International Journal of Latest Trends in Finance & Economic Sciences

ExcelingTech
Foster the knowledge

Editorial Board

Abstracting / Indexing

International Journal of Latest Trends in Finance and Economic Sciences (IJLTFES) is abstracted / indexed in the following international bodies and databases:

- EBSCO
- Google Scholar
- DOAJ
- Scirus
- Getcited
- Scribd
- NewJour
- citeseerx

Table of Contents

Methodological Issues for Estimating the Total Value of the Rehabilitation of Mining Fields: the Case of S. Domingo's Mine

Isabel Mendes[1], Idalina Dias Sardinha[2], Sérgio Milheiras[3]

(1) ISEG – School of Economics and Management, Department of Economics /SOCIUS – Research Center in Economic and Organizational Sociology, Technical University of Lisbon. Rua Miguel Lupi, 20, 1249-078 Lisbon, Portugal; Author for correspondence (midm@iseg.utl.pt);
(2) SOCIUS – Research Center in Economic and Organizational Sociology, Technical University of Lisbon. Rua Miguel Lupi, 20, 1249-078 Lisbon, Portugal (idalinasardinha@iseg.utl.pt;
(3) SOCIUS – Research Center in Economic and Organizational Sociology, Technical University of Lisbon. Rua Miguel Lupi, 20, 1249-078 Lisbon, Portugal (rehmine@socius.iseg.utl.pt).

Abstract - **The rehabilitation of abandoned mining fields is perceived by locals as of great value for nurturing the sustainable development of socio-economically depressed regions, as it is characteristic of regions home to abandoned mines. One way of contributing towards the success of such rehabilitation projects is to evaluate their total economic value. In this paper we discuss the use of a contingent valuation methodology as the most appropriate to estimate the total economic value that the rehabilitation of the abandoned S. Domingos Mine will generate. We seek to provide a preliminary discussion of some key aspects essential to design a convincing stated preference methodological framework, enabling us to further estimate a valid and reliable money measure for the total benefits of the rehabilitation process. Such money measure should be an additional incentive towards the commitment of local authorities and stakeholders towards the project and the overall acceptance and recognition of its environmental and social value by society (besides the more obvious market economic value). Furthermore, the elicitation of the non-market benefits of the rehabilitation can be used subsequently for a Cost-Benefit Analysis, enabling public authorities to take truly sustainable local development decisions promoting development in accordance with the Triple-Bottom-Line framework.**

Key Words -*Contingent Valuation; Mine; Non-Marketed Benefits; Rehabilitation.*

1.   Introduction

Governments are often left with liabilities for abandoned mine rehabilitation because the effective process of such contaminated sites implies expensive undertakings, complex technological solutions, the involvement of local authorities and the input of many other differentiated stakeholders, and the acceptance and recognition of the rehabilitation project by society. Overall, rehabilitation is perceived by locals as of great value for nurturing the sustainable development of socio-economically depressed regions, given this represents a characteristic of many regions home to abandoned mines. The success of such rehabilitation projects definitely depends on the overall acceptance and recognition of their total economic and social value by society in conjunction with the commitment of local authorities and other stakeholders. One way of contributing to a successful outcome is estimating all the monetary benefits, particularly non-marketed social and environmental benefits, generated by rehabilitation projects for such contaminated sites. In this paper, we propose and discuss some key preliminary questions for using a contingent valuation methodology to estimate the non-market benefits of the abandoned S. Domingos mine rehabilitation project. We begin by characterizing the scope of intervention, defining the rehabilitation project and the marketed and non-marketed benefits that are expected following successful project implementation. Furthermore, the theoretical monetary measure for non-marketed social and environmental benefits is ascertained and an empirical methodology for its estimation is proposed. A contingent valuation stated preference approach seems most appropriate for this purpose. After a literature review of the empirical applications of stated preference approaches for valuing the benefits of abandoned mine field projects, the main steps necessary to apply a contingent valuation to the S. Domingos Mine rehabilitation project are set out. For each step, particular aspects emerging from the empirical application to the S. Domingos Mine are discussed with some solutions put forward for more effective empirical application. We expect to obtain a convincing preliminary stated preference methodological framework that will further enable us to estimate a monetary measure for the non-market social and environmental benefits that the S. Domingos rehabilitation project will provide. This monetary measure represents an additional incentive towards the commitment of local authorities and stakeholders to the project and the overall acceptance and recognition of its environmental and social value by society (besides the more obvious economic value). In addition, the monetary environmental and social benefits

can be used for an eventual Cost-Benefit Analysis phase of the rehabilitation project thus helping public authorities take truly sustainable decisions and thereby promote real sustainable local development. After this Introduction, in the Experimental Part, we first characterize the scope of intervention and define the rehabilitation plan. Then the overall expected benefits will be ranked and stakeholders' perceptions presented. Finally, the expected rehabilitation benefits will be linked with the concepts of welfare and total economic value, in order to define the monetary money measure that will be used to evaluate the value that society attributes to non-market benefits of the rehabilitation plan. In *Results and Discussion* we defend the Contingent Valuation Method as the most adequate valuation technique for estimating the plan's rehabilitation value and describe the methodological steps before discussing some preliminary aspects arising from its application to the particular context of S. Domingos Mine. Finally, we present our conclusions.

2.   Experimental Part

One must be aware that the task of getting a money measure for measuring the impacts that a mine rehabilitation project causes on local welfare is not straightforward. Firstly because there are several rehabilitation actions implemented in different time periods and not only one. The actions will be applied to a significantly large and environmentally degraded area, triggering a network of impacts that will cause changes in the ecosystem and related functions. These environmental improvements will create new development opportunities to the local populations, thus enhancing local social welfare. Changes in the local population's welfare will be triggered by the benefits generated by the uses that local society will make of the rehabilitated mining area. Some of these benefits are easier to evaluate because they are market based. Non-market benefits on the other hand, despite being sometimes far more important than the former, are more difficult to monetize. In order to get a money measure of the changes in local welfare generated by the rehabilitation plan, several phases must be accomplished, such as: the characterization of the intervention area and the definition of the rehabilitation plan; the description of the benefits that the rehabilitation plan is supposed to generate and the assessment of the perception that the stakeholders have over them; the design of a linkage between those benefits, the social welfare, and a theoretical money measure which enables their measurement in monetary terms; and finally, the definition of a valuation technique enabling the estimation of the non-marketed benefits.

2.1 The Intervention Area: S. Domingos Mine

The São Domingos Mine is located in the Baixo Alentejo region in southern Portugal, on the left bank of the Guadiana River (Figure 1). It is surrounded by three remarkable urban centers: the cities of Mértola (17 km), Beja (district center, 65 km) and Serpa (36 km). It is close to the Spanish frontier and not far from the touristic region of the Algarve (136 km), Évora (UNESCO

heritage – 142 km), and Europe's largest artificial lake, the Alqueva Dam (81 km). The entire area occupies 450 hectares, equivalent to approximately 450 football pitches. S. Domingos occupies a valley that extends from the Tapada Grande and Tapada Pequena dams, passing at the confluence with the Mosteirão river, and reaching as far as the Pomarão harbor on the Guadiana River (Figure 2)

Figure 1. S. Domingos Mine location

The soil is thin and shale is abundant. The climate is Mediterranean, with long, luminous, hot and dry summers with temperatures rising to more than 35º Celsius, and slightly rainy, soft and short winters. Geologically the S. Domingos Mine is at the heart of the Iberian Pyrite Belt (IPB). The IPB extends from Spain across the entire Baixo Alentejo region. The IPB is classified as a Metallogenetic Province[1] and a member of the European Network of Mining Regions[2]. The main S. Domingos

output was copper and the processing of cupriferous pyrite as a basic source of sulphur (Sardinha et al 2010). Historically, the operation of the mine is very ancient dating from the Chalcolithic Age (the Copper Age) more than 4,000 years ago through to 1966 when it was abandoned due to ore depletion (Batista 2004). The first period of excavation occurred perhaps during the Copper Age by the Carthaginians and Phoenicians.

Figure 2. S. Domingos Mine Area Map[Pereira et al 2004]

The second is the Roman period where the production of copper was intensified on a large scale. Romans engaged in intensive exploitation operations for over 385 years (12-397 AD) and using ore extraction technologies that significantly altered the environment and the landscape of the region. (Alarcão 1988) refers to one of these

technologies, the *ruinamontium*, described by Pliny. The technology consisted of damming a large quantity of water. From time to time, the dam was opened and the water frenetically gushed out along gullies and galleries or over rock previously partially disassembled. The strength of the water dislodged the rock by throwing stone against stone and thus causing the takedown of large quantities of rock. Two different extraction processes were used. The first comprehended open pit exploitation by means of a single cut (the *corta*). The *corta* covers an area of 42,000 m^2 to a depth of 120m from where 3 million m^3 of soil was removed. This operation ceased in the 1880s. The second was an underground extraction process involving a network of galleries and wells were dug. The wells, located at about 400m below the level of superficial circulation, were used to suck contaminated air from the interior of the mine. The copper and pyrite extracted was transported to the treatment factory in Achada do Gamo. Extraction was not the only activity at the S. Domingos mine. Incineration processes in closed ovens were used to extract sulphuric acid.

Closed ovens were used instead of open pit incineration process (as in Rio Tinto), in an attempt to avoid the disastrous environmental damages caused by the emission of highly toxic gases like SO_2, As and Sb to the fauna and flora of the region as well as compensation paid to owners of polluted fields (Baptista 2004).

Associated with the mining works, several facilities were built including an autonomous new mining village - S. Domingos - clean water reservoirs, cementation tanks, sulphur factories, a network of channels for the evaporation of acid waters, a railway to transport the ore and a harbor (Pomarão) on the Guadiana River. The new urban center was built for the thousands of workers employed by the mining complex. It included a market, several food stores, a church, a hospital and one pharmacy, a cemetery, police and military headquarters, management housing,stables and barns.The railway was the second ever built in Portugal and it was disassembled after the mine's closure. Along the 15 km of railway line, several workshops were built to supply the train with coal and water, together with several railway stations including S. Domingos Mine, Moitinha, Achada do Gamo, Telheiro, Santana de Cambas, dos Bens, Salgueiros and Pomarão, the latter near the harbor. Also built were four kilometers of tunnels, embankments, many small culverts and aqueducts in what constituted one of the most important investments ever made in the region. S. Domingos became a big, autonomous industrial village, and the biggest Portuguese mining company. It was to become the most important employer in the entire Alentejo, revolutionizing the region social-economically and profoundly affecting the regional development of that time. Located in a region with a very low density population, no other relevant economic activities apart from low income agriculture, fishing and smuggling, S. Domingos became an influential industrial centre and the biggest Portuguese mining company.

The mine's closure in the 1960s constituted a severe blow for the region. Currently, S. Domingos is subject to

extensive desertification, with an incipient level of economic activity and an aging resident community with some social problems. The current mine landscape strongly reflects the impact of alterations produced by industrial exploitation over a period in excess of a millennium. Besides some well conserved facilities like the manager's houses, the English palace, the church and the worker's houses, the area is sprinkled with ruins. From the environmental point of view, the current S. Domingos landscape is a unique portrait of the consequences of the intensive extraction and treatment of 25 million tons of ore for over a century. Waste mining materials like slag heaps and smelting ashes are spread across the area. The mining wastes are estimated to be around 32 Mton and contain toxic substances including Zn, Pb, Sb, Cu, As, Hg and Cd (Alvarez-Valero et al 2008). Several open slag dumps surround many of the ruined infrastructures. The waste mining material types take on fundamental importance because of the particular chemical characteristics of IPB ores. These undergo through sulphide oxidation processes accelerated by contact with water, leading to the production of highly concentrated acid fluids (or acid mining drainage – AMD) (Batista 2004). This AMD disperses in water, soils, and sediments, giving rise to high levels of ecosystem contamination. All around the industrial areas of Achada do Gamo and Moitinha, several lagoons were dug by miners to enable slag from the mine to settle. The S. Domingos brook, the principal water stream in the area, flows from the S. Domingos mine through the slag dumps and tailings, originating the AMD and carrying it into the Chança dam, whose waters are used for human consumption and irrigation. In spite of the dangerous environmental impact the extinguished mine poses to the environment, the fact is that the type of mining exploitation undertaken in S. Domingos, combined with the waste mining materials deposited and associated contamination, combine to form a very particular industrial landscape of unique characteristics and potential.

2.2 The S. Domingos Mine Rehabilitation Project

The S. Domingos Mine represents an important Portuguese cultural heritage both because of its long historical past and especially its more recent industrial legacy of the last 150 years. The large area covered by the mine, the mining processes used to extract the ore (pyrite, copper, zinc, blende, chalcopyrite and galena) and to produce sulphur, gave rise to an uncommon industrial landscape. The particularities of the environmental landscape, the ruins of the industrial mining complex, together with the characteristics of the S. Domingos urban centre, denote great potential for cultural tourism activities (for more detailed information, see Sardinha et al (2010)). This potential is even greater should we consider the privileged geographical location of S. Domingos. It is very close to three important urban centers (Mértola, Serpa, Beja), near Évora (UNESCO's World Heritage) and the Algarve, 200km from Sevilla (Spain) and250km from the capital (Lisbon). It is

integrated into the Guadiana Natural Park and not far from either the Alqueva Dam or the Natural Park of Costa Vicentina (located by the Atlantic Ocean, in the southwest of Portugal). The size of the area has the potential for generating substantial direct economic benefits like new short-run and long-run jobs in economic sectors increasingly in demand in global markets, as is the case with tourism based activities.

Any income generated by new jobs will circulate throughout the Alentejo economy, creating new secondary jobs, improving and strengthening the diversification of the regional economy. The increasing economic performance will add to tax revenues for local and regional governments and overall earnings as well. Despite its recognized potential, the area has not been yet submitted to a sustainable development plan integrating the three main vectors of a triple-bottom line based sustainable development strategy including environmental remediation, social improvement, and economic growth.

In Portugal, the state was held accountable for the rehabilitation of abandoned mine-fields including S. Domingos. *Rehabilitation* "seeks to repair damaged or blocked ecosystem functions, with the primary goal of raising ecosystem productivity for the benefit of local people" (Aronson *et al* 1993). It differs from Restoration (both in *sensu strictu* as defined by the Society for Ecological Restoration or in *sensu lato* as defined in Aronson, J. *et al*, (1993) in that the last one seeks to conserve or recover the ecosystem structure and dynamics to its initial state previous to the human intervention. Ecosystem rehabilitation is therefore the process of restoring the ecosystem's functions and components lost due to human activities or natural disasters, but without seeking to recover the original ecosystem state. To implement the rehabilitation actions projected, the Portuguese state created a state-owned enterprise –EDM – and granted it a concession for the design and implement of the environmental rehabilitation that may lead to socio-economic enhancement of the existent abandoned mining fields. The environmental rehabilitation that EDM wants to carry out in S. Domingos is based on one main aim: the environmental rehabilitation of the former industrial zone, which EDM expects will also contribute indirectly to the social-cultural requalification of the entire S. Domingos area, including the existing urban zone, by creating the momentum that promote actions that can stimulate the appearance of parallel projects with positive impacts. The area of intervention is the overall 450ha area occupied by S. Domingos Mine.

In light of the technical appraisal produced by EDM thus far, the minimization of acid effluents will combine cost-efficient environmental and landscape rehabilitation actions. Those actions will include the rehabilitation of the drainage system and associated soils, the reforestation of some areas, the confinement of heaps, the implementation of a system for the treatment of acid mine drainage and for environmental monitoring.

A first intervention phase has already taken place in 2004/2005 in which areas of greatest accident risk were

closed off and signaled. It is easy to conclude that should the EDM's rehabilitation succeed positive changes in the local ecosystem's functions and related landscape are to be expected. These should also generate additional benefits to society, thus, EDM's rehabilitation program may generate a local Pareto improvement. Considering the extent of the intervention area and the characteristics of the EDM's rehabilitation plan, one can count on benefits of different sorts, impacting on different stakeholders located in different geographical locations. Table 1 summarizes and categorizes the general bundle of benefits that are expected to arise from the EDM's rehabilitation of the ecosystems damaged by the mining activities, by applying the ecosystem[3] service typology defined by the Millennium Ecosystem Assessment (MEA 2005), considered to be the most appropriate for our purposes[4]. But other types of classification were also added (Haines-Young, R. et al, 2009), to complement the MEA typology. Throughout this article, we generically refer to the S. Domingos mining area as an ecosystem heavily operated on by man and where the environment, landscape, and material signs of human activity deeply interact to constitute a single environmental and cultural unit.

Accordingly to Table 1, the MEA defines ecosystem services as the social benefits provided by ecosystems. Such benefits are classified into four categories: provisioning services; regulating services; habitat services; and cultural and amenity services. Provisioning services refer to the tangible, material outputs from the ecosystem that society uses in different manners: as food (fish, plants, game, and fruits), water (for drinking, irrigation, cooling, leisure, and water transport), raw material (fibers, timber, fuel wood, fertilizer, and fodder), genetic and medicinal resources (for crop improvement, medicinal purposes, or research), ornamental uses, education, and research resources. Regulating services are those produced by the ecosystem itself, functioning to guarantee its own survival and resilience. Besides such living supporting benefits, regulating services act as regulators of the quality of the air, soil fertility and water purification, and by providing flood and disease control, waste treatment, and others. Habitat services sustain the overall ecosystem services. Ecosystem functions that supply provisioning and regulating services are the same as those providing the living conditions that support ecosystem biodiversity including human ways of life. Finally, cultural and amenity services include the aesthetic, spiritual, and psychological non-material benefits people obtain from contact with the ecosystem's landscapes and those related with recreation and touristic activities.

The environmental rehabilitation of areas spoiled by earlier mining involves a range of actions that manipulate the ecosystem in such a way that ecosystem's functions and related services may be gradually improved. In the current project phase, we do not have the information to categorize exactly which of the S. Domingos ecosystem services will be affected by the EDM rehabilitation program, nor the physical dimension of the impacts. Nevertheless, we believe we can say that the rehabilitation

plan will have a positive local impact and so improvements to S. Domingos ecosystem services are to be expected. The expected first positive impacts effects will be environmental, enhanced by the control of the soil and water pollution (first column of Table 1). Actions such as the drainage system and associated soil works, the confinement of heaps, and the implementation of a system for the treatment of acid mine drainage may positively contribute to improving services like: water provisioning; erosion prevention; recovering soil fertility; to improving biological control. The expected second positive effects are related with the previous. Pollution control together with the reforestation action, may contribute to enhance the landscape and to rehabilitate the indigenous fauna and flora, thus creating conditions to meliorate the supply of: provisioning services (food, raw materials, genetic, medicinal, or ornamental resources); regulating services (pollination); habitat services. Social, cultural and economic effects are to be expected. Some may be direct and arise simply from the enjoyment of the peculiar S. Domingos landscape like recreation, aesthetic enjoyment, or cultural experiences. Others like touristic activities will be dependent from local initiatives for designing and implementing cultural projects like a museum site related with archeology, or the rehabilitation of the remaining railway for tourism purposes.

