

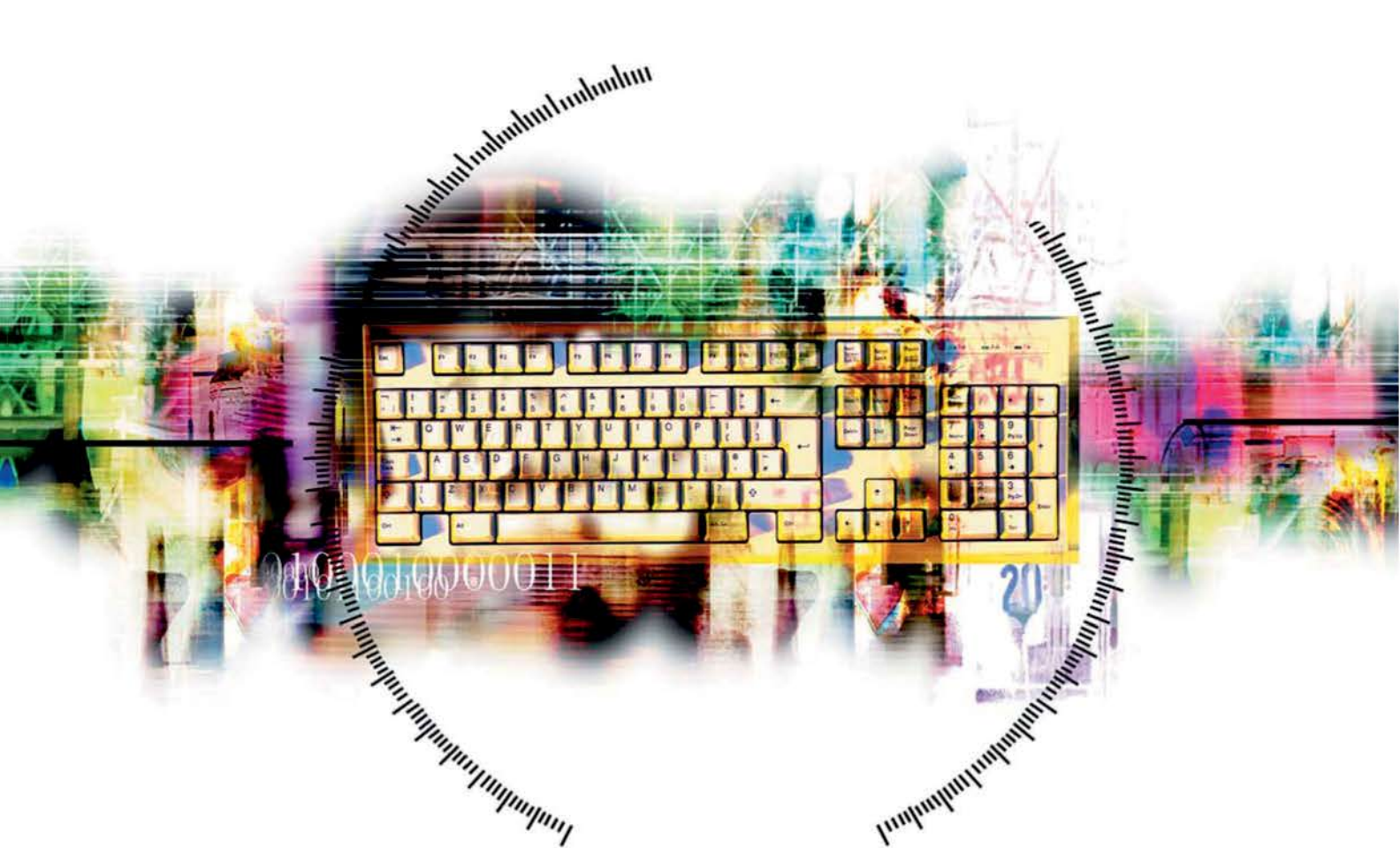
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Supply Chain Resilience and Sustainability

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'The only stable thing is that everything changes'
(Heraclitus, Ancient Greek Philosopher)

■ G. MALINDRETOS¹

■ S. BINIORIS²

Scope: Re-approaching the contemporary issue of a holistic re-engineering strategy in relation with the resilience in the value supply chain circuit. Increase in collective capabilities to overcome risks of increasing vulnerabilities and to improve business and economic sustainability. Research Methodology: Building-up an integrated methodology framework of mixed participatory interactive action. Systemic and process value chain analysis, collective use modern knowledge management combining multicriteria with proactive value creation process for sustainable competitiveness with the 'power structure' and 'institutional flexibility' to encompass physical and social technology infrastructure with modern cybernetics governance.

Anticipated Results: Improve understanding and use of an operational R&D framework for enhancing collaboration, strengthening collective capacities and performing holistic re-engineering strategy in support of resilience and sustainable competitive advantage. Critical role of the institutional efficiency to combat power concentration and leverage the interfirm and interdisciplinary Supply Chain Re-engineering (SCR) to ensure resilience and sustainability.

Originality/contribution: Contribution to better understanding the resilience to face the increasing trend of vulnerability and mitigate risks from globalization of markets, as cornerstone to company sustainability. Relation to the problem of world poverty, environment protection and development by collective intercompany and interdisciplinary value chain networks. Knowledge management by re-engineering and building-up an interactive methodology framework of broader relevance, to fulfil the multicriteria of stability and sustainability (Sustainable Supply Chain Management, SSCM). Role of new collective culture and vision to align governance with human face and solidarity for maximization of collective capabilities and integration synergies. Rethinking of the roots of increasing of increasing vulnerability and crises, for resilience to ensure sustainability, development, progress in peace and saving the collective human civilization.

Key words: SCM, Supply Chain Management. SCR, Supply Chain Re-engineering. HSCS, Holistic Supply Chain Strategy. SSCM, Sustainable Supply Chain Management. SMS, Sustainable Management Systems. RSC, Resilience of Supply Chain. SCR, Supply Chain Risk Management. CPAM, Constructive Participatory Action Methodology.

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1. Introduction

This paper focuses on the development of a managerial agenda for the identification and management of supply chain risk and formulates certain recommendations to improve the resilience of supply chains. The conceptual issue of the value chain resilience enhances the supply chain management (SCM), as further advance to supply chain re-engineering (SCR) and to sustainable supply chain management (SSCM) to become mainstream in recent years. The conceptual engagement is part of the literature review that followed the surge of interest concerning the value chain resilience in the last decade. It seems enough for practitioners to sketch out the literature review, to avoid repetitions and focus in filling gaps to strength the resilience concept for performing implementation.

The literature review is followed by special concern to the methodology issue for the purpose of formulating a workable integrated R&D framework, to support decision making at case level. More specifically, attention is attributed on bridging the gaps for improving performance of re-engineering strategy at intercompany value chain level. The zero start or restart approach of critique, analysis and synthesis aims at better understanding of the complex SSCM, selection and mobilization of all partners by concerted participatory action R&D methodology.

The next section concentrates on the realization of the critical requirement of interactive, multi-disciplinary and interfirm collaboration due to the complexity of the value network chain process. The attention then turns to the question of looking for most appropriate ways ('how') towards increasing collective capabilities to ensure resilience by two essential 'marriages': 'colpetition' (derived from collaboration and competition) and 'syntegration' (derived from synergy based on integration), as cornerstones to build-up a re-engineering plan, in view of the increasing risks of vulnerability in transactions environment.

The issue of new strategic thinking towards proactive strategies follows to cope with the changing environment of increasing risk and vulnerability, in view of the fact that the dominating tools and practices have ex-post reactive character following predetermined situations rather than proactive in-

tervention to achieve long-term competitive advantage (e.g. 'standardization', 'benchmarking', etc.). It calls therefore for participatory new innovative ideas of collective management to meet the challenge of increasing vulnerability and to mitigate risks, without impairing the sustainability goal.

The study goes on the question how to strengthen collaboration for increasing collective interactive capabilities, based on a designed process of advanced planning and co-ordination at timely oriented strategic, tactical and operational level. For this purpose the attention turns to the issue of agility into the supply chain processes, as a further advance of the lean manufacturing and prior inventories management techniques.

It proceeds with generalizing SCR to ensure resilience at value chain level, which emerged eight years ago, originated largely from the Canfield University, School of Management (2002, 2003). The task is to sufficiently understand the essence, the constraints and how to overcome them as the only way to face anymore the challenge of survival and sustainability.

The study is extended to further penetration into the roots, causes and processes of value creation. Main issues in the integrated approach are the institutional flexibility and changing 'power structure'. Thus, it epitomizes the system dynamic analysis with reference to the debate the power structure concentration and the integration at value chain level - the so-called 'new institutionalism' - and the possibilities of SCM extension to public administration, organizations and enterprises.

The paper ends with a number of conclusions based on the criterion of contribution in improving the process of increasing the collective capabilities to strengthen resilience for containing vulnerability and ensuring sustainability along with quality of life and social cohesion.

2. Literature review

There has been increasing concern of research and operations management during the last decade to cope with increasing vulnerability and risks of business disruptions. The initial study on supply chain resilience, conducted in the Canfield University School of Management (2002, 2003), came out in brief with the following: (1) supply chain vul-

nerability is an important business issue; (2) little research existed into supply chain vulnerability; (3) awareness of the subject was poor; and (4) a suitable methodology is required for managing supply chain vulnerability. In parallel, researchers especially at the Massachusetts Institute of Technology (MIT) analyzed many case studies of exterior supply chain disruptions useful for identifying vulnerability characteristics and management responses such as flexibility, redundancy, security, and collaboration (Chopra and Sodhi, 2004; Sheffi, 2005).

Apparently, the increasing research attention to vulnerability and supply chain resilience is critical for SSCM that has increased momentum in recent years (WBCSD, 2002; Sharma and Henriques 2005; Global Reporting Initiative, 2006; Scherrer et al., 2007; Seuring et al., 2008; Searcy, 2009; Borison and Hamm, 2010).

As effective SCM contributes significantly in improving performance and attaining sustainable competitive advantage, risk and uncertainty has always been an important issue in SCM and has become a need for companies nowadays (see Aven, 2002; Tang, 2006; Vanary and Zailani, 2009; Borison and Hamm, 2010). Earlier research considered risks in relation to supply lead time reliability, price uncertainty and demand volatility which substantiated the need for safety stock, inventory pooling strategy, order split to suppliers, and various contract and hedging strategies (Chen and Paulraj, 2004; Gaiardelli et al., 2007; Barber, 2008). The

notion of effective supply chain risk management (SCRM) has gained increasing momentum in more recent years due to increasing supply chains complexity and vulnerability, including the use of global contract manufacturers and suppliers. The topic of resilience in the supply chain literature has become more recognized and widespread, although SCRM is still in the infancy stage (Bakshi and Kleindorfer, 2009; Ponomarov et al., 2009; Vanary et al., 2009; Pettit et al., 2010).

The research of RSC is engaged with the phenomenon of increasing vulnerability and the techniques used to anticipate, mitigate and overcome disruptions (Bakshi and Kleindorfer, 2009; Pettit et al., 2010). Supply chains as complex networks of enterprises experience increasing turbulence and unpredictable disruptions. In effect, executives identify supply chain risks as the highest threat to their firms. Studies have found that, although effectively managing such operational risks directly affects financial performance, a majority of corporate board members are under-informed about those risks (Council on Competitiveness, 2007). Becoming aware of these gaps, an increasing number of researchers are realizing the significant role of the resilience concurrently at value chain level (Feller et al., 2006). The past uses of the concept of resilience in engineering, ecological sciences, and organizational research, facilitate creating a conceptual framework for supply chain resilience (figure 1).

Source	Definition	Field of study
Merriam-Webster (2007)	Capability of a body to <i>recover its size and shape</i> after deformation	Engineering
Folke et al. (2004)	<i>Ability to rebound</i> from a disturbance while maintaining diversity, integrity and ecological processes	Ecology
Gorman et al. (2005)	<i>Ability to bounce back</i> from adversity	Psychology
Stoltz (2004)	<i>Ability to bounce back</i> from adversity and <i>move forward</i> stronger than ever	Leadership
Rice and Caniato (2003)	<i>Ability to react</i> to an unexpected disruption and <i>restore normal operations</i>	Supply chain
Sheffi (2005)	<i>Containment of disruption</i> and <i>recovery</i> from it	Supply chain
Christopher and Peck (2004a)	Ability of a system to <i>return to its original state</i> or <i>move to a new, more desirable state</i> after being disturbed	Supply chain
Fiksel (2006)	Capacity for complex industrial systems to <i>survive, adapt and grow</i> in the face of turbulent change	Supply chain

Figure 1: Different Definitions of Resilience

The concept of RSC combines these previous tenets with studies of supply chain vulnerability, defined by Svensson (2002) as ‘unexpected deviations from the norm and their negative consequences.’ RSC has been defined as ‘the capacity for an enterprise to survive, adapt, and grow in the face of turbulent change’ (Fiksel, 2006).

Mathematically, vulnerability can be measured in terms of ‘risk’, a combination of the likelihood of an event and its potential severity (Sheffi, 2005; Craighead et al., 2007). It has foundations in traditional risk management techniques and is expanded by other authors (Chapman et al., 2002, 2004; Peck, 2005; Svensson, 2000, 2002, 2004; Zsidisin, 2003).

SCR, require closer collaborations with partners across the supply chains as well as with governments, in order to make supply chains robust and resilient. The short-term costs of such security measures can be overbalanced by the long-term gains from improved supply chain performance and improved customer relations (Sarathy, 2006). Moreover, globalization involving increasing amounts of overseas components sourcing, overseas production, global factory networks and lengthy geographically dispersed supply chains servicing international markets across the world. It is noticeable that overseas shipping now accounts for over 90 percent of worldwide trade, however, the physical infrastructure underpinning globalization has been considered to be under threat (National Defence University, 2002).

The concept of adaptability is crucial to ‘living systems’ and supply chains may be seen as a network of ‘living’ systems. Based on this systems concept, Fiksel (2003) proposed four major characteristics of resilient systems: diversity, efficiency, adaptability, and cohesion. Peck (2005) has proposed multi-level supply chain framework identified on four key principles: (1) resilience can be built into a system in advance of a disruption (i.e., re-engineering); (2) a high level of collaboration is required to identify and manage risks; (3) agility is essential to react quickly to unforeseen events; and (4) the culture of risk management is a necessity (Cranfield University, 2002, 2003; Christopher and Peck, 2004b; Peck, 2005). Other researchers have later on advocated the use of simulation-based studies to help quantify the relationship between sup-

ply chain disruptions and relevant design characteristics at a strategic level (Kleindorfer and Saad, 2005; van der Zee and van der Vorst, 2005; Tierney and Bruneau, 2007; Craighead et al., 2007; Falasca et al., 2008; Vanary and Zailani, 2009). Supply chains are becoming more complex and more vulnerable, thus contributing to potential supply chain disruptions (Figure 2).



Adapted from: *Supply Chain Vulnerability: Executive Report*, School of Management, Canfield University, 2002

Figure 2: Factors of supply chain resilience

It has been maintained that prevention or resilience as the ability to maintain positive adjustment under challenging conditions is supported by grounded like theory (Blatt et al., 2006). Because. It allows participants to identify what they see as a problem in line with a methodology that is intellectually stimulating and supports simultaneous inductive-deductive thinking (Glaser and Holton, 2004).

An eco-efficiency approach pertained that strategy rarely results to optimization, as it may be eroding the resilience of production systems (Korhonen and Seag, 2008). A literature review of the SCRM for the period 2000-2007 classified studies into five categories (conceptual, descriptive, empirical, exploratory cross-sectional and exploratory longitudinal) and types of risks, unit of analysis, the industry sectors, and the management process or strategies addressed (Vanary et al., 2009). Resilience is still evaluated, however, as a relatively undefined concept in the emerging discipline of SCRM (Pomonarov and Holcomb, 2009).

Other studies focused on that disruptions can also bring opportunities for success, by ‘impress customers and win their loyalty’ (Knemeyer et al., 2003), with actual examples (Sheffi, 2005), or ‘can offer an opportunity’, and ‘successful recovery and adaptation to new market forces can lead to competitive advantage’ (Rice and Caniato, 2003).

The concept of resilience is encompassing, among others, the organizational leadership, pointing out that it is 'more than education, more than experience, more than training, the level of resilience will determine who succeeds and who fails' (Coutu, 2002). Therefore, creating resilient leaders 'is the best way to ensure that an organization will prosper in a very chaotic and uncertain future,' and resilient organizations consistently outlast their less resilient competitors (Stoltz, 2004). Organizations must learn to improve anticipating, absorb, and overcome disruptions (Pickett, 2006). Disruptions have adverse effects in both revenues and costs, though there is still a number of theoretical and methodologies gaps for managing integration perspective and a unified theory of resilience is still underdeveloped and waits for interdisciplinary approaching (Ponomarov et al., 2009).

Other studies pertained to a number of factors e.g. the best contingency and mitigation strategies for a firm with a single product and two alternative suppliers (Tomlin, 2006); an insurance risk management framework (Lodree Jr, and Taskin, 2007); developing a dynamic system model for supply chains (Huang et al., 2007); an agent-based framework for studying multi-product, multi-country supply chains subject to demand variability, production, and distribution capacity constraints (Datta et al., 2007); insurance and re-insurance (Doherty et al., 2008); joint venture (Darrough and Stoughton, 1989; Bakshi and Kleindorfer, 2009); applications of the Nash bargaining solution (e.g., Plambeck and Taylor, 2005); incentive to hide vulnerability to disruptions from global supply chain partners (with not efficient markets, 'asymmetric information' and subsequent 'adverse selection' and 'moral hazard'); the principal-agent literature (Laffont and Martimort, 2001); a framework to solve the bargaining problem with incomplete information and the 'revelation principle' (Harsanyi and Selten, 1972; Myerson, 1979); recent debate on the axiomatic approach to bargaining vis-a-vis the strategic approach (sometimes also referred to as the non-cooperative approach to bargaining), by use this as the starting point a two-player model (Bakshi and Kleindorfer, 2009). The interdependent nature of risk in supply chains pertains to Total Quality Management (TQM) and new product introduction (NPI), although the differentiating

feature of catastrophic disruptions is that, unlike in quality management, it does not make sense for the players to design contingent contracts that use occurrence of failures as a gauge for performance. Melnyk et al. (2010) maintain that the supply chains of tomorrow must be properly designed to deliver varying degrees of six outcomes – the traditional cost-related benefits, plus responsiveness, security, sustainability, resilience and innovation – depending on key customer needs. It is increasingly recognized the need for meeting the requirements of 'reduced cost-fast delivery-improved quality', so that a more sophisticated supply chain is emerging, that also will serve as a vehicle for developing and sustaining competitive advantage under a variety of performance objectives. While the old supply chain was strategically decoupled and price driven, the new supply chain must be strategically coupled and value driven. Therefore, it should be designed and managed to deliver specific multiple outcomes.

3. Revisiting the Methodology Issue

The attention to the research methodology issue aims at supporting decision making through overcoming pervasive long past methods and practices, including the associated misconceptions, misunderstandings, contradictions, paradoxes, attitudes, culture, philosophy, asymmetric information, inertia and inaction to change. The real problem is how to amalgamate knowledge and multidisciplinary R&D attributes to serve the critical role of the methodology issue, as 'there are hardly any publications on methodological questions in the field' (Kotzab et.al, 2005). However, it has been pointed out that 'few companies take the right approach' when it comes to improving their supply chains (Lee, 2004).

Special attention is going to be attributed on how strategic thinking and knowledge management can be used to build-up proactive holistic re-engineering strengthen collective capabilities for achieving resilience, mitigating risks from increasing vulnerability to ensure sustainability of progress and quality of life. The task to motivate all available resources requires a new vision and a new state-of-the-art, taking into account the 'institutional efficiency' and 'power structure' for improving

integration and supporting the application of SCR. Moreover, it will be studied whether the rootstalk of SCM can contribute in an alternative strategy, to overcome the constrain of debt, compared with the austerity stabilization program established in the end of the Second World War.

A converging remark from the literature review is the usefulness of conceptual research framework by modeling it and taking varying degrees of provision for quantification and measurement and control of the results. However, research concerning the supply chain resilience does not always relate sufficiently to the causes of vulnerability, as a way of avoiding the risks of trapping into misuse of concepts and long dominating conventional methodologies, theoretical preoccupations, philosophy, culture, techniques and practices (deduction, positivistic, partial character, etc.). The hasty move to new concepts, like value supply chain, holistic re-engineering and sustainability, can exert adverse effects on the long-term sustainability objective without sufficient provision on the methodology background. This can lead to possibly adverse effects by misuse of both logistics and of sustainable issue, namely the ‘fatal sins of outsourcing’ and the myths associated with the issue of the sustainability (Seuring et al., 2008; Pagell and Zhaohui, 2009).

More particularly, such a fragmentation is associated with neglecting the role of the institutional framework, flexibility and change in the power structure. In so far as there is a trend of power concentration and institutional glitch, these can act as vulnerability generators and at the same time as breaks to the SCR, namely they can have double adverse effects on sustainability. Therefore, to strengthen the integrated network character of the SCM and its advance to SCR, the research has to be driven directed towards two directions: firstly, to formulate a R&D framework to support decision making at case level; secondly to penetrate into the interrelationships of the power structure and the institutional flexibility and their effects on vulnerability, introduction of SCR and collective capabilities.

This double purpose prerequisite a formation of a workable R&D framework and step inside to the issue of dynamic interrelationships between power structure and the institutional flexibility which incubates the collaboration forces and strengthen resilience and sustainability. More specifically, the

concept of the network of value supply chain is based on collaboration attitude and practices which presupposes discipline to the socioeconomic axiom of active participation, conceived as a new social agreement of collaborative action. This prerequisite is often neglected in the number of frameworks and models seen in the literature review. It obviously suggests modern strategic thinking for genuine holistic redesigning from zero start to end, namely partnership in sacrifice as well as in the expected ‘syntegrating effects’ (from synergy and integration). It is a complex unique project, not easily rationalized, formalized and generalized.

Realism seems to suggest a ‘wisdom and phantacy mix’, with the need of collaboration to make compatible humanism with efficiency anymore, operating in today ‘chaos-tolerant supply chain in a world of increasing uncertainty’, namely relaxing the ambitions of generalizations and the risks of idealizing in office work away from the real world. Objectively, it is a complex interdisciplinary and interfirm task that has not prior paradigm to follow. This is feasible through change in attitudes and practice with social spirit and responsibility, on historical necessity for avoiding sinking altogether. For instance, nobody alone can say in advance, whether a firm or an institution in operation has to demolish in scrap and rebuilt or to go on restructuring for collective confrontation with others.

The actual challenge and opportunities of tomorrow call for a united front of start / end character for value creation to users. Thus, the resilience literature converges to the necessity of increasing collective capabilities, throughout re-engineering at value supply chain level, leaving aside differentiations in details. What each will be called to do in the new conglomeration will conform to the criteria of relative efficiency, talent, experience, etc.

Therefore, overcoming conventional practices and use of genuine holistic strategy requires social responsibility, extended to institutional level, including academicians and modern means of mass information. The R&D challenge of maximizing collective capabilities, by awareness and mobilization of all available resources, is not just a matter of formal organization, with possible harming innovation promotion and effective participation in the value creation process. A sufficient R&D methodology seems to be found in a constructive

participating action framework (CPAF), as partnership in the 'extended company' to ensure flexibility to changing circumstances and become a 'learning hyper-organization'. Such thinking leaves room for specific infrastructure requirements and inter-organizational layers, as well as for 'local' behavior of sub-networks (Peck, 2005). It seems further to help the determination of an 'optimal' strategy under different conditions, through an approach such as multicriteria simulation-optimization and a context of providing computer-aided decision support (see more, Joines et al., 2002; Falasca et al., 2008).

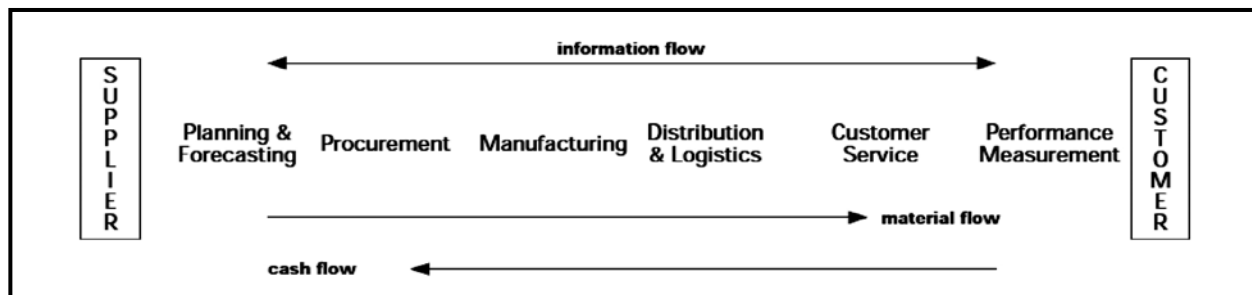
4. Complexity and Collaboration in the Value Creation Process

4.1 Increasing Complexity

The resilience for capturing the dynamics of turbulence and vulnerability into the concept of a 'supply chain,' adds to its complexity. Better understanding of the concept of a supply chain is critical for the

network of companies involved in the upstream and downstream flows of products, services, finances, and information from the initial supplier to the ultimate customer (Christopher, 1992; Lambert et al., 2005; Mentzer et al. 2001). Therefore, to deal from the beginning with the vast degree of turbulence and complexity in supply chains requires an enterprise view with collaboration among all business functions within the firm (Ahlquist et al., 2003), as well as inter-organizational alignment among supply chain members (Lambert, 2006; Slone, Mentzer and Dittman, 2007), otherwise inbound and outbound logistics. Because, changes, in the turbulent corporate environment, result in increasing complexity and vulnerability.

Supply chain incorporates three main flows: material, information and cash flow (Figure 3). Material flow activities aim at delivering to the final customer, via procurement of raw materials, manufacturing, distribution and customer service. These must be managed from upstream to downstream, based on the bidirectional flow of information and the movement of money from downstream to upstream.



Source : Spekman et al., 2004

Figure 3: Flows in the supply chain

Sufficient understanding of SCM is very useful, as well as of how it emerged and how it has been rapidly progressed to become mainstream at research and application level. Also, the implications of advance to SCR, acknowledged as a 'revolutionary change' must be realized, since it has been attributed as comparable to the scientific management and planning by Frederic Taylor and Henri Fayol that emerged just about one century ago (Boone and Bowen, 1987; Hammer and Champy, 1993; Knights and Willmott, 2000; Malindretos et al., 2002). Seeds of these changes go back to early after the 2nd world war (Drucker, 1954, 1988),

by severe criticism of the functional firm structure and side effects of fragmentation of management, against coordination and effectiveness.

Especially, the distribution functions, such as procurement and replenishment, transport and warehousing, marketing and selling, were treated in the past as 'cost burden' and 'liability'. Therefore, the emergence of logistics as a scientific discipline deals with their inter-depended management, taking into consideration the trade-offs and the potential positive effects in cost, quality, time, service and value creation to the final users. The use of such effects has been supported by assignment of 'non-

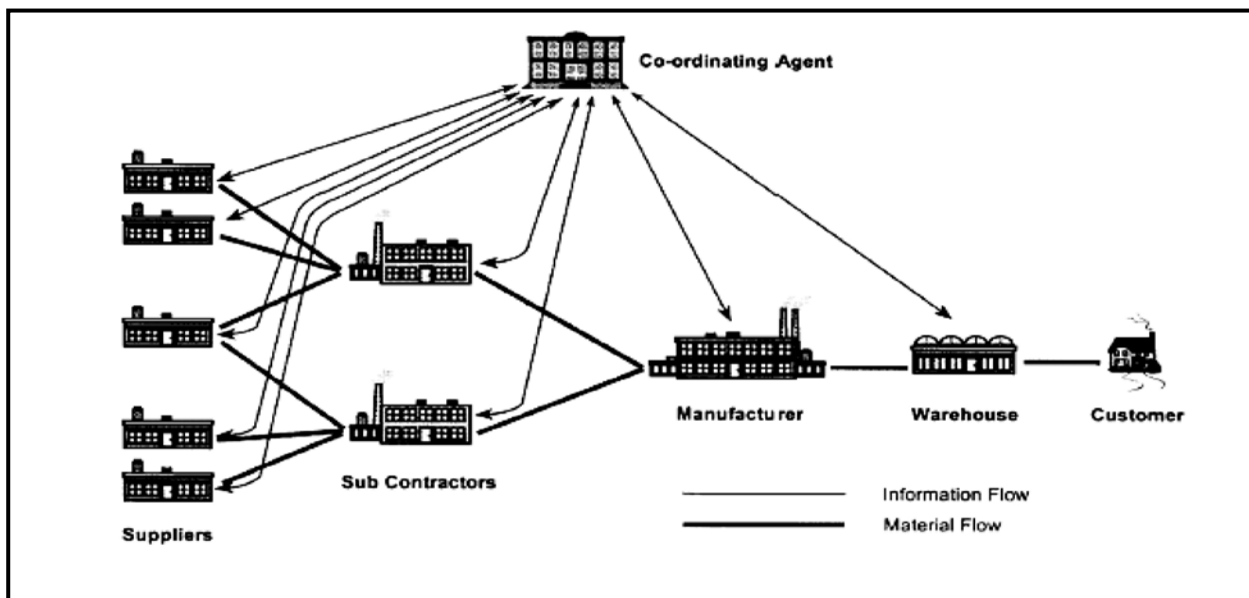
core' functions to third parties (outsourcing: 3PL), upon the 'make-or-buy question' (Lambert and Stock, 1993; Rushton and Oxley, 1989; Gattorna, 1990; Christopher, 1992; Ballou, 1992). Processes are specified and classified in two categories: core processes which express the main business goal and non-core ones, which are supplementary and can be assigned to outsourcing. The make-or-buy decisions have to be based on strategic integrated planning at supply chain level (Malindretos and Moschouris, 2008).

The next historical advance was the drive to further strengthening of the role of Logistics with entire move to interfirm supply chain level with stable interdisciplinary collaboration. SCM is an integrated concept throughout the supply chain as a source of value maximization and total cost minimization, based on interrelationships mix in a network sense. Such a conceptualization was first presented by Forrester (1961), however it was put in action later. Different experts have been discussing the usefulness of sustainable management systems (SMS) as holistic systems that might integrate environmental, social and economic elements (Esquer-Peralta et al., 2008). Focus has turn to value creation to the customers through higher service quality. This new change has helped in clearing up alternative distinctive firm strategies to ensure competitive advantage: 'cost leadership', 'product differentiation'

and 'combined focus', with marked contribution of Porter (1980, 1985).

An arbitrary taxonomy in differentiated frameworks of the changes includes the following: the focus in 'cost leadership' strategies during the 1970's was followed by 'product differentiation' during 1980's. 1990's has been earmarked by the so-called 'globalization phenomenon', after the unprecedented peaceful collapse of the central planning system in Europe by late 1980's. To face the challenge of adjustment to the new ever changing transactions environment, there has been a further major change for first time in the economic history, characterized by the unification of firms at supply chain level, the so-called business process or supply chain re-engineering (SCR) (Hammer and Champy, 1993). Further attention during the first decade of the new millennium was given to the so-called sustainable supply chain management (SSCM) and to the issue of agility and later on to resilience, putting vulnerability and sustainability, in the mainstream of attention. The rebuilding of a supply chain into a SCM network has been subject to a very complicated exercise that requires long-run collaboration, holistic strategy, discipline, and control (figure 4).

The literature focuses on conceptual and empirical aspects, not always in balance, often without adequate connection with the fundamentals of



Source: Jagdev and Browne, 1998

Figure 4: A typical extended enterprise

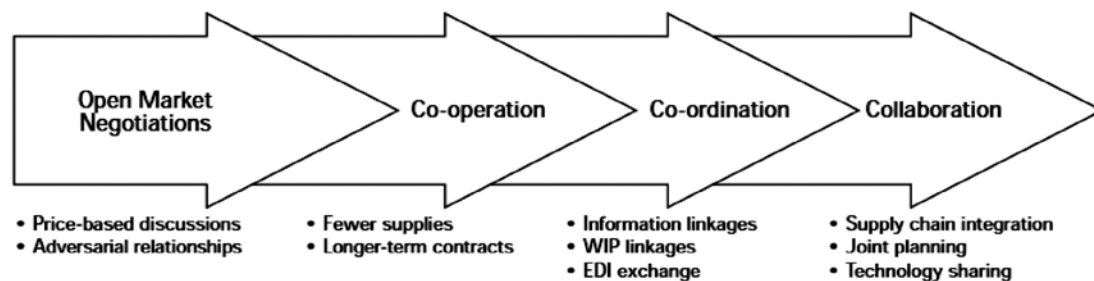
the SCM and SSCM. Clarification of many other relevant concepts is associated with the historical change, such as integration, holistic character, networks, value strategy, management systems (MS), power structure, institutional flexibility, etc. Such issues are increasingly studied without always sufficient specification, in a variety of fields, including cybernetics and governance, academy, politics, and non-governmental organizations, also being used by the general population.

4.2. Critical Role of Designed Collaboration

In meeting a challenging business environment, the emergence and rapid extension of SCM has not to be conceived as prescription, savior and a safety belt. True that no single firm can anymore ensure effective provision of product (or product/service bundle) since inefficiency, delays and other 'wastes' (i.e. non-value adding activities) can emerge anywhere in a disorganized supply chain. Contemporary effective integrated supply chain can create maximum end-user value, with agents working together as partners. The real challenge is how to marry collaboration with competition (col-petition), by designing and coordinating in order to create the desired value for the customer throughout the whole supply chain. Facing this new era of business practices, successful winners will be those that can collaborate and work together with all partners, in a supply chain committed to better, faster and closer relationships with the final users (Christopher, 1992). The modern electronic high technology can facilitate collaboration and information for sharing risks and costs, taking an equitable share in the outcomes to be created. The partners can be motivated to help each other, to improve collectively the operational efficiency

towards eliminating eliminate waste, so that the whole chain will be optimized and integrated as a single system.

The sense of collaboration in the network supply chain level is to achieve high collective capabilities and performance, beyond temporary long-term cooperation. Collaboration goes side by side with co-ordination, involving a set of relations to develop seamlessly linked activities between and among trading partners, through JIT systems and other mechanisms. Thus, co-ordination is not sufficient for the overall SCM and therefore it calls for a new sense of collaboration. True collaboration partnerships are based on high levels of trust, commitment, consistency and information sharing among the partners (Spekman et al., 1998; Slack et al., 2004). Partners throughout the supply chain must be integrated in a user customership relation so that to attain maximum satisfaction for the final users. Thus, there can be significant impact on own performance as well as that on the whole supply chain. Close collaboration with partners, including manufactures, suppliers, distributors, transporters and end-customers are the key to success. A climate of closer collaboration among all partners creates common goals for the mutual benefit of each individual partner. Failing to collaborate would result in the distortion of information, which, in turn, can lead to inefficiencies, excess stock, slow response and lost profits (Lee et al, 1997). Collaboration enables partners to gain a joint understanding of future product demand and to implement realistic programmes for satisfying it and yielding major business benefits: increase in the market share, stock reductions, reduction in cost and lead-time, improved quality and shorter product development cycles (Corbett et al., 1999).



Source: Spekman et al., 1998

Figure 5: Key role of collaboration in the supply chain

The changing business environment has called for close collaboration in the form of ‘extended enterprise’, (Browne et al., 1995; Browne et al., 1996; Jagdev and Browne, 1998), ‘adaptive supply chain’ (SAP, 2002), and linking of firms into ‘learning organizations’, with knowledge to become ‘the currency of exchange’ (Spekman and Davis, 2004), through frequent exchange of status information (Jagdev and Thoben, 2001). All activities for movement of materials and information should be operated through collaboration with partners in a synchronized and coordinated way (Scholz, 1997).

5. Syntegration and Cybernetics

5.1 From Synergies to Syntegration

To overcome the main limitations, environmental management systems (EMS) have to explicitly address cultural and structural issues in a true a holistic approach and to look for innovative insights into the combined use of complexity and cybernetics for understanding complex networks dynamics (Espinosa and Leonard, 2009).

The transition that the postmodern western societies from the industrial to the information age and knowledge management are experiencing is a major subject for companies, non-profit and public organizations alike (Hasler Roumois, 2007). The actual ‘synergy effects’ can be best achieved through building-up integrated supply chains, so that the concept of ‘syntegration’ and ‘syntegration method’ have been introduced. It works out in a ‘cybernetically sound’ method that has scientific background and structure to enable for practical experiences of governance useful to analyze the current global crisis (‘cybernetics of crisis’). Further clarification is helpful from avoiding irresponsible misuse of the synergy concept without substantiation of integration and holistic SCS. The ‘syntegration’ approach can be integrated in a modern systems theory and is, therefore, very suitable component of a ‘learning organization’ (Maturana and Varela, 1987; Leonard and Beer, 1994; McMullin, 2004). Syntegration, based on management-cybernetics, results in optimal integration that brings forth the maximum benefit of communication processes. Empirical findings and practical experience account for outstanding success of Syntegration (Diringer, 2010).

