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Editorial

Adam Szyszka*

Editorial

<https://doi.org/10.2478/ijme-2018-0001>

I have a pleasure to welcome you to the first issue of the *International Journal of Management and Economics* in 2018. We continue our efforts to maintain the high academic profile, diversity, and international recognition of our Journal. We have greatly increased our presence in indexing and full text data bases. Currently the *IJME* is covered by over 30 different services, including among others ProQuest, EBSCO, and EconLit. We are also proud to announce that since the beginning of this year we operate *ScholarOne Manuscripts*, the peer review and submission software by Clarivate Analytics. We hope that thanks to this fully integrated on-line publishing platform we will be able to process the increasing volume of submissions in a timely manner and to deliver better solutions for our authors and reviewers.

We have also enlarged our Editorial Board by inviting Thematic Editors for each of the disciplines covered by *IJME*: Prof. Izabela Kowalik will be helping us with submissions in management, Prof. Mariusz Próchniak and Dr. Piotr Maszczyk with papers in economics, and Dr. Katarzyna Sum will cover papers in finance.

This issue contains six papers covering various areas in economics and management. Four of them are based on empirical research and there are also two original conceptual works.

Andrea Szalavetz in the first article entitled “Sustainability-oriented cross-functional collaboration to manage trade-offs and interdependencies” identifies the barriers to environmental performance improvement that can be mitigated through cross-functional collaboration (CFC). She argues that CFC can effectively address trade-offs and interdependencies among different aspects of sustainability, and it fosters the architectural components of green capabilities. The reasoning is illustrated with adequate real-life cases of trade-offs and interdependencies encountered by practitioners.

In the second paper, “Leader Power, Conflict Handling Styles, and Subordinate Compliance: A Study on Information Technology Professionals in Turkey”, Ada T. Cenkci examines the impact of leaders’ power sources and styles of conflict management on subordinate behavioral and attitudinal compliance. Employing a large convenience sample of IT professionals in Turkey, the study reveals that subordinates’ behavioral compliance is positively influenced by leaders’ cooperative and dominating conflict management styles (CMS), expert and referent power, and legitimate power. Attitudinal compliance is positively affected by expert and referent power, and legitimate power, but negatively influenced by avoiding and dominating CMS.

The third article lays in the field of neural-science, namely neuromarketing. Urszula Garczarek-Bąk in the paper entitled “Eyetracking and EEG Research on Explicit and Implicit Factors Determining Private Labels Possible Purchase” applies modern methods of brain research in a managerial context in order to investigate private label purchase decisions of customers in five different retail chains. She finds that the greater left frontal activation (i.e. higher approach motivation) during the pre-decision period is positively correlated with an affirmative purchase decision. The eye-tracking study did not reveal the difference between women’s and men’s aesthetics sensitivity toward presented products. What is particularly interesting, the EEG research showed that decision makers were not influenced by price – this is contradictive to common intuition that cost is an important factor for private label products customers.

The next paper, entitled “A Concept for Ontology-Based Value of Cybersecurity Knowledge”, is by Adiel Aviad, Krzysztof Węcel, Witold Abramowicz. The authors argue that cybersecurity knowledge may

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have a value of its own and they suggest a market mechanism to foster the creation of this kind of value. They conceptually demonstrate how it is possible to increase the accessibility of knowledge and observe externalities from sharing thereof. A market mechanism like one described in the paper encourages creation of value by sharing the benefits. The process of value creation is additionally accelerated by mechanizing it. The proposed model also promotes the benefits of economy of scale by augmenting a lot of sources in parallel and makes the market and the competition more perfect through sharing of knowledge.

The fifth article, “Should Income Be Taken for Granted as a Sole Driver of Welfare? Bayesian Insight on the Relevance of Non-Income Drivers of Welfare”, is an interesting voice in a discussion on the relevance of non-income drivers of welfare within a general concept of welfare perception by individuals. Tomasz P. Wiśniewski takes a position that income should not be seen as the only driver of welfare, as there are also non-income factors (uncorrelated with income) that may affect individuals’ perception of welfare. The key issue of his approach depends on converting a subjective perception into a methodological Bayesian probability assessment. It turns out that the relevance of non-income factors for people’s perception is higher than the assumed 50% probability (i.e. almost 65%) of their conviction on that matter.

The final article of this issue, “Agglomeration Economies and Foreign Direct Investment in Advanced Business Services in Poland”, is by Artur Klimek. The paper focuses on a distinctive type of services, i.e., advanced business services (ABS) that have recently become an important part of the foreign direct investment (FDI) in the Central and Eastern Europe. The author points out the importance of agglomeration economies in the decision of the firms investing in Poland in ABS, in particular the concentration of supply factors, like availability of well-skilled and educated employees. On the other hand, local demand factors play a less important role due to specific features of ABS that typically are targeted to foreign markets anyway.

The last position of this issue is a book review. Włodzimierz Januszkiewicz reviews the work by Andżelika Kuźniar entitled “Międzynarodowy handel produktami wiedzy” (International Trade in Knowledge Products). The book has been recently published in Polish by Warsaw School of Economics Print. The review in English is a unique opportunity to present its content to our international Readers.

We hope you will find many interesting facts and a lot of inspiration in the current issue of the *International Journal of Management and Economics*. Please enjoy reading!

Research Article

Andrea Szalavetz*

Sustainability-oriented cross-functional collaboration to manage trade-offs and interdependencies

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Abstract: Despite a consensus view in the literature about the importance of cross-functional collaboration (CFC) for corporate environmental performance improvement, there is a dearth of studies that explain how exactly sustainability-oriented CFC can foster this objective. The purpose of this paper is to explain the role of CFC in corporate environmental performance improvement. We do this by undertaking two rounds of literature review, developing a proposition after the first round and by collecting illuminative real-life examples that illustrate our arguments in the second round. We propose and illustrate that CFC can effectively address two systemic properties of corporate environmental performance: trade-offs and interdependencies among different aspects of corporate environmental sustainability. If left unaddressed, these systemic specifics would result in organizational, managerial, and behavioral outcomes, such as inertia, opposition to change, lack of information, and so on, which would turn into effective barriers to corporate environmental performance improvement. put CFC addresses these barriers through information sharing, knowledge building, and interest reconciliation.

Keywords: environmental sustainability, cross-functional collaboration, knowledge management, trade-off, interdependence

JEL codes: Q56, O32, M19, L21

“Without appropriate organizational structure and management systems, corporations may not reap all the benefits associated with sustainability performance.” [Epstein and Roy, 2001: p. 593]

1 Introduction

It is generally acknowledged that cross-functional knowledge management (KM) and integration strategies are indispensable for maintaining proper alignment with the complex and dynamically changing technological and contextual factors of value creation. One instrument of organizational knowledge integration is the practice of cross-functional collaboration (CFC). CFC is defined as a process of interaction and collaboration among team members representing different functional departments of an organization, so that they can exchange information and work together in a cooperative manner to arrive at mutually acceptable outcomes [Kahn, 1996].

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CFC, enabled by relevant organizational and technological solutions, is shown to contribute to the following: (a) generating new knowledge by recombining existing knowledge components; (b) converting tacit, individual-level knowledge into explicit, organization-level knowledge; (c) achieving goal congruence across different departments of an organization; and (d) improving organizations' adaptive capacity so as to cope with a complex and dynamically changing business environment [Hart, 1995; Gold et al., 2001; Galbraith, 2010].

One of the challenges that organizations are expected to address is the environmental sustainability of their activities. Integrating environmental considerations into firms' production systems requires technological, managerial, organizational, and behavioral changes, as well as competence accumulation [Trianni et al., 2017], since it considerably increases the complexity of the system and the number of intertwined operational and business constraints. It is no surprise that KM for sustainability in general, CFC in particular, has received increased attention among scholars investigating how management practices can support the improvement of corporate environmental performance [e.g., Michelon et al., 2013; De Medeiros et al., 2014].

Our initial review of this literature (detailed in the following section) has, however, revealed that beyond asserting, again and again, the importance of CFC, there is a dearth of studies that explain how exactly collaboration across different functional departments can foster corporate environmental performance improvement. Most papers discussing sustainability-oriented collaboration focus on collaboration with external stakeholders, for instance, across-company environmental partnerships and collaboration with suppliers or customers [e.g., Handfield et al., 2005; De Marchi, 2012; Grekova et al., 2016; Wassmer et al., 2017]. Conversely, the issue of building down organizational silos to connect environmental sustainability with other dimensions of corporate strategy – in particular, the way in which the ensuing new management practices can foster corporate environmental performance – has received much less attention. The purpose of this paper is to fill this gap in the literature by addressing the following research question (RQ).

RQ: What is the role of CFC in corporate environmental performance improvement?

We define corporate environmental performance improvement as the outcome of efforts aimed at economizing on resources and reducing the environmental harm associated with corporate activities from a life cycle perspective.

This RQ clearly delimits the topics covered. This study focuses on environmental sustainability-oriented (ESO) intraorganizational collaboration. Consequently, although it is a commonplace ever since Elkington [1997] stated that in addition to the environmental dimension, corporate sustainability needs to be evaluated also from the perspective of social justice, without subordinating the traditional economic criteria that enable sustaining the business itself, this paper focuses only on the environmental dimension of corporate sustainability performance. On the other hand, although obviously a broad range of external stakeholders influence corporate environmental performance, we take a narrow perspective, centering our attention only on collaboration across functional departments.

To answer the RQ, we undertake two rounds of literature review. Reviewing the vast literature on corporate environmental sustainability, which adopts an *organizational approach* and calls for CFC and KM, we make a proposition about the ways in which CFC can contribute to environmental performance improvement. In the second round of the literature review, we collect illuminative real-life examples to illustrate our arguments.

The paper is structured as follows. Next, we briefly review some of the diverse strands in the literature to which our RQ is related (first round of literature review). This is followed by the presentation of our proposition about the role of CFC and the description of the research design and data collection method. Subsequently, we present the findings of the data collection, i.e., the examples that illustrate our arguments. To conclude, we provide a few summary remarks and elaborate on the managerial implications of our research.

2 Literature review

Our research is related to multiple strands in the literature, including the literature on corporate environmental strategy and sustainability management practices, barriers to improving corporate environmental sustainability, green (dynamic) capabilities, and KM for sustainability. As it is beyond the scope of this paper to review each of these strands in detail, only a couple of messages will be picked and presented in this section – takeaways from the literature that are closely related to our RQ. These bits and pieces will be complemented in the subsequent sections with the results of our data collection exercise: we summarize some findings from environmental management papers that discuss real-life challenges encountered by manufacturing companies when implementing ESO changes in processes and practices.

One of the most influential – albeit heavily debated – assertions of the environmental management literature is that *it pays to be green*: investments in improving environmental performance improve firms' economic and financial performance [Porter and Van der Linde, 1995]. Nevertheless, a substantial proportion of firms fail to adopt measures that would improve their environmental performance. This fact is ascribed to the presence of a variety of barriers to environmental performance improvement [Trianni et al., 2017]. Some of these barriers are economic, market-related, and technological (e.g., lack of resources, long payback time, technological lock-in, and risks of production disruption); others – more related to the focus of this paper – are managerial, behavioral, and organizational. Examples include lack of awareness, resistance to change, risk aversion, and lack of knowledge and technical skills [Trianni et al., 2017]. The organizational and managerial barriers closest related to our study are lack of information (e.g., about costs, risks, impact, returns, and so on), vested or split interests [e.g., Rohdin and Thollander, 2006], silo thinking and low organizational power of the environmental department, decision-makers' bounded rationality [Simon, 1957] and short-term priorities, and an exclusively technocentric focus on sustainability issues that neglects the necessary organizational changes [Lozano 2012a, 2012b].

Considering the issue of barriers to corporate environmental performance improvement from the perspective of another research strand closely related to this study, namely, that of (dynamic) green capabilities [Teece et al., 1997; Rugman and Verbeke, 1998; Chen and Chang, 2013], it seems obvious that in addition to *functional green capabilities*, such as green innovation capability, ecodesign capability, green supply chain management capability, energy management capability, and so forth, other types of green capabilities are also indispensable. Examples include the capability to plan, orchestrate, and institutionalize ESO changes, i.e., to drive the necessary organizational change management process [Lozano et al., 2016] and integrate the related knowledge that is scattered across various departments of the organization.

These latter components of green capabilities are referred to as *architectural components* [Teece et al., 1997]; as opposed to the functional components of green capabilities. The architectural components of green capabilities are necessary for the integration of sustainability-specific knowledge into broader contexts of corporate strategy.

This leads us to the third, closely related strand of the literature: KM for sustainability. The point of departure of the literature on KM is that in response to the increasing complexity of both value-adding activities and the environment of operations, global firms usually modify their structures and processes [Schneider et al., 2017], e.g., they establish new organizational divisions or departments. Employees in the new units build up specialized knowledge to solve the problems assigned to them and manage all the relevant issues. The outcome is increased functional specialization, which, in turn, may inhibit the effective management of knowledge, e.g., its intraorganizational transfer and recombination.

As the capability of bundling and recombining knowledge resources has been regarded one of the key explanatory factors of competitive advantage at least since Penrose [1959], much research has been dedicated to KM within global companies. Effective KM is regarded an essential organizational capability enabling organizational learning [Nelson and Winter, 1982]. Gold et al. [2001] emphasize that KM needs to go beyond intraorganizational *information management*, i.e., beyond consolidating data as well as allow for smooth information flows. Effective KM also involves *organizational adaptation* and the development of organizational structures and routines that allow the firm to recognize, create and mobilize, as well as

combine and transform knowledge. Hence, KM is closely related to the literature on dynamic capabilities [Teece et al., 1997; Eisenhardt and Martin, 2000].

KM also requires governance mechanisms to coordinate, integrate, and reconfigure routines across intraorganizational boundaries, as well as reconcile potentially conflicting interests and incentives [Birkinshaw et al., 2017]. Consequently, KM also requires *boundary spanning* activities within an organization, i.e., integration of activities across multiple organizational contexts [Schotter et al., 2017].

KM for sustainability is a rapidly growing subfield within the KM literature. Here, the point of departure is that the inherent complexity and the multidimensional and systemic nature of corporate environmental performance necessitate cross-disciplinary, cross-sectoral, and cross-functional collaboration [Harms, 2011; Ketata et al., 2015].¹ Collaboration across different functional departments is regarded as a means of integrating environmental methods and tools in the overall business strategy of the company [De Medeiros et al., 2014; Ketata et al., 2015; Mårtensson and Westerberg, 2016].

These papers emphasize that environmental strategy will deliver if, and only if, integrated in the broader context of the firm's competitive strategy, throughout their business processes, and at all corporate hierarchical levels [Hallstedt et al., 2010; Zhang et al., 2013].

One of the main organizational barriers to this integration is the *silos* mentality, when excessive structural (functional) differentiation is accompanied by rigid intraorganizational boundaries. Organizational decentralization and the creation of cross-functional teams with shared responsibilities are regarded adequate means to breaking through organizational silos [Stock and Seliger, 2016].

Some contributions discussing sustainability management practices provide details about the functions that need to be aligned through CFC. The majority of papers focus on collaboration between the specialized environmental unit and other functional departments, for instance, between environmental management on the one hand and product-and-process design or new product development on the other [Byggeth and Hochschorner, 2006; Dangelico et al., 2017], between environmental management and quality management [Curkovic et al., 2000], between environmental management and marketing [Hart, 1995; McDonagh and Prothero, 2014], or between environmental management and supply chain management [Handfield et al., 2005; Seuring and Müller, 2008].

Other papers take a more systemic view and propose multifunctional integration. Walton et al. [1998], e.g., underscore that greening requires product design, procurement, supplier evaluation, and logistics to be addressed simultaneously. Hajmohammad et al. [2013] discuss the requisite alignment of lean and green operations management and supply chain management for enhanced environmental performance. According to Harms [2011], sustainable supply chain management is a cross-functional undertaking integrating several functional areas in a business enterprise, including research and development (R&D), marketing and sales, public relations, procurement, and environmental management. Zhang et al. [2013] assert that an integrated sustainability perspective needs to span (a) the strategic level (enabling the top management to contextualize environmental strategy, define strategic targets, and harmonize them with organizational resources and capabilities), (b) the tactical level (supporting departmental managers in formulating a roadmap), and (c) the operational level.

However, when emphasizing the need for CFC as a means of integrating sustainability issues into company activities and adapting the organizational structure to the systemic nature of the sustainability concept, there are few papers that provide insights into precisely how ESO CFC can foster corporate environmental sustainability [notable exceptions are the papers by Harms (2011) and Székely and Strebel (2013)].

¹ As mentioned previously, environmental partnerships and collaboration with external stakeholders so as to tap into geographically dispersed knowledge will not be discussed in this paper.

3 Proposition development, research design, and data collection

Following our initial review of the literature, which helped us to identify the research gap that needs to be addressed, we formulate a proposition regarding the role of CFC in corporate environmental performance improvement.

Our point of departure is that the sustainability imperative has added to the technological and contextual complexity of firms' external and internal business environments, i.e., to the number of aspects that need to be dealt with simultaneously. Consequently, firms need to deal with new operational and business constraints. Moreover, many of the new items that organizations need to address are interconnected in a synergistic, conflicting (trade-off laden), or conditional manner.

Trade-offs are situations requiring a sacrifice in one area to obtain benefit in another, related area [Byggeth and Hochschorner, 2006]. In the specific case of corporate environmental performance improvement, trade-offs refer to the situations when improvement in one aspect of environmental performance may come at the expense of another [Hahn et al., 2010].

In the context of this paper, conditional interconnections or interdependencies refer to the fact that some aspects *jointly* determine corporate environmental performance: if addressed in isolation, the related efforts will fail to deliver the expected results.

Firms respond to the ever-increasing complexity in their environment by *adaptation* and *innovation*. In accordance with the tenets of the strategy–structure–performance literature [Chandler, 1962], it can be asserted that these strategic actions involve *changes in the organizational structure*. Organizations become more segmented and specialized.

However, organizational silos may become an effective barrier to addressing, or even recognizing, interconnections (e.g., trade-offs) and conditionalities (e.g., interdependencies). Consequently, trade-offs and interdependencies – the systemic specifics of corporate environmental performance (together with various other factors not discussed here) – pose formidable challenges to intraorganizational goal congruence and cause uncertainties about priorities and ESO intervention-related risks. These specifics are behind several organizational, managerial, and behavioral barriers to environmental performance improvement.

In order to manage complexity and address newly emerging trade-offs and interdependencies, it is indispensable to establish organizational procedures and routines that facilitate coordination, enable information sharing, and foster knowledge integration. This leads us to advance the following proposition.

CFC is an organizational routine and management practice that enables the identification and addressing of two systemic specifics of corporate environmental performance, namely, trade-offs and interdependencies, among the various aspects of environmental sustainability.

If left unaddressed, these systemic specifics would not only weaken the effectiveness of ESO interventions, but they would result in organizational, managerial, and behavioral outcomes, such as inertia, opposition to change, lack of information, and so on, which could even impede the adoption of ESO measures. CFC enables to recognize the practical consequences of these systemic specifics. It addresses them through information sharing, knowledge building, and interest reconciliation, which enables the management of change. In this way, CFC can mitigate organizational, informational, and behavioral barriers to corporate environmental performance improvement. Figure 1 provides a graphic summary of our arguments.

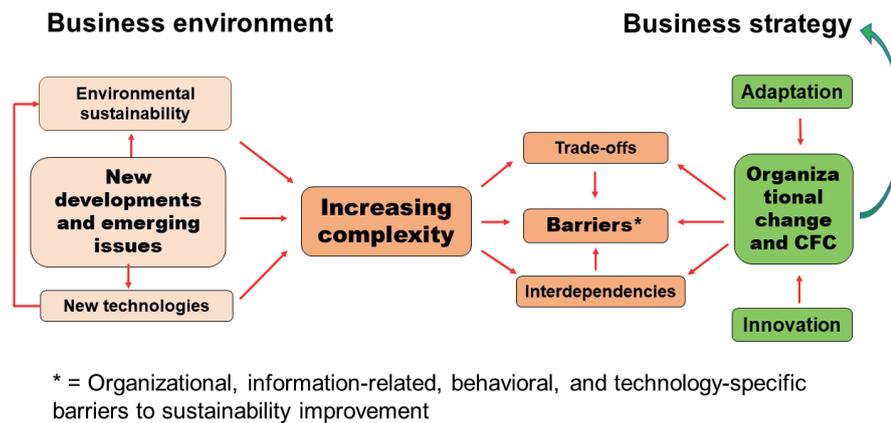


Figure 1. Conceptual framework.

The proposition we developed has guided our data collection. We conducted a review of the literature using the concepts therein as search strings. To make our search as broad and inclusive as possible, we conducted a search through Google Scholar, searching for peer-reviewed academic publications, written in English, from 1995² up to the present, using *trade-off* AND *corporate sustainability/trade-off* AND *environmental management*, and conversely, *interdependen*/interconnect** AND *corporate sustainability/environmental management* as search strings.

Since Google Scholar ranks the hits in terms of their relevance, we decided to check the first 100 papers from the hits of both searches. These hits were filtered by checking their titles and the content of the abstracts for relevance. The relevant papers were read in full, and applying a snowball sampling technique [Fink, 2012], the citations therein were also checked and read in full if found to correspond to our research topic.

While this method worked well in the case of trade-offs, yielding several highly relevant papers, it turned to be useless in the case of interdependencies. Most of the hits proved irrelevant, since the papers suggested by the search engine discussed interconnections among business, environmental, and social considerations or were concerned with the interconnectedness of stakeholders. Conversely, when considering the notion of interdependence (interconnection) as a not-to-be-neglected property of corporate environmental sustainability, we were interested rather in interdependence (interconnections) *among aspects of environmental sustainability*, which originate rather in the systemic nature of sustainability.

Consequently, we decided to use the search strings *environmental sustainability/environmental management* AND *system interaction/functional interfaces*. These searches had already produced an acceptable number of hits, so we could undertake a similar sampling, filtering, and snowball-type sample expansion exercise as in the case of papers on trade-offs.

Finally, 36 papers were selected to be read in full.³ The selected papers pertain either to the *business and the environment* literature or to the environmental science and technology literature. The initially collected sample was later complemented with 11 additional papers that had been brought in by focused searches for studies that highlight particular subtopics or clarify technical questions that emerged over the course of the analysis.

² We decided to use 1995 as a temporal boundary for our search because two salient papers, by Hart [1995] and Porter and Van der Linde [1995], marking the beginning of a new era in sustainability theory and environmental management thinking, were published that year.

³ Note that not all papers have been included among the references of this paper, only the ones that were eventually used in the analysis are cited.

All in all, the objectives of our data collection and the subsequent analysis were as follows:

1. to collect illuminative real-life examples of problems and challenges associated with trade-offs and interdependencies among aspects of environmental sustainability;
2. to check whether practitioners encountering these problems could, in principle, mitigate them through CFC; and
3. to illustrate our proposition regarding the twin roles of CFC.

4 Addressing trade-offs in sustainability management – the second round of literature review

Traditional trade-off issues, such as trade-off between environmental performance and financial performance, are addressed, albeit implicitly, by the extensive *pays-to-be-green* literature [e.g., Ambec and Lanoie, 2008] and, more explicitly, by the critics of the win–win paradigm [see review by Hahn et al. (2010)].

Contesting the dominant view of the win–win paradigm, Hahn et al. [2010] argue that trade-offs and conflicts in corporate sustainability are the rule rather than the exception. The concept of trade-offs has become deeply embedded in the corporate sustainability literature and is utilized at a variety of levels (e.g., individual, organizational, industrial, and societal), contexts, and dimensions [Van der Byl and Slawinski, 2015; Haffar and Searcy, 2017].

As regards our proposition, three specific dimensions of trade-offs have proved relevant. The first one is the strategic choice perspective in the context of resource constraints: here, trade-offs become manifested when selecting among ESO investment objectives. This is an area that deserves proper scrutiny, since most sustainability-related issues are trade-off-laden ones, involving hard choices with respect to strategic orientation, technology, process, or supply chain. An example of this dimension is the trade-off concerning the timing of investment in ESO technological solutions. First-movers face a trade-off between contingent high benefits and higher-than-the-average uncertainties.

Another example is the trade-off between scope and depth, described by Csutora [2011]. Investigating firm-level strategies based on a survey by the Organisation for Economic Co-operation and Development (OECD) on environmental policy tools and firm-level management practices, she found that increasing the number of dimensions targeted by firms' ESO initiatives counters the degree of their sustainability performance improvement.

The second relevant dimension includes trade-offs between competing implementation approaches that would produce different ESO outcomes, i.e., where alternative solutions emphasize different domains of environmental performance; consequently, these domains have to be balanced against each other [Byggeth and Hochschorner, 2006; Haffar and Searcy, 2017].

The third, often-encountered trade-off is a situation when individual ESO solutions compromise other ESO targets, i.e., when a favorable outcome in one environmental respect may result in an adverse outcome in another [Robèrt, 2000].

The surveyed *environmental science and technology* literature abounds in details about each of these three kinds of trade-off. They are listed in Table 1, complemented with suggestions regarding the functions required to collaborate and integrate function-specific knowledge to address the given trade-off.

The trade-offs in Table 1 are ordered from relatively simple to increasingly complex ones. They demonstrate that environmental sustainability is not a straightforward, but rather a trade-off-laden, issue. It seems obvious that even the simplest trade-off issues require systems thinking [Williams et al., 2017] and CFC, involving the representatives of a range of corporate functions. Trying to explain how CFC can improve corporate environmental performance, the foregoing discussion focused on the interrelated, conflicting dimensions of environmental sustainability. Next, we turn to the issue of interdependencies. Similarly to trade-offs, interdependencies among aspects of environmental sustainability may also weaken the effectiveness of environmental performance improvement efforts, in addition to causing uncertainties about risks and returns on investments.