Environmental rehabilitation plans for large spoiled areas by early mining similar to that of EDM, will positively affect many different people and both public and private entities. The following methodological step will be the identification, enumeration, and characterization of stakeholders' perceptions towards the rehabilitation plan. Relevant stakeholders[5] were identified by the research team and questioned about what they expect from the rehabilitation plan, using semi-structured interviews. The summary of the contents of these interviews are presented in Table 2 where stakeholders are organized by groups using a sustainable development framework (Sardinha et al. 2013), and where it is possible to see the topics which they mentioned more frequently and consider of greater concern.

In the environmental rehabilitation dimension, the water and soil quality is the concern more frequent in all the groups, while landscape as a space appears to be more relevant for interest groups and for end-users. The cultural regeneration dimension is another of the issues most addressed within the regulatory entities, interest groups and expert groups.

Considering the social revalorization dimension, the category livability stands out, especially among the regulatory entities and end-user groups and the public safety appears to be more important to the regulatory entities and to some interest groups. It is also possible to see that the economic revitalization dimension is referred by all stakeholders owing to the widespread perception of the potential of tourism to become an emergent driving economic activity. Many other institutions and people are going to be affected to a greater or lesser extent by the rehabilitation of the S. Domingos mining area. For instance, the local and regional populations might benefit

from usage of the mining area for tourism and cultural purposes. These economic activities will create jobs, wealth, and retain population. Cultural based tourism enables the improvement of infrastructures and the integration of the local population. Locals will also benefit indirectly from the improvement in regulation ecosystem services: a better environment improves property values, enhancing the ability of local economic interests to locate businesses and raise families.

Table 1. Typology of ecosystem's services potentially generated by the rehabilitation program

EDM's rehabilitation project [Sardinha et al 2010]	Types of Ecosystem Services that may be affected directly by the intervention	Types of Ecosystem Services that may be affected indirectly by the intervention
Environmental Rehabilitation actions Rehabilitation of the drainage system and associated soils; Reforestation of 250 ha; Confinement of heaps; Implementation of a system for the treatment of acid mine drainage. ⇩ Moderation of the water pollution effects; Moderation of the soil pollution effects.	Provisioning Services Water	Provisioning Services Food Raw Materials Genetic Resources Medicinal Resources Ornamental Resources
	Regulating Services Contribution to the recovering of the hydrological net functions; Contribution to erosion prevention; Contribution to recovering soil fertility; Contribution to improving biological control.	Regulating Services Contribution to improving pollination
		Habitat Services Contribution to improving Life Cycle of Migratory Species; Contribution to improving genetic diversity.
Social Cultural Promotion actions: Build an environmental interpretation centre	Cultural, Amenity Services Aesthetic Information Opportunities for Recreation Inspiration for Culture, Art and Design Spiritual Experience Information for Cognitive Development Education and Research	Cultural, Amenity Services: strengthening and improvement Aesthetic Enjoyment Opportunities for Recreation and Tourism Inspiration for Culture, Art and Design Spiritual Experience Information for Cognitive Development Education and Research Enhancing and strengthening of social coalition

Table 2. Discursive dimensions and categories in the semi-structured interviews for each stakeholder's group and organized in accordance to the framework (Milheiras et al 2011)

	G1 (N=10) Regulatory entities	G2 (N=9) Interest groups	G3 (N=2) Property owners	G4 (N=6) Experts	G5 (N=7) End users	Total (N= 34)	%
Environmental reconversion							
Landscape as space	3	4	1	1	4	13	38,2
Water and soil quality	6	7	1	3	7	24	70,6
Biodiversity	1	2	0	1	0	4	11,8
Cultural regeneration							
Social identity	4	7	1	5	3	20	58,8
Landscape as a place	7	6	1	4	4	22	64,7
Cultural events	2	4	0	0	4	10	29,4
Social revalorization							
Public safety	6	3	0	1	1	11	32,4
Livability/?	7	4	1	1	5	17	50,0
Education/?	0	1	0	2	1	4	11,8
Economic revitalization							
Multifunctional territory	3	3	1	3	4	14	41,2
Driving economic activities: tourism	9	9	2	6	7	34	100,0
Community reinforcement							
Empowerment	1	2	0	2	2	7	20,6
Ownership and responsibilities	5	7	2	1	3	18	52,9
Strategic reframing							
Integrated planning	7	6	2	6	5	26	76,5
Funding strategies	4	2	1	0	0	7	20,6
Territorial competitiveness	6	7	2	4	6	25	73,5

Other stakeholders such as tourists or regional governments geographically close to the S. Domingos area, including the districts of Beja and Évora as well as adjoining Spanish entities, can also benefit from mine rehabilitation. The diagram in Figure 3 clarifies the relationship between the expected benefits from EDM's intervention and the components of well-being[6]. The findings reported in Table 2 allow us to conclude that the

set of EDM project rehabilitation stakeholders is composed of many different individuals and organizations, some with different perspectives on what issues are more relevant to the project. This heterogeneity is not unusual in complex interventions such as that of EDM's in S. Domingos, the principal consequence associated being greater complexity in monetizing the overall expected benefits. Some may be
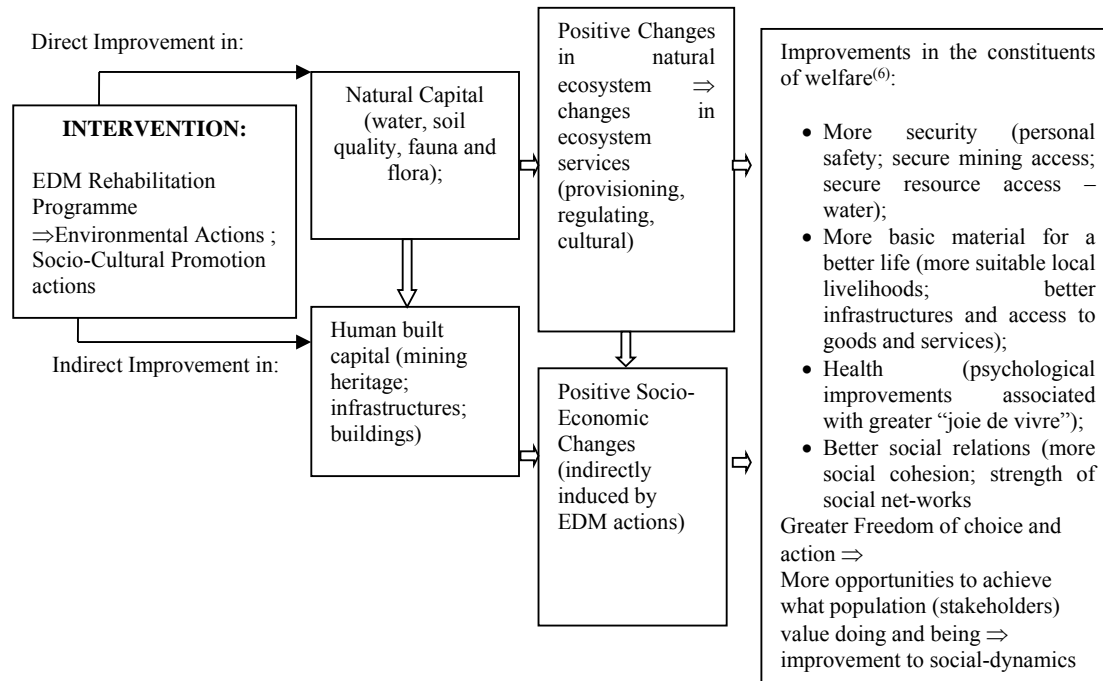
Figure 3 . The Relationship Between EDM Intervention and Welfare

generated in the short run as a direct result of the execution of the program itself; mainly economic benefits like job creation and increasing local demand for goods and services. The others are expected after the end of the requalification program. These are a fuzzy set of long run benefits differing in nature, involving various degrees of uncertainty and risk. Some of this uncertainty and risk comes from the lack of complete information as is the case with environmental rehabilitation actions. Firstly, because there is a lack of knowledge about the way they function and secondly because there is also a lack of sufficient environmental indicators to credibly quantify the real impacts of rehabilitation actions on ecosystem conditions and trends. As for the socio-economic benefits, the uncertainty and risk derive from the fact that their magnitude is highly dependent on stakeholders involvement and compliance with the main objectives of the S. Domingos Mine rehabilitation program.

3. Defining a Money Measure for the Non-Market Benefits of Rehabilitating S. Domingos Mine

Economic valuation is a way to value a wide range of individual impacts and to assess the well-being deriving from the requalification of S. Domingos. The valuation process expresses in a single unit (not necessarily, but typically a monetary unit) the disparate components of well-being, making them intelligible and comparable to the costs of intervention. As changes in utility cannot be measured, economic valuation is based on the monetary benefits arising out of usage of the environment's services.

The utilitarian based approach to evaluation ensures the value of a restored S. Domingos mining area[7] stems from a number of ways depending on how individuals engage with the mining area. The approach is based on the fact that locals may benefit (or gain satisfaction or utility) from the use of S. Domingos recovered area (including the overall built capital), either directly or indirectly, in the short run or in the long run. Although economic valuation attempts to translate benefits into monetary

units, this does not mean that marketed benefits, whose values are directly assessed through market prices, represent the only factor taken into consideration in the valuation process. On the contrary, the valuation process aims to monetize not only the benefits that enter markets but all the others that are non-marketed.

The concept of Total Economic Value (TEV) (Pearce 1993) is a framework largely deployed to disaggregate individual utility into different components of well-being and benefits. To apply TEV, ecosystem services are classified according to how they are used. TEV's taxonomy and terminology varies from analyst to analyst but broadly includes Use Values and Non-Use Values. Use values are derived from usage of ecosystem services by individuals, and Non-Use values refer to the value people may gain from knowing that the ecosystem persists even if not intending to use it either in the present or in the future.

Use Values include Direct Use-Value, Indirect Use-Value and Option Value. Direct Use-Value includes the benefits from consumptive uses (either for the individual's own consumption, final consumption or intermediate production consumption) of natural resources (e.g. game, fish, timber, plants, water, etc.), and the benefits from non-consumptive uses (e.g. the enjoyment of recreational and cultural amenities, or spiritual benefits). It further includes *Vicarious Use-Value* addressing the possibility that an individual may gain satisfaction from pictures, books, or broadcasts of natural ecosystems even when not able to visit such places. Direct Use–Values broadly correspond to the Provisioning and Cultural Services MEA taxonomy (see Table 1). Indirect Use-Values include the benefits arising from the use society makes of ecosystem functions like watershed values (e.g. erosion control, local flood reduction or regulation of stream-flows) or ecological processes (e.g. fixing and recycling nutrients, soil formation, cleaning air and water, carbon sequestration). These benefits correspond to the MEA's Regulating and Supporting Services category. Finally, Option-Values derive from preserving the option of using the ecosystem's services in the future when they cannot be used in the present by oneself. The overall MEA Provisioning, Regulating and Cultural Services may be part of Option-Values where some individuals do not intend to use them in the present, but want to preserve the right to use them in the future.

Non-Use Values (or Passive Use Value) include benefits some individual may have in knowing that the

ecosystem exists and persists even if they never will use it. This value category includes two other sub-categories: the Existence and the Bequest Value. The Existence value (or Intrinsic Values) reflects the moral, ethical, ecological, religious, or philosophical satisfaction felt by an individual from knowing that the ecosystem survives unrelated to current or future uses. The Bequest Value reflects the individual's altruistic satisfaction from knowing that the environment will be recovered and preserved for their heirs. Non-Use Values may be part of MEA Cultural Services. Figure 4 provides a diagram detailing the relationship between the TEV's taxonomy of use and non-use values and the MEA's services concept.

In this paper, we seek to estimate solely the monetary non-marketed benefits. This includes estimating the Cultural and Amenity services (tourism, recreation, leisure, educational, scientific, etc.) resulting from direct use, option use, bequest use and intrinsic value, and Regulating and Supporting Services. Using a broader term, we aim to estimate the non-market value of the requalification of the S. Domingos mining area. Following Hicks (Hicks, 1939) and Kaldor (Kaldor, 1939) generic economic definitions of value, the economic value of an improvement of some ecosystem and subsequent improvements in ecosystem services, is the amount of money an individual would pay or be paid to be as well off with the ecosystem or without it. Thus, economic value is an answer, mostly expressed in monetary terms (but not necessarily), to a carefully defined question in which two alternatives are being compared. The answer (the value) is very dependent on the elements incorporated into the choice, which are basically twofold: the object of choice and the circumstances of choice (Kopp R.J. et al, 1997), Following Mäller's (1971), (1974) basic model of individual utility, one can define welfare measures related with changes in the ecosystems and related services: *i.e.* where ecosystem's services are objects of choice, then a change in the quality of environmental amenities matters to the individual well-being. Such changes can be represented trough either changes in the individual preference function or in a constraint's change and they can be monetarily captured via an individual utilitarian model like the one described below.

Let $U(x, q)$ be a well-behaved utility function of some individual affected by the rehabilitation mining project where U denotes the level of utility (satisfaction, well-being) of the individual, x is a vector of marketed

Figure 4 TEV Taxonomy and MA's Ecosystem Services (adapted from TEEB (TEEB, 2011)
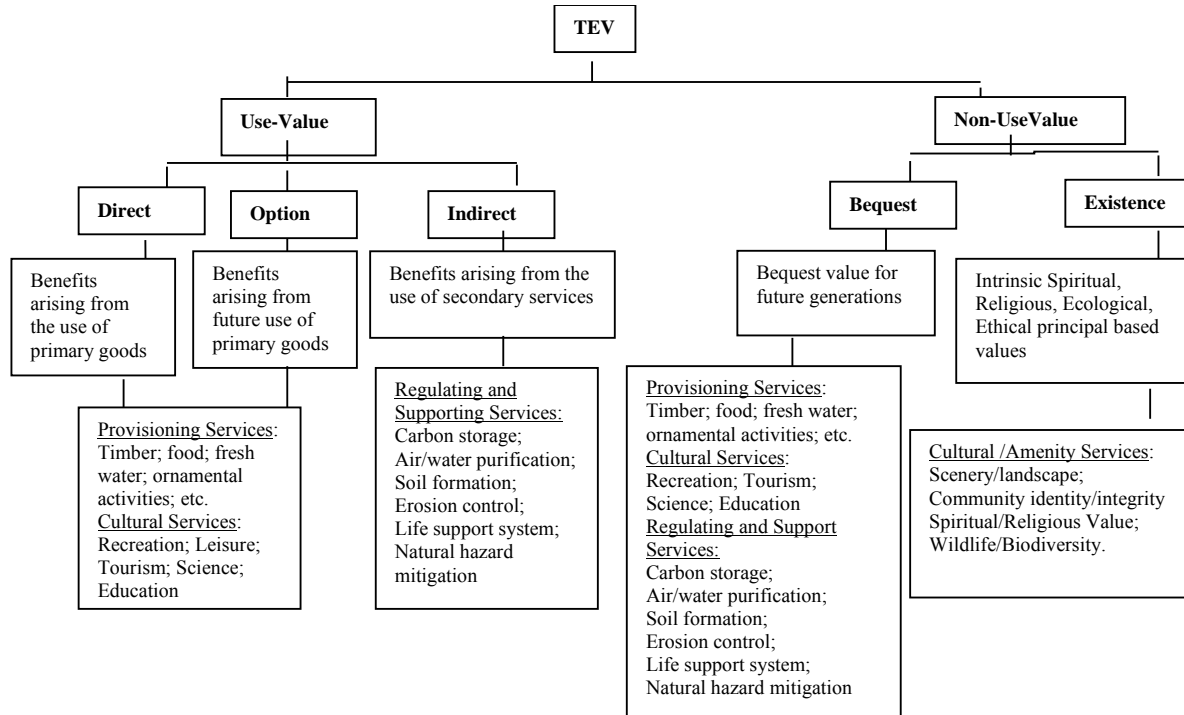
goods and services, and q is a vector of non-marketed environmental and cultural benefits.

The individual wants to choose the optimal quantity x^* that maximizes his/her utility being constrained by his/her budget restriction $\sum_i p_i x_i = m_i$ where p_i is the market price of the i marketed good belonging to x. The solution for the maximizing problem is the set of the individual's ordinary demand functions for the market goods denoted $x^* = g(p, q, m)$. Substituting the ordinary demand functions in the individual utility function, we attain the individual indirect utility function, denoted by $dU(x, q) = \varphi(p, q, m) = U[g(p, q, m); q]$. This function represents the set of maximum utility (or well-being) the individual can benefit, given his/her utility function and budget restriction.

The individual monetary measure of the change in q represents the change in the individual's utility from the initial environmental state q^0 to the final environmental state q^1, while prices and income remain constant at the initial levels. If the environment change is positive i.e. where $q^1 > q^0$ (which is what is expected from the rehabilitation of the mine area) then individual utility will rise by $\varphi^1(p^0, q^1, m^0) - \varphi^0(p^0, q^0, m^0)$. Such positive change in individual utility can be translated into monetary units through two welfare measures. These welfare measures applied to non-market transacted objects of choice, as is the case of ecosystem services, were first proposed by Mäler (1971) (1974) as an extension of the standard theory of welfare measurement related to market price changes formulated by Hicks[8].

The first measure is the maximum amount of money the individual is willing to pay to secure the improvement, i.e. the Willingness to Pay Compensated (WTP^C) money measure. This is the amount of money the individual has to pay to secure the right of having access to the additional benefits and is provided by the equation $\varphi^1(p^0, q^1, m^0 - WTP^C) = \varphi^0(p^0, q^0, m^0)$. The second measure is the minimum amount of money the individual is willing to receive to make him give up on the improvement, *i.e.* the Willingness to Accept Equivalent (WTA^E) money measure. This is the amount of money the individual wants to receive to make him/her as satisfied as he/she could be with the improvement and is given by the equation $\varphi^1(p^0, q^1, m^0) = \varphi^0(p^0, q^0, m^0 + WTA^E)$.