5.2. Proactive Supply Chain Strategy

The Porter’s strategy options (1980) and the proposed five-forces model, actually underline different degrees of markets imperfections (competitive rivalry; barriers to entry; threat of substitutes; the power of buyers and the power of the suppliers) and the value creation process. It substantiated three ‘generic strategies’ (cost-leadership, differentiation and focus), in pursuing competitive advantage (Porter, 1985). The five forces analysis, is one part of the complete Porter strategic models, whereas the other are the value chain and the generic strategies. It has been pointed out that the primary social mission of companies as institutions is to create value to the citizens and society at large. Main duty of the modern management and leadership has to revisit social mission and responsibility, in order to articulate a moral corporate philosophy, contrary to thinking about companies in very narrow terms and to weaken their ability to create value for the society (Ghoshal and Moran, 1999). On the other hand, strategic planning should not harm strategic thinking, as the most successful strategies are visions, not plans (Mintzberg, 1994).

Moreover, within increasing vulnerability in business environment, the management has to turn attention to forward and rethinking in terms of a proactive strategy at supply chain level (figure 6).

It deviates from the past evaluation of the tools and methods (e.g. ‘best practices’, standardization, benchmarking, etc.), without rejection of their usefulness. Because, they are based on an industry’s general idea of what it does today and not foreseeing future, missing, thus, innovation. In other words, they are not proactive, forward-looking exercise, but reactive. For instance, best practices already exist and therefore to create competitive advantage requires enhanced collective capabilities, beyond the ‘generally acceptable business capabilities’ within an industry (Vivek Sehgal, 2010). It involves a ‘configure-to-order’ model and a new paradigm of promoting innovative ideas for attaining mutual benefits for customers and partners involved in the value chain.

Vulnerability Factor	Definition	Sub-Factors
Turbulence	Environment characterized by frequent changes in external factors beyond your control	Natural disasters, Geopolitical disruptions, Unpredictability of demand, Fluctuations in currencies and prices, Technology failures, Pandemic
Deliberate threats	Intentional attacks aimed at disrupting operations or causing human or financial harm	Theft, Terrorism/sabotage, Labor disputes, Espionage, Special interest groups, Product liability
External pressures	Influences, not specifically targeting the firm, that create business constraints or barriers	Competitive innovation, Social/Cultural change, Political/Regulatory change, Price pressures, Corporate responsibility, Environmental change
Resource limits	Constraints on output based on availability of the factors of production	Supplier, Production and Distribution capacity, Raw material and Utilities availability, Human resources
Sensitivity	Importance of carefully controlled conditions for product and process integrity	Complexity, Product purity, Restricted materials, Fragility, Reliability of equipment, Safety hazards, Visibility to stakeholders, Symbolic profile of brand, Concentration of capacity
Connectivity	Degree of interdependence and reliance on outside entities	Scale of network, Reliance upon information, Degree of outsourcing, Import and Export channels, Reliance upon specialty sources
Supplier/Customer disruptions	Susceptibility of suppliers and customers to external forces or disruptions	Supplier reliability, Customer disruptions

Source: Pettit, 2008

Figure 6: Vulnerability Factors

Business functions that grow organically, simply don't deliver any competitive advantage. The underlying reasons are that evolutionary change of business processes is actually reactive and therefore, it is like building fire-fighting infrastructure when the house is already on fire. Management must be proactive in order to build-up competitive advantage and create capabilities that need to grow, instead of simply reacting to the business conditions.

The clear conclusion is that supply chain strategies need to deliberate the design of the supply chain rather than pursuing concepts that are outrun and therefore irrelevant. It means that corporations must explicitly design supply chain processes directly towards the goals of business strategy. This applies whether minimizing cost is the strategic goal - when the management should be designing supply chain to squeeze cost out through reducing shipping expenses etc. initiatives - or increasing warehouse and transport efficiencies through better labor scheduling, wave planning, stocking effi-

ciencies, etc. Alternatively, if the strategic goal is product differentiation, the attention should be centered on product design, mass-customization, product-quality and variety. Similarly, if the business strategy is based on customer-service, the supply chain must enable customer-centric capabilities, such as order fulfillment, tracking, visibility during manufacturing and transit, etc.

Actually, processes, in any case, involve complex issues derived from their interdependence, interfirm design, mathematical programming or some complex statistical modeling – anything that is hard to understand, like a 'black-box'. Thus, it is critical to have the clearest vies of their interrelations and 'bottle-necks' in order to interfere on time and effectively.

All in all, staying in conventional wisdom, hinders innovations and progress at application level. It is noticeable that before 'six-sigma' became a corporate diet and SPC (statistical process control) became a standard method for

controlling quality, they were merely statistical tools; before linear programming became fashionable in solving supply chain problems - using the constraints of available material and resources - and time-series analysis became a standard in demand forecasting, they were just mathematical theories.

As the list of collective capabilities factors can go on, no management can wait for each of them to become history before assuming new business initiatives and the associated risks. It would lead to stagnant society, economy and civilization, if not still living in the trees!

As resilience is a key ingredient in logistics risk management, it is a 'wicked problem', since it is open-ended and almost impossible to solve by addressing some part of the perceived problem; this often creates adverse consequences in other areas. Building resilience in organizations calls for new ideas, merging and blending different approaches to craft a solution (Simpson, 2010). Resilience was seen as collective skill acting on three levels, individual, group and organizations level; organizational resilience is not the sum of group resilience and group resilience is not the sum of individual resilience. Many businesses are somehow nested in a stable environment, relying on today and are confounded when things suddenly change. A critical question that arises is 'adapt or transform', that is 'adaptive fit' versus 'robust transformation': though adaptation may work temporarily, transformation and building a resiliency capability is what works best in the long run, and presumes a triple of 'agility, adaptability and alignment' (Lee, 2004).

6. Re-engineering based Resilience

6.1. Agility versus Leaning

The changing role of the inventory has passed from the Economic Order Quantity (EOQ) model (Ford W. Harris, 1913), industrial revolution and inter-city transport of goods motivated the invento-

ry as the primary means of decoupling production from demand and combating myriad of uncertainties throughout the system, later adapted to account for uncertainty in lead-time and demand (Whitin, 1954). Adding safety stock to cycle stock extended the use of inventory as primary buffer against uncertainty for decades.

The era of customer focus in the 1980's brought service to the forefront (Kent and Flint, 1997). To manage the interaction of supply and demand risks, some methods were developed for Quick Response, using policies such as Just-in-Time (JIT), Real Time, Vendor Managed Inventory (VMI) and Continuous Replenishment (Herron, 1987; Schwarz and Weng, 2000; Waller et al., 1999; Zinn and Chames, 2005).

Among proposals of how to deal with an uncertain and unpredictable environment, the three notions of 'adaptive organization', 'flexible organization', and 'agile enterprise' are the most predominant and popular. There are many different approaches to define each of these terms and there is much confusion and ambiguity concerning definitions and components of each of these concepts (Sherehiy et al., 2007). Agility was defined as a rapid and proactive adaptation of enterprise elements to unexpected and unpredicted changes (Kidd, 1994). Other definitions of the 'agility' concept point out 'a manufacturing system with capabilities (hard and soft technologies, human resources, educated management, and information) to meet the rapidly changing needs of the marketplace (speed, flexibility, innovation, infrastructure, customers, competitors, suppliers, responsiveness) (Yusuf et al., 1999). Despite differences, all definitions of 'agility' emphasize the speed and flexibility or adaptability and flexibility as the primary attributes of an agile organization (Gunasekaran et al., 2001; Yusuf et al., 1999). Although, studies on agility utilize some ideas and practices related to the adaptive and flexible organization, many important developments on this topic from the organizational and management field were overlooked (Sherehiy et al., 2007). Still, there are a number of significant conceptual shortcomings concerning agile methods and the associated literature in its current state, including a lack of clarity, theoretical glue, parsimony, limited applicability and naivety regarding the evolution of the concept of agility in fields outside systems

development (INFORMS: Institute for Operations Research and Management Sciences, 2010). Quick Response systems increase the brittleness of supply chains by imposing connectivity requirements and reducing inventory buffers (Monahan et al., 2003). This brittleness may be offset through increased responsiveness based on shorter lead-times; however, in such a highly-constrained system disruptions can be disastrous (McBeath, 2005).

Lean manufacturing - used in the 1990's with increasing globalization for continuing cost reductions - is defined as a 'systematic approach to identify and eliminate waste (non-value-adding activities) through continuous improvement by flowing the product at the pull of the customer in pursuit of perfection' (Optiprise, 2006). However, as these process improvements yielded mixed benefits, Christopher and Rutherford (2004) had recommended that one way to avoid 'leaning down too far' is to integrate the expected cost of recovery into the total cost equation so an optimum level of leanness can be identified. In today interesting times, powerful forces are re-shaping the global business scene: financial and economic upheaval in the Far East, Latin America and Russia, are creating a tidal-wave of change in the firms' environment. Organisations that once felt insulated from overseas low-priced competitors, now realize that they must constantly continue to create new value for their customers at a lower price. This challenge requires a radically different approach, with basic key to success the creation of an agile supply chain on a worldwide scale. Agility should not be confused with 'leanness'. Lean is about doing more with less and is often used in connection with lean manufacturing to imply a 'JIT' approach to the business. Many companies that have adopted lean manufacturing are anything but agile in their supply chain.

From yesterday's world, characterised by mass production of standardised products, produced for generally predictable market demand, today's world is almost the opposite, since customers demand tailored solutions (high variety) in small quantities (low volume) with a high degree of uncertainty.

Figure 7 suggests that there will still be conditions where lean concepts are appropriate, in particular where the product is standard and volume

demand is high and predictable. Such conditions however tend to become fewer, as global forces lead to higher levels of market volatility.

Agile or lean?

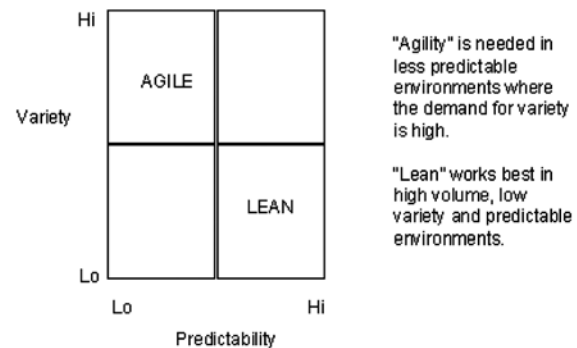


Figure 7: Agility versus Lean Production

6.2. Revival of Re-engineering

Supply chains are complex networks of enterprises that experience continual turbulence, creating a potential for unpredictable disruptions. In fact, executives identify supply chain risk as the highest threat to their firms (FM Global, 2007). Studies by the Council for Competitiveness found that, although effectively managing such operational risks directly affects financial performance, a majority of corporate board members were under-informed about those risks (Council on Competitiveness, 2007). Furthermore, traditional risk management techniques are lacking ability to assess the complexities of supply chains, evaluate the intricate interdependencies of threats and prepare an enterprise for the unknowns of the future (Hertz and Thomas, 1983; Starr et al., 2003; Vanany et al., 2009). Becoming aware of these gaps, many supply chain researchers are beginning to understand the value of the concept of resilience, defined as 'the capacity for an enterprise to survive, adapt, and grow in the face of turbulent change' (Fiksel, 2006).

The broad view of resilience in order to capture the dynamics of turbulence and complexity, responds to the supply chain definition as the network of companies involved in the upstream and downstream flows of products, services and information from the initial supplier to the ultimate

customer (Christopher, 1992; Lambert et al., 2005; Mentzer et al., 2001). The vast degree of turbulence and complexity in supply chains requires an enterprise view with collaboration among all business functions within the firm (Ahlquist et al., 2003), as well as inter-organizational alignment among supply chain members (Lambert, 2006; Sloan, Mentzer, and Dittman, 2007). However, as a result of environmental changes, supply chains are becoming more complex and vulnerable.

Many tools and methods have been proposed to help business enterprises cope with continual change and survive in the long-term. In this section, we briefly review those methods, both old and new, that have contributed in dealing with supply chain disruptions, providing a foundation for the concept of supply chain resilience.

Considering the factors contributing to potential supply chain disruptions the following example demonstrates the importance of even small disruptions to the automotive manufacturing supply chain. Thus, a big earthquake in central Japan on July 16, 2007, damaged severely the facilities of Riken Corp., a supplier of automobile components including specialized piston rings. Riken had located all of its plants in a single area of Japan to increase efficiency, making the entire production capacity vulnerable to a catastrophic incident (Chozick, 2007). Earthquake damage to Riken facilities and its utilities completely shut down production for one week, and required another week of repairs to return to full output. As a result of carrying limited inventories, Toyota, one of Riken's many customers, was highly vulnerable to production and transportation disruptions. Toyota's sourcing strategy emphasized close relationships with a limited number of suppliers, but in this case Toyota was forced to shut down all 12 of its domestic assembly plants, delaying production of approximately 55,000 vehicles.

Supply chain managers are becoming increasingly aware of these vulnerabilities. A study found that at the time a disruption is announced, the average shareholder return immediately dropped to 7.5 %. Four months after a disruption, the total loss grown to an average of 18.5 % (Singhal and Hendricks, 2002).

The study of re-engineering supply chains to improve resilience has a number of discernible gener-

al principles, which should be followed:

Firstly, resilience underpins the supply chain and largely the principles of SCM.

Secondly, resilience needs additional design. Integrated re-engineering of a supply chain, can improve its resilience.

Thirdly, as supply chains extend across different corporate entities there will need to be a high level of collaborative working if risk is to be identified and managed effectively.

Fourthly, resilience implies agility, namely being ready to react quickly to unpredictable events, that is clearly a distinct advantage in an uncertain environment.

Finally, resilience in the supply chain will be enhanced by creation of a risk management culture in the organization. The biggest risk to business continuity may derive from the wider supply chain rather than from within the business.

Understanding these key principles implies a number of particular issues for reconsideration. More specifically:

- Choice of supply chain strategies that keep several options open: this may not be the lowest cost course of action in the short term but may provide an opportunity to reduce the impact of a disruption if and when it occurs. There is an analogy here with 'Real Options Theory' in investment planning. Thus, a strategy that is based around centralization of distribution facilities may be the lowest cost option but it could also shut down other options and hence increase vulnerabilities.
- Re-examination of the 'efficiency vs. redundancy' trade-off: conventionally surplus capacity and inventory have been seen only as 'waste' and therefore undesirable. However, the strategic disposition of additional capacity and/or inventory at potential 'pinch points' can be extremely beneficial for resilience throughout the supply chain. The trade-offs inevitably involve the judgmental balancing of the cost handicap involved in maintaining slack 'just-in-case', against the probability and likely impact of a negative event. There is not a general message that corporate executives would be willing to hear. Nevertheless, if resilience is to be taken seriously, surplus capacity may well be the lesser evil than excess inventory withholding.

- Both capacity and inventory can provide ‘slack’ in a supply chain to enable restrain effects to be coped with. Inventory, carried in a generic or semi configured form, can enable the creation of a ‘de-coupling point’ which, together with additional capacity (e.g. production, transport, people), can enable demand uncertainty to be more effectively managed. This doesn’t advocate a return to the days of buffering every stage in the supply chain with safety stock or excess capacity. It seems that the strategic and selective use of ‘slack’ may be fundamental to supply chain resilience.

7. Power Structure and Institutional Flexibility

Multidisciplinary collaboration, the cornerstone of a value supply chain, reflects a network of interrelationships and suggests a system dynamics approach and advanced planning to be ‘process-based’ – rather than ‘fixed-goal’ – oriented (Scott, 2004; Bagheri and Hjorth, 2007). As it has been affirmed, ‘sustainable development and sustainability are about collective values and related choices and are therefore a political issue’ (Prugh, 2003). Thus, in an integrated framework, it is necessary to consider the principles and values and look for specific actions to solve real current problems (Frankel, 1998). However, it has been seen that the literature review has not shown enough attention in the roots of values and the institutions and how these are related with the phenomenon of increasing vulnerability and resilience of sustainability. To fill this gap, attention turned to the possible interactive role of institutional flexibility in relation to changes of the ‘power structure’ within the process of value creation. The main question is whether the neglect of these possible interrelationships can have adverse effects on the sustainability and how they may be overcome.

This research incorporates two main pillars: the institutional flexibility and the phenomenon of changes in the power structure. It therefore focuses on whether and how they accommodate with changing technological, economic and social environment. More specifically, the concept of the SSCM attributes critical role on

interfirm and interdisciplinary collaboration to attain sustainable competitive advantage. The issue of institutional flexibility goes back to the roots and the fundamental sources of value creation. Economic theory of plural value creation (of utilitarian and marxist origins) is approached in combination with the Sociology that concerns the conglomeration of societies upon concrete value roots of common acceptability (Scott, 2004). The so-called ‘new institutional school’ accentuates the behavior-constraining aspect of institutions, as the ‘rules of the game’ (North, 1990), which reduce transaction costs and face problems of ‘information asymmetry’ (Williamson, 2000). It is beyond the conventional definition of institutions as ‘durable systems of established and embedded social rules that structure social interaction’ (Hodgson, 2003). In contrast to the conventional liberal view of institutional neutrality, it has been pointed out that the institutional flexibility plays critical role on the technological, economic and social progress (Kay et al., 2003). Moreover, the increasing social vulnerability and the need for resilience reflect the degree to which societies or socio-economic groups are affected by stresses and hazards, whether brought about by external forces or intrinsic factors – internal and external – that negatively impact the social cohesion in a country’ (Witte & Reinicke, 2005; UNDP, 2007).

The institutional flexibility is related with the concept of power and ‘power structure’ and in multidisciplinary approach it received increasing interest especially after C. Wright Mills (*The Power Elite*, 1956) and Floyd Hunter (*Community Power Structure*, 1953). The more recent research turned to the diversion from the pluralism of fair competitive conditions and efficient markets (no discriminations, equal treatment, knowledge diffusion, symmetric information, etc.), through established cells of power concentration in minority interests (big corporations, lobbies, control of modern electronic information, ‘virtual reality’ cultivation, etc.) (Domhoff, 2005, 2007).

Moreover, resilience mirrors a new philos-

ophy, civilization, culture and state-of-the-art, as the concepts of the SCM and SCR go back to the roots of the western capitalist system, founded on the protestant ethics and social values of extreme individualism and modernization. It turns to inherent instability and to 'creative catastrophe', in Schumpeterian sense. It is not in line with the collective and participatory basis of the SCM, as it has power foundation, so that a question arises whether it inclines to vulnerability and crises or whether they are system or civilization crises; in this case it calls for incorporation of other civilization elements or complete replacement (inclusive social responsibility, solidarity, mutual interests, collaborative spirit, solidarity, trust, etc.).

The global dimensions of the supply and value chain bring in historical perspective the trend of increasing turbulence and vulnerability. Rethinking on its roots goes back to the end of the World War II in 1944, in the establishment of the Bretton Woods agreement, the International Monetary Fund (IMF) and the rest international economic organizations. It is recognized that the technological change and later on the globalization phenomenon, have facilitated the production and marketing of a hugely increased variety of goods, but simultaneously pushed also certain industries to concentrate giving contrasting impressions of greater variety as the beginning of many complex socio-economic and cultural issues remaining to be resolved (Storper, 2001; Krasner, S. (2001). Also, there has been emergence, widening and deepening of 'consumerism', extended further down the social hierarchy, along with an increasing status hierarchy in consumption and fragmentation of the contemporary material and cultural life (Miller and Berger, 2001). Concerning more particularly the last twenty years the 'consumerism' has attributed to change in the society in terms of individual values, aspirations and consumer behavior patterns, related to underlying demographic, eco-

nomical, technological and social trends. Thus, the 'consumer society' has been raised to reinforcing firms in industrial western countries to implement defensive technological changes (Howard and Mason, 2001). Further analysis shows that the consequent phenomenon of over debt and discounting future income by the 'consumer society' is rooted back to the foundation of the international monetary system (IMS) and a strategic choice concerning the world income distribution after the end of the World War II. It has formed on the World Power Structure (WPS) at that time, that is not irrelevant to the favorable power of the USA not participated totally in the war (Pit, 2010). Thus, there has been an exclusive pegging of the US\$ with the gold as 'reserve currency'. Thus, in brief, the over debt situation is 'the price' of the post growth of western countries, which is destabilizing itself. Moreover, the 'stabilization program' is actually destabilizing, as single sighted against deficit countries and is biased against investment and development, by austerity and deflation penalization to them. It is further on indicative of change in the 'time preference' in terms of favoring current over future consumption, so raising interest rates and withholding productive investments. Moreover, more recently, the European Monetary Union (EMU) has moved to the IMF stabilization mechanism, after failure of the 3/60% rule of current deficits/debt ratios to GDP, which however, has been the result lack of fiscal policy integration and of control mechanism.

It is therefore cleared up that the phenomenon of increasing vulnerability and the problem of resilience for ensuring sustainability is attributed to a mix of systeming and strategic and management reasons. The non industrialized countries have entered into trade liberalization environment without carrying out structural changes and consequent disproportional rise in government and external debt.

However, the debt problem and the crises and vulnerability may also turn massively against the surplus/lender countries, in case of concerted bankruptcies and stop debt servicing by collective action of the debtor countries to increase their bargaining capabilities with lender countries. Moreover, it has not to be neglected the structural changes that have taken place during the second half of the 20th century, to mention here the collapse of the ‘iron curtain’ and the ‘opposite fear’ of the USSR by the end of the 1980s, the rise of the ‘developing economies’ more particularly China, India, Brazil, etc. Also, the control of the information mechanism along with ‘asymmetric information’ and intransparency that are distorting equal terms and competition chances and create moral hazard and corruption, that inhibit genuine globalization and global supply chains, along with global governance based on a single civilization attributes (figure 8).



*Figures are in current \$'s. Source: WTO—<http://stat.wto.org/Home/WSDBHome.aspx>

Source: Kleindorfer, 2009

Figure 8: Smoothened global transactions circuit

The integrated re-engineering based resilience at value network level enables in particular proactive resolving critical local problems, although their emergence is uncertain. It calls for design of emergency planning by building-up a crisis model for earthquakes in sensitive countries, as it seems to have happened in Japan two years ago; a similar emergency plan for debt crisis is going to mitigate

risks of deadlock in the IMF austerity program, insofar as it threatens to sovereign debt crisis and social cohesion, sometimes called Plan B, etc.

8. Main Conclusions

This study main goal was the provision of useful insights concerning the issue of resilience in relation to sustainability, as a means to hit the phenomenon of increasing vulnerability, along with the globalization phenomenon. The high relevance of the resilience issue rests in mitigating risks of unexpected events and ensures company sustainability in turbulent environmental conditions, due to economic, social, technological and physical climate changes. Therefore, the conclusions that are drawn have broader relevance for companies and any type of economic and social organization working out in an increasing risky world, as it is reflecting the need of an integrated R&D framework for designing a new holistic strategy of SSCM based on breakthrough re-engineering. More specifically, the conclusions drawn are epitomized as follows:

Firstly, the use of the resilience concept in relation to the broad challenge of sustainability represents a new way of risk management, with practical orientation.

Secondly, within the issue of integrated value chain analysis the objective of resilience is founded on close, dedicated connection with designed ‘collective capabilities’, for achieving sustainability within the new and ever changing economic, social and physical environment, of vulnerability, high complexity and interdependence.

Thirdly, the successful transformation of the historical challenge of sustainability to chances of reduction of disruptions depends critically on holistic re-engineering strategy, in a brainstorming process throughout the value supply chain, with new strategic priorities re-ordering that exerts counterbalancing impact to the vulnerability with proactive ‘crisis management’ in the new turbulent and volatile global environment.

Fourthly, the success of resilience presupposes use of modern advance planning based on major move from past dominating research methods and practices that underlie extreme ‘individualism’ and ‘statism’, to a new vision, philosophy, culture, attitudes, awareness, common front, beliefs and inter-

ests, state-of-the-arts and day-to-day practices.

Fifthly, the feasibility study and the cost/benefit analysis for building up a resilience ‘business plan’ can be facilitated by a holistic R&D constructive participating action research framework (CPAF): from zero start and solid strategic partnerships, feed-back process, co-ordination and effective control system. It can be supported by multidisciplinary strategic thinking, for use of all available resources, knowledge and know-how in a learning organization (knowledge management), in alignment with critical role to the ‘human capital’ and proper combination with modern electronic information systems, towards producing multiple collective synergic benefits (‘syntegration’, from synergy and integration).

Sixthly, the holistic strategy based on the integrated management solution is in effect contrasted with the power concentration management model; as this model superimposed the policy option associated with the phenomenon of post-war consumerism and ‘consumer society’; it has been based on ‘asymmetric information’ that undermines equal opportunities, conventional wisdom, foresight, human values, institutional malfunction, resources waste, moral hazard, corruption, mismanagement and massive future discounting by destabilizing debt accumulation.

Seventhly, the critical role of a new ‘collaboration culture’ contrasted to the ‘stabilization program’ of the IMF established in the end of the war (1944) on the basis of the then ‘world power structure’ and accepted severe criticism as it penalizes solely the debtors, disfavors direct investment and exports and is impediment to introducing SCM/SCR for resilience and sustainability.

Eighthly, further analysis of resilience relates the ‘consumer society’ with a likely deeper change in ‘time preference’ and consequent rise in interest rates against investment, development and debt reduction. Moreover, the social status aspect of the consumerism, undermines fair competition and efficient markets, driving more broadly to an opportunity of abandoning the reliance on others, in alignment with the revisionist views of UN (ECLA), of Prebish, Hirschman, etc, for a long north-south ‘dialogue of deafs’. It also expresses creative convergence and filling the gaps of economic efficiency and ethics with collaboration based on human val-

ues, common beliefs, mutual interest, participation, trust and social responsibility.

Ninthly, the value chain analysis of resilience combined with re-engineering and strategic thinking can contribute significantly in overcoming the past dominance of the ‘power structure’ criterion, that affected negatively ‘institutional efficiency’, violated the principles of effective management (such as equal chances and treatment and reward/punishment, positive sum ‘group game’) and inhibited the roots of people’s satisfaction and the necessary structural changes for achieving sustainable competitive advantage (giving sense to ‘global value chain’).

Tenthly, the emergence of financial crisis in 2008 in USA and its later passing over through compliance and hit disproportionately the EU area, beyond the common cause of long extensive use of artificial overexpansion in debts by ‘derived financial products’, hedge funds, etc. The consequent creation of over debt and of the so-called ‘bubbles’, e.g. in the real estate, in stock exchanges, in the banking sector has proceeded in threatening the ‘sovereignty of states’ and the international economic and social order, raising a ‘genuine globalization’ issue. Its persistence and duration reflects in addition the lack of federation in EU and of common fiscal policy and discipline, partly for systeming reasons and for strategic defective European Monetary Union (EMU).

Altogether, this study has been engaged with the resilience based on holistic re-engineering strategy by multidimensional collaboration for SSCM at micro and macro-level, by restoring institutional flexibility, fair competition and equal terms between big-size multinationals and united value creation networks of the local SMEs and overcoming ‘asymmetric information’, adverse selection and moral hazard, etc. Such an overall designed collaboration of local resources (upgrading and localization problem) can increase policy performance for overcoming crises and achieving sustainable development, poverty, income redistribution, at local and global level, for social cohesion and lasting order of progress and peace for all.

A transparent fertilizing debate is proposed and further implementation research required at case study level.

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Lead - Lag Relationships Between Stock Market and Derivatives Market: the Case of Greece

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Abstract: The present study aims to examine and analyse the application and behaviour of GARCH volatility models, for two financial time series, of the Athens Stock and Derivatives Exchange Markets. Different parameter values, confidence intervals, forecasting time horizons and distribution density functions were used for this purpose. These two time series have a range of dates from 01/02/2000, to 05/30/2008. Also, we present the mathematical relations that construct and define the procedure of GARCH modelling. A series of statistical controls and tests, help the empirical application methodology. Two different types of GARCH models were used, the Symmetric GARCH(P,Q) and the Asymmetric EGARCH(P,Q) model. The innovation of this paper is that these models were estimated and forecasted with the use of the 'N Observations Rolling Window of Estimation-Forecasting'. The results showed that the Spot Market was better described with the use of the GARCH(P,Q) model, and the Futures Market with the use of the EGARCH(P,Q) model.

Key words: Time-varying volatility, GARCH modelling, lead-lag relationships, Spot and Futures Market, N-Observations Rolling Window, Estimation-Forecasting.

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1. Introduction

The area of investigation is the Athens Stock Exchange Market (A.S.E.) and more specifically the FTSE/ASE 20 stock market index that refers to the A.S.E. market of Greece. This index refers to the spot market (meaning the prices of the stocks) and the derivatives market (meaning the prices of derivatives products, such as futures, options, etc.), of the Athens Market. The research takes place with the use of multivariate volatility models, GARCH(P,Q) and EGARCH(P,Q), that refer to a specific econometric procedure (Baillie, Bollerslev, 1992) of testing the given time-series for some phenomena, such as heteroscedasticity, volatility clustering, skewness and excess kurtosis (Liu, Neudecker, 2009). These models (Bollerslev, Chou, Kroner, 1992) were estimated (parameter estimation) according to the appropriate data of the FTSE/ASE 20 index (model estimations for the spot market time series and the derivatives time series, separately) and forecasts were generated of the above time series returns, up to a specific time horizon (Lu, Perron, 2009). Finally, these models were statistically tested for their reliability and adequacy according to the results of the forecasted returns (Bera, Higgins, 1993).

1.1. Principles of Econometric Modelling

During the procedure of financial econometric modeling, the analyst does not control the process that generates the data. This procedure is actually the stochastic environment. In this environment there are probability relationships that connect the variable-target, with the other descriptive variables. So, the analyst actually tries to collect a sample of observations $\{(x_t, y_t), t = 1, \dots, T\}$ that actually refer to jointly distributed stochastic procedures $\{(X_t, Y_t), t = 1, \dots, T\}$. The next step is to try to conclude to a probability relationship that connects the variable Y_t with the variables X_t , where $t=1, \dots, T$. This probability relationship is called the *conditional probability law* of the variable Y_t given the variables X_t ,

$P(Y_t \in A | X_t \in B)$. In order to describe the behavior of the variable Y_t , the analyst has to collect an information set, I_t . The information set I_t includes some exogenous variables Z_t that are not affected by the performance of the variable Y_t and consequently they are assumed to be fixed in the sample data that reappear. Also, these exogenous variables include some past time information Z_{t-i} of the above Y_{t-i} (where $i=1, 2, \dots$) and these observations consist the past of the variables Y_t and Z_t (Lu, Perron, 2009).

So, if the *conditional probability law* is well defined, then there is a *conditional probability density function* $p(y_t | I_t)$ which refers to the probability the variable Y_t to take values near the y_t (given the information set I_t). In the "world of the finance", the center of the interest is focused on the description of this *conditional probability density function* and of its characteristics. These are the following (Bera, Higgins, 1993):

1. The *conditional expected value* $E(Y_t | I_t)$: It is a measure of the expected value of the Y_t , given the information set I_t . So according to the fact that it is certain that the value of Y_t will differ from the $E(Y_t | I_t)$, there always be an expected error, better known as "innovation-surprise term". So the conditional mean value is a function of the given information set and consequently of the $X_t \equiv (Z_t, Z_{t-1}, \dots, Y_{t-1})$, $E(Y_t | I_t) = g(X_t)$. This leads to the following equation:

$$Y_t = g(X_t) + \varepsilon_t$$

In econometric modeling the ε_t does not refer to an exogenous "noise effect", but is actually the part of Y_t that cannot be described according to the given information set (Gouriéroux, and Monfort, 2007).

2. The *conditional variance* $Var(Y_t | I_t)$: It is a measure of the average uncertainty for the applied value of Y_t according to the given information set I_t . The variance $Var(Y_t | I_t)$ is a function of I_t and consequently of time. The precise description of the dynamic of

the $Var(Y_t | I_t)$ is very important for portfolio management and for the analysis and management of financial risk (Bollerslev, Chou, Kroner, 1992).

2. Literature Review

It is known that the asset pricing functions are based on the measurement of the risk that appears in the asset and that the level of risk (uncertainty) is represented from the volatility return of this asset. This level of volatility returns is inextricably depended on the daily closing returns, which means that is related to the time periods which are examined. So, in order to understand how the volatility returns changes over time, it is very important to consider some basic financial issues and procedures, such as the asset valuation, the investment decision and the portfolio management (Hung, 2009).

The distributions of density functions for returns of capital usually represent the “fat tail behaviour” phenomena than the normal distribution density function or the Gauss distribution. This phenomenon is known as excess kurtosis. So, respectively the financial time series that introduce such a phenomenon of distribution with “fat tails”, are also referred as leptokurtic (Bai, and Zhihong Chen, 2008).

If someone accepts the fact that the financial time series are a pattern of unrelated and random observations, this stochastic procedure may easily be displayed in a particular level of correlations effects, from one observation to another. In such a manner, someone can use this presented correlation to predict future series of the above modelling procedure, which is based in the already known past time interval of the observations of the given financial time series.

The following equation uses these components, to present a univariate model of each financial time series, for a predetermined amount of data:

$$y_t = f(t-1, X) + \varepsilon_t \quad (\text{Eq. 1})$$

In the above Equation 1:

- The factor $f(t-1, X)$, represents the function of the current return, in relation to any information that can be known until the (t-1) moment, by using innovation factors from past information $\{\varepsilon_{t-1}, \varepsilon_{t-2}, \dots\}$, past observations $\{y_{t-1}, y_{t-2}, \dots\}$ and generally any other exploratory data and facts of the variable X.
- The factor ε_t is the random component. It represents the term of innovations (lags) in the model of mean of the y_t . Moreover it is obviously observed that this factor of random innovation (“noise factor”) can easily be translated as a prediction error for the predetermined period of time.

2.1. The Conditional Variance

The GARCH models are mainly characterized by the conditional distribution of ε_t , by creating a specific type of linear dependence, between the factors of the conditional variance and the innovation terms. More specifically the model of variance, also known as GARCH, is given by the following Equation 2:

$$Var_{t-1}(y_t) = E_{t-1}(\varepsilon_t^2) = \sigma_t^2 \quad (\text{Eq. 2})$$

, where the right term of the above Equation, σ_t^2 , is given and explained by the following Equation 3:

$$\sigma_t^2 = \kappa + \sum_{i=1}^p G_i \sigma_{t-i}^2 + \sum_{j=1}^q A_j \varepsilon_{t-j}^2 \quad (\text{Eq. 3})$$

So, according to the above two Equations, it can be easily seen that the term σ_t^2 , is a prediction of the variance for the next time period, which is a forecast that depends on the past variances σ_{t-1}^2 , and on the innovation factors ε_{t-1}^2 . The term Var_{t-1} refers to the variance at the time moment t-1. The coefficient κ is a constant and the coefficients G_i and A_j , are respectively, the GARCH factor that refers to the

heteroskedasticity phenomenon and the ARCH factor that refers to the innovation factor ε_{t-1} (Bollerslev, Chou, and Kroner, 1992).

2.2. Restrictions on the parameter values

The literature for GARCH modelling imposes that the following parameter must be confined under the conditional parameters of the GARCH variance:

$$\sum_{i=1}^P G_i + \sum_{j=1}^Q A_j < 1$$

,where, $G_i \geq 0, A_j \geq 0$ and $i = 1, \dots, P, j = 1, \dots, Q,$ (Eq. 4)

The first restriction term is adequate and necessary for the existence of a finite, time independent variance of the innovation process ε_t . The other restriction terms are satisfactory to assure that the conditional variance (σ_t^2) is certainly positive (Lundbergh, and Terasvirta, 2002).

When the parameters of short-term conditional variance satisfy the restriction terms of the Equation 4, the long-term unconditional variance of the innovation process ε_t is given by the following Equation 5 (Hung, 2009):

$$\sigma^2 = E(\varepsilon_t^2) = \frac{\kappa}{\left(1 - \sum_{i=1}^P G_i - \sum_{j=1}^Q A_j\right)} \quad \text{(Eq. 5)}$$

Even though the Equation 3 declares that the conditional variance of the ε_t innovation process changes according to time periods passing, the Equation 5 shows that the long-term variance remains stable (homoskedasticity).

2.3. The model of Mean

The general form of the conditional model of mean, ARMA (R,M), can be applied for all different types of conditional variance models and is given by the following Equation 6:

$$y_t = C + \sum_{i=1}^R (AR_i) y_{t-i} + \sum_{j=1}^M (MA_j) \varepsilon_{t-j} + \varepsilon_t \quad \text{(Eq. 6)}$$

In the above Equation 6, the variable y_t refers to the valuation of the model of mean at the time moment t, the term C is the constant term, the term y_{t-i} refers to estimates of the model of mean (lags), up until i time moments in the past. Also the term ε_{t-j} refers to estimates of the innovation factors, up until j time moments in the past periods and the term ε_t is the disturbance term. Furthermore, the coefficients AR and MA are respectively the autoregressive factor and the coefficient of heteroskedasticity (Mantegna, and Stanley, 1998).

The amount of the last two observations is usually presented as MA and AR coefficients, where the coefficient MA actually refers to observations from the past innovations ‘‘noise’’ process, with only goal the forecasts of future observations of the dependent variable of the returns. On the other hand the coefficient AR is the autoregressive factor. This means that this factor actually asserts that the volatility does not remain stable and depends on random facts and on the passage of time periods. Usually a financial time series model, includes both of the above coefficients, MA and AR. The total amount of y_{t-i} and of ε_{t-j} , according to the Equation 6, depends on the coefficients R and M, which actually show how ‘‘deep’’ in the past observations the analysts want to use information for the above parameter values (McAleer, Chan, and Marinova, 2007).

