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AN EVALUATION OF THE TECHNICAL EFFICIENCY OF CULTURAL INSTITUTIONS IN POLAND

ADAM MATEUSZ SUCHECKI (PHD)

Department of Economics and Sociology
University of Lodz
Poland

ABSTRACT

The political transformation of 1989 as well as Poland's accession to the European Union in 2004 had a significant impact on the cultural sector and forms of its organisation and funding. These events also contributed to setting new directions for Polish cultural policy. This is a part of a wider public policy understood as an intentional and purposeful process of achieving objectives in particular areas of public life. The aims of cultural policy depends on the type of the cultural institutions, in example libraries, theatres, community centres or museums.
Since 2001, public spending on culture in Poland has remained below 1% of total expenditures of the state budget. Limited financial resources from the national and provincial budgets earmarked for culture are the main reason for performing a comparative study of the technical efficiency of cultural institutions in Poland. The Polish system of financing the public cultural institutions is highly decentralised and the functioning of these institutions requires adequate funding to guarantee the satisfaction of society's cultural needs.
The research presented in this paper focused on the analysis of public cultural institutions operating in the Polish provinces. In this study, one of the nonparametric methods, Data Envelopment Analysis (DEA) was applied.

Keywords: Culture, Economics of Culture, Data Envelopment Analysis, Public Policy, Efficiency.

JEL: C69, H72, Z18

A DISCUSSION OF STOCHASTIC FORMULATION, NUMERICAL EXAMPLES & NUMERICAL MODELING IMPLEMENTATIONS

ADEWOLE O MAYOWA

Ligs University, Honolulu, USA
Rome Business School, Italy
clef.may1@gmail.com

Example & Draft Publication:

A Stochastic Formulation for Asset Stock Delineation & Interpretation viz Euler–Maruyama Method and Illustrations of Simulated 'Asset –Stock' Prices Following a Random Path

ABSTRACT

Fluctuations or randomness, are driven by various processes such as the Wiener diffusion path, Poisson or Compound process, etc.

It would become imperative to apply stochastic methods in practical delineation of finance models, thus SDE expressions are potentially useful for delineation of asset stock price and volatility, the Euler-Maruyama method has been considered, and proposed here.

Examples of simulated 'asset – stock' prices following a random path are illustrated as elaborated.

Keywords: Asset Stock Price, Stochastic Process, Random Simulated Path, Ito lemma, Euler-Maruyama**.**

Introduction

Stochastic variations are frequently encountered in diverse number of processes. Fluctuations or randomness are encountered in a number of practical applications in biology, physical sciences, atmospheric science and oceanography, finance, etc, which are driven by various processes such as the Wiener diffusion path, Poisson or Compound process, etc.

The Black-Scholes model has been previously applied in explaining, & analyzing the European option pricing, several other models are available, each with its own distinguishing, & characterizing feature. The Black-Scholes model is a static model, & a call for dynamicity, which might require some modalities, and consideration to incorporate dynamics as typical of fast fluctuation, and rapidly volatile models, thus stochastic model, is tremendously useful, and should be explored, with suitable modifications, and theoretical approach in addition to the pre-existing empirical models.

It would become imperative to apply stochastic method in practical delineation of finance models, thus SDE expressions are potentially useful for delineation of asset stock price and volatility.

Euler–Maruyama method

In mathematics, more precisely in Ito calculus, the **Euler–Maruyama method**, also called simply the **Euler method**, is a method for the approximate numerical solution of a stochastic differential equation (SDE). It is a simple generalization of the Euler method for ordinary differential equations to stochastic differential equations. It is named after Leonhard Euler and Gisiro Maruyama. Unfortunately the same generalization cannot be done for the other methods from deterministic theory, (Kloeden et al, 1992),e.g. Runge–Kutta schemes.

Consider the stochastic differential equation (see Itō calculus)

$dX_t = a(X_t)dt + b(X_t)dW_t$,……..(i)

with initial condition $X_0 = x_0$, where W_t stands for the Wiener process, and suppose that we wish to solve this SDE on some interval of time [0, T]. Then the **Euler–Maruyama approximation** to the true solution X is the Markov chain Y defined as follows:

- partition the interval [0, T] into N equal sub - intervals of width $\Delta t > 0$:

  $0 = \tau_1 < \tau_2 < \cdots . \tau_N = T$,and $\Delta t = {}^{T}/_{N}$.

- set $Y_0 = x_0$;

- recursively define, Y_n for $1 \leq n \leq N$ by

  $Y_{n+1} = Y_n + a(Y_n)\Delta t + b(Y_n)\Delta W_n$,…….(ii)

,where

  $\Delta W_n = W_{\tau_{n+1}} - W_{\tau_n}$,……..(iii)

The random variables ΔW_n are independent and identically distributed normal random variables with expected value zero and variance, Δt.

Discussion

Two naïve approaches to stochastic process comprises, the standard Weiner process and Poisson process. Where S(t) should be defined as a diffusion process with constant drift, suppose;

$$dS(t) = \lambda dt + \sigma dW(t) \quad \text{..... (iv)}$$

W(t) is a standard Weiner process (Karlin, 1981, Grimmett and Stirzaker, 2001, Whitt, 2002).

Another approach; also suppose, $dS(t) = dN_{\lambda}(t)$ …….. (v)

Uses a Poisson noise process (Feller, 1950). As in equation(vi), S(t) also has expectation λt in equation(v). These two stochastic processes could be applied in principle to delineate the situation.

Stochastic Differential Equation

A typical stochastic differential equation is of the form

$$dX_t = \mu(X_t, t)\, dt + \sigma(X_t,t)dB_t \quad \text{.....(vi)}$$

where B denotes a Weiner process (standard Brownian motion).

For functions fεN, the Ito integral is

$$F[f](\omega) = \int_S^T f(t,\omega)dB_t(\omega) \quad \text{..... (vii)}$$

In integral form, the equation is;

$$X_{t+s} - X_t = \int_t^{t+s} \mu(X_\mu, u)du + \int_t^{t+s} \sigma(X_u, u)dBu \quad \text{..... (viii)}$$

For functions fεN, the Ito integral is

$$F[f](\omega) = \int_S^T f(t,\omega)dB_t(\omega) \quad \text{..... (ix)}$$

where B_t is 1-dimensional Brownian motion.

The Stratonovich integral, is an alternative to the Ito integral. Unlike the Ito calculus, the chain rule of ordinary calculus applies to Stratonovich stochastic integrals and the two can be converted viz the other for convenience as demanded.

A comparison of Ito and Stratonovich integral could be done.

The white noise equation;

$$\frac{dx}{dt} = b(t, X_t) + \sigma(t, X_t)W_t \quad \text{..... (x)}$$

has the solution X_t given as:

$$X_t = X_o + \int_o^t b(s,x)ds + \int_o^t \sigma(s, X_s)dB_s \quad \text{..... (xi)}$$

Conversion between the Ito and Stratonovich integrals may be performed using the formula;

$$\int_o^T \sigma(X_t) o dW_t = \frac{1}{2}\int_o^T \sigma^1(X_t)dt + \int_o^T \sigma(X_t)dW_t \quad \text{..... (xi)(b)}$$

Where X is some process, σ is a continuously differentiable function with derivative, σ^1 and the last is an Ito integral.

W(t) is used in deriving a stochastic differential equation.

Further Discussion

Stochastic Differential Equation for Asset Stock Price.

Write up:

$\Delta S = rS\Delta t + \sigma\sqrt{\Delta t}Z$ ..... (xii)

; is an SDE i.e stochastic differential equation. Stochastic differential equations are no doubt encountered in diverse applications in biology and physical sciences, climate and oceanography, etc. Finance is an inevitable area of application, for instance asset or stock price can be delineated extensively by applying an SDE, stochastic differential equations follow a random pattern; obviously the SDE includes a noise or random variable or term. Noise term takes different definitions among; White noise, Poisson and Compound noise, etc, which has been previously discussed in our discussion.

The asset or stock price follows a random trajectory obvious from the stochastic differential equation (xii). It is proposed and therefore inevitable that the asset or stock price can be extensively delineated following a stochastic formulation. In the real practical scenario or market as frequently experienced in finance, there abound various forms of fluctuations from different variables or market factors, the asset or stock price does not practically follow a definite pattern or fixed predetermined law. Thus, these variations would best be explained by a stochastic differential equation.

S equivalently S(t) denotes the asset or stock price, r is the interest rate, **σ**is the volatility, Δt is the time step or partition, Z is a stochastic random variable or noise.

Analogous to the method adopted in derivation of the expression or formula for the mass of a fish larva in an uncapped rate stochastic process, the SDE (xii) can be solved explicitly (**Adewole O.O, 2013**) and thus obtain the following expression;

$$S = S_0 \exp(-\left(r - \tfrac{1}{2}\sigma^2\right)t + \sigma W_t) \quad \text{.....(xiii)}$$

, where W_t defines a White noise or equivalently some noise or random variable (Higham,2004, Hull, 2005).