Table 1 Examples of trade-off-laden sustainability issues requiring CFC

Trade-off	Description	CFC	Source
Trade-offs between particular process parameters and sustainability	Shift to high-speed cutting (e.g., to achieve better-quality surfaces) increases the energy demand of processing. Moreover, high-speed cutting enhances tool wear. Reducing tool wear requires the application of special coating or the use of cooling lubricants, which, however, implies environmental concerns. Energy consumption is higher with a worn tool. However, early replacement of tools increases not only costs but also waste of resources.	Process design, operations, R&D, quality, and environmental management	Vijayaraghavan et al. [2013]
Trade-off between the environmental impact of particular product parameters	Strength-to-weight ratio and energy density: some materials considered for automotive components, e.g., carbon-fiber-reinforced polymer composites (or magnesium, aluminum, and other alloys) feature a better strength-to-weight ratio than pure steel. They would effectively reduce vehicle mass and thus contribute to fuel efficiency. However, the production of these alternatives to steel-based components requires more energy and produces more greenhouse gas emissions per unit of mass than what conventional steel would. The catalytic-converter problem: catalytic converters reduce toxic exhausts but increase the consumption of precious metals.	Strategic planning, product and process design, supply chain management, and environmental management	Robèrt [2000]; Kirchain et al. [2017]
Design for product longevity or for remanufacturing vs. technology development for improved environmental performance of new products	Against intuitive ESO considerations, improvement in the environmental performance of products would call for shorter product life, as the benefits associated with new models featuring superior environmental performance may outweigh the environmental costs related to early product replacement. New-generation consumer goods, e.g., refrigerators or vacuum cleaners, consume less energy in use. Ozone-depleting chlorofluorocarbon (Freon) emission by old vintage refrigerators is eliminated in newer vintage pieces. This calls for replacing inefficient products before their designed lifetime. However, the disposal of old models is associated with high environmental burden. However, an opposite trend is observed in the case of successive generations of smartphones (of identical companies, e.g., Apple). Life cycle assessments of successive product models show a consistent increase in greenhouse gas emissions, as new product families become increasingly complex.	Strategic management, innovation management, R&D, marketing, and environmental management	Gutowski et al. [2011]; Suckling and Lee [2015]
Different stages in the product life cycle would require different and contradictory product design attributes	The use of low-impact, e.g., recycled, material (design phase) may be in contradiction with product life span and remanufacturing considerations (end-of-life phase), as these latter would require durable and often relatively high-impact material. Notice that the early stages of the design process have the greatest impact on the environmental performance of the products. However, designers in this stage have limited information about environmental properties of the product and thus concentrate rather on aesthetic and functional aspects.	New product development, process design, operations, marketing, and environmental management	Lagerstedt et al. [2003]

Trade-off	Description	CFC	Source
Trade-offs with respect to moving to a paperless manufacturing environment	Shifting to paperless shop floors as well as warehousing operations eliminates (reduces) the costs related to printing and paper disposal. Paperless manufacturing and warehouse picking may also improve the productivity of both the core and the support functions, which, in turn, can have beneficial resource efficiency implications. However, paperless manufacturing and warehousing may have nonnegligible energy costs and implications for WEEE. ⁴	Strategic planning, production planning, operations, IT, logistics, and environmental management	Mleczko [2014]
Lean vs. green	Just-in-time management practices reduce waste (e.g., excessive inventory), eliminate inefficiencies along the supply chain, and contribute to more effective use of resources. However, this practice requires more transportation, resulting in more emissions. A similar trade-off can be observed between excessive work in progress (inventory), which may lead to late recognition and, thus, to the propagation of defects between subsequent processing stages. The outcome is wasted production capacity (processing parts that are already defective) and reduced resource efficiency. However, the reduction of this type of inventory through lean practices can increase lead time, because without buffers, bottlenecks in the system are more difficult to be prevented. This causes higher overall (in particular, standby) energy consumption.	Strategic planning, process design, operations, logistics, quality, and environmental management.	Colledani et al. [2014]; Carvalho et al., [2017]
Scope vs. depth	There is a trade-off between the scope and depth of sustainability agendas: if companies try to achieve improvement along a wide variety of sustainability dimensions, they may fail to have breakthrough achievements in areas of primary importance. They need to set priorities in terms of aspects with the greatest impact on environmental sustainability (e.g., prioritize a selected life cycle stage).	Strategic planning, product and process design, operations, logistics, R&D, communication, and environmental management	Csutora [2011]
Proactive vs. reactive	In the context of resource constraints, ESO firms usually need to make a strategic choice between investing in innovation for sustainability or scaling up (or extending) existing green technologies (the latter choice promises immediate and less-uncertain environmental performance improvements but may not resolve specific environmental problems). Similarly, firms usually need to select between complex pollution prevention technologies and pollution control technologies (a reactive strategy with immediate tangible benefits). Despite the immediate, low-risk, easy-to-measure benefits of the reactive strategies, firms choosing this latter option may, over time, face rising abatement costs.	Strategic planning, product and process design, operations, R&D, and environmental management	Klassen and Whybark [1999]; Pinkse and Kolk [2010]

⁴ Notable in this respect is the warning by Bull and Kozak [2014] that comparative life cycle assessments regarding paper and digital media are problematic, contingent on a series of assumptions. For example, the energy intensity of enhanced Internet use and of the storage, retrieval, and processing of orders of magnitude more data is also hard to calculate [Coroama and Hilty, 2014].

Trade-off	Description	CFC	Source
R&D targeting product stewardship vs. clean technology	While product stewardship innovations envisage incremental product improvements and development of products with lower-than-before life cycle costs, clean technology innovations leapfrog existing products and processes to achieve radical reorientation toward ecologically sustainable directions. Decision-makers face complex trade-offs because of competing product stewardship solutions (e.g., advanced, internal combustion engines with turbocharging systems in the automotive industry, or flexible fuel vehicles) and competing clean technology solutions (electric battery vehicles, hybrid electric vehicles [EVs], and so on), featuring different ecological impacts and unpredictable development trajectories.	Strategic planning, R&D, product and process design, marketing, and environmental management	Penna and Geels [2015]; De Stefano et al. [2016]
R&D targeting electric drivetrain technologies of automotive companies vs. vehicle weight reduction	A complex trade-off situation for ESO automotive companies. According to the results of the referred paper, vehicle weight reduction (in traditional vehicles) promises higher cumulative emission savings than shifting to EVs or hybrid vehicles. Strategic managers need to consider, however, the substantial government support targeting EV technologies, the evolution of consumer preferences, competition in the EV market, and the opportunity for changes in the incentive structure. R&D and product design staff need to consider weight reduction-related safety concerns.	Strategic planning, R&D, product and process design, marketing, communication and government relations, and environmental management	Serrenho et al. [2017]
Trade-offs related to manufacturing strategy selection: additive (3DP) vs. conventional manufacturing	The 3DP paradigm is associated with less waste, reduced inventory, higher resource efficiency, less transportation, easier inclusion of lightweight structures (improving, e.g., fuel efficiency); but the drawbacks include higher energy use in production partly because of low throughput; adverse impact on the environment because of the powder elaboration process; toxicological hazards related to the materials used in the 3DP process; unresolved quality problems (higher defect rate) because of the low maturity of the 3DP process.	Strategic planning, product design, operations, R&D, and environmental management	Chen et al., [2015]; Paris et al. [2016]

Abbreviations: 3DP = three-dimensional printing; CFC = cross-functional collaboration; ESO = environmental sustainability-oriented; IT = information technology; R&D = research and development; WEEE = waste electrical and electronic equipment.

5 Linking CFC and interdependencies in sustainability management

The point of departure of the literature discussing interdependencies in sustainability management is that environmental performance improvement initiatives cannot be considered as isolated projects. Every ESO initiative is part of the technological, infrastructural, and organizational systems of the firms in question [Williams et al., 2017]. ESO changes in products, production processes, and corporate practices are therefore bound to spill over to interconnected corporate subsystems and trigger related changes within the system itself. If these changes do not take place or are not addressed adequately, ESO investments and initiatives will fail to deliver or, at least, will not bring the expected results.

Considered from a systems perspective, it can be asserted that individual ESO interventions do not necessarily lead to a *cumulative* improvement in the production system: interventions may have *synergistic* or – as illustrated in the previous section – *antagonistic* effects. Further, the beneficial impact of certain ESO interventions may be *conditional* on other (complementary) actions.

This section considers this latter dimension of interdependencies among the aspects of environmental sustainability. We argue that the challenges to corporate environmental performance improvement generated by within-system interactions can be mitigated through CFC.

Most papers linking ESO CFC and interdependencies are concerned with product life cycle management⁵ as a salient example of ESO activities involving practically all functional areas [Pujari, 2006; Umeda et al., 2012; Mårtensson and Westerberg, 2016].

Compared to life cycle management, the concept of sustainable supply chain management represents a somewhat narrower view of interdependencies. This concept takes into account interdependencies along the supply chain of the focal firm and calls for collaboration across functions responsible for the environmental performance of operations, procurement, supplier management, and logistics [Walton et al., 1998; Hajmohammad et al., 2013].⁶

A recurring aspect in the literature concerned with interdependencies in sustainability management is that environmental performance improvement necessitates a range of complementary assets that are developed by firms not necessarily as part of their environmental strategy but rather throughout their other value-creating activities [Christmann, 2000], for instance, when accumulating firm-specific human capital, or information and communication technology (ICT) capital.

When companies decide to initiate ESO activities, they need to consider the wide variety of interdependencies that these activities may entail, ranging from pure technological and infrastructural to strategic interdependencies. ESO initiatives involve new practices and require new technologies; hence, companies need to train existing – and hire new – employees and make investments. The effective implementation of ESO initiatives requires *building new* and *synthesizing* existing know-how.

One example illustrating both the interdependencies among and the conditional effects of ESO interventions is materials substitution in automotive components. Materials substitution is an extensively researched means of reducing vehicle mass, resulting in improved fuel efficiency. If implemented effectively, i.e., if significant mass reduction is achieved, this will require also the optimization of the vehicle engine, the transmission, the drive shafts, and the drive wheels for the lighter vehicle [Kirchain et al., 2017] to achieve the intended improvement in fuel efficiency. Further, material substitution will obviously necessitate synthesizing the expertise of not only the product and process design and the R&D departments but also that of operations, procurement, logistics, and enterprise resource planning.⁷

The diversity of interdependencies to be considered when implementing specific ESO initiatives is best illustrated by the case of remanufacturing.⁸ When companies decide to engage in remanufacturing activities, they need to consider a multiplicity of connected issues [Priyono, 2016].⁹ They need to evaluate whether they possess capabilities, infrastructure, and equipment for reverse logistics, disassembly, diagnostics, and testing (to evaluate the physical condition of the disassembled parts and components), cleaning, repair, and reconditioning or upgrading. All these critical activities in the

⁵ Product life cycle management is an approach that considers the environmental impact of products in a holistic manner: “from cradle to grave”, i.e., from raw material extraction through materials processing, manufacture, distribution, use, repair, and maintenance, to disposal or recycling [see review by Finnveden et al. (2009)].

⁶ Notice that both life cycle management and green supply chain management require not only intraorganizational collaboration across functions but also collaboration with external stakeholders, an issue that is beyond the scope of this paper.

⁷ Similarly, ESO changes in product architecture or in components require changes in processes, tooling, and plant logistics and, additionally, may also have supply chain repercussions.

⁸ Remanufacturing is defined as restoring used products to a like-new functional state, by disassembling, cleaning, and rebuilding them, as well as by replacing defective components, to ensure that the products meet or exceed the standards of a newly manufactured product [Sundin and Bras, 2005].

⁹ Considerations that affect business performance exclusively, such as positioning the remanufactured products in relation to new ones in terms of price, brand image, market niches, and so on, or the issue of outsourcing remanufacturing vs. retaining it as an in-house process are not analyzed here.

remanufacturing process require assets and capabilities that may not exist in firms specialized in new product manufacture.

This far-from-exhaustive list of complementarities and interconnections demonstrates that CFC encompassing environmental management, strategic planning, product and process design, operations, financial management, brand management, logistics, quality management, and human resources management is indispensable to lay the groundwork for the remanufacturing decision and, later, to implement it.

6 Conclusion and implications

The purpose of this paper was to explain why CFC is considered important for corporate environmental sustainability: to highlight how CFC can foster the improvement of corporate environmental performance. Illuminative real-life examples were collected to illustrate our arguments.

We argued that the systemic nature of and interdependencies in corporate environmental sustainability call for an integrated approach when designing and implementing ESO interventions. An integrated approach allows for consideration of a variety of possible domains that may be influenced by the given ESO initiative. CFC is a management practice that facilitates transferring and integrating function-specific components of knowledge. Accordingly, CFC fosters the *architectural components of green capabilities*: it strengthens the capabilities necessary for the integration of environmental sustainability-specific knowledge both in the corporate strategy and in the individual functional constituents of corporate strategy (this integration is represented by the green arrow in Figure 1).

Altogether, this study provides support for arguments asserting the importance of CFC in integrating the sustainability agenda in overall business strategy and extends our understanding of the specific ways in which ESO CFC fosters corporate environmental performance improvement.

It needs to be emphasized, however, that CFC is not a panacea: new management practices cannot change the existing trade-offs and they do not mitigate technological, financial, skill-related, or market-related barriers to corporate environmental performance improvement. CFC simply enables recognizing the complexity of the system and contributes to identifying some interrelated and potentially conflicting issues. This is the first step in coping with the behavioral, managerial, and organizational barriers that originate in the systemic features of sustainability. As a second step, CFC contributes to learning and to the management of change, since it institutionalizes communication and knowledge sharing and facilitates the reconciliation of conflicting interests.

Regarding the managerial implications, a key lesson for both the corporate C-suite and the functional officers is that in order to recognize and take care of trade-offs and interdependencies, sustainability-related issues should not be addressed from a narrow operational perspective. Efforts need to be devoted to designing and institutionalizing organizational practices that facilitate and routinize CFC.

In accordance with the paper by Madhavan and Grover [1998], it can be asserted that the collective knowledge of functional units constitutes only potential knowledge. In the case of corporate-level systemic issues such as environmental sustainability, CFC is indispensable for mobilizing the isolated components of knowledge and directing them toward suprafunctional objectives.

While helping to clarify these issues, this study has raised some points requiring further scrutiny. Further theoretical refinements are needed to reveal the specific mechanisms that govern CFC, e.g., whether the dominance of selected functions (e.g., environmental management) in collaborative projects should be preferred over a perfectly decentralized governance or not. Another issue is the extent of autonomy to be granted to ESO cross-functional teams: whether CFC should be limited to information exchange and to laying the groundwork for strategic decisions made by the top management or, instead, cross-functional teams should set priorities and implement actions autonomously.

An important direction of further research is to validate the conceptual framework outlined in this paper through case studies. Empirical evidence will add flesh to the bones of the framework presented.

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Research Article

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Leader Power, Conflict Handling Styles, and Subordinate Compliance: A Study on Information Technology Professionals in Turkey

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Abstract: The purpose of this study is to examine the impact of leaders' power bases and styles of handling conflict on subordinate behavioral and attitudinal compliance. Convenience sampling was used, and 353 information technology (IT) professionals in Turkey participated in the survey. The outcomes revealed that leaders' cooperative and dominating conflict management styles (CMSs), "expert and referent power", and legitimate power positively influence subordinates' behavioral compliance. In addition, "expert and referent power" and legitimate power positively affect attitudinal compliance, while avoiding and dominating CMSs negatively influence it. Overall, the results partially support the influence of leader power bases and styles of handling conflict on subordinate compliance. This study contributes to the literature by investigating the listed variables with a sample of IT professionals employed in various industries in Turkey. Organizations can utilize the study results to increase leadership effectiveness and to deliver better management of IT human capital.

Keywords: leadership, bases of power, conflict management styles, compliance, information technology professionals

JEL codes: M10, M12, M15, D23

1 Introduction

The changing environment of the business world has created new challenges in relation to maintaining peace at the workplace. Rapid pace of business, escalated competition, workplace diversity, and flattened organizational structures are among these new challenges [Muir, 2000]. Modern organizations need to continuously learn and make changes to remain competitive, but such a change can also bring conflict within organizations. Hence, today's organizations and their leaders are in crucial need of structures and methods to manage conflict effectively. Former studies indicate that leaders' styles of handling conflict can influence a number of important employee outcomes, such as satisfaction with supervision and work [Richmond et al., 1983], job performance [Rahim et al., 2001], turnover intention [Chan et al., 2008], and anxiety/depression [Way et al., 2016]. Moreover, because of their work roles, employees may have different goals and behaviors, which can also lead to conflict. In such an environment, power is a vital instrument for leaders to influence others in getting things done and accomplishing organizational goals.

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Power is the capability to affect others' actions, thoughts, and emotions [Borkowski, 2011]. Leaders utilize different power bases to influence followers by attracting one or more of their needs [Hellriegel and Slocum, 2007]. Previous research has shown that leaders' power base choices affect a number of organizational outcomes, such as the degree of cooperative behavior and organizational commitment [Munduate and Dorado, 1998], employee job stress [Erkutlu and Chafra, 2006], and organizational citizenship behavior [Reiley and Jacobs, 2016]. Hence, it is important for leaders to determine their power bases and styles of handling conflict effectively in order to maximize their influence, manage organizational conflict well, and influence employee outcomes, such as subordinate compliance. Organizations that direct these issues well and effectively manage their IT human capital can acquire distinctive competencies.

IT professionals are chosen as the focus of this research, because they have characteristics that differ from those of other professionals [Armstrong et al., 2007]. The IT professional can be described as an individual who works directly with the development, implementation, support, and/or management of computer-based information systems, in particular, software applications and computer hardware [Marchewka, 2006; Messersmith, 2007; Rose, 2009]. An IT professional job functions include positions such as information system professional, programmer, developer, and software engineer [Maudgalya et al., 2006], all requiring highly skilled employees. In general, they have a high level of intelligence and education, consequently demanding very competitive wages [Maudgalya et al., 2006]. They exhibit certain distinguishing characteristics, such as youth, mobility, short tenure, adaptability to change, and sensitivity to their work (owing to their viewing their output as an extension of their personality) [Peterson, 1987; Thite, 2006]. IT careers, more than most other professions, necessitate long hours, travel, and frequent updating of skills [Ahuja, 2002].

Moreover, an operational IT infrastructure is critical in most of today's organizations as they continuously need to implement new IT initiatives to overcome the competition. The focus on IT initiatives usually causes its professionals to work longer hours and, hence experience more work-home life conflict, compared to employees in other functional units [McGee, 2003; Messersmith, 2007]. In addition to long and unfixed work hours and lack of distinction between work and home life, the following are among the stress factors affecting today's IT work environment: growing market pressures, tight deadlines, budgetary limitations that frequently lead to understaffing (therefore, overworking), and managerial policies that do not have an understanding of the IT operations [Maudgalya et al., 2006]. For the reasons listed here, the present study examines the influence of leaders' power bases and styles of handling conflict on subordinates' attitudinal and behavioral compliance. The study has been conducted on Turkish IT professionals.

Pasa et al. [2001] stated that for a significant amount of time, the dominance of American management theory created the assumption that a "good" manager in the US would also be a good manager in other countries. However, differences in national culture require different management practices [Pasa et al., 2001]. This study also provides a contribution to the existing literature by examining leadership practices of the IT industry in Turkey. Furthermore, this research contributes to the literature by conducting an investigation on various aspects affecting IT professionals employed in various industries. In the Turkish context, there has been very little research covering the various industries in which IT professionals are employed.

It should also be noted that the Turkish IT market is one of the fastest developing markets in Europe [Turkey Information Technology Report, 2011], and it is expected that IT spending in Turkey will grow faster than the world average. IT spending on hardware, software, IT services, and telecommunication services in Turkey are expected to reach 35 billion USD by 2018 [Information and Communication Technologies (ICT), no date (n.d.)]. Employment in the Turkish IT industry can be expected to accumulate as the market size becomes bigger. The expected growth in the Turkish IT industry increases the importance of this study in terms of providing insights into how to manage IT human capital effectively.

2 Literature Review

2.1 Power

As an important force for leader effectiveness [Barrett, 2010], power can be defined as the capacity of a person, team, or organization to influence other people [French and Raven, 1959]. Leaders achieve goals, and power is an instrument for facilitating this achievement [Robbins and Judge, 2009]. Without power, it would not be possible for leaders to use their influence to get things done [Barrett, 2010]. Individuals can have power over others due to a variety of reasons, such as gender, social class, and ethnicity. The emphasis here is on the nature of power as a social resource in organizations [Hewison, 2005]. Several classifications have been made of social power bases in organizational settings. However, French and Raven's [1959] power taxonomy (coercive, reward, legitimate, expert, and referent) has been widely accepted by scholars, being also drawn upon for this work, the categories of which are defined below.

“Coercive power” refers to the capacity of the power holder to take something away from the target person or to punish her/him for not complying with a request [Spoelstra and Pienaar, 2008]. “Reward power”, being its opposite, pertains to the ability to provide things that others want or need in exchange for desired behaviors [O'Connell and Cuthbertson, 2009]. “Legitimate power” is the authority assigned to a person with a social position within a group [ibid], while “expert power” rests upon the influencee's belief that the influencer possesses important knowledge, information, or skills in a desirable area [Busch and Wilson, 1976]. As jobs have become more specialized, dependence on experts has increased. Specialists such as computer specialists, tax accountants, and industrial psychologists are capable of gaining power because of their expertise [Robbins et al., 2009]. Finally, “referent power” is based on identification with another person [French and Raven, 1959], and popularity or charisma is often used to describe this form of power [O'Connell and Cuthbertson, 2009]. Next, the topic of conflict is discussed.

2.2 Conflict

Conflict is inevitable and unavoidable among humans. Relationships among two or more social beings (humans, groups, organizations, or nations) can become incompatible or inconsistent for different reasons. For instance, conflict can arise when these entities desire a scarce resource or when they differ in attitudes, values, and/or skills [Rahim, 2011]. There is a wide variety of definitions for conflict. For example, Putnam and Poole [1987] define it as the interaction of interdependent individuals, who see opposition of goals as well as values and who perceive the other side as potentially obstructing the reaching of these goals. Next, how organizational members attempt to deal with conflict is discussed.

Follett [1940] was among the first to propose that there might be patterns to response conflict. She proposed that individuals can manage conflict in three main ways: domination, compromise, and integration. Blake and Mouton [1964] offered a grid to classify conflict behaviors, according to concern for production or concern for people. The five styles of handling interpersonal conflict in this model are forcing, withdrawing, smoothing, compromising, and problem-solving. Based on Blake and Mouton's work, Rahim and Bonoma [1979] classified the handling of interpersonal conflict under two main dimensions: concern for self and concern for others. The first dimension is the extent to which an individual tries to satisfy his/her personal concerns, while the second refers to the degree to which a person attempts to satisfy others' concerns. The combination of these two dimensions creates five styles: integrating, obliging, dominating, avoiding, and compromising. Based on this model, Rahim [1983] developed the Rahim Organizational Conflict Inventory (ROCI), which has been widely used by researchers.

“Integrating” (or collaborative) style is associated with “high concern for self and for others” [Rahim and Buntzman, 1989, p. 197; Gudykunst, 2005]. This style emphasizes problem-solving and seeks a result that provides both sides with what they want [Phillips and Gully, 2012]. “Obliging” (or accommodating) style is characterized by “low concern for self and high concern for others” [Rahim and Buntzman, 1989, p. 197; Gudykunst, 2005; Collins, O'Rourke, 2009]. This involves trying to minimize differences and

emphasizing common points so as to satisfy the other party's concerns [Rahim et al., 2002]. "Dominating" (or competitive-controlling) style involves "high concern for self and low concern for others" [Rahim and Buntzman, 1989, p. 197; Gudykunst, 2005]. This is confrontational [Collins and O'Rourke, 2009], being described as having a win-lose orientation or a forcing behavior aimed at asserting one's position [Rahim et al., 2002]. "Avoiding" style reflects "low concern for self and for others" [Rahim and Buntzman, 1989, p. 197], which is a passive CMS that involves ignoring the conflict or denying that it exists [Phillips and Gully, 2012]. "Compromising" style involves "intermediate concern for self and others" [Rahim and Buntzman, 1989, p. 197]. This has been associated with a give-and-take concession approach, with the aim to get to a midpoint agreement [Gudykunst, 2005], and by following this style, each party sacrifices something to end the conflict. This middle-ground style shows a moderate concern for one's personal interests and a moderate concern for those of the other party [Phillips and Gully, 2012].

Conflict management styles (CMSs) that treat the other side with a moderate-to-high level of concern, i.e., integrating, obliging, and compromising, are named as "cooperative" CMSs. Similarly, styles in which little concern is given to the other party, i.e., avoiding and dominating, are called "uncooperative" CMSs [Rahim et al., 2000; Song et al., 2000; Milic et al., 2011]. Conflict handling styles can differ from culture to culture. For instance, the study by Morris et al. [1998] indicated that Chinese managers tend to use the avoiding style more because they have relatively high conformity and tradition value-orientation. However, US managers tend to use the competing style more, since they have relatively high value orientation toward individual achievement [Morris et al., 1998]. In the next section, the topic of compliance with the supervisor's wishes is examined.

2.3 Compliance With the Supervisor's Wishes

How people organize and relate to each other to accomplish planned goals is a central issue in organizational and administrative theory. The overreaching problem in organizations is securing follower compliance [Porter et al., 2003]. The compliance variable is an ideal criterion to associate with leader power bases, because it is most directly related with the outcomes of power use [Rahim and Afza, 1993]. Compliance is about achieving the result aimed for from the use of power [Fairholm, 2009]. It indicates that people are following the direction of the person of power, even though they may not agree with the orders given. Resistance, on the other hand, means that employees intentionally attempt to avoid carrying out orders or they will try to disobey instructions [Daft, 2008].

Warren [1968] differentiated between attitudinal and behavioral compliance. The former is the degree to which a target person is willing by him/herself to fulfill an actor's wishes (with or without acting accordingly), while the latter refers to the extent to which a target person adheres behaviorally to those wishes (with or without being willing to do so by him/herself) [Emans et al., 2003]. Rahim and Afza [1993] stated that a power base is effective to the degree to which it causes both attitudinal and behavioral compliance, where the latter results from a target's wish to get favorable reactions or to avoid the actor's unfavorable reactions. On the other hand, attitudinal compliance is the product of an actor's influence on the target's self-definition, which creates real persuasion and true internal change that remains in the absence of monitoring [Moscovici, 1976; Pérez and Mugny, 1990; Pérez, 1994; Emans et al., 2003].