2.4.1. The GARCH (P, Q) model

The general form of the Symmetric GARCH(P,Q) model, which more simply is known as GARCH(P,Q) model, of the conditional variance, of the innovation factors, was first introduced by Bollerslev (1986) and is given by the following Equation 7:

$$\sigma_t^2 = \kappa + \sum_{i=1}^P G_i \sigma_{t-i}^2 + \sum_{j=1}^Q A_j \varepsilon_{t-j}^2 \quad \text{(Eq. 7)}$$

, and has the following restrictions on its parameter values:

$$\sum_{i=1}^P G_i + \sum_{j=1}^Q A_j < 1$$

, with the values of $\kappa > 0$, $G_i \geq 0$, $A_j \geq 0$ and with $i = 1, 2, \dots, P$, $j = 1, 2, \dots, Q$.

In the above Equation 7, σ_t^2 is the conditional variance that needs to be estimated, κ is the constant, G_i is the GARCH coefficient, which refers to the heteroskedasticity of the above GARCH model, σ_{t-i}^2 is the factor that refers to the estimates of the variances that refer to an amount of past observations of the financial time series. Moreover the factor A_j is the ARCH coefficient and refers to the homoskedasticity phenomenon of the above model and the factor ε_{t-j}^2 represents the estimations of the innovation factors which rely on information from past observations of the given financial time series (Charles and Darne, 2005).

2.4.2. The EGARCH (P, Q) model

The general form of the Asymmetric (means that it captures the leverage effects) EGARCH(P,Q) model, for the computation of the conditional variance of the innovation factors process, is given by the following Equation 8:

$$\log \sigma_t^2 = \kappa + \sum_{i=1}^P G_i \log(\sigma_{t-i}^2) + \sum_{j=1}^Q g(z_{t-j}) \quad (\text{Eq. 8})$$

, where the values of the $g(z_t)$ factor are given by the following Equation 9:

$$g(z_t) = \lambda z_t + \phi \left| z_t - \sqrt{\frac{2}{\pi}} \right| \quad (\text{Eq. 9})$$

, and of the product between the factors σ_t and z_t , which is described by the following Equation 10:

$$\varepsilon_t = \sigma_t z_t \quad (\text{Eq. 10})$$

The above Asymmetric EGARCH(P,Q) model of conditional variance, was initially introduced by Nelson in 1991, and presents some very important characteristics which make it capable to imprint known phenomena of asymmetry (such as the leverage effects) and that of the volatility clustering (McAleer, Chan and Marinova, 2007).

Also, in the EGARCH(P,Q) model, the innovation coefficient ε_t , which is related to the daily returns r_t , is imprinted by the function of the Equation 10, only in a way that in this particular occasion the factor may also follow either standard normal distribution density function (Gaussian), or the Student's t distribution density function. In order to better explain this matter, the following Equation 11 describes the values of the factor, when the critical value of the factor z_t , either follows a Gauss distribution, or a Student's t distribution (Liu, and Hung, 2010):

$$g(z_t) = g(\varepsilon_t / \sigma_t) = \sqrt{\frac{2}{\pi}} \quad (\rightarrow \text{Gauss Distribution})$$

, or

$$= \sqrt{\frac{\nu-2}{\pi}} \Gamma\left(\frac{\nu-1}{2}\right) \left(\frac{\nu}{2}\right) \quad (\rightarrow \text{Student's } t \text{ Distribution}) \quad (\text{Eq. 11})$$

, with values of the degree of freedom to be greater than 2 (meaning $\nu > 2$).

In this point, it is very important to be mentioned that Bollerslev in 1987, has mentioned that when someone uses a Student's t distribution for the computation of the conditional variance of the model of the unexpected returns ε_t , but at the values of the parameters of the model used, the GARCH models actually can better imprint the phenomenon of leptokurtosis ("excess kurtosis") for the values of the z_t which occur from the confidence level that is being used (Zaffaroni, 2009).

3. GARCH model construction – the Hypotheses

The methodology that is going to be used is better known as *Model Construction Cycle*, (Doornik, Ooms (2008); Lu, Perron (2009); Bollerslev, Chou, Kroner (1992)) and it is actually a sum of hypotheses that leads to an adequate and simple model (not too many parameters – parsimony, but also adequate to be applied). The models were tested at several confidence intervals (20%, 50%, 70%, 90%, 95% and 99%) and two probability distributions (Normal Distribution and Student’s t Distribution). The hypotheses that lead this study are the following:

- H.1: A good model’s parameter estimation will lead to good results of the diagnostic tests.
- H.2: Good results of the diagnostic tests

will lead to an adequate model.

- H.2.1: If the results of the diagnostic tests are not good, new parameters will be added at the model, or some of the old ones will be removed.
- H.3: If the model is adequate, it will be tested for its reliability.
 - H.3.1: If the model is not adequate, new parameters will be added at the model, or some of the old ones will be removed.
- H.4: Once the model’s form has been changed, the procedure will start from the beginning.
- H.5.: If the new model successfully passes all the steps, after several trials, the *Model Construction Cycle* finishes and the final model is supposed to be simple and adequate.

The above hypotheses are better visual presented by the following Figure 2:

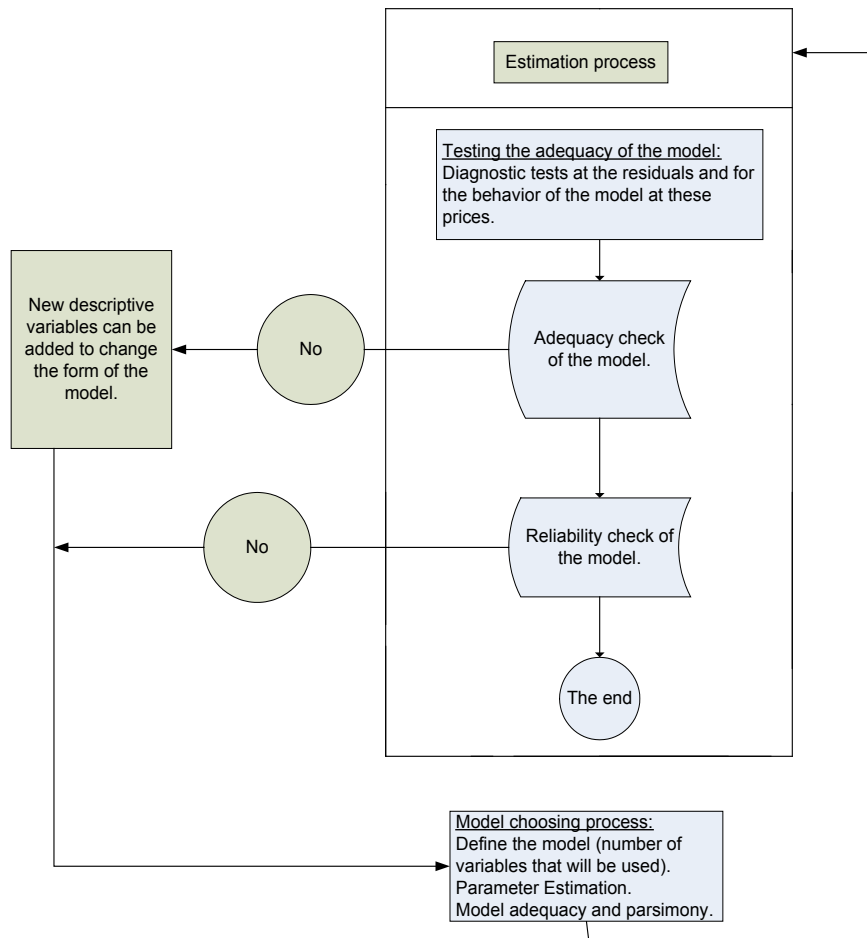


Fig. 1: This figure represents the Model Construction Cycle and is based on the principles of econometric modeling, the ARCH estimation and testing procedure and the GARCH parameter estimation with the help of maximum likelihood ratio (Charles, Darne, 2005; Doornik, Ooms, 2008; Kang, 2003).

3.1. Defining the GARCH models

Before starting the analysis by which the econometric modelling of financial time series took place, it is very important to define the GARCH(P,Q) models that are going to be used and to set some basic goals and aims, which will help the understanding of the process that was done (Bera, and Higgins, 1993):

1. Examine if the total amount of the sample data that were used, are represented by the basic characteristics of the financial time series.
2. Based on the fact that the analyst knows that a GARCH model (either Symmetric GARCH(P,Q) model, or Asymmetric EGARCH(P,Q), AGARCH(P,Q), TGARCH(P,Q) model, etc.) is actually consisted of two separate models, the model of mean and the model of the conditional variance, he must define the process of construction of the above models, based on the amount of the variables used.
3. The analyst must decide if the model of the distribution density function (Gaussian, or Student's t Distribution) that is going to be applied for the estimation of the related GARCH model, is the appropriate and if the confidence intervals that are going to be used for the computation of the forecasts of the variances and of the total sample of the observations for a predetermined time period, are the suitable (Delgado and Velasco, 2010).
4. It is important to understand whether the concluded GARCH model is adequate (meaning that it has the correct number of variables) and prudent and it does not have any additional and non important variables for the procedure of the econometric modelling.
5. It is important to be mentioned that when the analyst models small fractions of an amount of data by using GARCH models, these models cannot easily "imprint and recognize" the long-term disturbances and for the analyst is not common to define the autocorrelations at the models of mean, of the variance and of the distribution density function.

3.2. Diagnostic tests on GARCH models

The reason to apply different types of diagnostic tests is to examine the adequacy of the model and evaluate the significance of the autocorrelation level that is presented in the model of mean, variance and distribution density function. There are many types of diagnostic tests that can be applied in the post-estimation process of a GARCH model. The reason for choosing the appropriate diagnostic tests depends on the goal of their application and on the GARCH model that it has been used. For example, for Asymmetric GARCH models (such as the EGARCH(P,Q) or the TGARCH(P,Q) model), the diagnostic tests that are usually applied, examine if there is any level of asymmetry in the time series of the logarithmic returns (leverage effects) (Berkes, Horvath, and Kokoszka, 2004).

This section describes three different types of diagnostic tests:

- The Ljung-Box-Pierce Q-Test (which refers to the model of the mean and to the model of the conditional variance).
- The Jarque – Bera Test (which refers to the model of the distribution density function and examines the level of adequacy for the standard normal distribution, Gaussian).
- The Kolmogorov – Smirnov Test (a diagnostic test which is applied when the model of the distribution density function is changed from standard normal distribution, to Student's t distribution).

4. Empirical application

4.1. General information and data samples

The empirical application refers to two different financial time series of the same stock exchange index:

- The financial time series of the Spot Market of the FTSE 20 index of the Athens Stock Exchange Market,
- And the financial time series of the Futures Market of the FTSE 20 index of the Athens Stock Exchange Market.

These two different financial time series are used for the application of the Model Construction Cycle that was mentioned in previous section. The first step is the control step for heteroskedasticity and next the definition of the used GARCH model (meaning parameter estimation). After the application of various diagnostic tests to the estimated GARCH model (to the model of the mean, of the variance and of the distribution) with a series of repeated trials, the final GARCH model is adjusted to the results of these trials (Pesaran, and Timmermann, 2007).

Furthermore the two financial time series that were econometrically analysed and used for the application of the GARCH models have the following information and date range:

- The Spot Market time series refers to a date range from January 2, 2000 to May 30, 2008.
- The Futures Market time series refers to a date range from January 2, 2000 to May 30, 2008.

The steps for the empirical application of the ‘‘adjusted’’ GARCH models (the Symmetric GARCH(P,Q) model and the Asymmetric EGARCH(P,Q) model), for two financial time series (Spot and Futures), two different distributions (Gaussian and Student’s t), six different confidence intervals (20%, 50%, 70%, 90%, 95% and 99%), a total amount of given observations equal to 2,100 logarithmic returns, three different past time periods of these series for the ‘‘adjusted’’ estimation of the parameters of the GARCH models equal to samples of 300, 700 and 1,000 observations and finally a total amount of 1,000 forecasted standard deviations for the two series that are going to be used for the examination of the lead-lag relationships (compared to the corresponding sample of 1,000 observations of the given time series) between the two markets, are extensively presented below (Buhlmann, and McNeil, 2002):

- For the estimation of the parameters (‘‘adjusted’’) of the model which is defined

through the diagnostic tests, the initial sample data is separated into two individual ones; the biggest one represents the 2/3 of the initial sample (this is used for the estimation of the parameters of the model) and the smaller one refers to the 1/3 of the initial sample (this is used for the forecasts of the variances, the model of the mean and of the observations of the estimated sample).

- For the computation of the forecasts of the standard deviations (sigma-Forecasts) are used several confidence intervals that refer to the initial sample of data of the time series (two samples – Spot and Futures) which is predicted in comparison to the Lower and Upper bounds of the forecasts (the squared root of the forecasted variance is equal to the absolute value of the forecasted standard deviations).
- With the use of ‘‘loops’’ (through programming code), the result is the creation of ‘‘adjusted’’ GARCH models (‘‘rolling’’ samples of N amount of observations), not only for the estimation of their parameters, but also for the forecast of the related observations sample. In this way the whole diptych ‘‘estimation – forecasting’’ is ‘‘moving’’ to any amount of sample data that can be modelled and is the most appropriate process to capture the investigated econometric phenomena (heteroskedasticity, volatility clustering, etc.).
- The way which these ‘‘adjusted’’ GARCH model are ‘‘moving’’ (loops) is the following: define the sample of the data in which there will be the estimation of the parameters of the model (i.e. from 14 February 1994 and for a time interval of 700 observations ‘‘in the past’’) and next forecast the observation of the next day (i.e. 15 February 1994) from that where the estimation process has ended. After that the whole process ‘‘shifts’’ to the next day which means that for example, the parameter estimation now starts from the date 15 February 1994 and for a time interval of 700 observations ‘‘in the past’’ and the forecast refers to the date 16 February 1994.
- After that the next step is the application

of a statistical criteria (measurement of the adequacy and reliability of the forecasts) in order to examine the appropriateness of the collected forecasts. According to this criteria the goal is to compute the percentages of the values of the observations of the given financial time series that “are falling” outside the Upper and Lower bounds of the computed forecasts.

4.2. GARCH model construction and the FTSE 20 index

This section presents the application of the steps of the GARCH Model Construction Cy-

cle and the relative figures that result from this application in the above two different financial time series, the Spot and Futures Market of the FTSE 20 A.S.E. index (Pichl, Kaizoji, and Yamano, 2007).

Below, are presented the figures of the time series and the logarithmic returns for the two time series, along with the figures that represent the autocorrelation that might exist in the logarithmic returns and in the square of these returns (from Figure 5, to Figure 12).

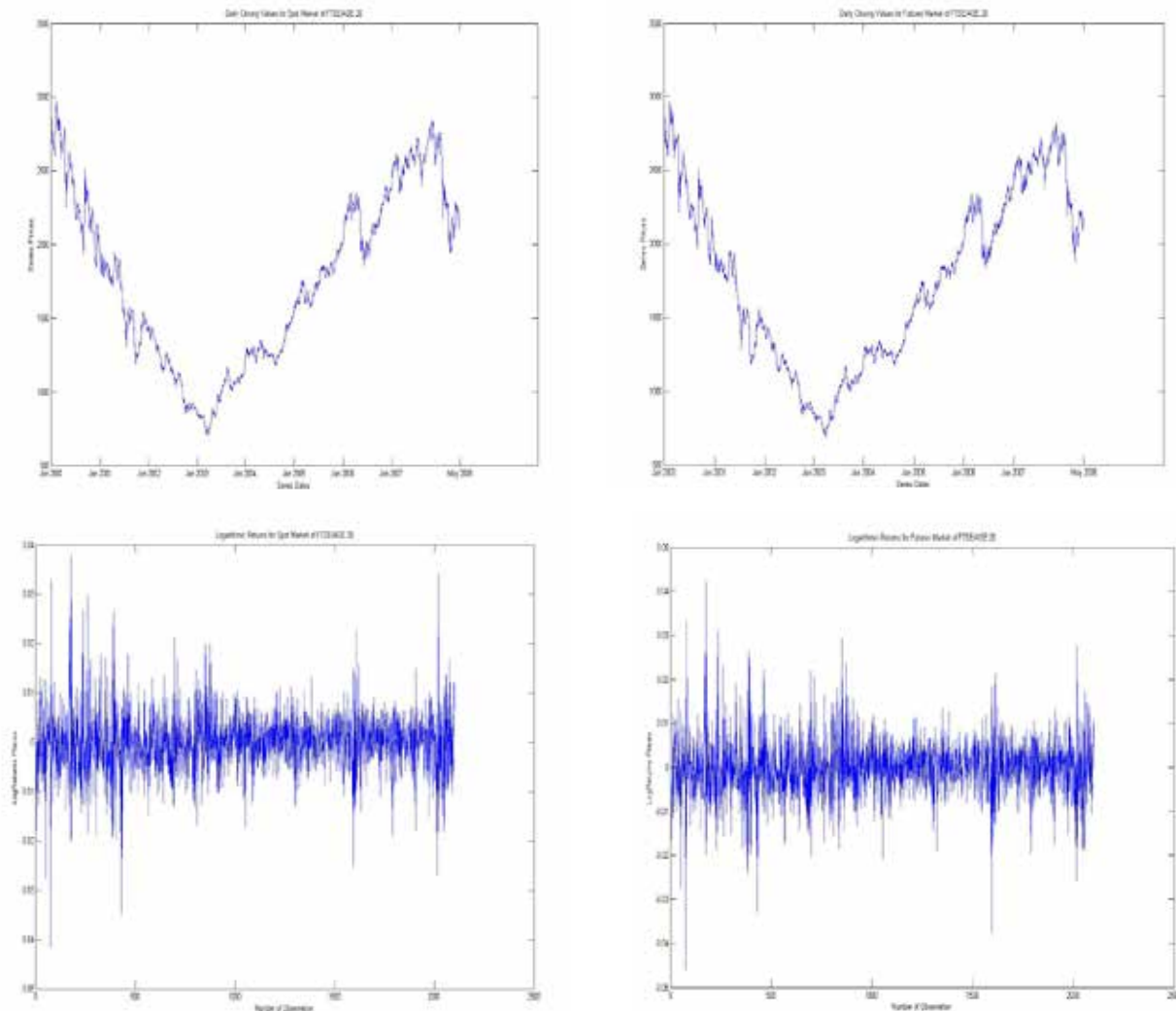


Fig. 2: Daily Closing Values and their logarithmic returns for the Spot and Futures Market of the FTSE 20 index of A.S.E., for the dates from 02/01/2000 to 30/05/2008 (total amount of 2,100 observations).

From the above figures it is observed that among the range of the 100 and 500 observations and the range of 1,800 and 2,000 observations, there is high level of volatility clustering. This means that for these periods the estimations of the variances will give higher values for the relative parameters (Lu, and Perron, 2010).

the parameters of the above models was done is the 2/3 of the total sample of observations for each of the time series (which means that the observations samples for both the Spot and Futures Market are 1,400 observations respectively). The results that are presented in the following tables refer to the above details and in combination with the application of the

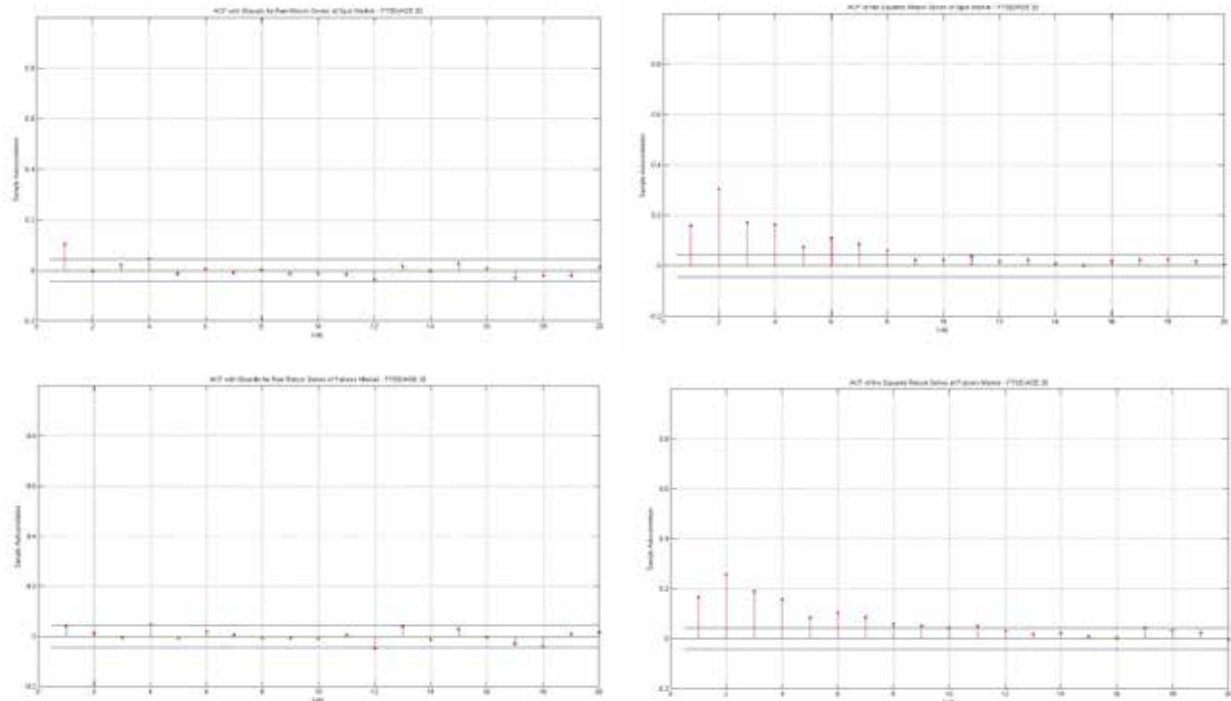


Fig. 3: The above figures present the autocorrelation of the logarithmic returns and their square values, of the A.S.E. Spot (left column of figures) and Futures (right column of figures) Market, from the dates 02/01/2000 to 30/05/2008 (total amount of 2,100 observations).

According to the above figures only the first figure shows a relatively small level of significance of autocorrelation in the logarithmic returns of the Spot Market. The other figures show that there is not significant level of autocorrelation in the logarithmic returns and in the square of these returns for both markets. Furthermore it is observed through the above figures that through the whole range of the observations the variance interval of the autocorrelation remains relatively stable.

The GARCH models that have been applied to both the financial time series are the Symmetric GARCH(P,Q) model and the Asymmetric EGARCH(P,Q) model and the total amount of the observations in which the estimation of

diagnostic tests, the two GARCH models are presented after repeated trials in the lag coefficients of the models of the mean, of the variance and of the distribution.

The following table 1 presents the vales of the parameters of the GARCH(1,2) model that were computed for a sample of 1,400 observations for the Spot Market and the parameters of the GARCH(1,1) model for 1,400 observations of the Futures Market respectively, of the FTSE 20 index of the A.S.E. and for an amount of four lag coefficients for the model of the mean. The models of distribution density function that were used are the standard normal Gaussian distribution and the Student's t distribution.

A.S.E. FTSE 20 - Spot Market							
Mean: ARMAX(4,0,0); Variance: GARCH(1,2)				Mean: ARMAX(2,0,0); Variance: GARCH(1,2)			
Conditional Probability Distribution: Gaussian				Conditional Probability Distribution: Student's T			
Confidence Interval: 95% → $\alpha=0.05$				Confidence Interval: 95% → $\alpha=0.05$			
Parameter	Value	Standard Error	T Statistic	Parameter	Value	Standard Error	T Statistic
C	5.4095e-005	0.00015519	0.3486	C	-8.9174e-005	0.00014287	-0.6242
AR(1)	0.12824	0.029392	4.3629	AR(1)	0.12963	0.027194	4.7670
AR(2)	-0.029111	0.030436	-0.9565	AR(2)	-0.05008	0.028526	-1.7558
AR(3)	0.020801	0.029325	0.7093	K	5.9501e-006	1.8092e-006	3.2889
AR(4)	0.058418	0.025512	2.2899	GARCH(1)	0.66068	0.071677	9.2175
K	5.2122e-006	1.0709e-006	4.8670	ARCH(1)	0.081344	0.034229	2.3765
GARCH(1)	0.67988	0.040533	16.7734	ARCH(2)	0.11023	0.049417	2.2306
ARCH(1)	0.092667	0.020653	4.4869	DoF	5.9996	0.96911	6.1908
ARCH(2)	0.09831	0.029549	3.3270				
A.S.E. FTSE 20 - Futures Market							
Mean: ARMAX(4,0,0); Variance: GARCH(1,1)				Mean: ARMAX(2,0,0); Variance: GARCH(1,1)			
Conditional Probability Distribution: Gaussian				Conditional Probability Distribution: Student's T			
Confidence Interval: 95% → $\alpha=0.05$				Confidence Interval: 95% → $\alpha=0.05$			
Parameter	Value	Standard Error	T Statistic	Parameter	Value	Standard Error	T Statistic
C	9.1186e-006	0.00017465	0.0522	C	-0.000113	0.00015412	-0.7390
AR(1)	0.066131	0.032092	2.0607	AR(1)	0.065387	0.028485	2.2955
AR(2)	0.0025033	0.028863	0.0867	AR(2)	-0.018928	0.026678	-0.7095
AR(3)	0.0075053	0.027239	0.2755	K	4.7657e-006	1.48e-006	3.2201
AR(4)	0.076975	0.026653	2.8880	GARCH(1)	0.77277	0.045258	17.0747
K	2.8794e-006	6.5507e-007	4.3956	ARCH(1)	0.12957	0.027466	4.7176
GARCH(1)	0.82187	0.018453	44.5390	DoF	5.3167	0.8127	6.5420
ARCH(1)	0.11966	0.011706	10.2226				

Table 1: The above table presents the results from four different Symmetric GARCH(P,Q) models, the GARCH(1,2) model, with four and two lag coefficients in the model of mean, that refer to Spot and Futures Market, respectively and the GARCH(1,1) model, with also four and two lag coefficients in the models of mean, that refer to the Spot and Futures Market, respectively. The sample of observations is 1,400 and is equal to the 2/3 of the total given sample. The distributions used are the Gaussian and the Student's t and the confidence interval is equal to 95%.

The following table 2 presents the results from the application of the above diagnostic control test in the models of mean, of the variance and of the distribution for the models GARCH(1,2) and GARCH(1,1) that refer

to the Spot and Futures Markets, respectively, under the use of Gaussian and Student's t distribution and with a confidence interval equal to 95%, for a sample of 1,400 observations of the given series (Malliaropulos, 1997).

A.S.E. FTSE 20 - Spot Market							
Symmetric GARCH(1,2) Model Estimated with 4 lags in the model of mean							
Conditional Probability Distribution: Gaussian							
Confidence Interval: 95% → $\alpha=0.05$							
Total sample of observations → 1,400							
Ljung-Box-Pierce Q-Test – Diagnostic test for the model of the Mean with 5 lags				Ljung-Box-Pierce Q^2 - Test – Diagnostic test for the model of the Variance with 5 lags			
H	P - Value	Q - Statistic	Critical Value	H	P - Value	Q - Statistic	Critical Value
0	0.8473	0.0371	3.8415	0	0.6911	0.1579	3.8415
0	0.9630	0.0755	5.9915	0	0.2693	2.6241	5.9915
0	0.9941	0.0798	7.8147	0	0.4272	2.7777	7.8147
0	0.9972	0.1523	9.4877	0	0.3725	4.2558	9.4877
0	0.8809	1.7631	11.0705	0	0.5008	4.3453	11.0705
Jarque – Bera Test – Diagnostic test for the model of the Distribution with 5 lags							
H		P - Value		T - Statistic			
1		0		212.8594			
Symmetric GARCH(1,2) Model Estimated with 2 lags in the model of mean							
Conditional Probability Distribution: Student's T							
Confidence Interval: 95% → $\alpha=0.05$							
Total sample of observations → 1,400							
Ljung-Box-Pierce Q-Test – Diagnostic test for the model of the Mean with 5 lags				Ljung-Box-Pierce Q^2 - Test – Diagnostic test for the model of the Variance with 5 lags			
H	P - Value	Q - Statistic	Critical Value	H	P - Value	Q - Statistic	Critical Value
0	0.8745	0.0250	3.8415	0	0.5440	0.3682	3.8415
0	0.8082	0.4259	5.9915	0	0.2569	2.7183	5.9915
0	0.7739	1.1132	7.8147	0	0.4207	2.8170	7.8147
0	0.1043	7.6741	9.4877	0	0.3248	4.6533	9.4877
0	0.1247	8.6313	11.0705	0	0.4494	4.7327	11.0705
Kolmogorov-Smirnoff Test – Diagnostic test for the model of the Distribution with 5 lags							
H		P - Value		K - Statistic			
1		4.1514e-004		0.0549			
A.S.E. FTSE 20 - Futures Market							
Symmetric GARCH(1,1) Model Estimated with 4 lags in the model of mean							
Conditional Probability Distribution: Gaussian							
Confidence Interval: 95% → $\alpha=0.05$							
Total sample of observations → 1,400							
Ljung-Box-Pierce Q-Test – Diagnostic test for the model of the Mean with 5 lags				Ljung-Box-Pierce Q^2 - Test – Diagnostic test for the model of the Variance with 5 lags			
H	P - Value	Q - Statistic	Critical Value	H	P - Value	Q - Statistic	Critical Value
0	0.9533	0.0034	3.8415	0	0.6738	0.1772	3.8415
0	0.9907	0.0186	5.9915	0	0.1729	3.5100	5.9915
0	0.9376	0.4128	7.8147	0	0.0718	7.0044	7.8147

0	0.9342	0.8315	9.4877	0	0.0832	8.2399	9.4877
0	0.9748	0.8336	11.0705	0	0.1199	8.7395	11.0705
Jarque – Bera Test – Diagnostic test for the model of the Distribution with 5 lags							
H			P - Value			T - Statistic	
1			0			208.0373	
Symmetric GARCH(1,1) Model Estimated with 2 lags in the model of mean							
Conditional Probability Distribution: Student's T							
Confidence Interval: 95% → a=0.05							
Total sample of observations → 1,400							
Ljung-Box-Pierce Q-Test – Diagnostic test for the model of the Mean with 5 lags				Ljung-Box-Pierce Q^2 - Test – Diagnostic test for the model of the Variance with 5 lags			
0	0.9456	0.0047	3.8415	0	0.4496	0.5717	3.8415
0	0.7646	0.5368	5.9915	0	0.2435	2.8250	5.9915
0	0.9033	0.5699	7.8147	0	0.0645	7.2443	7.8147
0	0.2439	5.4530	9.4877	0	0.0672	8.7681	9.4877
0	0.3608	5.4744	11.0705	0	0.1043	9.1227	11.0705
Kolmogorov-Smirnoff Test – Diagnostic test for the model of the Distribution with 5 lags							
H			P - Value			K - Statistic	
1			1.5821e-004			0.0579	

Table 2: The above table presents the results from the three different diagnostic tests for the model of mean, of variance and of distribution. The models used are the Symmetric GARCH(1,2) and the GARCH(1,1) models, that refer to Spot and Futures Market, respectively. The sample of observations is 1,400 and is equal to the 2/3 of the total given sample. The distributions used are the Gaussian and the Student's t and the confidence interval is equal to 95%.

The following table 3 presents the values of the parameters of the EGARCH(2,4) model that were computed for a sample of 1,400 observations for the Spot Market and the parameters of the EGARCH(2,4) model for 1,400 observations of the Futures Market respectively, of the FTSE 20 index of the A.S.E. and for an amount of four lag coefficients for the model of the mean. The model of distribution density

function that was used is the standard normal Gaussian distribution. On the other hand and for the Student's t Distribution the models that were used are the EGARCH(2,5) model for the Spot Market and the EGARCH(3,4) model for the Futures Market, with 2 lag coefficients for the model of the mean and all of the other details and parameters remaining the same.

A.S.E. FTSE 20 - Spot Market							
Mean: ARMAX(4,0,0); Variance: EGARCH(2,4)				Mean: ARMAX(2,0,0); Variance: EGARCH(2,5)			
Conditional Probability Distribution: Gaussian				Conditional Probability Distribution: Student's T			
Confidence Interval: 95% → a=0.05				Confidence Interval: 95% → a=0.05			
Parameter	Value	Standard Error	T Statistic	Parameter	Value	Standard Error	T Statistic
C	-5.6149e-005	0.0001463	-0.3838	C	-0.000132	0.00014088	-0.9413
AR(1)	0.11498	0.027341	4.2052	AR(1)	0.12143	0.026244	4.6268
AR(2)	-0.003766	0.029441	-0.1279	AR(2)	-0.048248	0.028564	-1.6891
AR(3)	0.010773	0.030161	0.3572	K	-0.090377	0.088849	-1.0172
AR(4)	0.063221	0.024202	2.6122	GARCH(1)	1.4818	0.24976	5.9326
K	-0.0221	0.018875	-1.1709	GARCH(2)	-0.49054	0.24299	-2.0187

GARCH(1)	1.6146	0.13663	11.8175	ARCH(1)	0.14426	0.063066	2.2875
GARCH(2)	-0.61678	0.13528	-4.5593	ARCH(2)	0.10526	0.1173	0.8974
ARCH(1)	0.16485	0.040502	4.0702	ARCH(3)	-0.27018	0.12409	-2.1773
ARCH(2)	0.02354	0.081128	0.2902	ARCH(4)	0.22998	0.12125	1.8967
ARCH(3)	-0.10491	0.094866	-1.1059	ARCH(5)	-0.17103	0.077022	-2.2205
ARCH(4)	-0.063222	0.073284	-0.862	Lever.(1)	-0.056299	0.044849	-1.2553
Lever.(1)	-0.045217	0.030452	-1.4849	Lever.(2)	0.044286	0.07914	0.5596
Lever.(2)	0.026479	0.061427	0.4311	Lever.(3)	-0.000533	0.078577	-0.0068
Lever.(3)	-0.003924	0.065697	-0.0597	Lever.(4)	-0.019691	0.078031	-0.2524
Lever.(4)	0.012114	0.034822	0.3479	Lever.(5)	0.015336	0.046313	0.3311
				DoF	6.5232	1.2199	5.3472
A.S.E. FTSE 20 - Futures Market							
Mean: ARMAX(4,0,0); Variance: EGARCH(2,4)				Mean: ARMAX(2,0,0); Variance: EGARCH(3,4)			
Conditional Probability Distribution: Gaussian				Conditional Probability Distribution: Student's T			
Confidence Interval: 95% → a=0.05				Confidence Interval: 95% → a=0.05			
Parameter	Value	Standard Error	T Statistic	Parameter	Value	Standard Error	T Statistic
C	-4.1137e-005	0.00016148	-0.2548	C	-0.0002528	0.00014571	-1.7350
AR(1)	0.054691	0.028057	1.9493	AR(1)	0.061019	0.02577	2.3679
AR(2)	0.009906	0.028176	0.3516	AR(2)	-0.021273	0.027982	-0.7603
AR(3)	-0.01277	0.02971	-0.4299	K	-0.03248	0.011686	-2.7794
AR(4)	0.081226	0.025077	3.2390	GARCH(1)	0.84414	0.07276	11.6017
K	-0.07167	0.036496	-1.9645	GARCH(2)	0.90839	0.069767	13.0203
GARCH(1)	1.3831	0.15188	9.1065	GARCH(3)	-0.75575	0.002694	-280.5293
GARCH(2)	-0.39036	0.14952	-2.6107	ARCH(1)	0.13771	0.062	2.2212
ARCH(1)	0.16418	0.039302	4.1773	ARCH(2)	0.16692	0.0808	2.0658
ARCH(2)	0.021383	0.075503	0.2832	ARCH(3)	-0.091048	0.067656	-1.3458
ARCH(3)	0.055294	0.074987	0.7374	ARCH(4)	-0.23129	0.068544	-3.3744
ARCH(4)	-0.1913	0.056944	-3.3595	Lever.(1)	-0.010513	0.045297	-0.2321
Lever.(1)	-0.02943	0.031196	-0.9434	Lever.(2)	-0.070298	0.04761	-1.4765
Lever.(2)	-0.05486	0.057072	-0.9613	Lever.(3)	0.025501	0.052108	0.4894
Lever.(3)	0.10714	0.059076	1.8136	Lever.(4)	0.043987	0.046819	0.9395
Lever.(4)	-0.05066	0.033709	-1.5030	DoF	6.0465	0.0018709	3231.7738

Table 3: The above table presents the results from four different Asymmetric EGARCH models, the EGARCH(2,4) model, with four lag coefficients in the model of mean, that refer to Spot and Futures Market, respectively and the EGARCH(2,5) and EGARCH(3,4) models, with two lag coefficients in the models of mean, that refer to the Spot and Futures Market, respectively. The sample of observations is 1,400 and is equal to the 2/3 of the total given sample. The distributions used are the Gaussian and the Student's t and the confidence interval is equal to 95%.

Furthermore, the following table 4 presents the results from the application of the relative diagnostic control tests in the models of mean, of the variance and of the distribution for the models EGARCH(2,4), with four lags in the model of mean, and EGARCH(2,5) and

EGARCH(3,4), with two lags in the model of mean, that refer to the Spot and Futures Markets, respectively, under the use of Gaussian and Student's t distribution and with a confidence interval equal to 95%, for a sample of 1,400 observations of the given series.