With equation (xii), the asset or stock price can be delineated and thus sketch its path or trajectory.

Following the Euler-Maruyama method, alternative to equation (xii), it is proposed that,

$$S_{n+1} = S_n + a(S_n)\Delta t + b(S_n)\Delta W_n \quad \text{.....(xviv)}$$

This expression (xviv) would be quite suitable to delineate the asset stock defining a & b as appropriate parameters or constants of choice, apart from the one in (xiii).

Various pricing options comprises the European option and American option also the Asian , these can be explained a stochastic formula given the variables among the asset price (S), interest rate (r) or risk-free interest rate, expiration date (T), the exercise price (K), etc.

Pricing Options: Concise discussion:

European Option Pricing

For example, a European call option has a payoff max(S(T)-X,0) at expiry. Assuming a log-normal process, S has the form;

$$S = S_0 \mathrm{e}^{\left(\mathrm{r}-\frac{1}{2}\sigma^2\right)\mathrm{T}} + \sigma\sqrt{T}Z) \quad \text{.....(xv)}$$

,where Z is a standard normal N(0,1) random variable. Thus the call option can be valued by sampling S(T) if Z is generated.

American Option Pricing.

Formulation:

A general class of American pricing options can be formulated by specifying a Markov process$\{X(t), 0 \leq t \leq T\}$ representing relevant financial variables such as an underlying asset price, an option payoff h(X(t)) at time t, an instantaneous short rate process$\{r(t), 0 \leq t \leq T\}$, and a class of admissible stopping times $\boldsymbol{\mathcal{T}}$ with values in $[0, T]$.

The American option pricing formulation is to find the optimal expected discounted payoff

$$supE^{\sup_{\tau \epsilon \mathcal{T}} E}[e^{-\int_0^{\mathcal{T}} r(u)du} h(X(\mathcal{T})].$$

It is implicit that the expectation is taken with respect to the risk -neutral measure. In this course we assume that the short rate constant, $r(t) = r$, a non-negative constant for, $0 \leq t \leq T$.

For example, if the option can be only be exercised at times; $0 < t_1 < t_2 \ldots < t_m = T$ (this type of option is often called (Bermudan option), then the value of an American put can be written as;

$$supE_{i=1,\ldots,m}[e^{-rt_i}(K - S_i)^+].$$

,where K is the exercise price ,S_i is the underlying asset price $S(t_i)$, r is risk-free interest rate.

More details on option pricing can be found elsewhere. However, we have given a detailed insight into the stochastic formulation of asset or stock price with requisite factors or variables mentioned.

Figures & illustrations based on starting stock price and selected parameters based on eqn (xiii): (Adewole O.O, 2013)

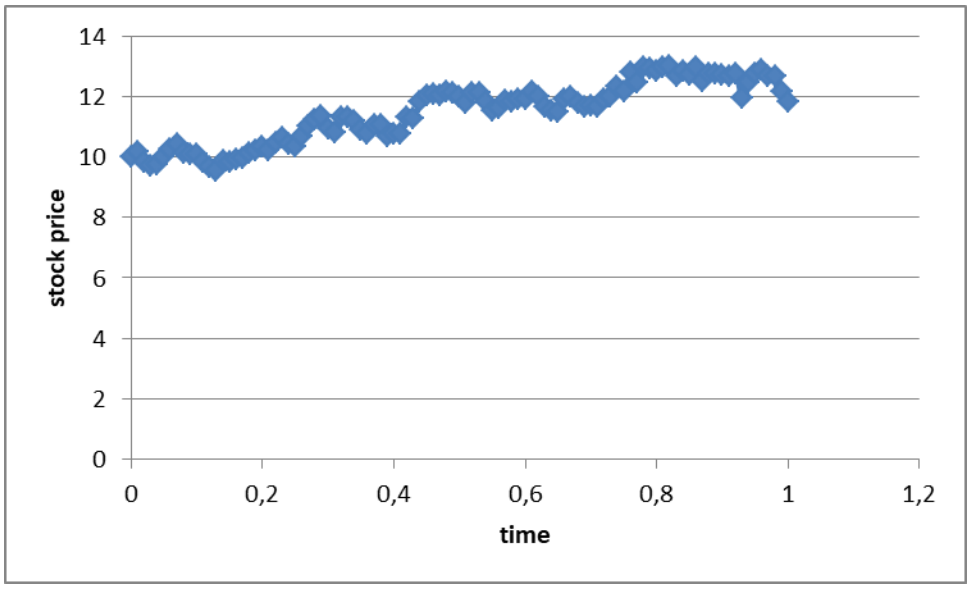
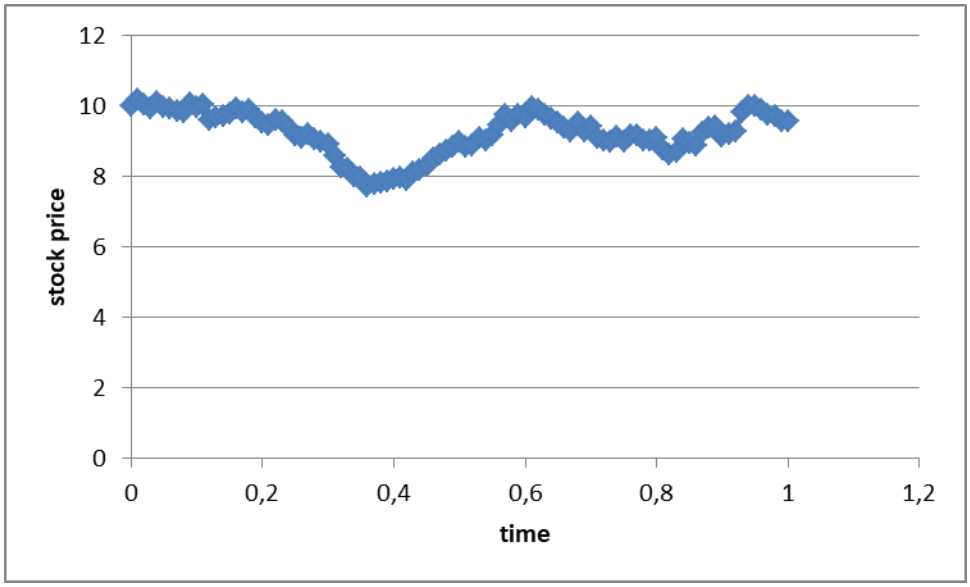


Fig.1: 'simulated asset –stock price' following random path based on parameters input in eqn.(xiii).



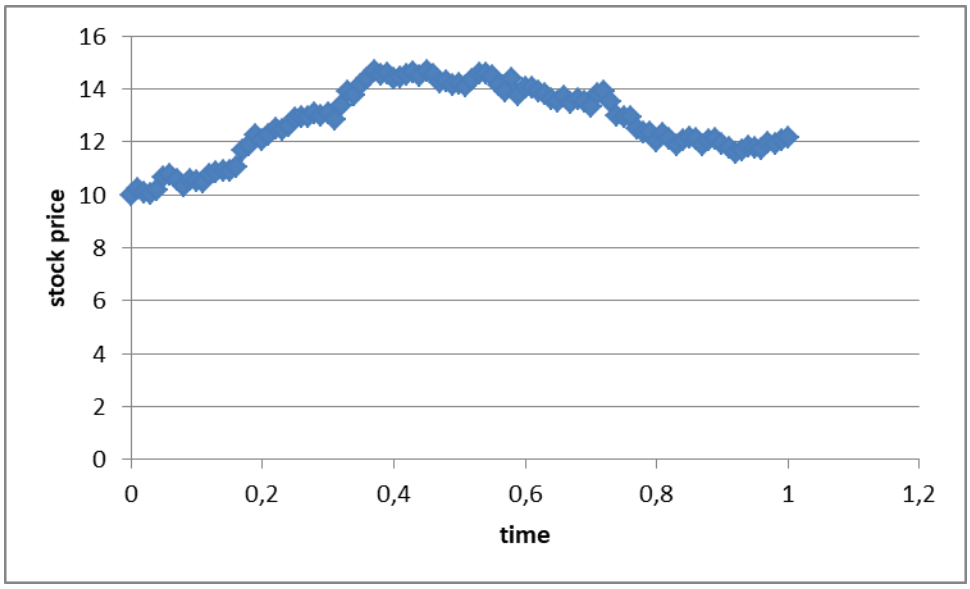


Fig.2: 'simulated asset –stock price' following random path based on new set of parameters input in eqn.(xiii).