As we ignore the individual's utility function to attain the measures, we have to use the theoretical duality between the unknown indirect utility function and the known individual's expenditure function. The expenditure function, denoted $e(p, q, U)$, represents the minimum expenses incurred by the individual to buy a bundle of quantities of marketed products, that make him/her satisfy a previously set level of utility. Because of the aforementioned duality, $e(p, q, U) = ph(p, q, U) = m$, where $h(p, q, U)$ is the vector of individual's compensated demand functions for the marketed products. Therefore the formulae to reach the two welfare money measures associated with an improvement in the utility associated with an improvement in q, after the expenditure function are:

$$WTP^C = e(p^0, q^1, U^0) - e(p^0, q^0, U^0) =$$
$$\int_{q^0}^{q^1} \frac{\partial e(p,q,U^0)}{\partial q} dq \quad (1)$$

And

$$WTA^E = e(p^0, q^1, U^1) - e(p^0, q^0, U^1) =$$
$$\int_{q^0}^{q^1} \frac{\partial e(p,q,U^1)}{\partial q} dq \quad (2)$$

In equations *(1)* and *(2)* the term $\frac{\partial e(p,q,U^1)}{\partial q}$ is the derivative of the expenditure function with respect to *q*, where *t = 0* refers to the initial level of utility (at the current state of S. Domingos area) and *t =1* the final expected level of utility after the change in *q* (after the requalification plan). Such a derivative gives the marginal value of the change in *q* which is theoretically equal to the income variation that is just sufficient to maintain utility at its initial level *t = 0* (in the case of WTP^C money measure) or final level *t =1* (in the case of WTA^E money measure,). Thus WTP/WTA are the fundamental, individual monetary measures in economics for non-market TEV. As changes in ecosystems provide flows of services (or of use and non-use benefits) over a time path, the TEV associated to the ecosystem improvement will be equal to the discounted sum of WTP/WTA over the individuals affected for those benefit flows instead. By applying the inter-temporal utilitarian approach just described, we may estimate the non-market TEV for the positive changes in an ecosystem generating a flow of amenities over a relevant period of time *T* by simply summing up the present value of the single-period welfare measures by the following equation:

$$TEV = \sum_{t=0}^{T} \frac{TEV^t}{(1+\rho)^t} \quad (3)$$

whose continuous version is:

$$TEV = \int_{t=0}^{T} TEV^t e^{-\rho t} dt \quad (4)$$

Where: ρ is a subjective rate of time preference assumed to be positive; TEV^t is the estimate of the aggregated *TEV* for the relevant affected population (*N*) by the changes at the moment *t* and is obtained so that $TEV^t = \overline{WTP^t}/\overline{WTA^t} \times N$ being $\overline{WTP^t}/\overline{WTA^t}$ the mean (or median) of individual's WTP/WTA. Having thus defined the money measure, one easily concludes that to estimate the *TEV* of the requalification plan of S. Domingos mining area after equations *(3)* or *(4)*, one must: *i)* ascertain the individual WTP/WTA for the S. Domingos change; *ii)* to choose a subjective rate of time reference - ρ ; and *iii)* to define a relevant period of time *T* during which it is assumed the change will generate social benefits to the population. In this paper, we are interested only in discussing how we can identify the individual WTP/WTA.

4. The Contingent Valuation Method (CVM)

CVM is one of the most popular valuation techniques for estimating the value of goods and services that do not exist in markets[9]. It was first described by Bowen (1943) and Ciriacy-Wantrup (1947)(1952).They propose the use of specifically structured questionnaire surveys for valuing social goods like beautification of landscape (Bowen, 1943) or collective, extra-market goods from soil conservation (Ciriacy-Wantrup, 1947, 1952). However, the first empirical work was only done by Davis (1963) one decade later. Bohm's work (1972) played a key role in demonstrating the reliability of CVM money measures; he proved that the potential strategic behavior problem arising from the aggregation over individual's benefits might not be as important as Samuelson (1954) had earlier pointed out. Further theoretical and empirical works like those of Randall (1974) (among others) developed the field over the 1970s, strongly contributing towards the improvement and acceptability of the method among academics and politicians. In 1980, the method was unreservedly recognized by the USA federal government as an important tool for supporting judicial decisions, by recognizing its use (among other valuation techniques like the Travel Cost Method, for example) for valuing the welfare changes arising from environmental disasters in the text of the *Clean Water Act* (1972) and of the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) (1980). The second half of 1980s was crucial in terms of proving the credibility of CVM and its popularization in the USA and European countries. Two important works are especially credited for such popularity, Cummings et al. (1986) and Mitchell and Carson (1989) with the latter contributing towards the generalization of CVM beyond environmental economics and welfare. During the 1990s, a series of relevant environmental disasters renewed discussion over the real reliability of the valuation method. With the intention of once for all proving the reliability of the method for monetizing environmental impacts beyond any doubt, the National Oceanic and Atmospheric Administration (NOAA) asked a specifically formed committee of experts chaired by the Nobel prizes Kenneth Arrow and Robert Solo to provide their evaluation. One of the main outputs of the committee was the well Known NOAA Report (Arrow et al 1993) where CVM's credibility, validity, and reliability were clearly recognized, and a number of guidelines proposed to improve the quality of subsequent empirical applications. Currently, the method has vast applications far beyond the scope of environmental valuation impacts and is largely recognized as the only means enabling the elicitation of values for fuzzy, not well known and likely to vary across individuals (stakeholders), and services (benefits) (Borghi, 2007). Furthermore, CVM is the only existing valuation technique that generates one money measure for non-use values. Such distinctive characteristics ensure CVM is the only existing valuation technique one can apply for getting the S. Domingos rehabilitation plan's non-market monetary value. More specifically, CVM is the only method that enables us to ascertain the individual

WTP/WTA non-market values embedded in equations *(3)* and *(4)*.

Studies concerning the welfare valuation of the rehabilitation of degraded mining fields are few but all of them applied CVM or refer to this technique as being the more appropriate for eliciting the rehabilitation benefits. Examples in the literature are Damigos et al. (2003), Ahlheim et al. (2004), Damigos (2005), Lienhoop et al. (2007), Simonset et al. (2008), Strong et al. (2008), or Pemberton et al. (2010). Damigos et al. (2003) make a fairly general analysis providing information about the monetary benefits of mined land reclamation and the valuation methods that can be used for such purposes. Ahlheim et al (2004) carried out a contingent valuation approach for appraising the social benefits arising from a reclamation project of a vast landscape area destroyed by mining pits to the north of the city of Cottbus, in Brandeburg, Germany. Damigos (2005), focuses on the application of environmental valuation methods in mining. Lienhoop (2007) report a contingent valuation study to value the economic benefits of Lusatia Region, a post-mining lake-district in East Germany. Simons, et al (2008), used a CVM's probit model based approach to determine the perceptions of risk regarding airborne mine dust and radon and the effect that these perceptions had on the valuation of residential properties impacted by these substances. Pemberton et al (2010) used a CVM not to estimate the benefits triggered by some rehabilitation plan, but to estimate instead the cultural bias through the valuation of environmental resources threatened by copper mining on the island of Dominica.

CVM approaches are based on stated preferences for directly evaluating the individual's WTP/WTA for a non-market change. The basic idea of the valuation technique is to recreate a contingent, hypothetical market for eliciting individual WTP/WTA for alterations in welfare associated with any change in the quantity or quality of the environment, by simply asking people by means of questionnaires.

Therefore, CVM is basically an interview technique where the questions in the questionnaire try to recreate a hypothetical market. A classical CVM application is applied in nine steps. Firstly, a clear characterization of what we want to evaluate must be made and presented to the interviewee supported by graphical means. Secondly, the definition of the relevant population whose welfare is going to potentially change must be made. The third step deals with the simulation of the hypothetical market's basic features including: *i)* what quantity of the non-market good is going to be evaluated and what is the alternative to the proposed change; *ii)* when is the good or service going to be provisioned; *iii)* and which of the welfare monetary measures WTP or WTA is going to be used. In the four steps, the type of interview must be chosen: personal interview, telephone interview or mail interview. The fifth step deals with the sample definition and in the sixth, the questionnaire is set out. In the seventh step, interviews are held before, in the eighth step, individual answers are exploited in order to build up a consistent database. Finally, as the last step, the median or media WTA/WTP is estimated as their

sensitivity to the socio-economic and demographic determinants analyzed.

The use of CVM to estimate the theoretical economic measures to quantify the TEV of non-market services has been one of the most fiercely debated issues within environmental economic valuation literature over the last twenty years. One of the most debated issues has been the validity and reliability issues to CVM welfare measure estimates, in terms of how closely they actually represent an accurate measurement of the real value. The closer the real values are to the estimated, the more accurate the valuation method is. If WTP/WTA were observable, there would be no problem. But given they are not, it is then necessary to use other complex criteria and "rules of evidence" to assess accuracy. In measurement, accuracy means the *reliability* and *validity* of data analysis used for the valuation framework [10]. A number of guidelines have been developed to assume CVM credibility, validity, and reliability (Portney 1994), (Arrow et al.1993), The most important are related to the presentation of adequate information over the object of choice (i.e. the environmental change), the context of choice, the choice of a credible (hypothetical) payment mechanism and the use of a referendum format. In presenting the object of choice to the interviewee, the level and type of the expected provision of the environmental attributes "with or without intervention", and if there are undamaged substitute commodities, must be presented very clearly. The researcher must previously determine which and how environmental services affect the individual's non-market value. This can be done by using techniques such as focus groups or by simply talking with the stakeholders. On defining the context of choice, it is important to explain what is the extent of the hypothetical market by informing respondents of how and when the environmental change will occur, and about the decision rules in the use for such provision e.g. if by majority vote or by individual payment.

The choice of a credible (hypothetical) payment mechanism is very important. Taxes, property taxes, sales taxes, entrance fees, changes in the market prices of goods and services or donations to special funds are the more commonly used. Finally, the referendum format is the only elicitation format that is, under certain circumstances, incentive compatible. Detractors argue that respondents provide answers inconsistent with basic assumptions of utilitarian rational choice and non-corresponding to their real WTP. Defenders acknowledge that early applications suffered from many of the problems critics have noted (see Mitchell et al 1989), however, recognition is required of how more recent and more comprehensive studies have dealt and continue to deal with those objections (see Carson et al. 2005). As a matter of fact, the CVM's welfare estimates are particularly affected by several types of biases (see for instance Mitchell et al. (1989), and Alberini et al. (2006), for a comprehensive definition of the biases and of the more current practices used in empirical research to avoid them or subtract there effects). Such biases arise from the way the CV application is applied. There are several types of biases: the choice of the true value for

the environmental change; WTP or WTA?; biases related with elicitation formats; information biases; anchoring biases; vehicle bias; hypothetical biases. Detractors argue that the existence of *embedding effects* provide answers that are not theoretically consistent. *The embedding effect* refers to several interrelated regularities in contingent valuation surveys like insensitivity to scale and scope, the sequential and sub-additive effects. These types of effects happen, firstly because welfare measures like WTP are sometimes much less dependent on the quantity of the environmental service provided than it theoretically should be (*insensitivity to scale and scope*). And secondly because, when more than one environmental service is being evaluated by the same survey, the WTP for a particular one often depends on its position in the sequence of public goods (*sequential effect*). Finally, the sum of WTP for individual changes often exceeds the WTP for a composite change in a group of public goods (*sub-additive effect*). Some CVM critics see the *embedding effect* as evidence for non-existent individual preferences for the public good but an individual *warm glow* effect instead, created by the survey process itself. In spite of all the difficulties arising from the implementation of a valuation technique as complex as CVM, the NOOA Panel recognized that the method is grounded firmly in economic theory and that CVM's welfare estimates are valid and reliable. They recommend CVM researchers to follow a set of guiding principles, defined by the Panel (Arrow et al., 1993), to guarantee the best valuation practices, theoretically consistent and empirically reliable.

5. Results and Discussion

We aim to apply a CVM approach to pursue two main objectives. Firstly, we wish to assess the induced social welfare change associated with the rehabilitation of S. Domingos's abandoned mine field; i.e., we seek to appraise whether society as a whole will be better off after the project than it was before it. And, secondly, we wish to assess the determinants of the individual's stated WTP/WTA for the rehabilitation program. We found the CVM approach to be the most appropriate because of the large project area and the sort of projected rehabilitation actions that are expected to increase the flow of several services arising from the improvement in the mining environment and in the built mining capital. The major part of the expected post-project services basically consists of non-use services such as option-values to secure the use of the mining field for development, indirect values associated with the use of secondary environment functions, values associated with direct usage of the mining environment, or non-use values. These varieties of benefits are expected to affect the welfare of many different stakeholders.

CVM is the only existing valuation technique enabling the estimation of market and non-market values affecting many different individuals with different expectations and perceptions regarding the rehabilitation mining field scenario. Our main aim is to estimate the non-market

values of the rehabilitation project. To achieve the task, NOOA's guidelines are taken into consideration in order to ensure estimated welfare measurements through the CVM technique are valid and reliable by diminishing to the greatest possible extent the effects of the several sources of biases. In that CVM is mainly a questionnaire based technique, its design, the description of the contingent scenario to be valued, and the formulation of the questions related to the hypothetical market are crucial to obtaining reliable and robust results. In this section, we enumerate the several key questions we shall have to answer during the phase of questionnaire design and application in order to ensure appropriate welfare money measures for the rehabilitation of the S. Domingos mine. Table 3 summarizes those main questions. Currently, a qualitative approach is under development to characterize the stakeholders and to elicit their attitudes and opinions towards the project and further local development. These practices will allow us to understand the social and political attitudes of the populations regarding the S. Domingos Mine, the rehabilitation project itself, and the level of credibility it enjoys among locals. These are important steps previous to the questionnaire design. They provide information enabling us to identify the relevant population and to design a reliable sample; to describe the scenario that is going to be valued; to formulate the hypothetical question; and to choose a credible payment vehicle. Thus far, several existing factors have already been identified that will affect the choice of the relevant population, the sample, and the questionnaire design. First, S. Domingos inhabitants have a special and emotional attitude towards the current state of the mine. They tend to be critical about both the mine owner's and central government's role in the mine closure process. The region has economic and social issues and they look at the environmental rehabilitation of S. Domingos as an opportunity for improving the conditions and even creating a momentum that eventually leads to sustainable local development with tourism as the main activity. Most stakeholders recognize a local potential in tourism based development. Therefore, they are cautious regarding the environmental rehabilitation actions, if such actions destroy the specific and unique scenic characteristics of the S. Domingos mining landscape. To more clearly identify the impacts of the rehabilitation actions, a life-cycle assessment (LCA) is being implemented to help us identify and quantify (where possible) which are the main global environmental effects of the rehabilitation serving to define scenarios of development. There will be different direct and indirect impacts and therefore some comprehensive identification of them will be an important tool to help us in defining the contingent scenario to be valued. Several preliminary questions and conclusions may be put forward after our initial, very preliminary contacts. The first is that the relevant sample population should include not only S. Domingos inhabitants but also regional habitants from Beja District and Évora District; ideally the relevant population should include the Spanish district neighboring S. Domingos (because they are directly affected by the water pollution, and because they usually visit the region for tourism purposes), and the

Lisbon, Setúbal, and Faro Districts (potentially these are the origin regions of the tourists expected to visit S. Domingos). However, financial restrictions lead us to adopt a more conservative relevant population. The second conclusion is that the sample and the questionnaire must be constructed in such a way as to avoid a great number of protest responses. In fact, the social-economic characteristics of the research area's inhabitants and the economic crisis that currently affects the country lead us to conclude that the probability of getting a high number of NO responses to our WTP question during the phase of the questionnaire may be high. One way to decrease such probability is to previously probe the populations about: what they think of the rehabilitation project; what are their expectations towards the rehabilitation benefits; if they are willing to pay some amount to secure those benefits, how much and how long. The rehabilitation includes different actions, which will generate many different direct and indirect types of values triggered throughout different periods of time. The existence of several levels of uncertainty associated with the concretion and the dimension of those values must also be taken in to account. Besides this, the population's perception of the rehabilitation benefits may also be considered. Probably we will be forced to conclude that the rehabilitation plan generates a fuzzy set of values. Plus there is still some uncertainty amongst the population about the property rights of different entities in the Mine. If there is a fuzzy set of values, and problems with the property rights of the plan, difficulties will definitely arise with the project's acceptance by the populations, and with population's recognition of its viability and concretion.

One way to surmount such difficulties may be through the design of a contingent scenario where some entity (to whom the direct benefits of the project should be affected) will implement overall project rehabilitation (whose benefits would be generically defined in order to highlight the positive expected change in local welfare), instead of describing a complex rehabilitation scenario that might seem confusing to respondents. S. Domingos is an economically depressed region inserted in a current national context of financial crisis. That poses a problem to the definition of the vehicle of payment: taxes are certainly a concept to be avoided. An alternative should be to ask the populations whether they are willing to contribute towards a financial fund to be run by the entity that has the property rights of the project (under strict supervision by credible external entities) and exclusively attributed towards the rehabilitation of S. Domingos.

6.   Conclusions

The São Domingos mine is located in the Baixo Alentejo region in southern Portugal occupying an area of 450 ha, which is equivalent to approximately 450 football pitches. The main activity was copper and the processing of cupriferous pyrite as an elementary source of sulphur. Historically, mineral extraction on this site is ancient dating from the Chalcolithic Age (the Copper Age),

more than 4000 years ago, through to 1966 when it was abandoned due to ore depletion. The mine's closure constituted a severe blow for the region. Currently, S. Domingos has an incipient level of economic activity and an aging resident community. Nevertheless, local stakeholders demonstrated to be concern about revitalizing S. Domingos. From the environmental point of view, the current S. Domingos landscape is a unique portrait of the consequences of the intensive extraction and treatment of 25 million tons of ore for over a century. The waste mining materials like slag, heap dumps and tailings are spread across the area.

The waste mining materials assume great importance in the IPB because of the particular chemical characteristics. They are very unstable, giving rise to highly concentrated acid fluids dispersed in water, soils and sediments, with high levels of ecosystem contamination. In spite of the dangerous environmental impact that the extinct mine has over the environment, the fact is that the type of mining exploitation used in S. Domingos, combined with the waste mining materials deposited and associated contamination, create a very particular industrial landscape of unique characteristics and potential.

EDM is a state own enterprise held accountable by the rehabilitation of abandoned mine-fields including S. Domingos. The environmental rehabilitation that EDM wants to carry on in S. Domingos is based on one main aim: the environmental rehabilitation of the earlier extraction and industrial zone; which EDM expects will also contribute indirectly to the social-cultural requalification of the entire S. Domingos area, including the existing urban zone. Considering the extension of the intervention area and the characteristics of the rehabilitation plan, one can count with benefits of different sort, marketed and non-marketed, affecting different stakeholders located at different geographical locations. Welfare money measures are a way to value wide range of individual impacts and to assess well-being from S. Domingos's requalification. Particularly, they enable us to assess how much non-market benefits are to be generated by the rehabilitation plan (or the non-market TEV), being this our main goal. In order to assess the desired value estimate, a CVM must be applied and a number of guidelines developed to ensure as far as it will be possible the reliability and validity of the estimated money measure. For the case of S. Domingos, some particular economic, social, political, and demographic aspects are important for the design and implementation of the CV questionnaire and to guarantee data reliability.