A.S.E. FTSE 20 - Spot Market							
Asymmetric EGARCH(2,4) Model Estimated with 2 lags in the model of mean							
Conditional Probability Distribution: Gaussian							
Confidence Interval: 95% → $\alpha=0.05$							
Total sample of observations → 1,400							
Ljung-Box-Pierce Q-Test – Diagnostic test for the model of the Mean with 5 lags				Ljung-Box-Pierce Q^2 - Test – Diagnostic test for the model of the Variance with 5 lags			
H	P - Value	Q - Statistic	Critical Value	H	P - Value	Q - Statistic	Critical Value
0	0.5027	0.4492	3.8415	0	0.3042	1.0555	3.8415
0	0.4423	1.6316	5.9915	0	0.1929	3.2910	5.9915
0	0.6425	1.6750	7.8147	0	0.3456	3.3146	7.8147
0	0.7918	1.6939	9.4877	0	0.2498	5.3871	9.4877
0	0.6503	3.3229	11.0705	0	0.3705	5.3872	11.0705
Jarque – Bera Test – Diagnostic test for the model of the Distribution with 5 lags							
H		P - Value		T - Statistic			
1		0		101.6023			
Asymmetric EGARCH(2,5) Model Estimated with 2 lags in the model of mean							
Conditional Probability Distribution: Student's T							
Confidence Interval: 95% → $\alpha=0.05$							
Total sample of observations → 1,400							
Ljung-Box-Pierce Q-Test – Diagnostic test for the model of the Mean with 5 lags				Ljung-Box-Pierce Q^2 - Test – Diagnostic test for the model of the Variance with 5 lags			
H	P - Value	Q - Statistic	Critical Value	H	P - Value	Q - Statistic	Critical Value
0	0.6398	0.2191	3.8415	0	0.2094	1.5754	3.8415
0	0.7438	0.5919	5.9915	0	0.1832	3.3940	5.9915
0	0.7312	1.2915	7.8147	0	0.1189	5.8539	7.8147
0	0.0978	7.8348	9.4877	0	0.1617	6.5488	9.4877
0	0.1197	8.7440	11.0705	0	0.2510	6.6131	11.0705
Kolmogorov-Smirnoff Test – Diagnostic test for the model of the Distribution with 5 lags							
H		P - Value		K - Statistic			
1		0.0039		0.0470			
A.S.E. FTSE 20 - Futures Market							
Asymmetric EGARCH(2,4) Model Estimated with 4 lags in the model of mean							
Conditional Probability Distribution: Gaussian							
Confidence Interval: 95% → $\alpha=0.05$							
Total sample of observations → 1,400							
Ljung-Box-Pierce Q-Test – Diagnostic test for the model of the Mean with 5 lags				Ljung-Box-Pierce Q^2 - Test – Diagnostic test for the model of the Variance with 5 lags			
H	P - Value	Q - Statistic	Critical Value	H	P - Value	Q - Statistic	Critical Value
0	0.6428	0.2151	3.8415	0	0.2029	1.6212	3.8415
0	0.8407	0.3471	5.9915	0	0.3062	2.3672	5.9915
0	0.9489	0.3573	7.8147	0	0.4424	2.6872	7.8147
0	0.9259	0.8908	9.4877	0	0.4144	3.9386	9.4877

0	0.9707	0.8934	11.0705	0	0.5579	3.9415	11.0705
Jarque – Bera Test – Diagnostic test for the model of the Distribution with 5 lags							
H			P - Value			T - Statistic	
1			0			120.1320	
Asymmetric EGARCH(3,4) Model Estimated with 2 lags in the model of mean							
Conditional Probability Distribution: Student's T							
Confidence Interval: 95% → $\alpha=0.05$							
Total sample of observations → 1,400							
Ljung-Box-Pierce Q-Test – Diagnostic test for the model of the Mean with 5 lags				Ljung-Box-Pierce Q^2 - Test – Diagnostic test for the model of the Variance with 5 lags			
0	0.8139	0.0554	3.8415	0	0.3058	1.0488	3.8415
0	0.6874	0.7497	5.9915	0	0.5908	1.0524	5.9915
0	0.8550	0.7769	7.8147	0	0.7531	1.1995	7.8147
0	0.2259	5.6612	9.4877	0	0.8253	1.5073	9.4877
0	0.3379	5.6866	11.0705	0	0.8455	2.0263	11.0705
Kolmogorov-Smirnoff Test – Diagnostic test for the model of the Distribution with 5 lags							
H			P - Value			K - Statistic	
1			1.3445e-004			0.0584	

Table 4: The above table 4 presents the results from the three different diagnostic tests for the model of mean, of variance and of distribution. The models used are the Asymmetric EGARCH models, the EGARCH(2,4), the EGARCH(2,5) models and the EGARCH(3,4) models, that refer to Spot and Futures Market, respectively. The sample of observations is 1,400 and is equal to the 2/3 of the total given sample. The distributions used are the Gaussian and the Student's t and the confidence interval is equal to 95%.

According to all of the above tables, it is obvious that the models that are concluded are capable, adequate and reliable to be used to the section of the "adjusted" GARCH models. They seem to pass all of the diagnostic control tests for the models of mean, of the conditional variance and of the distribution.

Finally, these models were applied and tested under different confidence intervals and past time periods of the given sample data and this will lead to better and more complete view of the capability of the GARCH econometric modelling and forecasting for financial data (Liu and Hung, 2010).

4.3. Construction of "adjusted" GARCH models

The "adjusted" GARCH models are based on the appliance of the diptych "estimation-forecasting". This means that firstly it is important to determine the sample of the data that is going to be used (in this section the above application is presented for three different sample data /

time intervals in the past information data) for the estimation of the parameters of GARCH models and for the forecasts of the prices of the next observation, in which the process of the estimation is over. The next step is to shift the sample of the data that was previously used for the diptych "estimation-forecasting" one observation "ahead" and in this way the forecasted observation that is collected (forecasted standard deviation, or time varying volatility) refers to one observation "ahead" of the previous forecast.

So, if the amount of the sample of the data that is needed for the model's parameter estimation starts from the date February 14, 1994 and refers to a time interval of 300 past observations, the process of the estimation will take place, up until the observation that refers to the date of February 15, 1994. So the process of the model's parameter estimation will end at this date and the process of the forecasted observation will refer to the next date of this last one, which is the February 16, 1994. In this way the whole

procedure (“estimation-forecasting”) continues until an efficient and adequate amount of forecasted observations is collected (i.e. 1,000 forecasted standard deviations).

One method to apply the above diptych, is with the use of programming language and the creation of loops (which is actually applied in this study under the use of the Matlab software environment) (Matías, Bande, Manteiga, and Reboredo, 2010).

In order to create the steps for the completion of the above process, three different time intervals were used as sample data, from which the last observation timely coincides with the date June 01, 2004 between the two markets and uses the follow information from the past observations, which are presented in the next table 5.

The reason for which the estimation of the above models starts from the date June 01, 2004 and continues for the related time intervals “in the past” is that it is important to avoid incorporating in the estimation process phenomena, such as financial crises and other events that may include “bad news” and might happen during the total period of time (which is from the date January 02, 2000 to the date May 30, 2008). Otherwise the adequacy and reliability of the sample of the forecasts will be seriously affected in a wrong way (Storti, 2006).

It is important to examine how the used GARCH models behave for great confidence intervals and small percentages of error, respectively (i.e. for confidence interval equal to 95% and percentage of error equal to 5%) and on the other hand for small confidence in-

Two Financial Time Series → Spot and Futures Market of the FTSE 20 index of A.S.E.	
Models used : a) Symmetric GARCH(1,2) – 4 lags in the model of mean (Gauss Distribution) & 2 lags in the model of mean (Student’s t Distribution)	
b) Symmetric GARCH(1,1) – 4 lags in the model of mean (Gauss Distribution) & 2 lags in the model of mean (Student’s t Distribution)	
c) Asymmetric EGARCH(2,4) – 4 lags in the model of mean (Gauss Distribution) & Asymmetric EGARCH(2,5) - 2 lags in the model of mean (Student’s t Distribution)	
d) Asymmetric EGARCH(3,4) - 2 lags in the model of mean (Student’s t Distribution)	
Confidence Intervals used: 20%, 50%, 70%, 90%, 95%, 99%	
Total amount of observations (logarithmic returns) given: 2,100 for Spot and Futures Market	
Time Intervals of the sample data	
Sample data / Market	Spot Market
300	13/03/2003 – 01/06/2004
700	01/08/2001 – 01/06/2004
1,000	23/05/2000 – 01/06/2004
Sample of 1,000 forecasted observations	02/06/2004 – 30/05/2008
Time Intervals of the sample data	
Sample data / Market	Futures Market
300	13/03/2003 – 01/06/2004
700	01/08/2001 – 01/06/2004
1,000	23/05/2000 – 01/06/2004
Sample of 1,000 forecasted observations	02/06/2004 – 30/05/2008

Table 5: The above table refers to all information that were used for the application of the “adjusted” GARCH models and for the presentation of the related results.

tervals and great percentages of error (i.e. for confidence interval equal to 20% and percentage of error equal to 80%). For this reason a statistical criterion is applied (measurement of the adequacy of the forecasts) which examines the percentages of the given observations (Spot and Futures Market) that “fall” outside the Upper and Lower bounds of the forecasted observations (standard deviations). These percentages must be approximately equal to the half of the alpha coefficient of the confidence interval that was used each time.

4.4. Measuring the adequacy of the models

Assume that:

- $n_h = \# \text{ of observations}$, that refer to the number of given observations (logarithmic returns), which their prices are bigger than the prices of the Upper bound of the forecasted observations (standard deviations), and,
- $n_l = \# \text{ of observations}$, that refer to the number of given observations (logarithmic returns), which their prices are lower than the prices of the Lower bound of the forecasted observations (standard deviations).

Three different percentages are needed to examine if the individual samples and their sum are “close” to the confidence interval that was used. These percentages are given by the following equations:

$$\frac{n_h + n_l}{n_{total}} \cong a \tag{Eq. 12}$$

, where the price of n_{total} is the sum of the prices n_h and n_l , respectively, and the price of a , is the confidence interval that was used (i.e. for confidence interval equal to 95%, the price of a is equal to 5%).

Furthermore the equations:

$$\frac{n_h}{n_{total}} \cong a / 2 \tag{Eq. 13}$$

And,

$$\frac{n_l}{n_{total}} \cong a / 2 \tag{Eq. 14}$$

, are the separate percentages for the forecasted samples of observations that refer to the Upper and Lower bounds of the forecasted standard deviations, respectively. These percentages must be approximately equal to the ½ of the percentage of the confidence interval that was used (i.e. for confidence interval equal to 95%, must be equal to 2.5%).

It is important to explain with the use of mathematical equations how the Upper and Lower bounds of the forecasted standard deviations (sigmaForecasts) are converted into time series, according to the forecasts of the model the mean (meanForecasts).

It is known that the model of the mean is given by the following mathematical equation (McAleer, Chan, and Marinova, 2007):

$$y_t = f_{t-1} + \epsilon_t \tag{Eq. 15}$$

, and for each of the distribution model that is going to be used, the values of the standardized residuals z_t follow the relative values for the price of mean and of the variance, where the values of z_t are given by the following equation:

$$z_t = \frac{\epsilon_t}{\sigma_t} \tag{Eq. 16}$$

By combining the system of the above two equations, the result are that:

$$z_t = \frac{y_t - f_{t-1}}{\sigma_t} \tag{Eq. 17}$$

Now, let’s assume that the values of the z_t follow a standard normal distribution, with price of the mean equal to zero and price of the variance equal to one. This means that:

$$\frac{y_t - f_{t-1}}{\sigma_t} \sim N(0,1) \tag{Eq. 18}$$

Also assume that the confidence interval used is equal to 95%. Then the value of a coefficient will be equal to 5% and the values of a coefficient, in the edges of the two tails (left and right) of the distribution used will be equal to 2.5%. This means that according to the theory of probabilities the conclusion is the following equation:

$$P(-z_{a/2} < \frac{y_t - f_{t-1}}{\sigma_t} < z_{a/2}) = 1 - a \quad (\text{Eq. 19})$$

, where the value of $z_{a/2}$ is the critical value in the $a/2$ confidence interval. For example, the value of $z_{a/2}$ is approximately equal to 1.96 (absolute value), with confidence interval equal to 95%. By, further solving the above equation, the conclusion is the following two equations (McMillan, 2007):

$$P(-z_{a/2} * \sigma_t < y_t - f_{t-1} < z_{a/2} * \sigma_t) = 1 - a \quad (\text{Eq. 20})$$

And

$$P(f_{t-1} - z_{a/2} * \sigma_t < y_t < f_{t-1} + z_{a/2} * \sigma_t) = 1 - a \quad (\text{Eq. 21})$$

The last equation is used for the computation of the Upper and Lower bounds of the forecasted observations. This means that the left ‘leg’ of the above equation is used for the computation of the Lower bound and the right ‘leg’ is used for the computation of the Upper bound of the forecasts.

This equation was used for two different distribution density functions; the standard normal distribution Gauss and the Student’s t Distribution. Due to the fact that the behaviour of the ‘adjusted’ GARCH models imposes the estimation of the model in a ‘Rolling Window’ of a predetermined number of observations in the past (i.e. 300 observations in the past), it is appropriate to save all of the values of the parameter Degrees of Freedom in an individual table. Through this pattern, every time the ‘Rolling Window’ of estimation-forecasting shifts to the next date, the DoF parameter will change. In such a way the critical value of the distribution should be computed in two ways: either by approximately estimating the average of the DoF parameters and with this value to extract the value of the z , or by creating a table with all of the computed critical values (in this study since the desirable result is 1,000 forecasts, a table of 1,000 critical values of the z , was created). On the other hand, in the Student’s t Distribution occasion, the critical values were computed immediately and it was not

necessary to apply the previously mentioned methodology (Mittnik, Paolella, and Rachev, 2002).

For each of these markets, the prices of the statistical criterion were estimated for six different confidence intervals, 20%, 50%, 70%, 90%, 95% and 99%. This whole process was applied for two different distribution density functions, the Gaussian distribution and the Student’s t Distribution (Stavroyiannis, Makris, and Nikolaidis, 2010).

The percentages, $P_t = \frac{n_h + n_l}{n_{total}} \cong a$, $P_h = \frac{n_h}{n_{total}} \cong a/2$ and $P_l = \frac{n_l}{n_{total}} \cong a/2$, where the P_t , P_h and P_l , refer to the previously mentioned three percentages, are presented extensively to the following tables and must be equal approximately to a and $a/2$, respectively, in order for the forecasts to be adequate and reliable.

5. Results of “adjusted” models application (Estimation & Forecasting)

The following tables 6 and 7 present all of the results of the empirical application of the ‘adjusted’ GARCH models, with the use of the ‘Rolling Window’ of Estimation-Forecasting, at the Symmetric GARCH(P,Q) models and the Asymmetric EGARCH(P,Q) model and also the results of the application of the statistical criterion for the results of the forecasts of this process. The tables exhibit all of the details that refer to the models used (lag coefficients in the models of mean and of variance) and to the models of distribution. Also the following tables refer to the three different time intervals of ‘past’ information used for the modelling process and to the six different confidence intervals that were used both for the empirical application and for the statistical criterion.

Spot Market of the FTSE 20 index of A.S.E.				Futures Market of the FTSE 20 index of A.S.E.			
Total sample of forecasts equal to 1,000				Total sample of forecasts equal to 1,000			
Symmetric GARCH(1,2) model with 4 lags in the model of mean.				Symmetric GARCH(1,1) model with 4 lags in the model of mean.			
Gauss Distribution and 300 observations time interval used.				Gauss Distribution and 300 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.023	0.069	0.109	P_{t}	0.021	0.072	0.133
P_{h}	0.007	0.023	0.038	P_{h}	0.004	0.025	0.055
P_{l}	0.016	0.046	0.071	P_{l}	0.017	0.047	0.078
	a=30%	a=50%	a=80%		a=30%	a=50%	a=80%
P_{t}	0.301	0.482	0.793	P_{t}	0.313	0.486	0.806
P_{h}	0.142	0.228	0.398	P_{h}	0.137	0.235	0.411
P_{l}	0.159	0.254	0.395	P_{l}	0.176	0.251	0.395
Symmetric GARCH(1,2) model with 4 lags in the model of mean.				Symmetric GARCH(1,1) model with 4 lags in the model of mean.			
Gauss Distribution and 700 observations time interval used.				Gauss Distribution and 700 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.021	0.069	0.103	P_{t}	0.021	0.077	0.13
P_{h}	0.007	0.024	0.039	P_{h}	0.004	0.027	0.053
P_{l}	0.014	0.045	0.064	P_{l}	0.017	0.005	0.077
	a=30%	a=50%	a=80%		a=30%	a=50%	a=80%
P_{t}	0.298	0.485	0.794	P_{t}	0.321	0.488	0.801
P_{h}	0.141	0.236	0.41	P_{h}	0.148	0.245	0.416
P_{l}	0.157	0.249	0.384	P_{l}	0.173	0.243	0.385
Symmetric GARCH(1,2) model with 4 lags in the model of mean.				Symmetric GARCH(1,1) model with 4 lags in the model of mean.			
Gauss Distribution and 1,000 observations time interval used.				Gauss Distribution and 1,000 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.021	0.067	0.104	P_{t}	0.022	0.074	0.131
P_{h}	0.007	0.025	0.04	P_{h}	0.006	0.028	0.055
P_{l}	0.014	0.042	0.064	P_{l}	0.016	0.046	0.076
	a=30%	a=50%	a=80%		a=30%	a=50%	a=80%
P_{t}	0.289	0.488	0.793	P_{t}	0.318	0.492	0.791
P_{h}	0.14	0.247	0.414	P_{h}	0.149	0.254	0.416
P_{l}	0.149	0.241	0.379	P_{l}	0.169	0.238	0.375

Symmetric GARCH(1,2) model with 2 lags in the model of mean.				Symmetric GARCH(1,1) model with 2 lags in the model of mean.			
Student's t Distribution and 300 observations time interval used.				Student's t Distribution and 300 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.014	0.047	0.093	P_{t}	0.009	0.039	0.104
P_{h}	0.003	0.015	0.03	P_{h}	0.001	0.014	0.035
P_{l}	0.011	0.032	0.063	P_{l}	0.008	0.025	0.069
	a=30%	a=50%	a=80%		a=30%	a=50%	a=80%
P_{t}	0.273	0.469	0.792	P_{t}	0.294	0.479	0.8
P_{h}	0.119	0.217	0.396	P_{h}	0.129	0.233	0.406
P_{l}	0.154	0.252	0.396	P_{l}	0.165	0.246	0.394
Symmetric GARCH(1,2) model with 2 lags in the model of mean.				Symmetric GARCH(1,1) model with 2 lags in the model of mean.			
Student's t Distribution and 700 observations time interval used.				Student's t Distribution and 700 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.014	0.044	0.09	P_{t}	0.006	0.036	0.097
P_{h}	0.004	0.014	0.033	P_{h}	0.001	0.012	0.037
P_{l}	0.01	0.03	0.057	P_{l}	0.005	0.024	0.06
	a=30%	a=50%	a=80%		a=30%	a=50%	a=80%
P_{t}	0.273	0.469	0.792	P_{t}	0.297	0.484	0.8
P_{h}	0.127	0.232	0.409	P_{h}	0.134	0.243	0.417
P_{l}	0.146	0.237	0.383	P_{l}	0.163	0.241	0.383
Symmetric GARCH(1,2) model with 2 lags in the model of mean.				Symmetric GARCH(1,1) model with 2 lags in the model of mean.			
Student's t Distribution and 1,000 observations time interval used.				Student's t Distribution and 1,000 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.009	0.043	0.089	P_{t}	0.007	0.037	0.092
P_{h}	0.002	0.012	0.033	P_{h}	0.002	0.013	0.036
P_{l}	0.007	0.031	0.056	P_{l}	0.005	0.024	0.056
	a=30%	a=50%	a=80%		a=30%	a=50%	a=80%
P_{t}	0.262	0.464	0.779	P_{t}	0.295	0.475	0.791
P_{h}	0.125	0.239	0.416	P_{h}	0.137	0.247	0.423
P_{l}	0.137	0.225	0.363	P_{l}	0.158	0.228	0.368

Table 6: The above table presents the results of the empirical application and of the statistical criterion (measurement adequacy) for the Spot and Futures Market of the FTSE 20 index of A.S.E. with the use of several detailed parameters and the Symmetric GARCH(P,Q) models.

Spot Market of the FTSE 20 index of A.S.E.				Futures Market of the FTSE 20 index of A.S.E.			
Total sample of forecasts equal to 1,000				Total sample of forecasts equal to 1,000			
Asymmetric EGARCH(2,4) model with 4 lags in the model of mean.				Asymmetric EGARCH(2,4) model with 4 lags in the model of mean.			
Gauss Distribution and 300 observations time interval used.				Gauss Distribution and 300 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.021	0.073	0.107	P_{t}	0.021	0.079	0.132
P_{h}	0.006	0.021	0.037	P_{h}	0.005	0.027	0.056
P_{l}	0.015	0.052	0.07	P_{l}	0.016	0.052	0.076
	a=30%	a=50%	a=80%		a=30%	a=50%	a=80%
P_{t}	0.297	0.484	0.788	P_{t}	0.317	0.494	0.795
P_{h}	0.138	0.231	0.393	P_{h}	0.144	0.245	0.401
P_{l}	0.159	0.253	0.395	P_{l}	0.173	0.249	0.394
Asymmetric EGARCH(2,4) model with 4 lags in the model of mean.				Asymmetric EGARCH(2,4) model with 4 lags in the model of mean.			
Gauss Distribution and 700 observations time interval used.				Gauss Distribution and 700 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.02	0.068	0.106	P_{t}	0.023	0.075	0.133
P_{h}	0.006	0.024	0.041	P_{h}	0.006	0.027	0.056
P_{l}	0.014	0.044	0.065	P_{l}	0.017	0.048	0.077
	a=30%	a=50%	a=80%		a=30%	a=50%	a=80%
P_{t}	0.3	0.488	0.791	P_{t}	0.32	0.49	0.808
P_{h}	0.14	0.245	0.408	P_{h}	0.151	0.25	0.418
P_{l}	0.16	0.243	0.383	P_{l}	0.169	0.24	0.39
Asymmetric EGARCH(2,4) model with 4 lags in the model of mean.				Asymmetric EGARCH(2,4) model with 4 lags in the model of mean.			
Gauss Distribution and 1,000 observations time interval used.				Gauss Distribution and 1,000 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.02	0.068	0.106	P_{t}	0.023	0.074	0.135
P_{h}	0.006	0.024	0.041	P_{h}	0.007	0.031	0.059
P_{l}	0.014	0.044	0.065	P_{l}	0.016	0.043	0.076
	a=30%	a=50%	a=80%		a=30%	- a=50%	a=80%
P_{t}	0.3	0.488	0.791	P_{t}	0.323	0.496	0.797
P_{h}	0.14	0.245	0.408	P_{h}	0.155	0.261	0.427
P_{l}	0.16	0.243	0.383	P_{l}	0.168	0.235	0.37

Asymmetric EGARCH(2,5) model with 2 lags in the model of mean.				Asymmetric EGARCH(3,4) model with 2 lags in the model of mean.			
Student's t Distribution and 300 observations time interval used.				Student's t Distribution and 300 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.018	0.062	0.101	P_{t}	0.016	0.053	0.113
P_{h}	0.005	0.019	0.036	P_{h}	0.002	0.016	0.041
P_{l}	0.013	0.043	0.065	P_{l}	0.014	0.037	0.072
	a=30%	a=50%	a=80%		a=30%	a=50%	a=80%
P_{t}	0.293	0.474	0.787	P_{t}	0.295	0.48	0.802
P_{h}	0.134	0.229	0.399	P_{h}	0.132	0.236	0.408
P_{l}	0.159	0.245	0.388	P_{l}	0.163	0.244	0.394
Asymmetric EGARCH(2,5) model with 2 lags in the model of mean.				Asymmetric EGARCH(3,4) model with 2 lags in the model of mean.			
Student's t Distribution and 700 observations time interval used.				Student's t Distribution and 700 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.016	0.055	0.092	P_{t}	0.015	0.049	0.11
P_{h}	0.005	0.017	0.034	P_{h}	0.002	0.019	0.043
P_{l}	0.011	0.038	0.058	P_{l}	0.013	0.03	0.067
	a=30%	a=50%	a=80%		a=30%	a=50%	a=80%
P_{t}	0.282	0.479	0.797	P_{t}	0.302	0.487	0.801
P_{h}	0.13	0.243	0.412	P_{h}	0.139	0.245	0.419
P_{l}	0.152	0.236	0.385	P_{l}	0.163	0.242	0.382
Asymmetric EGARCH(2,5) model with 2 lags in the model of mean.				Asymmetric EGARCH(3,4) model with 2 lags in the model of mean.			
Student's t Distribution and 1,000 observations time interval used.				Student's t Distribution and 1,000 observations time interval used.			
	a=1%	a=5%	a=10%		a=1%	a=5%	a=10%
P_{t}	0.007	0.036	0.082	P_{t}	0.011	0.043	0.097
P_{h}	0.002	0.009	0.031	P_{h}	0.002	0.017	0.039
P_{l}	0.005	0.027	0.051	P_{l}	0.009	0.026	0.058
	a=30%	a=50%	a=80%		a=30%	a=50%	a=80%
P_{t}	0.268	0.449	0.773	P_{t}	0.301	0.483	0.786
P_{h}	0.129	0.231	0.419	P_{h}	0.139	0.256	0.424
P_{l}	0.139	0.218	0.354	P_{l}	0.162	0.227	0.362

Table 7: The above table presents the results of the empirical application and of the statistical criterion (measurement adequacy) for the Spot and Futures Market of the FTSE 20 index of A.S.E. with the use of several detailed parameters and the Asymmetric EGARCH(P,Q) models.

6. Summary and Conclusions

As far as concerned the Spot Market, it seems that the model that best describes all of the phenomena that appear in financial time series and can adequately and reliably forecast these series, is the Symmetric GARCH(1,2) model, with 2 lag coefficients in the model of the mean, time interval of 1,000 observations in the "past", the Student's t distribution density function and the more relative confidence interval equal to 95%. This conclusion is resulted by comparing the values of the statistical criterion of the two above tables 6 and 7.

On the other hand, as far as concerned the Futures Market, it seems that the model that best describes all of the above phenomena that appear in financial time series and can adequately and reliably forecast these series, is the Asymmetric EGARCH(3,4) model, with 2 lag coefficients in the model of the mean, time interval of 1,000 observations in the "past", the Student's t Distribution density function and the more relative confidence interval equal to 95%.

According to the above conclusion, the Futures Market of the FTSE 20 index of the A.S.E., presents all of the previously mentioned econometric phenomena, like the Spot Market does and moreover it captures the leverage effects that appear through the use of the EGARCH(3,4) model.

The methodology of forming these models and the procedure of estimating the parameters of a GARCH model are not only a process of routine but also of many differences according to the total amount and the type of the observations used, but also according to the method which these samples are separated into individual ones. For the present research there were used two different samples of financial time series which each one contained about 2,100 observations, respectively.

The steps that are followed in order to be sure that the model that is about to be used is the appropriate one are constant and efficient methods of defining the GARCH models and generally they are summarized in the *GARCH Model Construction Cycle*. Nevertheless there

are more ways (except the steps of the GARCH Model Construction Cycle) for an analyst to apply the above process. On the other hand and before starting the application of the diagnostic control tests for the definition of the model that will be used some details for the GARCH modelling must be known.

Finally, according to the results of the empirical application of the models, the Student's t Distribution presented almost zero deviations from the expected values. It seems that with the use of the Gaussian distribution and for great confidence intervals (and respectively for great confidence intervals, i.e. for confidence interval equal to 20% and price alpha parameter equal to 80%) the results were better than with the use of small confidence intervals. This means that the results from the application of the GARCH models for Gaussian distribution present instability. As a result it is better to use the Student's t distribution than the Gaussian.

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Disclosure of environmental information within the business market through the use of financial and accounting tools

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Abstract: The environmental information within a business unit is very often recorded and disclosed through the use of accounting tools. In terms of this paper, taking seriously into account possible undisclosed financial risks about which investors should be definitely informed, there is being made an attempt to analyze the need as well as the appropriate way for an enterprise to illustrate this environmental information. However, despite the existing international and European relevant legal framework there seem to be certain unclear points that necessitate further clarification. Moreover, special emphasis is being put on the way in which the environmental information is being incorporated into the formal financial statements in accordance with financial stakeholders' and financial accounting standards' demands, so as to provide an understanding of the financial accounting framework and disclosure of environmental liabilities, intangible assets as well as of environmental risks. For this means, the profile of financial market participants, is also being analyzed, while at the same time there is also being made an attempt to highlight the compliance of environmental policy and management with capital market operation and business strategy.

Key words: Environmental information, financial accounting standards, environmental accounting

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1. Introduction

It cannot be doubted that there is a strong connection among the environmental policy applied by business units and the market risks as well as the uncertainty that investments include. The quality of the environmental information as well as the consistency, on which this information is delivered to shareholders, plays a crucial role for decision making among the investing community. Thus, it has been recorded that an enterprises' environmental performance definitely influences their stock values. (Gentry et al., 1997, Reed, 1998).

The sustainable financial services industry is still an emerging field that hasn't been yet fully developed across most European countries, but for sure underlies prospects for strengthening national markets' economies. Along with the efforts taking place, during the last years, so as to establish ways of rating organizations, creating environmental indexes of benchmarking (that serve counseling and delivering information to the investing community on companies applying sustainable environmental policies), several remarkable financial houses (e.g. Dow Jones and Financial Times) have undertaken initiatives on this direction. Their major motive for that has been the possible profit that may come out of sustainable development. Characteristic examples of the above, considered to be sustainable indexes, are Dow Jones Sustainable Group Index (DJSGI) and the Financial Time Security Exchange for Good (FTSE4G) (Halkos and Sepetis, 2007).

Generally speaking when additional information is given to investors, then the rate of risk and uncertainty has proven to be lowering and this usually results in a positive feedback for markets. (Gupta and Goldbar, 2005). For example when Hamilton (1995) carried a research on whether information concerning pollution was actually influencing the markets (through data the Environmental Protection Agency and the Toxis Release Inventory had published in 1989), he found out that the stock performance of the companies involved was far below than the market returns expected at that time (Halkos and Sepetis, 2007).

2. Materials and Methods

Environmental reporting, especially when strictly defined and enclosed by regulations that ensure its implementation, almost most of the times indicates the need for environmental protection especially in terms of corporate social responsibility and welfare. Thus arises the need for analysis and for comparing the various existing tools that disclose the environmental information required. After all, this need comes out of the urge for delivering accurate and credible information to investors, and generally so as to ensure in a way, the effectiveness of stock market.

3. Disclosure of environmental information

A remarkable number of researchers (Bradshaw and Miller, 2008, Kvall and Nobes, 2010) have commented on the fact that adopting a single set of accounting standards is definitely not the most effective way to have comparable financial statements, on a regular basis (Barbu et al, 2012).

National regulations and different reporting traditions are the main reason for the most important differences among companies' financial reports in an international level. For example, even when examining just the application of IAS or IFRS concerning environmental requirements, we still come across with differences because of national regulations on environmental disclosures as well as among firms because of pre-IFRS reporting practices, at times when disclosure of environmental information was still delivered voluntarily. Thus, serving the need for a common set of accounting standards worldwide, and in the context of globalization, increased financial market interdependence and high capital mobility, there arises the need to examine closely disclosure practices in international level (Barbu et al, 2012).

Despite however the fact that a number of researchers have worked and carried out studies on the voluntary disclosure of environmental information, there seems to be limited litera-

ture on the actual environmental disclosure requirements on the basis of accounting standards, which is obviously far more essential in terms of the effort being put to reach a convergence in environmental reporting (Barbu et al, 2012).

3.1 Reporting in National and European level

In the majority of national legislation systems, the companies that are required to follow the environmental regulations are those that are subject to reporting duties. There are several exceptions though, like France and South Africa where the state obliges only companies admitted to the stock exchange, for reporting. In Norway though, reporting is general and applies for all companies. A very remarkable example, as far as its legislation is concerned is that one of Australia, where for all financial products including an investment component, especially for the case of pension funds, it has to be clarified what are the social and environmental criteria considered in their investment policies. More specifically, according to the Financial Service Reform Act's requirements "all financial products with an investment component, including pension funds and mutual funds, have to include disclosure of the extent of which labor standards or environmental social or ethical considerations are taken into account in the selection, retention or realization of the investment" (Gregor, 2007).

As far as European countries are concerned, the concept of sustainable development, along with reporting and disclosure is well established for many years now, especially through the use of EC Environmental Action Programmes (EAP). It is worth mentioning that, for example, in the 5th EC EAP there is special emphasis on the reporting of environmental issues in financial accounts, with an ultimate goal of improving companies' awareness on environmental issues. Indicative of that, is the paragraph where it is argued that despite the difficulty in valuing many environmental assets "valuations, pricing and accounting mechanisms have a pivotal role to play in the achievement of sustainable development". It

also suggests that companies should "disclose in their annual reports details on their environmental policy and activities, and effects thereof", "disclose in their accounts the expenses on environmental programmes", as well as to "make provision in their accounts for environmental risks and future environmental expenses" (Linehan, 2010).

Still though it remains a question, whether the already established rules on financial reporting and accounting are clear enough and easily adaptable. Environmental issues in financial reporting were fairly well developed in terms of "Single Market and Environment Communication (COM (99) 263 final)", where it was argued that "The demands of investors and consumers led many companies beginning to disclose environmental information in their annual reports and accounts. However, in the absence of authoritative reporting guidelines in this area comparability between companies is difficult". Later on, it was decided that there was an urgent need for further measures from the Commissions' side, so that a Recommendation can be issued on "how to integrate environmental considerations into financial reporting". This Recommendation actually failed to apply in European countries' national laws. The next EAP (6th) didn't emphasize that much on this need, but rather on voluntary initiatives of environmental information disclosure (e.g. EMAS) (Gregor, 2007).

In Greece, firms that are trading on Athens stock exchange are obliged to follow the principles of International Accounting Standards. There is no doubt that proper implementation of the legislation, together with special emphasis on the need for environmental reporting on national level would contribute significantly in optimizing the investment information for companies' environmental and sustainable performance while it can always ask pressure towards companies so that they redefine their environmental objectives.

3.2 Effects of environmental information disclosure

Having emphasized on the need for deliver-

ing environmental information to the markets, the next critical point is definitely the proper way in which this information is supposed to be disclosed. Environmental liabilities can very easily stand for a company overstating or understating its actual value. Indicatively, when environmental liabilities are understated (for example certain intangible assets such as emission allowances), a company's market values is likely to be overstated as opposed to its book value or in other words, there appears an increase in the P/B ratio (price-to-book ratio). This indicates the importance of the financial accounting standards as well as of the whole framework used for disclosure of environmental liabilities. It also indicates the need for organizations specializing, through the use of accounting and financial reporting tools and systems, in disclosing corporate financial information, as a means of providing objectivity, transparency and secureness at the markets. Otherwise, both investors and creditors may be misled which can result in an uncertain, unsecure and eventually inefficient investment environment.

Most of the times a company's market value is higher than its book value, since there are certain parameters included that cannot be resulted through a company's balance sheet, as for example a company's potential for future growth as well as intangible assets. Among intangible assets, very important non-monetary assets are included, as copyrights, patents, research and development, corporate social responsibility, reputation and customers, brand names and even human resources. Of great interest is market's tendency during the last years to count for climate risk as an intangible asset liability that influences a company's market value.

4. Financial Accounting Standards and Guidance for the Disclosure of Environmental Liabilities.

Several financial accounting standards have been developed in order to help markets work efficiently to the direction described above,

dating back to the 1970s. Popular examples of that kind of standards that serve in disclosure of environmental liabilities are: Accounting Bulletins by the SEC, Statements of Position by the AICPA, Financial Accounting Standards by FASB, and most recently, the Sarbanes-Oxley Act of 2002.

4.1 Environmental Reporting in terms of FASB

The Financial Accounting Standards Board (FASB), which is a private non-profit organization, has been set responsible for introducing standards for financial accounting and reporting in US. These standards in fact govern the preparation of financial reports and are considered essential for the efficient function of the economy as they provide investors, creditors, auditors and generally stakeholders, with accurate, credible but above all, comparable information. The International Accounting Standards Board (IASB) on the other hand, is also an independent non-profit organization responsible for international harmonization of published financial statements and generally for the harmonization of accounting practices. IASB in fact succeeded IASC (International Accounting Standard Committee). During the last years there are being made efforts by FASB and IASB so as to reach a consolidation among the American accounting standards and the international financial reporting standards (IFRS).

As far as environmental liabilities are concerned, since FASB and IASB, started working jointly, there has been remarkable progress in standards related to environmental liabilities. (e.g., FAS 157 and FAS 141-R)

The FAS 5 "Accounting for Contingencies" was first issued in 1975 and was the first standard related to evaluating and reporting environmental liabilities. The concept through which environmental liabilities are explained through FAS 5 has to do with the "loss of contingencies". More specifically, contingency constitutes a liability resulting in either gain or loss, always depending on the uncertainty future events underly. Granted the fact that there

can always be either a gain contingency or a loss contingency, depending on the forthcoming event, what plays a crucial role is the rate of uncertainty. This uncertainty can vary form: a) “probable” which means that future events are likely to occur, b) “reasonably possible” when it is not that likely for future events to take place c) “remote” when it is highly unlikely for the future event to occur. The main disadvantage of FAS 5 is that an environmental cost through a contingent liability is supposed to be accrued only if it is considered “probable” that a liability would be incurred and as long as this liability is “reasonably possible”. This can result in remarkable future environmental remediation costs, that are closely related to some facility, not being reflected properly or at all on the company’s financial statements, even when the necessity of an important remediation, when it’s going to shut down, is highly likely. On the grounds of this disadvantage, some relevant guidance has been issued so as to resolve the above mentioned problem. According to FASB interpretation 14 “Reasonable Estimation of the Amount of a Loss”, if only a range of possible loss can be established, then what has to be accrued is just the minimum amount in the range, except for the case when an amount within the range, seems to be a better estimate. In the first case, where the minimum is accrued, the additional exposure to loss has to be as well disclosed if there is a reasonable possibility of loss that surpasses the minimum amount accrued in the financial statements.

