812) in a paper published two years after his death:

$$P(h|d) = \frac{p(D|h)P(h)}{P(D)}, \quad (1)$$

where $P(h)$ is the prior probability of hypothesis h -prior, $P(D)$ is the prior probability of training data D -evidence, $P(D|h)$ is the probability of D given h -likelihood, and $P(h|D)$ the is the probability of h given D -posterior probability.

Naïve-Bayes Classifier. It is a simple probabilistic classification based on Bayes theorem. This classification is called naive because it assumes that one class is independent (Pandey et al. 2013; Huang, Chen, and Hsu 2004). Another important classification variable is necessary for the Naïve Bayes Classifier, a small number of data to calculate parameters such as mean and variance.

There are several types of Naïve Bayes Classifiers:

- *Multinomial Naïve Bayes* is primarily used for issues with document classification, i.e. whether a document is a sport, political, technical etc. category. The features/predictors used by the classifier are the frequency of the terms present in the text.
- *Bernoulli Naïve Bayes* is similar to the naive multinomial bayes, but Boolean variables are the predictors. The parameters used to predict the class variable only take value Yes or No whether a word is present in the text or not.
- *Gaussian Naïve Bayes* When the predictors are continuous and non-discrete, it is concluded that the values from the Gaussian distribution are being sampled.

Bayesian Belief Network. The chain rule states that a Bayesian Network represents the general distribution of all variables represented by the Directed Acyclic Graph. For each node of the network, it is possible to measure the margins and conditions of probabilities.

A Bayesian Network consists of stochastic nodes that are either unknown, unknown or latent variables, which can be observed. In the first case, the distribution of the node is indicated by the distribution of the observation error or the distribution of data, while in the other case pre-dispositions for the nodes are defined. Each node has a subset of the other nodes that affect the respective distribution. The Bayesian networks have their relationships to decide the nodes and the network is a directed acyclic graph. A node relies only on its nodes of the 'parent.' Bayesian networks therefore have a local property in Markov. Because of its parent, each node is dependent on other nodes.

Decision Tree. The Decision Tree is a model for mapping the comment on a branch element to achieve a target in leaves. This is one of the supervised techniques best monitored. This learning method marks each internal node or non-leaf node with an input function. A class or probabilistic class distribution is available to each leaf node in the tree (Bask et al. 2011;

Curran and Orr 2011). The branches between the nodes indicate potential values in these characters, while the terminal nodes indicate the ultimate value of the factors to be observed (Wang, Wang, and Lai 2005).

Binary Decision Trees. Non-linear multi-stage classifier are binary decision trees. This classification scheme functions until the right class is identified by sequentially rejecting classes. The feature area is divided into regions that fit the various groups. When large numbers of classes are provided this classification system will be highly useful. The tree is searched sequentially and a decision is taken on the form $x_i \leq \alpha$, with x_i being a function of the axis, and α being a threshold value, in each node. This processing scheme is an important part of many tree-based vector-quantification algorithms. The processing scheme is a key component of the measurement period

Fuzzy Decision Tree. Fuzzy decision tree is one of the most common data mining and machine learning algorithms. The decision tree is called a tree structure classifier, where each node is either a leaf indicating the target value attribute (class) or a decision which specifies for each potential result one branch and sub-tree (Wang, Yeung, and Tsang 2001).

Support Vector Machine (svm). The support vector machine is another supervised learning method testing data with a corresponding learning algorithm for classification and regression. svm constructs a high- or infinite-dimensional plane or set of hyper-planes that can be used for classification, regression and other tasks (Chorowski, Wang, and Zurada 2014). svm was first introduced by Vapnik in 1995 for machine learning and proven its usefulness in several fields. A good distance from the closest training information point (functional margin) accomplishes a good separation (Danenas and Grasva 2015). The greater the margin, the lower the classification mistake (Huang, Chen, and Hsu 2004). svm is useful in text and hypertexts, as its implementation can substantially reduce inductive and transductive requirements for labeled training instances (Hearst et al. 2008). The svm can also be used to classify pictures. Many experimental results indicate that svm is more reliable than conventional query refinement (Hui and Yang 2011). svm can be used to identify handwritten characters.