Table 3. Questionnaire design and Implementation

Questionnaire Implementation and design		Content	Aspects to be considered	CVM Related Biases to be Avoided
Questionnaire implementation	To define the relevant population and choose the sample	Define the population that is going to be affected by the rehabilitation plan.	The reliability of the elicited values depends on the survey design elements, such as sample size and interview format	Sample Bias
Questionnaire sections	Warm-Up Questions	- Description of the survey goal: guaranteed anonymity; research purposes only; - Questions regarding the local population degree of familiarity with the problems arising from the abandoned S. Domingos mining fields (both environmental and social-economic); - Questions for appraising how informed and involved the respondents are with respect to the S. Domingos rehabilitation plan.	- The greater the level of respondent familiarity with the object of valuation, the greater the success of the CV study: more familiarity and involvement $\Rightarrow$ more reliable WTP answers (Munro and Hanley, 2001); - Before undertaking the CVM study, it is important to engage in some media sessions to inform the population about the rehabilitation project; - Preparatory interviews or focus groups techniques and pre-testing of preliminary questionnaires is highly recommended.	
	The Contingent Market Scenario	- Clear, comprehensive, and short description of the object of valuation: what is to be valued (the area) and how much is it going to be enhanced (the multiple plan values: historical, scenic, ecosystem, social, development; - What is the alternative to the rehabilitation project to be valued: other rehabilitation projects with different scenarios?; the status quo? Separate rehabilitation actions that may fall under the responsibility of the mining company[1] if any, from others paid for by state funding; When will the project be finished? The project is entitled to whom?	To facilitate the design of the contingent-scenario, environmental impacts should be extensively enumerated and their effects measured whenever possible – life-cycle assessment? [2] - The same prescription for the Socio-Economic impacts. - The scenario must be read by the interviewer and illustrated with some displays containing maps, or other visual materials. - It is very important to inform respondents about the project finish date and which entities are entitled. - Pre-testing of preliminary questionnaires is highly recommended.	
	The hypothetical market mechanism explanation	Payment vehicle;	Pre-testing of preliminary questionnaires is highly recommended.	

Questionnaire sections	The Elicitation Question	- What welfare measure? WTP/WTA [3] - Open question or referendum format [3] with or without boundaries, with or without follow up question? - A "do not know" answer should be considered.	The choice of the elicitation question format depends on the financial restrictions on CV survey implementation, and between the incentive compatibility question and the efficiency level (Haab and McConnell, 2002; Freeman III, 2003).	- Hypothetical biases: this problem arises when respondents lack the incentives to reveal their true WTP $\Rightarrow$ respondents should believe their opinions will be considered. - Strategic Bias: free-riding and over-pledging $\Rightarrow$ to use incentive compatible question formats, like dichotomous choice or iterative bidding. - Instrumental bias: question ordering and wording; the interviewer should be neutral; • Anchoring bias;
	Additional Information	Needed to reach conclusions about result reliability: what are the determinants of elicited individual WTP?	- To be theoretically valid, elicited individual WTP should display: positive income elasticity; be positively correlated with the level of education and negatively correlated with age. - WTP is also correlated with individual attitudes: where individual consider S. Domingos rehabilitation is an exclusive task for the government or the mine company, WTP will be lowered.	

(1)   Most probably, populations will not be willing to pay for actions that fall under the responsibility of the mining company.(2)   If the project is going to generate a fuzzy set of different benefits, the contingent scenario to be evaluated may be a foundation. (3) NOOA Panel Recommendation.

Endnotes

(1) In accordance with the Encyclopaedia Britannica, a Mettalogenetic province is a geographic area characterized by a particular assemblage of mineral deposits or by a distinctive style of mineralization. The great belt of porphyry copper deposits that extends north from central Chile into Peru is another example of a metallogenic province.

(2) The European Network of Mining regions aims to develop a European Partnership out of regional mining region partnerships and to improve regional sustainable development strategies in mining regions http://www.enmr.org/.

(3) In biology, an ecosystem is a system that includes all living organisms (several populations of animals and plants also call biotic factors) in a specific area as well as its physical environment (the abiotic factor) on which it depends. The biotic and abiotic factors function together as a unit. Ecosystems also include humans and their interactions with the physical environment (adapted from [19]. In ecological economics, ecosystems are natural production systems, producing natural services and goods that are used by society (stakeholders) directly and indirectly, generating benefits and therefore improving social welfare.

(4) There are several typologies to classify the set of ecosystem services. See [21].

(5) By stakeholder we mean a person, group, or organization that has direct or indirect stake in an organization as they affect or are affected by the organization's actions, objectives, and policies.

(6) We used the Millennium Ecosystem Assessment definition of welfare constituents [32] [33].

(7) The Millennium Ecosystem Assessment uses the economic valuation framework to evaluate trade-offs between alternative ecosystem states, producing alternative quantities of services, resulting from alternative management decisions or human actions. Therefore, this valuation type may be policy relevant. This is one of the reasons we consider economic valuation to be an adequate framework to assess in monetary terms the rise in the welfare potentially provided by the rehabilitation of S. Domingos mining area.

(8) Analysis of this type of problem involving changes in either the quantities or the qualities of non-market environmental goods and services rather than changes in prices or income is often referred to as the *theory of choice and welfare under quantity*[23] to [27].

(9) You can get a very good picture of the theoretical and empirical history of CVM from [12].

(10) See [35] or [3] for a comprehensive description of these methodological CVM problems and their potential effect upon estimates and [19] as well.

Acknowledgments

References

[1] Ahlheim, M., Frör, O., Lehr, U., Wagenhals, G., and Wolf, U., (2004), *Contingent Valuation of Mining Land Reclamation in East Germany*, WP 245/2004, InstitutfürVolkswirtschaftslehre, UniversitätHohenheim, Stuttgart.

[2] Alarcão, J. de, (1988), *O Domínio Romano em Portugal*. Publicações Europa-América, Lisbon

[3] Alberini, A. et al., eds., (2006), *Handbook on Contingent Valuation*. Edward Elgar Publishing, Cheltenham.

[4] Alvarez-Valero, et al, (2008)*Use of Sequential Extraction Procedure for Assessing the Environmental Impact at Regional Scale of the Sao Domingos Mine (Iberian Pyrite Belt)*.Applied Geochemistry**,** Volume nº23**,** 3452-3463.

[5] Arrow K. et al., (1993), *Report of the NOAA Panel on Contingent Valuation***,** Federal Regulation, Volume nº 58, 4601 *et seg.*.

[6] Aronson, J. et al, (1993) *Restoration and Rehabilitation of Degraded Ecosystems in Arid and Semi-Arid Lands. A View from the South*, March, 8-9, http://www.globalrestorationnetwork.org/uploads/files/LiteratureAttachments/246_restoration-and-rehabilitation-of-degraded-ecosystems-in-arid-and-semi-arid-lands-i.pdf (last viewed 17th September 2013).

[7] Batista, M.J., (2004) *Environmental State in the Portuguese Test Site: S. Domingos Mine: Past and Present*. Mineo Project, IGM InstitutoGeológico e Mineiro, Lisbon, www2.brgm.fr/mineo/**Site**Report/IGM_**test_site**.pdf (last viewed 9th February 2011)).

[8]   Bohm, P., (1972), *Estimating demand for public goods: an experiment*. European Economic Review**,** Volume 3, 111–130.

[9]   Borghi, J. et al., (2007), *Using Focus Groups to Develop Contingent Valuation Scenarios – A Case Study of Women's Groups in Rural Nepal*. Social Science & Medicine, Volume 64, 531-542.

[11] Bowen, H.R., (1943),*The interpretation of voting in the allocation of economic resources*, Quarterly Journal of Economics, Volume 58, 27– 48,

[12] Carson, R.T. et al., (2005),*Contingent Valuation*, Handbook of Environmental Economics.Valuing Environmental Changes, Mäler, K.-G., et al (eds),North-Holland, Elsevier, Amsterdam, Volume 2, Chapter 17th.

[13] Ciriacy-Wantrup, S.V., (1947), *Capital returns from soil-conservation   practices*, Journal of Farm Economics**,** Volume 29, 1181–1196.

[14]   Ciriacy-Wantrup, S.V., (1952), *Resource Conservation: Economics and Policies*. University of California Press, Berkeley.

[15]   Cummings, D. S., et al, (1986), *Valuing Environmental Goods: an Assessment of the Contingent Valuation Method*. Rowman&Allanheld, Totowa NJ.

[16]   Damigos, D. et al, (2003), *Environmental Economics and the Mining Industry: Monetary Benefits of an Abandoned Quarry Rehabilitation in Greece*, Environmental Geology, Volume 44, 356-362.

[17] Damigos, D., (2005),*An Overview of Environmental Valuation Methods for the Mining Industry*, Journal of Cleaner Production, Volume 14, 234-247.

[18]   Davis, R.K., *The value of outdoor recreation: An Economic Study of the Maine Woods*, Dissertation, Harvard University, (1963).

[19]   Freeman AM III, *The Measurement of Environmental and Resource Values: Theory and Methods*. Resources for the Future, Washington DC, (2003).

[20] Gilpin, A, *Dicionário de Ecologia*. Publicações D. Quixote, Lisbon, (1992).

[21]   Haab, T. C. et al, *Valuing Environmental and Natural Resources*. Edward Elgar, Cheltenham, (2002).

[22] Haines-Young, R. et al, (2009), *Methodologies for Defining and Assessing Ecosystem Services*, Centre for Environmental Management, University of Nottingham: Nottingham,www.nottingham.ac.uk/cem/pdf/JNCC_Review_Final_051109.pdf (last viewed 17tth September 2013).

[23]   Hicks, J.R., (1939),*The Foundations of Welfare Economics*, Economic Journal**,** Volume nº 49(196), 696-712.

[24]   Johansson, P-O, *The Economic Theory and Measurement of Environmental Benefits*. Cambridge University Press, Cambridge, UK, (1987).

[25]   Kaldor, N., (1939),*Welfare Propositions of Economics and Interpersonal Comparisons of Utility*, Economic Journal**,** Volume nº 49, 549-552.

[26] Kopp R.J. et al, (1997), *Constructing Measures of Economic Value*, Determining the Value of Non-Marketed Goods, Kopp R.J. et al (eds), Kluwer Academic Publications, USA, 101-126.

[27] Jakobsson K.M. et al, *Contingent Valuation and Endangered Species.Methodological Issues and Applications*. Elgar, Cheltenham, (1996).

[28]   Lankford, R.H. *Measuring Welfare Changes in Settings With Imposed Quantities*, Journal of Environmental Economics and Management**,** Volume nº 15(1), 45-63, (1988).

[29] Lienhoop, N. et al, (2007).*The Economic Value of Allocating Water to Post-Mining Lakes in East Germany*, Water Resources Management, Volume nº **23** (5), 965-980.

[30] Mäler, K.G., (1971), *A Method of Estimating Social Benefits from Pollution Control*, Swedish Journal of Economics**,** Volume 73, 121-133,

[31]   Mäler, K.G., 1974, *Environmental Economics: a Theoretical Inquiry*. Johns Hopkins University Press, Baltimore.

[32]   MEA **[**Millennium Ecosystem Assessment], *Ecosystems and Human Well-Being: A Framework for Assessment.* Island Press, Washington, DC, (2003).

[33] MEA [Millennium Ecosystem Assessment], (2005), Ecosystems and Human Well-being: Synthesis*.* Island Press, Washington, DC.

[34] Milheiras, S. et al, (2011), *A Framework for the Sustainable Development of a Rural Brownfield According to Public Participation: the Case of S. Domingos Mine, Portugal*, communication presented to the 17th APDR VCongress, Bragança-Zamora, 29th June.

[35] Mitchell R.C. et al, (1989), *Using Surveys to Value Public Goods: the Contingent Valuation Method*. Resources for the Future, Washington DC.

[36]   Pearce, D.W., (1993), *Economic Values and the Natural World.* Earthscan, London,.

[37]   Pemberton, C. A., et al, (2010), *Cultural Bias in Contingent Valuation Copper Mining in the Commonwealth of Dominica*, Ecological Economics, Volume 70, 19-23.

[38]   Pereira, R., et al, (2004) *Plan for an Integrated Human and Environmental Risk Assessment in the S.*

Domingos Mine Area (Portugal), Human and Ecological Risk Assessment, Volume10, 543-578,.

[39]   Portney P.R., (1994), *The Contingent Valuation Debate: Why Economists Should Care*, Journal of Economic Perspectives**,** Volume 8 (4), 3-17.

[40]   Randall, A., et al, (1974), *Bidding Games for the Valuation of Aesthetic Environmental Improvements*, Journal of Environmental Economics and Management, Volume 1**,** 132–149.

[41]   Rego, M., *Mineração no Baixo Alentejo.* Câmara Municipal de Castro Verde, (1996).

[42]   Samuelson, P., *(1954), The Pure Theory of Public Expenditures*, Review of Economics and *Statistics, Volume 36, 387–389.*

[43]   Sardinha, I., Carolino, J., Mendes, I., Verga Matos, P. 2010 *The REHMINE Research Project: the Threefold Value of S. Domingos Abandoned Mine in Southern Portugal*, Risk Analysis VII and Brownfields V, Brebbia, C. A. et al (eds)., WIT Transactions on Information and Communication Technologies, Volume 43, 27 – 38, United Kingdom.

[44] Sardinha, I., Craveiro, D., Milheiras, S. 2013. *A sustainability framework for redevelopment of rural brownfields: stakeholder participation at São Domingos abandoned mine, Portugal*. Journal of Cleaner Production. (Available online 12 June 2013).

[45]   Simons, R. A., et al, (2008), *Use of Contingent Valuation Analysis in a Developing Country: Market Perceptions of Contamination on Johannesburg's Mine Dumps*, International Real Estate Review, Volume 11, 75-104.

[46]   Strong, A. et al, (2008), *Estimating the Economic Benefits of Acidic Rock Drainage clean up using Cost Shares*, Ecological Economics, Volume 65, 348-355.

[47]   TEEB, (2011), *The Economics of Ecosystems and Biodiversity for National and International Policy Making*. Earthscan.

Cointegration and Structural Breaks in the PIIGS Economies

Nuno Ferreira[#1], Rui Menezes[#2], Sónia Bentes[*3]

[#]*Department of Quantitative Methods, IBS-ISCTE Business School, ISCTE*
Avenida das Forças Armadas, Lisboa, Portugal
[1]`nuno.ferreira@iscte.pt`
[2]`rui.menezes@iscte.pt`
[*]*ISCAL*
Avenida Miguel Bombarda, 20, Lisboa, Portugal
[3]`smbentes@iscal.ipl.pt`

Abstract - **Due to the economic recession which started in 2008, several members of the European Union became historically known as PIIGS. These states include Portugal, Italy, Ireland, Greece and Spain and if ombined together, they form the acronym PIIGS. The reason why these countries were grouped together is the substantial instability of their economies, which was an evident problem in 2009.**

The reason why the five countries gained popularity is a serious concern within the EU, with regard to their national debts, especially for Greece. The latter country was involved in a controversial affair after allegedly falsifying its public financial data. In the year 2010, it was evident that the five states were in need of corrective action in order to regain their former financial stability.

Because of the dirty farm animal associated with the acronym, several country leaders from the financially troubled countries have voiced out disagreement with the use of the term. However, there are quite a number of reporters and columnists who still refer to it when talking about the widespread economic crisis within the European Union. Although some prominent politicians have criticized the practice, the use of the word is very hard to shake off.

Keywords - *Stock Markets Indices; Interest Rates; Structural Breaks; Cointegration; EU Sovereign Debt Crisis; PIIGS*

1. Introduction

As a result of the financial crisis, modeling the dynamics of financial markets is gaining more popularity than ever among researchers for both academic and technical reasons. Private and public economic agents take a close interest in the movements of stock market indexes, interest rates, and exchange rates in order to make investment and economic policy decisions. The most broadly

used unit root test used to identify stationarity of the time series studied in the applied econometric literature is the Augmented Dickey Fuller test (henceforth ADF).

However, several authors have stated that numerous price time series exhibit a structural change from their usual trend mostly due to significant policy changes. These economic events are caused by economic crises (e.g. changes in institutional arrangements, wars, financial crises, etc.) and have a marked impact on forecasting or analyzing the effect of policy changes in models with constant coefficients. As a result, there was strong evidence that the ADF test is biased towards null of random walk where there is a structural break in a time series. Such finding triggered the publication of numerous papers attempting to estimate structural breaks motivated by the fact that any random shock has a permanent effect on the system.

In the current context of crisis, this study analyzes structural break unit root tests in a 13 year time-window (1999-2012) for the five European markets under stress also known as PIIGS (Portugal (PT), Italy (IT), Ireland (IR), Greece (GR) and Spain(SP)), using the United States of America (US) as benchmark. The PIIGS countries gained popularity due to their national debts, especially for Greece. Despite several country leaders have voiced out disagreement with the use of the acronym associated with the dirty farm animal, the use of the word is very hard to shake off by a quite number of reporters and columnists.

Considering the problems generated by structural breaks, the unit root test Zivot and Andrews, 1992 (henceforth ZA) was employed to allow for shifts in the relationship between unconditional mean of the stock markets and interest

rate. The ZA unit root test captures only the most significant structural break in each variable. To confirm the presence of structural breaks detected by ZA test, this paper also employs the method developed by Bai and Perron (1998, 2001, 2003a and 2003b) (henceforth BP). This third test consistently estimates multiple structural changes in time series, their magnitude and the time of the breaks. However, it must be stressed that the consistency of the test depends on the assumption that time series are regime-wise stationary. This implies that breaks and break dates accurate with BP are only statistically reliable when the time series is stationary around a constant or a shifting level. If the time series is nonstationary, BP tests may detect that the time series has structural breaks.

A limitation of the ADF-type endogenous break unit root tests, e.g. ZA test, is that critical values are derived while assuming no break(s) under the null. Nunes et al. (1997) and Lee and Strazicich (2003) showed that this assumption leads to size distortions in the presence of a unit root with one or two breaks. As a result, one might conclude when using the ZA test that a time series is trend stationary, when, in fact, it is nonstationary with break(s), i.e. spurious rejections might occur.

To address this issue, Lee and Strazicich (2004) proposed a one-break Lagrange Multiplier (henceforth LM) unit root test as an alternative to the ZA test. In contrast to the ADF test, the LM unit root test has the advantage that it is unaffected by breaks under the null. These authors proposed an endogenous LM type unit root test which accounts for a change in both the intercept and also in the intercept and slope. The break date is determined by obtaining the minimum LM t-statistic across all possible regressions. More recently, several studies started to apply the LM unit root test with one and two structural breaks to analyze the time series properties of macroeconomic variables (e.g. Narayan, 2006; Chou, 2007; Lean and Smyth, 2007a, 2007b).

Based on the studies cited above, we concluded the first part of the analysis assuming that the break date is unknown and data-dependent. The distinct tests applied aimed to detect the most important structural breaks in the stock market and the interest rate relationship of all markets under analysis.