Next, several studies from the literature relating to "the relationship between bases of leader power and subordinate compliance" are examined. Meng et al. [2014] investigated the relationship between subordinates' perceptions of leader power bases and the influence of these perceptions on subordinates' attitudinal compliance, behavioral compliance, and satisfaction with supervision. This research had 86 respondents, who were postdoctoral and PhD students at a science institution in the UK. The findings revealed that subordinates perceived that the expert power base was used by their leaders most, followed by legitimate power. In addition, the outcomes indicated that a leader's legitimate power and expert power were positively related to attitudinal compliance. Furthermore, legitimate power, coercive power, and expert power were positively related to subordinates' behavioral compliance. Rahim and Afza's [1993] research on 308 American accountants showed that expert and referent power bases were positively related to attitudinal compliance, while the referent and legitimate bases of power were positively related to

behavioral compliance. Based on a literature review, Rahim and Buntzman [1989] concluded that expert, referent, and to some degree, legitimate power bases, in general, cause compliance from subordinates. The authors added that subordinates perceive coercive and reward power bases as weak compliance reasons. Rahim [1989] contended that the lack of consistent associations between power bases and compliance might be partially related to measurement and sampling inadequacies.

Considering the literature review provided, in this current study, the following hypotheses are formulated according to the bases of leader power and subordinate compliance:

Hypothesis 1a and 1b: Supervisors' legitimate power positively influences subordinate behavioral compliance (1a) and attitudinal compliance (1b);

Hypothesis 2a and 2b: Supervisors' expert power positively influences subordinate behavioral compliance (2a) and attitudinal compliance (2b);

Hypothesis 3a and 3b: Supervisors' referent power positively influences subordinate behavioral compliance (3a) and attitudinal compliance (3b).

In terms of the literature review on the “relationship between leader styles of handling conflict and subordinate compliance”, there are a limited number of studies investigating this relationship. As stated earlier, one piece of research is that by Rahim and Buntzman [1989]. This study was conducted on 301 American students of business administration, and the following findings were reported: integrating CMS was positively associated with attitudinal and behavioral compliance; obliging CMS was positively associated with attitudinal compliance; and a compromising style was negatively associated with behavioral compliance. Furthermore, as pointed out earlier in this paper, former studies have indicated that cooperative CMSs (integrating, obliging, and compromising), which focus on satisfying others' concerns, generally produced positive outcomes for subordinates.

Hence, the following research hypotheses are formulated:

Hypothesis 4a and 4b: Supervisors' integrating CMS (conflict management style) positively influences subordinate behavioral compliance (4a) and attitudinal compliance (4b);

Hypothesis 5: Supervisors' obliging CMS positively influences subordinate attitudinal compliance;

Hypothesis 6: Supervisors' compromising CMS negatively influences behavioral compliance.

According to Rahim and Buntzman [1989, p. 197], an avoiding style involves “low concern for self and for others”, while a dominating one pertains to “high concern for self and low concern for others” [Rahim and Buntzman, 1989, p. 197]. The latter can help a person achieve individual goals, but as with the avoiding style, it is likely to result in an unfavorable evaluation by others [Singh, 2012]. In addition, former studies have indicated that an uncooperative CMS (dominating and avoiding) that ignores the needs of others is associated with negative job outcomes [Chan et al., 2008] and, thus, the following hypotheses are constructed:

Hypothesis 7: Supervisors' avoiding CMS negatively influences attitudinal compliance;

Hypothesis 8: Supervisors' dominating CMS negatively influences attitudinal compliance.

3 Research Methods

3.1 Research Design

Quantitative research is used in this study and it is a cross-sectional study. A questionnaire was deemed the appropriate data collection method. The model was tested using the SPSS (Statistical Package for the Social Sciences) software.

3.2 Sampling Method

As mentioned earlier, the target population of this study is Turkey's information technology (IT) professionals. Nonprobability techniques of convenience and snowball sampling were used to collect the data. According to Cooper and Schindler [2003], factors such as nonavailability of the population, or high costs, might lead researchers to use nonprobability sampling techniques. In this study, convenience and snowball sampling techniques were applied to increase the number of participants and to reach a variety of IT professionals employed in different industries. In total, 353 Turkish IT professionals participated in the survey over a period of 2 months. In the end, 72.5% of the people who started the questionnaire finished it; partially completed surveys were not used in the study.

3.3 Data Collection Procedures

A questionnaire, in Turkish, was distributed through a survey website to collect data from IT professionals. It was put online to reach IT professionals from a variety of industries and because of its convenience to the participants. It should be noted that IT professionals are considered Internet users, because it is related to their profession. The online distribution of the questionnaire might also have had benefits in terms of ensuring the confidentiality of responses, compared to distributing paper-based questionnaires in organizations. There were questions in the survey asking the participants to evaluate their leaders' behavior and attitude and, therefore, the respondents might not have felt comfortable about filling in paper-based questionnaires at work.

The survey link was sent to the participants along with an invitation text, which included a briefing about the purpose of the study and assurances of the confidentiality of the responses. The survey invitation was sent to contacts working in various IT organizations in Turkey, and these people distributed the invitation within their organizations. The invitation to join the survey was also posted to a number of email groups related to Turkish IT professionals and groups of Turkish IT industry professional associations on an online networking site. Before distributing the questionnaire, a pilot study on 153 IT professionals was conducted. After the pilot study, the results from the data analysis were scrutinized, and the Turkish translation of the scales was reviewed. Then, as is explained in the following section, modifications were made to Rahim's (1988) Behavioral and Attitudinal Compliance with Superior's Wishes Scale (CSWS).

3.4 Measurement Scales

To measure IT professionals' perceptions about their supervisors' sources of power, Rahim's (1988) Leader Power Inventory (RLPI) was chosen, which has 29 items. Rahim and Afza's [1993] research provided evidence for the RLPI scale's construct and criterion validities. Representative items include the following: "My superior has a pleasing personality", "I approach my superior for advice on work-related problems because she (he) is usually right", and "My superior's position entitles her (him) to expect support of her (his) policies from me". The instrument has five subscales: coercive, reward, legitimate, expert, and referent. The translation of the questionnaire was undertaken by the researcher, and Acar's [2009] Turkish translation of the instrument was used in this translation as a resource. In the current study, Cronbach's alpha coefficient was found to be 0.891 for the instrument.

To measure subordinates' perceptions of supervisors' CMSs with them, Rahim's (1983) scale was used, namely, the ROCI-II, which has 28 items, but it was altered to measure subordinates' perceptions. For instance, the item "I try to investigate an issue with my subordinates to find a solution acceptable to us" from the original questionnaire was modified as "My supervisor tries to investigate an issue with us to find a solution acceptable to us". This alteration in wording to measure subordinates' perspective has been used by several other studies, such as Rahim and Buntzman [1989] and Chan et al. [2008]. Sample items from the instrument are "My supervisor generally tries to satisfy our needs", "My supervisor uses his/her expertise to make a decision in his/her favor", and "My supervisor tries to avoid unpleasant exchanges with us".

The ROCI-II instrument is widely used, and it has five independent dimensions that represent interpersonal conflict: integrating, obliging, dominating, avoiding, and compromising. In Rahim and Buntzman's [1989] study, the values of Cronbach's alpha for the subscales ranged between 0.64 and 0.87. Rahim and Magner's [1995] research with five different samples supported the convergent and discriminant validities of the scale. In this current research, a Cronbach's alpha coefficient of 0.893 was obtained for the ROCI-II scale. The translation of the instrument was undertaken by the researcher, and Sirin's [2008] Turkish translation of the instrument was used as a resource.

Rahim's (1988) Behavioral and Attitudinal Compliance with Superior's Wishes Scale (CSWS) was used in this study, which has satisfactory construct and criterion validities [Rahim and Buntzman, 1989]. Representative items include the following: "I like to do what my superior suggests" and "I follow the work procedures set up by my superior". The translation was undertaken by the researcher. After the pilot study, it was seen that Turkish translations of some items in the CSWS have very similar meanings. Hence, scale Item 1 (I follow my superior's orders) and item 3 (I prefer not to comply with my superior's instructions) were removed for the subsequent main study. The final instrument has eight items. In this current research, the Cronbach's alpha coefficient was found to be 0.870 for the modified CSWS.

All scales were translated from English to Turkish. The translations of the scales were examined by two bilingual academicians, and the items were reverse-translated to compare the English and Turkish versions. Corrections were then carried out to make the questionnaire more understandable, and the responses were anchored on a six-item Likert scale (completely disagree = 1, completely agree = 6).

3.5 Demographic Variables

The respondents were also asked to provide information about themselves and the organization they worked for. Demographic questions that were asked included the following: gender, age, highest level of education attained, marital status, organization industry category, level in the organizational hierarchy (top management, middle management, or nonsupervisory employees), tenure in the company (in years), and job experience (in years).

4 Research Findings

The descriptive statistics of the sample are given in Table 1. From the table, it can be seen that the participants' mean age was 32.1 years, and 34.8% of the respondents were female, with 49.9% being single. Most of the participants had a university degree (66.3%). The mean of the tenure at work was 4.6 years, while the mean of total job experience was 9.9 years; most of the participants were nonsupervisory employees (56.7%).

The industry category of the organizations in which the participants worked was classified. It emerged that most of the participants worked in the information and communications industry (44.1%), with the financial and insurance activities industry following this with 19.0%. Next came the 12.2% of the respondents who were employed in the manufacturing industry.

Factor analysis using the principal components solution with varimax rotation was used to find the factor structure of the leader power bases scale. Four factors were found, and these explained 62.486% of the total variance. This was despite the Rahim Leader Power Inventory (RLPI) [Rahim, 1988] having five factors, as the items belonging to expert and referent power loaded on a single one and this factor was thus

named “expert and referent power”. This commonality could be related to the fact that the participants see expert and referent personal power bases as being closely associated. As indicated earlier, expert power is based on the influencee’s belief that the influencer has important knowledge, information, or skills in a desirable area [Busch and Wilson, 1976], whereas referent power rests upon identification with another person [French and Raven, 1959]. IT careers, more than most other professions, demand constant updating of skills [Ahuja, 2002]. In addition, IT employees possess a strong need for growth and personal development in comparison to professionals in other occupations [Lee, 2000]. Hence, for IT professionals, having expert power might be associated with having referent power, thus causing these factors to load on one factor, “Expert and referent power”. Table 2 shows the results of the factor analysis for the bases of the leader power scale and the Cronbach’s alpha values.

Factor analysis was used to find the factor structure of the “styles of handling conflict with subordinates” scale. Three factors were found, and these explained 67.139% of the total variance. The factor analysis results are given in Table 3.

The first factor was composed of items from the integrating, compromising, and obliging styles. As stated earlier, CMSs that are treating the other side with a moderate-to-high level of concern, i.e., integrating, obliging, and compromising, are known as “cooperative” CMSs. On the other hand, styles in which little concern is shown for the other party, i.e., avoiding and dominating, are defined as being “uncooperative” CMSs [Rahim et al., 2000; Song et al., 2000; Milic et al., 2011]. In this current study, since the first factor was composed of items from the integrating, compromising, and obliging styles, it was named the “cooperative style”.

Table 1: Descriptive Statistics of the Sample

Variable	N	Percentage	Mean	Standard Deviation	Range
Gender					
Male	230	65.2	–	–	–
Female	123	34.8	–	–	–
Age	–	–	32.1	7.3	21–61 years
Marital Status					
Married	177	50.1	–	–	–
Single	176	49.9	–	–	–
Education Level					
High School	17	4.8	–	–	–
University	234	66.3	–	–	–
Masters’ Degree	99	28.0	–	–	–
PhD	3	0.8	–	–	–
Tenure	–	–	4.6	5.5	1–35 years
Total Experience	–	–	9.9	7.7	1–40 years
Position					
Top Management	40	11.3	–	–	–
Middle Management	113	32.0	–	–	–
Nonsupervisory Employee	200	56.7	–	–	–

Table 2: Results of the Factor Analysis of the Bases of the Leader Power Scale

Bases of Leader Power (Overall) Cronbach's Alpha: 0.891	Factor Loading
Factor 1: Expert and Referent Power; % Variance: 24.114; Cronbach's Alpha: 0.928	
When a tough job comes up, my superior has the technical "know-how" to get it done.	0.815
My superior has considerable professional experience to draw from in helping me to do my work.	0.795
My superior does <i>not</i> have the expert knowledge I need to perform my job.*	0.790
I prefer to do what my superior suggests because he (she) has high professional expertise.	0.752
I approach my superior for advice on work-related problems because she (he) is usually right.	0.733
My superior has specialized training in his (her) field.	0.713
My superior has a pleasing personality.	0.682
My superior is <i>not</i> the type of person I enjoy working with.*	0.679
I like the personal qualities of my superior.	0.677
Factor 2: Reward Power; % Variance: 17.683; Cronbach's Alpha: 0.886	
My superior can recommend a promotion for me if my performance is consistently above average.	0.827
My superior can get me a bonus for earning a good performance rating.	0.801
My superior can recommend me for merit recognition if my performance is especially good.	0.757
If I put forth extra effort, my superior can take it into consideration to determine my pay raise.	0.721
My superior can provide opportunities for my advancement if my work is outstanding.	0.694
My superior <i>cannot</i> get me a pay raise even if I do my job well.*	0.620
Factor 3: Coercive Power; % Variance: 11.618; Cronbach's Alpha: 0.762	
My superior can fire me if I neglect my duties.	0.842
My superior can fire me if my performance is consistently below standards.	0.781
My superior can see to it that I get no pay raise if my work is unsatisfactory.	0.694
My superior can suspend me if I am habitually late in coming to work.	0.632
My superior can take disciplinary action against me for insubordination.	0.569
Factor 4: Legitimate Power; % Variance: 9.071; Cronbach's Alpha: 0.723	
I should do what my superior wants because she (he) is my superior.	0.804
My superior's position entitles her (him) to expect support of her (his) policies from me.	0.702
It is reasonable for my superior to decide what he (she) wants me to do.	0.627
My superior has the right to expect me to carry out her (his) instructions.	0.581
Note: *Reverse-scored items. Kaiser–Meyer–Olkin value: 0.918; Bartlett significance value: 0.000; <i>df</i> : 276; chi-square value: 4906.096.	

Table 3: Results of the Factor Analysis of the Styles of Handling Conflict with Subordinates Scale

Handling Conflict With Subordinates (Overall) Cronbach's Alpha: 0.893	Factor Loading
My supervisor...	
Factor 1: Cooperative Style; % Variance: 41.211; Cronbach's Alpha: 0.973	
Usually proposes a middle ground for breaking deadlocks.	0.858
Collaborates with us to come up with decisions acceptable to us.	0.856
Negotiates with us so that a compromise can be reached.	0.852
Tries to work with us to find solutions to a problem that satisfies our expectations.	0.845
Generally tries to satisfy our needs.	0.828
Tries to integrate his/her ideas with our ideas to come up with a decision jointly.	0.827
Tries to investigate an issue with us to find a solution acceptable to us.	0.826
Tries to work with us for a proper understanding of a problem.	0.825
Tries to bring all our concerns out in the open so that the issues can be resolved in the best possible way.	0.822
Exchanges accurate information with us to solve a problem together.	0.818
Tries to satisfy our expectations.	0.795
Tries to find a middle course to resolve an impasse.	0.788
Accommodates our wishes.	0.761
Uses a "give-and-take" approach so that a compromise can be made.	0.682
Often goes along with our suggestions.	0.631
Gives in to our wishes.	0.553
Factor 2: Avoiding Style; % Variance: 13.792; Cronbach's Alpha: 0.786	
Tries to stay away from disagreement with us.	0.835
Avoids an encounter with us.	0.790
Tries to keep his/her disagreement with us to himself/herself in order to avoid hard feelings.	0.648
Tries to avoid unpleasant exchanges with us.	0.567
Attempts to avoid being "put on the spot" and tries to keep his/her conflict with us to himself/herself.	0.529
Usually allows concessions to us.	0.526
Factor 3: Dominating Style; % Variance: 12.136; Cronbach's Alpha: 0.861	
Sometimes uses his/her power to win a competitive situation.	0.769
Uses his/her authority to make a decision in his/her favor.	0.726
Uses his/her expertise to make a decision in his/her favor.	0.706
Uses his/her influence to get his/her ideas accepted.	0.701
Is generally firm in pursuing his/her side of the issue.	0.699

Note: Kaiser–Meyer–Olkin value: 0.958; Bartlett significance value: 0.000; *df*: 351; chi-square value: 8551.804.

The ROCI-II [1983] offered five dimensions that represent interpersonal conflict: integrating, obliging, dominating, avoiding, and compromising. However, in this study, as a result of factor analysis, only three dimensions were found. This result might be due to the fact that the study was conducted with Turkish IT professionals. In other words, cultural differences or the participants' occupational differences might have caused such a result. It should also be noted that this research involved measuring participants' perceptions about their supervisors. There have been other studies on styles of handling conflict conducted in Turkey using ROCI-II. However, in many of these, either the participants evaluated their own CMSs (such as the studies by Ozgan [2006] and Kilic [2006]) or when the researchers did ask the participants' perception

regarding their supervisors, factorial analysis was not conducted (such as the research by Polat [2008] and Gunes [2008]). Consequently, a comparison between these listed former studies conducted in the Turkish context on the one hand and the current research on the other regarding the factor structure of the styles of handling conflict cannot be made.

Factor analysis was also used to find the factor structure of CSWS. Two factors were found, which explained 73.091% of the total variance. The first factor was composed of items mostly from behavioral compliance, just a few attitudinal compliance items. Table 4 shows the outcomes of the factor analysis scale and the Cronbach's alpha values.

Table 4: Results of the Factor Analysis of Compliance with Supervisor's Wishes Scale

Compliance with Supervisor's Wishes (Overall) Cronbach's Alpha: 0.870	Factor Loading
Factor 1: Behavioral Compliance; % variance: 55.552; Cronbach's Alpha: 0.924	
I comply with the instructions of my superior.	0.882
I do what my superior suggests.	0.859
I follow the work procedures set up by my superior.	0.850
I like to do what my superior suggests.	0.836
I comply with the directives of my superior.	0.814
I prefer to follow the work procedures set up by my superior.	0.812
Factor 2: Attitudinal Compliance; % variance: 17.539; Cronbach's Alpha: 0.570	
I prefer not to comply with the directives of my superior.*	0.915
I don't like to follow my superior's orders.*	0.649

Note: *Reverse-scored items. Kaiser–Meyer–Olkin value: 0.880; Bartlett significance value: 0.000; *df*: 28; chi-square value: 1809.238.

The overall reliability of the scale was checked and found to be 0.870. The Cronbach's alpha value for Factor 2 (Attitudinal Compliance) was found to be 0.507. Clark and Watson [1995] recommended a minimum value of 0.15–0.20 for the mean inter-item correlation for broad higher-order constructs (e.g., extraversion) and a range of 0.40–0.50 for those tapping narrower constructs (e.g., talkativeness). In addition, the items were quite relevant and created a meaningful factor. Hence, none of the Factor 2 items were removed for the subsequent analysis.

Table 5 shows the means and standard deviations of all the scales used, as well as for their subscales. According to the findings, subordinates perceive that their supervisors used expert and referent power more than other power bases and that coercive power was the power base least used by the latter. In addition, supervisors used a cooperative style more than other styles when dealing with conflict with subordinates. Finally, the avoiding style was the least used CMS by supervisors.

Table 5: Means and Standard Deviations of Scales and Subscales

Scale	Mean	Standard Deviation
Bases of Leader Power		
Expert and Referent Power (Factor 1)	3.877	1.232
Reward Power (Factor 2)	3.547	1.239
Coercive Power (Factor 3)	3.510	1.056
Legitimate Power (Factor 4)	3.611	0.962
Conflict With Subordinates		
Cooperative Style (Factor 1)	3.713	1.120
Avoiding Style (Factor 2)	3.171	0.921
Dominating Style (Factor 3)	3.331	1.169
Compliance With Supervisor's Wishes		
Behavioral Compliance (Factor 1)	4.184	0.913
Attitudinal Compliance (Factor 2)	4.212	1.114

Table 6 shows the correlations among the study variables.

Table 6: Correlations Among Study Variables

Variables	1	2	3	4	5	6	7	8	9
1. Expert and Referent Power	–	0.662**	–0.062	0.375**	0.767**	0.401**	–0.512**	0.554**	0.425**
2. Reward Power		–	–0.013	0.255**	0.668**	0.315**	–0.435**	0.411**	0.275**
3. Coercive Power			–	0.322**	–0.104	–0.144**	0.279**	0.192**	0.069
4. Legitimate Power				–	0.294**	0.248**	–0.018	0.668**	0.273**
5. Cooperative Style					–	0.576**	–0.615**	0.502**	0.304**
6. Avoiding Style						–	–0.292**	0.340**	0.033
7. Dominating Style							–	–0.127*	–0.340**
8. Behavioral Compliance								–	0.384**
9. Attitudinal Compliance									–

Notes: **Correlation is significant at the 0.01 level (two-tailed); *correlation is significant at the 0.05 level (two-tailed).

Before the regression analysis, the linearity of the model was checked by looking at the scatterplot matrices. The data were also examined to see whether the errors were normally distributed and the variances of the residuals were constant. The residual scatterplots were also checked and, overall, it was seen that these assumptions were met. In addition, multicollinearity was tested for by examining the variance inflation factor (VIF) values, eigenvalues, and the collinearity diagnostics table. Table 6 indicates that there are significant correlations between some of the independent study variables (such as “expert and referent power” and cooperative CMS). However, the additional multicollinearity tests listed indicate that multicollinearity was not a problem for this research.

Regression analyses were conducted between the independent and dependent variables, the results of which are shown in Table 7. In this table, only the significant results are listed. For the first analyses, the independent variables are CMSs and bases of leader power, and the dependent variable is compliance with the supervisor’s wishes. The findings indicate that cooperative (Factor 1) and dominating (Factor 3) CMSs, “expert and referent power” (Factor 1), and legitimate power (Factor 4) explain the variance of subordinate behavioral compliance. Legitimate power has the greatest explanatory power on behavioral compliance, compared to the other independent variables ($\beta = 0.497$).

Table 7: Regression Analyses for Compliance with the Supervisor’s Wishes

Dependent Variable: Behavioral Compliance (Factor 1)			
Independent Variables:	Beta	t-Value	p-Value*
Cooperative Style (Factor 1)	0.274	4.629	0.000
Dominating Style (Factor 3)	0.178	3.922	0.000
Expert and Referent Power (Factor 1)	0.248	4.430	0.000
Legitimate Power (Factor 4)	0.497	12.946	0.000
R = 0.765; Adjusted R ² = 0.580; F-value = 122.599; p-value = 0.000			
Dependent Variable: Attitudinal Compliance (Factor 2)			
Independent Variables:	Beta	t-Value	p-Value*
Avoiding Style (Factor 2)	–0.212	–4.151	0.000
Dominating Style (Factor 3)	–0.24	–4.137	0.000
Expert and Referent Power (Factor 1)	0.310	5.097	0.000
Legitimate Power (Factor 4)	0.205	3.987	0.000
R = 0.512; Adjusted R ² = 0.254; F-value = 30.893; p-value = 0.000			

Note: *One-tailed t-test significances.

Moreover, the outcomes pointed to avoiding (Factor 2) and dominating (Factor 3) CMSs, “expert and referent power” (Factor 1), and legitimate power (Factor 4) explaining the variance in subordinate attitudinal compliance. Avoiding and dominating CMS factors are negatively associated with attitudinal compliance, while the “expert and referent power” factor has the greatest explanatory power regarding attitudinal compliance compared to the other independent variables ($\beta = 0.310$).

5 Discussion

The first research hypothesis is “supervisors’ legitimate power positively influences subordinate behavioral compliance (1a) and attitudinal compliance (1b)”. This is accepted, and this underlines the importance of legitimate power in getting subordinate attitudinal compliance and behavioral compliance. The outcomes indicate that leaders’ legitimate power (meaning power based on their respective positions) is an effective tool to get IT professionals’ attitudinal compliance and behavioral compliance, simultaneously. The finding is in line with former studies. For instance, Meng et al.’s [2014] study on postdoctoral and PhD students at a science institution in the UK pointed to leader’s legitimate power being positively related to subordinates’ attitudinal and behavioral compliance.

The second hypothesis is “expert power positively influences subordinate behavioral compliance (2a) and attitudinal compliance (2b)”, while the third is “supervisors’ referent power positively influences subordinate behavioral compliance (3a) and attitudinal compliance (3b)”. During the factor analysis stage, the items belonging to expert and referent power loaded onto one factor, named as “expert and referent power”. Thus, the second and third hypotheses were not tested. The outcomes indicate that supervisors’ “expert and referent power” (that is, their expertise, special skill, knowledge, follower attention, respect, and/or admiration) positively influences employee behavioral and attitudinal compliance. Such results are in line with hypotheses (2a), (2b), (3a), (3b), and former literature. For instance, based on a literature review, Rahim and Buntzman [1989] concluded that, in general, expert, referent, and to some degree, legitimate power bases receive subordinate compliance. Moreover, Palenzuela [2001] investigated prekindergarten teachers’ perceptions of their supervisory relationship with their educational specialists. The outcomes show that the expert, legitimate, referent, and informational power bases of these specialists have the most influence on the attitudinal and behavioral compliance of teachers.

As a result of the factor analysis, it was seen that the integrating, compromising, and obliging CMS items loaded on one factor, named as “cooperative style”. Hence, hypotheses 4, 5, and 6 were not tested. The findings indicate that a cooperative style positively influences employee behavioral compliance, which is in line with the results of former studies. Chan et al. [2008] point out that previous research has found that managers’ cooperative CMS (integrating, obliging, and compromising) generally produces positive subordinate outcomes. The findings imply that when supervisors use more cooperative styles, IT professionals comply with their wishes more.

Hypothesis 7 is “supervisors’ avoiding CMS negatively influences subordinate attitudinal compliance” and hypothesis 8 is “supervisors’ dominating CMS negatively influences subordinate attitudinal compliance”. These hypotheses are both accepted. An avoiding style is associated with “low concern for self and for others” [Rahim and Buntzman, 1989, p. 197], while a dominating one involves “high concern for self and low concern for others” [Rahim and Buntzman, 1989, p. 197]. Dominating and avoiding styles are likely to result in an unfavorable evaluation by others [Singh, 2012]. In addition, as stated earlier, former studies indicate that managers’ demonstration of dominating and avoiding CMSs is related to negative employee outcomes [Chan et al., 2008]. Thus, it can be said that the hypothesis testing results are in line with results from former studies.