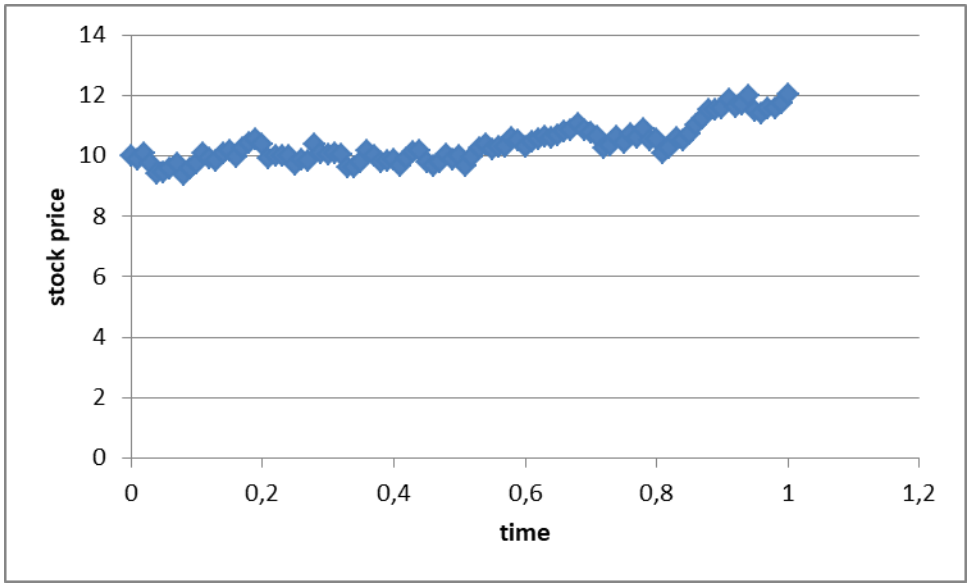


Fig.3: Fig.1: 'simulated asset –stock price' following random path based on parameters input in eqn.(xiii).

Conclusion

A rhobust stochastic formulation would be of tremendous boost with stochastic differential equations for interpretation of asset stock price and volatility in finance, precisely asset stock issues, the Euler-Maruyama method promises to be exciting.

A stochastic formulation following Euler-Maruyama method has been proposed for asset stock interpretation.

Examples of simulated 'asset – stock' prices following a randomly numerically simulated path are illustrated with schematics/graphs obtained by slight change of parameters in extant equation and literature, (**Adewole O.O, 2013**) as elaborated.

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UNIVERSITY MANAGEMENT STRATEGY IN THE CONTEXT OF SOCIAL RESPONSIBILITY

ANNA HORZELA
PhD student
Silesian University of Technology, Poland
anna.horzela@gmail.com

ABSTRACT

Corporate Social Responsibility (CSR) is gaining more and more importance nowadays. It is connected with the activity that includes the ethical conduct of the organization towards the public, in particular its recipients, employees, other stakeholders as well as the impact on the natural environment. The universities deserve special attention in terms of socially responsible activities, which play a huge role in shaping the society, its development and are a source of information for it. The role of higher education in the context of social responsibility is special. This is due to the fact that, like any educational institution, they are responsible for educating and taking care of young people. Therefore, they bear huge responsibility for the knowledge and skills they provide their students, and thus how they will be able to cope in their lives. However, the university responsibility does not end with this. In addition to educational activities, they also conduct research activities. This means that it is in them that new discoveries are made and the further direction of societies development is shaped. The topic of the work is research in the field of university management strategy in the context of the idea of social responsibility. The work includes collecting, processing and analyzing data, information and knowledge necessary to identify applicable management strategies at selected universities. The developed conclusions will contribute to building a list of recommendations of a new university management strategy taking into account the concept of social responsibility.

Keywords: CSR, Social Responsibility, Higher Education, Universities, Strategy.

Introduction

The issue of the university's social responsibility is of great interest to many scientists. Burton Clark, writing about entrepreneurship universities, emphasizes the importance of building bridging organizations, i.e. those that connect universities with their stakeholders (Clark 1998; Clark 2004). In turn, Judith Sutz recognizes the need to extend the traditional roles of universities, i.e. education and scientific research, by a third mission, known as the creating of mutual relations between universities and the environment (Sutz 1997). Henry Etzkovitz and Loet Leydesdorff emphasize the need to build lasting ties between the university and the business and government and local government environment, calling them a "triple helix", which illustrates the strength of these connections (Etzkovitz, Leydesdorff 1997).

Currently, universities are subjected to great pressure from both the business and governmental and local governmental environment to more effectively create, transfer and use knowledge. Every university should know and understand the concept of social responsibility, in order to create certain values, as well as to meet its obligations to its stakeholders. The strategic objective of higher education is to improve quality in three main areas of activity: education, scientific research and relations between the university and the socio-economic environment. The university's success is also built through openness to dialog with others and awareness of education in line with the needs of society and the market. Persons managing universities should feel the need to develop relationships, both at the university itself, as well as to cooperate with external entities. It is important to ensure that you conduct your business reliably and responsibly, with a view to constantly improve the quality of university activities.

The changing importance of universities is a subject of interest to many world organizations. According to the 2005 Glasgow declaration "Strong Universities for a Strong Europe" (adopted by the European University Association) Europe needs creative and strong universities that will shape the European knowledge society. One of the most important elements of this declaration is the statement that universities recognize the need to strike a balance between autonomy and responsibility by using internal procedures (Leja 2009).

University history

The idea of the university is attributed to Latin schools. The concept of university from the very beginning meant a corporation, union or association, always emphasizing the community nature of the university's organization (Aleksander, 2009: 99). Nowadays, following the pattern of Latin *communio*, the term academic community or academic society is used in reference to the university. Recalling the Great Charter of Universities (signed in Bologna in 1998), D. Antonowicz writes, that the university is an autonomous institution that plays an important role in the development of societies (Apanowicz 2005: 21). The University researches, creates and transfers knowledge, as well as academic culture, doing so in the course of teaching and research activities. In turn, E. Wnuk-Lipińska indicates that the purpose of the university (Wnuk-Lipińska 1996: 9) is to multiply, store and transfer knowledge. This is true, regardless of the views expressed, both traditional and new ideas.

The modern university was established from the combination of two traditions: medieval and Enlightenment. They shaped the model of the university, whose main objectives are education and scientific research. This model is undergoing some transformations due to the development of the information society and knowledge-driven economy. Generations of universities stand out in the literature. The first generation university is called the medieval university (dated to 1700). The University of Bologna was called the "student university", in which students employed professors. The University of Paris was known as the "professor university", in which teachers were the dominant force. These universities belong to the archetypes of the university from the Middle Ages. The third model, appearing in Paris in the 12th century, was a university college (Rosa, Wanat 2013: 17), which was followed by the first transitional period (1450-1850). From 1850 to 1950, the period of the second generation university counts. Humboldt University (Leja 2013: 43) was based on a modern scientific method, including drawing conclusions from objective, systematic and repetitive experiments. These conclusions were formulated as laws that predict the behavior of various systems or arrangements. Later, there was a second transition period. Literature dates the year 2000 as the establishment of the third generation university. This is the concept of professor J.G. Wissema (Wissema 2005: 40), who claims that high level of teaching and scientific research is still of key importance in the educational activity of universities, but the development of universities depends on their ability to create or change into international technology transfer centers. A characteristic feature of this model is the university's third goal, understood as the practical use of know-how by the academic society (Burawski 2013: 9). This objective includes cooperation between science and business spheres. In the discussions on university management (Leja 2009; Pawłowski 2004; Thieme 2009, Kozłowski 2000; and others) the concept of a fourth generation university appears. This model defines a university as a university of entrepreneurship, based on knowledge, creating opportunities for local development. The key importance of

areas, i.e. knowledge and technology transfer (Pawłowski 2005: 19-37), education of residents, innovation of companies and scientific research, is also emphasized.

Social responsibility of the University

The concept of social responsibility has been used both in business (the idea of CSR) and in non-profit organizations, such as hospitals, theaters, cultural centers, art centers and universities. Corporate Social Responsibility is a concept that, according to the ISO 26000 standard, means "The responsibility of an organization for the impact of its decisions and activities (products, service, processes) on society and the environment" (PN:ISO26000: 2012), through transparent and ethical behavior that contributes to the sustainable development, health and well-being of society, takes into account the expectations of stakeholders, is in accordance with applicable law and consistent with international standards of behavior, is consistent with the organization and practiced in its relations. To confirm this definition, it is worth mentioning that the World Business Council for Sustainable Development[1] defines social responsibility as "the commitment of business communities to active participation in sustainable economic development, in cooperation with employees, their families, the local community and broadly understood society to improve their quality of life"[2]. According to Griffin, the subject of social responsibility is "a set of organizational obligations to protect and strengthen the society in which it operates" (Griffin 1998: 144). It can be acknowledged, that this definition can also refer to the mission of any university. Implementing the needs of potential clients in a socially responsible way allows to clearly define the main message of the existence of universities. Universities must be guided by global thinking (Geryk 2007: 271), where the social interest is perceived higher than the own interest of the organization. Only long-term goal planning and systemic measures can condition the enhancement of the effects of socially desirable activities, and often may prove to be necessary for the organization's market survival.