A characteristic example of how environmental liabilities are supposed to be disclosed is what is described in terms of FIN 47. More particularly, FIN 47 “Accounting for Asset Retirement Obligations”, was issued in 2001 but was activated in 2005 and is considered one of the most crucial reporting standards as far as environmental liabilities of publicly traded companies are concerned. FIN 47 focuses on Conditional Asset Retirement as well as on when an entity has the necessary information that allows it to estimate the fair value of an asset retirement obligation (Lee and Trabucchi, 2008).

The Conditional Asset Retirement is defined in terms of Statement 143, as the “legal obligation to perform an asset retirement activity in which the timing and (or) method of settlement are conditional on a future event that may or may not be within the control of the entity.” According to FASB however, as far as “conditional” is concerned, the legal obligation for a company to perform the asset retirement activity is considered unconditional, no matter what the level of uncertainty on timing and method of settlement is. In other words, despite the fact that the timing and the method of settlement might be conditional on a future event, the liability is definitely considered unconditional on the grounds of legal obligation (e.g. law or regulatory statute). As described in FIN 47 through the example of asbestos, removing this material is not a parameter that can be ignored, since the buildings’ life duration is not infinite and furthermore the asbestos has to be removed before demolishing a building. Even when it comes to sale the building, the asbestos has to either be removed or be incorporated in the building’s purchase price. Thus, arises the need to recognize the cost of asbestos removal for already owned buildings otherwise, it has to be recognized when the company acquires a new asset (Lee and Trabucchi, 2008).

Furthermore according to FASB, the asset retirement obligation has to be recognized at the fair value (market value) of the liability, of course as long as it can be estimated when the obligation is incurred (during acquisition, construction, or development of the asset). As for the time when a company has sufficient information for the fair value of the asset retirement obligation, in FIN 47 it is clearly stated that this can take place when it is either evident that the fair value of the obligation is incorporated into the acquisition price of the asset or when there is an actual market for obligations or when the information is sufficient enough to apply the present value technique where timing and method of settlement can be counted in for the fair value (Lee and Trabucchi, 2008).

The impacts of FIN 47 overall have been quite remarkable, since there have been quoted important differences in companies’ public

filings. Indicatively, when it was first applied, and the companies had to report any associated charges, by the end of the fiscal year 2005, a great number of manufacturers, mining companies, energy producers, financial institutions and other public companies reported significant charges to their earnings. According to a study carried by Controller's Leadership Roundtable (CLR) in 166 companies, the financial impact of FIN 47 among companies in the same industry and around the same size varied up to \$ 202 million (Lee and Trabucchi, 2008, Bibler and Brodeur, 2007, CLR, 2006).

4.2 Environmental Reporting in terms of IFRS, IAS and IFRIC.

The crucial matter that concerns both society and markets is how to reduce disclosure differences among companies through the use of well founded recognition, measurement and reporting system. The role of International Accounting Standards Board in terms of systems like the above is to manage to establish the statement of environmental assets and liabilities, as a part of companies' mandatory financial statements.

In terms of this section there is being made a short analysis on the way, the related to environmental reporting IFRS, IAS and IFRIC interpretations, define their requirements (ICAEW and Environment Agency, 2009, Barbu et al, 2012).

Intangible assets with exploration of mineral resources, which is a quite environmental-sensitive field, can be well defined through the use of both IFRS 6 and IAS 36. According to IFRS 6 "Exploration for and Evaluation of Mineral Resources", mineral resources should be recognized as assets and moreover any dismantling and relocation obligations have to be recognized as well, as a result of the exploration of mineral resources. IAS 36 "Impairment of Assets" is also supposed to be applied every time a company's environmental assets are suffering impairment either because of contamination, some physical accident, loss of contractual rights or even depletion of mineral resources.

As far as Emission rights assets are concerned, apart from what IAS 36 includes, also IAS 38 "Intangible Assets" describes partly the recognition and measurement of environmental assets (development expenses, emission rights etc, received or acquired as a subsidy from the market). Taking into account IFRIC 3 (issued in 2004), under discussion are also being put, the possible assets for allowance held, government grants for the value of allowances at the date of receipt and liabilities for the obligation to deliver allowances equal to emissions already made. In other words according to IFRIC 3, an entity has to account for emission allowances as intangible assets, recorded initially at fair value. However actual emissions usually give rise to liabilities for the obligation to deliver allowances and thus cover the emissions or pay for example a penalty. In 2005, IASB withdrew IFRIC 3 because of reactions from the European Commission. Since no interpretation was delivered after the withdrawal, there hasn't been a consensus yet on the recognition of emissions. However, according to IAS 8, entities can apply US GAAP methods to deal with this matter, since it is allowed to use other standards' policies if there is no international standard clarifying a particular subject.

Issues like concessions, licenses, trademarks as well as other intangible assets are well defined and described in terms of IAS 38 and IAS 36. For tangible assets, on the other hand, apart from IAS 36, there is also an important commentary on IAS 16 "Property, plant and equipment". More specifically, some fixed assets can have been acquired for either safety or environmental reasons and despite the fact that there might not be any future economic benefits, their acquisition can be considered necessary for the uncompromised use of other operating fixed assets. It is thus considered that when an entity lacks certain environmental assets future economic benefits might be at risk, even though currently they seem to be useless. A typical example, also used in terms of the Standard, is that one of a chemical plant that has to follow new substance manipulation processes so as to conform to the current legal obligations. In this case, those kinds of operation-

al improvements shall be capitalized as environmental assets, as the company wouldn't be able to trade its chemicals, not following these processes. In terms of IAS 16, it also clarified that it is necessary to incorporate future dismantling and decommissioning costs¹ into the value of a fixed asset.

As for the inventories (waste), taking into account IAS 2, it seems to be necessary to recognize waste as inventories only when it is planned to convert the waste products into marketable goods and thus there are going to be additional costs. This mostly applies in highly polluting industries (mining industries for example) that consider their waste assets with residual value.

Regulations for contingent liabilities and assets, as well as for fines and taxes for environmental purposes lie in IAS 37 (or FRS 12) "Provisions, Contingent Liabilities and Contingent Assets". It is very often in case of environmental liabilities that have to do with waste pollution etc, to be hard for the company to forecast contingent liabilities due to uncertainty over time or value. A typical example of this can be long-term and contingent waste such as radioactive waste, where in the far future there is going to take place some waste management process assets. In the far future there cannot be sufficient information on what the technology will be or the extent to which the land might be contaminated and thus what is the remediation cost. As a result, since it will not be easy to make reliable estimates, it is necessary to have narrative disclosure. This is the case as well with emissions, in the sense that a provision has to be made as pollution is emitted equal to the value of allowances required to cover the pollution or to the fines to be paid in case of insufficient allowances.

Environmental provisions such as provision for dismantling, removing assets, site restoration, CO2 emissions, insurance, environmen-

tal litigates and so on, are clarified in terms of IAS 37, IFRIC 1 and IFRIC 3 IFRIC 5 IFRIC 6. IFRIC 1, "Changes in Existing Decommissioning, Restoration and Similar Liabilities" includes information on the recognition and measurement of liabilities that are generated by decommissioning and dismantling activities (closure of a chemical plant, restoration of sites after extracting activities, removal of heavy equipment). IFRIC 5 "Rights to Interests Arising from Decommissioning, Restoration and Environmental Funds" has to do with integrating these rights into the accounting practice. Decommissioning, restoration and environmental rehabilitations funds aim at segregating assets so as to fund part or all of the costs of plant decommissioning (e.g a nuclear plant) or equipment (e.g cars) or even undertaking some environmental rehabilitation activity (e.g rectifying pollution of water, restoring mined land etc). In IFRIC 6 "Liabilities Arising from Participating in a Specific Market – Waste Electrical and Electronic Equipment", it is made clear that electrical goods' producers have to recognize liabilities regarding IAS 37, for the cost of waste management involving decommissioning of waste electrical and electronic equipment supplied to private households.

As far as emission rights governmental grants are concerned, IAS 20 "Accounting for Government Grants", in a way refers to the initial distribution of emission rights as well as to their recognition in the financial statements. When companies apply for government grants, as long as their projects meet the retrospective sustainability criteria and they finally succeed in getting one, then this grant has to be matched with the specified expenditure. Otherwise, the grant can also be contingent on achieving some goals like an emissions reduction or an increase in the offered jobs and thus the grant is being matched with the identifiable costs of achieving that objective. In this way, environmental costs, benefits and the grants are at least recognized at the same time period.

Lastly, as far as other environmental expenses are concerned, associated information can be found in IAS 8, IAS 38 and IFRS 6. In IAS 8 (FRS 18) "Accounting Policies" there

¹ Such costs are being estimated at the beginning of the asset's useful life (IAS 37). Costs occurring in future that have to do with dismantling and site restoration can also be considered to have resulted out of continuous use of an asset with important environmental impacts.

is a description of the way assets and liabilities should be handled on an accounting level. In fact it includes treatments of changing accounting policies, disclosure of changes in accounting estimates and errors' corrections. Although, it might not be directly mentioned in the Standard, it applies when there is a change in the company's estimates on environmental provisions or when there is a correction of material errors in accounting of environmental costs and liabilities. A typical example can be revaluation of the company's assets. If land is being revalued on a regular basis, then the carrying value on the balance sheet would eventually reflect its real (commercial) value, having taken into account environmental incidents, contamination as well as remediation. Thus, it is of great importance, from the environmental side of view, to disclose that kind of information so that all interested groups can also have comparable financial statements among companies of the same sector.

5. Conclusion

Having taken a closer look on reporting as far as environmental information is concerned, through both FASB and IFRS, IAS, it's obvious that it still takes a lot of effort to reach international accounting harmonization in environmental disclosure. Furthermore, one of the major problems, apart from the obvious differences in Accounting Standards is the discretion with which most companies are characterized when it comes to selecting the information intended for the business review section of annual reports. It cannot be doubted that the existing accounting framework for the disclosure of environmental information may often result in disparate and inconsistent accounting practices, which has been recorded especially on environmental liability accounting (e.g. under-reporting environmental liabilities). Phenomenon like misconduct in reporting and disclosure of environmental information should be definitely treated with responsibility towards stakeholders, investors, markets generally speaking and above all society, as it all ends up to be part of corporate responsibility issue.

There has to be put effort in designing a more environmentally sensitive reporting policy among companies both on international and on national level, which can be achieved through reconsidering or even enforcing measures such as mandatory disclosure as well as through introducing new measures, such as establishing an auditing system for environmental information. After all, publicity succeeds in providing strong incentives for business and government managers as well as in eliminating information asymmetries through disclosure. Despite possible entities' initial negative reaction to disclose properly environmental information, it definitely results in increasing market efficiency and stability, which is the ultimate goal in terms of a safe, reliable and secure reporting financial system.

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Abstract: The recent financial crisis highlighted the need for shifting focus from micro-prudential to macro-prudential regulation and supervision of the financial system. Macro-prudential policies aim to provide a cushion against the disastrous effects on the financial system and the economy at large of the occurrence of financial crises by using an intervention approach that fits with monetary policy for the economy and the traditional regulation/supervision of individual financial institutions. There are several definitions of macro-prudential policy and policy instruments but the core concept is about managing factors that could endanger the financial system as a whole, even if they would not constitute serious threats when viewed from an individual institution's point of view. Risks that are common to many individual financial institutions at the same time, such as explosive growth of housing credit, can combine with a high degree of interconnections within the networks of financial institutions to create systemic risks, even when institutions appear individually sound, thus creating the potential for financial contagion. Enforcing macro-prudential policy in an effective way is a serious challenge that remains to be dealt with. (J.E.L.: G21, G28)

Key words: Micro-prudential, macro-prudential, enforcement, regulation.

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1. Introduction

The recent international financial crisis presented new challenges for financial institutions and policy. The traditional approach to financial regulation was based on the assumption that it was possible to ensure the stability of the financial system as a whole by supervising the financial soundness and security of individual institutions and instruments. This traditional regulatory approach proved incapable of preventing the crisis because it was largely micro-prudential in nature (Crockett, 2000; Borio, 2003; Kashyap and Stein, 2004; Kashyap *et al.*, 2008; Brunnermeier *et al.*, 2009; Bank of England, 2009; French *et al.*, 2010). The micro-prudential approach to financial regulation aims at preventing the costly failure of individual financial institutions and largely focuses on consumer (investor and depositor) protection. Risk characteristics of institutions are assumed to be exogenous, the extent of correlation and mutual exposition across institutions is irrelevant for policy and the calibration of instruments is related to individual institutions following a bottom-up approach.

In light of these events, a rising consensus has emerged on the need to supplement and strengthen current micro-prudential regulation and supervision (focusing on individual institutions and instruments) with macro-prudential regulation and supervision, that takes into consideration risks for the financial system as a whole. These risks can, among other causes, be a result of the collective behavior of financial institutions during the credit cycle, of varying risk-absorbing capacity of institutions, as well as the type or scope of risk that individual institutions accept, or of the high degree of interconnectedness of certain companies.

The macro-prudential approach is based on a market-wide conception and seeks to safeguard the financial system as a whole. Financial regulation needs to move toward a macro-prudential direction. A system-wide or macro-prudential oversight would broaden the mandate of regulators and supervisors to encompass consideration of potential systemic risks and weaknesses. The primary task of

macro-prudential supervision and regulation is to prevent or reduce the probability of occurrence of financial system distress, which, if occurred, could have devastating effects for the real economy. Risk characteristics of institutions are assumed to be partly endogenous, the extent of correlation and mutual exposition across institutions is important for policy and the calibration of instruments is related to the system's risk as a whole following a top-down approach.

This paper provides an analysis of the fundamental elements of a macro-prudential financial regime. The analysis follows a specific theory of financial crises and argues that both an unregulated financial system and one based on capital rules that only apply to traditional financial institutions, is likely to be fragile. Key market failures are identified, and some concrete steps to remedy these market failures are described. The paper concludes by assessing the likely effectiveness of recent global regulatory reforms.

2. Approaches to financial stability regulation

2.1 Micro-prudential regulation

Micro-prudential regulation of financial institutions rests on the principle that the purpose of regulation is to ensure the soundness of individual financial institutions, financed with government-insured deposits against the risk of loss on their assets. While deposit insurance contributes to preventing financial institution runs, it creates an incentive for financial institutions to take excessive risks, knowing that losses will be socialized (Diamond and Dybvig, 1983; Bryant, 1980).

Capital regulation policy (based on Basel II) therefore aims at forcing financial institutions to internalize losses, thereby protecting the deposit insurance fund and mitigating moral hazard of excessive risk-taking. Thus, if the probability of the deposit insurance fund bearing losses is reduced to a low enough level, micro-prudential regulation is perceived to achieve its goal.

Micro-prudential regulation implies that ensuring the soundness of each individual institution ensures the soundness of the financial system as a whole. Consequently, policy actions that enhance the soundness of a particular institution are expected to promote overall financial stability.

Micro-prudential regulation examines the responses of an individual financial institution to exogenous risks. It does not incorporate endogenous risk and it neglects the systemic implications of common behavior in the market (Persaud, 2000). The proposition that policy actions enhancing the soundness of a particular institution are also promoting overall financial stability is vulnerable to the fallacy of composition. It is possible, indeed often likely, that attempts by individual institutions to remain solvent could instead push the system to collapse. A recurring withdrawal of financial institution engaged in lending from risk when faced with external shocks can cause a cumulative collapse of the system (Northern Rock bank in 2007, securities houses Bear Stearns and Lehman Brothers in 2008).

Prevalent capital adequacy rules have managed to dis-incentivize a greater reduction of risk into the financial system. In the name of modernity and price-sensitive risk management, a lending institution is encouraged to incur higher exposures when measured risks are low, only to reduce them as fast as it can when risks do materialize, irrespective of the consequences for the rest of the system. Unfortunately, the withdrawal from risk by one lending institution generates greater materialized risk for others, highlighting the existence of pervasive externalities in the financial system, which eventually extend to the real economy. The loading up and subsequent shedding of risks show up in the leverage cycle of financial institutions that characterizes all major financial crises (Adrian and Shin, 2009).

The real problem is not that financial institutions willingly hold assets that they know will deliver a large loss with a high probability until regulators require institutions to dispose risky assets off, but that assets become 'toxic'. When this occurs regulatory instruments do not help

regulatory goals. The individual financial institution is required now to sell the risky asset so as to restore minimum capital ratios and indeed, where these requirements become generalized standards, every regulated institution is forced to sell the same asset at the same time, causing the asset's price to collapse towards zero and making financial institutions short of capital (when compared with the higher risks and lower value of their assets). This in turn forces financial institutions to sell other assets previously held for their low correlation with the original problem asset, causing asset correlations to rise, giving the impression that risk has risen further, and causing financial institutions to sell more assets. This loss spiral was a feature of credit markets in 2007-08, of the dotcom debacle of 2000-01, of the Long Term Capital Management crisis of 1998, of the East Asian crisis of 1997-98, of the stock market crash of 1987 and of other modern financial crises.

Micro-prudential capital rules paradoxically can turn a bad situation into a worse one. Arguments that in response to the crisis financial institutions should follow micro-prudential rules strongly enough and that these rules must be deepened and made more comprehensive, have proved wrong. The expanded and simultaneous implementation of micro-prudential rules can undermine systemic resilience. The best solution from a systemic perspective to the problem causing assets to turn 'toxic' is that the institutions that have funded these assets with short-term liabilities should indeed mark them down, while other institutions who have access to long-term liabilities should be able to consider whether the assets are now fair valued at the marked-down price and whether they should therefore purchase them. Instead, the spread of micro-prudential rules to non-financial institution financial institutions like insurance institutions (Solvency II) and funds (sometimes via brokerage arrangements with regulated financial institutions) tend to lead to everyone being a seller at the same time, thus causing the system to collapse.

Micro-prudential regulation has largely emphasized institutional transparency, risk-sen-

sitivity and prudence relying on the use of market prices in valuation and risk assessment. Market prices shape behavior through several channels: mark-to-market valuation of tradable financial assets; regulator-approved market-based measures of risk (i.e. credit spreads in internal credit models, or price volatility in market risk models); and the use of credit ratings, where the signals are more slowly but positively correlated with financial markets. These channels produce homogeneity of market behavior which amplifies systemic fragility in three main ways.

First, following rising asset valuations, market participants herded into assets that were safe in the past but now have become overvalued and therefore risky, and increasingly correlated with other assets owned by investor herds. This causes market price-based measures of risk to exhibit highly pro-cyclical behavior, falling in the build-up to boom phases and rising in the subsequent downturns leading to crashes. Micro-prudential behavior can endogenously create macro-prudential risks.

Second, insufficient regulatory attention to the different sources and time-dimension of asset funding as well as the structure of leverage lead financial institutions to rely on cheaper, short-term funding, which increases interconnectedness and systemic fragility. In a crisis where there is a rush for cash and funding dries up, all market participants who had purchased long-term assets using short-term funding are forced to sell assets simultaneously. The sell-off is more pronounced if prior asset purchases were highly leveraged and the drying up of funding forces highly leveraged holders to try and sell before others do, so as to save what little capital is left to them.

Third, the regulatory treatment of risk as a single homogenous magnitude, measured by the volatility of short-term market prices, fails to understand that risk is not one thing alone, but there are different types of risk (credit, liquidity, market risk) requiring different, but also interacting hedging measures. Credit risks are best hedged by finding uncorrelated or negatively correlated credits: the credit of oil companies with inventories of oil may be in-

versely related to the credit of airlines, as they are generally 'short' of oil. Liquidity risks are best hedged across time: the more time you have before you have to sell an asset, the more you can hold assets that are hard to sell quickly. Market risks, like the value of equity markets, are best hedged using a combination of time and diversification. A financial system will be safe if each of these risks is held by market participants with a capacity to deal with the specific type of risk. A financial system is unsafe, even if each institution holds more capital, if risks are not held where there is appropriate capacity. Arguably the neglect of issues of funding and the overemphasis on market prices did just that.

A troubled financial institution can restore its capital ratio either via the numerator (raising new capital) or via the denominator (shrinking assets), as long as either adjustment brings the financial institution's probability of failure back to a low-risk level. Such indifference to the method of adjustment is justified by competition whereby the cutting back on lending by a troubled individual financial institution can be made up by other untroubled institutions. Asset shrinkage is like a Darwinian process, whereby market share is transferred from weaker troubled institutions to their stronger peers. However, if several financial institutions are in trouble, a simultaneous attempt by many institutions to shrink their assets is likely to be more damaging to the financial system and the economy.

Applied micro-prudential rules, especially those referring to market measures of value and risk, must be proper and ensure that they do not artificially create homogenous behavior. Often, the problem is that in booms financial institutions and borrowers underestimate risks and, when the crash comes, they overestimate risks. An essential problem is the big shift in risk perceptions, from 'too low' initially to 'too high' eventually.

While micro-prudential supervisors have an important role to play in addressing consumer protection issues and abuses of market insurance guarantees, the quality of micro-prudential regulation requires that supervisors under-

stand exactly how a financial institution earns its profits as well as the amount and type of risk they are taking to earn those profits. Endogenous risks that undermine the financial system often relate to an ill-considered application of micro-prudential regulation.

2.2 Macro-prudential regulation

From the macro-prudential point of view, financial risks stem from the collective behavior of individual institutions and their mutual interconnectedness, so risks are perceived as endogenous. Institutions can collectively influence the price of financial assets, executed volumes, and thus the strength of the economy as such, which leads to strong feedbacks.

Macro-prudential regulation forces financial institutions to assume they have undertaken more risks than they perceive they do during the market boom, by putting aside more capital than they think they need, and to try and support lending in the crash by releasing this capital. The crisis has shown that financial institutions devised complex special purpose vehicles in order to get more exposure to toxic products, which they did not perceive as such, than their capital adequacy requirements would allow.

The macro-prudential approach to regulation considers the systemic implications of the collective behavior of financial firms (Galati and Moessner, 2011). A critical feature of macro-prudence and systemic stability is the heterogeneity of the financial system. Homogenous behavior – everyone selling at the same time or buying at the same time – undermines the system. Market participants start off being heterogeneous but several regulatory and other factors drive them to homogeneity. Thus, systemic risk is endogenous and macro-prudential regulation is about identifying endogenous processes that turn heterogeneity into homogeneity and make the financial system fragile.

The macro-prudential approach to financial regulation is an effort to control the social costs associated with excessive balance-sheet shrinkage of financial institutions hit with a common shock. Two questions must be answered (Hanson *et al.*, 2011). First, what are

the costs imposed on society when many financial institutions shrink their assets at the same time? Second, why do individual institutions not properly internalize these costs? That is, following an adverse shock, why do they shrink assets (denominator channel) rather than raise fresh capital (numerator channel)? Or alternatively, why do they not build sufficiently large capital buffers ahead of time, so that they can withstand a shock without needing either to raise capital or to reduce assets?

Generalized asset shrinkage has two primary costs: credit-crunch and fire-sale effects (Hanson *et al.*, 2010). If financial institutions shrink their assets by cutting new lending, institutions find credit more expensive and reduce investment and employment with contractionary effects for the economy. If a large number of financial institutions shrink their assets by all dumping the same illiquid securities the prices of these securities can drop sharply (Shleifer and Vishny, 2010).

Moreover, fire-sale and credit-crunch effects are intimately connected (Diamond and Rajan, 2009; Shleifer and Vishny, 2010; Stein, 2010). If the price of an illiquid security falls to the point where it offers a (risk-adjusted) certain percent rate of return to a prospective buyer, this will tend to drive the rate on new loans up towards that percent as well, since from the perspective of a financial intermediary that can choose to either make new loans or buy distressed securities, the expected rate of return on the two must be equalized. In market equilibrium, the real costs of fire sales manifest themselves in the further deepening of credit crunches (Ivashina and Scharfstein, 2010)

Of course, to make a case for regulatory intervention, one has to explain why the percent rates of return inside the financial sector, which are much higher than the outside rates on Treasury securities, don't naturally draw in enough private capital to eliminate the return differentials.

One reason why capital is immobile once a crisis is due to the debt overhang problem (Myers, 1977). Once a financial institution is in trouble and its debt is impaired in value, this institution is reluctant to raise new equity even

to fund profitable investments. This is because much of the value that is created is drained off by the more senior creditors. Given the debt overhang problem, financial institutions that act in the interests of their shareholders will tend to fix their damaged capital ratios by shrinking assets rather than by raising new capital, even when the latter is more desirable from a social perspective.

If so, why don't financial institutions voluntarily build up adequate buffer stocks of excess capital in good times, when debt overhang is not yet a concern, so they can absorb losses in bad times without having to either shrink assets or raise new capital under distress? After all, such a strategy would allow them to exploit profitable opportunities should a crisis arise. If short-term debt is a cheaper form of finance than equity, financial institutions will tend to take on socially excessive levels of debt: while the financial institutions capture the benefits of cheap debt finance, they do not internalize all of its costs (Stein, 2010).

The assumption that short-term debt is a cheap form of finance represents a particular deviation from the Modigliani-Miller (1958) capital-structure irrelevance framework. In the context of financial firms, this deviation can arise to the extent that their short-term claims are money-like and carry a premium that reflects their usefulness as a transactions medium. In particular, when a financial institution takes on more debt, it does not account for the fact that by doing so, it degrades the collateral value of any assets it holds in common with another financial institutions, since in a crisis state of the world, the former institution's fire-selling of its assets lowers the liquidation value that the other institutions can realize for these same assets. A subtlety is that this is a pecuniary externality—i.e., it works through prices. For a pecuniary externality to cause a misallocation of resources, one requires a departure from the standard assumptions that deliver the fundamental welfare theorems (Geanakoplos and Polemarchakis 1986). This departure is in the form of a collateral requirement: financial institutions' ability to raise short-term debt is constrained by the collateral value of their assets.

In sum, a model based on fire sales and credit crunches suggests that financial institutions have strong incentives: first, to shrink assets rather than recapitalize once a crisis is underway; and, second, to operate with too low capital buffers before a crisis occurs, thereby raising the probability of an eventual crisis and system-wide balance-sheet contraction. The macro-prudential approach to capital regulation aims to counterbalance these two tendencies.

With this in mind, we turn next to some of the individual items in the macro-prudential instrument kit. Before doing so however, we should emphasize that, in contrast to the micro-prudential view, nothing in this alternative theory relies on the existence of deposit insurance. In other words, in a model of crises based on fire sales, there is socially excessive balance-sheet shrinkage, and a rationale for regulation, even absent government deposit insurance. Thus, there is a strong presumption that macro-prudential regulation should apply to more than just insured deposit-takers. The broader point is that regulators need to pay attention to all the channels through which the actions of financial institutions, insured and not insured, can cause damage (Tucker, 2010; Kashyap, Berner and Goodhart, 2010).

3. Instruments of micro-prudential regulation

A micro-prudential regime includes the following intervention instruments: rules and regulations, authorization of institutions and their owners/managers, mandatory disclosure requirements, rules on what assets can be held by whom; how instruments are listed, traded, sold and reported; and measures of the value and riskiness of assets creating appropriate incentives, establishing principles and guidance, monitoring, intervention, sanctions and compensation. A key choice for any policy maker facing multiple objectives, is the selection from the various instruments available in the regulatory regime, and the way they are combined to achieve the broad set of objectives. The various instruments can be used in a variety of combinations, and with various degrees

of intensity. The micro-prudential approach focuses on the stability of individual institutions and the protection of their clients; it has therefore a partial equilibrium basis.

There are two particular dimensions of systemic risk which micro-prudential regulations may not handle. One is the time dimension: with micro-prudential regulations, the evolution of risk-taking behavior over time may result in a procyclicality problem. The other dimension of systemic risk is the cross-sectional dimension, which implies that since financial institutions are interconnected, financial crises may occur simultaneously. The interconnectedness within the financial system is established from either a direct channel such as interfinancial institution lending or an indirect channel that institutions share common exposures due to diversification at individual level (Laguno and Schreft, 2001; Wagner, 2010). Since micro-prudential regulations are designed for regulating individual financial institutions, they may not prevent the systemic risk on the cross-sectional dimension.

A micro-prudential regime includes the following intervention instruments: rules and regulations, authorization, mandatory disclosure requirements, creating appropriate incentives, establishing principles and guidance, monitoring, intervention, sanctions and compensation (Goodhart *et al.*, 1998; Dewatripont and Tirole, 1994). A key choice for any financial regulator, as with any policy maker with multiple objectives, is the selection from the various instruments available in the regulatory regime, and the way they are combined to achieve the broad set of objectives. The various instruments can be used in a variety of combinations, and with various degrees of intensity.

3.1 Rules and regulations

Rules and regulations include the following instruments: entry and standards requirements; ownership requirements; functional activity requirements; jurisdictional requirements; pricing requirements; and operational requirements.

Entry and standardization requirements. Entry and standards requirements vary and often

depend on a specific sector in the financial industry. By contrast, standards of probity, such as having a clean criminal record, are applicable generally. Entry and standards requirements involve: stipulating “fit and proper” standards for individuals and for firms; the setting of disclosure and advice standards; and the setting of minimum issuance requirements for financial instruments.

Functional activity requirements. The restriction of functional activity of every financial institution to the four main activities of a financial system (banking, securities listing/trading, fund management, and insurance) aims to ensure that there is a clearly defined relationship between institutions and functions. The restriction has major implications for the structure of the financial industry. The issue arises as to whether banking, insurance underwriting, securities trading and fund management may be conducted within the same firm and, if so, to what extent Chinese walls, fire walls and dedicated capital allocated to each activity are to be imposed.

Jurisdictional requirements. Most restrictions on domestic jurisdiction have been eliminated over time and replaced with appropriate capital requirements. However, in large countries (i.e. the US and the EU) unavoidably restrictions remain (provision of credit). Restrictions on inter-state/inter-nation provision of financial services are no longer as vigorously enforced as in the past. However, in many developing countries, exchange control regulation remains a serious barrier for firms wanting to expand globally.

Pricing requirements. Although free competition primarily implies pricing freedom, restrictions on pricing private pricing cartel agreements (e.g. on setting interest rate ceilings by financial institutions or fixed-brokerage charges) may be imposed. In these cases, authorities balance reduced price competition against reduced systemic risk, particularly in an economic environment where price competition can become “cut-throat” or “excessive”. Restricting price competition creates economic rents, which go against consumers’ interests. However, in this way business risk may be re-

duced to the extent that profits can be earned without moving into high-risk areas.

Operational-prudential requirements. Operational requirements embrace a wide field of regulatory restrictions in the form of prudential requirements; business conduct requirements; trading requirements; and compensation scheme requirements. Prudential requirements are imposed on capital, organization/management, risk analysis, and control systems. Prudential requirements for capital and liquidity for individual institutions are considered to be the backbone of the micro-prudential regime. Capital requirements are balance-sheet requirements – which are imposed on a consolidated basis for a financial conglomerate – aim at addressing the problems emanating from increased domestic competition (financial institutions versus non-financial institutions, and financial versus non-financial institutions), globalization, financial innovation and deregulation. In general, equity capital is needed for the following reasons: to absorb operating losses while enabling the firm to stay in business; to support the basic infrastructure of the business on the grounds that it would be inappropriate for this to be financed by borrowed funds (e.g. deposits or term loans); to maintain public confidence through an indication that shareholders are prepared to make funds permanently available to support the business; to enable a firm to absorb risks and sustain shocks while continuing to operate; to enable assets to be written off while still maintaining solvency; to provide long-term funds to mitigate the hazards of maturity transformation; and to buy time to enable an institution to adjust to changing market conditions and patterns of business.

Market conduct of business requirements. The imposition of principles and core rules for the conduct of financial services business aims at providing an adequate level of investor protection and reducing regulatory costs. The underlying philosophy of this requirement is that the various codes of business conduct, as developed for each industry/institution, should provide adequate consumer protection without being excessively cumbersome. Conduct of business regulation follows a three-tier system

as follows: The first tier consists of broad principles which all financial institutions have to abide by. The chief executive of a firm is directly responsible for ensuring that the principles of investment business are complied with. The authorities can discipline a firm if it does not apply the principles, but no prejudiced investor can sue a firm for not complying with a principle. The second tier consists of designated rules, which are derived from principles. The designated rules have more substance than the principles, but are still more simplified than the detailed rules contained in the rulebooks. A private investor could sue his adviser if the latter breaks a designated rule. The third tier consists of the rulebooks of the self-regulatory organizations, which have to incorporate all the designated rules (though the authorities are prepared to make exceptions).

Compensation scheme requirements. Compensation schemes are a useful instrument for protecting the small consumer. Government can be involved in a compensation scheme either by being party to the scheme or by regulating the scheme (i.e. laying down the regulations and supervising the scheme). Compensation schemes of sufficient size are usually required for regulated exchanges to protect the interests of the small investor. Moreover, in situations where netting arrangements are not legally enforceable, the authorities can still allow offset on a regulated exchange if the overall exposure risk is covered by an approved compensation scheme. Here compensation schemes significantly contribute to market liquidity, as without them financial gearing would be significantly lowered.

3.2 Incentive contracts and structures

Incentive structures and moral hazards faced by decision makers (financial institution owners and managers, lenders to financial institutions, borrowers and central banks) are major issues to consider in the regulatory regime. Various moral hazards and perverse incentive structures, such as fixed exchange-rate regimes, anticipated lender-of-last-resort actions, IMF bailouts, ownership structure of financial in-

stitutions and their corporate customers, and safety net arrangements, as factors contributing to excessive risk-taking. Incentive contracts can cover a whole range of financial activities. At the top of this list are the incentives to ensure proper corporate governance. If a firm has a good corporate governance culture, a host of other regulatory requirements will automatically fall into place, such as a proper compliance culture and adequate risk-management systems. The ultimate aim of incentive contracts is to replace or supplement a one-size-fits-all official dictate with a specific, tailor-made corporate contract that acknowledges the firm's own responsibility for sound business practices. For example, the compliance manual of each individual firm can be seen as an incentive contract. Similarly, financial institutions may be offered a choice by the authorities either to fulfill a fixed-ratio prudential requirement, or to replace this inflexible standard with its in-house value-at-risk model to calculate its statutory capital requirement. In particular, capital regulation should create incentives for the correct pricing of absolute and relative risk. If differential capital requirements are set against different types of assets (e.g. through applying differential risk weights), the rules should be based on actuarial calculations of relative risk. If risk weights are incorrectly specified, perverse incentives can be created for firms because the implied capital requirements are more or less than those justified by true relative risk calculations. A major critique of the current Basel capital requirements for financial institutions is that the risk weights bear little relation to the relative risk characteristics of different assets, and the loan book carries a uniform risk weight even though the risk characteristics of different loans in a financial institution's portfolio vary considerably.

3.3 Market monitoring and discipline

Besides official monitoring and supervision, the financial markets also monitor the performance of financial institutions. If markets are dissatisfied with the performance of certain financial institutions, their discipline can be

harsh and sudden. Usually, market discipline works through the share price, the price of subordinated debt, and willingness to trade with a firm. Particularly for financial institutions, where trust is the basis of all business, a major fall in a financial institution's reputation can be extremely painful. On balance, the markets are far more successful in enforcing a change in incompetent directors and management than are the authorities. As virtually every financial institution failure has had poor management as one of the underlying reasons, it is in the interest of the authorities to promote market monitoring and discipline to the maximum.

Market monitoring is only possible if there are proper disclosure and transparency arrangements. Transparency is supported if financial institutions report in terms of generally accepted accounting standards and external auditors report any misgivings they may have. The rating agencies, the unsecured creditors in the capital market and the financial press are also important role players in ensuring market discipline.

3.4 Corporate governance

If a proper corporate governance regime is put in place, the regulatory authorities need not be too prescriptive in their codes of business conduct, as these requirements are already "privatized" in the sense that they have become supervisory tasks of the private rather than a public sector. Corporate governance rules can be seen as a form of market discipline: i.e. their standards are set by international competitive forces. Corporate governance is essentially about proper direction and control of public companies. More particularly, it is about effective leadership for efficiency, probity, responsibility, transparency and accountability. Business efficiency is necessary to compete in the global economy. Business probity is required to obtain the trust of investors. Business responsibility is increasingly considered as including not only profitability but also legitimate social concerns. Business transparency and accountability are the essential characteristics of good leadership without which there can be no trust

in the leaders. It is mainly the responsibility of the board of directors to ensure good corporate governance. This involves a set of relationships between the management of a corporation, its board, its shareholders and other relevant stakeholders. Accordingly, the board must agree on the corporation's purpose, its values and the strategy to achieve its purpose. It must be accountable to shareholders and be responsible to its stakeholders. Good corporate governance requires that the board must govern the corporation with integrity and enterprise in a manner that entrenches and enhances the license it has to operate. This license is not only regulatory but also embraces the corporation's interaction with its shareholders and other stakeholders. The board is accountable to the owners of the types of competition from a wider range of competitors.