Moreover, even though it was not hypothesized, the outcomes indicate that dominating CMS positively influences employee behavioral compliance, while it negatively influences attitudinal compliance. Furthermore, dominating CMS may increase conflict, and the losing party could try to retaliate [Phillips and Gully, 2012]. Hence, supervisors should use dominating CMS with caution. In addition, according to the research outcomes, subordinates perceive that their supervisors use a cooperative style more than other

styles in dealing with conflict with their subordinates. The cooperative style is composed of items from the integrating, compromising, and obliging styles. Furthermore, the IT professionals indicated that their supervisors exerted “expert and referent power” more frequently than the other power bases. Moreover, it was reported that coercive power is the power basis least used by supervisors. Another research work conducted in the Turkish context was by Kozan et al. [2014], which involved the examination of the power bases and managerial intervention strategies vis-à-vis subordinates’ conflicts on a sample of 39 supervisors and 165 subordinates. This study was conducted with employees from different organizations in a variety of industries, including the textile, banking, mining, and government ministries. The contrasting findings indicated that supervisors use legitimate and expert power most, followed by referent power. The higher use of legitimate power seen in Kozan et al.’s [2014] study, compared to this current research, may be due to the differences in the research samples. In other words, their research did not involve targeting a specific group of professionals in Turkey, while this study was singly aimed at IT professionals. The results were expected because, in general, IT professionals are highly skilled and educated [Maudgalya et al., 2006], with a high need for learning and they possess a strong desire to be challenged [Lee, 2000]. Hence, IT supervisors may well prefer to use “expert and referent power” and the cooperative CMS more frequently to manage such a group of workers than their counterparts in other sectors.

6 Conclusion

While leadership, social power, and conflict management are widely researched concepts, these aspects still need further attention by scholars and practitioners alike, because they are highly critical issues for organizations. These matters are especially important for IT professionals, because, as stated earlier, they possess characteristics (such as high skill levels, education, and intelligence) that differ from those in many other professions [Maudgalya et al., 2006; Armstrong et al., 2007]. In addition, an operational IT infrastructure is highly important for competing in today’s business world.

The results of the study partially support the influence of leader power bases and styles of handling conflict on subordinate compliance. Furthermore, the outcomes underline that leaders’ expert and referent power, as well as legitimate power, need special attention. Leaders of IT professionals can use these findings in different ways. For instance, IT managers could use a combination of their expert and referent power bases to accomplish behavioral and attitudinal compliance of the employee. To utilize their expert power base, they could make their expertise easily accessible by subordinates when needed and recommend solutions to problems that employees are facing. In addition, it would be beneficial for IT managers to develop a good reputation for their work-related expertise. Moreover, to make use of a referent power base at work, organizations can hire IT supervisors who have charisma and who can get admiration, attention, and respect from IT employees. In addition, supervisors can aim to be role models or mentors to their subordinates. Legitimate power, which is the ability to influence because of a formal position [Spoelstra and Pienaar, 2008], can also be used to influence employee attitudinal and behavioral compliance.

In terms of legitimate power, it should be noted that today’s IT work environments require flexible work schedules [Richard, 2009] and have a less-distinct legitimate power structure. IT work environments vary from industry to industry, and in some branches, such as the software industry, there tends to be a laid-back, flexible workspace [Careers in Information Technology, 2009]. The lines of legitimate power are blurred in more-organic type of organizations such as these, and an employee may work for more than one boss at the same time. In addition, the leaders and subordinates may have almost equal organizational standing [Griffin and Moorhead, 2012]. Such issues may create challenges in terms of application of legitimate power to get IT employee compliance. Hence, these organizations could use different practices to make the authority of IT managers’ clearer, such as writing more detailed job descriptions for them and their subordinates. It would also be beneficial to define clearly the job responsibilities of IT employees who work on different projects at the same time, under the supervision of different managers.

Moreover, the research outcomes show that special attention should be given to the leader’s cooperative CMS. Cooperative CMSs (integrating, obliging, and compromising) focus on satisfying others’ concerns

[Chan et al., 2008]. IT supervisors could apply cooperative CMS to achieve employee behavioral compliance. IT leaders might utilize cooperative CMS with subordinates by applying techniques such as openness, exchange of information, minimizing differences, and emphasizing common points, or even making sacrifices, depending on the situation. Furthermore, leaders' avoiding and dominating CMSs should be used with caution, because both of these styles negatively influence subordinate attitudinal compliance. However, such CMSs could be used when the situation requires them. For instance, a downsizing situation may require a manager to utilize dominating CMS, and the supervisor might be obligated to make decisions that will not be well received [Collins and O'Rourke, 2009]. In contrast, an avoiding CMS may be beneficial when issues are not important or when the costs related with challenging someone outweigh the benefits [Tosi and Plati, 2011]. Moreover, IT leaders are encouraged to assess their preferred power bases and CMSs with subordinates, as well as the influence of these factors on subordinate compliance, in order to increase their leadership effectiveness. For such assessment, organizations can offer leaders development opportunities, such as executive coaching or management development training.

With these findings, this research has contributed to the literature in several different ways. As stated earlier, different cultures necessitate different managerial practices [Pasa et al., 2001]. This research has provided contributions to the existing literature by examining leadership practices in the Turkish IT industry. In addition, as previously discussed, there is scarce empirical research that examines the relationship between leader styles in relation to handling conflict and subordinate compliance. This study has added to the literature by investigating the association between these variables. Moreover, in the Turkish context, there has been limited research conducted on different industries in which IT professionals work. This study questionnaire has been administered to IT professionals employed in various industries. Furthermore, the Turkish IT market is one of the fastest-developing ones in Europe [Turkey Information Technology Report, 2011] and, hence, this situation increases the importance of this study.

Some of the limitations of this study also need to be noted. First of all, the data were collected through responses to questionnaires from IT professionals with self-reported measures. Hence, the answers represented the perceptions of employees, such as those about supervisors' use of power bases or conflict handling styles with subordinates. This is a limitation, because both the independent and dependent variables were collected from the same source, which could have led to common method variance due to single-source bias. Second, convenience and snowball sampling were used to collect data, which might limit the generalizability of the survey results. Moreover, the data collection was conducted through an online survey website. Even though using the Internet ensured the confidentiality of responses and helped reaching a wide range of participants, it also limited tracking the number of leaders who were evaluated and the names of the organizations in which the participants work. However, asking questions that could have identified the respondents' leader or organization name would have restricted their willingness to complete the questionnaire. Furthermore, it is common for IT professionals to work on more than one project at the same time [Schwalbe, 2011]. Thus, if a respondent has more than one supervisor, the IT professional may hesitate about which one of the supervisors he/she should consider when answering the questionnaire. These issues should be taken into account in future studies deploying the research model.

Some aspects of this study need to be investigated with further research. Future studies could test alternative models with additional variables, such as organizational climate, different leadership styles (e.g., transactional or transformational), employee role ambiguity, role conflict, or intention to quit. In addition, the sample size could be increased to test the validity of the hypothesized model. Moreover, in this research, participants employed in different industries completed the survey instrument. This study could thus be replicated to conduct industry-specific analyses (such as for the financial activities, manufacturing, or education industries).

In this research, to measure leaders' styles of handling conflict with subordinates, the ROCI-II (1983) was used. After conducting the data analysis, it was seen that some of the items in the scale did not aggregate under the proposed subscales. As indicated earlier in this study, such a result might be due to cultural differences or participants' occupational differences. In future studies, additional modifications could be made to the scale to account for the Turkish context and the IT profession. Furthermore, for this research, questionnaires were used to collect data. Future studies could also use qualitative research methods (such

as interviews or focus groups) to generate more insights and expand our understanding on the subject. In addition, future studies on this topic, especially in non-Western settings, would prove fruitful.

Overall, the outcomes of this study can benefit organizational leaders and human resource practitioners in terms of understanding the influence of leaders' bases of power and styles of handling conflict on IT professionals' attitudinal and behavioral compliance. The results may also be useful for organizations in increasing leadership effectiveness and delivering better management of IT human capital.

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Research Article

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Explicit and Implicit Factors That Determine Private Labels' Possible Purchase: Eyetracking and EEG Research

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Abstract: Objective: This paper investigates the explicit and implicit factors affecting private-label (PL) products' possible purchase decision for different retailers. Design: The study uses eyetracking and electroencephalography (EEG) to explore the differences in eye movement and brain activity for PL products. This article examines how approach motivation, measured by total fixation duration and by EEG asymmetry over the frontal hemisphere of the brain, predicts PL purchase decision. Findings: This study investigates implicit variables that can influence consumers' willingness to PL purchase. The relatively greater left frontal activation (i.e., higher approach motivation) during the predecision period predicted an affirmative purchase decision in some cases. The eyetracking study did not reveal differences between women's and men's esthetics sensitivity toward the presented PL products. EEG research proved that consumers were not influenced by the PL product price. Originality/value: Literature lacks credible information on young buyers' behavior in the context of PL products. This paper elaborates on PL perception, revealing the neural origins of the associated psychological processes.

Keywords: neuromarketing, EEG, eyetracking, private labels, consumer behavior

JEL codes: M31, L81

1 Introduction and Background

1.1 The Concept of Neuromarketing

While neuromarketing (NM) research methods are gaining popularity, there is still insufficient exemplification of their actual application. NM has emerged after the applicable concepts were brought together from the field of neural science. In the past few years, it has been one of the most commonly applied concepts, making use of brain research in a managerial context, slowly and steadily gaining considerable attention from academia and practitioners [Agarwal, 2015]. At its core, NM aims to better understand the impact of marketing stimuli, by examining and interpreting human emotions [Thomas, 2017]. Calvert and Brammer [2012] define NM as the application of cognitive neuroscientific tools in marketing in order to measure the unconscious responses of consumers. This tool can provide measures of hidden preferences and of implicit processes [Venkatraman et al., 2012]. NM possesses knowledge on subjects' perception and

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memory and thus can be applied in real-life marketing situations [Sharma et al., 2010]. According to Häusel [2007], it can help in gaining understanding of the unconscious decision-making processes and the neural mechanisms which they are based on, since it focuses on assessing consumers' cognitive and emotional responses to various marketing stimuli [Karmarkar, 2011]. Classic marketing methods (which harvest qualitative, subjective data) do not carry the same degree of accuracy regarding the decision-making process as NM does [Ariely and Berns, 2010]. Zurawicki [2010] highlights that the major part in decision-making is governed by unconscious processes, which need to be studied for obtaining better understanding of the human decision-making process.

1.2 NM Methods

There are different tools and methods in neuroscience that can be applied in marketing to determine consumer reactions and decision-making, which can be grouped into 3 categories, based on the purpose for which they are used. Functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) record the metabolic reactions occurring in the brain, to localize and exhibit neural activity, by measuring the changes that occur in the blood flow. Electroencephalography (EEG), magnetoencephalography (MEG), steady-state topography (SST), and transcranial magnetic stimulation (TMS) monitor and document electric activity in the brain to measure the frequency of electrical current and electrochemical changes in the signals. And the last group – nonneurological tools – contains the biometric and other body response tools, measuring specific elements of the body (e.g., skin, face, and eye – to read the responses of these body parts to stimuli) [Bulley et al., 2016, p. 271]. EEG, fMRI, and MEG rank among the most frequently used NM technologies [Goker and Dursun, 2016, p. 158]. Some authors suggest that the greatest benefit can be probably derived from combining the use of multiple technologies. Brain imaging tools (such as EEG) and physiological measures (such as eyetracking [ET]) can be used to predict the engagement and vigilance decrement during various tasks [Berka et al., 2007; Martel et al., 2014]. According to Zurawicki [2010], EEG integrated with ET is a better predictor of consumer behavior than any of these 2 tools alone. Similarly, Ohme et al. [2011] clarify that combining EEG with ET can enrich marketing research on static advertising. The integration of EEG and ET measures offers deeper understanding of the emotional reactions experienced by a consumer while seeing a chosen stimulus (e.g., product or advertisement). Bridger [2015, p. 183] explains that, in theory, this can be a good combination that can provide more-specific interpretation of how people are reacting to each stimulus. Such an integrated approach can identify a causal relationship between marketing communication and emotions on an analytical level. Pairing ET with biometric data gives the opportunity to collect unbiased, behavioral, quantitative data.

1.3 EEG Studies

EEG allows for the monitoring of large-scale human brain activity patterns noninvasively and with millisecond precision. It measures changes in the electrical fields of the brain by reading electrical signals as they register with varying degrees of frequency and amplitude across a series of electrodes applied to the scalp [Ariely and Berns, 2010]. EEG captures variations in brain waves, and the amplitudes of the recorded brain waves correspond to certain mental states when the brain undergoes any stimulus [Agarwal and Xavier, 2015, p. 31]. For standardization reasons, the International 10-20 system (where 16-20 electrodes are separated by 10%–20% the total distance around the circumference of the head) has been used to describe the locations of EEG scalp electrodes relative to anatomic landmarks on the human head to minimize the variation in electrode placement [Freeman and Quian Quiroga, 2013, p. 5]. Some alternatives, providing for a larger number of channels, have been proposed. A revised system, called the 10-10 electrode placement system is based on the same landmarks as the 10-20 system, but it involves the addition of electrodes¹. More closely spaced electrodes in the 10-10 system clearly provide better spatial resolution [Acharya et al., 2013]. The most commonly noted, commonly present, and easily recognized rhythm in clinical EEG interpretation is the alpha

¹ The modified 10-10 terminology replaces the inconsistent T3/T4 and T5/T6 terms with the consistent terms T7/T8 and P7/P8.

rhythm. It has a frequency of 8–13 Hz, with amplitude between 40 and 50 mV in adults, and is present over the posterior head regions. Alpha activity can be suppressed or desynchronized when individuals open their eyes, engage in mental activity, or become alert or drowsy [Pizzagalli, 2007], so it attenuates or disappears with concentration, drowsiness, stimulation, or visual fixation [Stern, 2013]. According to Winkler et al. [2010, p. 373], the phenomenon of frontal EEG asymmetry has played a prominent role in research on emotions. Frontal asymmetry in alpha oscillations has been studied in research on individual differences in emotional and motivational processes. It refers to the average difference in brain activity between the left and right frontal areas, measured as hemispheric differences in alpha power in EEG recordings [Harmon-Jones et al., 2010]. Frontal asymmetry, assumed to be associated with individual differences in emotional responses [Quaedflieg et al., 2015], can be extracted using EEG headsets with electrodes located at frontal scalp regions (ideally, F3 and F4). John's [1977] neurometric analytic approach to quantitative EEG typically defined amplitude asymmetry of transformed measures at specific electrode sites by the following ratio: Brain symmetry index (BSI) = $(\text{left} - \text{right}) / (\text{left} + \text{right})$. As in previous research, a frontal asymmetry index was computed as follows: $\log(\text{alpha EEG power right F4}) - \log(\text{alpha EEG power left F3})$ [Allen et al., 2004]. This index captures a particular asymmetry in spectral power between hemispheres and is normalized between 0 (perfect symmetry) and 1 (maximal asymmetry) [Billeci et al., 2013]. The excellent time resolution of the EEG allows for the analysis of short-term changes in motivation over the course of a stimulus presentation (e.g., picture of a product/s). According to Davidson's [1993] influential approach/withdraw motivational model of emotion, left frontal activity indicates a positive (or approach-related) emotion, whereas higher right frontal activity indicates a negative (or withdrawal-related) emotion. It should be emphasized that the EEG's sensors are sensitive to a certain amount of artifacts, so it is important to create a recording environment that minimizes the potential for ambient artifacts [Gutberlet et al., 2009, p. 34]. This term refers to any electrical potential that is recorded on an EEG but does not originate in the brain (they can be both physiological and nonphysiological) [Freeman and Quiñan Quiroga, 2013].

1.4 ET Studies

ET is used for the analysis of visual attention and, from the perspective of NM, it seeks to associate visual attention with the cognitive and emotional responses of consumers [Santos et al. 2015, p. 32]. According to Romano-Bergstom and Schall [2014, p. 6], an eyetracker can be a powerful tool that gives researchers a highly accurate representation and understanding of a respondent's eye movement behavior. Most modern eyetrackers rely on a method called corneal reflection to track the location of the eye as it moves. In this case, light source is used to illuminate the eye, which then causes a reflection that is detected by a high-resolution camera. The captured image is used to identify the reflection of the light source on the cornea and in the pupil. Then, advanced image-processing algorithms are used to establish the point of gaze related to the eye and the stimuli [Romano-Bergstom and Schall, 2014, p. 3–4]. In order to understand the ET operation, basic attributes must be clarified. The location of the user's eye gaze at a particular moment in time provided the most basic unit of analysis for visual attention understanding. Generally, eye movements consist of a series of fixations and saccades while viewing images or reading information. The duration describes the length of time that a user fixates on a particular area on the screen. It is used to understand whether the subject is paying attention to a specific visual element. A fixation is usually defined as a relatively stable state of eye movement (ranges from 100 to 500 ms, depending on the viewed materials), and a saccade as the rapid eye movement between 2 consecutive fixations [Rodrigues and Rosa, 2017, p. 4]. During fixations, the eye is almost completely still and information can be extracted from a stimulus; during saccades, the focus of visual attention is moved to another location [Azevedo and Alevelen, 2013, p. 9]. Long prevalence at a certain region points to a high level of interest, while shorter prevalence times may indicate that other areas on the screen might be more catchy [Imotions 2015]. Duchowski [2007, p. 173], among the most common set of ET metrics, listed fixation (and its duration, rate, mean, and number), scan path, area of interest (AOI), gaze% of AOI, number of fixations per AOI, and mean gaze duration per AOI. Fixations can be mapped to specific x - and y -coordinates on a grid that help pinpoint where the user looked on a given display, but it does not necessarily mean that the user really saw it or that it registered cognitively in his/her brain. To interpret

ET data, the researcher must choose some aspects (dependent variable or metrics) to analyze in the data stream. It is difficult to provide general guidelines to suit all specific experiments. The aim here was to provide something of a workable context or framework for designing an ET study.

1.5 The Growth of Private-Label Brands

According to Sebri and Zaccour [2017], private labels (PLs) (brands sold exclusively by retailers) are no longer a marginal phenomenon in retailing. Cuneo et al. [2015] suggest that PLs have become a challenge for manufacturer brands, as evidenced by PLs' impressive growth over the past decade, having earned the trust of a large number of customers [Lamey et al., 2012]. The latest Private Label Manufacturers Association (PLMA) [2017] data shows that the popularity of PL keeps growing across Europe, with increasing interest in this topic among both managers and academic researchers [Koschate-Fischer et al., 2014]. The 2017 *Yearbook* statistics reveals that PL's market share reached all-time highs in 9 European countries. Poland led the way among the Central and Eastern European countries, climbing 1.4 points to cross over the 30% market share mark (the PLs' market value was estimated at >PLN 48 billion, by experts brought together for the 4th Future Private Labels Exhibition and Conference in Targi Kielce), just behind the biggest market share increases posted in Austria and Germany.

Noormann and Tillmanns [2017] notice that, recently, the positioning of PLs in consumers' minds seems to have changed. For the consumer, PL represents the choice and opportunity to regularly purchase good-quality food and nonfood products with savings compared to purchasing manufacturer brands (without waiting for discount). The PLMA report [2017] indicates that PL products consist of the same or better ingredients than the manufacturer brands, and because the retailer's name or symbol is on the package, the consumer is assured that the product meets the retailer's quality standards and specifications.

Most of the scientific interest in PLs is in terms of the impact they have on the food market with reference to national brands [Gaviglio et al., 2015], since PLs have gained an increasing share of the food market [Ailawadi et al., 2008], with a growth rate twice as high as for national brands [Martenson, 2007]. Doyle [2013] explains that customers show different responses to different categories of PLs and, in terms of beauty products, consumers feel bigger personal risk, making this category problematic for PL producers to increase their market shares. However, major supermarkets and hypermarkets now offer almost any product under the retailer's brand (PLs cover, inter alia, full lines of health and beauty, over-the-counter drugs, cosmetics, as well as household and laundry products). Moreover, among the 10 top categories in store brands, dollars, and unit sales gains by channel in the U.S. PL market for supermarkets, PLMA [2017] listed predominantly nonfood sections. The illustrative list included, inter alia, seasonal general merchandise, women's fragrances, fresheners and deodorizers, total grooming aids, buckets and bins, as well as bath accessories, which offers an interesting snapshot of where opportunistic store brand innovation and growth are taking place.

2 Methodology

A total of 16 healthy right-handed² respondents (8 female, 8 male)³ in the age group of 21–30 years (mean = 26 years and SD = 3 years), participated in the EEG and ET study conducted simultaneously. Subjects were informed about all factors that constituted potential contraindications in EEG research, such as

² Only right-handed individuals were chosen, because of the differences that occur in brain lateralization between right- and left-handed persons.

³ It should be pointed out that there is no one sample size appropriate for all eyetracking and EEG studies. As in any other type of study, the sample size depends on multiple factors, including research objectives and study design [Bojko and Adamczyk, 2010]. Literature review revealed that reasonable minimum eyetracking sample size ranged from 12 [Bertola and Balk, 2011] to 16 participants [Glaholt and Reingold, 2011], as well as 10 participants in case of EEG research [i.e., Vijayalakshmi et al., 2010]. Usually, in EEG consumer preference research, the sample consists of 15 [i.e., Telpaz et al., 2015] to 20 consumers [i.e. Aprilianty and Purwanegara, 2016]. The results of the research by Indira et al. [2012] on EEG research proved that "it was evident that 16 samples per class are required in order to have a power level of 95% and an α error probability of 5%". The general rule of thumb in literature is 10–20 subjects per group in a directional assessment of observable behaviors, but adding statistical comparisons requires larger samples, even up to 50 participants [Eyetracking, 2018].

neurological and sleep disorders, being under the influence of stimulants/sedatives and psychoactive substances (including strong coffee or tea), as well as the restrictions on ET research (which included, among others, nystagmus, vision defects >3 D [diopters]). With these constraints, a homogeneous group in terms of gender, age, and laterality was recruited, which is important in experiments such as this. When recruiting subjects for the study, a determinant criterion was that they had to have been shopping on a weekly basis in supermarkets that have both national and own-label branded products. This guaranteed that the subjects were aware of the existence of national and PL products and also guaranteed that they were acquainted with market prices. Pictures of high-quality products were combined on the gray board (instead of white, in order to avoid distracting the participants).

EEG and eye movements were recorded simultaneously after participants were informed about the procedure and the purpose of the study and they had signed an informed consent. Anonymization of the participants was followed. The research was conducted in a protected environment, under strict hygiene conditions. All subjects received financial compensation for their participation. B-Alert X10 wireless EEG Headset System (Advanced Brain Monitoring), with the 9-channel combination of midline and lateral EEG sites placed according to the International 10–10 system, was used. The impedance of all electrodes was reduced to <40 k Ω . The data were recorded at a sampling rate of 256 Hz and online bandpass filtered between 0.1 Hz and 100 Hz. A set of baseline tasks (3 minutes: a 3-choice vigilance task, an eyes-open rest task, and an eyes-closed task) was performed to ensure that the EEG system was working properly. Participants were instructed to remain relaxed for the duration of the recording. Once the EEG baseline was complete, the participant underwent a calibration procedure to align the eyetracker coordinate system (Tobii X-60) with that of the monitor (Dell PC with 21" screen) displaying the content. This eyetracker has an accuracy of 0.5, which averages to 15 pixels of error, with a drift factor of <0.3 and a sampling rate of 60 Hz. To calibrate the eye position, a 9-point grid was used. The experiment was carried out in a quiet room with controlled level of luminance. The eye tracker was recalibrated for each subject to provide accurate measurements for the participant's gaze during the experiments. IMotions (version 6.0) software platform was used to integrate ET and EEG data. Detecting and removing artifacts in the EEG data due to muscle activity, eye blinks, electrical noise, etc., is an important problem in EEG signal-processing research. Advanced brain-monitoring algorithm was used to detect and automatically clean the artifacts in the EEG signal (in the time domain related to amplifier saturation and deviations). Discrete wavelet transform was used for denoising nonstationary signals, such as blink artifacts and muscle movements). After the decontamination, the EEG signal was analyzed in a second step. The main aim of this research is to identify the implicit factors that determine young customers' behavior in the process of buying PL products of distributive networks in Poland. Consumers' decision-making processes are way more complicated than any single construct could possibly and clearly explain [Weib, 2015, p. 203].

First of all, there are important biological and behavioral differences between the 2 genders [Regitz-Zagrosek, 2012, p. 596]. In the marketing literature, researchers have examined gender differences in different streams of research, such as message processing, price promotions, impulse purchases, advertising, and attitudes toward shopping forms [Sohail, 2015, p. 36]. In terms of PL products, there are important differences between men and women in their behavioral attitude toward the PL's packaging. In the literature on the subject, it is said that women seem to possess a higher esthetic sensitivity to the design of products [Krishna, 2006, p. 3]. Gender had a significant influence, in that females indicated attaching more importance to esthetics than males [Creusen, 2010, p. 29–30]. The esthetics is basically in the eyes, and the perception formed is based on the senses of the observer [Baisya and Das, 2008, p. 24]. Thus, the first hypothesis reflects this difference.

H1. Women possess a relatively greater esthetic sensitivity to the private-label product's appearance than men.

The term "esthetic sensitivity" needs to be operationalized. The total fixation time (total duration of all fixations) on the certain AOI during the participant's evaluation of each of the presented product's esthetics was adopted. It is assumed that the longer the subject is looking, the more he or she is sensitive to esthetic aspects. Eventually, the hypothesis took a measurable form: women's total fixation time within particular product categories will be longer than men's.

An important factor in the purchase decision-making process is price, specifically, price in relation to the product's value [Schindler, 2012, p. 6]. It has been observed that many consumers are sensitive to price while making purchase decisions [Vicdan et al., 2007]. It is also assumed that perceptions of quality are positively correlated with price [Rao and Monroe, 1989]. In the past, there was a general assumption that PLs were for low-income households or those that needed to economize by buying bigger sizes [Lincoln and Thomassen, 2008, p. 25]. Nowadays, it is rather considered smart shopping to purchase PL products of supposedly comparable quality for a much lower price [Kumar and Steenkamp, 2007, p. 12]. PL brands have become increasingly essential in the marketplace, since they have come to represent better selection, value, and savings for many consumers [Wu, 2016, p. 3]. Because price is a differentiating characteristic, allowing for distinguishing between PL brands (despite the similar price), its influence is also studied [Santos et al., 2016].

H2. The price knowledge will not affect the subjects' private-label products' purchase decision within particular retailers.

This hypothesis is verified by comparing the choices measured on the Juster scale in the 2 parts of the research (products projected without and with the product market price).