The decision function $f(x)$ is given by:

$$f(x) = \text{sgn}(w, x + b). \quad (2)$$

To compute optimal hyper-plane the optimized problem is to be solved;

minimization $1 \div 2\|w^2\|$, subject to: $y_i = ((w \cdot x_i) + b - 1) \geq 0$. The margin of hyper-plane $= 2 \div \|w\|$ equivalent optimization is:

$$\sum_{i=1}^l y_i \alpha_i = 0. \tag{3}$$

GROUPING ALGORITHMS

K-Nearest Neighbor (KNN) is the non-parametric regression and classification method. This involves a favorable and unfavorable package of preparation. It is also called the lazy algorithm. It does not use any data point for generalization (Islam, Wu, and Ahmadi 2007). This ensures that the training stage is really quick and all knowledge is stored. All training data are required during the test process. A measured distance is used to assess the size of a training data collection (Huang, Chen, and Siew 2006). For the valued entrance variable, the most common Euclidian distance is used.

Euclidean distance is calculated as:

$$d(x, y) = \sqrt{\sum_{i=1}^n (x_i - y_i)^2}. \tag{4}$$

However, other distance or resemblance metrics such as Minkowski Distance, Jaccard, Simple Matching Coefficient, Cosine Similarity etc. can be used depending on the data collection.

With KNN regression, a median or average of most similar *K* cases is used to forecast. In the majority of comparable cases where KNN is used for classification, KNN may be computed as a class at the highest frequency. It is expected that each case will vote for its party and the group that has the largest number of votes.

The classifier determines the *K* points in the data nearest to x_o , given that the positive integer *K* and a test observation are carried out. Thus if *K* is 5, five observations nearest to observation x_o are identified. Usually these points are shown by N_o . The KNN classifier then calculates the conditional likelihood for class *j* as a fraction of the observation points in N_o . This is expressed mathematically by:

$$Pr(Y = j|X = x_o) = \frac{1}{K} \sum_{i \in N_o} I(y_i = j). \tag{5}$$

It is no surprise that altering *K* results vary drastically. If $K=1$ is minimally restricted, KNN models can generate low bias, but high variance. $K=1$ is not limited. As the number *K* increases, the classifier's flexibility

is reduced and the decision limit is increasingly linear. These models are low variance, but highly predictive. Both of these models don't work particularly well on a test accuracy basis, so we need to find a model with a well-balanced varying and bias.

K-Means is an unsupervised learning technique used when information is given unlabeled. The objective of this algorithm is to find groups with the number of K groups in the details. According to the specification, the algorithm assigns one K -group to each data point (Curran and Orr 2011). The K -cluster centroids can be used as low-marked data and labels for training information. This algorithm displays a number of functional vectors as an aggregated dataset. The quantity of seed by k selects randomly as a cluster base. Assign the cluster's closest data point.

K -Means is among the most popular clustering algorithms with its enhanced version K -Medoids. Their drawbacks, however are that before the algorithm is used the number of K clusters must be known, algorithms sensitive to surface, noise, and the initial location of the centroids significantly affects the algorithms outcome. It should be noted that clusters cannot be used to predict credit rating (or any other prediction). Instead they are generally used as a pre-processing step for data mining in accordance with a supervised classification algorithm.

NEURAL NETWORKS

Artificial Neural Network. An artificial neural network is a group of neural networks linked to one weighted node (Dhaiya and Singh 2016). Each node can replicate the neuron of a creature, and the synaptic interactions between these nodes are the same. The neural network consists of three layers, the input, hidden layer and output layer, defined as a multi-layer perception (Olafsson, Li, and Wu 2008). In the MLP, the layer network, connected as an input unit layer to the hidden unit layer, is connected to the output unit layer.

Multilayer Perceptron. MLP consists of the input, output and one or more hidden layers between them (Chen and Huang 2003). It interconnects each layer entirely. The processing part is called nodes that function as a neuron, except for the input layer for each layer. Any node in one layer in the next layer is connected by weights with another node. Non-linear activation is available in many neuron layers. The network will learn from these layers the relation between input and output vectors. The input nodes are entered and the result nodes are released. This is referred as

front propagation only. Interestingly enough, back-propagation is a training algorithm where the values are forwarded, the error is measured and replicated back to the previous stages. In other words, forward spreading is part of the back spreading algorithm, but is performed before the node signals are propagated again.