4. Instruments of macro-prudential regulation

Several instruments can be helpful in implementing a macro-prudential approach to financial regulation (ECB, 2010; Elliott, 2011; Hanson *et al.*, 2011; FSB, 2011, among others). The aim is not to provide a comprehensive list of reform proposals, but rather to show how a particular conceptual framework provides a unified way of thinking about what otherwise might seem like a mixture of different fixes. If the goal of regulation is to prevent financial institutions from shrinking their balance sheets excessively in an adverse state of the world, a simple accounting identity imposes a lot of discipline. In particular, when a financial institution is hit with a shock that depletes its capital, there are only two ways to prevent it from shrinking its assets: it can either raise new capital to replace that which was lost, or it can let its ratio of capital-to-assets to decline. Many of the instruments discussed below are just different mechanisms for facilitating adjustment on one of these two margins.

4.1 Counter-cyclical capital requirements

One response to the problem of balance-sheet

shrinkage is to apply a regime of time-varying capital requirements, with financial institutions being asked to maintain higher ratios of capital to assets in good times than in bad times. Under such a rule, financial institutions can draw down their buffers when an adverse shock hits, and continue operating with less pressure to shrink assets. Time-varying capital requirements can emerge as an optimal solution to maximizing a welfare function that weights both the micro-prudential objective of protecting the deposit insurance fund and the macro-prudential objective of maintaining credit creation during recessions (Kashyap and Stein, 2004). In bad times, when financial institutions' capital is scarce and credit supply is tight, a policy maker concerned with both objectives should tolerate a higher probability of financial institution failure than in good times.

One challenge in designing such a regime is that, in bad times, the regulatory capital requirement is often not the binding requirement on financial institutions. Instead, as the risk of their assets rises, a tougher test on financial institutions maybe imposed by the market than the regulator, refusing to fund institutions that are not strongly capitalized. This tendency may be amplified by the widespread use of Value at Risk (VaR) models. As measured volatility and hence VaR go up in bad times, such models mechanically call for financial institutions to hold higher ratios of capital. Thus, financial institutions' own internal risk management practices might compel shrinkage even if market funding remains available.

In light of the observations above, capital requirements need to have a counter-market-price (counter-cyclical) element to them in order to dampen rather than amplify the financial and economic cycle by requiring buffers of resources to be built up in good times. In the next Chapter we look at credit cycles in greater depth, especially their international component, and we consider the appropriate regulatory and institutional responses.

Counter-cyclical requirement is the instrument which has received the most attention and the widest acceptance by policy-makers. It has been endorsed by both the Basel Committee on

Banking Supervision (Basel Committee), the committee of regulators that coordinates global banking rules, and the Financial Stability Board (FSB), a multi-lateral body empowered by the Group of Twenty (G-20) world leaders to advise on financial stability issues. The G-20 itself has endorsed countercyclical capital as part of its approval of the Basel Committee and FSB recommendations.

As described earlier, the idea is to force financial institutions (and sometimes other regulated credit providers) to hold more capital during worrisome booms. The primary purpose is to build up protection against the hidden risks that lie below the surface of over-exuberant booms, so that financial institutions will be in a better position to continue providing credit if the boom turns into a bust. A secondary purpose is to discourage excessive lending by making it more expensive, since capital is more expensive for financial institutions than other funding sources⁶. This is particularly important because capital tends to be too cheap during booms, due to realized and unrealized gains feeding through balance sheets and the excessive eagerness of markets to supply new capital as a result of “bubble thinking.” Countercyclical capital surcharges can either be set across-the-board for each financial institution or type of institution or can be specific to a given credit product or sector of lending. There are pros and cons to each approach, which are laid out in detail in Appendix B.

4.2 Dynamic loan-loss provisioning

In a similar rationale to countercyclical capital requirements, financial institutions can be forced to reserve a higher level of loan-losses during a boom than they would otherwise. Provisioning for loan losses refers to the accounting mechanism used in the recognition of credit losses and is a critical issue to effective financial reporting and to prudential supervision. Provisions for loan losses reduce an institution’s reported net income in the period in which the provision is recognized and decrease the carrying value of the loans held by the institution (Wall and Koch, 2000). Higher loan-losses can be implemented in one of two

ways. First, rules can offset the procyclical conventional loan-loss reserving; during periods of over-optimism reserves fall and loans expand raising potential risk. Traditional loan-loss provisioning methodologies generally require or encourage financial institutions to estimate losses based on relatively recent experience. During a boom, that recent experience will show unusually low loss levels, leading to diminished provisions. Dynamic loan-loss provisioning applied in this manner essentially tries to keep loan-loss provisions at a level sufficient for an average downturn. Second, rules could incentivize the building up of quasi-capital reserves above the true best estimate of future loan-losses during booms, either by accounting for losses under stress or by adding some margin of error.

4.3 Countercyclical liquidity requirements

Financial institutions are increasingly being required to hold minimum levels of safe, shorter-term or highly liquid assets to meet urgent short-term liquidity withdrawals caused by a bank run or credit market freeze. Rules can impose some form of liquidity requirements over time, in a mandatory or discretionary form (Perotti and Suarez, 2009). The impact of higher liquidity requirements in a boom would be similar to that of higher capital requirements, by raising credit costs to individual institutions and therefore discouraging them from funding themselves excessively with cheaper short-term debt. Capital requirements are a more effective way to handle cyclical pressures, but they could be complemented by dynamic liquidity requirements. Both countercyclical capital requirements and liquidity requirements raise the important decision-making issue in the form of a trade-off between systemic resiliency and cost burden on both the individual institutions and the whole economy. The trade-off largely depends on public perceptions about the relevant liquidity vs. solvency considerations of individual institutions.

4.4 Higher quality capital

Capital measurement focuses mainly on the

ratio of total Tier 1 capital to risk-weighted assets. Tier 1 capital includes both common and preferred stock, being counted in the same way towards meeting capital requirements. From a micro-prudential perspective, in the event of financial institution failure if the only concern is avoiding losses to the deposit insurance fund, so long as both common and preferred stock holders are strictly junior in priority to the deposit insurance fund, they will provide the desired loss-absorption cushion. From a macro-prudential perspective, common stock is a higher-quality form of capital than preferred stock, since it is considered friendlier to the post-crisis recapitalization process of troubled financial institutions, because it is more junior and hence less problematic in terms of the debt overhang problem. It is therefore reasonable to require that most, if not all Tier 1, of the capital requirement be satisfied with common stock, or equity-linked instruments that are contractually guaranteed to convert into common stock in adverse conditions.

4.5 Focus on nominal issues of capital and not on capital ratios

Financial institutions that fall below a designated capital ratio threshold may be subject to a variety of sanctions (for example, restrictions on dividends) until they repair that capital ratio. The problem is that a financial institution may choose to fix the ratio not by raising the numerator (capital) but by reducing the denominator (assets). Therefore, it is important to create incentives for raising new capital rather than shrinking assets. This could be incentivized if capital requirements take account of maximum current and lagged assets (Kashyap *et al.*, 2010). Following the results of frequent stress-tests of major financial institutions and their associated capital needs, regulatory sanctions should be designed to require financial institutions failing to raise the needed capital from the private markets to accept an equity injection from the Treasury, which would have involved, among other things, strict limits on executive compensation, Hirtle, Schuermann and Stiroh, 2009). In this case, the adverse-se-

lection problem normally associated with common stock issues disappears. At the presence of choice, a financial institution that decides to issue equity may signal in the market that its management believes it to be overvalued, and hence may knock down the stock price (Myers and Majluf 1984). At the absence of choice, the financial institution faces no information content and hence no negative price impact.

4.6 Contingent capital

An idea closely related to immediate recapitalization when a financial institution gets into trouble is to pre-wire the recapitalization with a contingent instrument that automatically increases the institution's equity position when some pre-specified contractual threshold is triggered. Contingent capital can include two types of instruments. First, sometimes called reverse convertibles or contingent convertibles, involves the issuance of a debt security that automatically converts into common stock when some measure of either the regulatory accounting capital or stock-market value falls below a given threshold (Flannery, 2005; French *et al.*, 2010; McDonald, 2010). The second is capital insurance, which involves the purchasing of properly collateralized insurance policy that pays off in adverse conditions (Kashyap, Rajan and Stein, 2008). The motivating basis is that financial institutions view equity capital as an expensive form of finance, thus violating the Modigliani-Miller (1958) conditions. Thus, financial institutions could be required to maintain very large precautionary buffers of equity only in those bad states where it is most valuable. Contingent capital should be allowed to count towards regulatory capital requirements. Further, the use of contingent capital should be linked with executive compensation by imposing bonus holdbacks on key executives, such as, for example, withholding a significant share of each senior manager's total compensation for several years (French *et al.*, 2010). The withheld compensation would not take the form of stock or options, but would instead be a fixed nominal amount. However, managers would forfeit their holdbacks if the

institution were to fail or to receive extraordinary government assistance. This holdback proposal may alternatively require institution managers—rather than, say, a pension fund—to be the insurance provider (Kashyap, Rajan, and Stein, 2008). The merit of this approach is that not only does the held-back compensation create an extra contingent capital buffer, but it also helps to improve fair incentives within the firm. In particular, by making insiders bear downside risk, without any additional upside potential, it aligns their fortunes with those of taxpayers and other creditors.

4.7 Regulation of debt maturity

Most of the financial institutions' debt is short-term, in the form of deposits or wholesale funding, inclusive of commercial paper and repurchase agreements. Deposits are generally insured and hence not likely to suffer a run at the first sign of trouble, but wholesale funding is not. Wholesale funding runs, in the form of refusal of repo and commercial paper creditors to roll over their loans, was an important factor of the recent crisis (Shin, 2009; Gorton and Metrick, 2010; Duffie, 2010). Rules should regulate the use of short-term debt above and beyond setting maximum total leverage for the following reasons. First, the run of short-term lenders leads to higher system fragility than the run of equivalent value long-term lenders (Diamond and Dybvig, 1983). Second, in the presence of market-wide fire sales, the choice of debt maturity creates an externality. When an individual financial institution opts to finance itself largely with short-term debt, it fails to internalize that in a crisis, an inability to roll over short-term debt will force it to liquidate assets, thereby imposing a fire-sale cost on others who hold the same assets and who see the value of their own collateral diminished (Stein, 2010).

4.8 Administrative caps on aggregate lending

Rules can put a limit on total lending by financial institutions as a class and/or on an individual basis. This approach is generally more effective where there is deeper state intervention

and lending institutions dominate the financial sector. The extent of credit volume is controlled, at the expense of substituting government decisions for market signals. In contrast, this approach is generally less effective where the financial sector and its issued credit instruments is more sophisticated and complex. Whether the financial system is bank-based or market-based, matters for the efficiency of this instrument. In market-based systems, the impact of aggregate lending caps on financial institutions may be offset by an increased issuance of bonds. Trying to enforce caps in a more sophisticated financial system may end up causing excessive state intervention resulting in overregulation. On the other hand, in bank-based systems the impact of aggregate lending caps on financial institutions may be more effective in controlling credit volumes.

4.9 Reserve requirements

Financial institutions in many countries are required to hold a certain minimum percentage of their deposits as reserves with the central bank. These reserve requirements are allowed to vary in order to influence the propensity of financial institutions to lend. This has ceased to be effective in the more advanced economies for reasons similar to those that limit the effectiveness of administrative caps on lending volumes. However, reserve requirements are still an important instrument in less financially developed economies.

4.10 Limitations on leverage in asset purchases

Rules can limit the amount of leverage allowed on various types of transactions as opposed to controlling the total leverage at different types of institutions. This instrument could work well if substantial amounts of borrowing are tied to market transactions, such as asset purchases, rather than to general borrowing by households or businesses. Transactions tied to real estate and securities comprise a large portion of the credit market in most countries. The imposition of caps on leverage for different types of market transactions could vary over time to re-

duce the riskiness of loans being made during a boom period or to relax limitations during a bust period.

4.11 Loan-to-value ratios for mortgages

Setting maximum loan-to-value ratios for mortgages is suitable to real estate investment since it is difficult to evade the restriction by carrying out further lending without tying real estate collateral protection that comes with the mortgage form of the transaction. In particular, households and small businesses generally cannot obtain very much credit without using their homes or business premises as collateral. In the US case, the common maximum loan to value ratio was once 80% for most private loans (equivalent to a 20% down payment). In recent decades, the maximum ratio offered by private financial institutions occasionally exceeded 95%, although many borrowers put more down payment in order to obtain a better rate. When mortgages are securitized with the backing of a lending institution, the latter can impose its own LTV requirements, charging arbitrarily a higher borrowing rate in the market if the loan could not have the benefit of their backing. But the degree of effectiveness of LTV ratios has limits. Not all mortgages are securitized, some that are securitized are done outside official channels, and there the large financial sector can provide second mortgages and home equity finance lines that effectively allow homeowners to increase their leverage after taking the original mortgage.

4.12 Loan to income ratios

Setting maximum loan-to-income ratios is another way to limiting mortgage risk. Rules can require borrowers to have an undoubted ability to service the loan from their earnings, so that lenders do not rely excessively on the value of the collateral. Such restrictions can help prevent the exuberant real-estate bubble. However, the ability to protect financial institutions from loss is lessened, although not eliminated, by several factors. First, jurisdictional differences in legal structures may not allow the mortgage lender residing in one jurisdiction any effective

recourse to the income or other assets of the borrower residing in another jurisdiction if s/he defaults on their mortgage. If a borrower in one of those states chooses to default when the value of their home declines below the mortgage principal, then the lender has little more protection than the value of the collateral, regardless of the loan-to-income ratio. Second, borrowers' income levels can fluctuate and are correlated with overall financial and economic conditions. Borrowers with good initial ratios at the time their mortgages are issued may still be caught in a recession and find themselves unable to pay.

4.13 Minimum margins/haircuts on secured lending

In recent years, an increasing share of financial transactions among big institutions was undertaken through secured lending, such as repurchase agreements. This has been particularly the case in the so-called "shadow banking" sector that has gained market share from official lending activities but it is not subject to the same regulatory oversight nor it enjoys access to insured deposits or other stable sources of funds. Margins and haircuts that are used for such secured lending should be made subject to regulatory minimums that would vary over time (Bank of England, 2009; Committee on the Global Financial System, 2010). The worsening of the recent financial crisis was considerably due to large, swift increases in required margins and haircuts as providers of lending against securities responded to adverse developments. This forced many investors to sell significant amounts of their holdings regardless of the price they could obtain, since they could no longer finance the securities at any reasonable cost under the panicked market conditions. These "fire sales," pushed securities prices down further, often leading lenders to demand even higher margins and haircuts, initiating another round of fire sales.

Rules should aim to avoid these strong cyclical moves, by ratcheting up the minimum levels of capital and liquidity more smoothly during boom times so as to avoid a sudden

spike in requirements during periods of panic, thus preventing extensive fire sales (Kashyap *et al.*, 2011). Usually, central banks retain the ability to use margin requirements to limit the amount of borrowing against common stock, which is a special case of secured lending that is often used by individual or institutional investors. Securities brokers may provide margin financing to their clients only at a certain specified percentage of the value of a stock and if the stock declines too far in value then they have to make a “margin call” asking for additional collateral. Variations in required margin can mitigate excessive risk-taking but restrictions can always be circumvented thus reducing the instrument’s effectiveness. For example, much higher effective levels of leverage can also be obtained through the purchase of options or futures on stock prices without the need for direct financial leverage, undermining the effectiveness of margin requirements focused on outright purchases.

4.14 Taxation

Targeted taxes represent another way of affecting risk-incentives of individuals or financial institutions. For example, proper tax can be used to encourage sounder liquidity management. Various transactions or capital gains taxes belong in the instrument kit, as well as any tax exemptions on assets funded by deposits and capital and with varying degrees of long-term debt maturities. Such measures could shift the balance towards more stable funding sources. Almost any instrument which uses a minimum or maximum ratio or absolute cap or floor could instead be arranged to tax violations of these levels, rather than absolutely forbidding them. If taxation is used to influence the level of risk in the financial system, rather than being imposed simply to raise revenue, then changes in tax policies could respond to booms and busts. A key difference exists between taxation and the setting of safety margins such as through capital resources. Increased capital requirements both provide incentive effects and directly improve the ability of the system to withstand losses. Taxation does produce revenues for the

government that can be used for other purposes or saved to support interventions to mitigate financial crises (Jeanne and Korinek, 2010). The latter point, of course, also leads to questions of moral hazard if the existence of taxation leads to an assumption that government rescues would be readily available.

4.15 Requirements on currency mismatches

Often a considerable portion of credit activity takes place in currencies other than the country’s own. This became a problem in emerging markets during the recent crisis and, in general, these exposures represent a risk factor that becomes more important during boom times. Limits could be tightened during booms and released again during busts or in more normal times.

4.16 Capital controls

Foreign capital flows are a major force of credit cycles, with a strongly pro-cyclical effect. Foreign capital inflows during good times and outflows during bad times exaggerate the domestic credit cycle. Coordinated capital controls can be used in a macro-prudential manner. There is a long history of economic debate on capital controls and their effectiveness, which is not discussed here. There are certainly theoretical arguments for using capital controls as a macro-prudential instrument, but also deep concerns. First, capital controls can have adverse stability consequences, which may be outweighed by stability benefits particularly in emerging markets. Second, capital controls might be imposed for other, less stability-oriented, reasons but be protected by labeling them as “macro-prudential” in nature.

4.17 Regulating the shadow banking system

The fire-sale risk associated with excessive short-term funding comes from both insured depositories and financial intermediaries whose combination of asset choice and financing structure may exacerbate a systemic fire-sale problem. Thus, regulation should cover large, systemically important non-bank financial in-

stitutions, which do not finance themselves with insured deposits, but are nevertheless subject to wholesale financing runs. However, there is more to regulation that dealing with systemically important institutions. Some of the crisis damaging effects arose not only from individual institutions, but also from the collapse of an entire market, that of asset-backed securities. Investors buying tranches of asset-backed securities frequently rely on short-term borrowing. Entities known as structured investment vehicles or conduits, which in the past tended to be affiliated with sponsoring commercial financial institutions, hold such tranches of sellable asset-backed securities and finance them with commercial paper, which typically has a maturity of only days or weeks. Hedge funds and investment firms may finance their holdings of asset-backed securities with repurchase agreements, a form of overnight collateralized borrowing. Collectively, these investors who acquire asset-backed securities and finance them with short-term debt are often referred to as the shadow financial banking system. The collapse of the asset-backed securities market resembled the essential elements of a classic bank run, that is an inability of investors in asset-backed securities to roll over short-term financing (Gorton, 2010; Gorton and Metrick, 2010; Covitz *et al.*, 2009). One manifestation of the withdrawal of short-term lending to the asset-backed securities market comes from the behavior of haircuts in repurchase agreements. When an investor borrows in the repo market, the investor is required to post a margin, or down payment, known as the haircut. Haircuts on most highly-rated asset-backed securities were very low prior to the crisis, on the order of 2 percent. Thus, a massive purchase of asset-back securities could take place by a minimum own-funds down-payment while the rest could borrowed on an overnight basis in the repo market; in many cases the ultimate lenders were money-market mutual funds. This is not to say that the borrowing institutions' overall leverage would be very high, but that it could borrow aggressively against certain highly-rated assets that were seen as low-risk and hence as very good collateral. In the midst of a crisis,

haircuts will skyrocket, so leveraged institutions would have to put down a much higher down payment. If they do not have the cash to do so, they would be forced to liquidate their holdings thereby depressing asset prices. The rise in price level and volatility, in turn justifies a higher withdrawal of lenders in the repo market, since their protection depends on the rapidly eroding value of accepted collateral assets. The disruption in the asset-backed securities market may end in a margin spiral (Brunnermeier and Pedersen, 2009).

In order to prevent such a disastrous effect, it has been suggested to adopt a narrow banking model, whereby tightly regulated financial institutions are restricted to core deposit-taking and lending activities, and a substantial chunk of their other business is pushed out to a more lightly-regulated periphery. While such an approach may keep certain functions (such as the payments system) safe, the risk is that the overall process of credit creation may be made more, not less vulnerable to shut-down in the event of a crisis. Instead, a useful first step would be to impose similar capital standards on a given type of credit exposure, irrespective of which institution winds up ultimately holding the exposure. The broad-based regulation of minimum and time-varying haircuts on asset-backed securities with the value of the haircut depending on the seniority of the tranche, the quality of the underlying collateral or other factor, could be a useful instrument (Geanakoplos, 2010; Stein, 2010). A regulatory instrument kit with only a capital ratio and a single liquidity ratio will be inadequate for controlling instability arising from deposit defaults, fire sales and credit crunches (Goodhart *et al.*, 2010b). The proper regulation of haircuts can have two benefits. First, it could help to harmonize regulation across organizational forms, thereby reducing the incentive for lending activity to migrate into the shadow-banking sector. Second, for those assets that do end up in the shadow-banking system, it can dampen the destabilizing dynamics described above. If haircuts start out at a very low percent, and in a crisis shoot to a very high one, this creates a powerful forced-selling pressure on owners of

asset-backed securities. If haircuts are set instead at a higher percent before the crisis, this forced-selling mechanism and the ensuing vicious spiral might be contained. Central banks, through their discount window and emergency-lending facilities, have already developed significant expertise in determining prudent values of haircuts on various kinds of asset-backed securities. Moreover the problems of the asset-backed securities market arguably go beyond fire sales and extend to the chosen structure of securitizations. When large fractions of underlying collateral pools are turned into AAA-rated securities during the tranching process, can blunt the incentives of investors to seek more information as the potential gain from higher information is minimal due to the perception of AAA-rated securities being very low risk ones (Hanson and Sunderam, 2010). Uninformed investors can in turn make securitization markets more fragile when times turn bad and the need to analyze different securitization cash-flows rises.

5. Monetary stability, financial stability and macro-prudential policy

Monetary stability and financial stability are intertwined. Monetary policy decisions affect financial behavior and vice versa. Asset price developments, monetary policy and prudential policy are interrelated, both domestically and internationally.

On the one hand, monetary policy decisions play a significant role in either exacerbating or suppressing financial cycles. Persistently low interest rates have encouraged financial institutions and market participants to take levels of risk that they would not otherwise have assumed (Altunbus *et al.*, 2008). The undisputed impact of monetary policy actions on risk-taking behavior of financial institutions has raised the question of whether monetary policy authorities should adjust the policy rates so as to accommodate the smooth operation of financial markets. On the other hand, changes in asset prices can directly impact upon the nominal variables targeted by central banks through a number of channels. Rising asset prices can:

increase household wealth, provide more collateral for mortgages and may reduce the need for precautionary saving; stimulate firms' expenditure through a better access to financing, which may lead to inflationary pressures; and contribute to the build-up of financial and real imbalances which, even if they do not directly impinge on price stability, might indirectly pose serious risks for macroeconomic stability.

Thus, monitoring of asset prices is an important task of conducting monetary policy. The question then arises as to how asset price monitoring should be best integrated within monetary policy strategy. A financial stability-minded conduct of monetary policy needs to be aware that during periods of asset price inflation there is usually feedback between the financial and the real sector which leads to credit and investment booms and long periods of economic expansion. The increase in the value of assets tends to reduce the perception of risk and makes available more collateral for the growth of external financing to the private sector, raising investment and consumption expenditure. At the same time, if the increase in the value of assets is perceived to be of a permanent nature, expenditure is continuously expanded through the traditional wealth effect. As long as the boom in asset prices continues, the ensuing optimism for higher future returns sustains this self-reinforcing process.

Although these developments may be driven by fundamentals at first, the interaction of asset and credit markets may generate asset-price misalignments, high private indebtedness, over-investment and ultimately serious financial and real imbalances. These, in the event of an unfavorable shock or a sudden asset price reversal, could materialize in a severe economic contraction with important disruptive effects in the financial and the real sectors of the economy. In general, the larger the build-up of private debt and the greater the distortions in the allocation of capital during the economic boom, the higher the risks and the potential disruptions.

In order to integrate asset price monitoring into monetary policy strategy, central banks are being called to loosen monetary conditions to

counter the recessive and deflationary consequences for the economy of a sudden and sharp contraction of asset prices. However, views on how this should be done differ: some like to focus only on the direct impact of asset price volatility on monetary targets, others argue for an early identification of misalignments during the boom phase with a view to taking preventive action beyond what strictly concerns monetary policy goals, while others advocate a more intermediate and flexible view (Bean *et al.*, 2010).

The first approach relies on a pessimistic stance on whether central banks are able to detect a departure of asset values from their fundamentals early enough (Bernanke and Gertler, 2001). Even if misalignments could actually be identified in a timely manner, the ability of central banks to affect the bubble is questioned. Any preventive action would therefore be difficult to explain to the public, as it would require a substantial deviation from monetary policy goals. This may entail significant costs in terms of reputation. In addition, lags in the transmission of monetary policy could also lead to undesired effects. For instance, if the bubble was about to burst, a tighter monetary policy could aggravate the recessionary impulses of the correction in asset prices instead of moderating the effects of the upswing phase. Further, there are those take the more extreme view that the damage to the wider economy from higher interest rates more than offsets the benefits of taming the financial cycle.

The second approach recommends a more flexible framework under which central banks should try to identify and respond to price misalignments in order to improve macroeconomic performance (Cecchetti *et al.*, 2003). Asset prices should not be directly targeted and, more importantly, the reaction of monetary policy should never be mechanical and would always depend on the nature of underlying sources. If asset prices are driven by changes in fundamentals alone, say a productivity shock, a reaction would never be useful. However, if changes cannot be fully explained by fundamentals, a tighter monetary policy during the upswing phase would offset the impact of the bubble

on investment and consumption and would contribute to greater macroeconomic stability. Notwithstanding the ability of central banks to timely detect asset-price bubbles and intervene to reduce their destabilizing effects, some judgment is inevitable. The third approach takes the previous approaches to be partly true. Dealing with asset price developments when making monetary policy decisions merits a pragmatic and flexible approach. In particular, while in normal conditions monetary policy should focus on changes in its nominal target forecasts, there are exceptional occasions on which central banks have enough signals to conclude that significant risks are stemming from broad financial developments. In these situations monetary policy may have to pay more attention to this other information and to respond directly to it, even if inflation deviates from its objective in the short-term (Issing, 2003). Empirical evidence has provided support of this view, since financial imbalances are found to contain useful information about subsequent banking crises, output and inflation beyond traditional two-year policy horizons (Borio and Lowe, 2004). This approach is also consistent with the idea that monetary policy should act not only on the basis of a central scenario but also by considering the distribution of risks around the most probable outlook. In this sense, abrupt corrections in asset prices are a clear example of shock with a low probability of occurring but with significant macroeconomic implications if it actually occurs.

Arguably, the more one believes in an active monetary response to financial distress, the less likely one would be to support macro-prudential instruments that work by affecting the financial system as a whole. That does not mean that such a belief would be inconsistent with more focused uses of macro-prudential policy, such as dealing with bubbles confined to a single sector, such as real estate. But, certainly, this does mean that the right and undisputed post-crisis restructuring of regulatory authority and responsibility between the central bank, the macro-prudential regulator and the micro-prudential regulator will not be an easy task or a success.

6. Implementing macro-prudential regulation policy

The implementation of an effective macro-prudential policy requires the timely and proper combination of the various macro-prudential instruments. The understanding of macro-prudential instruments is still basic even when examining these instruments one at a time. There is a need to understand how these instruments can be effectively combined, particularly as regards the most important one, that is countercyclical capital requirements. In addition, the right choice may vary considerably depending on the precise circumstances of the country, its financial and economic system, its macro-prudential governance structure, and the particulars of the systemic threat.

A useful macro-prudential decision-making structure would emerge from addressing a series of policy-relevant issues (Barell, 2010; Elliott, 2011). These issues include, among others, the nature of the uncertainty about the systemic threat and potential responses, the choice of macro-prudential instruments that are legally available and politically feasible, the extent of concentration of the systemic threat in a single sector, the extent to which activity can be contained within the closely-regulated financial sector as well as the existence of regulatory authority to exercise sufficient control of the consequences of regulatory actions, the international ramifications of the systemic threat, the adequacy of the capital and liquidity levels in the relevant financial sector, the level of risk involved and the broader macroeconomic policy position.

The nature of uncertainty about the systemic threat and its potential response is an important macro-prudential policy issue. One way to deal with this policy question in regard to contain uncertainty is the trade-off between a price-like mechanism (say, a tax or a minimum countercyclical capital or liquidity ratio that adds costs to credit provision) and a quantity limitation (say, a limit on total level of lending by an institution or sector) (Weitzman, 1974). The choice of instrument depends to a significant extent on the relative degree of

uncertainty about the social costs of allowing too much social costs versus the uncertainty about the cost to the private sector of obeying the rules. Regulation of systemic financial risk imposes costs on the private sector that must be weighed against the cost to the whole economy from excessive risk-taking. If the costs of regulation are relatively clear, but the economy-wide costs of excessive risk-taking are unclear, then quantitative requirements should be applied to maximize the ability to avoid the potential catastrophe. If, on the other hand, the cost of regulation is more uncertain than the economy-wide costs, then taxes or capital requirements should be applied or other actions that give the private sector flexibility to respond with the lowest-cost solution to the need to limit systemic risk. In certain circumstances, taxation might be superior to minimum liquidity ratios for inducing the socially appropriate behavior in regard to systemic liquidity (Perotti and Suarez, 2009; Jeanne and Korinek, 2010). To this end, judgment is important as each macro-prudential authority will have to decide on its degree of confidence in using each instrument in predicting the ensuing effects, including side-effects, as well as the nature and extent of market response. For example, one of the arguments advanced for using countercyclical capital requirements is the long experience regulators have acquired from implementing capital requirements in general.

The choice of macro-prudential instruments requires that the competent authority has the legal right to do so, and that the political establishment can bear its consequences. Even if the authority is there, the prospective political costs or requirements might outweigh the uncertain excessive risk-containing benefits from choosing a given instrument for full or partial implementation. For example, in some jurisdictions and depending on the state of the economy, raising capital requirements for individual institutions holding mortgage assets might be relatively more acceptable and politically less resistant than decreasing the maximum loan-to-value ratio on mortgages. The political costs and requirements may matter most in the early stages of macro-prudential policy implementa-

tion due to the lack of experience as to the likely results. This effect may, however, be counteracted by the yet un-faded, persistence of social memory regarding the disastrous effects of the crisis. Moreover, the choice of the proper instrument may sometimes depend merely on the degree of its comprehension. For example, an increase in the down payment requirements for obtaining a mortgage relative to another credit-control instrument is easily understood by voters who can better integrate it into their own life modes. Further, the choice of instrument may sometimes crucially depend on the relevant intervention authority of different regulators and the degree of potential conflicts that this choice may inflict in their cooperation in exercising supervision.

Depending on whether the systemic threat is concentrated in one or more sectors of the economy, a need for a clear focus on the risk on the particular sector(s) (say, a housing bubble) arises, which would make it reasonable to apply a given macro-prudential instrument to the specific sector. This has the advantages of a direct response to a specific problem and of the maximization of the market signaling benefit by focusing straight on the specific problem. But, it also has disadvantages because (a) there may not be a particularly suitable and efficient instrument available for that particular sector, (b) the instrument may be inadequate, as for example, lowering the maximum loan-to-value ratio for mortgages may reduce both the volume of risky loans and the risk inherent in each loan, but still not completely prevent a housing bubble since lenders might even raise the volume of their loans reassured by the reduced riskiness, and (c) the true problem might be system-wide, but has manifested itself first, or most strongly, in one particular sector, so the application of a given instrument may not have the expected results. Specific intervention instruments should be applied as part of combination of instruments within a broader macro-prudential policy.

If the source of the systemic threat can be controlled by the closely-regulated financial sector and there is little potential for the systemic activity to move outside that sector, then

direct administrative controls, such as caps on lending, are effective. Thus, direct administrative controls are more effective in market conditions characterized by a small number of domestic financial institutions, as long as there is little danger that those controls would create or enhance existing less-regulated credit providers. On the other hand, direct administrative controls are less effective in market conditions characterized by more sophisticated financial systems, since the sources of credit finance can be diversified into non-bank or less regulated intermediaries. However, even if a less sophisticated economy is dominated by closely regulated institutions, there is still a question as to whether regulatory authorities have the ability to enforce its administrative controls without overshooting private sector costs. Accounting and auditing systems may not be adequate to enforce the caps. Regulatory capture can be very strong not only in terms of political/private influence on the whole macro-prudential policy decision but also in terms of the specific direction and strength of each instrument's implementation among different individual institutions. Also, the box-ticking problem is present: the letter of the administrative controls may be complied with but excessive lending may still result from other indirect sources, such as explicit or implicit guarantees.

Even if administrative controls appear feasible and enforceable, there is a core question as to whether the regulatory authority is in a better position than private financial institutions to make the decision about lending caps or other controls. Administrative controls run the risk of substituting the distant judgment of a government entity for the informed judgments of the actual financial system. While, due to the externalities of systemic risk, government intervention is clearly warranted, certain policy instruments, such as the use of countercyclical capital requirements and direct administrative controls, would sharply limit the room for judgment by market participants. Depending on the degree of financial system sophistication, a set of proper compliance incentives need to be devised in order for financial institutions and market participants make proper judgment

and arrive at the right lending choices over and above any government action to the same end.

Domestic macro-prudential policy is bound to be more difficult if the financial system is open to international financing transactions. Lending caps to hold down excessive domestic speculation could be rendered less effective because foreign lenders step in to take on the risk. To the extent that domestic risky products are sold to foreigners, some of the risk and eventual the adjustment cost is transferred overseas, but the consequences of any resulting disruption can still be quite severe for the domestic institutions. Further, if excessive risk-taking extends overseas, domestic institutions may move portions of their risky lending overseas too, thus reducing the domestic burden of cost of any foreign bubble's breakup but also exposing domestic financial institutions to large losses on their foreign risks. The international consequences in an open financial system result from the implementation of all macro-prudential policy instruments, from lending caps to administrative controls to countercyclical capital requirements. In the case of the latter, there is a global consensus that if the domestic macro-prudential regulator raises countercyclical capital requirements for some types of domestic borrowing, the regulators in other countries will do likewise in regard to such loans made into that country. The effectiveness of this global agreement in practice remains to be seen.

The international consequences of domestic macro-prudential instruments that focus on individual transactions, rather than institutions, are smaller. For instance, imposing a lower maximum loan to value ratio on mortgages in a country would have an effect on any mortgage made in that country, regardless of the lender's location. Thus, both domestic and foreign lending would become less risky, also possibly associated with a further dampening of a housing bubble, the extent to which depends on the willingness of foreigner relative to domestic institutions to raise their lending supply. It is obvious that the effectiveness of macro-prudential policy instruments requires the ability and willingness to apply them in a globally co-

ordinated manner, the balance of which would depend significantly on the particular circumstances of a country.

The impact of raising minimum required levels of capital and liquidity for financial institutions will considerably depend to initial conditions (Miles *et al.* 2011). If the industry's capital levels adjusted for risk are already high enough, there might be little benefit to increasing the minimums to counter excessive risk-taking in the markets. If initial capital levels adjusted for risk are low enough, then raising capital levels could easily lead financial institutions to feel comfortable taking more liquidity and counterparty risk. Under those conditions, raising minimum liquidity levels may be a more effective instrument for safety than raising capital ratios and be a greater deterrent to excessive lending, since it would have more effect on the lenders' costs than would an increase in a minimum capital ratio that was not currently binding.

The greater the perceived risk, the wider the set of instruments required to be optimally combined. First, each instrument has a limited effectiveness and the more strongly it is pursued the lower its marginal benefit will be. Dealing with a big systemic risk problem may require a combination of many instruments. Second, the bigger the problem, the more important it becomes that macro-prudential policy works. At the presence of high uncertainty, all instruments must be used, even if there is only one discrete target variable (Brainard, 1967). However, the use of multiple policy instruments may not be efficient if the systemic threat is not large. Implementation will be harder the more instruments are combined and enforcement experience will eventually tell which policy instrument works well in the area of macro-prudential policy. Similarly, the signaling effects on markets may be weakened if too many actions are taken at the same time. For that matter, communicating necessary macro-prudential actions to the market would be easier with single policy moves.

Finally, macro-prudential policy takes place in a larger context, necessarily influenced by macroeconomic policy decisions. These affect

both the level and nature of risk in the financial system and may make some macro-prudential choices more or less attractive than they would otherwise be. For example, changes in monetary policy normally affect the difference between shorter- and longer-term funding cost. If, as an extreme, short-term funds are actually more expensive than long-term funds for an extended period of time, then changing the minimum liquidity requirements may be less effective than usual, since financial institutions will already have economic incentives to hold medium- to long-term funding.

The implementation of macro-prudential instruments for financial development and efficiency is an important issue for emerging markets (Moreno, 2011). The novelty of macro-prudential instruments and the lack of implementation experience even in advanced markets make the implementation efficiency of these instruments in emerging markets difficult to predict. However, it is beyond doubt that relying on market discipline is not enough to guarantee financial stability, much less in emerging markets. Moreover, the latter are in greater pressure to integrate the use of macro-prudential instruments with overall macroeconomic and regulatory policies in order to prevent fluctuations in global capital flows from causing severe disruptions in emerging market economies.

7. Conclusions

The macro-prudential approach to regulation and supervision focuses on the financial system as a whole. Its primary task is to prevent or reduce the probability of occurrence of financial system distress, which could have devastating effects for the real economy. Systemically important institutions and systemically important markets are interlinked through networks of transactions which following negative extreme shocks make risk endogenously determined, which could lead to a systemic collapse. A set of macro-prudential policy instruments has been developed and debated aiming at the providing the macro-prudential approach with effective intervention in financial markets.