Changes in operating conditions and the environment of higher education in Poland (Piotrowska-Piątek 2018: 103), both in terms of the external and internal institutional order of the university, as well as economic, demographic and social changes, mean that higher education management cannot currently be limited to an administrative approach, but requires a conscious and responsible concept of managing various resources, as well as shaping proper relations with external stakeholders (Piotrowska-Piątek 2015: 26). Systemic changes expressed, among others, in the evaluation model in the field of financing the activity of universities, joining Polish universities into the mainstream of new public management. It is understood as a transition from bureaucratic administration (Humboldt model) to commercial management (market model), adhering to the development of the entrepreneurial university (Dziedziczak-Foltyn 2011: 183). Strategy is considered as a tool enabling management of higher education in a managerial manner (Piotrowska-Piątek 2018: 104). A. Piotrowska-Piątek defines strategy as "a management plan for all university resources, created in the process of rational analysis and environment, facilitating conscious shaping of the university's future (Piotrowska-Piątek 2018: 104)". It is worth mentioning, that in light of the Act on Higher Education, amended in 2011 (Act of 18 March 2011 amending the Act on Higher Education), the rector is required to develop and implement a development strategy for universities and individual organizational units. The new Act of 20 July 2018 on Higher Education and Science (Act of 20 July 2018 on Higher Education and Science) also determines, in the tasks of the rector, among others, university management, preparation of the university's strategy project and submitting a report on the implementation of the university's strategy.

Each activity of both enterprises and universities is not only based on external resources, but also interacts with the environment. The idea of social responsibility is increasingly considered as an indispensable element of the enterprise management strategy, regardless of the adopted scope of its activities (Geryk 2007: 271). Currently, it is even treated as a necessary condition to achieve harmonious coexistence of the company with the environment. Universities as an indispensable element of social life are, in particular, obliged to meet the requirements of the environment, which, in turn, translates into their image and prospects for further development. They play an important role in shaping the knowledge society. The source of knowledge is not only the work and cooperation of research teams, but also the increasingly important relations of the university

[1]WBCSD, World Business Council for Sustainable Development.

[2]The World Business Council for Sustainable Development is a leading association, grouping about 200 enterprises pursuing business-only interests and supporting sustainable development. The Council provides programs to enterprises wishing to explore sustainable development, knowledge of actions taken, gain experience, optimize operations and support the position presented by business environments in various forums, while working with governments, non-governmental and intergovernmental organizations. The Council focuses on four key areas: energy and climate, development, the role of business and ecosystems (compiled on the basis of www.wbdsd.org).

with the economic, government and local government environment, as well as the social environment (Leja 2008: 5). The quality of these relationships is of key importance to building the social position of universities.

Principles of social responsibility of the University

Today, the perception and functioning of higher education institutions is changing. Based on literature sources (Hajduk 2014: 23) and available reports, one can note the significant impact of commercialization, technological progress, as well as economic development on the shape and functioning of educational services. The USA, Great Britain and Australia, which are closely competing with each other, are at the forefront of the most chosen study countries, thus setting industry trends. New technologies treated as a knowledge transfer, as well as European funds, which enable the development of academic mobility and contribute to the deepening of inter-institutional cooperation, are often the instruments of university success. Implementation of the principles of social responsibility seems, therefore, necessary to ensure the expected level of satisfaction (Lawrence, Weber 2008: 17-18). Such an approach can ensure the sustainable development expected by all, based on coexisting relations with the natural environment and its resources.

More and more researchers are asking themselves about the role of universities in educating future leaders and paying attention to the need for providing adequate education for future managers (Stachowicz-Stanusch 2010: 141-144). Interest in ethics is increasing both in the business world and in the academic environment (Stachowicz-Stanusch, Amann 2018). Due to the above needs, some initiatives have been created, which aim to improve the teaching process of those responsible and ethical business leaders. One of them is PRME, Principles for Responsible Management Education, which were introduced at the Global Compact Summit in Geneva in 2007. PRME is the world's largest initiative enabling the United Nations to cooperate with business schools. The PRME mission is to transform global managerial education, research and leadership by providing a framework for responsible management education, developing learning communities and promoting awareness of the United Nations Sustainable Development Goals. Educational institutions that have signed a PRME declaration undertake to implement 6 basic principles (www.unprme.org). The characteristics of the PRME principles are presented in Table 3.

Table 1 Characteristics of PRME principles

Principle	Name	Characteristics
Principle 1	**Objective**	This principle allows students to develop their abilities, so that they can be future creators of sustainable values for business and the general public and that they can work for an inclusive, global economy.
Principle 2	**Values**	This principle consists in incorporating the principles of global social responsibility, presented by international initiatives, such as the United Nations Global Compact, into academic activities and school curricula.
Principle 3	**Method**	This principle creates an educational framework, materials, processes and environments that will enable effective assimilation of learning and knowledge of responsible leadership.
Principle 4	**Research**	This principle implies a commitment to conceptual and empirical research that will develop an understanding of the role, dynamics and impact of corporations on creating sustainable social, environmental and economic values.
Principle 5	**Partnership**	This principle means working together with corporate and business management to broaden knowledge of the challenges that the university faces on the way to undertaking environmental and social responsibility and to jointly explore effective approaches to these challenges.
Principle 6	**Dialog**	This principle assumes facilitating and maintaining dialog and debate on decisive issues related to global social responsibility and sustainable development, between educators, students, business, governments, consumers, the media, non-governmental organizations

		and other stakeholders.

Source of own study based on www.unprme.org (accessed 20/10/2019).

The objective of these principles is to establish a process of continuous improvement of institutions educating managers to create a new generation of business leaders able to face the complexity of challenges faced by companies and society in the 21st century. PRME principles are a useful instrument for management schools, enabling the development of educational activities towards the implementation of ethical goals. Dissemination of the principles of social responsibility through their implementation in the everyday life of the university affects the increase in awareness of future social and economic leaders. The result of these activities is also the growing number of consultants, legal regulations and international actions promoting socially responsible business, as well as social reporting (Utting 2003: 9).

Conclusion

The issues of the social responsibility of universities discussed in the article constitute an interesting topic for further scientific research. In order to increase the level of knowledge in the field of social responsibility, it is reasonable to take actions aimed at disseminating the quoted idea and to use educational policy instruments in the development of academic social responsibility. The PRME initiative, discussed in the chapter, indicates that both the world universities and Polish institutions, that declared their principles, strive for continuous development of society in the field of social responsibility.

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SUSTAINABILITY OF PUBLIC DEBT AND BUDGET DEFICIT IN SOUTH AFRICA

EPHREM HABTEMICHAEL REDDA (PHD)
Senior Lecture: Faculty of Economic & Management Sciences
North-West University, South Africa
Ephrem.Redda@nwu.ac.zaa

ABSTRACT

The purpose of this paper is to assess the sustainability of public debt and budget deficit in South Africa. In doing so, it aims to provide a deeper understanding and insight into the fiscal outlook in the medium-to-long run. Stationarity test and Johansen cointegration test are utilized to determine whether the current trajectory of public debt and budget deficit is sustainable. The results of the econometric analysis reveal that the sustainability of public debt and budget deficit is not guaranteed. These challenges become untenable especially in the context of South Africa`s very low level of economic growth projection in the short-to-medium term. It is recommended that major fiscal adjustment measures are introduced in the near future in order to avoid major fiscal crises in the future.

Keywords: Sustainability, Public Debt, Budget Deficit, Fiscal Crises, South Africa.

"SPATIAL DISPARITIES IN THE FUNCTIONING OF SOCIAL ASSISTANCE ENTITIES IN THE CONTEXT OF EXPENDITURE POLICY OF LOCAL GOVERNMENT UNITS IN POLAND"

KATARZYNA MISZCZYNSKA
University of Lodz

ABSTRACT

The purpose of the work is to analyze the spatial diversity of the functioning of social assistance in the context of the expenditure policy of local government units. The specific objectives of the study will relate to the identification of social problems in individual regions of Poland together with a direct reference to the expenditure policy of individual local government units. By embedding the study in 2012-2017, it will be possible to capture regional differences in the occurrence and financing of social problems, with their simultaneous reference to the theoretical concepts of regional development indicating spatial concentration. In addition, based on the research it will be possible to examine the existence and scope of impact of the expenditure policy of local government units on the functioning of social assistance in Poland.