Extreme Learning Machine (ELM): ELM is designed by Huang for widespread feedback networks with one hidden layer (Chen and Huang 2003). ELM randomly selects the hidden node parameter, which can describe a network as a linear system (Huang and Zhu 2006). ELM tends to meet minimal exercising defects, resulting in effective broader use and minimum weight requirements. ELM is easy to learn and provides excellent generalization efficiency in many real and artificial applications (Zhou et al. 2012). ELM is a modern and efficient single-layer feedback network training algorithm. Given N distinct training samples $(x_i, t_i) \in R_n * R_m, (i = 1, 2, \dots, N)$, the output of an SLFN with N hidden nodes can be represented by:

$$O_j = \sum_{i=1}^N \beta f_i(x_i) = \sum_{i=1}^N \beta f(x_j; a_i, b_i), j = 1, \dots, N \quad (6)$$

where, O_j is the output vector of SLFN with respect to input sample x_i . $a_i = [a_{i1}, a_{i2}, \dots, a_{in}]T$ and b_i are the learning parameter generated randomly of the j th hidden node that is $\beta_i = [\beta_{i1}, \beta_{i2}, \dots, \beta_{im}]T$ is the link connecting the j th hidden node and the output node. $f(x_j; a_i, b_i)$ is the activation function of the original ELM.

THE COMBINATION OF CLASSIFIERS

A group of independently qualified simple classifiers is part of the group of classifiers. The basic classifiers are chosen to create a classifier. The new cases are classified collectively by voting and the invisible ones. The vote may be weighted or not. In a mixed classification, the basic classifiers are combined to achieve greater output than the single classifier. Various aggregation methods used to improve the classification accuracy. Like regression, individual trees can be grouped and tuned as ensemble patterns. Multiple trees are grown simultaneously by using ensemble methods. Individual trees have a high variance but low bias. The variance of the ensemble system is typically significantly reduced when combining the expected values of the individual trees.

Bagging, boosting and random forests are the most aggregation methods (Pandey et al. 2013).

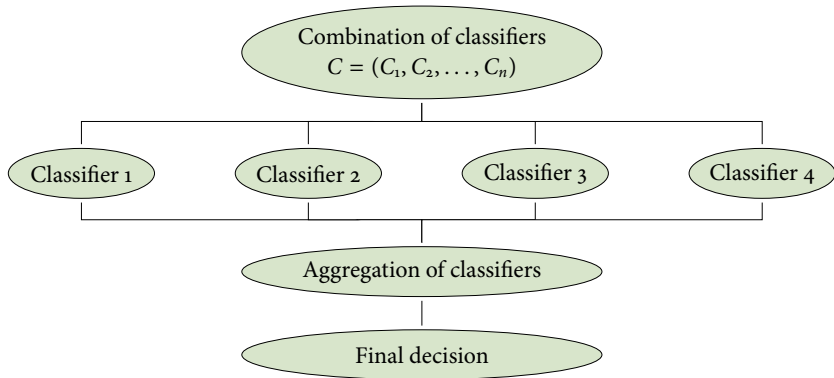


FIGURE 1 The Mathematical System of Combination of Classifiers

The mathematical system of combination of classifiers: a combination model of several classifiers in is presented in figure 1.

The $C = (C_1, C_2, \dots, C_n)$ are a sample of n -dimensional classifiers with different attributes. The classifiers can be different or same type of classifier with different attributes.

Bagging. The Bagging method was developed in 1996 by Breiman (Hui and Yang 2011). This is a meta-algorithm for machine learning designed to improve the reliability and accuracy of machine learning algorithms used for classification and regression statistics. It contributes to reducing suit. The bagging is an average type approach. The comparable classification is chosen primarily as a simple bagging classification. With bagging, by separate training sets of the same size and sampling of the training sets ‘with replacement’ can produce distinct decision-making structures (Jain and Kumar 2007).

Boosting. Boosting is an integration technique, trying to add new models which succeed when previous models are lacking (Pandey et al. 2013). Increasing the variance is not the goal. It is ideal for designs with high biases and low variance. Most of the stimulating algorithms are a weak classification and add to a high ranking (Huang, Chen, and Siew 2006). The boosting produces a classification ensemble through the re-evaluation and cost-function or majority vote of the training data kit.

Random forests: Random forests also use the construction of multiple classification trees based on bootstrapped training samples similar to bagging. However a random sequence of predictors is picked from the whole set of predictors for every split in a tree. Usually, the size of the

random subset is the square root of the number of features. The division can only be chosen from the randomly selected predictor sub-group. A new predictor sample is taken on each split, so that the majority of predictors cannot be taken into account on each split. This method decreases the association of the individual trees.