According to Smith [2014], price is not the only decisive factor in the customers' purchasing decisions. Identifying the motives that underlie a buying decision is sometimes quite easy, but at other times, it may be impossible. Buying motives can be grouped into 3 levels: conscious, preconscious, and latent, depending on the buyer's awareness of them and willingness to divulge them. At the third, latent level, customers cannot explain the factors motivating their buying actions because these are unconscious or subconscious motives [Cant et al., 2009, p. 77]. To further complicate the situation, a purchase is often a result of multiple reasons (even in conflict with another). Implicit attitude measures are valid predictors of behavior across very different domains, including person perception, nonverbal behaviors, and consumer choices [Greenwald et al., 2009]. Therefore, it is proposed the following:

H3. Young customers' behavior in the process of buying private-label products of distributive networks can be highly affected not only by declared, but also by latent, factors.

Indirect measurement was used to detect implicit factors determining customers' attitude toward private labels (respondent's task was to watch and evaluate different products).

3 Procedure

A 10 (Product Category) \times 6 (Brand) \times 2 (Variant) within-subjects design was used. As the majority of consumer studies on PLs focus on the food market [i.e., Marques dos Santos et al., 2016], both food products and body care products were taken into consideration in order to look for potential differences in purchase decision-making. Seven food product categories (chips, chocolate, biscuits, cornflakes, jam, milk, and juice) and 3 hygiene-related products (tissues, toilet paper, and liquid soap) were selected for the research. For each product category, 6 products were chosen from different retailers: Auchan, Biedronka, Lidl, Piotr i Paweł, Stokrotka, and Tesco. The selection of product categories was based on the product's similarity to branded products in terms of their potential attractiveness to the young customers and the everyday usage. The third factor included variants without showing the price and with normal price to control for the meaning of this factor. Products were displayed in random order, to minimize the risk of achieving the same scan path for each retailer's product combination.

During the experiment, the participant filled in a questionnaire on the computer where they rated each of the products on 2 dimensions. Perceived product esthetic appearance was rated on a 6-point scale, ranging from 1 (poor) to 6 (high). Perceived likelihood of buying the product was also rated, but using the Juster scale, ranging from 0 (not at all) to 11 (for sure).

Before the study itself, the participants were asked about prompted awareness of different PL brands (the name of which was not identical with the retailer's). The most popular ones were Biedronka's brands, bought by 10 participants. However, the respondents declared purchasing PL at least from 2 retailers.

Additionally, subjects made an evaluation of the retailers' service quality based on the following aspects: 1 – price/quality ratio, 2 – friendly service, 3 – vast offer, 4 – organized merchandise spacing, 5 – efficient cashier's service, 6 – nice atmosphere, 7 – store reputation, and 8 – retailer image, in order to determine their preferences that lead toward the point of purchase. Cronbach's alpha⁴ is considered to be a measure of scale reliability. The alpha coefficient for the 8 items was 0.863, suggesting that the items have relatively high internal consistency. Average notes for each retailer were quite approximate, and their ranges were between 31 and 34 points (only the Polish retailer Piotr i Paweł got a higher score – 38 points). Surprisingly, while analyzing notes given by individuals, one could notice huge discrepancies between the respondents (i.e., service quality in Auchan ranged between 16 and 48 points).

Subsequently, it was examined whether women and men may vary, depending on the following variables: age, income, PL familiarity, and combined service quality. The results revealed only 1 statistically significant variable differentiating females and males: only service quality assessment, and that too only in the case of 1 retailer, namely, Piotr i Paweł. Mann–Whitney *U*-test revealed that women evaluated service quality significantly higher (median = 40) than men (median = 35), $U = 10$, $p < 0.05$.

4 Findings

In the ET study, there was a hypothesis (H1) predicting that women's total fixation time within particular product categories are longer than men's, due to their sensitivity to esthetics. Because the assumption of the normality of data was not met, a nonparametric version of the test was used. There were no statistically significant differences in women's and men's total fixation time within food and hygiene product categories in the 2 research parts ($p < 0.05$). Even when the significance threshold was 0.1, there were no differences between female and male total fixation times spent viewing and evaluating product esthetics in both categories (Table 1). Therefore, Hypothesis 1 was negatively verified. Hypothesis 2 from EEG research suggested that knowledge of the PL products' price will not affect the subjects' PL products purchase decision. A small sample determined the choice of the Wilcoxon signed-rank test, which is a useful nonparametric alternative to the dependent samples *t*-test, used to make a comparison between 2 dependent groups. Dependence test analyses did not reveal a significant difference ($p < 0.05$) between PL products without and with the market price for both product categories within particular retailers. Afterward, a frontal asymmetry index in alpha oscillation at F4–F3 was computed for each period using midfrontal sites. Positive alpha asymmetry scores indicate greater relative left than right frontal activity (either as a trait or a state, indicates a propensity to approach or engage a stimulus), while negative alpha asymmetry scores indicate greater relative right than left frontal activity (indicates a propensity to withdraw or disengage from a stimulus). This coefficient might not always be correlated with subjects' declarations; therefore, it was computed despite obtaining nonsignificant Juster scale results. The results did not reveal significant main effects ($p < 0.05$) for both variants, within particular retailers and product categories (Table 2), which means that H2 was positively verified.

Finally, Hypothesis 3 predicted that young customers' behavior in terms of PL product assessment and willingness to buy them can be affected not only by declared factors (age, income, esthetic assessment, PL familiarity, and service quality) but also by implicit factors (frontal EEG alpha asymmetry) and esthetic sensitivity (measured by the eyetracker). Based on the results from the previous analysis, in this case also, results were averaged over both parts of the study. SPSS was used to calculate the Spearman's (rho) correlation coefficients between the explicit and implicit variables with the probability of a future PL purchase (on a Juster scale). Table 3 contains several variables that are statistically significant for each retailer (only in the case of Stokrotka brand, statistically significant results were not achieved at all, perhaps due to the declared unfamiliarity of the brand and its products).

⁴ Cronbach's alpha for each retailer was as follows: Auchan – 0.881; Piotr i Paweł – 0.814; Tesco – 0.808; Lidl 0.835; Biedronka 0.875; Stokrotka – no adequate data due to the retailer's unfamiliarity.

Table 1. Comparisons between genders in terms of total fixation time for both product categories (version with the price)

	A	B	L	S	P	T
Food products						
Mann–Whitney <i>U</i>	26.000	27.000	31.000	30.000	32.000	23.000
Wilcoxon <i>W</i>	62.000	63.000	67.000	66.000	68.000	59.000
<i>Z</i>	−0.630	−0.525	−0.105	−0.210	0.000	−0.954
Asymp. sig. ^a	0.529	0.600	0.916	0.834	1.000	0.345
Exact sig. ^b	0.574 ^b	0.645 ^b	0.959 ^b	0.878 ^b	1.000 ^b	0.382 ^b
Hygiene products						
Mann–Whitney <i>U</i>	25.000	30.000	26.000	21.000	32.000	26.500
Wilcoxon <i>W</i>	61.000	66.000	62.000	57.000	68.000	62.500
<i>Z</i>	−0.735	−0.210	−0.630	−1.155	0.000	−0.578
Asymp. sig. ^a	0.462	0.834	0.529	0.248	1.000	0.563
Exact sig. ^b	0.505 ^c	0.878 ^c	0.574 ^c	0.279 ^c	1.000 ^c	0.574 ^c

Notes: Grouping variable – gender, ^a2-tailed; ^b2*1-tailed sig.; ^cnot corrected for ties. A – Auchan, B – Biedronka, L – Lidl, S – Stokrotka, P – Piotr i Paweł, and T – Tesco.

Abbreviations: Asymp. = asymptotic; sig. = significance.

Table 2. Comparing the price knowledge in terms of frontal alpha asymmetry measurement for both product categories

	A	B	L	S	P	T
Food products						
<i>Z</i>	−1.647 ^a	−0.625 ^a	−1.155 ^b	−0.582 ^b	−1.306 ^a	−1.874 ^a
Asymp. sig.*	0.100	0.532	0.125	0.394	0.191	0.061
Hygiene products						
<i>Z</i>	−1.533 ^b	−0.144 ^b	−0.966 ^a	−1.420 ^b	−0.057 ^a	−0.852 ^b
Asymp. sig.*	0.125	0.900	0.334	0.156	0.955	0.394

Notes: ^aBased on positive ranks; ^bbased on negative ranks; *2-tailed.

Abbreviations: Asymp. = asymptotic; sig. = significance.

Table 3. Spearman correlations between private-label purchase probability and the categories explicit and implicit variables

Mean Q	Explicit factors						Implicit factors		
	F/H	Age	Income	Esthetic assessment	PL familiarity	Service quality	Mean EEG – purchase probability assessment	Mean EEG – esthetics	Mean ET – esthetic sensitivity
Auchan	F	0.512				0.669		−0.462	
	H			−0.441					
Biedronka	F			0.741			0.544		
	H				0.559				0.440
Lidl	F					0.616			
	H		0.600				−0.572		
Piotr i Paweł	F								
	H	−0.472							
Tesco	F								
	H							0.680	

Notes: Statistically significant ($p < 0.05$) findings are in bold. For other results, p -value was < 0.1 .

Abbreviations: EEG = electroencephalography; ET = eyetracking; F = food; H = hygiene; PL = private label.

As predicted, the results revealed a significant main effect for the explicit and implicit variables, correlated with the predicting of purchase decision evaluated by the subjects. However, the unequivocal correlation cannot be definite, due to the fact that correlation is greatly dependent on the specific retailer, as well as on the product category. The purchase probability (measured on a Juster scale) was statistically significantly correlated at least with every variable for at least 1 retailer. For a significance level of 0.05, the purchase probability was moderately correlated with almost every implicit and explicit variable, except for the esthetics assessment for food from Biedronka (a strong correlation). Tesco's food product purchase probability intent was not significantly associated with any explicit variables, as were the Piotr i Paweł's hygiene products with any implicit variables.

Basically, the majority of foodstuffs' correlations were positive (except for esthetics' frontal alpha asymmetry for Auchan). Such regularity was not observed in the case of hygiene products. Moreover, for 2 retailers, some correlations were positive, while for others, negative. In case of Lidl hygiene products, purchase probability was positively correlated with the participant income, whereas negatively with the frontal alpha asymmetry (for product esthetics). In addition, in the case of Auchan, correlation coefficients were positive between PL purchase probability and the factors age and service quality; the coefficients were negative for esthetics (frontal alpha asymmetry).

Nine out of 13 correlations were positive, and this constitutes a logical relationship. The better the perception of PL products, the more willing are the participants to buy this type of goods. PL purchase probability tends to increase with age and income (people have their own money and gain buyers' experience). It is worth looking for answers and explanations for the negative correlations. There was a negative moderate association between probable purchase decision and the declared esthetics assessment for Auchan hygiene products ($p < 0.1$). This relationship would lack any entrepreneurial or economic logic. The increasing esthetics mark being connected with decreasing purchase probability decision is difficult to interpret, and further investigations should be carried out to clarify that relationship. Subjects did not declare the acquisition of Auchan's hygiene products, therefore such articles were unknown. It may be assumed that the commitment to the branded products from that category may have a huge impact on their unconscious decisions. Moreover, it should be noted that mean esthetics assessment for Auchan hygiene products was the lowest among all retailers (only 1.60, on a scale from 1 to 6), just as the perceived likelihood of buying (3.19 on a Juster scale). A slightly different situation occurred in the negative correlation between hygiene PL probable purchase and the participant's age in the case of Piotr i Paweł products ($p < 0.1$). Here, the relationship indicated that the likelihood of buying declines significantly as people get older. As consumers gain shopping experience and have increasing possession of financial resources, they may have higher expectations of PLs and decide to buy only branded products.

In case of the implicit variables' (frontal EEG asymmetry and ET fixations) correlations, 2 were negative and 3 were positive. Since alpha power is inversely related to cortical activity, positive alpha asymmetry scores reflect relatively greater left frontal cortical activity and negative alpha asymmetry scores reflect relatively greater right frontal cortical activity (Allen et al., 2004). For different retailers, different levels of correlation were obtained. Biedronka's food products purchase probability was positively correlated with frontal alpha asymmetry ($p < 0.05$). In other words, the relatively greater the left frontal activation experienced (higher approach motivation when seeing an image of a product), the more likely the participant was to purchase a product. However, in the case of Lidl's hygiene products, the purchase probability were negatively correlated with frontal EEG asymmetry scores, meaning that there was negative or withdrawal-related motivation, connected with an increasing likelihood of consumer purchase decision. An analogous situation arises from the esthetics frontal EEG asymmetry scores ($p < 0.1$) for Auchan's foodstuff purchase probability. These results are not in line with logic and are difficult to interpret; therefore, they require further investigation. For Tesco's hygiene products, purchase probability was positively correlated ($p < 0.1$) with frontal asymmetry for products' esthetics, indicating an approach motivation.

The fixation duration was positively associated with an affirmative purchase decision. Such a relation for Biedronka's hygiene products ($p < 0.1$) means that the longer the participants maintain the gaze in a constant direction (the longer the total fixation time), the greater is the likelihood of buying PL products. It is possible that the longer the respondents view the products, the more attractive they seem, and that enhances purchase opportunities.

5 Discussion

Based on the conducted NM research, it appears that consumers are influenced by a number of different factors when making a PL assessment and declaring the PL purchase probability. In the present investigation, the author examined (a) how the gender of a young customer determines the level of sensitivity toward esthetical aspects in terms of implicit attitude toward PLs, (b) whether a relatively low price of PL does not matter during PL purchase decision-making, and (c) the explicit and implicit factors determining young customers' probable behavior in the process of buying PL products of distributive networks. All the hypotheses except for H1 are accepted. As opposed to the H1 expectation, gender differences do not exist in consumers' PL product esthetics assessment within food and hygiene product categories in the 2 research parts ($p < 0.05$). In agreement with H2, the knowledge of the PL products' price does not affect the subjects' PL product purchase decision. To test H3, Spearman's (ρ) correlation coefficients were calculated between perceived purchase probability and the implicit as well as explicit variables. As predicted, the results revealed a significant main effect for explicit and implicit variables, correlated with the predicting of purchase decision as evaluated by the subjects. However, the unequivocal correlation cannot be definite, due to the fact that correlation is greatly dependent on the specific retailer, as well as on the product category. The present data set provides suggestive evidence that the influence of implicit affect on consumers' PL assessment and purchase probability is different. Cuneo et al. [2012, p. 961] propose that PL brand equity is built individually; therefore, treating PLs as 1 single composite of brands should be avoided in future studies. Considering the discrepancies, further research is suggested to understand consumers' behavior. Brown et al. [2012, p. 9] recommend the neuroscience techniques, due to their usefulness in marketing themes application, since they can reveal the true thoughts and emotions of the participants.

6 Conclusions

According to Khushaba et al. [2013, p. 3803] the application of neuroscience methods to analyze and understand human behavior has recently gained research attention. NM can increase the ability to access knowledge and aid in understanding how consumers behave and make decisions while accessing the unconscious thoughts, emotions, feelings, and desires that trigger the purchase decision. Apart from the contribution to the academic theory, the presented PL perceptions might result in relevant managerial implications for retailers and marketing professionals, especially in the field of product development and marketing communication. Measurement of spontaneous reactions of the respondents, based on numerical data, allows for the gathering of credible pieces of information regarding customers' perception of labels. Modern methods and technologies allow to "surpass declarations" included in the questionnaire and discover facts that are hidden from the researcher and the respondent [Ohme et al., 2011]. This suggests that at the current stage of development of brain wave analysis, it is possible to choose the best variant of logo and packaging exposition, describe reactions to images, point out elements that generate the strongest emotional involvement, and decide which version of the product encourages shopping activity. On the other hand, modern research methods allow for determining the areas that the customer is especially interested in (measurement of the level of noticeability and information gathering), as well as the level and time of intense customer concentration. The gathered data, based on the behavioral reactions of users, is objective, as it is not controlled by the user or manipulated by the environment. Combining the above-described methods will make it possible to gather more credible pieces of information than a traditional questionnaire research would. Furthermore, it will exclude the risk of gathering only the declared preferences of buyers, which do not affect their buying decision.

As with most studies, this research was also constrained by some limitations. It must be pointed out that due to the small sample size, transferability of the findings must be done with particular caution. The confinement to a relatively homogeneous group of undergraduate and graduate students participating in the experiments may limit the generalizability of the findings because age, education, and income might affect consumer purchase intentions of PL products [Richardson et al., 1996]. Furthermore, as alleged by

Jackson and Darrow [2005], young people are more susceptible to the influence of celebrity endorsements/recommendations, so this factor could be verified. Another limitation of the present study may be that some individuals had a preference for a particular product, so future research should expand the experiment to include additional demographic and socioeconomic segments and use different experimental products to increase the generalizability of the findings. Examination of differences in consumer perceptions of national vs. PL brands, such as the perceived authenticity gap, is another interesting future research track. According to Abril and Rodríguez-Cánovas [2016, p. 169], in the domain of PL brands, the phenomenon of brand equity is just emerging, and research on the topic is still scarce. There are only a few studies focusing on the manufacturer and PL brand equity comparison [e.g., Ravaja et al., 2013; Dawes and Nenycz-Thiel, 2013]. This research is limited to Poland and to the fast-moving consumer goods (FMCG) category. Future research should consider different countries and market differences in product categories.

Finally, due to the inverse relationship between (8–13 Hz) alpha power and cortical activity (decreased alpha power reflects increased engagement), the frontal asymmetry index can be also computed using the (13–25 Hz) beta or (> 30 Hz) gamma frequency bands to interpret with respect to the amount of motivation toward (approach) or away from (avoidance) a stimulus presentation [Imotions 2015]. Future research in the field of behavioral economics should also consider combining ET with advanced neuroscientific methodologies, such as EEG in combination with electrooculography (EOG), EMG, and galvanic skin response, to provide a full picture of human physiological cognitive activities, which may shed light on the state-of-the-art aspects in human decision-making [Sickmann and Le, 2016, p. 18].

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Research Article

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A Concept for Ontology-Based Value of Cybersecurity Knowledge

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Abstract: This paper focuses on cybersecurity knowledge, claiming that this knowledge may have a value of its own, and suggests a market mechanism to foster the creation of this kind of value. The goal is to elaborate the value of cybersecurity knowledge and propose a semantic approach with an example model to enable better handling of the relevant body of knowledge and its value. The problem of attributing value to cybersecurity should be perceived as analogous to that in information technology. We have examined the relevant body of knowledge with a focus on its characteristics from the viewpoint of different types of market players and their interests. By applying our model, it is possible to increase the accessibility of knowledge and observe externalities from sharing thereof.

Keywords: cybersecurity, threats, value, Semantic Web

JEL codes: D46, D62, D89

1 Introduction

Cybersecurity is the sum of the effort and steps taken to prevent the deliberate use of an information system in a way not intended by the system owners. It is very often considered by an enterprise as an investment that needs to be justified, i.e., it should yield the expected economic results. In general, it is difficult to assign value to information technology (IT), and a similar challenge concerns cybersecurity tools too. In this paper, we focus on treating cybersecurity knowledge as a subject with value of its own.

This paper aims to propose a market mechanism for the handling and valuation of the body of knowledge on cybersecurity. Such a mechanism should facilitate the creation of value for such knowledge. The proposed solution is to adopt a semantic approach, expecting an increase in value through the process of making the knowledge more useful in terms of accessibility, automatic processing, and sharing.

The paper is organized as follows. First, related work is presented, together with relevant concepts, including market forces. The global perspective is taken, considering all types of market players. The need for a proper market mechanism to add value to this knowledge is identified. The Semantic Web technology is presented, and the suitability of the semantic approach to the domain of cybersecurity knowledge is elaborated. A semantic market mechanism is proposed, enabling the assigning of values to all parts of the body of knowledge on cybersecurity. Finally, creation of value through the proposed mechanism is exemplified.

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2 Background and Related Work

We consider the concept of value in two senses. One is the sense of value as defined by Barney [1991]: a firm's resource is considered valuable if it "exploits opportunities and/or neutralizes threats in a firm's environment". In the context of cybersecurity, the value may be for a community of defenders ("well-behaving" organizations), relative to attackers. This is indeed a change from the common context of competition, yet it is another kind of competition as cyber threat agents may be considered risks that behave like a kind of competition with rival market players. The term "value" here is meant to quantify the benefit that such knowledge may bring to those who may use it. Using it may involve either consuming the knowledge or identifying missing knowledge to be added.

Another sense of value that we consider is the shared value. Companies can create economic value by creating societal value [Porter and Kramer, 2011] in three ways: reconceiving products and markets, redefining productivity in the value chain, and building supportive industry clusters. Having a well-managed, accessible, and shared body of cybersecurity knowledge may clearly follow the first and the third ways of creating such value. It also supports corporate social responsibility by providing such knowledge to the society. This kind of benefit to society is in a way that is appropriate to a firm's strategy and is not standardized for all companies, which is more productive [Porter and Kramer, 2006]. In recent years, creating shared value has become an imperative for corporations [Kramer and Pfitzer, 2016], and shared knowledge supports shared value.

The contribution of IT to value creation is subject to the modern productive paradox. Cybersecurity is a part of IT, and cybersecurity knowledge is a part of cybersecurity. In a previous study [Magnusson et al., 2007], value creation by investment in security is examined in an enterprise context. The "modern productive paradox" [David, 1990] is mentioned as a reason for the difficulty in justifying IT security investments like for other IT investments in general, as well as several other reasons. Three models of return on security investments (ROSI) are presented: the Hummer model [Wei et al., 2001], the Hoover model [Sudbury et al., 2001], and the Carnegie Mellon University (CMU) model [Moitra and Konda, 2000]. Their applicability in value creation is discussed, and the authors conclude that "it is neither easy to verify whether the models claim to be economically correct, nor if they claim to develop a valuation model for ex post or ex ante perspective". Three companies are then examined, but none had any knowledge of the three ROSI models or any other method, nor any evidence of shareholder value perspective on IT security. In our view, all these considerations reflect a problem that causes enterprises to not consider cybersecurity as a subject for value creation. Works such as that by Gordon et al. [2003] address this issue through an insurance viewpoint of an organization's assets and risk assessment. Other works [e.g., Ben Aissa et al., 2010] suggest a quantitative way to estimate the cost of security threats through the potential damage to stakeholders. These works consider only the viewpoint of an enterprise, apart from considering only the security measures as a whole, with no value for the knowledge itself. However, there is value for the security knowledge itself, and Miller [2007] provides the estimates of various kinds of vulnerabilities, and their worth ranges from \$500 to \$250,000.

A good economic perspective on the cybersecurity market (although not the cybersecurity knowledge market) is provided by Anderson and Anderson [2001], suggesting an explanation of this market using economical concepts: Asymmetric information or the "lemon" effect [Akerlof, 1970] is the lack of sufficient buyer information, which presses down prices of products since the buyer cannot make a distinction between highly secured products and poorly secured ones. The concept of dumping of liability or "tragedy of the commons" [Hardin, 2006] implies that owners of assets would not make any effort to avoid their assets being used by attackers (e.g., to serve in a denial-of-service attack) as the corresponding cost would be higher than their part of the damage caused. Network economy and network externalities are presented in the study by Shapiro and Varian [1999] and explain why vendors try to get the largest market share as soon as possible, neglecting security aspects.

In a previous study [Böhme, 2005], five possible models for the vulnerabilities market are presented: bug challenges, bug auctions, vulnerability brokers, exploit derivatives, and cyber insurance. The approach we present in this paper is about handling the body of knowledge on cybersecurity and is capable of supporting all these models.

These market models are judged by the following four criteria: (1) information function aims to counter the “lemon effect” by the ability to use market prices as forward-looking indicators for security properties; (2) incentive function involves compensation for security research-and-development in order to motivate firms and individuals to give security a higher priority; (3) risk-balancing function is the provision of instruments to hedge against large information security risks; and (4) the fourth criterion is the efficiency of the market model.

Our approach here refers to improving knowledge sharing, and therefore, it certainly counters the “lemon effect”. It also provides a means for the market players to demarcate and “bid” for missing pieces of knowledge – providing incentives for security researchers to make the effort and create this missing knowledge. Proper use of the proposed mechanism may also assist organizations in identifying and eliminating the detected security risks and to identify such risks even better in the future [Aviad *et al.*, 2016].

3 Market Mechanisms for Value in Cybersecurity

In this paper, we refer only to the knowledge part of cybersecurity, but in a global context, which is wide enough to include not only enterprises but all market players such as vendors seeking to improve their products, individuals (e.g., security experts) looking for opportunities to make a contribution, consulting services, and other organizations, in addition to enterprises. Cybersecurity knowledge parts may be considered products in their own right, having their own value. Each knowledge item, or collection of items, may have a value for some of the market players. Even an “empty” item of knowledge (e.g., identification of a required mitigation) may have a value by recognizing missing knowledge that is required. Some of these knowledge products are tightly related to other products, such as hardware or software to which they are applicable, while others may have value as independent products that provide solutions such as general mitigations (e.g., properly validating an input). The relations with other knowledge items can also be valued, such as a relationship between a threat and a hardware or software item to which the threat is applicable. All of these products/knowledge items are related to other knowledge items, creating a “fabric of knowledge”. These knowledge products are delivered and consumed by various market players as elaborated in the following sections. We suggest a market mechanism that may provide further valuation to the market. We consider security knowledge as goods with value of their own and not as components only, conditioned by the other commercial activities of the main services or products. Such a mechanism may counter the lemon effect and separate the aggregate value of the knowledge to many market players on the one hand from the cost of creating that knowledge on the other.

The mechanism we propose supports the assignment of value and management of the knowledge in a way that lends itself to many desired views and players. It also encourages sharing of knowledge so that the value of whole views is greater than the sum of their knowledge parts.

The market of cybersecurity may be characterized as a knowledge-intensive business service (KIBS), due to the expertise and knowledge required for offering services. We propose creation of a fabric of cybersecurity knowledge (existing or desired knowledge). Considering only the knowledge and excluding the goods makes this market to be a less goods-dominant (G-D) and more service-dominant (S-D) one. Much of the knowledge items refer to goods/products and foster supplier–customer interaction by identifying flaws in products, then creating products to compensate for the flaws, and so on. This kind of knowledge does not exist up-front (in this case, it is embedded in the design of hardware or software goods) but rather is discovered and added gradually later, when security deficiencies are discovered and cures are devised. This is an ongoing process rather than a one-time offering of goods. Such fabric of knowledge also enables the identification of desired knowledge (e.g., how to cope with flaws), thus encouraging supplier–customer cooperation in identifying vulnerabilities and finding mitigations.