The most important, perhaps, of these instruments is countercyclical capital requirements. Typically, macro-prudential actions used during periods of over-exuberance are reversed in periods of under-exuberance. Lower capital requirements make it easier and cheaper to lend and higher maximum loan-to-value ratios make it easier to issue mortgages. However, credit expansion faces considerable opposition from inflation-feared policy-makers whereas credit contraction has its limits, much like the “zero lower bound” problem in monetary policy. In a market boom, the advisable credit contraction may be difficult to enforce beyond the levels specified Basel III or other minimum liquidity ratios, taking into consideration that a severe credit contraction might stall overall economic activity to levels that are not politically feasible, and facing ardent opposition by the cash-strapped private sector. In a market bust, the advisable credit expansion may be difficult to enforce if financial institutions are scared to lend given their narrowing capital availability and the risk of non-performing loans or deposit outflow threatening their solvency position.

The difficulty in adjusting credit expansion margins and hence the effectiveness of macro-prudential instruments is dependent upon the phase of the credit cycle and the general market conditions. Different macro-prudential instruments have different effects and are suitable in different conditions and market structures and for different financial instruments. The determination of the optimal combination of these instruments is one of the most important challenges in the future implementation of macro-prudential policy to the regulation and supervision system as a whole. As implementation experience accumulates, the optimal combination will emerge and, most likely, will be different under circumstances. In this respect, monitoring efficiency is very important, and this raises the additional challenge of the most effective reorganization of regulatory and supervisory structures to achieve the goal.

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An Empirical Investigation of the Factors Influencing Tax Evasion with the Use of False and Fictitious Invoices

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Abstract: Tax evasion is a multifaceted and dynamic phenomenon. Over the last years in Greece, tax evasion with the use of fictitious and false invoices has turned into a major predicament. The purpose of the present study is to investigate and identify the factors that contributed to the use of forgery invoices in the six most important sectors of the Greek economy. Combining the directions of the relevant literature and the results of semi-structured interviews on experts, a valid and reliable research instrument with 11 factors was constructed. A survey was conducted, which was applied to a random sample of 319 participants consisted of accountants, tax consultants and tax auditors. Results of the regression analysis shown that, among others, auditing as well as motivational factors are the most important determinants in explaining tax evasion with the use of fictitious and false invoices. Tax rates were found significant only for the manufacturing, and tourism sectors. Policy makers should emphasize on the intensification of auditing practices supported by an integrated information system which will simplify taxing process and enable cross-checking and ex-ante controls.

Key words: Micro-prudential, macro-prudential, enforcement, regulation.

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1. Introduction

Tax evasion has enormous and undesirable financial and social effects. It subverts the efforts of a country to fiscally recover, to promote growth and develop its welfare. It also creates an environment of unhealthy competition in economy and revokes basic issues of equity in the society. It enlarges the social injustice and undermines the role of the social state canceling in essence the distributive role of the free market system.

Even though the limits of the meanings of the black economy, the shadow economy, the tax evasion and the corruption are not usually obvious, their differentiation is a combination of the double dimensions of the legal-illegal activities, of the registering or not registering of national accounts, of the reporting or not reporting of the economic affairs and activities and of the existence or non existence of monetary activities and exchanges (Enste & Snchneider (1998). Schneider et al (2001, p.3) define tax evasion as “an illegal reduction of tax payment (underreporting income or stating higher deduction rates)”. A tax evasion device is to create fake and fictitious invoices. A fake invoice states an incorrect price for a completed job while a fictitious invoice is produced by dummy or unregistered companies and/or for fabricated transactions.¹ The size of tax evasion differs from country to country and its extent depends on the infrastructure of each country, the size of their companies, their accounting organization, the structure and function of their tax system and the structure of the tax services.

It is commonly admitted that the size of tax evasion in Greece is very high compared to other countries. Transparency international put Greece in a three-way tie, with Bulgaria and Romania (TI, Annual Report 2010). During 2007, the shadow economy in Greece was estimated at 30% of GDP (IMF, 2011) which amounts to over 50 billion euros. According to a report of the Greek Federation of Enter-

prises and Manufacture (2009) tax evasion approached 30 billion euros. Over the last ten years the invoice forgery industry is flourishing, becoming a growing threat to the stability of the Greek economy. An annual report released by the Greek Ministry of Finance (2006) has shown that an investigation made by the Special Service of Inspection identified 20.851 business owners who were involved in the use of fake and fictitious invoices with a value over 505 million euro. In 2009, according to the same source that amount was doubled totaling to 1.039.800 euros (Ministry of Finance, 2006, 2010).

Measuring tax evasion and identifying the factor affecting it, is a formidable task. Schneider (200b, p1) describes tax evasion measurement “as a scientific passion for knowing the unknown”. The approaches used to investigate tax evasion are distinguished into indirect and direct methods. The first include econometric models and statistical indexes (e.g. Dubin et al, 1987; Giles, 1999) and the second are based on surveys with questionnaires and interviews (e.g. O’Neil, 1983; Mogensen et al., 1995). According to many researchers the direct approaches are not perceived as valid because the business owners and the households do not wish to reveal their fraudulent behavior (Mogensen et al., 1995). However, recent studies shown that due to the restrictions in the use of indirect methods the direct methods are more accurate and reliable (OECD,2002; Renooy et al. 2004). This paper aims to investigate and identify the factors affecting the use of fake and fictitious invoices in six important sectors of the Greek economy. These were the trading, the manufacturing, the tourism, the construction, the agriculture and the service sector.

The body of this research paper begins with the literature review related to models and methods used in the investigation of tax evasion. The next part includes the formulation of research hypothesis followed by the methodology and the results. It ends up with the discussion and the conclusions.

¹ For a detailed description of an item regarded as fake and fictitious see paragraph. 3 and 4 of article 19 of law No. 2523/1997

2. Literature Review

A large part of theoretical and empirical studies on tax evasion was based on Allingham & Sandmo's (1972) seminal work and subsequently on the modifications made by Yitzhaki (1974). In these models the decision by the tax payer to be engaged in an optimal tax evasion is a function of the expected utility of the tax payer which arises from the proportional relationship between the tax rate and the severity of penalty rate. It is assumed that auditing is constant. Following the model's logic, the tax payer performs tax compliance behavior when the costs of evasion outweigh the benefits and vice versa. In other words there is a negative relation between tax evasion with the probability of being caught and with the size of fines. When the penalty to the tax evaders is not related to the tax amount then a rise of the tax is adding bigger value to a sincere tax income statement while at the same time the cost of tax evasion for the tax payer remains the same. Therefore, bigger taxes are expected to provoke bigger tax evasion. In other words, bigger taxes are motivating instead of stopping the tax evasion. Several studies relied on these models to examine tax evasion (Andreoni, et al., 1998; Sandmo 2004). In most studies whether these rely on questionnaires or on econometric models the results suggest that an increase in tax rate will lead to higher tax evasion (Christian & Gupta, 1993, Andreoni et al., 1998; Gupta, 2005, 2006). On the other hand Feinstein (1991) and Alm et al. (1993) found a negative instead of a positive relationship between tax rates and tax evasion. However, their results are a minority since Gupta (2005, 2006) finds important research results that state the opposite. Some other surveys (Cowell & Gordon 1988; Yaniv, 1999; Niepelt, 2005) found that the tax penalties can lead to tax compliance.

Even if the Allingham-Sandmo and Yitzhaki models were the starting point for the conduct of several surveys for the research on the relationship between tax liability and tax evasion. Many of those try to answer the question of why the models predict more tax evasion than the one that really exists (Andreoni et al.,

1998; Pestieau et al., 2004; Sandmo, 2004). A different perception is the Public Choice Theory, which has to do with the legal and illegal actions as a result of the decisions the tax payers make for their benefit in order to gain more utility. Within this framework of thought the behavior of the tax payer depends on his tax morale and the faith he has on the government administration. The Behavioral theories reject the hypothesis that the tax payers are isolated and immoral people and state that their decision to commit tax evasion is influenced by the social norms and their correlations. For instance, Frey (1997), supports that the tax compliance is not a result of fear that possible penalties may create. The overconfidence in extrinsic motivation for the tax evasion prevention (e.g. raise of penalties) may in the long run affect the intrinsic motivation of people like their "civic virtue". Furthermore, Fortin et al. (2007) examined the case that the personal tax compliance is affected by the behavior of other people. Moreover, they found that justice, especially as far as the equal rights for all is concerned, plays an important part since when injustice is revealed then the tax evasion rises.

Many studies emphasize on the importance of other factors in tax evasion apart from those that has to do with financial issues. Richardson (2006) in his empirical research for 45 countries shown that the non-financial factors have a stronger impact in tax evasion and more specifically that the tax morale plays a very important role.

Alm and Torgler (2006) found out that the tax morale can explain more than 20% of the total fluctuation of the tax evasion variable and that shadow economy rises when the tax consciousness falls.

Amongst the financial researchers it is a common ground that the behavior of the person is the result of the social norms and the financial motives. Furthermore, it is often suggested that the financial factors can shape the social norms (Frey, 1997, Lindbeck, 1997). For instance, a social norm like tax consciousness can raise or fall depending on the income (Shleifer, 2004).

Due to the nature of the problem it is almost

impossible to measure the exact size of shadow economy and tax evasion. During the last decades several researchers and research institutions have tried to develop satisfactory measurement and methods for the size of shadow economy but there is no clear preference for any method or approach.

The review of literature suggests that the methods used to measure the size of shadow economy and of tax evasion can be distinguished into two general categories: the direct and indirect methods.

The direct approaches use the sampling surveys with the use of questionnaires or interviews in order to extract the needed information in a direct way from the participants regarding shadow economy and tax evasion. If the sample is representative and the participants (e.g. business owners, households, labor force) are honest with their answers then it is possible to measure the size of shadow economy or tax evasion. The direct methods can be applied in a level of country teams or in a regional or local level; in most cases they are applied in regions (e.g. Leonard, 1994; Pahl, 1984; Renooy, 1990; Williams & Windebank, 2002), in certain socioeconomic teams (e.g., Phizacklea & Wolkowitz, 1995) or in specific industry sectors (e.g., Ram et al., 2003). The method of tax auditing is susceptible to biased sample selection because the selection is based on the tax elements registered to the tax offices and therefore it is not independent from the possibility of tax evasion (Schneider, 2002). The tax payers that are recognized as tax evaders can only be the "top of the iceberg" since it is almost impossible that the tax offices have traced down all the tax evaders.

The indirect methods use statistical data that relate to tax evasion and shadow economy. The measurements can include financial variables (e.g. liquidity of money, demand for money, national accounts), or not financial variables (e.g. consumption of electricity). Among the most popular indirect methods are: the currency demand approach (Tanzi, 1983; Williams & Windebank, 1995; Johnson et al., 1998; Schneider & Enste, 2000), the transaction approach (Feige, 1996; Giles, 1999; Giles & Caragata,

2001), the electricity consumption method (Portes, 1996; Kaufmann and Kaliberda, 1996; Schneider, 2004) the model approach (Lacko, 1996; Giles and Tedds, 2002; Del' Anno, 2003) and the discrepancy between national expenditure and income statistics (MacAffe, 1980). These techniques, like the direct ones, have their cons too. The technique of income and consumption inclination faces the untrustworthiness of the statistical mistakes (Thomas, 1992). The money approaches can overvalue the real ability of the money market (Thomas, 1999) while the consumption of energy approach depends in a great degree from the assumption that the activities of the shadow economy include the electricity consumption (Lacko, 1998).

To sum up, even if there are many analysis and measurement methods for the size of shadow economy and tax evasion, there is an inclination within the international research that the indirect methods have limitations in their usability and that the direct methods are more appropriate, precise and trustworthy. This is the conclusion of OECD (OECD, 2002) for the measurement methods stated in the most recent report of the European Committee for shadow economy (Renooy et al., 2004) which is a conclusion consistent with the findings of several academic researches on the usability of these measurement methods (Williams, 2004).

3. Hypothesis Formulation

Sanctions

A common characteristic of the tax evasion tactics is the existence of a common penalty system for tax evasion offences (Devos, 2004). These penalties are divided into administration (increment enforcement, fines etc. but also removal of certain offender's rights) or criminal (prison sentences) (Finokaliotis, 2005, p401).

Although researchers have found that sanctions encourage tax compliance the relative effectiveness of the perceived severity of legal actions alone remains open to question (Devos, 2004). Accordingly the following hypothesis can be stated:

Hypothesis 1: Sanctions affect tax evasion with the use of fake and fictitious invoices.

Tax Evasion Detection

Several authors (Grasmick & Scott, 1982; Minor, 1978; Tittle, 1980; Westat, 1980) report that the sample that admitted some kind of tax evasion it was less probable to believe that these actions could lead to the arrest and penalty enforcement compared to those that were tax consistent. However, Warneryd and Walerud, (1982) have not found evidence of such a relationship between perceived risk of punishment and reported noncompliance with tax laws. Therefore, it is expected that the possible exposure of the businessmen's tax evasion will influence their decision to publish or receive virtual or counterfeit evidence. The second research hypothesis that is created is:

Hypothesis 2: The perception that the businessman has for the possible detection of his tax evasion can influence his decision for it.

Intervention for the avoidance of sanctions

The intervention from powerful people from the social elite that have the influence to help the companies may cover or bypass sanctions of the law for tax evasion or even mediate for the removal of penalties that have been already enforced. This is usually happening through bribing, which apart from money give and take can also include a number of presents or favors (Kim, 2008). Several studies focused their interest on the existence of tax evasion and bribing minutes and on the bureaucratic clientelism (Stones, 1980; Harriott (2000); Munroe (2003); Pashev (2005). These practices are a complicated phenomenon which includes economic motives, business culture, social expectations and political factors.

Therefore, if the businessman or the civilian has access to the appropriate mechanisms can influence his perception or inclination towards tax evasion. According to this the following hypothesis can be created:

Hypothesis 3: The disposition of the appropriate mechanisms (political, legal or administrative) can influence tax evasion.

Knowledge of Evidence that Lead to a Default.

According to the latest restrictions of article 19 section 1 article 21 section10 of the law n.2523/1997, in the occasion of article 19 of law n.2523/1997, for the foundation of the offence the knowledge from the offender's side, that the tax element is virtual and that its purpose is underreport, is not needed.

Elements of research for tax evasion from the chamber of Finance show that the 50% of the sample stated that they had full knowledge for the consequences of tax evasion. Also the better the financial state of the sample was the most probable was that they were fully aware of the positive and negative consequences. Also, the social status appeared positive towards the combat against tax evasion, as in a great extent the sample assumed that hiding the real earnings is the same as stealing and it consist antisocial behavior. Therefore, the information, the knowledge of the law and penalties that follow the offence can influence the decision of the businessmen to give in to tax evasion. The forth hypothesis is as follows:

Hypothesis 4: The knowledge of the laws and penalties for the tax violations can influence the tax evasion.

Severity of Sanctions

Several researchers have found a significant and a positive relationship between severity of sanctions and tax compliance (Chen, 2003; Fjeldstad & Semboja, 2001; Gupta, 2008). However, the impact of the severity of sanctions found to be unresolved (Devos 2004). The impact of the sanctions' severity was at the better occasion small according to many researchers (see Bayer & Sutter, 2009). Furthermore, other the studies (see Weigel et al., 1987) indicated that higher audit probabilities reduced tax evasion behavior, whereas the severity of fines had a negligible impact.

According to these the following hypothesis can be shaped:

Hypothesis 5: The severity of sanctions has an impact on tax evasion with the use of fake and fictitious invoices.

Motivation

As for the expediency that the publishing or receiving of fake tax elements is concerned, this can be due to a number of factors. Some of them are listed below.

1. In order to show smaller gross earnings and consequently smaller tax outflows for VAT.
2. In order to cover illegal actions, like money-laundry, or the cover of smuggled imports.
3. Towards nonexistent clients in order to cover other exchanges for which no tax sale details were published.
4. For serving a third party who is unable to publish tax elements due to several reasons such as not having a legal company or the appropriate license due to owing to the state etc.
5. Because during the tax year high buy in and small sales were registered.

All these elements create a framework of motivation that can easily lead a business to tax evasion.

Hypothesis 6: Several reasons that are related to accounting or extra accounting parameters can lead a business to tax evasion by creating fake and fictitious invoices..

Reasons for tax evasion (Causes)

There is an abundant of factors that lead companies to tax evasion practices (Schneider, 2002, 2007). A widely accepted reason for the size and growth of the phenomenon of registering smaller income than the real one is the high tax income coefficients (Clotfelter, 1983). According to Bayer's (2006) model the tax coefficients is the motivational power for the size of the tax evasion.

Financial controlling is the mean which has the best aiming in the decision to tax evade (Sandmo, 2004). The possibility of tax control seriously influences that percentage of the income that is registered and the number of the tax evasion cases (Webley, 1987). Furthermore, the bigger the chances for control the smaller the tax evasion is (Friedland et al., 1978), but there are no evidence that the tax control fear limits the numbers of tax evasion cases and not

the amounts (Webley, 1987).

The perception of the tax payers regarding how fair the tax system is and if all the tax payers are treated in the same way can have negative effects on the tax compliance-behavior (Dell'Anno, 2009). Studies show that the tax payers take decisions regarding the justice of the tax system by comparing what they pay to the state and what they receive back from it (Bordignon, 1993, Kirchler et al., 2003). The perception that the taxes are fair, the cooperation or the social norms, are of fundamental importance for the tax decisions (Kirchler et al., 2003).

The complexity and the lack of clarity of the tax law play an important role in the tax behavior (Kaplow, 1996; Slemrod, 2001; Richardson, 2006). However, many accept that an amount of complexity is needed if we expect the income counting to be as precise as possible (Kaplow, 1998).

Lastly, the creation of the common market between EU nations in 1993, the rise of the number of EU states, the removal of customs controls and the easier procedures created a rapid increase of the inter-community exchanges which made tax evasion easier.

According to all the above the question that can be raised in a hypothesis form is:

Hypothesis 7: To what extent the tax controls, the taxation way, the existing tax coefficients can consist basic factors that influence the tax evasion inclination. In these parameters the tax system legislation and the environmental factors, as the extent of corruption in the social and production sectors of the country are added.

4. Methodology and Results

Research Approach

The survey was conducted using a 5-point Likert scale questionnaire. Stratified sampling has been used in deciding the numbers of experts from different profession. This sampling procedure is often used in the investigation of tax evasion among business owners (e.g. Slemrod & Yitzaki, 2002) and households (e.g. Fiorio & D'Amuri, 2005). From the total of

500 questionnaires, 40 have been distributed to charter accountants and the rest 460 evenly divided have been distributed to accountant-tax experts and tax-auditors. The response rate on average was 63,8%, that is 150 questionnaires were returned by accountants-tax experts, 143 by tax auditors and 25 by charter accountants.

The questionnaire consists of 9 questions excluding the demographic and personal questions. Eight questions and their items represent the variables which are assumed that determine tax evasion with the use of fake and fictitious invoices. These are: 1) sanctions, 2) perceived likelihood of detection, 3) third party interference in order to avoid penalties 4) knowledge that tax evasion can lead to an offence, 5) severity of sanctions, 6) reasons that motivate companies to tax evasion, 7) causes that encourage tax evasion and 8) third parties that act jointly or mediate to the use of fraudulent invoices. The last question asks from participants to classify, according to their view, the tendency about the size of tax evasion with the use of fake and fictitious invoices in the sectors of trading, manufacturing, services (self-employed), tourism, construction and agricultural. The questions were formulated according to previous research and to the semi-structured interviews with 27 experts consisted of 5 charter accountants, 7 tax auditors, 9 accountants and 6 tax experts. The aim was to get a broader and more complete picture of the research context and to increase reliability and representativeness of the explanatory variables. A total of 500 questionnaires have been distributed. The internal reliability of the questionnaire was tested with the estimation of Cronbach alpha and its construct validity with Confirmatory Factor Analysis. Prior to reliability and validity analysis, the principal components method with varimax rotation was applied to the data for a factor extraction. Finally regression analysis (general to specific) was adopted so as to identify the significance of these factors. The dependent variable was represented by the data obtained from the views of the respondents about tax evasion in the six sectors of the Greek economy. All statistical analysis was conducted using SPSS (version 16) and

AMOS 7.0

Results

The following information was produced from the answers of the experts.

- The knowledge of business owners is small with regard to sanctions
- The limited time available to tax auditors, the multitude of tax information, the weakened preventive tax controls, the lack of cross-checking and the complexity of the legal tax system influence a lot the perception of business owners regarding the chance to be detected.
- The perception of business owners regarding the avoidance of legal sanctions through the intervention of third parties belonging to the political and juridical system was found to be average. However, employees in the tax authorities appeared to play a very significant role.
- The level of severity of sanctions is characterized mediocre.
- The main reason that prompts business owners in using fraudulent invoices is the chance they have to inflate the price of goods and services linked to subsidies by the Greek government and European Union and regarded as deductible expenses. Money laundering, smuggling and usury were found to be a very small motivator.
- In the cases of tax evasion the intense and the level of auditing as well as the justice and fairness prevailing in the tax and social system was considered important, followed by the high income tax rates and the size of V.A.T..

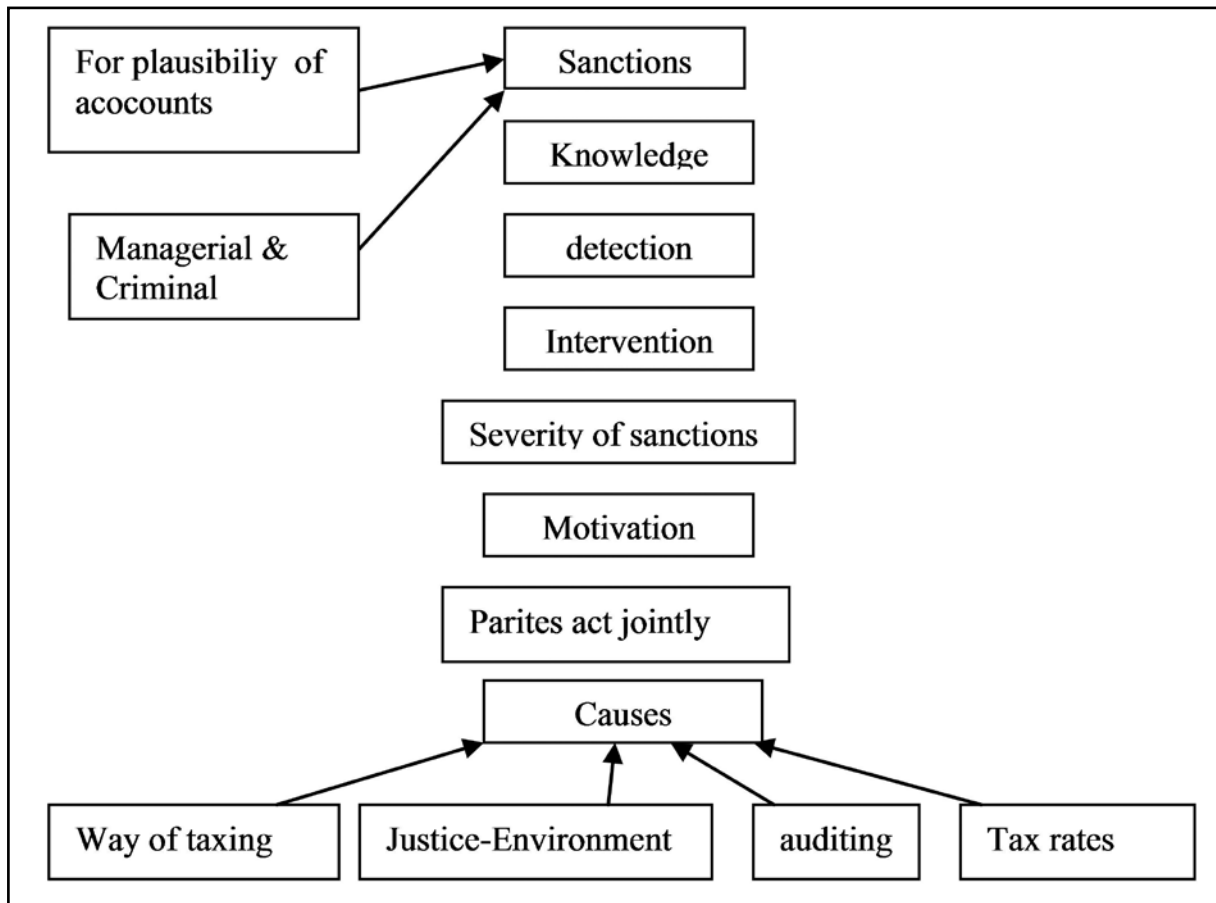
As far as it concerns the tendency of tax evasion with fake and fictitious invoices in the six business sectors the descriptive data have shown that: The enterprises in the construction sector are those that have the higher tendency for tax evasion followed by those in agricultural sector and then by tourism and services sector. The manufacturing and trade sector appeared to move about in mediocre levels.

The results of the principal components factor method suggested a twelve-factor solution which accounted for 67.5% of the total variance. All of the 53 original items (variables)

retained in the factors since factor loadings found to be greater or equal to 0.4 (Hair et al., 1995). The exception was two items regarding the reasons that motivate business owners to tax evasion with factor loadings 0.34 and 0.39. The two items, however, retained into the factor named “motivation” since they performed significant correlation with all six dependent variables (sectors of the economy). The 17 items assessing “causes” were grouped into the factors of “size of tax rates” (2), “way of taxing”

(2), “auditing” (5) and “justice-environmental conditions”(8). The 13 items associated with “sanctions” were grouped into the factors of “sanctions for plausibility of accounts” (6) and “managerial and criminal sanctions” (7). Therefore, the original 53 items were grouped into 13 factors with 29 variables. Theoretically, the 12 factors extracted from principal components can be compiled to 9 factors since four of them are linked to the causes of tax evasion. Figure 1 illustrates the 12 factors with eigen values greater or equal to 1.

Figure 1. Factors with eigen values greater or equal to 1.



The next step concerns the reliability and validity of the questionnaire. The estimated values of Cronbach's alpha for each factor as well as for the entire scale can be considered satisfactory (table 1).

Table 1. Reliability test

Factors (items)	Cronbach's alpha
Sanctions (13)	0,92
Knowledge (3)	0,71
Detection (5)	0,83
Intervention (3)	0,72
Severity (3)	0,86
Motivation (5)	0,75
Parties act jointly (4)	0,83
Causes (17)	0,78
All items	0,85

Figure 2 presents the model in a causal path diagram to show hypothesized relationships among factors. Confirmatory factor analysis (CFA) using AMOS 7.0 was applied to the 9 factor measurement model to test the dimensionality and validity. As shown in Table 2 the results of CFA indicate unidimensionality with some doubts coming from the value of CFI index which receives a value (0.85) near the border line of 0.9. Also the estimated value of χ^2 rejects the null of a good fit. However, this test is more reliable with small samples ($n=100-200$), and is susceptible to samples greater than 200 and therefore other criteria should be taken into consideration in the evaluation of the appropriateness of the model to the data (Hair et al. 1998). For example χ^2/df re-

ceives a value below the acceptance level of 3 and the RMSEA is less than the recommended 0.08. On this basis, overall, the fit of the model to the data can be considered adequate.

In order to reveal support for the hypothesis of the research, the 29 items related to the 9 factors were used as explanatory variables in a multiple regression analysis. Six regressions were estimated having as dependent variables the six sectors of the economy. Results show (table 3) that among the 29 explanatory variables, auditing is the most important variable since its explanatory power was found significant in all six sectors. The next most important variable is motivation. Specifically the variable associated with overpricing of goods and services in subsidizing programs from E.U. and Greek government appeared significant in all equations except the one related to trading sector.

The knowledge of sanctions was found to have an impact in tourism, agricultural and construction sector. The negative sign of the variable "managerial and criminal sanctions" show that the higher the knowledge the less tax evasion with fraudulent invoices will occur. However, the positive sign of the sanctions associated with the plausibility of accounting books might be an indication that this knowledge helps business owners to find ways of tax evasion especially when the probability of detection and the severity of punishment are low. This reasoning can be verified to a certain extent by the relative insignificance of the "severity of penalties" and the "detection" variables. The intervention by people with political power was not found significant to any of the sectors while that by employees in the tax administration system appeared to have a

Figure 2. Path diagram

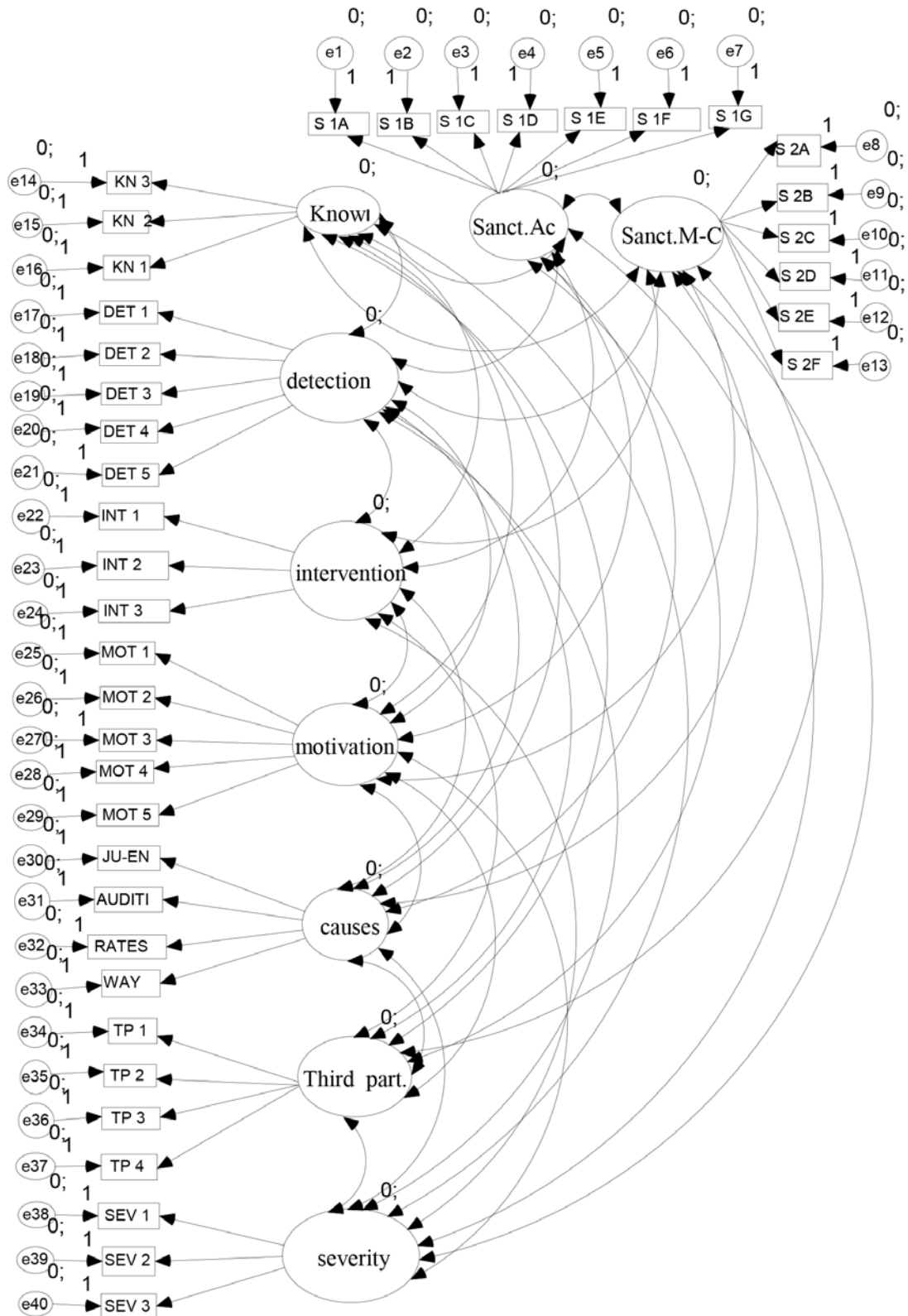


Table 2. Regression Weights and Goodness of Fit Statistics

Regression Weights					
		Estimate	S.E.	C.R.	P
SANCT. M-C	<--- SANCTIONS	1,000			
SANCT. Ac	<--- SANCTIONS	,912	,073	12,482	***
KNOWL 1	<--- KNOWLEDGE	1,000			
KNOWL 2	<--- KNOWLEDGE	1,403	,157	8,948	***
KNOWL 3	<--- KNOWLEDGE	1,422	,166	8,586	***
DETECT 5	<--- DETECTION	1,000			
DETECT 4	<--- DETECTION	,879	,088	10,001	***
DETECT 3	<--- DETECTION	,896	,085	10,530	***
DETECT 2	<--- DETECTION	1,075	,088	12,218	***
DETECT 1	<--- DETECTION	1,017	,091	11,124	***
INTERV 3	<--- INTERVENTION	1,000			
INTERV 2	<--- INTERVENTION	1,696	,236	7,194	***
INTERV 1	<--- INTERVENTION	1,759	,245	7,181	***
MOTIV 5	<--- MOTIVATION	1,000			
MOTIV 4	<--- MOTIVATION	1,041	,126	8,257	***
MOTIV 3	<--- MOTIVATION	1,163	,153	7,583	***
MOTIV 2	<--- MOTIVATION	,920	,122	7,542	***
MOTIV 1	<--- MOTIVATION	1,396	,152	9,193	***
SEVER 3	<--- SEVERITY	1,000			
SEVER 2	<--- SEVERITY	1,029	,066	15,646	***
SEVER 1	<--- SEVERITY	,879	,060	14,536	***
WAY TAX	<--- CAUSES	1,000			
TAX RATES	<--- CAUSES	,692	,111	6,225	***
AUDITING	<--- CAUSES	,295	,076	3,864	***
JUST-ENV	<--- CAUSES	1,124	,154	7,279	***
T-P 4	<--- THIRD PARTIES	,720	,051	14,196	***
T-P 3	<--- THIRD PARTIES	,786	,062	12,706	***
T-P 2	<--- THIRD PARTIES	,852	,055	15,557	***
T-P 1	<--- THIRD PARTIES	1,000			
Goodness of Fit Statistics					
Chi-square (χ^2)	RMSEA	CFI	TLI	IFI	χ^2 (CMIN/DF)
901,925	0,071	0,848	0,810	0,851	2,584

positive impact on tourism and services sector. Interference by the judiciary appeared to have a small and a negative influence, but only to the service provision sector meaning that any judicial engagement leads to a reduction than an increase of tax evasion with fraudulent invoices. The knowledge business owners have about the

violation of accounting rules and laws and the consequences appeared significant only to the manufacturing and trading sectors. The consequences (sanctions) receive a negative sign showing that the more business owners know about them in the manufacturing sector the less they evade. The size of the tax rates was

Table 3. Regression Results

<i>Dependent:</i>	<i>Trading</i>	<i>Manufacturing</i>	<i>Services</i>	<i>Construction</i>	<i>Tourism</i>	<i>Agricultural</i>
<i>Independent:</i>						
Constant	0,67 (0,07)*	0,44 (0,23)	2,25 (0,00)	1,97 (0,00)	1,12 (0,02)	1,17 (0,02)
Sanctions Ac					0,14 (0,07)	0,25 (0,00)
Sanction M-C				-0,13 (0,01)	-0,17 (0,04)	-0,32 (0,00)
Detection 1					-0,22 (0,00)	
Detection 2	0,11 (0,04)					
Detection 3			0,09 (0,08)			
Detection 4				-0,09 (0,09)	0,11 (0,05)	
Detection 5				0,13 (0,01)		
Intervention1						
Intervention 2			0,13 (0,02)		0,19 (0,00)	
Intervention 3			-0,09 (0,05)			
Knowledge 1	0,10 (0,06)	0,08 (0,1)				
Knowledge 2	0,09 (0,08)	0,14 (0,01)				
Knowledge 3		-0,09 (0,03)				
Severity 1			-0,12 (0,04)	0,1 (0,06)		
Severity 2						0,1 (0,09)
Severity 3						
Motivation 1	-0,17 (0,01)	-0,11 (0,07)				
Motivation 2	0,18 (0,00)	0,13 (0,03)				
Motivation 3						
Motivation 4		0,18 (0,00)	0,14 (0,02)	0,2 (0,00)	0,12 (0,05)	0,12 (0,08)
Motivation 5	0,11 (0,04)					
Tax Rates		0,09 (0,09)			0,13 (0,02)	
Way of Taxing				-0,14 (0,00)		
Auditing	0,27 (0,00)	0,34 (0,00)	0,37 (0,00)	0,31 (0,00)	0,27 (0,00)	0,27 (0,01)
Justice-Environ.			-0,21 (0,00)			
Third Parties 1						
Third Parties 2			0,24 (0,00)			
Third Parties 3			-0,15 (0,5)	0,11 (0,02)		
Third Parties 4						0,16 (0,00)
R ²	0,14	0,22	0,22	0,25	0,18	0,16
R ² _{adj}	0,12	0,2	0,2	0,23	0,15	0,14
F	7,36 (0,00)	10,37 (0,00)	9,13 (0,00)	12,39 (0,00)	7,86 (0,00)	9,4 (0,00)

* In parenthesis significance p-value.

significant in explaining tax evasion in the manufacturing and tourism sectors while the way of taxing only in construction sector. Fairness of the taxing system and environmental conditions like the globalization of markets, the low tax moral among entrepreneurs, the lack of a stable tax system and the overregulation and complexity of the tax system found to have an impact only on the services sector. Finally, in the decision to use fake and fictitious invoices, suppliers play a positive role in the construction sector and negative in the services one. Customers appeared to engage in the provision of services while third persons appeared to act as mediators to the use of fraudulent invoices only in the agricultural sector. Accountants and consultants were not found to have any engagement.