Utilization of Data Mining Algorithms for Credit Risk Analysis

CLASSIFICATION ALGORITHMS

The efficiency of the bank's credit portfolio is in line with the Bank's competitiveness and profitability. The efficiency of the bank's loan rises with the number of highly credible customers. The key decision support system used to test the credit ratings of the applicant is the credit rating. Therefore, the credit score can be defined as the modelling method of credit ratings for the applicant (Crook, Edelman, and Thomas 2007).

The credit scoring literature includes different meanings. The statistical methods are used to direct the choice of a loan that transforms the related variables of the loan into numeric action (Anderson 2007). Malhotra and Molhotra (2003) have identified them as an analytical model that has empirically established data from previous applications to predict applicants' reputation using the default probability.

The roots of the scoring systems can be traced to the 1930s when some postal companies started to use an evaluation system to eliminate differences between loan analyses. Because of the important responsibility that credit analysts had to provide military services during the Second World War, the management of the credit risk was a concern for businesses operating in the financial sector. Therefore, businesses needed analysts to write down the loans they used. These guidelines were used by non-experts to help companies enforce their loan decision processes and to control their expert systems (Thomas, Edelman, and Crook 2002).

The scholarly literature on credit scoring dates back to the 1940s when Durand published his work outcomes in order to detect credit factors which significantly affected a good and bad classification of loan applications based on the concept of loan scoring 'same characteristics could be used in separation of the groups within the same group' (Durand 1941).

Altman (1968) used a biased appraisal methodology by using information from companies operating in the United States – manufacturing sector. He has developed a general accuracy model in his research to forecast the company's failure.

Since banks supply a wide range of items, the number of credit applications has greatly increased. The huge demand growth in the banking sector has led to higher applications for credit scoring. Banks have begun reviewing almost all use of mortgage loans, credit cards, small business loans, and domestic loans (Emel, Oral, and Yolalan 2003).

Beaver (1966) submitted a survey to examine potential bankruptcy predictors. He showed statistically that many loan variables were primarily used to determine the risk of bankruptcy.

As the early credit rating models for approved applications took note of only the historical data, the consistency of the rejected applications could not be known. Feelders (2000) applied accepted and rejected applications to construct a mixture model and has shown that when rejected applications are included the performance of the model dramatically improves.

The banks used credit scores for residential mortgages and small business loans in the 1980s by doing a good review of credit card application methods (Thomas, Edelman, and Crook 2002). There have been so many applications that the conventional approach in which a loan specialist has reviewed the applications one by one has become economically difficult to implement. Both credit applicants' and banks' willingness in the fairest time to review applications encouraged banks to use credit scoring in evaluating credit applications (Lewis 1992).

Banks are concentrating more on conducting many observational experiments to benefit from the already efficiently applied classification methods. This helps them to distinguish between good and bad credit applications and build strategies that optimize the benefits of new and existing customers (Finlay 2010).

The credit score system uses a prior credit record to obtain a quantitative model to determine loan applications for separation of approval or refusal. Both credit rating applications in the credit rating system are continuously covered by the credit evaluation criteria. With the credit scoring system, credit decisions can be made promptly. Moreover, credit scoring maintains improved customer satisfaction due to the brief timeframe taken to complete the loan request. It can also provide a comprehensive approach for assessing success (Nisha 2017). One of the best business predictive applications is the credit score model (Bailey 2004).

There have been many quantitative methods in the literature for credit scoring. Although these approaches have problems modelling complex economic systems, they are based on fixed characteristics and statistical assumptions, several statistical methods exist for the evaluation of

credit risk. Studies comparing statistical methods and methods of machine learning for assessing credit risk have shown that machine learning techniques are better than statistical methods (Saberi et al. 2013).

The risk assessment of credit by nature is a problem of classification. Harris (2013) presents a bilateral classification technique for quantitative assessment of credit risk using Support Vector Machines (SVM). The study applied the SVM technique using both large and narrow data when widths are less than 90 days and narrows over 90 days. The comparison of the models' performance showed that the models developed using narrow data outperform with broad data. Danenas and Garsva (2012) presented another research using SVM in order to assess SVM credit risk in association with the selection of development parameter.