The suggested mechanism may provide not only knowledge but also serve as a channel of communication between customers and providers, as well as among peers of all kinds. In another study [Lusch, 2006], there is emphasis on the “central role of networks and interaction in value creation and exchange”. The suggested mechanism may provide such a network and thus enable efficient interaction. In addition, the notion of

co-creation of value during product use as a “rather drastic departure from G-D logic” is stated. The authors explain that value is added with the user during the consumption process rather than during production, while the goods comprise the “distribution mechanism for service provision”. With our suggested mechanism, a significant part of the knowledge will be created with the users (as the “operant resources” of S-D logic), pointing out the required knowledge and implementing it when added, while having the hardware/software products serve as the distribution mechanism – to which the desired knowledge refers and to which added knowledge is applied. Therefore, the suggested mechanism is expected to encourage the market behavior to be more S-D oriented rather than entail G-D logic.

4 Sources of Value, Network Effects, and Externalities

Enterprises may perceive the value of cybersecurity in several ways. In the study by Magnusson et al. [2007], the following are identified: saving the cost of cyber attack damage, saving the cost of manual security processes, and enabling business services that would not be sustainable without cybersecurity. In addition, improved cybersecurity may provide the enterprise with a competitive edge over enterprises that consumers perceive as less secured.

For integrators, such knowledge may ease and improve the security aspect of their work and enable the higher-value outcome for their customers. The possibility of revealing their “trade secrets” should not be of major impact as this kind of knowledge is usually not a commercial asset for integrators.

For vendors that manufacture commercial off-the-shelf (COTS) tools for cybersecurity, the revenue comes from selling and supporting their products. Such products may be either general-purpose “payload” technology or defense products. The difference in the purpose of the product may influence the manner of quantifying the value, since for general-purpose products, the value may be perceived by analogy to insurance premiums, while for defense products, the value is in the essence of the product. However, in both cases, cybersecurity adds value to the product or the services.

The dynamic, complex, and scattered nature of cybersecurity requires efforts to make the relevant body of knowledge a prominent enabler for cybersecurity, thus creating value in cybersecurity knowledge. Intelligent risk assessment should consider the nature of threats. Knowledge is needed to determine and prioritize threats and countermeasures. Creation and utilization of the knowledge is done by individuals, enterprises, vendors, and state agencies.

Cybersecurity knowledge does not carry a network effect, as a consumer does not get any benefit from others consuming that knowledge (for vendors, this may even increase competition). Yet, there is a positive externality of having a better, more-secure environment by reducing infections by viruses if other enterprises consume the same knowledge (for vendors, this is of minor importance). Moreover, attacks carried out by an attacker by controlling “innocent” computers (i.e., distributed denial-of-service attacks) would be reduced if attackers would not get so many computers under their control. The case of Advanced Persistent Threat (APT) – where the attacker targets a specific target for a long time – is an exception, but the general case is of having a better environment for all. Once again, for vendors, the case is different as they focus on products and are less sensitive to the environment. This externality may imply that there is a justification for some intervention by governments or global organizations, since the overall benefit of a better-secured environment is higher than the benefit for a single consumer. Therefore, the desired market equilibrium should be based on having more and better security knowledge than the equilibrium that would satisfy a single consumer, who would tend to research less and be satisfied with less security knowledge. In fact, agencies and organizations such as MITRE, National Institute of Standards and Technology (NIST), and Open Web Application Security Project (OWASP) are already active in this field.

Cybersecurity knowledge requires a high level of expertise over a wide range of technological disciplines, together with traits of creativity, dedication, and other characteristics of highly skilled personnel. The costs of such personnel are the main reason why this is a case for economy of scale. Indeed, there are a lot of individual contributors of cybersecurity knowledge, such as researchers and hackers, but they usually do this not for profit but for prestige. The prestige is important not only for researchers but also for hackers,

as this is a discipline with no certifications, and achievements are the way to gain recognition. Individual contributions usually involve finding breaches in a certain technology or environment, while cybersecurity requires mastering the full range of technologies in use in order to secure all possible breaches. The expenditure on retaining such expertise and the required infrastructure is fixed in nature, implying significant advantages for economy of scale. If the benefits of such security knowledge could be shared, then the burden of cost could be lighter. This requires attribution of value to cybersecurity knowledge.

5 Added Value of Cyber Threat Intelligence

Having presented the value of cybersecurity, it is worthwhile to point out the value of cyber threat intelligence. Cyber threat intelligence, in addition to the above-mentioned reasons for sharing, entails another feature: the whole is bigger than the sum of its parts, as items must be connected in order to get insights. It seems that it has already been recognized how important it is to have the relevant knowledge shared, to build an integrated “big picture”, and extract better insights. The USA Cyber Threat Intelligence Integration Center (CTIIC) was established in 2015 as a federal agency meant to be “a fusion center between existing agencies and the private sector” [Aliya Sternstein, 2015], focusing on “connecting the dots” [The White House, Secretary, no date (n.d.)]. The Cyber Intelligence Sharing and Protection Act (CISPA) is a US-proposed law, which allows for the “sharing of certain cyber threat intelligence and cyber threat information” [Permanent Select Committee on Intelligence, 2012]. At the technical level, the Structured Threat Information Expression (STIX) language was developed to standardize information about cyber threats [Barnum, 2014]. Standards may be seen as enablers for cooperation and sharing of information. These three are examples that indicate an increasing awareness of the importance of cooperation and the sharing of efforts regarding cyber threat intelligence.

6 Semantic Technologies for Knowledge Organization

The vision of the Semantic Web, as presented by Berners-Lee et al. [2001], points to ontology as the third and most advanced pillar of knowledge organization. Ontology provides the means to create taxonomy of concepts, relationships, and inference rules, in addition to serialization formats such as Extensible Markup Language XML and Resource Description Framework RDF, which provide structure and “local” meaning, respectively (that is not communicated across the above-mentioned boundaries). As the World Wide Web Consortium (W3C) states, “The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries” [W3C, n.d.].

The Semantic Web technology may provide a mechanism that supports attribution of value to varying pieces of knowledge. Furthermore, it may provide a mechanism for global crowdsourcing, in addition to enabling individual contributions. Basic content sharing over the Web is enabled by the design, but the Semantic Web enables more intelligent sharing by both humans and applications using ontologies. This requires handling of the meanings of pieces of the contents (concepts) and the relationships between such concepts.

Ontology enables the Semantic Web to bridge over the differences in terminology and meaning that apply in a community such as the diverse and scattered community of the cybersecurity. The classifying mechanism of concepts provides a way to express the “family” nature of cyber threats, IT assets, attack vectors, and countermeasures. Concepts representing such entities are characterized by their origin from a base form in accordance with the “carrying” technology. This means that concepts representing such entities may be handled by subclassifying them from a common superclass. Rules enable reasoning of new facts, based on already-known facts.

Ontology of cybersecurity knowledge may provide a market platform for this knowledge. Pieces of knowledge may be demarcated – from a single concept as a threat or countermeasure, to a facet of the ontology that pertains to a specific technology, to the entire ontology. Each such piece of knowledge may (optionally) be assigned a price tag; however, larger facets would be more useful, such as all existing vulnerabilities

and countermeasures that apply to a certain technology, vendor, or product, providing a sound base for its valuation, in addition to serving commerce. Such a price may be assigned for already-existing knowledge or for knowledge that does not exist yet, e.g., a solution sought for a known vulnerability – as priced by the requesting enterprise or several enterprises, reflecting its value for the intended buyers. In a case like this, the aggregate value of several offers, submitted by a number of enterprises in need, may bring experts to conduct a research and find a solution that otherwise would not cover the cost of the research. Vendors may see this as an indication for the more painful (and of higher value) problems. Such a market may include future contracts and options similar to other markets. The prominent difference from other markets is that knowledge goods may be sold several times to several buyers or be requested several times by interested buyers although it does not exist yet. Such a market may resemble a music market, except the dimension of future – future music may not be defined and demarcated as a vulnerability, countermeasure, and so on. The suggested market may be characterized as a knowledge market that is part of the knowledge economy.

The proposed market mechanism may support various models of consumption by subscription, by pay per answer, or by the trading of pieces of knowledge (monetization). The latter encourages cross-specialization, wherein one organization specializes in cybersecurity knowledge that pertains to its core business, such as threats to specific machinery or health equipment, and trades it with a partner for cyber knowledge regarding systems of secondary importance such as general-purpose IT.

7 Proposed Semantic Security Model

The Semantic Web, as defined by Shadbolt et al. [2006], is indeed a technology that includes important features to accommodate the cybersecurity knowledge: the ontology to specify and organize all entities and relationships; the rules to reason new knowledge; the classes and subclasses to capture the “family” nature of threats and the richness of varieties; the capability to semantically bridge over terminology variations; and the capability of sharing content all over the Web to enable everybody to access the knowledge. Yet, a market must secure both the goods and the transactions.

Securing the goods can be implemented by separating the text parts from the concepts and storing them in a file system or a database subject to access control, with the properties of the concepts serving as the metadata identifying this particular piece of knowledge. Common technologies may also secure the transactions, handling authentication of users, authorization, nonrepudiation, information integrity, and confidentiality, like any other transaction. Data on the move (in transaction) may be encrypted asymmetrically using a private key for each consumer.

Securing the transactions depends on the monetization model but can also be done using common technologies. The Semantic Web has several evolving ways to support security, from secured Web services to XML encryption. This may enable automatic computer software to consume the knowledge, but this is beyond the scope of this work.

8 Example Value-Creation Scenarios

Let us consider a hacker who finds a product defect and publishes it (i.e., an exploit) for free, gaining the appreciation of a hacker society. This way he may get a wider exposure and a higher value for the effort – so he may do further work of this kind, to the common “benefit” of the entire community.

An enterprise that uses this product has a cyberinsurance in case a cyberattack causes a denial of business service or leakage of customer information. However, the insurance company is expected to raise the premium for enterprises that have such unmitigated vulnerabilities. The enterprise has to consider replacing the product to avoid the premium raise.

Help can be expected from a security vendor who publishes a configuration for its security product. Its customers can set up their products to work with improved configuration – an alert can be raised in the case of an attack. The enterprise has this security product installed in its environment, so it devises a mitigation that is based on such an alert followed by a manual procedure. The raise of the insurance premium can

thus be avoided. The value of the security product is increased – for the enterprise, for the vendor, and all customers.

Vendors that make use of the defective product or technology (e.g., a protocol) in their own products also observe this. Possibly, they could note this through an automatic mechanism that monitors all their products for the discovery of new defects. Semantic inference may be used to reason about the defects of infrastructure products so that other products that are based on these infrastructure products can avoid problems.

Two further scenarios for threat handling can be distinguished. One product vendor publishes a bypass through a secure setup in the form of a new product – this raises the product’s value, but for the enterprise, it means replacing the product it already owns and uses. Such a replacement involves costs, and the management prefers to avoid it, so they keep using the old product with the alert from the security product and the manual procedure that follows each alert. Another product vendor publishes a solution – a new version of its product. This is the product that is in use by the considered enterprise, so it upgrades the product version and gives up the manual procedure.

The above-described scenarios involve cybersecurity concepts such as attack patterns, exploits, mitigations, and vulnerabilities, as well as their relationships. These concepts and relationships are included in the proposed model and may be processed even automatically so that all the mentioned players are provided with the knowledge they need. This can be done using preprepared queries that monitor the body of knowledge for new relevant knowledge. Each player may use the query that fits his needs, e.g., the hacker contributes a description of the vulnerability and relates it to the product, the enterprise queries for vulnerabilities of its assets, vendors query for opportunities in their area of expertise and contribute mitigations, and so on. The players become more knowledgeable, and the market becomes more perfect (in terms of knowledge). The body of knowledge expands and even more value is created.

9 Discussion and Conclusions

The semantic approach to handling the body of knowledge on cybersecurity encourages creation of value for this knowledge and makes it more shared and accessible. Adding a new knowledge item, e.g., a new threat, not only improves security in general but also creates business opportunities for various kinds of entities: security vendors, administrators, and integrators. A market mechanism such as the suggested one encourages this creation of value by sharing the benefits and expedites the creation of value by mechanizing it. Such a mechanism also promotes the benefits of economy of scale by augmenting a lot of sources in parallel and makes the market and the competition more perfect through sharing of knowledge. The activity in this field as of today implies that due to externalities, there is a place for some intervention from governments or international organizations.

In this work, we suggest that cybersecurity knowledge may be considered to have value by itself, to make it shared and accessible through the semantic approach, and make it a relevant, implementable model. We have described how this would enable better valuation of this knowledge and improve security.

We have not provided a mechanism for the trading of knowledge but for the handling and valuation of it. A safe trading mechanism still requires further work, considering the various types of market players as well as the various views and parts of knowledge that might be requested. The body of knowledge relevant for cybersecurity is a prominent part of cybersecurity as a whole. Handling it as a good in its own right through a dedicated mechanism would give it a more appropriate value and better overall security as a result.

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Research Article

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Should income be taken for granted as a sole driver of welfare? Bayesian insight on the relevance of non-income drivers of welfare

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Abstract: The paper consists of a discussion on the relevance of non-income drivers of welfare. This discussion is based on a subjective Bayesian reasoning, where welfare perceptions are subjectively rational decisions of individuals, who are, as author suggests, the ultimate decision-makers in respect of what welfare actually means for them.

The objective of the paper is to investigate if income should be taken for granted as a sole driver of welfare. The conclusion is drawn from a methodological investigation of this question in a Bayesian concept of probability with a consideration for correlations among income and non-income drivers of welfare. It suggests that income should not be taken for granted as a sole driver of welfare since the non-income factors, which are not correlated with income, appear to be relevantly affecting individuals' perceptions of welfare with Bayesian probability of almost 65%.

Thereby, the paper is a reaffirmation of a need for further research in the area of welfare measures that might constitute an alternative to income-dominated indicators. Its value emanates from unambiguous answer in favour of the relevance of non-income drivers across welfare perceptions, which, without Bayesian reasoning, could remain unsolved at the point of 50% odds for relevance (irrelevance).

Keywords: welfare, non-income welfare, subjectivism of welfare, drivers of welfare, welfare perception, welfare measurement, Bayesian probability

JEL codes: I 31, C 11

1 Introduction

Welfare is a complex philosophical concept that covers a socioeconomic well-being. Its complexity results from the fact that agents within the society may fare the welfare notion differently (Deardorff, 2014). A careful reading of welfare definition by Deardorff can attract readers' attention to the expression 'fare differently'. When we take this expression as a starting point for the discussion, we get a fundamental assumption for further reasoning in this paper – the assumption that welfare is a subjective concept that emanates different qualities for different people. Simplistically speaking, welfare is a concept that can be perceived differently throughout the society. Consequently, the paper is based on a subjective reasoning approach. This way of framing a concept of welfare makes the paper consistent with new classical economics, where according to Ikeda and Yagi (2012), the mainstream of economics belongs to the camp of subjectivism. The paper is equally anchored in neoclassical paradigm relating to rational expectations within the society. At this stage

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(for simplicity), the discussion disregards evolutionary nature of welfare and does not cater to the fact that welfare perceptions may change dynamically over time.

The welfare perceptions can be driven by different factors. For the purposes of this paper, a segregation of welfare perception factors is based on a distinction between (i) income-related drivers of welfare perceptions (*income drivers, income factors*) and (ii) drivers that are not directly linked to income (*non-income drivers, non-income factors*). The objective of this paper was to investigate if income should be taken for granted as a sole driver of welfare. The resulting investigation is supposed to answer a question whether non-income factors can relevantly affect welfare perceptions. Owing to a subjective nature of welfare perceptions, highlighted at the beginning, the subjectivism hidden in the above question is selfsame. I decided to employ Bayesian reasoning as a framework for this investigation, retaining the consistency of the paper with new classical economics. This allows using subjective probability interpretation for drawing the conclusions.

The remaining part of the paper is structured as follows. A brief literature review on the matters of (i) welfare subjectivism and individualism and (ii) welfare drivers not linked to income (Literature Review) is described next. This is then followed by an assessment of materiality of non-income factors through statistical reasoning under Bayesian concept of probabilities (Problem analysis under Bayesian reasoning). The paper ends with concluding remarks (Conclusions).

2 Literature review

2.1 Subjectivism and individualism of welfare

When reading the introduction of this paper, it may not be clear what is the meaning of the assumption made in respect of subjective nature of welfare perceptions. It may neither be clear what it triggers. A brief look at the history of economic thought however can be of a help to understand that matter. According to Ikeda and Yagi (2012), subjectivism started to play a role in economics in the late nineteenth century. This role emerged as a result of subjective way used in late classical economics to determine the prices, where the prices were determined through utility maximisation of individuals. This was evolutionary from an original objectivism canon of Smith who postulated that prices are determined by the cost of labour, capital and rent that are needed to produce goods (Smith, 2007)¹. Then, such approach differences in determining prices between subjectivism and objectivism concepts can be translated into similar approach differences in perceiving welfare. As a result, we will have a subjectivism attitude on one hand, suggesting that welfare is determined through factors that are perceived individually by individuals, and an objectivism method of approaching welfare on the other hand, suggesting that it is determined through commonly known and accepted qualities – factor(s) that is given for everyone, no matter what are the individual attitudes towards such factor(s).

Furthermore, as already noted before, the assumption of subjectivism embedded in welfare perceptions is consistent with neoclassicism in economics, where the mainstream of economics is based on subjectivism. The increasing role of subjectivism in neoclassical economics started in 1930s when Hayek first discussed an inevitable role of subjectivism in economics and rejected the relevance of objectivism. He argued that most knowledge relating to economic behaviour is not a common knowledge but rather a private knowledge of agents involved in this behaviour (Hayek, 1937). However, regardless of the criticism about the role of objectivism in economic science, neoclassicism is still convinced (even if sceptically) that subjectivism and objectivism mutually coexist in economics. The result of such a conviction is that an objective outcome can be produced from economic analysis based on a subjective principle of utility maximisation (Ikeda and Yagi, 2012). Consequently, this might convince that investigating welfare as a subjective concept (likewise utility) is coherent with neoclassical canon.

¹ The original edition of *An Inquiry into the Nature and Causes of the Wealth of Nations* by Adam Smith was first published in 1776.

The view that welfare is subjective can also be derived from the analysis of Heathwood (2014) where he discussed opposite views of subjectivism versus objectivism used for conceptualisation of well-being. He based his analysis on the utilitarian theory and pointed out that conceptualisation of matters relating to well-being and welfare, or to quality of life, involves the same notion. All these topics are derived from a fundamental concept of well-being, which naturally becomes a philosophical question. He noted that, from Socratic perspective, subjectivism of well-being (and consequently welfare) means that something is good for individuals as a consequence of a favourable attitude towards this thing taken by these individuals. This suggests that a strong and common intuition may be a plausible reason for thinking about well-being as of matter of attitude or in other words, a subjective matter. Further reading of the analysis by Heathwood shows that subjectivism of welfare could also be derived from two popular theories of well-being: (i) hedonism, with its psychological hedonism postulate, and (ii) desire theory, also called as a preference satisfaction theory of welfare.

There is also a view represented by Lin (2017) that the subjectivism of welfare is actually a false feature. Lin argued that the falsity of welfare subjectivism can be drawn from potential divergence between the welfare of adults and the welfare of newborns. The argument suggests that welfare subjectivism, which implies that something has given quality for an individual (is good or bad), is the case if and only if, under the right conditions, this individual has appropriately given attitude towards it (favourable or not favourable). If so, such a theory of welfare should, according to Lin, be tested for what it implies about newborn infants. Consequent philosophical polemic is that such an argument could be rejected if actually tested for newborns, since neonatal welfare carries counterintuitive suggestions versus adults' welfare. This polemic however received a counterargument from Yelle (2016) who strived to avoid a criticism from Lin by distinguishing two types of welfare –welfare in qua human sense and welfare in qua person sense. He further claimed that a divergence observed in qua person, welfare on the example of adults and newborns, does not imply falsity of qua human welfare subjectivity.

In addition to the polemic about validity of welfare subjectivism, there are also works discussing a wider topic of welfare as a dynamic and individualism-driven concept. In this regard, Nelson and Winter (1982) claimed that evolutionary feature of economic reality calls for a need of evolutionary paradigm in welfare economics. These considerations are not directly defending the view of welfare subjectivism in favour of objectivism; however, they imply that its drivers should not be regarded as passive given variables. Such drivers evolve in time and are subject to individualism, what may indirectly suggest opting for subjectivism approach in researching welfare. The author believes that welfare linkage to individualism and subjectivism that is anchored in rational paradigm of neoclassicism may call for looking at welfare perceptions as at subjectively rational decisions made by the society. The concept of such decisions was defined by Gilboa (2009) and used in Gilboa et al. (2010). The subjectively rational decisions are, according to this work, decisions upon which a decision-maker cannot be convinced that they are wrong. The author further suggested to look at welfare perceptions through an angle of subjectively rational decisions. It may indeed not be feasible to convince an agent that his or her philosophical perception of welfare is wrong. Consequently, the author further claimed that such an angle brings into sharp focus the reliance of welfare perceptions on the beliefs of decision-makers. Then, if subjective beliefs are at stake, the reasoning in Bayesian world is somehow a natural direction to be taken in further part of the paper.

Even if concluding that welfare is a subjective matter resulting from its individualism-driven nature, the researchers tend to encounter another conceptual barrier. The question arises whether this individualism of welfare relates to utility or choice preferences of agents. Vanberg (2009) made a distinction between what he called a utility-individualism and a choice-individualism of welfare. Following his analysis:

Utility-individualism is interested in individual persons only as metering points from which utility values are collected, to be then processed in a social welfare calculus; the person as a sovereign chooser is lost out of sight [...] by contrast choice-individualism looks at individuals as the ultimate sovereigns in social affairs whose voluntary and informed choices are the only source from which the observing economist can derive conclusions about social welfare (Vanberg, 2009, p. 4).

Advocating choice-individualism over utility-individualism might be a separate discussion; however, considerations for this topic are not in the scope of this paper. Nevertheless, the take-away for the herein

paper from this distinct discussion is that welfare perceptions do originate from individual agents and are subject to their individualism and beliefs.

I also decided to refer to discussions about the nature of welfare in the debate by Keller (2009). His discussion may help to realize that any theory or paradigm regarding welfare can potentially earn criticism. Keller gave some logical reasoning for looking at welfare as a matter of individual subjective experiences. However, he subsequently suggested a counterargument for not treating welfare solely as a subjective experience and advocated some broader consideration. This counterargument is supported by the example of generating a fake experience for an individual to improve his or her experience himself or herself, without improving his or her actual welfare (or even worsening it). I suggest that looking at welfare as a matter of individual subjective perception, rather than individual subjective experience, could be a possibility for broadening welfare consideration. Indeed, individual's perception may equally be fake due to some manipulation but at least should not involve him or her in experiencing anything rationally harmful. Perception may appear less vulnerable than experience in terms of criticism around manipulations of mental state theory. Keller pointed out that similar counterargument can be addressed to desire theory of welfare. This is because individual's desire may not improve welfare at all (like a desire that stranger's medical treatment turns out successful – such a treatment outcome has no impact on individual's welfare). He further presented the cons of an informed desire theory applied to welfare to move towards objective list theory of welfare. Again, I claim that understanding welfare through an angle of perceptions instead of desires should neither involve desiring anything that could be self-destroying nor involve targeting something not rationally important. So this might be potentially a way of conceptualising welfare so that its conceptualisation is less vulnerable to criticism. Nevertheless, the conclusion pertaining to all these theories and approaches is that each of them may be subject to criticism and counterarguments. This is due to complexity of welfare's nature, which is not easy to frame by one single and solely right theory.

2.2 Non-income drivers of welfare

I have observed that discussions, where a distinction between income and non-income dimensions of welfare is at stake, are often dominated by a topic of poverty. When it comes to discussions involving non-income welfare measurement, these debates tend to be dominated by poverty even more. My finding from literature review is that when jointly searching for terms 'welfare' and 'non-income' in abstracts of JSTOR database (across publications with abstracts), 50%² of publications included the word 'poverty'. Furthermore, when jointly searching for terms 'welfare' and 'non-income' in abstracts of JSTOR database (across publications with abstracts and comprising word 'measure'), more than 56%³ of publications included the word 'poverty'. The corresponding results for ScienceDirect database suggested weaker (but still) dominance of poverty considerations with results of 43% and 45%, respectively⁴, whereas a ProQuest database sample showed an extensive domination of poverty issues with more than 57% and 85% results, respectively⁵. This phenomenon of – one could say – overpresence of poverty in non-income welfare considerations – which I want to rebalance – is equally apparent in the case of discussion by Zhuang (2011). Nonetheless, I refer to Zhuang's work since (in my opinion) it draws a relevant conclusion in light of herein discussion that 'the relationship between income and non-income welfare attainment cannot be taken for granted'. Following Zhuang further, the improvements in non-income welfare do contribute to economic growth, i.e. contribute to income dimension of welfare; however, improvements in economic growth may not necessarily improve non-income dimension of welfare. Given a common sense, the arguments of Zhuang may seem accurate, as in general, the data and past experience can provide evidence for contradiction between income growth and inertia (or deterioration) of non-income qualities in a society. Consistently with such evidence, Skidelsky,

² Result of 101 instances out of 202 records in JSTOR.

³ Result of 66 instances out of 117 records in JSTOR.

⁴ Result of 136 instances out of 319 records and 126 instances out of 282 records in Science Direct, respectively.

⁵ Result of 12 instances out of 21 records and 12 instances out of 14 records in ProQuest, respectively.

emeritus professor of political economy at the University of Warwick, claimed in 2012 that ‘it is increasingly understood that economic growth does not necessarily increase our sense of well-being’.

Various measures of welfare considering the non-income components of welfare or non-income well-being can be found in the literature. A concept of net economic welfare, introduced by Nordhaus and Tobin, is one of the discussions where non-income considerations of welfare are allowed (Nordhaus and Tobin, 1972). As a result of a question whether past economic growth had been a growth in any meaningful sense, Nordhaus and Tobin started looking at welfare from a wider perspective. They allowed for some of known discrepancies between gross national product and a general notion of economic welfare by constructing (how they called it) a primitive and experimental measure. The measure of net economic welfare tried to capture social cost of factors such as pollution or crime (i.e. to somehow capture non-income considerations) when measuring national income. They were sceptical themselves about the controversy of their concept and measure, as well as aware of corresponding limitations in terms of calculus. However, they justified introduction of their concept, despite expected criticism, by the virtue of producing relevant welfare-oriented measure, which was at that moment a compelling challenge to economists.