Having linked the source of the breaks found with some economic events during the time window under study, it was possible to advance with the second part of the analysis in which the main goal was to explore a possible cointegration relationship between interest rates and stock market prices. Therefore, the Gregory and Hansen (1996) regime shift model (henceforth G-H) was used to find evidence of structural regime shifts that could explain the contamination of the severe EU debt crisis. The results identified the most significant structural breaks at the end of 2010 and consistently rejected the null hypothesis of no cointegration. Moreover, they showed that both the regional credit market and stock market have reached a nearly full integration in both pre and post crisis periods.

2. Methodology

2.1 Zivot and Andrews test

The ZA is the most widely adopted endogenous one-break test. Building on Perron's (1989) exogenous break test, it only considers a break under the alternative but not under the null when carrying out unit root testing. Of the three types of ADF test proposed by Perron, the authors applied the one in which the Ha is a break in the intercept and in the slope coefficient on the trend at an unknown breakpoint. Estimating by OLS:

$$\Delta y_t = \alpha + \theta_1 D_{1t}(\lambda) + \beta t + \theta_2 D_{2t}(\lambda) + \gamma y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta y_{t-i} + u_t \qquad (1)$$

Thus many sequential regressions are computed where $D_{1t}(\lambda)$ and $D_{2t}(\lambda)$ change each time. The t-test statistic (concerning $\gamma=0$) is also computed in each regression. Zivot and Andrews (1992) re-examined the Nelson-Plosser dataset and found a number of problems with the unit-root tests employed; thereafter, the literature documented an exhaustive list of empirical studies which employed this test (e.g. Ibrahim, 2009; Karunaratne, 2010; Ranganathan and Ananthakumar. 2010; Ramirez, 2013).

2.2 Bai and Perron test

In The Bai and Perron (1998, 2001, 2003a, 2003b) methodology to estimate and infer multiple mean breaks models was based on dynamic linear regression models. They estimate the unknown break points given T observations by the least squares principle, and provide general consistency and asymptotic distribution results under fairly weak conditions, allowing for serial correlation and heteroskedasticity. In Bai and Perron (1998) the authors developed a sequential procedure to test the null hypothesis of one structural change versus the alternative of one plus one break in a single

regression model. Thus, the pure structural change model is considered in several studies and is defined as $j = 1,…, m + 1$, $t_0=0$ and $t_{m+1} = T$. The dependent variable is subject to m breaks and c_j is the mean of the series, r_t for each regime j. The model allows for general serial correlation and heterogeneity of the residuals across segments. The pure structural change model can be estimated as follows. For each m-partition, the least squares estimate of c_j is obtained by minimizing the sum of squared residuals, where minimization occurs over all possible m-partitions.

Several authors have recently implemented the BP test for multiple break dates (e.g. McMillan and Ruiz, 2009; Yu and Zivot, 2011; Loscos et al., 2011; Zhou and Cao, 2011; Dey and Wang, 2012).

2.3   Lee and Strazicich test

The first part of this empirical analysis ends with the LS test also known as LM test due to Langrage multipliers. The main advantage over previous tests is that they are not affected by structural breaks under the null hypothesis because the critical values of the ADF-type endogenous break unit root tests (such as ZA and LP) were derived while assuming no break(s) under the null. The test employed in this paper (model A, known as the "crash model") could be briefly described considering: $Z_t = [1, t, D_{1t}, D_{2t}]'$ where $DT_{jt} = t - T_{Bj}$ for $t \geq T_{BJ} + 1, j = 1,2$ and 0 otherwise. Consequently, it could be evidenced that DGP incorporated breaks under the null ($\beta=1$) and alternative hypothesis ($\beta>1$) as already noted. Making the value of β uncertain, we could rewrite the both hypotheses as

$$\begin{cases} H_0: y_t = \mu_0 + d_1 B_{1t} + d_2 B_{2t} + y_{t-1} + v_{1t}, \\ H_A: y_t = \mu_1 + \gamma_t + d_1 D_{1t} + d_2 D_{2t} + v_{1t}. \end{cases} \quad (2)$$

Where and are stationary error terms with for and 0 otherwise. The LM unit root test statistic is obtained from the following regression Arghyrou (2007) designed this component as the LM score principle. The LM test statistic is determined by testing the unit root null hypothesis that The LM unit root test determines the time location of the two endogenous breaks, whereas represent each combination of break points] using a grid search as follows: The break time should minimize this statistic.

Critical values for a single break and two-break cases are tabulated from Lee and Strazicich (2003, 2004) respectively. Another approach to searching for unit roots with breaks by allowing nonstationarity

in the alternative hypothesis is adopted in several studies following the Lee and Strazicich (2003, 2004) procedure testing.

2.4   Gregory and Hansen test

Gregory and Hansen (1996) used a residual-based test for cointegration in a multivariate time series with regime shifts; they proposed the ADF tests, which are intended to test the null hypothesis of no cointegration against the alternative of cointegration in the presence of a possible regime shift. This test examines whether there has been a one-time shift in the cointegration relationship by detecting any cointegration in the possible presence of such breaks and presents four different approaches. A single-equation regression with structural change starting with the standard model of cointegration (model 1):

$$y_{1t} = \mu + \alpha^T y_{2T} + \varepsilon_t, t = 1, …, n \quad (3)$$

In this case, if there is stated a long-run relationship, μ and α are necessarily defined as time-invariant. The G-H approach consider that this long-run relationship could shift to a new long run relationship by introducing an unknown shifting point that is reflected in changes in the intercept μ and/or changes to the slope α defining Model 2 and 3 in the following form (model 2 - level shift (C)):

$$y_{1t} = \mu_1 + \mu_2 \alpha^T y_{2T} + \varepsilon_t, t = 1, …, n \quad (4)$$

This model represents a level shift in the cointegration relationship, and is modeled as a change in the intercept μ variable. μ_1 and μ_2 represent the intercept before and at the time of the shift. In order to account for the structural change, the authors introduced the dummy variable definition:

$$\varphi_{t\tau} = \begin{cases} 0 \ if \ t \leq [n\tau], \\ 1 \ if \ t > (n\tau). \end{cases} \quad (5)$$

where the unknown parameter $\tau \in (0,1)$ represents the relative timing of the change point and [.] denotes integer part. Model 3: Level Shift with Trend (C/T):

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \beta_t + \alpha^T y_{2t} + \varepsilon_t, t = 1, …, n \quad (6)$$

In this model, the authors extended the possibilities by introducing a time trend β_t into the level shift model. And finally, the model 4 - Regime Shift (C/S):

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha^T y_{2t} + \alpha^T y_{2t} \varphi_{t\tau} + \varepsilon_t, t = 1, \dots, n \quad (7)$$

The last model integrates a shift in the slope vector, which permits the equilibrium relation to rotate and a parallel shift. For this case, α_1 is the cointegrating slope coefficient before the regime shift, and α_2 is the change in the slope coefficients, whereas $(\alpha_1 + \alpha_2)$ is the cointegrating slope coefficient after the regime shift.

Concerning the software, all routines applied were run with WinRATS Pro 8.0 and are available in Estima website.

2.5 Dataset

The variables under study cover daily data from April 1999 to December 2012 and are expressed in levels after a logarithmization procedure. For instance, the stock market price (*Pi*), the (*Y1*) and (*Y10*) are the government bond yield and the interest rates at 1 year and 10 years, respectively. All the three variables have been collected for each selected market (Portugal (PT), Spain (SP), France (FR), Ireland (IR), Italy (IT) and Greece (GR)) from the European countries under most stress in the recent years. We also included the US market as a benchmark. All data have been collected and are available online from Datastream database.

3. Results and discussion

The results of the unit root testing procedures are presented in the tables below, starting with the price index (Pi variable) (Table 1) which was implemented using both the intercept and trend options (ZA test).

Table 1. Unit-root tests (variable Pi). (**) indicates critical values at 1%. The optimal lag length

Variable	ZA[a]		BP		LS (2 breaks)		
	TB1	Statistic	TB1	TB2	TB1	TB2	Statistic
Pi_Pt	Aug-03	-2.631	May-01	Aug-11	Feb-06	Jul-11	-1.384
Pi_Ir	Aug-04	-3.153	Jul-05	Sep-08	Oct-08	May-10	-1.664
Pi_It	May-08	-4.233	Nov-04	Jul-08	Mar-07	Sep-08	-1.519
Pi_Gr	Nov-05	-11.216[**]	Feb-00	Nov-05	Sep-00	Nov-05	-33.674
Pi_Sp	Aug-04	-3.012	Dec-05	Oct-08	Sep-04	Aug-11	-1.907
Pi_US	May-03	-3.217	May-02	Jul-05	Sep-01	Jan-03	-2.043

Note: [a] Both Intercept and Trend

was determined by SBC.

The corresponding time of the structural break (TB1 and TB2) for each variable is also shown in each test. For the Pi variable in the established crisis period, the ZA test fails to reject the null hypothesis of a unit-root at the 1 percent significance level in all countries except Greece. This means that the price index series of the remaining countries are non-stationary. For the 1 year interest rate (variable Y1) series (Table 2), the ZA test fails to reject the null hypothesis of a unit-root at 1 percent significance level US.

Table 2. Unit-root tests (variable Y1). (**) indicates critical values at 1%. The optimal lag length was

Variable	ZA[a]		BP		LS (2 breaks)		
	TB1	Statistic	TB1	TB2	TB1	TB2	Statistic
Y1_Pt	Sep-07	-13.643[**]	Sep-07	Jun-12	Sep-07	Aug-11	-34.279
Y1_Ir	Sep-07	-16.770[**]	Sep-07	Jun-12	Dec-04	Sep-07	-45.173
Y1_It	Dec-10	-13.682[**]	May-09	Jul-12	Mar-06	Aug-11	-34.730
Y1_Gr	Dec-10	-9.454[**]	Jan-01	Apr-12	Aug-01	Aug-11	-29.893
Y1_Sp	Sep-07	-16.308[**]	Sep-07	Jun-12	Sep-07	Aug-11	-40.278
Y1_US	Feb-06	-2.048	Sep-03	Apr-08	Jul-01	Nov-02	-4.553

Note: [a] Both Intercept and Trend

determined by SBC.

The analyses of the 10 year interest rate (variable Y10) series reveal that all countries are stationary meaning that this is not a good indicator to cointegrate (Table 3).

Table 3. Unit-root tests (variable Y10). (**) indicates critical values at 1%. The optimal lag length

Variable	ZA[a]		BP		LS (2 breaks)		
	TB1	Statistic	TB1	TB2	TB1	TB2	Statistic
Y10_Pt	Dec-10	-17.942[**]	Jan-03	Mar-11	Aug-03	Mar-11	-57.984
Y10_Ir	May-03	-21.050[**]	Feb-03	Mar-03	Mar-02	Apr-08	-58.534
Y10_It	Nov-10	-20.006[**]	May-11	May-11	Oct-03	Mar-11	-61.385
Y10_Gr	Dec-10	-18.223[**]	Dec-10	Apr-11	Jun-05	May-10	-55.450
Y10_Sp	Dec-10	-19.066[**]	Feb-04	Mar-11	Dec-03	Mar-11	-57.631
Y10_US	Nov-10	-19.195[**]	Aug-09	Nov-10	Sep-00	Nov-10	-47.352

Note: [a] Both Intercept and Trend

was determined by SBC.

In light of these results, the cointegration hypothesis was tested with the Pi variable of all European countries (except GR) against the Y1 variable of US (Table 4). The structural break points defined through the different tests consistently coincide with important dates through the time-window analyzed, with special emphasis on the US.

According to Lee et al. (2006) and citing Ghoshray and Johnson (2010), by allowing for the possibility of a break in the null, the LM test can be considered genuine evidence of stationarity; this means that we can rely more on the break points calculated by the minimum LM test than those estimated by the remaining tests. This could lead to size distortion which increases with the magnitude of

the break; this does not occur with the LM test as a different detrending method is used.

Following these assumptions and focusing on the structural break points identified by the LM test (two breaks), all dates related to 2001-2003 reveal the economic impact of the September 11 attacks on the US, namely in New York City and Washington D.C. in 2001 and the repercussions in the following years with the concerted military action against Iraq.

Further, a mild recession in 2001, caused partly by the bursting of the dot-com bubble, prompted the Fed (led by Chairman Alan Greenspan) to lower the target federal funds rate from 6% to 1.75% in an effort to stimulate employment. The Fed kept interest rates low for the next two years; it dropped to just 1% - the lowest rate in 50 years - in summer 2003, and only rose again one year later. By late 2003, the US was in the midst of the most serious world economic setback, originated by the credit boom (interest rates were at a 50-year-low and mortgage credit stood at an all-time high) and the housing bubble (prices had exceeded all previous levels).

The first half of 2004 was characterized by a trend towards gradual economic recovery. However, there were still some obstacles hindering the growth of the world economy; for example, a rise in the price of oil per barrel to record high contributed to raise expectations in the major economic areas.

The marked depreciation of the euro against the dollar from May 2005 could have also played a role. In the run-up to this decision, the ECB had considerably stepped up its use of moral suasion to signal its readiness to raise interest rates "at any time".

Meanwhile, when the downturn in housing prices finally began in 2006, everyone had difficult in repaying their mortgages as home equity loans shrank. Subprime borrowers were, by definition, more prone to default on their mortgages than the average person. The resulting wave of subprime foreclosures fueled the aforementioned downward spiral of prices, as it prompted a glut in housing supply and a contraction of housing demand.

By 2007, more than just a few farsighted economists were noting that the unprecedented rise in housing prices might be an unsustainable bubble (though most still underestimated the bubble's economic significance).

In 2008, developments took a turn for the worse, and the growth slowdown became acuter. In early 2009, the conclusion was that this would be a deeper recession than the average of "Big Five" (those in Spain, 1977; Norway, 1987; Finland, 1991; Sweden, 1991 and Japan, 1992). The conjuncture of elements is illustrative of the two channels of contagion: cross-linkages and common shocks.

There can be no doubt that the US financial crisis of 2007 spilled over into other markets through direct linkages. The governments of emerging markets had experienced stress, although of mid-2009 sovereign credit spreads had narrowed substantially in the wake of massive support from rich countries for the IMF fund. European banks began to face liquidity problems after August 2007, and German banks continued to lend heavily to peripheral borrowers in the mistaken belief that peripheral countries were a safe outlet. Net exposure rose substantially in 2008. Speculators focused on Greek public debt on account of the country's large and entrenched current account deficit as well as because of the small size of the market in Greek public bonds. Greece was potentially the start of speculative attacks on other peripheral countries – and even on countries beyond the Eurozone, such as the UK – that faced expanding public debt.

Greece thus found itself in a very difficult position in early 2010 and imposed cuts and raised taxes in order to pay high interest rates to buyers of its public debt. The country was able to access markets in January and March 2010, but the rate of interest was high on both occasions - well in excess of 6 percent. On 2 May 2010, the EU announced a support package for Greece, put together in conjunction with the IMF fund. Lapavitsas et al. (2012) documented that the sovereign debt crisis that broke out in Greece at the end of 2009 was fundamentally due to the precarious integration of peripheral countries in the Eurozone. Its immediate causes, however, lie with the crisis of 2007-9.

The result in the Eurozone was a sovereign debt crisis, exacerbated by the structural weaknesses of monetary union. Meanwhile, with the global economy likely to perform indifferently in 2010-11 and given the high regional integration of European economies, exports were unlikely to prove the engine of growth for Europe as a whole. The austerity policy ran the risk of resulting in a major recession.

These are but a few insights into the dates of structural breaks given in Tables 1 to 3. The crisis in the different financial markets (e.g. credit, debt, derivatives, property and equity) are just the tip of the iceberg of a severe financial crisis of huge proportions worldwide. In Europe, the sovereign debt crisis should be considered as spreading across a broad front the instability of each country, leading to an employment crisis and in turn a social crisis, and eventually turning into a political crisis.

The Greek case is not discussed further in this study due to the deep crisis in which the country is submerged. This trend can be observed in both the Pi and the Y1 variables (Tables 1 and 2).

Table 4. Cointegration results

Variables Pi (market) and 1Y (US):	Cointegration models	Minimum T-Statistic	Critical Values	
			1%	5%
	C	-3.864	-5.130	-4.610
Pi_Pt	CT	-3.494	-5.450	-4.990
	CS	-2.819	-5.470	-4.950
	C	-4.204	-5.130	-4.610
Pi_Ir	CT	-3.508	-5.450	-4.990
	CS	-3.177	-5.470	-4.950
	C	-5.003	-5.130	-4.610
Pi_It	CT	-4.753	-5.450	-4.990
	CS	-4,667	-5.470	-4.950
	C	-4.306	-5.130	-4.610
Pi_Sp	CT	-3.776	-5.450	-4.990
	CS	-3.506	-5.470	-4.950

Note: the critical values from Gregory-Hansen (1996a)

The cointegration hypothesis was tested by performing the relationship between the stock market prices and interest rates (Table 4). Bivariate cointegration was considered for this purpose, allowing for structural break tests between the price indexes of each stock market and the interest rate at 1 year of US market benchmark.

This test detects regime-shift as well as stable cointegration relationships. Thus, the rejection of the null hypothesis does not entangle the instability of the cointegration relationship. The differentiation of these situations is made using stationarity tests and with the structural breaks previously presented. It is possible to infer the US influence on the European equity markets through the timing of structural breaks (Tables 1 to 3) and because both variables show prolonged upward and downward movements (resumed in Table 4).

The corresponding time of the structural break (TB1 and TB2) for each variable is also shown in each test. For the Pi variable in the established crisis period, the ZA test fails to reject the null hypothesis of a unit-root at the 1 percent significance level in all countries except Greece. This means that the price

index series of the remaining countries are non-stationary.

4.   Conclusion

This paper explored possible structural changes in the stock market and interest rate variables (in PIIGS states) as well as the relationship between them. With this purpose, first the ZA and the LS (2 breaks) were employed to test for the presence of structural breaks with unknown timing in the individual series; multiple structural breaks was then detected with BP test. Secondly, the G-H test was used for cointegration between stock market prices and the interest rates for the European markets under stress and infected by the vast sovereign debt crisis since 2003. The results effectively revealed that there was a relationship between the two variables in all analyzed countries which implies important economic repercussions. Conducting monetary policy by targeting a monetary aggregate requires reliable quantitative estimates of the demand for money determined by the interest rate behavior.

An examination of the crisis reveals that economies are already quite integrated, and this resulted in its spread from the US to the rest of the world.

References

[1]   Arghyrou, M.G., 2007. The price effects of joining the Euro: Modeling the Greek experience using non-linear price-adjustment models. *Applied Economics*, 39(4), 493-503.

[2]   Bai, J., Perron, P., 2003b. Critical values for multiple structural change tests. *Econometrics Journal*, 6, 72-78.

[3]   Bai, J., Perron, P., 2003a. Computation and analysis of multiple structural change models. *Journal of Applied Econometrics*, 18, 1-22.