GROUPING ALGORITHMS

A decision on credit allocation requires a precise decision support system since even a slight improvement in accuracy is a huge financial saving for financial firms. Credit scoring is the most widely used method that enables lenders to make decisions about credit allocation. The goal of clusters is to group patterns based on a criterion of similarity (or dissimilarity) in groups (or clusters). Because it can be easily and quickly used, *K*-means is a famous clustering method (Saritha et al. 2010; Gholamiana, Jahanpourb, and Sadatrasoul 2013).

NEURAL NETWORKS

Useful research, which showed superior efficiency compared to statistic loan assessment models conducted by Sousa, Gama, and Brandao (2016) suggested a fresh dynamic structure for credit risk assessment. The technique comprises of sequential knowledge through the implementation of new information that enables the projections to be adjusted with changing information volumes.

Bekhet and Eletter (2014) have introduced artificial neural network models for Jordanian corporate banks' lending decisions. The radial function model was used in the neural network model, rather than the logistic regression. Although the neural network model is less reliable in general, the authors have found that the default alternative is more efficient when recognizing clients.

In Akkoç's work (2012) which utilizes statistical techniques and neuro-fuzzy, the adaptive neuro-fuzzy inference system (ANFIS) is presented as a model for credit scoring. The efficient use of international bank credit

card information, linear discrimination analysis, logistical regression and the artificial neural network have been evaluated against this suggested model. The overall right classification rate and the expected error cost were lower with the ANFIS technique.

THE COMBINATION OF CLASSIFIERS

The Bavarian Method and two-stage regression trees process (Kao, Chiu, and Chiu 2012) have developed a template that involves two techniques. The first step is to build a hierarchical Bayes model for customers that represent reimbursement choices and credit usage behavior. These predicted customer performance results are used as an inscription into the CART algorithm in the second level, as are client credit reports and demographic information.

The results of the CART are used to draw up policy guidelines in order to decide whether applicants are to grant loans, define loan limits, the annual performance rate and other levels of bank items. Based on these findings, the authors conclude that a cardholder's credit report is the most explanative of credit scoring and demographic variables are less relevant as they are less successful in credit score.

Regression is one of the well-known and robust approaches used in the literature for credit scoring and evaluation. Van-Gool et al. (2012) applied a logistic regression in the evaluation of applicants' features and the characteristics of loans and of the branches and credit officers. The applicant assessed the socio-economic attributes, the loan characteristics and experiences of credit officers in another logistics regression inquiry (Kinda and Achonu 2012). Dinh and Kleimeier (2007) have used logistic regression by analyzing credit characteristics, applicant characteristics and connections between the applicants and the bank.

Recent studies have shown that traditional techniques of statistical analysis and artificial intelligence (AI) typically apply to the choice of features that can enhance credit risk identification accuracy.

With regard to conventional statistics, current research investigates factors influencing credit risk to clients, primarily through statistical methodologies such as multiple bias analysis, multiple logic regression and the Markov chain. Multiple Discriminant Analysis was suggested for study by Pinches and Mingo (1973), and McAdams (1980) to investigate the contributing factors in the credit score. Pishbahar, Ghahremanzadeh, and Ainollahi (2015) have examined 779 farmers' details and identified key reimbursement effects by using the Nested Logit Model

(NLM). Karan, Ulucan, and Kaya (2013) analyzed loan appraisal metrics by constructing a rational regression model. Afolabi (2010) assessed some socioeconomic characteristics of 286 smallholder farmers in Nigeria through a quantitative assessment methodology. In order to investigate credit-risk factors, Karminsky and Khromova (2016) used Ordering Probit Regression, ANOVA and Survival-Duration Models. Bai, Shi, and Liu (2018) tested their credit qualifications with Fuzzy rough description technology and the F test method). For the study of customer credit scores, Zhang and Chi (2018) applied a genetic algorithm. For credit rating forecasts and yield substantially more dependable predictions, Petropoulos, Chatzis, and Xanthopoulos (2016) proposed a hidden Markov model. Hwang (2013) compared conventional statistical techniques and the result showed that the most effective models are ordered logit regression and ordered probit models. Shi, Yang, and Wang (2016) proposed a new approach by means of fluffy cluster analysis to distinguish the customer's standard. Shi, Wang, and Qi (2015) combined logistic regression and correlation analysis to extract features. A selection function also included R cluster analysis and coefficient of variation (Shi, Chen, and Wang 2016).