THE INTEREST OF NETWORK GOVERNANCE IN SUSTAINABLE TOURISM: THE CASE OF TUNISIA

OUERFELLI CHOKRI[1]and MZERGUI YESMINE[2]

[1]*Laboratory of Research Economy, Management and Quantitative Finance*
IHEC, University of Sousse, Sousse, Tunisia

[2]*Laboratory of Research Economy, Management and Quantitative Finance*
IHEC, University of Sousse, Sousse, Tunisia

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The purpose of this article is to study the collaboration of Tunisian tourism stakeholders towards a common collective interest. The commitment to a long-term common interest, in a difficult economic climate as the one that lives Tunisia is a dilemma in question.

In particular, the tourism sector is an area of activity, which is always brought to develop. It exercises, therefore, an effect of training on other economic sectors. Indeed, it is said a catalyst sector of the economy. The performance of a tourist destination is not always a sign of strength. The uncertainties of the future confront it with multiple problems such as tourism demand and its fluctuations(Pacini, 1996).Argue that tourism depends only on security in Tunisia is not a certainty because according to the report of the Global Peace Index (2015) it is in a 76 ranking in the global scale surpassing Morocco, Egypt and Lebanon.

The place of sustainable development has become in the heart of the action in the economy, with the constant research of growth and added value, with the interest of future generations and the pressure of climate warming. The concept of sustainable development indeed contains three shutters: economic, environmental and social (Brundtland, 1987). The environmental issue is now the subject of a real media audience (Marcelpoil & al, 2006). Several industries have recognized their responsibilities in the conservation of the environment and the insurance for sustainable development, but in a smaller way in developing countries. Nevertheless, the concept of sustainable development is increasingly important in the tourism sector (Kalisch, 2002). This importance dates from the last two decades (Nash and Butler, 1990; May 1991).

Generally, the environmental targets are considered immediate economic threats to the development of a tourist zone. For example, in the case of the preventive protection area, Mackelworth & al(2013) stated that cooperation between NGOs and local promotion of the local stakeholders would be appropriate, especially in the cooperative research projects. Necessarily, there should be a conscious effort to engage the interests of stakeholders and their views on documentation and paperwork submitted to the Institute of Environmental protection.

It's necessary to note that network governance is under several categories (Colletis& al, 1999), governance that is driven by private, or by public or by a collaboration of the two. It is in particular in front of two dilemmas. The first combines the private and the public interest and the second harmonizes the three components of sustainable development (economic, social and environmental). It provides, therefore, a new paradigm of tourism assessment and sustainable development.

Then networks would advance that the coordination of policies would develop the attention of economic, environmental and social concern of tourism in development strategies (Lane, 1994). Further, networking let to a large number of small actors having limited resources to take part of the process of decision, especially those who cannot follow the sustainable development individually. In this framework, it would be interesting to understand the contribution of different networks in developing a sustainable tourism (Erkus-Öztürk & al, 2010).

In tourism's field, conflicts and confrontations logic are likely. The private sector tends to use a market-based approach while the public sector tends to take a directed offer to the development of tourism in natural resources (Altinay & al, 2007). A contradiction exists between the risk of wearing the environment and the economic imperatives, especially for mass tourism, which creates regarding complications governance for the

development of the sustainable tourism for all destinations.However, a close link exists between the struggle for power, the influence of certain groups of stakeholders and the existence of a common reference between them. This link involves a process of exclusion of certain categories (Marcelpoil &Boudières, 2006). This exclusion risks to radicalize the positions of some groups and to affect the common interest in sustainable development.

Moreover, governance through collaboration facilitates the achievement of sustainable development. Indeed, individual actors contribute less to sustainable development and environmental protection than agents' networks (Devereaux Jennings and Zandbergen 1995).

The objective of this work is to guide both theoretical and practical reflection to surpass the classical techniques of tourism study and to move to a deep study of the links between stakeholders in tourism in order to determine the most appropriate policy context. Our empirical study would be based on a comprehension of the complex reality of "systemic" framework and the exploration of the future through a descriptive exploratory study. The exploratory approach is to determine the functioning of the role of actors and the descriptive approach is to develop the foundations of future policies for sustainability (Post & Andrew, 1982)

In this context, this work will not try to define the most effective governance structure, but to find the effect of cooperation of tourism stakeholders according to their expectations and evolution of their managements on their choice of development a sustainable strategy. It aims to provide the elements of understanding the link between governance and sustainable development in tourism in the Tunisian context. This research tries to model network governance adopted by tourism professionals to create a climate of understanding towards a common collective interest. This will be by considering the Tunisian tourism as a complex, dynamic system and in fluctuating economic conditions since the 2011 revolution, taking into account the successive weights of determining actors, getting their strategic choices ahead and setting sustainability goals, would be a way which can bring to the foreground a common project and can formulate a sufficiently coherent acting for the tourism policy out of its theoretical and scientific aspects and to become a practical implementation process.

For the framework of natural resources, usually searcher had used the prisoner's dilemma to present the tragedy of the commons (Ostrom, 1990). Further researches are focused on the relationship between tourism and sustainability principles and governance issues (Conti, 2007), the implementation of collaboration strategies (Bramwell & Sharman, 1999; Buhalis & Cooper, 1998; Jamal & Getz, 1995), on the power (Bianchi, 2003; Cheong & Miller, 2000), community participation in the decision-making process (Murphy, 1985; Pearce et al., 1996; Reed, 1997), and on the political dimension of tourism phenomena at the destination scale (Bianchi, 2004; Boissevain & Selwyn, 2004; Kousis, 2000). On the other side, prospective was used like a strategy for the creation of a new international network devoted to applied methodology (Bain &al, 1994) and like an approach which is presented to allow companies to move from prospective reflection to strategic action (Godet, 1990) and the importance of a collectivity's thinking together about the future and taking action (Godet, 2010).Bendahan &al (2012) had examined two approaches, the MACTOR and the game of theory applied to an assessment of the public wireless local area network landscape. The MACTOR method in future studies, like an analytic method was used to construe the actors' moves in an air transport method case study (Godet, 1991).

All these factors will use an approach that can answer at these treated characteristics, not as constraints that must adjust, but like elements of comprehension of the ground and environment of Tunisian tourism to formulate the policies adapted to the characteristic of the system. In this sense, prospective helps to aid the decision-making and public action. It is also a constructive attitude and willingness of future goals. By taking a proactive approach as research methodology (Roubelat, 1998) and the method of analysis of games players, we can find which ones are most susceptible to collaborate to achieve the goal of sustainable tourism. This approach has taken several appellations (Bain & Roubelat, 1994) which evokes each of relationships with principal disciplines in the humanities and social sciences.

Keywords: Prospective, Tourist Actor, Conflict, Collaboration, Actor Analysis, Scenario, Common Interest, Governance Network, Awareness, Tourism Policy.

EUROPEAN CENTRAL BANK (ECB) AND THE FEDERAL RESERVE SYSTEM (FED): AN ANALYSIS OF THEIR PERFORMANCES, GOALS AND OBJECTIVES

PELLEGRINO MANFRA Ph.D.
City University New York
pmanfra@qcc.cuny.edu

This article examines the world's two most prominent central banks— European Central Bank (ECB) and the Federal Reserve System (FED) and their recent expansionary monetary policy to solve the great recession of 2007-8. Never before had the Federal Reserve and European Central Bank, with other banks all worked together to try to ward off the threat of global depression. More than $10 trillion of QE and liquidity was injected in both economies. This modern financial engineering is unprecedented and uncertainty prevails.

However given the unprecedented 0% interest rate for so many years and massive amount of quantitative easing (QE), both the European Monetary Union countries and the U.S have seen lower growth rates, lower investment, lower trade and lower international investment. Despite zero interest rate from both central banks for so many years – unprecedented in history - and massive QE injection into the economy – both economies are still below pre crisis levels. Today the FED is on moderate contractionary monetary policy whereas the ECB is on expansionary path. Under president Draghi the ECB has started on a QE program injecting about 30 billion euros a month. The FED has temporarily ended its quantitative tightening - QT but uncertainty in the market prevails.

The primary goal of the ECB as set forth by the Maastricht Treaty is to "maintain price stability"(Article 105.1). The treaty further instructs the Eurosystem to "support the general economic policies" (Article 105.1) in the euro area without prejudice to the goal of price stability. Thus, the treaty makes it clear that any other objectives are secondary to that of price stability.

The FED on the other hand has three policy goals: "maximum employment, stable prices and moderate long-term interest rates" Unlike the Eurosystem's mandate, price stability is not given a higher priority than the other goals. Clearly, the policymakers of the FED must assign at least an implicit ranking to these goals; in the long-run all three goals are compatible.

The FED has stopped with the purchase of mortgage back securities and its QE program and are now on quantitative tightening (QT) but the ECB has continued at a diminished rate its QE program – about 30 billion euro a month. Confronting the recent high unemployment in the EMU the ECB has announced a continued round of "quantitative easing (QE) ," , to stimulate the European Economy bringing the interest rate to zero and negative rates on deposits.