[4]   Bai, J., Perron, P., 2001. *Multiple structural change models: A simulation analysis*. Manuscript, Boston University.

[5]   Bai, J., Perron, P., 1998. Estimating and testing linear models with multiple structural changes. *Econometrica*, 66, 47-78.

[6]   Chou, W.L., 2007. Performance of LM-type unit root tests with trend break: A bootstrap approach. *Economics Letters*, 94(1), 76-82.

[7]   Dey, M.K., Wang, C., 2012. Return spread and liquidity: Evidence from Hong Kong ADRs. *Research in International Business and Finance*, 26(2), 164-180.

[8]   Ghoshray, A., Johnson, B., 2010. Trends in world energy prices. *Energy Economics*, 32, 1147-1156.

[9]   Gregory, A.W., Hansen, B.E., 1996. Tests for cointegration in models with regime and trend shifts. *Oxford Bulletin of Economics and Statistics*, 58, 555-560.

[10] Ibrahim, S., 2009. East Asian Financial Integration: A Cointegration Test Allowing for Structural Break and the Role of Regional Institutions. International *Journal of Economics and Management*, 3(1), 184-203.

[11] Karunaratne, N.D., 2010. The sustainability of Australia's current account deficit – A reappraisal after the global financial crisis. *Journal of Policy Modeling*, 32, 81-97.

[12] Lapavitsas, C., 2012. *Crisis in the Eurozone*. Verso Books.

[13] Lean, H.H., Smyth, R., 2007b. Are Asian real exchange rates mean reverting? Evidence from univariate and panel LM unit root tests with one and two structural breaks. *Applied Economics*, 39, 2109-20.

[14] Lean, H.H., Smyth, R., 2007a. Do Asian stock markets follow a random walk? Evidence from LM unit root tests with one and two structural breaks. *Review of Pacific Basin Financial Markets and Policies*, 10(1), 15-31.

[15] Lee, J., List, J.A., Strazicich, M.C., 2006. Non-renewable resource prices: deterministic or stochastic trends? *Journal of Environmental Economics and Management*, 51(3), 354-370.

[16] Lee, J. and Strazicich, M.C., 2004. *Minimum LM unit root test with one structural break*. Appalachain State University, Department of Economics, Working Paper No 17.

[17] Lee, J., Strazicich, M.C., 2003. Minimum Lagrange multiplier unit root test with two structural breaks. The *Review of Economics and Statistics*, 85(4), 1082-1089.

[18] Loscos A.G., Montañés, A., Gadea, M.D., 2011. The impact of oil shocks on the Spanish economy. *Energy Economics*, 33(6), 1070-1081.

[19] McMillan, D., Ruiz, I., 2009. Volatility persistence, long memory and time varying unconditional mean: Evidence from 10 equity indices. *The Quarterly Review of Economics and Finance*, 49, 578-595.

[20] Narayan, P.K., 2006. The behavior of US stock prices: evidence from a threshold autoregressive model. Mathematics and Computers in Simulation 71, 103-108.

[21] Nunes, L.C., Newbold, P., Kuan, C.M., 1997. Testing for unit roots with breaks: Evidence on the Great Crash and the unit root hypothesis reconsidered. Oxford Bulletin of Economics and Statistics 59(4), 435-448.

[22] Perron, P., 1989. The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. Econometrica 57(6), 1361-1401.

[23] Ramirez, M., 2013. Remittances and Economic Growth in Mexico: An Empirical Study with Structural Breaks. Working Paper 13-06. Trinity College Department of Economics.

[24] Ranganathan, T., Ananthakumar, U., 2010. Give it a break. 30th International Symposium on Forecasting, San Diego, USA.

[25] Yu, W.C., Zivot, E., 2011. Forecasting the term structures of Treasury and corporate yields using dynamic Nelson-Siegel models. International Journal of Forecasting 27(2), 579-591.

[26] Zhou, D., Cao, J., 2011. A quantitative assessment on the evolution of Chinese energy and US. Renewable and Sustainable Energy Reviews 15(1), 886-890.

[27] Zivot, E., Andrews, D.W.K., 1992. Further Evidence on the Great Crash, Oil Price Shock and the Unit Root Hypothesis. Journal of Business and Economic Statistics 10, 251-270.

Energy Policy and Forest Sustainability:
A Reflection on the New Brazilian Forest Code

Maria Dominguez[#], Manuel Coelho[*]

[#]*ISEG-UTL*
mariasndominguez@gmail.com

[*]*SOCIUS, ISEG/Universidade Técnica de Lisboa*
coelho@iseg.utl.pt

Abstract - **The world energy market has been suffering some modifications with the emergence of new energy resources as bio-fuels. In this context, Brazil has been proving to have the ability to produce enough ethanol derived from sugarcane through its huge territory and fertile soil, what enables the country to control a big share of the energy supply and to take the major role from other important energy producers. But, a considerable change in the use of the soil is required, being the major one the expansion of lands that leads to deforestation in Amazonia. All over the last two years, important changes were discussed and made in the Brazilian forest regulation. Our study consists on the explanation of what we think are the true and fundamental reasons for reviewing the Brazilian Forest Code; how sustainable are these changes and who will benefit from.**

Keywords – *Energy, Forest Sustainability, Forest Code.*

1.   Introduction

Changes in the Brazilian Forest Code have been discussed all over the next two years. Our focus is to connect this evolution with international exchanges, especially regarding the energy industry.

The world energy market has been suffering some modifications with the emergence of new energy resources, as bio-fuels. Through its huge and fertile soil, Brazil has been proving to have the ability to produce a large ethanol derived from sugarcane at a large scale. That, enables the country to control a big share of the world energy supply and take the major role of international energy policy to others important energy producers. Unfortunately, a considerable change in the use of the soil is required, the major one being the expansion of lands that leads to deforestation, so Brazil can be able to respond to this market increase.

Our study will consist on the explanation of what we think are the true and fundamental reasons for reviewing the Brazilian Forest Code. How sustainable will these changes be and who will benefit from?

The structure of the paper is the following: In the first point we introduce the issues relating bio-fuels and new energy systems and, in the second point, the specific situation of Brazil, in terms of these new forms of energy production and use, is discussed. The point three takes the analysis of the Brazilian Forest Code and makes the balance of the changes that were introduced in the new legislation. The economical and environmental consequences are discussed. Finally, these changes are critically reviewed and a special attention is given to the new features that were introduced in the last year, after the new Code was approved.

2.   The Challenge of Renewable Energies: The Bio-Fuel Case

Nowadays, there are many different externalities that affect oil consumers' preferences, directly or indirectly. The price of oil had a notable increase during the past last years. Its instability makes one think about different sources of energy, other than oil. This tendency is followed by an increase of ecologic consciousness that affects demand, and therefore, also affects supply. According to BP (British Petroleum) data, search for oil has been diminishing every year for the last ten years. At the same time, renewable energy markets have been increasing.

After Kyoto's Protocol, 1997, and others world's conferences about preservation of the environment that followed it, the impacts of GEE's emissions in global warming and pollution in the

atmosphere have been the core of many discussions and debates. These concerns lead into international agreements and international rules based on the reduction of carbon dioxide emissions as well as other pollutants and GEEs. They also included economic incentives (as subsidies for the emission reduction and tariffs and fees on oil importation and use of others fossil fuels). Consequently, these measures imply the reduction of oil demand in favour of the development and use of alternative energies.

At first sight, these environmental policies seem fairer and more environment- friendly. But won't these changes in consumption affect the whole mechanism of energy production already existent? What about renewable energy sources, won't they have to be produced on a larger scale? Who will suffer from this changes, and how?

Renewable energies considered more environmental friendly, such as bio-diesel, bio-ethanol, palm oil and others, are obtained from plants and cereals like corn, sugarcane, palm and many others. In some parts of the planet each of these are considered staples. With the renewable energies market expansion, demand for agricultural products will tend to rise. And if the ambitious goals for 2022 and 2050 are ever going to take place, this growth will not be modest. To have an idea, 1 litre of ethanol equals to two thirds of a litter of gasoline, in energetic terms. So it is necessary to produce one third more ethanol to get the same result as with gasoline. Further, for each quantity of input of corn used in the U.S, they get 1.5 of output (bio-ethanol made by corn).

Now that we have this information, we can assume two possibilities for the future of this industry development. First, if crop areas in the world do not enlarge, the results will be reflected in the increase of food prices. Products that once were destined to feed the population, as final goods, are now considered intermediate goods for bio-fuels production. As a result, the quantity of cultivated food offered in supermarkets will be reduced and so their real prices will rise.

On the other hand, crop areas could be extended and so we would have new energies' feedstock. That way, the amount of food offered would not have to be affected and we would still have enough to produce bio-fuels. Instead, it is the value of lands that will increase, as well as deforestation and its consequences.

Stimulating the production of bio-fuel has been at the centre of some of the latest environmental courses of actions. Self-sufficiency is a key-factor for the growth of a country, so, the developed and developing countries are most interested candidates to invest in this field. The domestic production of alternative energies as substitutes for fossil fuels, which have high production costs and high final price, leads to a reduction of imports and of dependence from politically unstable countries.

Acquiring energy independence from providers in these politically unstable countries was one of the main reasons that led the United States to expand in this industry. In 2007, the production of corn from the U.S. accounted for 40% of world production and 55-60% of international trade. Thus, the U.S. had an enormous influence on the international price of corn. When it began specializing in the production of corn-based ethanol, the price of grain tended to increase as their demand for energy. The impact on the price increase was also resented by the household consumption.

With the steady increase in the price of fossil fuel, the domestic industry of bio-ethanol increased too. Furthermore, the dedicated areas to the cultivation of soybeans, as well as other cereals, suffered with this growth having their areas of cultivation reduced to make room for cornfields, thus creating a change in American cultures. Faced with this policy, two opposing streams emerged:

- Farmers and industry supporters, who have seen their revenues increase, and senators, who noted a reduced dependence on oil imports;

- Environmentalists, defending that there is a limitation on the supply side due to the restriction of potentially dedicated areas to the cultivation, provided by the "Conservation Reserve Program"[1].

Another problem associated with the necessity of increasing the agricultural areas is the lack of productivity and inefficiency of the country compared to its competitors. As previously mentioned in this study, in the case of ethanol production, in the United States, for each input unit used is obtained 1.5 of output, which is very little taking into account that in Brazil, for each input unit

---

[1] USDA (United States Department of Agriculture) definition of the Conservation Reserve Program (CRP): It is a voluntary program for agricultural landowners. Through CRP, one can receive annual rental payments and cost-share assistance to establish long-term, resource conservation covers on eligible farmland.

used is obtained 8 units of output. If the U.S. devoted all their cornfields to ethanol it would supply only 4% of its national energy demand.

Several factors have led Americans to realize that it would be much wiser to abolish subsidies for domestic production of corn ethanol, as well as taxes on imports. On December 31st of 2011, tariff barriers for bio-diesel and ethanol, from Brazil and the U.S. (the largest producers of ethanol in the world) were abolished allowing these two countries to trade with each other at the renewable energy markets´ price.

Another important case to be analysed is that of China, because this country is the largest energy consumer in the world. In 2000, China was responsible for consuming 11% of the world energy, in 2010, they reached 20.3%. Despite this enormous demand for energy, China does not have the capacity to produce enough raw materials to generate renewable energy in order to meet their needs and, also, their basic food needs. Just to meet them, China would have to double or even triple their crops in some regions. However, this is not feasible due to topographical limitations of the country.

Another reason that also limits the possibility of extension of cultivated areas is the fact that large areas of marginal lands belong to the program "Grain for Green Program"[2] supported by the government. Not to be left behind in the race of green energy alternatives, China sets itself in search of alternatives to the production of raw material outside its borders, particularly in Brazil.

3.   Development of Renewable Energy Industry in Brazil

Brazil and the United States represent almost 90% of global production of ethanol. Brazil, along with Germany, France and Argentina, account for 10-14% of world's bio-diesel production. The weight of Brazil in this industry is due to the enormous demand for alternative fuels, particularly for the increase of purchasing efficient cars, and its huge competitive advantage, especially with regard to size and fertility of the soil in comparison with other producers.

So, there is a market demand on one side; and efficiency and productivity in the supply, on the other side, which seems to create a good balance. Given the size of its unexploited territory, Brazil has the capacity to expand its large-scale farming areas. As for productivity, the country has proven to have low production costs, and so being able to sell ethanol at competitive prices in order to meet domestic demand and even export. The production of ethanol distilled from sugar cane involves using less land and less fossil fuels than others energy fuels. All these factors promoted the integration of Brazilian energy industry in the international market letting it compete with fossil fuels.

Therefore, the Brazilian government adopted fiscal measures encouraging this growing industry, through tax incentives and subsidies. These measures, added to the country's climate that allows sugar cane to fit easily into different areas and so being produced in large scale, contributes to the growth of national economy. One third of the global sugarcane production is of Brazilian's responsibility. It represents 10% of the country's cultivated area, which means 5.6 thousand hectares. 54% of this sample accounts for 40% of national bio-fuel production for domestic demand.

Given the Brazilian success in this industry, is not expected that it will fall. Domestic demands and exportations of ethanol are expected to increase. This ambition is supported primarily by farmers expecting to increase their revenues. Besides, from the point of view of potential importers of alternative energy feedstock, this measure seems suitable: Brazil has a huge unexploited area of land and great facilities regarding agriculture.

Even though this approach seems to be a golden goose for Brazil and for the rest of the world, in large part, it is also a serious worldwide environmental issue. It is estimated that, in 2017, the Brazilian sugarcane area of cultivation will cover an additional 10 million hectares of fertile soil. At the same time, cattle pasture and other crops will move along with the deforestation of the Amazon, where it is more suitable for sugarcane plantation. It is expected that 40% of the Amazon will be deforested by 2050, due to this new needs.

---

[2] Grain for Green Program: Also known as Slope Land Conversion Program or The Conversion of Cropland to Forest and Grassland Program was launched in China as a national measure to control erosion and increase vegetation cover, in 1999. It features the conversion of steep-sloped and degraded cropland and barren land to forest and grassland by millions of small landholders in 25 provinces, municipalities and autonomous regions.
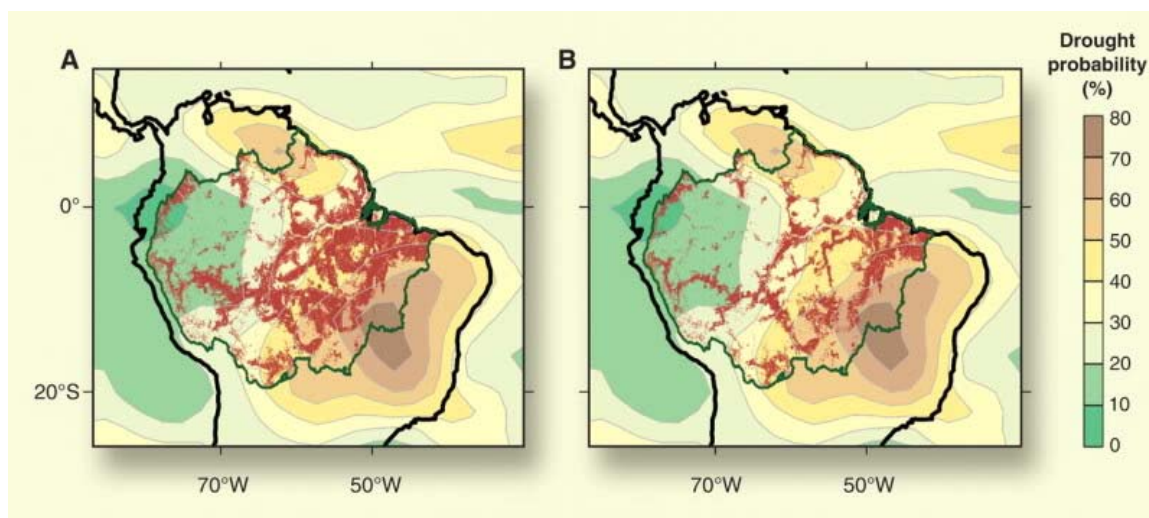
Figure 1. Two models of deforestation in 2050, under A) the current system and B) increased governance.

Source: Blog Action Day: A Picture is Worth a Thousand Trees

Given the need to preserve the Amazon, environmental groups, and others, alerted for a series of infrastructure projects planned for the next years that aim to move farmers into unexplored regions. These plans are followed by progressive changes in land use. The Midwest, and specially the state of Mato Grosso, suffer the most with these measures, due to the increasing movement to the north, during the past 30 years, with the purpose of cultivating.

The continuous growth of the deforestation makes us wonder about the Brazilian environmental policy and the protection of the world's largest rainforest. The government says that decision makers are developing the necessary measures to prevent this from happening, by fighting against illegalities and environmental crimes committed, responsible for a fifth of the Amazon lost forest, since 1970. That's where we meet the debate about forest conservation in Brazil and the associated discussion on the Brazilian Forest Code changes.

4.   The Brazilian Forest Code

The first Brazilian Forest Code was published in 1934 and it was still in use in the first decade of the new millennium. However, it has been subject to various changes, adapting to different requests throughout time. Several reasons lead to the need for the creation of the "Brazilian Forest Code", the main

one being the growing concern with the conservation of the ecosystems basic functions. In order to do so, a set of rules concerning land exploitation were created as well as boundaries regarding the maintenance of native vegetation and cropped areas.

Since then, Brazilian forests had been, supposedly, protected by law. But this did not turn out to be true. Different environmental crimes have been committed, such as illegal deforestation or non-official cutting of trees, all of them free of punishment. One of the most serious examples of "environmental chaos" was the construction of the Trans-Amazonas highway (BR230) inaugurated on August, 1972. Its purpose was to connect the north and northeast of Brazil to Peru and Ecuador. In order to reach its initial goal of building 8000 km of road, an enormous amount of areas had to be deforested. Nowadays, the only remains of it are a few passable stretches which led to Thomas Favaro's quote "The road that connects "nothing to nothing at all" is a scar in the middle of the jungle and a monument for the blindness of past generations and mud"[3].

---

[3] "*A estrada que liga o 'nada a coisa nenhuma' é uma cicatriz no meio da selva e um monumento à cegueira ambiental das gerações passadas e lama*" , FAVARO. T., 2009, *40 anos de poeira*

The Brazilian Forest Code has recently being subject to yet more changes which generated conflicts between farmers, environmentalists and even the government. One of the suggested changes was that all the land-owners who have been fined for deforestation in the past could cancel the penalties by regulating their property through recovery of the Areas of Permanent Preservation (APPs) and Legal Reservations (re-plantation of the forest). On the other hand, some untouched land would be available for agriculture exploitation, following some rules. Such verdict is supposed to allow deforestation to keep happening in the future, even though its growth was mitigated during last years. We should then ask ourselves which would be the government motivations to allow this to happen.