In the recent creation of an effective credit scored model for Artificial Intelligence (AI) technology, researchers have proposed an approach in hybrid information mining. A neural network, a support vector machine (SVM), genetic algorithm, and other techniques are investigated to test the credit scoring mechanism, Akkoc (2012) suggested a 3-stage hybrid credit scoring model of the Adaptive Neuro-Fuzzy Inference Method. Results have shown that the full value of assets, total liabilities and operating profit margins are necessary in order to ensure the credit risk of American examples (Huang, Chen, and Hsu 2004). In the credit risk assessment, Kim and Ahn (2012) investigated SVM and demonstrated the further enhancement of SVM general efficiency by selecting features. The genetic algorithm by Hájek (2011) used to choose input parameters. Hájek (2011) used genetic algorithms to select input variables. Hájek and Michalak (2013) have demonstrated that wrappers have improved the accuracy of US and European datasets better than filters.

The majority of risk characteristics depend on financial indices or private customer data that ignore macroeconomic variables. Second, most rating systems focus only on consistency in classification, but are not in a position to recognize key variables influencing customers' willingness to make repayments.

Conclusion

Risk is an aspect of banking activities which cannot be removed entirely, but which can be minimized by use of appropriate methods. One of the key priorities of the banking system is to maintain a sustainable and sound credit system from the credit application to the loan termination. Credit risk is closely related to the assessment and management of the excellence of this process. This is the most significant type of risk for banks.

No reimbursement or reputation measurements should be performed with care, speed, accuracy and realism in the highly dynamic banking sector today. This improves credit effectiveness and customer response rates and allows us to review applications quicker and for more customers. The banks' failure to evaluate credit requests means that the use of funds is inefficient. Where a bank finances a lender believing that the loan is not risky, but the issue is that there is no reimbursement or a bank does not lend the credit to an applicant that has no reimbursement problem causes the bank to lose heavily.

The main aim of the conventional credit assessment methodology is to give credit only to those customers who pay back the loan. The credit underwriting experts review the applications. The loan of the borrower is opened if the application is approved. This method, however, creates consumer discontent, as the subjective judgment of loan underwriting experts is introduced because of incoherence in the credit decision-making system and the absence of evaluation of each applicant with equally objective variables.

Credit applications are analyzed using the decision support system as a scorecard with different classifiers in the current loan rating system approach. The strategy seeks to evaluate credit applications that develop quicker, easier, more effectively and more accurately. The pace of the method is related to the objective nature of the loan evaluation and the time taken to make decisions. Predictive intensity and quality depend on the efficacy and accuracy of the template used in the credit assessment process.

Various classifier forms are discussed in this paper and various classification types are discussed. This paper is focused on main classification algorithms.

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Uspeh agencije ACER pri vzpostavljanju in zagotavljanju delovanja notranjega energetskega trga skozi prizmo NRO in trgovcev

Alenka Lena Klopčič, Jana Hojnik in Aleš Pustovrh

Namen Agencije za sodelovanje energetskih regulatorjev (ACER), ustanovljene leta 2011, je prispevati k vzpostavitvi in delovanju notranjega energetskega trga EU. Cilj pričujoče študije je oceniti uspeh agencije ACER pri vzpostavljanju in zagotavljanju delovanja notranjega energetskega trga tako z vidika agencije same kot tudi njenih deležnikov (regulatorji za energetiko in trgovci z energijo v državah članicah EU). V prispevku so podani rezultati intervjujev z devetimi nacionalnimi regulativnimi organi (NRO) in desetimi trgovci z energijo iz držav članic EU. Rezultati raziskave kažejo, da respondenti dojemajo vlogo agencije ACER kot ključno za delovanje notranjega trga. Poleg tega se NRO in trgovci z energijo povečini strinjajo, da ima EU skoraj delujoč notranji energetski trg ter da je ACER bistvenega pomena za delovanje notranjega trga.