I uncovered two phenomena in the existing literature: (i) non-income drivers of welfare tend to be mainly discussed alongside poverty issues, so within a pejorative side of welfare rather than across entirety of welfare scope and (ii) non-income drivers of welfare are often discussed jointly with income-related measures and are more rarely analysed in isolation from income. The following section will be a brief review of literature where non-income drivers of welfare are discussed and analysed under criteria of isolation from income measures and in respect of the entire scope of welfare, i.e. in both poverty and well-being senses. Among the apparent non-income drivers of welfare that have received attention in research (given both criteria flagged above), I decided to signal two of them: employment well-being and climate and environmental conditions. Another area of review and discussion could be evidence for – intuitively obvious – impact of health, including mental health, on welfare. This area however will not be covered in the following very concise literature review. When it comes to employment well-being, the work of Helliwell and Huang (2010) reveals significance of influence of non-financial job characteristics on life satisfaction and workplace efficiency by deriving findings from three Canadian surveys conducted in 2002 and 2003. At the beginning, Helliwell and Huang referred to Adam Smith’s feature of the job, called the agreeableness or disagreeableness. They further referred to a quality of workplace trust as a measure of social capital and claimed that the research had largely ignored social capital and life satisfaction in the workplace before. They then pointed out that there have been other papers exploring the linkages between job satisfaction and job performance, exemplifying the work of Judge et al. (2001). Another instance of employment well-being linkage to life satisfaction is demonstrated by Kassenboehm and Haisken-DeNew (2009). They articulated that economists had been keenly interested in determining the effect of labour market status on life satisfaction, especially unemployment implications. Their work examined the impact of unemployment on life satisfaction for men and women in Germany during the period between 1991 and 2006 and concluded that the negative and significant psychological effects of unemployment generally remain fairly constant over the whole period and similar in magnitude. Additionally, certain evidence for even increased vulnerability of women to such effects was equally discussed. I suggest that given a significant size of German population, the findings of Kassenboehm and Haisken-DeNew are worth noting. When it comes to climate and environmental conditions, the research of Dietz et al. (2016) published by Princeton University is an example of recent debate regarding impact of climate changes on future generations’ welfare. They discussed that valuation of future generations’ welfare is somewhat an ethical matter dependent on societal preferences. Their work referred to a larger notion of welfare that recognizes that changes in dollar terms alone may not be the best way to measure the degree to which a particular person is better off. They argued how to approach an intergenerational trade-off between cost and benefit of climate changes’ impact on social welfare. Dietz et al. not only claimed that climate and related changes do influence social welfare but also strived to convince that welfare of future generations may simply be threatened if current economic analyses and decision-making disregard intergenerational implications of climate changes. I read it as an implicit evidence by Dietz et al. (2016) that welfare in a larger sense, i.e. societal welfare across income and non-income dimensions, does depend on climate variables.

Furthermore, Frijters and Van Praag (1998) made such a suggestion explicit by advocating that ‘it is well known that differences in climate affect the quality of life’. Their analysis of data from a large survey in Russia concluded that well-being in Russia is influenced negatively by harsh winters but benefits from the number of sun hours. Going further, the stickiness factor and high levels of humidity together with high temperatures were seen to have a strong negative influence on well-being. One still can argue against such a view but indeed climate appears to matter for welfare.

3 Problem analysis under Bayesian reasoning

3.1 The problem

Should income be taken for granted as a sole driver of welfare? This question raised in the paper’s title is difficult to answer. The difficulty is as a result of a vague problem to which the question strives to refer – the problem of how welfare is perceived by people and how it can be measured. Such a question is especially hard to answer in an ordinary concept of probability based on frequencies. After having reviewed the literature in the previous section, I have provided some evidence for subjectivity of welfare and suggested to look at welfare as a matter of individual subjective perception. Hence, the answer to our question is dependent on the outcome of perception by individual agents.

If anchored in an ordinary concept of probability, it will be like a coin toss where there are two possible outcomes. In this case, if a coin is unbiased, both of these results are equally likely (Hogben, 1993). Such evenly distributed probabilities of outcomes are observed when the number of observations (coin tosses) increases. The same applies to perception of welfare by individuals, in which case, if society is unbiased, some people will perceive the given factor as representing something ‘good for them’ and some others will neglect such a given factor when assessing their welfare, treating it as an irrelevant one. Consequently, when expanding the sample size of individuals, so that it represents the whole society, the perception may become evenly divided, and the answer to the question will be that half of the society will claim that income can be a sole driver of welfare and the other half will claim the opposite. Coming back to probability, its concept based on frequencies may be good for a coin toss problem, as pointed by DeDeo (2016), since one can toss a coin multiple times to check what happens and use these observations to attribute an objective probability. However, for the question I raised, such objective probability derived from observations could turn out meaningless, as the question is referring to an ambiguous and subjective matter. Objective probability would very much assume that there is one predefined objective answer that can be derived from observations, which we know is not the case for welfare. If the number of such observations is big enough to make the law of large numbers work, answering the main question of the paper could conclude with expected half–half outcome: half of the society think that income can be a sole driver of welfare and it can be taken for granted, and the other half think that it cannot be a sole driver of welfare and should not be taken for granted, full stop. However, the problem remains unsolved if less than the whole society is considered and the problem is researched on the level of individuals.

3.2 Conversion of the problem towards Bayesian concept of probability

The research question of whether income should be taken for granted as a sole driver of welfare might however be turned into a methodological problem to solve. This can be achieved by moving it towards Bayesian concept of probability. Such a concept is based on subjective states of beliefs rather than frequency. The use of Bayes’ theorem has a power of inverting some difficult questions that are hard to answer into questions that can be answered more easily, even if they seem bizarre (DeDeo, 2016). DeDeo explained that the reasoning beyond Bayes’ theorem requires a segmentation of variables into a set of exhaustive theories about the world (T) and the data that may populate these theories (D). Consequently, the analysis of our problem will be based on such segmentation (Table 1). This segmentation illustrates four combinations relating to problem’s theories of the world (T) and problem’s data that populate such theories (D) for non-

income factors of welfare. The non-income factors, defined in the introduction of the paper, are summarised in the following (Table 2). Ultimately, the analysis will be based on the following architecture:

$T = \{t_1 = \text{the non-income factors affect perception of welfare, 'affect'};$
 $t_2 = \text{the non-income factors do not affect perception of welfare, 'not affect'}\}$

$D = \{d_1 = \text{the non-income factors are correlated with income, 'correlated'};$
 $d_2 = \text{the non-income factors are not correlated with income, 'not correlated'}\}$

Table 1. Segmentation of variables used for problem analysis

		Correlation of non-income factors with income	
Impact on perception of welfare	t_1, d_1 : the non-income factors affect perception of welfare, and given factors are correlated with income	t_1, d_2 : the non-income factors affect perception of welfare, and given factors are not correlated with income	
	t_2, d_1 : the non-income factors do not affect perception of welfare, and given factors are correlated with income	t_2, d_2 : the non-income factors do not affect perception of welfare, and given factors are not correlated with income	

Source: Own elaboration.

Table 2. Segregation of welfare perception factors

Correlation of factors with income	Income dimension of welfare	Income factors or income drivers of welfare Non-income factors (d_1) or non-income drivers of welfare, which have statistically significant correlation with income
	Non-income dimension of welfare	Non-income factors (d_2) or non-income drivers of welfare, which do not have statistically significant correlation with income

Source: Own elaboration.

Lemma 1: When the correlation of non-income factor(s) with income is significant, then the non-income factor (d_1) is dependent on income. Consequently, this dependence implies that income measurements implicitly include welfare, which would be measured by correlated non-income factor (d_1), and non-income factor (d_2) remains in the income dimension of welfare. Such an implication has a form of rational expectations across the society.

$$P(t_1|d_1) = 0 \text{ and } P(t_2|d_1) = 1$$

Lemma 2: When the correlation of non-income factor(s) with income is insignificant or there is no such correlation, then the non-income factor (d_2) is independent of income. Consequently, this independence implies that income measurements (income factors) do not include welfare measured by uncorrelated non-income factor (d_2), and such an implication has a form of rational expectations across the society.

$$P(t_1|d_2) > 0 \text{ and } P(t_2|d_2) < 1$$

Now, since the reasoning moved to subjective Bayesian concept, the probability of variables will depend on how people believe they are rather than on what they are, i.e. the variables describe perceptions. I assume even distribution (half–half) of such beliefs regarding two theories about the world in our problem (t_1 and t_2) – assumption that the probability distribution between them ('affect' vs. 'not affect') is even:

$P(t_1) = 0.5$ (probability that the non-income factors affect perception of welfare is 50%).

$P(t_2) = 1 - 0.5 = 0.5$ (probability that the non-income factors do not affect perception of welfare is 50%, as probabilities of state t_1 and state t_2 are exhaustive).

The assumption of a 50%:50% probability is a common sense arbitrary assumption. This is because a 50%:50% neutral probability is assumed to be a likely outcome under an empirical assessment of $P(t_1)$ or $P(t_2)$, providing a large sample of individuals⁶. It is important to notice that by stating that factors are correlated with income, I refer to statistically significant correlation relationship for these variables. Accordingly, when factors are being called as not correlated, they should not only be read as variables with zero correlation but equally variables with no statistically significant correlation (insignificant correlation).

The process of answering the question of whether income should be taken for granted as a sole driver of welfare will now follow a sequence assessment of selected Bayesian probabilities to ultimately draw the conclusion. The conclusion will be based on the probability measure of $P(t_1|d_2)$:

$P(t_1|d_2)$ = the probability that the non-income factors affect perception of welfare if such factors are not correlated with income.

$$P(t_1|d_2) = \frac{P(d_2|t_1) \cdot P(t_1)}{P(d_2)} \quad (1)$$

$$P(d_2) = P(d_2|t_1) \cdot P(t_1) + P(d_2|t_2) \cdot P(t_2) \quad (2)$$

$$P(t_1|d_2) = \frac{P(d_2|t_1) \cdot P(t_1)}{P(d_2|t_1) \cdot P(t_1) + P(d_2|t_2) \cdot P(t_2)} \quad (3)$$

$$P(t_1|d_2) = \frac{1}{1+A}, A = \frac{P(d_2|t_2) \cdot P(t_2)}{P(d_2|t_1) \cdot P(t_1)} \quad (4)$$

$P(d_2|t_1)$ = the probability that non-income factors are not correlated with income if the non-income factors affect perception of welfare.

$P(d_2|t_2)$ = the probability that non-income factors are not correlated with income if the non-income factors do not affect perception of welfare.

Now, turning the problem into Bayesian concept of probability will enable overcoming the issue of answering a question that is hard to answer:

$P(t_1|d_2)$ – what is the probability that the non-income factors affect perception of welfare if such factors are not correlated with income?

by swapping it to questions that can be answered based on the intuition:

$P(d_2|t_1)$ – what is the probability that the non-income factors are not correlated with income if such factors affect perception of welfare?

and

$P(d_2|t_2)$ – what is the probability that the non-income factors are not correlated with income if such factors do not affect perception of welfare?

The $P(t_1|d_2)$ question is difficult to answer as it depends on beliefs of people (their perception). However, the swapping questions $P(d_2|t_1)$ and $P(d_2|t_2)$ are easier to answer since they can be based on logical thinking (or logical intuition) rather than on subjective assessment of individual beliefs.

⁶ It would be like an empirical coin toss, where there are two possible outcomes, and (if the number of observations is big enough to make the law of large numbers work) both of these outcomes are equally likely.

3.3 The analysis of the problem

I will now assess the magnitude of probability $P(d_2|t_1)$, i.e. the probability that the non-income factors are not correlated with income, providing that such factors affect perception of welfare. The assessment will be performed assuming the 50% odds relating to a common conviction of people for a probability that the non-income factors affect perception of welfare. In other words, I will strive to assess what is a chance to get the data, which will imply that non-income factor(s) is not correlated with income, given that such non-income factor(s) affects perceptions of welfare, all under the assumption that half of people is convinced that non-income factors affect perception of welfare and the other half is convinced on the opposite. Based on logical intuition, it is highly likely that if non-income factor(s) affects perception of welfare, there is a chance of getting data that will demonstrate that such factor(s) is not correlated with income measurements. Apparently, this is especially valid for individuals with income above a certain level. The empirical data of the Gallup organisation suggest that above a certain level of stable income, individuals' emotional well-being is determined by factors other than income, referred to as 'other factors in temperament of people and circumstances of life' (Kahneman and Deaton, 2010). Such factors may imaginably indeed be uncorrelated with income. This is also because when non-income factor(s) affects perception of welfare, then this particular factor is somehow an effective measure of welfare. If so, it is then likely that this measure is independent of income. Moreover, I illustrate the above intuition-based reasoning by an example of climate. Intuitively, and based on the exemplary evidence in the work of Frijters and Van Praag (1998), a bad climate affects (impairs) welfare of people living around, and conversely, a good climate affects (enhances) welfare of people. This all has an influence on these people (societies), regardless of their income (national income). Reasonably, the magnitude of probability of $P(d_2|t_1)$ should be high – more than 50% of common conviction probability, however not extreme. I assess it at 90%. Read it as: 'if non-income factor(s) affects perception of welfare, then the belief probability that this non-income factor(s) is not correlated with income is 90%'. I do not set this degree of belief at 100%, to allow for some unobvious associations between income and welfare-affecting non-income drivers, especially due to a large theoretical variety of non-income factors.

Similarly, I will now assess the magnitude of probability of $P(d_2|t_2)$, i.e. the probability that non-income factors are not correlated with income, providing that such factors do not affect perception of welfare. Again, the assessment will be performed assuming the 50% odds relating to a common conviction of people for (this time) a probability that the non-income factors do not affect perception of welfare. The assessment looks at what is a chance of getting a datum that will imply that non-income factor(s) is not correlated with income, given that such non-income factor(s) does not affect perceptions of welfare, all under the assumption that half of people is convinced that non-income factors affect perception of welfare and the other half is convinced on the opposite. Intuitively, when non-income factor(s) does not affect perception of welfare, a chance of getting these data is relatively small. This is due to the logic that if a non-income factor does not affect perception of welfare, it is not an effective measure of welfare and people do not care about it (when talking about welfare). They may not care about this non-income factor for two reasons. The first reason is that the socioeconomic quality measured by a given factor is dependent on income (correlated with income) and already implicitly measured by income. This reason is however not applicable here, as in this instance, we consider a factor that is not correlated with income (d_2). The second reason is that people do not care about non-income factors since they represent qualities of no relevance for them when considering their welfare. Imaginably, these factors can either have correlation with income or not. Read it as: 'if non-income factors do not affect perception of welfare, then the belief probability that those non-income factors are not correlated with income is 50%'. I set this degree of belief at 50% for simplicity. Moreover, assigning empirical weights to either side could end up with no other result whatsoever, given possibly infinite quantity of irrelevant factors (law of large numbers).

The abovementioned logic-driven assessments allowed for setting the probabilities of $P(d_2|t_1)$ and $P(d_2|t_2)$. This is now a basis for assessing the probability of the question $P(t_1|d_2)$, which previously used to be the question difficult to answer due to its reliance on beliefs of people. The Bayesian equation (3) for our problem is now the following:

$$P(t_1|d_2) = \frac{P(d_2|t_1) \cdot P(t_1)}{P(d_2|t_1) \cdot P(t_1) + P(d_2|t_2) \cdot P(t_2)} = \frac{90\% \cdot 50\%}{90\% \cdot 50\% + 50\% \cdot 50\%} = \frac{45\%}{45\%+25\%} = \frac{45\%}{70\%} = \mathbf{64.29\%} \quad (5)$$

The interpretation of this equation result will be that it is more likely (almost 65% probability) that the non-income factors affect perception of welfare, given that these factors are not correlated with income, compared to 50% probability for assumed common conviction of people that the non-income factors affect perception of welfare. Consequently, the answer to the research question of the paper:

Should income be taken for granted as a sole driver of welfare ?

is

No, the income should not be taken for granted as a sole driver of welfare, since the non-income factors not correlated with income have a Bayesian probability of almost 65% to be relevantly affecting welfare perceptions, which is higher than assumed neutral 50% probability for a common conviction of people that the non-income factors affect perception of welfare.

In other words, it is not only a matter of intuition but equally a matter of fact based on high Bayesian subjective probability that there are factors other than income, and not related to income, that count for people when perceiving welfare.

4 Conclusions

Throughout the paper, I tried to defend a view that subjectivism approach to welfare concept is indispensable for investigating its inherent drivers in a methodological manner. The literature review contained in the commencing section might convince that investigating welfare as a subjective concept, likewise a concept of utility, is coherent with neoclassical canon. I further suggest to look at welfare perceptions through an angle of subjectively rational decisions, since such an angle brings into a sharp focus the reliance of welfare perceptions on the beliefs of individuals. These individuals are, as I suggest, the ultimate decision-makers in respect of what welfare actually means for them. This view is consistent with a concept of choice-individualism of welfare by Vanberg (2009).

The welfare perceptions can be driven by different factors, which for the purposes of methodological investigation were segregated into income and non-income factors (or drivers) spread throughout income and non-income dimensions of welfare. Furthermore, the methodological investigation on paper's research question of whether income should be taken for granted as a sole driver of welfare was set up in a Bayesian concept of probability. After having considered possible correlation associations among welfare drivers, after having swapped this research question into questions that can be answered based on logical reasoning and after using Bayes' theorem, I was able to conclude. The conclusion was that the income should not be taken for granted as a sole driver of welfare, since the non-income factors that are not correlated with income have a high⁷ Bayesian probability of almost 65% for affecting welfare perceptions.

I believe that this paper offers certain academic contribution to welfare economics. First, the implication is that it reaffirms a need for prospective further research on alternative welfare measurements. Second, it articulates that consideration for correlations to existing metrics, like correlations to GDP measure of income, is indispensable when investigating the alternate welfare metrics. Therefore, the paper suggests that research on alternative welfare measurements should rather focus on gaps that are not implicitly measured by income metrics. Subsequently, practical implications take a form of potential alternative measures that extend current quantifications of welfare in a value-adding scope. The expected result is that the

⁷ Respective to the assumed 50% probability for people's conviction that the non-income factors affect their welfare perceptions.

paper initiates a work on metrics (tools) that add marginal coverage to current income-dominated welfare measurements and does limit a work on extensions that risk a double counting of income-related variables. Consequently, the paper is fostering an alignment between the perception of welfare by individuals and the ‘creation’ of welfare by policy-makers. This could be ultimately contributing to a better policy-making in general.

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Research Article

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Agglomeration Economies and Foreign Direct Investment in Advanced Business Services in Poland

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Abstract: For many years, services attracted most of the foreign direct investment (FDI) in Central and Eastern European countries. Recently, a distinctive type of business services, i.e., advanced business services (ABS), has become the focal point in FDI in the region. This paper is aimed at defining the role of agglomeration economies in FDI in ABS in Poland. The topic is important from the policy point of view, as foreign investment is supported by the host country's authorities, and various incentives are provided. The research method applied in this paper is the negative binomial regression. The outcome variable was the number of firms operating in ABS in particular regions. Explanatory variables pertain to the characteristics of 16 regions classified as Level 2 under the *Nomenclature des Unités territoriales statistiques* (Nomenclature of Territorial Units for Statistics or NUTS) in Poland. The main conclusion of the research is that agglomeration economies are important in the decision of the firms investing in ABS in Poland. The most important factor is the concentration of supply factors, such as abundance of educated employees. The specific features of ABS are associated with lower importance of demand factors in a region.

Keywords: advanced business services industry, foreign direct investment, agglomeration economies

JEL codes: F21, F23

1 Introduction

For many years, services attracted most of the foreign direct investment (FDI) in Central and Eastern European countries (CEECs). Recently, a distinctive type of business services, i.e., advanced business services (ABS), has become the focal point in FDI in the region. These services are also described as knowledge-intensive business services (KIBS). ABS include business process outsourcing (BPO), shared service centers (SSC), information technology (IT) outsourcing (ITO), and research and development (R&D) centers. The first investments of this type took place in the region in the beginning of the 21st century. Among the CEECs, the largest amount of investment and the largest number of investors were directed to Poland.

Foreign investment in the ABS industry is encouraged by the authorities of many economies. Poland's policy regarding FDI treats the new services as a priority. However, there is a threat that the business services investment contributes to the exploitation of resources of talent in the host countries. This is important from the point of view of economies that are still in the process of transformation. The question is whether FDI in the industry will be a source of sustainable long-term development, or whether it will contribute to the curbing of future growth. Such a question is justified by the fact that the service centers focus on large

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numbers of well-educated talents. In many large cities, there is already dense competition not only between foreign investors and local companies but also among foreign investors.

This new sector influences the development of Poland's economy and alters the job market. According to recent data, firms belonging to the ABS employed almost 200,000 workers and there were seven cities with employment exceeding 10,000 workers [Polish Information and Foreign Investment Agency (PAIIZ), 2016]. An important feature of these jobs is a high level of education and language competence, as well as salaries often higher than average in an economy. Additionally, the advanced services companies frequently dominate the employment of university graduates. An indispensable element of the investment is the concentration among several locations.

This paper is aimed at defining the role of agglomeration economies in FDI in ABS in Poland. The topic is important from the policy point of view, as foreign investment is supported by the host country's authorities, and various incentives are provided. The question that arises with respect to FDI inflows in Poland, and in many other transition economies, is how to achieve the balanced development of all regions within a country. The positive impact of linkages between businesses in a certain region was already identified more than a century ago. However, over time, the roles of distance and geographic location seemed to diminish due to communication and technology advancements. Anyway, nowadays, we can notice a high level of concentration of economic activities in certain areas.

FDI in ABS, due to the distinctive feature of the latter, requires a specific approach to analyze agglomeration economies, when compared to analyses of FDI in manufacturing, or even FDI in services, in its broad meaning. The first issue is that, in the case of ABS, the need for agglomeration seems to be limited on the demand side. Second, the fact that must be underlined is the supply side of operations in the industry. Such establishments require a vast pool of trained staff and office space. Therefore, it is important to analyze the concentration of supply side factors.

There might be also a negative influence of the concentration of certain types of activities in limited areas. It can be named saturation of localization. Due to this fact, prices of production factors rise, and competition for talents may be increased. The author encountered such detrimental effects, resulting in selecting the second best localization of some foreign investors in the ABS industry.

Moreover, the approach to agglomeration of ABS must take into consideration two essential facts: intangibility of services and remote clients. The intangibility of services makes them easy to transfer over large distances. Moreover, the clients (internal and external) of ABS are mostly located in other countries. Therefore, localization is not very important to them.

The research method applied in this paper is the negative binomial regression (NBR). This method is used when the outcome variable is of count nature and when unobserved heterogeneity must be taken into consideration. In our case, the outcome variable is the number of firms operating in ABS in particular regions. The explanatory variables pertain to the characteristics of 16 regions classified as Level 2 under the *Nomenclature des Unités territoriales statistiques* (Nomenclature of Territorial Units for Statistics or NUTS) in Poland.

The remainder of the paper is organized as follows. Section 2 provides an overview of the theoretical and empirical contributions of agglomeration economies, with special focus on emerging and transition economies; Section 3 provides information on empirical procedures; and Section 4 contains concluding remarks.

2 Theoretical Background and Previous Contributions

The basics of the theory of agglomeration economies may be traced to the work of Marshall [1890]. He identified the positive influence of linkages between businesses in a certain geographic area. His concept was based on three pillars: spillover of knowledge by other firms in geographic proximity, supply of qualified labor, and supply of other factors [Marshall, 1920]. Krugman [1991] used the linkages between firms in a region to build the New Economic Geography strand in economics. However, his concept assumed many simplifications regarding the characteristics of firms.

According to Head et al. [1995], the factors deciding the choice of a particular location by firms may be divided into two groups: industry-level agglomeration economies and endowment effects. The authors also included choice-specific fixed effects, which allow controlling for unobservable characteristics of the localization. However, from the point of view of this paper, the two basic groups are particularly important. Anyway, the problem arising from this classification is the difficulty in disentangling the two effects.

The agglomeration economies have been commonly analyzed for FDI in the manufacturing sector. The role of agglomeration economies changes with the level of technical sophistication of the industry. According to Lee and Hwang [2014], foreign agglomeration was higher in high-tech industries compared to that in low-tech industries. This study also confirmed the positive influence of business service agglomeration on FDI localization.

The author does not agree that KIBSs nowadays require close contacts between provider and client. According to Keeble and Nachum [2002] and Muller and Doloreux [2009], KIBSs gather in metropolitan areas due to the proximity to their multinational corporation (MNC) clients. This is true for a certain portion of the KIBS firms; however, the picture is not complete. Due to the improvements in technology and codification of knowledge, the need for concentration should decay. An additional element that must be taken into consideration is the role of ABS in global value chains. This creates a challenge to agglomeration, and we should treat it with respect to ABS as ‘agglomerations in global networks’ [Mouleart and Gallouj, 1993]. This issue becomes even more crucial today due to the progress in technology and the organization of services’ production. Such an approach puts the interaction between KIBSs and MNCs into another context. The agglomeration is then perceived as a form of facilitating international delivery of services within a corporation.

Recently, there have been publications on the localization decisions of FDI in services. These studies frequently incorporate agglomeration economies as one of the explanatory variables explaining the decision to invest in a particular region. The current analysis uses NUTS Level 2 regions. This approach is justified by the concentration of FDI in services in larger markets [Jones and Wren, 2016].

There is a large strand in literature dealing with agglomeration of FDI in transition economies. Hilber and Voicu [2010] investigated the role of agglomeration in the case of Romania. Boudier-Bensebaa [2005] examined the determinants of FDI on the regional level, with special focus on agglomeration economies. The study on FDI (in both manufacturing and services sectors) in Turkey also found that both foreign and domestic agglomerations were crucial factors for investors selecting a location within the country [Yavan, 2010].

The agglomeration of FDI in Poland was analyzed by Cieřlik [2005]. According to his studies, the variables capturing industry and service agglomeration economies were positive and statistically significant. A recent study of location decisions in Poland by Krenz and Gehringer [2015] found that agglomeration economies stemming from R&D were significant in the case of both Polish and foreign firms investing in the country.