The Amazon has approximately 7000 km^2 through Brazil and eight other countries, being the major part in Brazilian territory (state of Amazonas, Amapa, Rondonia, Acre, Pará and Roraima). Because of its biodiversity and magnitude, the Amazon has been called "the lung of the world".

Since the Brazilian Forest Code had to be readjusted and taking into account the country's influence in world's agriculture, the relationship between environmentalists and farmers could not be friendly. The new code proposal was approved in the Senate, December 2011, with 59 votes against 7. Among the main important changes, the code suggested the following conservation tools:

o *Legal Reservation (LR)*

Preservation of native forest inside the property: 80% in Amazonia, 35% in Cerrado[4] and 20% in others regions, even though changes can be made with the Environmental National Board (Conselho Nacional do Meio Ambiente) authorization.

o *Permanent Preservation Areas (APPs)*

It was proposed a reduction from 30m to 15m of forest recovery in vulnerable locations such as river banks, top of hills and hillsides; which cannot be deforested, despite possible exceptions.

It, also, guaranteed, to all rural properties, the preservation of agro-forestry activities on riverbanks (as long as they were consolidated until 2008). And, allowed the use of APPs for some types of crops.

o *Conversion of fines*

Rural producers that had been fined until July 2008 are now able to convert their fines by reforesting; big landowners that deforested until July 2008 also benefiting with this measure.

o *Small Farmers*

According to the Senate, small properties or family farm agriculture could keep the cultivation and other activities of low environmental impact in APPs and LR, as long as the property was registered in the Cadastro Ambiental Rural[5] (CAR).

CAR established a stated period of one year that may be prorogued only once for the same period, so that landowners could register their properties in that registry. The register will able to store environmental information about all rural properties. It will allow the control, monitoring, economic and environmental planning; and prevent deforestation.

o *Economic Incentives*

Environmental preservation will be insured by the enlargement of economic mechanism incentives. Objectives: preserving native forests, conserving scenic natural beauty and biodiversity, maintaining clime stability and keeping healthy the APPs and LR.

The government should establish a programme stimulating the preservation and environmental recover, within 180 days after the code's publication.

5.   Critical Review

Analysing the global current energy scenario, one realises that alternative energies is an increasing important choice. Consumers are growing in ecologic consciousness as well as an awareness concerning Greenhouse gases (GHG) responsible for global warming, which are accentuated by disorganised deforestation. Bio-fuels are becoming one of the main answers for this line of enquiry in many developed countries, although some of them do not have the resources for producing them, which is not the case of Brazil. Having the largest Natural Reserve, the specific Brazilian situation implies that any changes in the Forest Code will inevitably have global consequences.

Given the above, certain questions should be raised concerning the new Brazilian Forest Code: how large a cultivated area is required to produce the bio-fuels? Will its expansion involve the conversion

---

[4] Cerrado comprises 21% of Brazil territory. It is a vast tropical savannah eco-region of Brazil and contains some of almost in extinction species.

[5] Environmental Rural Registry

of tropical forest and humid areas? How would other countries benefit from the production of these bio-fuels on Brazilian soil? Of course, some fundamental issues still remain unsolved through the changes proposed in the new Brazilian Forest Code. How is it sustainable in the long run? What changes will occur on a regional scale affecting the Amazon basin and the soil? What changes will occur on the habitat of native species, biodiversity, air (through emissions of GEE) and water quality?

An expansion on bio-fuels' production not only requires a bigger share of Brazil's land to crop areas but also an important industrial development by increasing technology infrastructures. A greater number of sugar-mills will be required as distilleries. Yet, the construction of pipelines to transport bio-fuels from its storage and production areas (centre and south of Brazil) to Santos (the distributor port and outlet) is necessary (and it is being intended for some time...).

Changes made in the New Brazilian Forest Code, aims promoting the country's economic growth. This is in fact beneficial to farmers who see the possibility of increasing their cultivated areas, thus increasing their revenues.

But, disordered deforestation in Brazilian forests has been occurring drastically for over 50 years, in order to respond to such political and economic factors. It must be clear, that this has been occurring long before the use of bio-fuels. But this new energy policy trend seems to favour this obnoxious development.

Last year, 2012, a profound debate was made in the most important fora in Brazil political circuits. The central problem relied on identified gaps along with Brazilian politics situation. Although having been voted in the House of Representatives and in the Senate, the text of the new Code should be re-voted in the Chamber of Deputies in March 2012 because its wording was changed in the Senate. And, most important, President Dilma Rousseff could have the veto possibility for all or some important norms of the proposed regulation.

There are important points to be set in this context. The new Forest Code replaced the last act of 1965, after a long and controversial process, which had, from one side, great popular mobilization to avoid setbacks in the mechanisms of environmental conservation. From the other side, the land-owners pushed through greater flexibility in the size of the

permanent protection areas (APP) and pretended the amnesty for deforestation occurring before July 2008.

Once approved by Congress, the law was accompanied to the Presidential "vetoes", in nine articles of the law. President Dilma, finally, signed the code on May 25, 2012. Among the removal vetoes were articles that benefited large farmers and decreased the protection and intermittent rivers and floodplains that allowed the recovery with exotic fruit. Even with these vetoes, the Nature Conservancy Organization estimated that the new law allowed a reduction of 15% to 40% mandatory conservation area. Furthermore, it is estimated that the amnesty law environmental liabilities of about 40 million hectares deforested illegally before July 2008.

For some environmental organizations and experts the fundamental problem is that, in addition to lowering the conservation areas, the new law barely got off the ground in the last year. Only on May 29, 2013, it was announced the decree regulating the items that will be implemented and, even before its publication, the "ruralists" already arming criticism of the decree.

There are important issues to be highlighted and (effectively) secured. An important issue of the new code is the creation of mechanisms for registration, control and planning of rural properties, which allows a more rigid supervision. The Program for the Environment (PRA) should be enacted by the states and provide the foundations for producers to recover degraded areas on their properties. Also, it becomes mandatory to environmental registry (CAR) of all rural property. This registration will be on-line and will geocode the property with information about different soil occupations.

The recent decree of regulation adds two more items in the process of environmental regulation: Plan for Recovery of Degraded or Amended Areas (Prada) and Proof of Environmental Compliance (Cram). So far, out experiments and pilot projects, nothing was implemented because there was no regulation.

The government promises to put briefly into operation the Rural Environmental Registry System (Sychar), which will allow the early entries. Despite being the main point of the new code, it is also the main execution problem of the law. The new law provides for the registration and monitoring of the environmental recovery of more than 5 million farms existing in Brazil, a huge task for the responsibility of state and local environmental agencies. In many areas

there is no capacity and infrastructure to these organs to perform actions of such proportions. Worse, for those who know a bit of Brazilian agrarian situation, it is anticipated that the overlapping bureaucracy and corruption plots "voids" illegally occupied areas at the same time it creates other difficulties. It is hoped that the new Brazilian Forest Code will end the disorderly destruction of forestry, allowing the farming community to become aware of the need to make the sustainable, territory-ordered use of soil. So, the eye in the compliance with the new law is now fundamental. Recently, the Ministry of Environment set up a group to monitor the actions on the new code and evaluate suggestions and proposals for enabling legislation. The group has the participation of representatives of Ministries of Environment, Land Development and Agriculture, Livestock and Supply, the Brazilian Association of Organizations of the Environment (Abema), the National Association of Municipal Environment Bodies (Anama) and other representations of civil-society as the National Confederation of Agriculture, National Federation of Workers in Family Agriculture, Via Campesina, Friends of the Earth and The Nature Conservancy-Brazil.

In parallel, facing the slowly development of putting the law into practice, seven organizations - Environmental Research Institute of Amazonia (IPAM), SOS Mata Atlântica, Instituto Centro de Vida (ICV), Brazil-The Nature Conservancy (TNC), Conservation International (CI), Socio-Environmental Institute (ISA) and WWF / Brazil - created the observatory of Forest Code to monitor the implementation of the new law. The Centre aims to generate data and reports to promote social control, increase transparency and enhance the debate. In addition, these institutions stressed that the government has not yet defined the economic incentive mechanisms, under the new law, to promote the forest restoration and conservation.

Recently, in the early June (4/6/2013), there was a public hearing in the Committee on Environment, Consumer Protection and Surveillance and Control of the Senate to evaluate the first year of the law. During the hearing, Senator Luiz Henrique (from conservative party) held that there was a year of peace in the countryside. In fact, this intervention seems to reflect the little interest in putting the law into practice, since the penalties for illegal logging were suspended immediately after the promulgation of the law and nothing will be done until that will be signed Programs of Environmental Regularization.

According to Maira Ribeiro, writer of a blog in the environmental area, the new Forest Code was a coronation of the political force of the so-called "ruralists" and, at the same time, this strengthening of traditional rural land owner desires was accompanied by the little space occupied by social movements, their struggles and agenda (whether by land reform, sustainable agriculture or environmental justice). In fact, curiously, it was the attacks against indigenous people and the legitimacy of their territories that took the agenda and turned noticeable, not the great land owners difficulties in adapting to the new Code. That seems a real victory for "ruralists".

What will happen next it's, of course, theme for another investigation. Let's wait and see. In any case, it seems that the traditional political and economical issue of "efficiency versus equity" will be posed, as the actual situation of political disruption in Brazil is giving clear signals.

Bibliography

[1] Campanha em Defesa do Código Florestal (2011), parte I/1, Associação Brasileira dos Estudantes de Engenharia Florestal (ABEEF), Entidade Nacional de Estudantes de Biologia (ENEBio) & Federação dos Estudantes de Agronomia do Brasil (FEAB), Viçosa, M.G. Available from: < http://www.youtube.com/watch?v=G8iMa8JUS6U >

[2] Campanha em Defesa do Código Florestal (2011), parte II, Associação Brasileira dos Estudantes de Engenharia Florestal (ABEEF), Entidade Nacional de Estudantes de Biologia (ENEBio) & Federação dos Estudantes de Agronomia do Brasil (FEAB), Viçosa, M.G. Available from: http://www.youtube.com/watch?v=KXt2eT1hiRU&feature=related

[3] Dominguez, M. & Coelho, M. (2012), "Behind the New Brazilian Forest Code", Proceedings of the International Colóquio "Sustain- Ability Goes Sustain-Active", SOCIUS, Technical University of Lisbon/ISEG, Lisboa

[4] Grundgings, S., (2008), "Amazon deforestation seen surging - with high oil prices!", Reuters U.S edition, http://www.kleanindustries.com/s/environmental_market_Industry_news.asp?ReportID=284002

[5] Gurgel, A., (2011), "Impactos da política americana de estímulo aos biocombustíveis

sobre a produção agropecuária e o uso da terra", Revista de Economia e Sociologia Rural (Impresso), Vol. 49, pp. 181-214.

[6] Ladle, R., Malhado, A., Todd; P. &, Malhado, A. C., (s/d), Perceptions of Amazonian deforestation in the British and Brazilian media. Available from: < http://acta.inpa.gov.br/fasciculos/40-2/BODY/v40n2a10.html >

[7] Naylor, R.L., et al. (2007),"The Ripple Effect. Biofuels, Food Security and the Environment", *Environment*, Volume 49, No. 9.

[8] Ostwald, M., Moberg, J., Persson, M. & Xu, J. (2011), "The Chinese Grain for Green Program – assessing the sequestered carbon from the land reform", in Linköping Electronic Conference Proceedings, ISSN 1650-3686, 57, pp. 2517-2522.

[9] O'Rourke, D. & Connolly, S. (2003) "Just Oil?: The Distribution of Environmental and Social Impacts of Oil Production and Consumption," *Annual Review of Environment and Resources*, Vol. 28, pp. 587-617.

[10] Tyler, W. & Gurgel, A. C., (2009), "Brazilian trade policies: some observed and estimated effects of the 1990 s",. *Estudos Econômicos* (USP, Impresso), Vol. 39, pp. 59-88.

Search:

- http://www.google.com/
- http://www.economist.com/
- http://veja.abril.com.br/
- http://globo.com
- http://www.codigoflorestal.com/

Other

- http://www.bp.com/sectionbodycopy.do?categoryId=7500&contentId=7068481
- http://faostat.fao.org/default.aspx

626

Int. Jour. Of Latest Trends in Fin. & Eco. Sc.   Vol-3 No. 4 December, 2013

The Portuguese Banking System and Capital Agreements (2005-2011)

Margarida Filipe[1] and Rita Martins de Sousa[2]

1 ISEG - School of Economics and Management, University of Lisbon.

margaridafilipe89@gmail.com

2 ISEG - School of Economics and Management, University of Lisbon.

martins@iseg.utl.pt

Abstract - **Basel III is set to come into force on 1 January 2014. This capital agreement will include the three pillars enshrined in Basel II and is designed to strengthen regulation and the microprudential supervision of each bank, while also adding the macroprudential dimension (system-wide risks). The purpose of this article is to analyse to what extent banking institutions of Portuguese origin, operating within the national banking sector, have implemented and observed the measures imposed by the Capital Agreements prior to Basel III.**

Our main results made it possible to identify three different groups of banks as far as the disclosure of information and the application of the risk measurement methods of Basel I and Basel II are concerned. An international comparison also allowed us to conclude that there has been a convergence of Portuguese and Spanish banking institutions in relation to some economic and financial indicators. However, as far as supervision is concerned, Portugal is to be numbered among the countries with more positive results, while Spain displays some weaknesses.

Keywords - *Bretton Woods; Basel; supervision; Portugal; Spain.*

1.   Introduction

The 1970s were marked by changes in both the internal and external monetary and financial context of the Portuguese economy. The political and economic upheavals occurring in Portugal in 1974 had direct repercussions for the banking system, resulting most immediately in its nationalisation, followed by its reprivatisation in the 1980s and 1990s together with a series of mergers and acquisitions (Valério *et al.*, 2010). Externally, the end of the Bretton Woods system marked a turning point in the international monetary system[1]. The demonetisation of gold, the emergence of the dollar-mark-yen monetary triad and the switch to a floating exchange rate regime, enshrined in the 1976 Jamaica

Agreements, were just some of the consequences arising from the declaration of the inconvertibility of the dollar in 1971 (Eichengreen, 1996; Bordo, 2003). At the same time, attempts to readjust parities through the Smithsonian Agreement met with difficulties arising from a decade marked by two oil crises. These shocks brought disequilibrium to the balances of payments of those economies that were most dependent on this energy source, resulting in stop-go policies that interrupted the monetary and financial solidarity of the two most important European economies – France and Germany (Eichengreen, 1996; Crockett, 2003). If, in some theoretical frameworks, there exists one endogenous relationship between financial development and economic growth, the resulting international monetary instability had repercussions on the banking system, most notably the increase in market frictions, and the rise in transaction costs in particular (Levine, 1997)[2].

Uncertainty and volatility once again returned to the markets from the 1970s onwards. But, bearing in mind that crises "are to the financial system what heart attacks are to the cardiovascular system. The organs central to its operation begin functioning erratically; in extreme cases they stop functioning entirely" (Eichengreen, 2012: 13), it was crucial to create control instruments to reduce the uncertainty and risks involved in financial activity. Thus, immediately following the first oil shock, in 1974, the G10 countries decided to form the Basel Committee on Banking Supervision (BCBS)[3] under the auspices of the Bank for International Settlements (BIS). At a time when, for most economies, the banking system was the supplier of credit and liquidity, its supervision was a guarantee of the system[4]. It was the Basel

---

[1] The most complete study on the Bretton Woods system is still considered to be that produced by Bordo, Eichengreen (ed.), 1993.

[2] Levine (1997) considers that market frictions include both information costs and transaction costs.

[3] BCBS is a Standing Committee set up by the governors of the central banks of the G10 group of countries.

[4] Even though economies can be historically subdivided into those financed by the capital market (USA, UK) and those financed by the banking system (Germany, France), since the 1990s there has been an increase in the importance of the capital market in all economies.

Concordat, approved by the BCBS in 1975, that established these supervisory principles, later revised in 1983. However, the foreign debt crisis of some Latin American countries drew attention to the fact that the financial institutions held levels of capital that ran counter to the solidity of the system (DeLong *et al*., 1996).

It was only in 1988 that the BCBS drew up the Basel Accord I, where, for the first time, international rules were established for fixing the equity levels of credit institutions, while assets were differentiated according to their degree of risk. The liberalisation of capital movements in the 1990s called for an enlargement of the Accord (1997), with it being envisaged that the losses to be covered by equity would include not only those linked to credit risk, but also those arising from market risk (Goodhart, 2012). After the first two phases of the Accord had been identified, it became clear that the regulation of banking activity was a form of prudential supervision (Eichengreen, 2012).

2004 brought Basel II with its enshrinement of the New Capital Adequacy Framework for Credit Institutions, which came into force at the end of 2006. As we already know that, on 1 January 2014, Basel III will be brought into force, which includes the three pillars enshrined in Basel II and strengthens regulation and the microprudential supervision of each bank, while also adding the macroprudential dimension (system-wide risks), the purpose of this article is to analyse to what extent banking institutions of Portuguese origin, operating within the national banking sector, have implemented and observed the measures imposed by the previous Capital Agreements. This will involve questioning the solidity of the financial system on the eve of the introduction of other reforms dictated by the BCBS. This research has been centred, above all, on the first pillar of Basel II during the period from 2005 to 2011. This time interval made it possible to analyse the implementation of Basel I and the changes introduced for Basel II, since in 2006 the use of simple methodologies was authorised, followed in late 2007/early 2008 by complex or advanced methodologies.

Our main results allow us to identify the Portuguese banking institutions that followed the criteria and guidelines of the Capital Agreements, as well as those institutions that need to make a greater effort in disclosing information and implementing risk measurement methodologies.

The remainder of the paper is organised as follows. Section two presents a comparative approach between Basel I and Basel II. Section three briefly reviews the evolution of banking supervision in Portugal. Section four studies the implementation of the guidelines of Basel I and Basel II by the Portuguese banking system. Section five compares Portuguese banking institutions and their Spanish counterparts, for the years 2001 and 2010. Section six concludes.

2. I and Basel II: a comparative approach

Basel I (1988) was the consequence of the international monetary events that occurred in the 1970s and 1980s. The main aims of this agreement were to fix the minimum regulatory capital of banks at 8% of their total assets, as well as to guarantee greater solidity, stability and equity of the international banking system.

Basel I did, however, prove to have certain limitations. The most immediate of these was the lack of any guarantee that the supervisory authorities would be capable of imposing the necessary requirements (as in the case of Japan). Secondly, the loans granted to OECD member countries were classified as being of lower risk[5]. On the other hand, the established levels of capital adequacy were the same (8%) for both developed countries and emerging markets, even though it is known that the latter always have volatile markets. Finally, no differentiation was made between risks, or, in other words, the risk coefficients applied to banks were the same regardless of their rating. Thus, according to Eichengreen, "the Basel Accord limited the pressure to do better" (Eichengreen, 2012: 37).