Only Unemployment in the US has declined from 10.7% in 2008 to about 3.7% in September 2019 where more than 18 million jobs have been created. Despite the low unemployment rate - there were many part time and lower paying jobs. On the other hand the ECB has no mandate to solve unemployment. The average unemployment rate in the European Monetary Union at the height of the crisis was about 12 % today is about 7.%

In the paper, I will argue and analyze that both central banks have embarked on a strategy unprecedented in history with many risks. Both banks have record balance sheet and the FED – to date - is extremely reluctant to shrink its balance sheet.

THE MINORITY SHAREHOLDER AND COMPANIES´DELISTING IN BRAZIL

PETER VAZ FONSECA
Mackenzie Presbyterian University

ABSTRACT

In the corporative scenario, publicly held company is believed to have advantages over privately held companies. However, international studies identify increased delisting. Administrators may apply specific accounting techniques to depreciate companies´value, manipulate dividends or even to deliberately reduce the results before the delisting announcement, with the purpose of impairing the minority shareholders´participation. This being so, this work aims at studying the shareholders´remuneration in the process of Brazilian corporative delisting. To investigate the returns to the majority and minority shareholders, in past and present periods, the econometric method of logistic regression is used. Impairing to shareholders is identified and, to the regulatory Brazilian agency is suggested the improvement of corporative governance, with gains for the whole society.

EXAMINATION OF THE REASONS FOR INEFFECTIVENESS OF BANKS USING THE NDEA METHOD ON THE EXAMPLE OF POLISH BANKS

PIOTR MISZCZYŃSKI
University of Lodz

ABSTRACT

The aim of the paper is to identify sources of inefficiency of selected banks in Poland. The paper attempts to use the NDEA (Network Data Envelopment Analysis) method along with bootstrap methods. The use of these modifications allows to some extent to identify individual factors affecting inefficiency, which is hindered by using the classic DEA approach.

MONTE CARLO TESTS OF THE CAPM

SIMON BENNINGA[1] and SHARON GARYN-TAL[2]

[1](Of Blessed Memory), Tel Aviv University.
[2]Emek Izrael College
sharon.tal.garyn@gmail.com

ABSTRACT

We simulate the capital asset pricing model (CAPM) using Monte Carlo (MC) methods. Our data is "statistically perfect" and enables us to generate many data sets drawn from a given multi-variate normal distribution with a given set of means and variance-covariance matrix. We replicate the standard tests of the CAPM and examine the relation between sample size and convergence to the theoretical results of the second-pass regression.

For sample size of 60 monthly observations typically used in much financial research, our results show no convincing statistical evidence supporting the security market line (SML). This, despite the fact that all statistical assumptions underlying the CAPM are fulfilled by our data and that in theory (Merton 1973) the second-pass regression should hold perfectly.

Reasonable approximations to the second-pass regression are achieved only for sample sizes equivalent to 5,000 months of data. Sensitivity analysis examines whether changes in the risk free rate, the variance-covariance matrix, the expected returns and the number of assets in the market affect the significance levels of the conversion to the theoretical results.

Keywords: CAPM; Second-Pass Regression; Monte Carlo.

JEL: G11, G12

INCUMBENT'S ADVANTAGES IN PRODUCT DESIGN: INTEGRAL KNOWLEDGE, ENTRY-BARRIERS AND MARKET PERFORMANCE

TOMOMI HAMADA
College of Business Administration and Information Science, Chubu University, JAPAN
hamada@isc.chubu.ac.jp

ABSTRACT

This study explores the product architecture design strategy that provides incumbents with a competitive advantage in exploiting existing technological knowledge, thus preventing imitation from new entrants and competitors when a new technology is introduced. This study focuses on Japanese digital imaging manufacturers. Both qualitative information (product architecture, market performance, and market entry-withdrawal data) and quantitative data (firm's applications for patents) are used to investigate the differences among each product's architecture and applied technologies in components and architecture interfaces. The existence of significant differences in the R&D competence between incumbents and new entrants is verified, and these differences are shown to define the product design and market performance of each product. This study's findings indicate that in the presence of an integral process in combining old and new technologies in the design and manufacture of a product, and if the interaction between these components is encapsulated, then, incumbents can achieve sustainable competitive advantage. These conditions prevent imitation from competitors, including new entrants. These findings suggest that developing a new integral product by modular innovation is an effective strategy for incumbents in a mature industry. This study also shows that product architecture affects the extent of the entry barriers and the intensity of market competition. The proposed case study also indicates that firms' R&D experience restricts the markets they can enter.

Keywords: Product Architecture, Innovation Management, Management of Technology, Research and Development.

Introduction

Incumbent firms have difficulties adapting to discontinuous technological innovation (e.g., Christensen, 1997; Christensen and Bower, 1997; Cooper and Smith, 1992; Foster, 1986; Henderson and Clark, 1990; Hill and Rothaermal, 2003; Tripsas and Gavetti, 2000; Tushman and Anderson, 1986; Utterback, 1996). In particular, incumbents often avoid investing in new technologies owing to the low performance of newly developed technology in most functions of products (Arthur, 2009; Christensen, 1997; Zajac and Burgerman, 1991). In addition, such activities could conflict with established organizational operations, identities, and traditions (Oliver, 1997).

On the one hand, companies that adopt newly developed technology frequently face the risk of losing their market position. On the other hand, sometimes, incumbents achieve innovation that disrupts the industry (e.g., Bergek et al., 2013; Christensen, 1997; Fixson and Park, 2008; Rothaermel, 2001; Taylor and Helfat, 2009). Compared with new entrants, incumbents have an advantage in product development due to the accumulation of technological competence (Kang and Song, 2017). They more easily integrate established and new technologies by exploring the new aspects of technology and resources while exploiting established technologies (Bergek et al., 2013). Their accumulated knowledge leads to creating new technological innovation in the industry. By acquiring new technologies from external sources, incumbents can integrate new and existing elements at a rapid pace (Bergek et al., 2013; Lavie, 2006) and more efficiently than new entrants. Incumbents have accumulated knowledge and know-how on existing technologies through research and development (R&D), as well as the design and manufacturing of existing products. Therefore, to maintain a sustainable competitive advantage in the industry, they only need to combine old and new components to which the old and new technology is applied and design new products in a way that upgrades the existing product architecture.

Based on the product architecture perspective, this study explores incumbents' new product architecture strategy as a solution to maintain their benefits amid fears of product commoditization. The results of this study indicate significant differences in the R&D competence between incumbents and new entrants, and these differences define the product design and market performance of each product. If the integrating process of old and new technologies is incorporated in product design and production, incumbents can make substantial profit in the market for such product.

Observing the architecture of products is one of the established approaches for estimating the innovativeness of product design in innovation studies. Product architecture is the scheme by which the function of a product is allocated to physical components and includes the arrangement of functional elements, the mapping from functional elements to physical components, and the specification of the interfaces among interacting physical components (Ulrich, 1995). A modular architecture involves a one-to-one mapping from functional elements in the function structure to the physical components of the product and specifies de-coupled interfaces between components. An integral architecture comprises a complex mapping from functional elements to physical components and/or coupled interfaces between components (Ulrich, 1995).

On the one hand, the integral architecture of a product requires intensive managerial coordination to adjust the relationships among components (Clark and Fujimoto, 1990; Orton and Weick, 1990; Ulrich, 1995; Sanchez and Mahoney, 1996) and integral knowledge for understanding the technical interdependencies among components in the product architecture (Chesbrough and Kusunoki, 1999). All these elements are needed to realize high product performance and quality. The dependencies between components are often complicated, and specific interfaces between components are required. Hence, an integrality process is needed to link and coordinate each component within this complex architecture in product design and manufacture, and such products will take longer to be imitated by competitors (Pil and Cohen, 2006).

On the other hand, the modular architecture uses independently designed components without detailed adjustments and specific interfaces (Ulrich, 1995). Modularity reduces information processing in organizations that pursue performance improvement (Pil and Cohen, 2006). Products with modular architecture do not require special capabilities in the process of improving or redesigning products, making such products comparatively easy to imitate, which significantly reduces firms' product performance advantages (Pil and Cohen, 2006).

This study investigates effective product architecture strategies when incumbents create products with new architectures for exploiting existing technological knowledge and preventing imitation from new entrants and other competitors. To this end, the case of the Japanese imaging industry is discussed, and by taking the product architecture perspective, a strategic model for incumbents' choice, especially those that have accumulated integral knowledge in past activities, is proposed.

Data And Methods

This study focuses on Japanese digital imaging manufacturers and bases the analysis on data of their patents and market performance. Three new types of digital camera have been developed following the digitalization of recording media: the digital single-lens reflex (DSLR) camera, the digital single-lens mirrorless (DSLM) camera, and the compact digital still camera (compact DSC).