5. Discussion

Results have shown that the tax auditing is the dominant factor in determining the tax evasion with fake and fictitious invoices. Subsidies by the E.U. and the Greek Government appeared to be the next most important factor since the known methods of overpricing and adding fake deductible expenses are much profitable for companies. The variables of sanctions, knowledge of sanctions, and their severity was found significant to a small number of sectors with the explanatory power of the latter being almost negligible. However this is not a surprising result minded to the views (responses) of the participants in the survey that knowledge by the business owners about the existing sanctions is small and that severity of penalties is characterized as modest. Possible interference by employees in tax services in favor of business owners in the service (self-employed) and tourism sector appeared to play a significant role in inducing towards the use of fake and fictitious invoices. Tax rates and the way of taxing, together with the fairness of the tax system and the environmental conditions (e.g. complexity of tax laws) had relative small impact on tax evasion. Finally suppliers act jointly in the construction sector and customers in the services sector.

Overall, the findings of the present study call for a deterrence policy in several fronts with short run and long run effects in discouraging business owners to use fake and fictitious invoices. In the short run an effective audit program with more regular and intensive controls combined with sufficient fines will increase the cost of evasion considerably and provide incentives for tax compliance. The intensive investigation by the tax authorities and the increase in fines will be supported by new legislation which will be notified in an official and friendly manner towards business owners. It is important for taxpayers to have adequate knowledge about the tax laws and is equally important for tax authorities to collect sufficient evidence to prosecute and charge the suspect for tax evasion. In this context, tax authorities and policy makers should make good use of the technology provided and make a complete online information system. The aim of this project will be to improve the tax system and simplify the auditing processes. It will also untie the problem of the direct collation of the elements and items quoted on invoices as well as the origin and the validity of the issuer and recipient. The transactions made should pass to the Ministry of Finance and in this way knowing automatically and promptly the tax charge.

In the long run policy makers should focus in understanding how tax morale works and the probability to persuade people to pay their taxes. Studies have shown that apart from economic incentives, taxpayers are also motivated by moral aspects. (Alm et al., 1995; Torgler et al., 2007). In a society where there is a high degree of perception by its taxpayers that tax evasion is morally wrong then any free-riders will be disapproved (Fehr and Gächter, 2002). Also improving the quality of government institutions and the efficiency of public services will create positive attitudes to citizens against them and also increase tax morality thus enhancing the willingness of people to invest in public goods through tax compliance. Moreover, increasing motivation to be legal can also be managed by decreasing social security weights enforced on labor.

6. Conclusions

In the Greek economy tax evasion with the use of fake and fictitious invoices is intensified over the last few years. In this study, a survey was done which was applied on a random sample of 319 experts consisted of accountants-tax experts, charter accountants and tax auditors. To the best of our knowledge it is the first attempt to identify tax evasion through a survey on experts, the impact of derived factors on tax evasion with the use of forged invoices. Findings of the study indicated that the lack of proper auditing leads to higher tax evasion. The existence of subsidies from the European Union found to be the next most important driving force and motivator in creating fake and fictitious invoices. It is worth noting, that over the period 2000-2006, 21 billion euros was funneled into the Greek economy by the Third Community Support Framework. It is evident that the quality and quantity of auditing should increase and become more efficient in a sense that the probability of being caught and punished will rise up to a point, where the expected rate of return of tax evasion will be negative. Business owners should be well aware of the repercussions of tax evasion. Also the public services and various departments affiliated to government should produce positive externalities to the society in order to enhance the civic virtue thus increasing tax moral and reducing tax evasion.

Tax evasion is a complex phenomenon and its investigation is a formidable task. Empirical research on tax evasions includes tax models, sample surveys, and various macro indicators. It is common practice with surveys to collect data from households and business owners. The present study even if it differentiates and uses a sample of experts, doesn't stop from pumping the data from the opinions of those experts. A study that will also include the views of business owners will improve the generability of the findings. Furthermore, the determinants can be associated and not have a separate influence. For instance, the severity of penalties can lower when the tax evading businessman knows that can avoid the penalties

with the help of third parties, a fact that also differentiate his perception for the revealing of the tax evasion. The regression analysis can identify the important factors but within a static and not dynamic field which assumes the interaction between factors. The implementation of structural equation modeling- SEM could show those interactions but also their sequence (path analysis).

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Is Macroeconomic Stability a Factor of Market Efficiency? : The Eurozone Case

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Abstract: In this paper we examine the differences in market efficiency in twelve Eurozone countries divided in two groups, named North and South, following their different fates after the recent financial crisis, the period of study being 2002-2013. For each group a series of tests attempts to spot differences arising from macroeconomic instability. The conclusion is that the two groups are not substantially different in market efficiency and thus this characteristic is not directly influenced by economic status.

1. Introduction

Following almost five years since its initial appearance in America the 2008 financial crisis nowadays most commonly referred to as the Global Financial Crisis, still puzzles the world's economists as to how to end its catastrophic consequences (Burton G. Malkiel, 2011). The market that proved more vulnerable and therefore is the one of more urgent attention is the European Eurozone which due to its special political and economic structure demands a deeper understanding of the differences between the member states' financial needs and potential.

Shortly after the crisis crossed the Atlantic it became apparent that certain countries were in dire need of rescue plans, because of large deficits and government debts to GDP ratios, such as Greece and Portugal while others of significantly larger proportions like Italy or Spain saw their spreads soar and dreaded speculators and rating agencies' next moves. Up to this point (fourth quarter of 2013) most of the countries more severely stricken by the crisis are located in the European South with the only exception of Ireland. As a result, austerity measures proposed by the EU council and the IMF have been taken leading to increasing political instability and economic recession. On the other hand despite some increase in unemployment rates and some decrease in surplus most of the Eurozones' highly developed countries located in central and northern Europe have not been influenced by the crisis to such a large extent. Many economists and media analysts have named the two groups the South and the North respectively to point out these differences. However, despite the fact that countries included in the South category have had relatively poorer macroeconomic performance during the last years there has been so far no certain theory that can explain any structural weaknesses or inefficiencies in the way these countries' economies function so as to make clear whether the crisis was the last blow in economies already fragile or if it was internal functioning problems that let the problems grow. Therefore if there are any differences they are

bound to show up in the way economies and more specifically stock markets function.

2. Literature Review-The Efficient Market Hypothesis

EMH implies that stock prices always represent the true value of a company and thus trade at a fair value. Lack of efficiency is a sign that players in the market are not faced with a fair game and thus market manipulation is made possible and technical analysis is of some use. According to Eugene Fama (1970, 1991) there are three types of market efficiency: weak, semi-strong and strong.

According to weak form market efficiency historical data (e.g. prices, returns, volume) are already reflected in prices and cannot be used in order for an investor to get returns disproportionate to the risk taken over. Thus, technical analysis tools cannot result in excess returns. If market is weak form efficient, successive prices are not dependent, in other words there are not price patterns to be identified. In this case prices follow random walk. The existence of random walk also implies the existence of weak market efficiency. However, the opposite is not true.

Semi-strong market efficiency implies that prices reflect all publicly available information. Thus, neither technical nor fundamental analysis can be used in order for someone to get excess returns. Testing for semi-strong market efficiency mainly consists of checking the reaction of prices to previously unknown news.

Strong market efficiency implies that prices reflect any kind of information, be it public or private. Its existence means that no trader has monopolistic access to information. In order for someone to test for strong form, investor returns must be checked for a decent amount of time, although there is always a possibility that some of them are really capable or merely lucky to beat the market.

There are several articles in literature which have already referred to market efficiency in re-

lation to developed and developing markets as well as the financial crisis. Andrew C. Worthington and Helen Higgs (2003) have shown that all of the markets which we are about to test are weak form efficient. Similar research was done by the same authors for Asian markets, again with a distinction between developed and developing markets (2005). In this case, the results differ depending on the methodology. Serial correlation and runs tests indicate weak form efficiency among all countries. Unit root tests indicate weak form efficiency in most markets, with one exception from developing and one from developed countries. The only test that indicated a difference between emerging and developed markets was the multiple variance ratio test, according to which no developing market was weak form efficient but some developed ones are (Hong Kong, New Zealand, Japan). However, the effects of the crisis demand a post accidental second survey to validate the previous results. A series of articles has been written on market efficiency in emerging economies. Mobarek and Fiorante (2014) tested its existence in BRIC countries and came up with the result that these markets are approaching market efficiency especially in the recent years. A similar article by Lagoarde-Segot and Lucey (2008) on MENA countries characterizes stock market size and corporate governance as factors of market efficiency while economic liberalization does not seem to have such a role. The relationship between the latter and market efficiency in emerging countries was tested by Ben Rejeb and Boughrara (2013). According to their article there is greater efficiency in the recent years (something which Mobarek and Fiorante also came up with) and financial liberalization is positively correlated with market efficiency and also deterrent to possible financial crises. Regarding market efficiency itself, Burton G. Malkiel (2011) studies the questions market efficiency in relation to the financial crisis and concludes that it is no use searching for perfect market efficiency. We should instead look for relative efficiency, to which most financial markets are very close, as he concludes. To statistically prove weak form efficiency

we would have to turn to random walk theory. Random Walk Theory suggests that prices in the market tend to move in a random way so that at each separate stage of its lifetime it has exactly the same probability to have a certain value (same density function probability). As a result there is no correlation between prices or a certain pattern that would enable players to outperform the market if they make full analysis of historical data concerning these particular equities. Thus random walk theory (RWT for the purposes of this survey) rises and falls with weak form efficiency in the market.

3. Data/Methodology

In order to reach to a conclusion concerning the relationship of macroeconomic level and market efficiency, we have taken data for 12 Eurozone countries since 2002. Judging from their credit rating, GDP, deficit, bond spread and unemployment we have separated those countries into two categories: the first contains those with the better economic performance (Germany, Austria, France, Netherlands, Finland and Belgium) and the latter consists of Greece, Italy, Spain, Cyprus, Portugal and Ireland. Data taken include a blue chip index from each state (e.g. DAX), as these indices have usually the highest trading volume and are therefore the most suitable for a market efficiency test.

For our sample we have used the daily prices from the main indexes of each country. Throughout the article these abbreviations are used: for Austria (AUS), for Belgium (BEL), for Finland (FIN), for France (FRA), for Germany (GER), for Greece (GRE), for Ireland (IRE), for Italy (ITL), for the Netherlands (NTH), for Portugal (POR) and for Spain (SPN) and (CYP) for Cyprus.

Most of the countries adopted the Euro on 1/1/2002 with the exception of Cyprus 1/1/2008 which was added despite its late adaptation of Euro due to its similar situation as mentioned above.

All data was obtained for Bloomberg database and refer to the period from 2002 to 2013. For

each index we have calculated its daily logarithmic returns as follows:

$$R_t = \log(p_t/p_{t-1})$$

Then we submitted our data into a series of tests in order to determine if there is any difference between the North and the South concerning weak market efficiency, and thus if the macroeconomic condition influences it in any way.

Descriptive Statistics

At first, some fundamental descriptive statistics was implemented such as mean, median, standard deviation, kurtosis, skewness and the Jarque Bera test. Some critical features of the sample were noted, especially regarding the Jarque Bera test. The latter is a goodness of fit test which is used to determine whether sample data have the skewness and kurtosis of a normal distribution. Its test statistic is defined as

$$JB = n/6(S^2 + 1/4(K-3)^2)$$

where n stands for degrees of freedom, S for skewness and K for kurtosis.

Kolmogorov-Smirnov test

The Kolmogorov-Smirnov is a non-parametric test used to determine if data follows a specific distribution. Its hypotheses are:

Ho: Data follows a specific distribution.

H1: Data does not follow a specific distribution.

Its test statistic is defined as:

$$D = \max_{1 \leq i \leq N} [F(Y_i) - \frac{i-1}{N}, \frac{i}{N} - F(Y_i)]$$

F represents the theoretical cumulative distribution of the one being tested. The hypothesis is rejected if D is greater than the critical value.

Runs Test

The runs test is a non-parametric way to check if data comes from a random process. In other words it is tested whether successive prices changes are independent. An advantage of this method is the absence of any requirement for normal distribution of the data. The test tests if the elements are independent and identically distributed.

A run is a sequence of consequent adjacent equal elements. In case of stocks and price changes, a run is a series of consequent positive or negative price change. The test compares the amount of runs in the existing data with the amount of runs which a normally distributed sample would have. Under the null hypothesis, if the sample consists of N elements, the number of runs is approximately normal with:

$$\text{Mean: } R' = \frac{2n_1n_2}{n_1+n_2} + 1$$

$$\text{Variance: } s^2 = \frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1+n_2)^2 (n_1+n_2 - 1)}$$

Where n1 stands for positive and n2 for negative values

The null and the alternative hypotheses go as follows:

Ho: series is random (temporal independence)

H1: series is not random

In order for the Ho to be rejected, $|Z| > z_{1-\alpha/2}$,

where $Z = \frac{R-R'}{s}$ (R defines the observed number of runs). If Ho is rejected, this means that the number of runs is not indicative of a normal distribution.

Unit Root Tests

Unit root tests are implemented in order for a time series to be characterized as stationary or non-stationary. Three unit root tests were used within this paper: the Augmented Dickey Fuller (ADF) test, the Phillips-Perron (PP) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test.

ADF is conducted in the form of the regression equation:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \dots + \delta_{p-1} \Delta y_{t-p+1} + \epsilon_t$$

where α is a constant, β the coefficient on a time trend and p the lag order of the autoregressive process.

The Phillips Perron test is an alternative for ADF test. Its test statistic is modified in a way that its asymptotic distribution is not affected by serial correlation.

For ADF and PP test the null and alternative hypotheses are:

Ho: series contains a unit root (is non-stationary)

ary)

H1: series does not contain a unit root (is stationary)

The KPSS test is another test which is used to complement ADF test. The difference is that the hypotheses go vice versa in comparison to those of ADF and PP:

Ho: series does not contain a unit root (is stationary)

H1: series contains a unit root (is non-stationary)

Ljung Box Test

Ljung Box is a test for residual autocorrelation. It is used to measure whether there is dependence of random variables in a series. It is defined as follows:

Ho: series has zero autocorrelation (data are independently distributed)

H1: series has nonzero autocorrelation (data not independently distributed)

The test statistic is defined as:

$$Q = n(n+2) \sum_{k=1}^h \frac{P_k^2}{n-k}$$

Where r_k is the estimated autocorrelation at lag k and h is the number of lags. Ho is rejected when $Q > \chi^2_{1-\alpha, h}$

Technical Analysis & Sharpe Ratio

The existence of weak market efficiency means that one cannot use published information such as historical prices in order to get returns disproportionate to the risk undertaken. Thus, one way to test if there is weak market efficiency is to evaluate the returns of a strategy implementing technical analysis. In order to do this we opted for a simple technical analysis strategy based exactly on the idea of historical prices, the indicator "Rate of Change". It is a pure momentum oscillator calculated as follows:

(Closing Price Today - Closing Price "n" Periods Ago) / Closing Price "n" Periods Ago

We implemented a simple trading strategy: a buy signal when the oscillator crosses the zero line from negative values to positive and a sell signal in case of an opposite zero line crossover. We also used a two days' filter in order for better signals to be taken. Using Matlab we

calculated the returns that a trader would have had if he had used this strategy for each index from 2002 and 2013. We did that in a form of sensitivity analysis as we calculated the returns for a holding period of 1,2,3...30 days for each signal.

After calculating the returns from each signal we submitted them into a right t-test. The hypotheses of the right-t test are:

Ho: The mean of the distribution of the returns is zero

H1: The mean of the distribution of the returns is greater than zero

After examining the ability of technical analysis to provide investors with positive returns, we imported in our paper the idea of adjusted to risk return in order to test the existence of weak market efficiency. In order to achieve this we created two portfolios, one consisting of 6 southern countries and one of the 6 northern (all indexes were equally weighted in both portfolios). For the period between 2008-2013, when the macroeconomic differences between the two groups of countries became more eminent and apparent, we compared the Sharpe Ratio of a Rate of Change strategy to a Buy and Hold strategy. In other words, it was not a North vs South matter, but a comparison of Buy/Sell & Hold to technical analysis trading for the North and the South separately. Positions on Buy/Sell & Hold and Trading were equally risky, as they consisted of exactly the same assets with the same weights. Thus, a difference in the returns of the two strategies would imply returns surpassing the amount of risk taken over. What we wanted to test was if there is any difference between the two groups in the ability of someone to get returns disproportionate to the risk undertaken, thus if there is any difference concerning weak market efficiency between the North and the South.

Considering the different options for calculating adjusted to risk return, we rejected both options based on CAPM (alpha and beta) since data tested represent more or less the market itself, which would render the tests meaningless. The existence of beta in Treynor's ratio was the reason why this alternative was also left out of the question. R squared was also not a good

choice for a similar reason; it needs a benchmark index in order to function. Thus we opted for Sharpe Ratio although it is more reliable for normally distributed data and not for data like the ones being tested in this article.

4. Empirical Results

Regarding descriptive statistics (Table 1 below), most noteworthy is the Jarque Bera test, according to which no country returns are normally distributed. Thus, there is no difference between the two groups concerning the distribution of the returns. We draw exactly the same conclusion from the Kolmogorov-Smirnov test.

The runs test (Table 2 below) is the first test which seems to evince a difference between the two groups, as far as weak market efficiency is concerned. Only two countries from the North (Finland and France) but four countries of the South (Greece, Cyprus, Italy and Portugal) rejected the null hypothesis. In those countries succeeding market prices seem to be dependent and not to follow random walk.

Unit root tests (Table 3 below) did not prove any difference between the North and the South, perhaps with the exception of the KPSS test. Null hypothesis of ADF and PP was rejected for all 12 countries. Irrespective of the macroeconomic condition, no countries return contains a unit root. In other words, they are stationary and have no indication of random walk. However, the results of the KPSS test demonstrate that three of the six southern countries (Greece, Cyprus, Ireland) do have a unit root and consequently follow random walk. This is contradictory not only to the rest of the unit root tests but also the runs test which showed an absence of serial independence especially in those three countries.

The Ljung Box (Table 2 below) test also confirmed the similarity of all countries concerning weak market efficiency. Null hypothesis was rejected for all of them, proving the existence of autocorrelation and serial interdependence of the variables and thus the absence of random walk.

Concerning the use of technical analysis, the

first part (Tables 4&5 below) indicated that there is a certain reason why someone would use it and actually take advantage of the knowledge of historical prices. For all countries, the use of a simple momentum indicator resulted in significant returns as long as the holding period in case of each signal was simply more than two or three days. Null hypothesis of the right sided t-test was rejected in all cases for a holding period of more than two or three days, with mostly a probability of 0.00.

However, the fact that technical analysis resulted in positive returns does not exclude the existence of weak market efficiency. Risk had to be put in the equation in order for this to be examined, which we did afterwards (Table 6 below). On the upper part we see the Sharpe Ratios of the portfolios that followed a Buy & Hold or Sell & Hold Strategy for both the North and the South. On the down part we see the Sharpe Ratios of the portfolios that implemented Rate of Change. Each portfolio used the signals arising from Rate of change for a holding period of 1,2,3..30 days. We do not compare the North to the South, but the adjusted to risk returns (Sharpe Ratios) of passive strategies with those of active strategies for both groups separately. What we see again is that a mere holding period of more than 3 days for each signal produces better adjusted to risk returns than a passive strategy for both groups. This leads us to two results. First, there is no evidence of weak market efficiency since one can use past prices in order to get results which surpass the risk one has taken over. Second, the situation is similar in all cases, regardless of country of domicile and macroeconomic condition.

5. Conclusions/Further Research

The results point out that Random Walk Hypothesis is rejected for both groups. All 12 tested countries do not follow normal distribution as Jarque Bera and Kolmogorov-Smirnov test results have shown. Moreover as far as autocorrelation and dependency are concerned the tests with minor exceptions agree upon the absence of random walk, when it comes to the

differences of the two groups and not focusing on each of the countries separately. The Ljung Box resulted in the unanimous rejection of the null hypothesis thus assuming autocorrelation and interdependence, while results from the three unit root tests (ADF, PP, KPSS) were mostly similar with complete rejection of null hypothesis in the first two but during KPSS unit roots were confirmed for three countries of the South (Greece, Cyprus, Ireland). However random walk is again observed absent in the runs test where two countries of the North (Finland and France) and four countries of the South (Greece, Cyprus, Italy and Portugal) have their null hypothesis rejected. The results are somewhat contradictory in some cases but strong evidence of a major difference between the two remains to be found.

When it comes to Efficient Market Hypothesis, putting aside the results of the tests mentioned above about Random Walk Hypothesis, technical analysis has led to rejection. The right sided t-test showed significant returns as a rule of thumb and dismissal of the null hypothesis which in fact neither confirmed nor rejected the possibility of weak market efficiency. However that possibility lessened to zero in the second phase of technical analysis where we used Sharpe ratio to compare active and passive strategies returns and found that the former bested the latter by a long shot. Thus the results following were that an investor can use past prices in order to get results which surpass the risk one has taken over while this situation is similar in all countries of both groups, regardless of different macroeconomic characteristics.

In conclusion we can assume that since both random walk theory and efficient market hypothesis are rejected for our two groups there is no particular reason to believe the recent financial crisis has so deeply affected the market conditions in the South so as to become substantially different from those in the North and that perhaps macroeconomic condition is not directly related with market efficiency.

Future research could follow two separate ways in our opinion: First, the countries of the South or more generally the Eurozone coun-

tries which face similar problems regarding macroeconomic stability could be compared with developing countries so as to understand if the tests we put in use are effective for judging the economic proprieties and conditions of countries concerning stability, market efficiency and growth. If there major differences it's inescapable that they will appear when comparing developed and developing countries. Second, as the first way seems to imply there are some doubts cast upon how effectively the theory of market efficiency has been formulated. Theoretically there are three types of market efficiency, one more general than the other but the results of accepting/rejecting the weak form (which is the one most usually tested since higher forms are very rarely found) do not agree with some empirical data which suggest that although we might have random walk/weak form there are periods when there is in fact serious correlation (Burton G. Malkiel 2011). As a result the theory might have to be modified so as to focus on both short term and long term periods and if applied provide us with clearer answers. For these reasons we strongly recommend search making use of variations of the original theory like the theory of Adaptive Market Hypothesis (Lo, 2004) which suggest that dependence varies across time so that there are periods of complete, little or no correlation (Todea, Ulici, Silaghi 2009).

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7. Tables

Table 1. Descriptive Statistics

	Mean	Standard Error	Median	Standard Deviation	Kurtosis	Skewness	Count	Jarque Bera	JB-prob
AUS	0,000271464997775	0,000292757	0,000959	0,015811565	6,61338554	-0,3117752	2917	5346,3850	0,0000000
BEL	0,000007759015898	0,000246473	0,000321	0,01352684	5,83685453	0,03014514	3012	4264,2340	0,0000000
GER	0,000163529159495	0,000288227	0,000832	0,015773669	4,7187117	0,0507349	2995	2763,8300	0,0000000
FR	-0,000039873580780	0,000280969	0,00033	0,015420061	5,23559776	0,0730566	3012	3420,7360	0,0000000
FIN	0,000124924004607	0,000281482	0,000588	0,01530131	3,90147364	0,10597703	2955	1858,8820	0,0000000
NTH	-0,000097899300770	0,000281228	0,000446	0,01543427	6,38015352	-0,0236968	3012	5089,0160	0,0000000
GRE	-0,000479367414989	0,000381364	7,56E-05	0,020653619	4,398823	0,1637125	2933	2370,8700	0,0000000
IRE	-0,000164919512291	0,00036311	0,0003	0,016949885	7,95451427	-0,5510365	2179	5834,2400	0,0000000
POR	-0,000093183035121	0,000214499	0,000274	0,011758399	8,5510984	-0,1449468	3005	9107,0290	0,0000000
SPN	0,000029640149130	0,000282457	0,000664	0,015429485	5,74387704	0,15005536	2984	4087,9280	0,0000000
CYP	-0,000941587551042	0,000457869	-0,0005	0,024779983	4,36820397	0,0825621	2929	2317,7890	0,0000000
ITL	-0,000195589367068	0,000284631	0,000659	0,015556055	4,85295041	-0,0351465	2987	2912,3730	0,0000000

Table 2. Kolmogorov/Smirnov, Runs Tests, Autocorrelation test

	Kolmogorov-Smirnov			Runs Test						Autocorrelation		
	h	p	ksstat	h	p	Runs	Cases> mean	Cases< mean	z value	h	pvalue	stat
AUS	1	0	0.4755	0	0,125296	1415	1533	1386	-1,5329	1	0,001659135	43,68297319
BEL	1	0	0.4783	0	0,825898	1499	1561	1452	-0,2200	1	0,000000014	76,72972144
GER	1	0	0.4741	0	0,094983	1541	1576	1420	1,6696	1	0,002915126	41,82427338
FR	1	0	0.4758	1	0,006116	1552	1531	1425	2,7409	1	0,000002896	62,50604684
FIN	1	0	0.4752	1	0,000256	1607	1549	1464	3,6544	1	0,000000169	70,19749657
NTH	1	0	0.4739	0	0,83889	1499	1567	1446	-0,2033	1	0,000004532	61,26331517
GRE	1	0	0.4689	1	0,000114	1361	1524	1410	-3,8570	1	0,000373980	48,39794948
IRE	1	0	0.4620	1	0,022395	1403	1498	1432	-2,2834	1	0,000027508	56,15905547
POR	1	0	0.4764	1	0,023591	1553	1573	1415	-2,2634	1	0,000004617	61,21150873
SPN	1	0	0.4755	0	0,239623	1523	1560	1425	1,1759	1	0,000053098	54,25070888
CYP	1	0	0.4820	1	0,011139	1431	1571	1435	-2,5381	1	0,000045397	54,70793599
ITL	1	0	0.4747	0	0,053338	1044	1130	1050	-1,9320	1	0,000074345	53,26283152
			cr. value:0.0247									cr. value: 31,41043

Table 3. Unit root tests

	ADF t stat	ADF p value	ADF result		KPSS p value	KPSS stat	KPSS result		PP p value	PP stat	PP result
AUS	-51,354721	0,001	H1(no unit root)		0.0723	0.1339	Ho(no unit root)		0,0010000	-51,36320	H1(no unit root)
BEL	-52,134337	0,001	H1(no unit root)		0.0876	0.1257	Ho(no unit root)		0,0010000	-52,14320	H1(no unit root)
GER	-55,673404	0,001	H1(no unit root)		0.1000	0.0764	Ho(no unit root)		0,0010000	-55,84050	H1(no unit root)
FR	-55,637347	0,001	H1(no unit root)		0.1000	0.0734	Ho(no unit root)		0,0010000	-56,18100	H1(no unit root)
FIN	-56,986705	0,001	H1(no unit root)		0.1000	0.0694	Ho(no unit root)		0,0010000	-56,99740	H1(no unit root)
NTH	-55,533750	0,001	H1(no unit root)		0.1000	0.0763	Ho(no unit root)		0,0010000	-55,54300	H1(no unit root)
GRE	-51,079562	0,001	H1(no unit root)		0.0397	0.1584	H1 (unit root)		0,0010000	-51,77970	H1(no unit root)
IRE	-49,573866	0,001	H1(no unit root)		0.0189	0.1924	H1 (unit root)		0,0010000	-50,28010	H1(no unit root)
POR	-54,946893	0,001	H1(no unit root)		0.1000	0.0820	Ho(no unit root)		0,0010000	-55,19270	H1(no unit root)
SPN	-54,357204	0,001	H1(no unit root)		0.1000	0.0691	Ho(no unit root)		0,0010000	-54,62190	H1(no unit root)
CYP	-51,592444	0,001	H1(no unit root)		0.0972	0.1205	Ho(no unit root)		0,0010000	-51,66120	H1(no unit root)
ITL	-44,506869	0,001	H1(no unit root)		0.0455	0.1514	H1 (unit root)		0,0010000	-52,33930	H1(no unit root)
					cr value: 0,1460					(c value: -1,9416)	

Tables 4&5. T test for technical analysis returns

Holding Period(Days)	AUS		BEL		GER		FRA		Finland		NTH	
	h	p	h	p	h	p	h	p	h	p	h	p
1	0	0,128574	1	0,010466	1	0,033455	0	0,121362	0	0,101879	0	0,148824
2	0	0,085346	1	0,003443	0	0,075389	1	0,014006	1	0,03158	1	0,014328
3	1	0,036606	1	0,00322	0	0,077763	1	0,002373	1	0,012387	1	0,00188
4	1	0,028175	1	0,001887	0	0,088392	1	0,000384	1	0,004459	1	0,004688
5	1	0,028121	1	0,001241	1	0,007055	1	7,45E-05	1	0,001401	1	0,018465
6	1	0,026692	1	0,00021	1	0,001287	1	3,79E-08	1	9,84E-05	1	0,000365
7	1	0,02538	1	0,000208	1	9,96E-06	1	1,43E-09	1	1,27E-07	1,00E+00	5,37E-07
8	1	0,024037	1	1,19E-15	1	2,99E-16	1	1,82E-20	1	6,16E-19	1,00E+00	2,60E-19
9	1	0,023586	1	2,03E-22	1	2,73E-20	1	7,00E-23	1	1,21E-23	1,00E+00	1,37E-23
10	1	0,023544	1	9,94E-26	1	1,81E-23	1	3,56E-28	1	3,56E-29	1,00E+00	7,92E-27
11	1	0,023655	1	1,58E-21	1	1,18E-21	1	1,17E-23	1	1,96E-25	1,00E+00	2,05E-24
12	1	0,023691	1	6,01E-17	1	6,90E-18	1	6,35E-21	1	1,43E-19	1,00E+00	2,73E-21
13	1	0,023759	1	1,08E-14	1	3,53E-16	1	3,82E-20	1	2,28E-19	1,00E+00	7,34E-19
14	1	0,023766	1	1,40E-14	1	1,23E-14	1	2,71E-18	1	4,19E-16	1,00E+00	3,74E-19
15	1	0,023707	1	2,34E-14	1	2,50E-13	1	1,16E-15	1	9,42E-14	1,00E+00	2,63E-16
16	1	0,023881	1	7,21E-12	1	1,52E-12	1	5,44E-14	1	1,36E-12	1,00E+00	2,62E-14
17	1	0,024163	1	1,09E-12	1	5,97E-13	1	1,35E-13	1	1,94E-12	1,00E+00	1,29E-13
18	1	0,0245	1	8,40E-11	1	2,15E-11	1	7,99E-11	1	6,45E-13	1,00E+00	1,00E-11
19	1	0,024603	1	7,10E-11	1	1,40E-11	1	2,40E-11	1	1,29E-12	1,00E+00	6,72E-12
20	1	0,024392	1	3,40E-10	1	5,93E-11	1	1,39E-10	1	9,57E-12	1,00E+00	7,02E-12
21	1	0,024463	1	1,98E-09	1	3,41E-10	1	2,82E-10	1	6,72E-13	1,00E+00	1,36E-12
22	1	0,024564	1	1,29E-08	1	1,73E-11	1	8,02E-10	1	2,72E-12	1,00E+00	3,32E-12
23	1	0,024885	1	4,57E-08	1	2,00E-10	1	1,41E-09	1	3,29E-11	1,00E+00	1,16E-11
24	1	0,024577	1	1,10E-08	1	4,47E-10	1	3,19E-09	1	1,60E-11	1,00E+00	9,80E-11
25	1	0,024665	1	7,68E-09	1	3,71E-10	1	4,76E-09	1	1,23E-11	1,00E+00	3,53E-10
26	1	0,024833	1	1,56E-08	1	8,31E-11	1	7,59E-09	1	2,12E-10	1,00E+00	1,07E-10
27	1	0,024721	1	3,64E-08	1	2,44E-10	1	4,77E-09	1	2,38E-10	1,00E+00	1,36E-10
28	1	0,024795	1	2,40E-07	1	5,28E-10	1	3,24E-09	1	1,47E-10	1,00E+00	2,39E-10
29	1	0,02496	1	7,05E-07	1	3,66E-10	1	3,51E-09	1	5,07E-11	1,00E+00	1,89E-10
30	1	0,025141	1	4,83E-06	1	2,68E-09	1	1,67E-08	1	3,55E-10	1,00E+00	1,65E-10

Holding Period(Days)	GRE		IRE		POR		SPN		CYP		ITL	
	h	p	h	p	h	p	h	p	h	p	h	p
1	0	0,863045	0	0,245886	1	0,01271	0	0,226972	0	0,594489	1	0,016681
2	0	0,851977	0	0,173593	1	0,007492	0	0,16093	0	0,820245	1	0,009958
3	0	0,355396	1	0,021986	1	0,000951	0	0,129545	0	0,678502	1	0,003091
4	1	0,024545	1	0,000718	1	0,000776	1	0,029991	0	0,242565	1	0,001393
5	1	0,026334	1	0,00068	1	1,33E-05	1	0,048409	1	0,006127	1	0,000149
6	1	0,000128	1	9,53E-05	1	7,39E-07	1	0,001515	1	0,000682	1	2,59E-05
7	1	3,26E-09	1	2,54E-06	1	8,42E-09	1	0,000105	1	1,73E-06	1	1,25E-10
8	1	5,68E-15	1	2,71E-11	1	4,22E-20	1	5,53E-18	1	5,97E-20	1	3,01E-18
9	1	2,60E-15	1	6,01E-17	1	4,96E-25	1	1,80E-19	1	2,50E-22	1	1,71E-19
10	1	6,25E-16	1	7,16E-18	1	2,05E-29	1	3,22E-22	1	4,67E-22	1	1,71E-22
11	1	5,24E-14	1	1,14E-15	1	5,70E-26	1	7,49E-21	1	7,18E-20	1	9,93E-21
12	1	1,17E-13	1	4,51E-15	1	5,11E-22	1	8,11E-19	1	2,93E-20	1	8,50E-18
13	1	1,68E-12	1	4,14E-14	1	2,45E-21	1	1,08E-17	1	2,75E-19	1	2,41E-17
14	1	5,74E-12	1	5,22E-14	1	3,62E-19	1	1,73E-16	1	1,47E-18	1	2,02E-15
15	1	1,86E-12	1	7,71E-15	1	6,87E-17	1	6,74E-13	1	5,58E-15	1	7,10E-13
16	1	2,19E-12	1	1,09E-12	1	8,44E-15	1	4,17E-12	1	2,09E-14	1	4,22E-12
17	1	6,71E-11	1	2,06E-10	1	1,53E-13	1	1,49E-09	1	7,04E-13	1	2,42E-11
18	1	4,36E-10	1	1,07E-08	1	5,08E-14	1	1,40E-09	1	3,17E-12	1	6,71E-11
19	1	1,52E-09	1	2,65E-08	1	1,21E-13	1	1,80E-09	1	2,54E-12	1	9,35E-10
20	1	3,67E-10	1	3,61E-09	1	2,52E-13	1	6,80E-08	1	2,21E-11	1	8,02E-08
21	1	1,08E-09	1	7,48E-09	1	1,35E-11	1	1,82E-07	1	1,50E-10	1	7,53E-08
22	1	1,48E-08	1	1,91E-08	1	5,80E-11	1	1,07E-07	1	5,09E-10	1	8,74E-08
23	1	1,89E-08	1	2,04E-07	1	3,50E-10	1	3,09E-08	1	1,04E-10	1	1,98E-07
24	1	1,48E-08	1	2,14E-08	1	3,63E-09	1	1,64E-07	1	7,96E-10	1	1,72E-07
25	1	2,98E-08	1	4,37E-08	1	2,34E-08	1	1,39E-07	1	4,58E-10	1	4,62E-07
26	1	4,04E-08	1	1,46E-07	1	7,70E-09	1	1,88E-06	1	3,47E-10	1	1,89E-06
27	1	8,25E-08	1	6,68E-08	1	3,23E-09	1	3,07E-06	1	4,10E-09	1	1,11E-05
28	1	2,05E-08	1	1,13E-07	1	2,42E-08	1	1,59E-05	1	4,31E-09	1	1,54E-05
29	1	3,91E-08	1	3,22E-07	1	4,62E-07	1	1,20E-05	1	8,30E-09	1	0,000132
30	1	3,01E-07	1	8,57E-07	1	5,63E-07	1	5,28E-06	1	1,50E-08	1	0,00028

Table 6. Sharpe Ratios for technical analysis VS passive strategies

		Sharpe Ratios(Hold)		South	North
		Buy and Hold		-0.9934	-3,0736
		Sell and Hold		0.7738	0,5529
		Sharpe Ratios		Sharpe Ratios	
HP(Days)	South	North	HP(Days)	South	North
1	-0,68729	-0,063080354	16	2,1444637	9,796185
2	-0,3792	2,956837998	17	2,2268561	10,42388
3	0,29834	3,465999763	18	2,1240628	10,09531
4	1,549218	2,378782624	19	2,0383849	9,827118
5	1,96039	2,437529289	20	1,9943551	9,996767
6	4,003784	2,692930652	21	3,2959295	6,712939
7	3,795121	2,597685977	22	2,9188327	6,685851
8	4,869397	8,152553731	23	2,9072614	6,820295
9	4,034943	10,30248424	24	2,7572226	9,724941
10	3,985666	10,69132946	25	2,5824856	12,25995
11	3,464107	8,574962736	26	2,4572905	15,52396
12	3,305333	7,837335934	27	2,5107731	12,322
13	3,528246	8,167489435	28	2,4195707	11,09307
14	3,814821	7,70247259	29	2,4422904	10,12418
15	3,769739	8,031463963	30	2,3547202	11,39959

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Every stone has a history and a value



appreciate it

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