Ključne besede: regulator, notranji energetski trg, EU, delovanje, ACER
Klasifikacija JEL: K32, L43, F16, G14

Managing Global Transitions 18 (2): 91–110

Zastopanost žensk na vodstvenih položajih in vrednost delnic podjetij: posredniška vloga učenja veččin upravljanja

Felicity K. Mathye in Collins C. Ngwakwe

Cilj prispevka je oceniti razmerje med številom žensk na najvišjih vodstvenih položajih ter vrednostjo delnic podjetij. Študija obstoječo literaturo dopolnjuje z novim modelom, ki število žensk na najvišjih vodstvenih položajih korelira s spremenljivko »učenja veččin upravljanja/vodenja«, ki je prejšnji raziskovalni modeli ne vključujejo. Uporabljen je bil pristop panelne regresije. Rezultati prve analize (brez učenja veččin upravljanja) izkazujejo pozitivno korelacijo (čeprav ne statistično pomembno). Ugotovitve, izpeljane na podlagi druge analize (z učenjem veččin upravljanja), kažejo, da je prisotnost žensk v najvišjem vodstvu pozitivno in pomembno povezana z vrednostjo delnic podjetja. Rezultati kažejo, da lahko vključevanje in podpiranje žensk na najvišjih vodstvenih položajih skozi učenje veččin upravljanja ustvari konkurenčno prednost za organizacijo. Prispevek predlaga, da se ta novi model v

prihodnjih raziskavah razširi na različne časovne razpone in dodatne presečne enote.

Ključne besede: cene delnic, enakost spolov, zastopanost žensk na najvišjih vodstvenih položajih, upravljanje podjetij, tržna vrednost, učenje veččin upravljanja

Klasifikacija JEL: G1, G11, G12, G13

Managing Global Transitions 18 (2): 111–126

Viri poslovne rasti na različnih stopnjah inovativnosti: primer podjetij v državah EU

Ljiljana Božić

Namen te raziskave je raziskati, kako naložbe v raziskave in razvoj, usposabljanje zaposlenih, znamčenje (angl. *branding*) in ugled, oblikovanje ter pridobivanje tehnologije vplivajo na poslovno uspešnost, merjeno z rastjo prometa v podjetjih, ki delujejo v državah EU na različnih ravneh inovacijske uspešnosti. Pričujoča študija prispeva k literaturi z opredelitvijo dejavnosti, ki vodijo do poslovne rasti podjetij v manj inovativnih državah, za katere so raziskave in razvoj manj pomembni. Empirični del članka se opira na anketne podatke Flash Eurobarometer 433 (Evropska komisija 2016). Ugotovitve raziskav razkrivajo precej zapleteno zgodbo, ki stoji za rastjo podjetij v državah EU. Vpliv raziskav in razvoja na rast podjetij se na različnih ravneh inovativnosti v državah EU dejansko razlikuje. V državah z nižjo stopnjo inovativnosti se poslovna rast opira na usposabljanje zaposlenih, znamčenje (angl. *branding*) in ugled ter pridobivanje novih tehnologij.

Ključne besede: raziskave in razvoj, usposabljanje, znamčenje (*branding*), pridobivanje tehnologije, oblikovanje

Klasifikacija JEL: M20, O30

Managing Global Transitions 18 (2): 127–145

Klasifikatorji na osnovi podatkovnega rudarjenja za analizo kreditnega tveganja

Armend Salihu in Visar Shehu

Za vrnitev glavnice, izposojene pri depozitni banki, bodo pobrane obresti, ki jih zberejo glavni upniki. V prispevku smo predstavili glavne klasifikatorje, ki se uporabljajo pri ocenjevanju kreditne sposobnosti. Iz raziskave smo opazili, da obstajajo nekateri klasifikatorji, ki jih upoštevajo pri odločitvi o dodelitvi kredita. Ocena kreditnega tveganja postaja ključno področje upravljanja finančnega tveganja. Za oceno kreditnega

tveganja se uporabljajo številni pristopi nabora podatkov o strankah. Vrednotenje nabora podatkov o kreditnem tveganju vodi do možnosti preklica posojila ali zavrnitve zahteve posojilojemalca, kar zahteva podroben pregled nabora podatkov ali podatkov stranke. Prispevek obravnava različne samodejne metode analize kreditnega tveganja, ki se uporabljajo za oceno kreditnega tveganja. Metoda podatkovnega rudarjenja je bila opredeljena s poudarkom na različnih algoritmih, kot je nevronska mreža, in kot najpogosteje uporabljen pristop za analizo kreditnega tveganja.

Ključne besede: analiza bančnega posojila, klasifikatorji, analiza kreditnega tveganja, strojno učenje, rudarjenje podatkov

Klasifikacija JEL: E 51, G 21, G 32, H 81

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