This study first surveys the differences among these products' architecture and applied technologies in components and architecture interfaces through a qualitative approach. This step helps explains how each of the three types of product architecture affects the characteristics and the degree of each product market competition, the maturity of the industry, and the degree of firm imitation. Next, by observing the patterns of Japanese camera manufacturers' product development, this study investigates the relationships between each firms' technological capabilities and their market performance using each firms' patent and market performance data.

The proposed case study uses both qualitative and quantitative data. Information on firms' market performance and strategies is collected from the "Comprehensive study of imaging-related market" published by Fuji Chimera Research Institute, Inc. (1990–2014). Each firm's annual reports and business magazine, such as "Nikkei Business," "Nikkei Technology," and "Toyo Keizai," are used to gather technical data about each of their products. For the extraction of patent data, "Patent Integration," the patent search database service offered by Patent Integration Inc., is used. Patent data are collected from 1991 to 2013. In this period, 11 Japanese firms that currently manufacture and sell digital cameras applied for patents. These manufacturers include JVC Kenwood Corporation (JVC), Olympus Corporation (Olympus), Casio Computer Co., Ltd. (Casio), Canon Inc. (Canon), Sigma Corporation (Sigma), Sony Corporation (Sony), Tamron Co., Ltd (Tamron), Nikon Corporation (Nikon), Panasonic Corporation (Panasonic), Ricoh Imaging Company, Ltd. (Richo), and Fujifilm Corporation (Fujifilm).

Patent data of these 11 Japanese firms are searched for using the keyword "camera," and 251166 patents are extracted. However, the resulting dataset includes patents for products that are unrelated to cameras for taking photographs, such as microscopes, telescopes, and communication devices. To discard such observations, this study uses the F-term assigned to a patent and excludes patents that are assigned to at least one F-term that is unrelated to "camera." As a result, 201800 patents are finally extracted.

The analysis focuses on the first three digits of the International Patent Classification (IPC) code, which classifies each patent according to the technological area. Three IPC codes are utilized: the "G02" code for "optics," the "G03" code for "pictures, movies, similar technology using waves, excluding light waves, electrophotography, and holography," and the "H04" code for "electronic communication." Section G represents physics and Section H electronics.

Two types of firms are distinguished: incumbents and new entrants. Incumbents are defined as firms that have previous experience in manufacturing film-type SLR cameras, which were designed and manufactured before the emergence of digitalized cameras. New entrants are defined as firms that entered the camera market after digitalization became commonplace. The study's sample comprises seven new entrants, namely, Olympus, Canon, Sigma, Tamron, Nikon, Ricoh, and Fujifilm, and four incumbents, namely, JVC, Casio, Sony, and Panasonic.

Product Architecture And Market Condition

The DSLR camera has some distinctive optical components, such as the mirror box, which includes the lens, mirror, and pentaprism to reflect incident light in a camera body to the optical viewfinder. This arrangement of components is the same as that adopted for the film-type SLR but differs from the DSLM camera and compact DSC.

The DSLR camera is different from the film-type SLR in that some of its modules, components, and interfaces are electronic and digitalized. The recording film has been replaced by an electronic memory and a solid imaging element unit, to which an image sensor, automatic exposure (AE) sensor, and autofocus (AF) sensor have been added. In the DSLR camera, an interrelationship exists between optical components and electronic components through an electronic circuit, such as a sensor-based electronic adjusting lens, and interlocking shutter modules and mirror position. Each of the optical and electronic components is linked to control system modules through an electronic circuit. Such interrelationships among optical and electronic components are not present in the architecture of the film-type SLR camera, DSLM camera, and compact DSC.

For the assembly of these interrelated components, to link the optical and electronic components in the same product architecture, an interaction adjustment between components in the assembly process is required. If the focusing position is displaced from the optimal position, even by only a micrometer, the camera's image quality is severely affected. To guarantee a high-quality image, engineers need to assemble the optical and electronic components of the camera body, especially the adjustment of the focusing position, using fine adjustment. Therefore, the DSLR camera is more expensive to manufacture, and assembly takes more time.
Table 1 shows the quantity-based global market size and market share of the SDLR, compact DSC, and DSLM camera, respectively. The market size of the DSLR camera has been increasing year by year. Currently, Canon and Nikon control 90 percent of the SDLR camera market.

Table 1. Global market size and market share of DSLR camera, DSLM camera, and compact DSC in 2010 and 2015 (quantity based)

	DSLR Camera		DSLM Camera		Compact DSC	
	2010	2015	2010	2015	2010	2015
Market size	10370	9400	2180	3950	136100	23000
Canon	0.47	0.55		0.02	0.15	0.28
Nikon	0.40	0.42		0.04	0.09	0.22
Sony	0.06	0.01	0.38	0.53	0.17	0.18
Sumsung EL.			0.18	0.13	0.11	0.04
Fujifilm				0.09	0.08	0.06
Panasonic			0.28	0.06	0.07	0.06
Casio						0.05
Olympus	0.03		0.17	0.11	0.07	0.03
Ricoh						
HOYA	0.03					
Kodak					0.08	
Others	0.00	0.02	0.00	0.02	0.19	0.08
HHI	0.39	0.48	0.28	0.33	0.13	0.18

Note: a. The data source is the "Comprehensive study of imaging-related market" published by Fuji Chimera Research Institute, Inc. (1990–2014).
b. Others after 2014 include Ricoh. HOYA merged with Pentax in 2008. HOYA transferred its imaging business to Ricoh in 2011.

Table 2 shows the timing of firms' entry into the DSLR and DSLM camera markets from 1995 to 2012. The results indicate that this market has gradually become oligopolistic. Nine camera manufacturers entered the DSLR camera market during this period, although some firms later withdrew, including Samsung Electronics Co., Ltd. (Samsung), Kodak, Panasonic, and Konica Minolta Inc. (Konica Minolta). Sony, Olympus, and Pentax remained in the market but failed to expand their market share.

Table 2. The timing of market entrants to the SDLR and DSLM camera market

		1995	1997	2003	2006	2007	2008	2009	2010	2012	Total
DSLM Camera	Entrant						2	2	3	1	8
	Withdrawal										0
DSLR camera	Entrant	3	1	2	1	2					9
	withdrawal				2	1				1	4

Note: a. The data source is the "Comprehensive study of imaging-related market" published by Fuji Chimera Research Institute, Inc. (1990–2014).

The DSLM camera was developed in 2008 by Panasonic and introduced a new type of camera architecture. Because the DSLM camera's architecture does not include a mirror box, the process of adjustment for focus and detection of the screen's optimal position is not required in the assembly of the components. In other words, an integral process involving components is removed from the manufacturing process. The resulting architecture allows firms to design and manufacture cameras without possessing technological knowledge and skills about optics and the integral process of optical and electronic components.

The information reported in Table 2 indicates that eight firms have remained in the DSLM camera market over the sample period. Olympus, Panasonic, Samsung, and Fujifilm withdrew from the DSLR camera market, and then, they entered the DSLM market. Although the DSLM camera was productized after the DSLR camera, competition among firms in the DSLM camera market has become fierce over time. In the DSLM camera market, new entrants include electronics firms that have not manufactured the DSLR camera before but hope to expand their market share. By removing some optical components and simplifying the product architecture compared to the DSLR camera, the DSLM camera assembly process was simplified for all manufacturers, and the market entry barriers of the DSLM camera market were essentially removed. Thus, not only the incumbents but also new entrants began entering this market with a comparatively low entry barrier. In 2015, the Herfindahl–Hirschman index in the DSLM camera market was 0.48, higher than the 0.33 value for the DSLR camera market (Table 1). In other words, DSLM camera manufacturers face greater competition in balancing product quality, differentiation, and cost than DSLR camera manufacturers.

Because DSLR and DSLM cameras were more expensive and less portable, compact DSCs became prevalent among individual users in the imaging industry, even though they were launched after the DSLR and DSLM cameras. In this study, the compact DSC is defined as a lens-integrated digital camera. The compact DSC has a similar product architecture to the DSLM camera except for an unchangeable lens. The degree of modularization of the compact DSC is progressing, and this product can now be assembled without firm-specific knowledge and expertise. Because compact DSCs do not have a mirror box and are comparatively easy to assemble, entrants do not face significant technological entry barriers. Table 1 shows that all major camera manufacturers possess only 10–20 percent of the DSC market. In 2015, the Herfindahl–Hirschman index was 0.18 for the compact DSC market, the highest value among the three camera markets. Due to the intensification of price competition, Japanese and Western camera manufacturers, such as Kyocera Corporation, Kodak, Konica Minolta, Hewlett-Packard Company (HP), Fujifilm, Canon, Panasonic, and Olympus, have already withdrawn from the compact DSC market or ceased R&D activities.