According to the best knowledge of the author of the present study, there are no contributions dealing explicitly with the topic of agglomeration economies in the ABS industry in CEECs. This paper contributes to the literature in three ways. First, the topic of agglomeration economies in the ABS industry requires a new analytical approach due to the unique characteristic of ABS activities. Second, the combination of firm-level data with regional-level data creates an optimal analytical environment for investigating the impact of agglomeration economies. Third, this paper is designed to explain new trends in FDI in an economy in transition.

3 Data and Empirical Procedures

The decision about localization of FDI in a particular region depends on the set of determinants. Specifically for ABS firms, the factors attracting a firm to a particular region are as follows: the presence of peer ABS firms (information about favorable local conditions, preparedness of a region to serve a certain type of business, and also potential competitors); presence of other firms (information about business attractiveness); quality of education and R&D infrastructure (information on the quality of human capital in a region);

and migrations (attractiveness of a region to local and foreign workers). The optimal way to investigate it is to apply a discrete choice model, estimated using firm-level data. We also followed this pattern, and the empirical method used in this paper is the NBR. This is one of the methods applied for count-dependent variables. It uses the Poisson regression approach but additionally incorporates unobserved heterogeneity. We estimated the NBR model using the panel data due to the advantage over purely cross-sectional or time series data [Hsiao, 2003]. The basic form of a Poisson probability function is given as follows:

$$P(n) = \frac{\exp(-\lambda)\lambda^n}{n!} \quad (1)$$

where λ is the mean and the variance of the distribution, and n is the count of the number of times an event occurs. In our case, λ means the set of predictor variables x_i influencing the number of foreign-controlled companies operating in the business service sector in a particular region:

$$\lambda_i = \exp(\beta x_i) \quad (2)$$

Equidispersion can be presented by the following equation:

$$E(n) = \text{var}(n) \quad (3)$$

However, the observed data frequently display overdispersion [Greene, 2008]. Overdispersion (mean of the outcome variable was much lower than its variance) of data was revealed by summary statistics; therefore, an extension to the general Poisson form had to be applied [Long and Freese, 2005]. Following Castellani et al. [2013], the functional form of the model used in this paper is given as follows:

$$\ln \lambda_i = \beta x_i + \varepsilon \quad (4)$$

The outcome variable was the number of foreign-owned ABS firms in a particular NUTS 2 region. The source of firm-level data was the Amadeus database by Bureau von Dijk. The firm-level approach was useful to determine precisely which firms belong to the industry of interest. An important element of the analysis is the focus on captive offshoring. Due to such an approach, we could grasp the changes in the geographic structure of MNCs. Five activities under the *Nomenclature statistique des activités économiques dans la Communauté européenne* or Statistical Classification of Economic Activities in the European Community (NACE) Rev. 2 were selected as follows: 6209 – Other information technology and computer service activities; 6910 – Legal activities; 6920 – Accounting, bookkeeping and auditing activities, tax consultancy; 7219 – Other research and experimental development on natural sciences and engineering; 7211 – Research and experimental development on biotechnology; and 7220 – Research and experimental development in social sciences and humanities. Firms that were established in the period 2004–2013 were selected.

Particular activities were very unequally represented among the business services firms operating in Poland (Figure 1). The dominating activity in almost half the analyzed firms was “Accounting, bookkeeping and auditing activities, tax consultancy”. This was associated with the fact that MNCs still delegate less-sophisticated tasks to emerging market service subsidiaries. It is also the result of the abundance of personnel skilled in such tasks. Important types of activity are also “Other information technology and computer service activities” and “Research and experimental development in natural sciences and engineering”. Such a composition of the sample means that four main types of ABS business units are represented. “Accounting, bookkeeping and auditing activities, tax consultancy” is the dominating activity in BPO and SSC units; “Other information technology and computer service activities” refers to ITO; “Research and experimental development on natural sciences and engineering” refers to R&D.

Further stylized facts confirm that distribution of ABS firms across Poland is highly uneven (Table 1). In order to present the real results of operations of ABS, we used the revenue of ABS firms in particular regions. This operation helps to overcome the issue of illusory flows of FDI and to control for the size of firms. When we compare the share in the revenue to the share in the number of units, we can see that Mazowieckie voivodship is significantly stronger in the former category. It also means that the largest service firms are located in this region. Moreover, the revenue of the firms in the top five regions is >85% of the entire revenue of the ABS sector, which confirms the concentration of service firms.

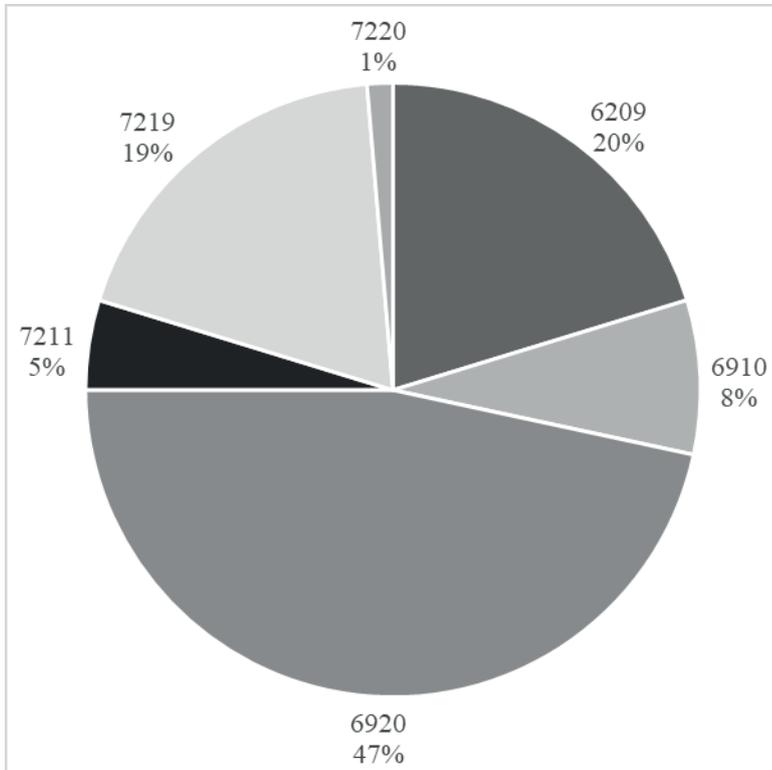


Figure 1. Distribution of firms by NACE Rev. 2 codes. Source: Own elaboration. NACE Rev. 2 = Statistical Classification of Economic Activities in the European Community, Revision 2.

Table 1. Cumulative revenue of the analyzed ABS firms in the period 2004–2013

NUTS 2 regions	Revenue (million euros)	Revenue as a % of total revenue of the ABS sector in Poland	Revenue as a % of total number of ABS firms in Poland
PL12 - Mazowieckie	14,538.87	61,09	51.35
PL21 - Malopolskie	1,841.41	7,74	9.46
PL63 - Pomorskie	1,642.96	6,90	6.08
PL51 - Dolnoslaskie	1,592.99	6,69	8.11
PL61 - Kujawsko-Pomorskie	841.00	3,53	2.03
PL22 - Slaskie	815.65	3.43	4.73
PL42 - Zachodniopomorskie	764.00	3.21	1.35
PL11 - Lodzkie	709.29	2.98	4.05
PL41 - Wielkopolskie	673.21	2.83	10.81
PL33 - Swietokrzyskie	363.00	1.53	0.68
PL62 - Warminsko-Mazurskie	10.87	0.05	0.68
PL31 - Lubelskie	5.60	0.02	0.68
Sum	23,798.86	100.00	100.00

Source: Own elaboration.

Abbreviations: ABS = advanced business service; NUTS 2 = Nomenclature of Territorial Units for Statistics, Level 2.

The source of data for the explanatory variables was the regional statistics provided by the Main Statistical Office (*Główny Urząd Statystyczny*) in Poland (Table 2). Summary statistics of the explanatory variables is provided in Appendix 1. The variables used to analyze the agglomeration economies may be described both as industry specific and endowment effects, based on the meaning proposed by Head et al. [1995]. Special attention was paid to the tertiary education sector in these regions. It indicates the agglomeration economies but also represents the endowment of talents in particular regions.

The variables describing the agglomeration effects were the number of ABS firms per square kilometer, number of firms per square kilometer, and the value of the gross domestic product (GDP). First, in order to investigate the impact of agglomeration economies on FDI projects, it is important to analyze the population and the geographic distribution of firms in the ABS services that invested in Poland. This variable represents industry-level agglomeration economies. In order to provide a wider perspective on agglomeration economies, the concentration of all businesses was taken into consideration. Foreign industry agglomeration may be described here as being derived from agglomeration by Polish firms. In other words, Polish firms, due to their incumbency in the country, have more knowledge about business conditions and thereby cluster in optimal locations. Foreign firms follow the same pattern and invest in regions providing the best conditions for their business. The variable GDP is used in agglomeration studies as the basic indication of the size and concentration of business activities in a region. A higher value of GDP should attract more firms.

The remaining explanatory variables belong to the group describing the endowment factors in a region. “GDP per capita” was used here as the indicator of wealth of citizens in a region, but it may also serve as the proxy for the cost of labor. The regions with higher GDP per capita normally offer higher salaries.

As mentioned earlier, the key variables are those describing the concentration of human capital. “Number of students” was used to indicate the abundance of highly educated workers and the supply of workers in general. Higher number of students will be translated into a higher number of graduates and, thus, candidates for work. It is also a fact that firms belonging to the ABS category recruit many final-year students. In such a situation, higher number of students is directly translated into higher number of candidates.

In order to investigate the role of tertiary education to a greater extent, two variables describing the population of students were used: “technical students” and “economics students”. These two groups of students are very employable by ABS. However, among the technical students, those with a major in IT are of particular interest for ABS employers. Therefore, the proportion of technical students desired by ABS firms may be lower when compared with the proportion of economics students, who represent a more homogeneous discipline.

The measure of technical sophistication of a region was the variable “R&D expenditure”. This can be also seen as the agglomeration variable due to the fact that foreign firms are important sources of this type of expenditures.

When investigating the data, the largest number of ABS was operating in the Mazovian voivodship, which still contains the capital city. It stipulated the use of the “capital” variable.

Two additional measures of human capital and economic prosperity of regions were applied: “internal migration density” and “external migration density”. Prosperous regions with good situation in the job market attract more migrants from less-prosperous regions. Therefore, we have some voivodships with positive and some with negative internal migrations. Moreover, the prosperous regions limit external emigration and boost external immigration. Indeed, ABS firms are those with internationally diverse employees.

In order to analyze the topic of agglomeration economies, three specifications of the econometric model were estimated (Table 3). The basic model (1) consists of variables pertaining to agglomeration and the quality of human capital. The coefficients of variables describing the agglomeration economies were mostly according to the underlying theory. Both density of ABS firms and density of firms irrespective of their industry proved to be statistically significant at 1% and 5%. The positive coefficients confirm the existence of agglomeration economies in the ABS industry. The coefficient for the size of regional economy was negative and significantly important. This may be explained by the fact that size of the economy is not important for ABS firms, because they rarely provide services to other firms in the region or even in the economy. In most cases, the services are intended for internal and external clients located abroad.

Table 2. Description of explanatory variables

Variable	Description
GDP	GDP at current market prices by NUTS 2 regions. Unit: million PLN. Source: GUS
GDP per capita	GDP per capita at current market prices by NUTS 2 regions. Unit: PLN. Source: GUS
Density of ABS	Number of ABS/km ² . Unit: ABS firms/km ² . Source: own calculation using GUS data
Density of firms	Number of firms by NUTS 2 regions. Unit: ABS firms/km ² . Source: own calculation using GUS data
Research and development expenditure	Research and development expenditure per capita by NUTS 2 region. Unit: PLN. Source: GUS
Students	Number of students by NUTS 2 region. Source: GUS
Technical students	Number of students of technical universities by NUTS 2 region. Source: GUS
Economics students	Number of students of economics universities by NUTS 2 region. Source: GUS
Capital city	Dummy for Warsaw
Internal migration density	Balance of internal migration by total population in NUTS 2 region. Source: GUS
External migration density	Balance of external migration by total population in NUTS 2 region. Source: GUS

Source: Own elaboration.

Abbreviations: ABS = advanced business service; GDP = gross domestic product; NUTS 2 = Nomenclature of Territorial Units for Statistics, Level 2.

The variables describing the availability of educated workers also proved to be important for the ABS industry. The larger the number of students was, the more the firms were attracted to a particular location. However, detailed analysis of the type of education did not provide clear conclusions. The number of students of economics institutions was positive but not statistically significant. On the contrary, the number of students in technical universities was significant but negative. This can be interpreted to mean that ABS also recruit many workers trained in other disciplines, e.g., legal sciences and linguistic studies. Moreover, ABS firms provide training adjusted to their specific needs. All in all, the most important aspect is to have a vast pool of students and then graduates, irrespective of the type. Further analysis should also distinguish between the main roles of ABS firms. Naturally, IT firms look for qualified IT students trained predominantly by technical universities.

In the specification (2), the dummy variable “capital” was included. It was confirmed to be an important factor explaining the agglomeration economies in the ABS industry. The capital city is the largest urban area in Poland. It is also the business and education center, thus attracting a vast number of investment projects. Two additional measures of the prosperity of regions were included in model specification (3). However, none of them proved to be statistically significant.

The results of the econometric analysis confirm the significance of agglomeration economies for FDI in the narrowly defined service industry. The variables pertaining to the agglomeration were positive and statistically important. This is in line with the results of previous studies based on the vast population of investors representing various industries. Similarly to Hilber and Voicu [2010] and Cieřlik [2005], the coefficient for the value of regional GDP had a negative sign; however, contrary to the mentioned studies, it was statistically significant. The main reason for such an outcome is the nature of ABS firms. They are not directly linked to the level of demand for services in a host region. ABS firms in Poland operate as elements of international networks and frequently provide services to recipients in foreign economies. This is in line with the arguments of Mouleart and Gallouj [1993], who claim that agglomeration economies of KIBS firms should be considered parts of global value chains. Special attention should be focused on the results of Cieřlik [2005], as his results also concern Poland and he faced similar challenges in explaining results that were in some parts contradictory to those in the literature.

Specific features of ABS firms require more attention on supply than demand. The models estimated in this study have a unique construction with particular focus on the quality of human capital in the regions. It was confirmed that large academic centers are attractive locations for foreign investors. However, such

results confirm that only prosperous locations are attractive to foreign investors in ABS. As the industry gains importance in Poland's economy, such concentration in limited number of regions may increase inequalities among them. In order to cope with this challenge, authorities should invest in the quality of human capital in less-attractive regions. The time is high, because we can observe saturation of top locations. Unless foreign investors encounter suitable conditions in second-tier cities in Poland, they will look for business opportunities in other countries in CEECs. It would cause double harm for Poland's economy. First, the most attractive locations, where investors did not need additional incentives, have been already exploited. Second, less-attractive locations, requiring assistance, may decay as talents will move to the first-tier localizations as more opportunities are provided. Such a sobering remark is justified by the evidence on the minor influence of FDI in business services on the creation of knowledge and improvement of innovating capacity in Visegrad countries [Capik and Drahokoupil, 2011].

Table 3. Results of NBRM using panel data

Variable	Model 1	Model 2	Model 3
GDP	-19.3000 *** (5.9000)	-23.3829 *** (7.0926)	-24.4000 *** (7.1100)
GDP per capita	0.1598 *** (0.0223)	0.1413 *** (0.0255)	0.1401 *** (0.0229)
Density of ABS	85.7252 ** (41.5843)	164.0711 *** (42.4744)	165.7344 *** (42.9641)
Density of firms	10.5880 ** (5.0709)	10.1525 ** (5.4215)	10.0919 ** (5.3751)
Research and development spending	-0.0005 (0.0009)	-0.0028 *** (0.0008)	-0.0028 *** (0.0008)
Students	0.0183 *** (0.0049)	-	-
Technical students	-0.0592 *** (0.0220)	-	-
Economics students	0.0078 (0.0090)	-	-
Capital city	-	3.5678 ** (1.6335)	3.4954 ** (1.6840)
Internal migration density	-	-	23.7909 (174.8257)
External migration density	-	-	56.2211 (185.8895)

Notes: Standard error in parentheses; ***significance at 0.01; **significance at 0.05; * significance at 0.1.

Abbreviations: ABS = advanced business service; GDP = gross domestic product; NBRM = negative binomial regression model.

4 Concluding Remarks

This paper has been devoted to the investigation of the role of agglomeration economies in FDI in the ABS industry in Poland. The topic required analysis due to the importance of the ABS industry, as well as the economic and social implications.

The main conclusion of the research is that agglomeration economies are important in the decision of the foreign firms that invest in ABS in Poland. The most important factor was the concentration of supply factors, such as abundance of educated employees. At the same time, the specific features of ABS are associated with lower importance of the demand factors in a region.

This paper provides important recommendations for policymakers. The distinctive characteristic of the analyzed industry alters the role of agglomeration. Investment in ABS does not need to be concentrated in certain regions, as was earlier confirmed for the manufacturing – or even service – sector in its broad meaning. Such a conclusion is supported by the negative coefficient for the variable GDP. It means that the size of the region negatively influences the inflow of ABS firms. It also means that more important are the endowment factors. The quality of human capital is the key factor.

This analysis was based on firms operating in the period 2004–2013. This period of time may be described as the first and the largest wave of ABS investment projects in Poland and other CEECs. The investors could cherry-pick the locations, and only those offering the most attractive conditions were selected. Therefore, the new phenomenon in localization of ABS firms should be to increase the number of such projects in smaller cities in Poland, as the larger cities are frequently crowded. This study should be repeated using the data for at least 5 more years and treating this period as the second wave. Such an approach should be more common in studies on agglomeration. They frequently omit the issue of time.

The ABS are located only in selected and prosperous regions, but additionally, they are located in a limited number of cities. Therefore, further analysis should also include NUTS 3 regions. However, the impact of the ABS is not limited to the cities but influences entire regions. Therefore, an even-more-detailed level of analysis could provide more insights into the issue of agglomeration and ABS; however, limiting the geographic scope could decrease the value of such an analysis instead of expanding the knowledge.

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Appendix 1. Summary statistics

Variable	Obs.	Mean	SD	Min	Max
GDP	160	0.0818858	0.0676127	0.021569	0.366343
GDP per capita	160	31,207.67	9,347.184	17,193.00	69,026.00
Density of ABS	160	0.0021285	0.0036219	0.00	0.0213732
Density of firms	160	0.1200764	0.0721314	0.0422209	0.3601457
Research and development expenditure	160	174.6031	173.8983	14.00	1,071.9
Students	160	114,210.1	77,914.33	19,000.00	350,947.00
Technical students	160	20,444.11	16,925.26	0.00	60,740.00
Economics students	160	20,181.93	21,487.53	203.00	90,811.00
Capital city	160	0.0625	0.2428215	0.00	1.00
Internal migration density	160	0.00	4,109.188	-5,160.00	16,268.00
External migration density	160	-799.4312	1,360.817	-8,521.00	832.00

Abbreviations: ABS = advanced business service; GDP = gross domestic product; Max = maximum; Min = minimum; Obs = observed sample; SD = standard deviation.

Book Review

Włodzimierz Januszkiewicz*

Andżelika Kuźnar – “Międzynarodowy handel produktami wiedzy” (“International Trade in Knowledge Products”), Warsaw School of Economics, Warsaw 2017, p. 365

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It is widely recognized that the role of trade in knowledge products in the global economy is increasing just as does the influence of knowledge on the benefits of producers of goods and services. The growing share of knowledge in production processes and in shaping the role of countries in the world economy is also being witnessed. However, these processes have not been examined empirically to a degree comparable to that of other factors affecting the position of countries in international trade and the benefits they derive from trade. One of the most interesting books covering important aspects of international trade in knowledge products is the currently peer-reviewed one, recently published by the Warsaw School of Economics, which is the author’s main achievement in her habilitation process.

The originality of the book stems from the fact that it is devoted to international trade in knowledge products. The author distinguishes three groups of knowledge products in international trade: tangible products of explicit knowledge, intangible products of tacit knowledge, and intangible products of explicit knowledge. Such an approach has forced the author to first define concepts related to the issues she examines, since – as is often the case in economics – individual researchers propose a slightly different approach to the issues discussed in the book.

And it is the definitional and methodological issues that are discussed in the extensive (76 pages long) first chapter of the book, titled “Knowledge in Economics”. The author treats knowledge as one of the factors of production, allowing more efficient use of resources, and an inherent, immaterial component of our reality. Knowledge as an economic good may be privately owned and exchanged at the market. In this chapter, the author makes many divisions and classifications of knowledge into various types (e.g., division of knowledge into explicit and tacit, and its consequences), which she then uses with high precision in further parts of the book. The most important achievement of this chapter is her own classification of knowledge products in international trade. Three consecutive chapters of the book are devoted to the so-distinguished types of knowledge products.

In the first chapter, the author also presents (p. 62) a very correct and unambiguous division into “goods” and “services” (after T. P. Hill) and consistently uses this division in her entire book, simultaneously promoting this very useful method of division of “commodities” in scientific research, which is not widely recognized in Polish economic literature. On page 50, the author too narrowly treats the concept of “just in time” as a method of production, whereas, in fact, it also relates to the system of supplying a company with various raw materials and intermediary products necessary for the production and the management of distribution of final products.

The second chapter is devoted to the examination of international trade in tangible products of explicit knowledge, i.e., high-tech goods, such as aerospace, computers and office machines, scientific instruments,

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pharmaceuticals, chemicals, electronics and telecommunications, electric and nonelectric machinery. The author has found unique statistical data that have enabled her to analyze the share of the above-mentioned high-tech goods in the global exports of the main exporters, which include mainly developed countries, but also, in the case of some high-tech goods, China, India, Singapore, and Hong Kong. When examining the imports of high-tech goods, the author (on p. 112) notices that global imports of these goods are greater than their exports, and yet, on a global scale, imports should be equal to exports. However, this is not happening, and the author gives five reasons for this. In my opinion, she omits two more important reasons. First, it is the fact that many products are shipped at the end of the year. Their value is included in statistical data for a given year in the exporter's country, but as they reach the importer's country in the following year, their value is included in its statistics that year. And second, exchange rates often change, which also distorts these statistics. In this chapter, the author has devoted a lot of space to the protection of intellectual property (IP). In the study of the dependence of trade in high-tech goods on the degree of IP protection, she has used the gravity model and formulated interesting but cautious conclusions on this basis.

In Chapter 3, the author analyzes international trade in intangible products of tacit knowledge, concentrating on knowledge-intensive services. The service sector has shown a steady increase in its share in world trade and in the domestic economies, especially in developed ones, increasing its share in terms of both gross domestic product (GDP) and employment. This causes, among others, the growing interest of researchers from different countries in making analyses of this sector. Knowledge-intensive services are among the three categories of knowledge products distinguished by the author.

On this occasion, I would like to refer in a polemic way to the use by the author of the term "trade" in relation to services. I would like to note that trade – as is generally known – is also a service that has the largest share in the services of virtually all countries, except for some developing countries, and therefore, instead of "trade in services", it would be more correct – in my opinion – to use the terms "turnover" or "exchange" of services (which is used by many Polish authors, including me). Moreover, the author uses these terms: for instance, on p. 21, she writes that knowledge can be "exchanged" at the market. The term "trade", instead of turnover (exchange), is widely used throughout the book, with one exception, when the author – on p. 241 – rightly writes about services "in international turnover".

In the final chapter, the author deals with the international trade of intangible products of explicit knowledge, to which the author included IP rights. In this chapter, we find a comprehensive description of the rules related to IP rights, the methods and purposes of IP protection in historical terms, as well as the practices of many countries in this regard. The methods for transferring IP rights, as well as the size and directions of international trade in IP rights, have been widely described. I noticed a certain inconsistency in this chapter: if the author uses the abbreviation "USD" for US dollars in the whole chapter, she should consistently use the international abbreviation "EUR" and not the full currency name "euro" (p. 278 and later).

The book ends with the synthesized chapter "Conclusions and final remarks", in which the author summarizes all the research contained in the reviewed book and indicates the desirable directions for further scientific research.

The book has been prepared for print very carefully, and there are rare minor errors and inaccuracies, which I present below as a careful reader and reviewer. First, the author consistently uses a three-sector division of the national economy in her work, but, for instance, on p. 109, she writes that scientific apparatus is applicable in "various sectors of the economy", instead of in "various industries". Similarly, on p. 266, she writes about the "wine sector", and on p. 222, "in the science sector", where it would be more appropriate to write "in the field of science"; finally, on p. 320, she writes about "sectors of the economy" instead of "industries of economy".

At the end of this review, I would like to refer to the main hypothesis formulated by the author in the Introduction to this book. It reads as follows: "since the beginning of the 21st century the world economy has experienced rapid acceleration of international trade in knowledge products" (p. 14). This is an intuitively correct formulation, maybe a bit too general, but the author's merit is to prove it in a multifaceted manner by gathering and interpreting rich factographic material as well as difficult-to-obtain statistical data. However, the phrase "rapid acceleration" used in the hypothesis is not very precise and unambiguously defined.

One can only suppose that the author is writing about the acceleration that occurred in relation to the 20th century, which is an undeniable fact. There has been a significant increase in the use of knowledge in the economy and a dynamic development of knowledge management in economic sciences.

Treating the in-depth review as my duty, I would like to draw attention to a few minor errors that I noticed in the text, mainly of an editorial and stylistic character. I strongly believe the author will be able to use my remarks in her further publishing activity. In several places (e.g., on pp. 13, 62, 209, and 225 twice), she writes about the “production”, instead of the “provision” of services, which is a more appropriate term, because we rather produce material goods, and services – we provide. There are also some inappropriate usages of several Polish words.

Despite some critical and polemical remarks of a different nature, I would like to emphasize that I highly appreciate the reviewed book due to its innovative and comprehensive treatment of international trade in knowledge products. The work is very richly documented (it contains 287 footnotes, >290 literature items, and >100 Internet sources, mainly in English), and the conclusions and statements formulated in the book are convincingly proven, and each time, the reasons for the analyzed phenomena are presented.

The book should be interesting to both academics and students doing research on international trade, as well as to the Patent Office of the Republic of Poland, due to the fact that the institution may use valuable content contained in the second and fourth chapters.