Patent Analysis

Using the data of patents applied for by Japanese camera manufacturers, this section analyzes how the differences in technological knowledge possessed by incumbents and new entrants affect market performance. To identify the technological areas of patents that each of the 11 firms applied for, odds are calculated using the ratio of the number of patents that are attached to a particular IPC code to total patent samples. The odds indicate the probability that a patent related to a particular technological area is observed compared to the probability that such a patent is not observed in all camera-related patents that a firm applied for. This variable is a proxy for the volume of R&D resources that a firm allocates to a particular technological area or combination of technologies. In other words, it indicates the technological area that corresponds to a firm's core competence. The differences in firms' resource allocation and capabilities are analyzed by comparing this variable across groups (incumbents vs. new entrants) for each technological area. By focusing on three different technological areas, this study clarifies how differences in R&D resource allocation affect market performance.

To compare between incumbents and new entrants, the odds ratio of having a particular IPC code is calculated for both groups, and then compared between groups. The odds ratio of one group compared to the other is expressed as follows:

$$\text{Odds ratio}=(\text{Odds A})/(\text{Odds B}) \qquad 0\leq \text{Odds ratio}<\infty$$

The 11 sample firms are classified into Group A, which comprises incumbents, and group B, which comprises new entrants. The odds ratio indicates a higher or lower probability that a patent related to a particular technological area is observed in the incumbent group or in the new entrant group. In other words, this variable is a proxy for how many times the incumbent group allocates R&D resources to a particular technology area and/or a combination of some technological areas compared to the new entrant group.

The odds ratio is calculated by dividing the odds of incumbents by the odds of new entrants. To confirm the statistical significance of the analysis results, a chi-square test is conducted on the differences between the incumbent and new entrant groups. The results for all IPC codes and their combinations are significant at the 1 percent level or higher. Over the five-year period, from 2010 to 2014, the number, odds, and odds ratio of

patents applied for by each group are calculated for each IPC code and their combinations. Table 4 shows these results.

For every code and their combinations, the odds of incumbents are greater than those of new entrants in all periods. This result implies that incumbents allocate more resources to both physics and electronics development compared to new entrants. In addition, the odds ratio for G03 is higher than that for G02, thus suggesting significant differences in research efforts between the two groups for G03. Incumbents seem to have a persistent advantage in physics over new entrants.

Incumbents typically have technological competence in optics, while new entrants have such competence in electronics. However, recently, incumbents have also begun to allocate their resources to electronics and cultivate their new advantage over new entrants. In addition, the odds ratios of the two physics section codes are higher than those of the electronics section code. In other words, incumbents' technological competence in physics assures them a more substantial competitive advantage than new entrants' technological competence in electronics does.

Incumbents show higher values for all the combinations of the three IPC codes compared to new entrants. The odds ratios of H04 and G02, G02 and G03, and G03 and H04 are 3.28, 3.87, 2.83, and 4.03, respectively. In regard to the combination of the two physics codes and of the electronics code with another code, incumbents have an advantage.

These results show that incumbents accumulated more technological knowledge and experience of the integral process of optics and electronics than new entrants through R&D and their experience in design and manufacturing of film-type SLR. Although new entrants may have higher technological competence in electronics, while they have substantial weaknesses in integrality of electronics and optics technologies.

Table 4

The odds ratio of the probability of each IPC code appearing in incumbents to new entrants

2010–2014

	Incumbents	New entrants	Odds ratio
The number of firms	7	4	
The number of patents	12866	4988	
The number of patents in each technological region			
H04	12866	4988	
G02	7735	1190	
G03	9493	1625	
H04*G02	3174	440	
G02*G03	3987	486	
G03*H04	6727	1200	
H04*G02*G03	2688	301	
Odds			
H04	1.15	1.01	1.14
G02	0.48	0.14	3.49
G03	0.65	0.20	3.34
H04*G02	0.15	0.05	3.28
G02*G03	0.20	0.05	3.87
G03*H04	0.39	0.14	2.83
H04*G02*G03	0.13	0.03	4.03

Discussion And Conclusion

The present analysis reveals that the characteristics of product architecture (i.e., whether an integral process is required in the design and manufacturing process) have a different impact on the behavior of incumbents and new entrants, their market performance, and their market strategy. Manufacturing a DSLR camera with high image quality requires firms to possess technical integral knowledge and skills in the assembly of optics and

electronics components in production and design. These requirements represent a high entry barrier for firms that possess limited optics technological knowledge and expertise. Incumbents, such as Canon, Nikon, Pentax, and Olympus, can utilize their proprietary optic technological knowledge and expertise in assembling the DSLR camera by taking advantage of their past experience in manufacturing film-type SLR. Most late movers that entered this market after camera digitization, especially firms that have no experience in manufacturing film-type SLR, subsequently withdraw from this market because they could not satisfy user demand for a high-quality image.

On the one hand, competition is moderate in the DSLR camera market due to the small number of firms that can integrate optical and electronic components in the manufacturing process. On the other hand, manufacturers of DSLM cameras do not need an integral competence-enhancing process for new entrants that are competent in electronics technologies. In the DSLM camera market, not only new entrants but also incumbents maintain their market share. Also, compact DSC is competence-enhancing for new entrants. These two products do not need an integrality process between optical and electronic components in the manufacturing of cameras. Based on this result, electronics firms entered these markets, thus causing competition among firms to intensify.

Firms' market performance data show that the technological area in which firms concentrated their R&D activities in the past affected not only firms' product features (Benner and Tripsas, 2012) but also their market performance. Firms that can exploit the technological knowledge that they acquired through past R&D activities perform well in the new product market. However, firms that do not possess the required technological knowledge cannot enter the new product market, or cannot perform well in that market if they enter it. Most firms with large market shares in the DSLR camera market have substantial experience in manufacturing film-type SLR, while new entrants without such experience withdrew from the market because they did not possess adequate knowledge of optics and integrality between optics and electronics. Except for Sony, Japanese incumbent firms could not reach a high level of image quality in the DSLR camera market, and they withdrew from this market. When firms launch a new product, the product architecture, including components, modules, and interfaces, is restricted by firms' R&D experience. In other words, the market they may have access to is limited.

Incumbents have an advantage in exploiting technological knowledge related to old products and acquired through past activities. For new product development, incumbents that exploit such knowledge in combination with new knowledge have an advantage in the new product market compared to new entrants (Bergek et al., 2013). Therefore, incumbents that develop a product with integral architecture by utilizing existing and new technological knowledge may prevent imitation from new entrants and achieve sustainable competitive advantage in the market.

The product architecture perspective suggests that arranging the integral process (Clark and Fujimoto, 1990) in the design and manufacture of a product is an effective approach to retrieve and protect incumbents' monopoly benefits (Fixson and Park, 2008). In addition, incumbents develop existing technologies at a rapid pace and can integrate new technologies and existing knowledge (Bergek et al., 2013) when developing a new product.

Incumbents have some advantages over new entrants. By exploiting the knowledge of the technology and the market acquired from past experience in manufacturing the old product, incumbents can choose the product architecture such that only they can provide the design and manufacture. Incumbents that arrange the new product with an integral process of new and old technology in design and manufacturing can enjoy the benefits of sustainable competitive advantage and retrieve their monopoly benefits for the de-maturity of the industry.

The proposed case study stressed the lack of a conceptual framework in previous research on this topic. First, a common concept in innovation studies is that the more the product architecture of innovation differs from the existing product, the more this innovation is competence-destroying for incumbents. However, this logic cannot be applied to any situation. In the digital imaging industry, the product architecture of the compact DSC and DSLM camera are significantly different from that of the film-type SLR, while the DSLR camera has similar architecture. Nevertheless, incumbents had no difficulty in entering these markets, and these products did not represent competence-destroying innovations for any firms. Rather, manufacturing the DSLR camera was a competence-destroying innovation for new entrants.

This study has some limitations. From the analytical perspective, the results of the case study should be confirmed using a larger sample. Different industries other than the digital imaging industry should be addressed to verify the effects and impacts of modular innovation across industries and incumbents' performance.

Second, the case study should also address the perspectives of customers and markets. This study focuses more on the technology side of innovation, while the innovation's effects on customer needs remain unexplored. According to Benner and Tripsas (2012), focusing on product features and consumer demand is the next step to combine firms' technology and market information.

Third, more patent data are needed for a more sophisticated analysis of firms' technological knowledge and behavior. Other countries' applications for patents should be considered to address oversees firms, and time-

series data should be used for analysis. In addition, using more detailed technological categorization would help observe technological trends in the industry.
Finally, for practical application, the discussion on management should be expanded, especially how firms acquire technological knowledge. This study does not address how firms restructure their organization or redesign communication among departments when entering a new product market and have to innovate.

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