In 2004, in order to overcome the limitations of Basel I, the BCBS signed the New Capital Adequacy Framework for Credit Institutions, known as Basel II. This agreement addressed other risks from banking activity, namely operational risk. It also allowed for greater flexibility in the risk coverage methods used by banks, enabling them to choose ones that were better adapted to their characteristics as financial institutions. The aim of this agreement was to cover the various risks with a minimum amount of equity (which remained unchanged at 8%, just as it had been in the case of Basel I), the difference being in the weighting of high-risk assets. In order to attain these objectives, Basel II was based on three pillars: minimum capital requirements, supervision and market discipline [6]. In order to facilitate the comparison between Basel I and Basel II, we have

---

[5] This assumption of the Basel Agreement created an incentive for countries to join the OECD, as was the case with Mexico and South Korea (Eichengreen, 2012: 35-36).
[6] On the three pillars of Basel II, see the internet links http://www.bis.org/bcbs/events/b2earoc.pdf
and http://www.bis.org/bcbs/basel3/b3summarytable.pdf.

628

Int. Jour. Of Latest Trends in Fin. & Eco. Sc.   Vol-3 No. 4 December, 2013

prepared the following table showing the main differences between the two Capital Agreements:

Table 1. The main differences between Basel I and Basel II

Basel I	Basel II
Calculation of the Minimum Capital Requirements in Basel I: $$\frac{Equity}{Credit\ Risk +\ Market\ Risk} \geq 8\%$$	Calculation of the Minimum Capital Requirements in Basel II: $$\frac{Equity}{\begin{array}{c}Credit\ Risk +\\ Market\ Risk +\\ Operational\ Risk\end{array}} \geq 8\%$$ Supervisory bodies can require this ratio to be above 8%.
In 1988, the agreement contemplated only one risk inherent in banking activities, namely credit risk. Revised in January 1997 to include market risk as well as credit risk. Low sensitivity in risk measurement.	Besides the risks contemplated in the previous agreement, also includes operational risk. Greater sensitivity in risk measurement.
Has only one way of calculating minimum capital requirements.	Includes various methods for calculating minimum capital requirements. Structure based on three pillars.
The methods used are the same for all financial institutions.	Financial institutions can choose the model best suited to their characteristics.
Fewer methods for measuring each of the risks (credit and market).	More methods for measuring each of the risks (credit, market and operational).
As these are the main differences between the two agreements, it can be stated that, whereas Basel I had only one method for calculating minimum capital requirements, Basel II is more comprehensive, being based on three pillars and emphasising such criteria as supervision, discipline and market transparency, which were not taken into account in the 1988 Agreement.	

Source: Filipe, 2012: 18.

3.   The Portuguese Banking System and its Supervision

The period running from the end of the Second World War to the beginning of the 1960s was marked by a significant increase in the importance of the banking sector in the Portuguese economy, as shown by the growth of both deposits and loans granted. Using gross deposits as an indicator, the leading bank was Caixa Geral de Depósitos, followed by Banco Espírito Santo & Comercial de Lisboa, with Banco Nacional Ultramarino in third place, and then Banco Português do Atlântico and Banco Borges & Irmão (Valério *et al.*, II, 2010: 129-130).

Over the following decades, in particular between 1961 and 1975, the main industrial-based groups expanded into the banking sector. On the one hand, there was CUF, which already owned Banco José Henriques Totta and took over two medium-sized

institutions, Banco Aliança and Banco Lisboa & Açores, the merger giving rise to Banco Totta & Açores, which, at the time, was one of the largest Portuguese banks. On the other hand, there was the Champalimaud group, which took over Banco Pinto & Sotto Mayor, and, in 1968, already controlled Companhia de Seguros Mundial and Companhia de Seguros Confiança, later taking control of Companhia Continental de Resseguros in 1971. The Espírito Santo group and the Português do Atlântico group were financial-based groups and formed three smaller-sized groups, Fonsecas & Burnay (resulting from the merger between Banco Fonsecas e Santos & Viana and Banco Burnay), Borges (Banco Borges & Irmão) and Nacional Ultramarino (the freshly renewed Banco Nacional Ultramarino) (Valério *et al.,* II, 2010).

In 1974, the change in the Portuguese political regime gave rise to a different way of viewing the financial system, with nationalisation of the sector being the political solution adopted at that time. In the 1980s, as a result of Portugal's joining the European Economic Community (1986), there was a major effort made towards modernisation, resulting in greater investment in Portugal by foreign financial institutions. As a result, various authorisations were given for the opening of foreign banks in the 1980s, such as, Citybank and Barclays Bank in 1985 and Deutsche Bank Investiment in 1990. The privatisation of previously nationalised banks also took place, such as: Banco Português Atlântico, Banco Totta & Açores, Banco Borges & Irmão and Banco Espírito Santo & Comercial de Lisboa, among others. The emergence of new private banks was another feature worth mentioning, with the creation of new banks such as Banco Privado de Investimento, Banco Comercial Português, Banco Português de Negócios and Finibanco during the 1980s and 1990s. The turn of the century brought an entirely new picture with the regular occurrence of mergers and acquisitions and with the supervisory bodies playing an ever more important role.

While the Bank of Portugal had collaborated with the Ministry of Finance in supervising, coordinating and inspecting the activity of credit institutions since 1957, it was not until 1990, with the approval of the Bank's new statutes that a new design was formally implemented for its supervisory role[7]. The Bank no longer merely implemented direct controls and required compliance with specific instructions, but instead a series of strict procedural rules was drawn up and the Bank was entrusted with the role of actual supervision (Valério *et al.*, II, 2010). Among these

---

[7] Decree-Law n. º 337/90 of 30 October.

629

Int. Jour. Of Latest Trends in Fin. & Eco. Sc.   Vol-3 No. 4 December, 2013

procedures was the requirement that institutions should comply with rules guaranteeing liquidity and solvency, together with the establishment of guidelines for the organisation of accounts and for the disclosure of information to the Bank of Portugal and to the public, as well as the frequency with which this should be done[8].

This was the background against which the Bank of Portugal was given the authority to carry out the prudential supervision of the activity of the credit institutions covered by the 1997 Basel Principles, and once again with the new 2006 version, when Basel II came into force. These amounted to 25 core principles that needed to be respected in order to ensure effective supervision. The principles can be grouped together under seven categories: objectives, autonomy, powers and resources of the supervisory authority; authorisation procedures and institutional structure; regulation and prudential requirements; supervisory methods; disclosure requirements; power of the authorities to impose corrective measures; cross-border supervision. The most important roles played by the Bank of Portugal in ensuring respect for these principles were as follows: establishment of accounting standards, which have to be followed by the institutions subject to its supervision, as well as the solvency ratio weighted by the risks to which banking activity is subjected; supervision of the regulatory information disclosed by banks, with the Bank of Portugal being able to take into account not only the information provided by the banking institutions, but also conducting audits and general or specific supervisory activities, in order to test whether the information disclosed was true or not; and the application of sanctions for infringements of the rules by the institutions supervised, which could range from simple fines to the winding up and liquidation of the bank.

The assessment made by the IMF in 2006 resulted in two of these principles not obtaining a classification of full compliance[9]. The assessment team considered that at the level of the regulation and supervision of the financial system "(1) the resources existing at the Bank of Portugal for analysing and assessing market risks and for validating the internal models of institutions needed to be developed even further; and (2) a methodology had not yet been implemented for the systematised assessment of the risk profile of institutions." (Freitas, 2008: 48)[10]. In comparative

international terms, of the six EU Member States that published the results relating to the extent of their compliance with the Basel Core Principles, only France obtained a more positive classification than Portugal [11]. Like most of the countries, Spain displayed weaknesses at the level of the prevention and suppression of money laundering. If we compare the results published by the IMF for 31 industrialised countries, the principle of monitoring market risks is generally the one that is least implemented (Freitas, 2008: 61-64).

In short, there was a modernization of the financial system as well as an evolution in terms of supervision of banking institutions and the Bank of Portugal became one of its key elements since the 1990s.

4. Did the Portuguese Banking System implement the guidelines of Basel I and Basel II?

4.1. Data and Methodology

Our analysis of the way in which the Portuguese Banking System implemented the Capital Agreements was based on a representative sample of the national banking network, which included the group of Portuguese banks [12]. As a whole, the ten banks selected account for 79.71% of assets, 86.06% of deposits and 80.58% of loans granted of the respective totals of the Portuguese banking network. As far as banking product is concerned, the banks in question account for 81.69% of the total weight of banking product, and 32.91% of the total weight of banking product in relation to the assets of each bank. The banking institutions with the highest scores in terms of the indicators mentioned are Caixa Geral de Depósitos (CGD), Banco Comercial Português Millennium (BCP), Banco Espírito Santo (BES) and Banco Português de Investimento (BPI) (cf. Filipe, 2012: 58-59).

The data was collected from *Consolidated Annual Reports* of between 2005 and 2011, of the various banks of the sample. In the case of the solvency ratio, this calculation should technically have been based on the banks' individual accounts. However, the banks did not present enough data in their reports to make this analysis possible.

---

[8] Cf. Chapter IV, section III of Decree-Law n. ° 337/90 of 30 October.

[9] The rating scale for assessing the principles includes the following classifications: "Observed", "Broadly observed", "Partly observed", "Not observed" and "Not applicable".

[10] Market risk is included in the principle of Regulation and Prudential Requirements. In turn, it should be noted that

some financial hedging products, such as swaps, are included here.

[11] The six EU Member States that published their results are: Denmark, Spain, France, Italy, Netherlands, and the United Kingdom.

[12] To gauge the representativeness of the sample, the following indicators were taken into account: the total weight of assets, the total weight of deposits, the total weight of loans granted, and, lastly, the total weight of the banking product.

630

Int. Jour. Of Latest Trends in Fin. & Eco. Sc.   Vol-3 No. 4 December, 2013

From these *Reports* we selected the relevant *items* to calculate the ratios which allowed us to study the different dimensions included in Capital Agreements. Thus we calculated the ratios of liquidity, return and solvency, according to the variables include in Table 2.

Table 2. Ratios of liquidity, return and solvency

Methodology		
Liquidity	**Return**	**Solvency**
$\dfrac{\text{Cash Bank Assets}}{\text{Total Assets}}$ $\dfrac{\text{Loans}}{\text{Total Assets}}$ $\dfrac{\text{Loans}}{\text{Cash Bank Assets}}$	ROA $= \dfrac{\text{Net Income}}{\text{Total Assets}}$ ROE $= \dfrac{\text{Net Income}}{\text{Equity}}$	Tier I Ratio Core Tier I Ratio Solvency $\text{Ratio} = \dfrac{\text{Equity}}{\text{Risk} - \text{weighted Assets}} \geq 8\%$
$\dfrac{\text{Available} - \text{for} - \text{sale financial assets} + \text{Loans and advances to credit institutions} + \text{Financial assets with repurchase agreements}}{\text{Total Assets}}$ $\dfrac{\text{Resources of central banks} + \text{Resources of other credit institutions}}{\text{Total Assets}}$		

4.2.   The application of the Capital Agreements

The crisis originating in the USA in 2007 spread to other economies[13], including the Portuguese one, with repercussions on the implementation of the risk measurement methods linked to Basel I and Basel II. In order to identify the changes that occurred between 2005 and 2011 at the banks of our chosen sample, we collected available information about capital agreements for each bank , detailing the criteria and methods used for risk measurement. Based on this information, the various institutions were grouped on a descending scale, assuming that more available

information reduced costs and that the lack of symmetry of information leads to a more healthy and sustainable financial system. On this basis, the banks were grouped into three groups, the first being based on information from all the years contemplated by the study.. The third group showed restricted and non-continuous information, whereas the middle group only published information from the relevant four years of the study. . It is important to stress that, for this middle group, not all the banks published using the Basel method, during the same years.

A table has been prepared showing the evolution of each bank in its introduction of advanced risk measurement techniques and criteria[14].

Table 3. Application of the Capital Agreements at Portuguese Banks

2005-2011	
	Banco Comercial Português Millennium **2005** Credit Risk – IRB Advanced Approach (used in Portugal, Poland and Greece). Other banks use the Standardised Approach. Operational Risk – Standardised Approach. **2006** Request made to the Bank of Portugal to use advanced methods from 2008 onwards. **2007** Request made to the Bank of Portugal to use the Internal Models Approach for Market Risk. **2008** Implementation of Basel II for all banks regardless of the techniques used. **2009** Authorisation given by the Bank of Portugal for the use of advanced models. Credit Risk – Internal Ratings-Based Approach. Market Risk – Internal Models Approach. Operational Risk – Standardised Approach. **2010** Credit Risk for the portfolio – IRB Advanced Approach. Credit Risk for the company – IRB Foundation Approach. **2011** Preparations for the adoption of Basel III, due to come into force on 1 January 2014.
	Caixa Geral de Depósitos **2005** Continuation of preparations for the implementation of Basel II (already in progress since 2002). **2006** Request made to the Bank of Portugal

---

[13] About 2007 crisis see for all, Reinhart and Rogoff (2009).

[14] It should be explained that Basel I is also considered here, since this Capital Agreement was in force until the implementation of Basel II, which only took place in 2006.

631

Int. Jour. Of Latest Trends in Fin. & Eco. Sc.   Vol-3 No. 4 December, 2013

1st Group: Millennium BCP, CGD and BES	to use the Internal Ratings-Based Approach for Credit Risk. **2007** Definition of targets to be adopted: Standardised Approach for Operational Risk, later using the Advanced Measurement Approach. **2008** Credit Risk – Standardised Approach. Operational Risk – Basic Indication Approach. Request made to the Bank of Portugal to use the Standardised Approach for Operational Risk. **2009** Authorisation given by the Bank of Portugal to use the Standardised Approach for Operational Risk. **2010** Authorisation given by the Bank of Portugal to use the Standardised Approach for Operational Risk on an individual basis. **2011** Preparations for the adoption of Basel III, due to come into force on 1 January 2014.
	Banco Espírito Santo **2005** Implementation of some of the measures of Basel II. Aims: IRB Foundation Approach for Credit Risk. Standardised Approach for Operational Risk. **2006** Request made to the Bank of Portugal to use the risk measurement models that were the aims in 2005. **2007** Negotiations with the Bank of Portugal about requests made in 2006. **2008** Authorisation given by the Bank of Portugal to use advanced risk measurement methodologies. **2009** Authorisation given by the Bank of Portugal to use the IRB Foundation Approach for Credit Risk (the first bank to do this). Standardised Approach for Operational Risk. **2010** Preparations began for the adoption of Basel III **2011** Announcement of the period of transition to Basel III from 1 January 2014 to 1 January 2019.
2nd Group: BPI, BANIF and MG	**Banco Português de Investimento** **2005** Credit Risk – Standardised Approach **2007** Credit Risk – Standardised Approach **2008** Credit Risk – Standardised Approach. Operational Risk – Basic Indication Approach. **2009** Credit Risk – Standardised Approach. **Banco Internacional do Funchal**

	2005 Preparations for the implementation of Basel II **2006** Continuation of preparations for the implementation of the Basel II criteria, to be adopted in 2007. **2007** Models developed for the recording of Credit Risk at the time of its recognition and subsequent monitoring. **2008** Compulsory adoption of Basel II by banks regardless of the techniques chosen.
	Montepio Geral **2007** Request made to the Bank of Portugal to use the Standardised Approach for Operational Risk. **2008** Implementation of Basel II techniques. Continuation of negotiations with the Bank of Portugal about the techniques to be used. **2009** Operational Risk – Basic Indication Approach. **2010** Authorisation given by the Bank of Portugal to use the Standardised Approach for Operational Risk. Presentation of Basel III.
3º Group: BPN, BiG, CA and Finantia	**Banco Português de Negócios** **2007** Market Risk – Value at Risk Approach **2008** Preparations for the use of Basel II. Attempt made to use the Internal Ratings-Based Approach for Credit Risk instead of the Basic Indication Approach.
	Banco de Investimento Global **2008** Began to create conditions for the implementation of advanced risk measurement techniques. **2009** Sought to change from the Basic Indication Approach to the Advanced Measurement Approach for the measurement of Operational Risk. **2010** Continued to create conditions for implementing advanced risk measurement techniques.
	Crédito Agrícola **2007** Began study for the implementation of the Standardised Approach for risk measurement. **2008** Continuation of the study of the criteria needed for the implementation of advanced techniques for risk measurement. **2010** Expressed knowledge of the existence of a new Basel III Capital Agreement.
	Finantia **2007** Market Risk – Value at Risk Approach

	through historical simulation	

Source: Filipe, 2012: 52-55. For a more detailed explanation of the risk measurement methods used, see Filipe, 2012: 40-43.

In short, the banks that made the greatest efforts to implement the measures of the Capital Agreements, evolving gradually through the requests for authorisation presented to the Bank of Portugal, were Millennium BCP, BES and CGD, followed by BPI and Montepio Geral (MG). As far as the other remaining banking institutions are concerned, a greater effort must be made regarding the disclosure of information and the implementation of risk measurement criteria, in order to draw closer to the institutions displaying greatest development in terms of regulation.

5.   Portugal and Spain: a comparative approach

In order to undertake a comparative analysis with other banking institutions subject to the Basel criteria, we chose the neighbouring country Spain, considered by the IMF in 2006 to reveal some weaknesses in regard to regulation (see section 3). The aim of this comparison between Portugal and Spain was to ascertain whether or not there was any indicators that reveal convergence between banking institutions. Bearing in mind that there is a correlation between the stability of the banking system and economic performance and that the implementation of the Basel agreement criteria contributed to this stability, , this comparison confirmed how the banking sector performed during the implementation of Basel II and the onset of the banking crisis in 2007. In other words, the use of certain financial indicators is an indirect way of observing the effect of the implementation of Basel II. In order to do this, we considered the years 2001 and 2010, for which there existed effectively comparative data, since the same methodology was used for their calculation[15].

In this comparison, the banks that were analysed were the ones that were common to the two studies used. However, since, for the analysis of supervision in Portugal, more Portuguese institutions were used in 2001 (see section 4) than originally contemplated, these institutions were taken into account for 2010.

---

[15] For 2001, the study by Alexandre, 2004, was used, and, for 2010, the study by Filipe, 2012, was used. For a more detailed explanation of the methodology adopted in Filipe, 2012, see section 4.

In 2001, for the indicators ROE and ROA, cost to income ratio [16], non-performing loans ratio [17] and solvency ratio (according to the BIS criteria), the Spanish banks recorded more positive scores than the Portuguese banks, except in the case of the solvency ratio. Although all the banks are above the 8% limit, the highest scores are those presented by Totta (still with its Portuguese origin) and BPI (see Table 4).

Table 4. Indicators of Portuguese and Spanish Banks (2001) (in percentage).

Banks	ROE	ROA	Cost to income ratio	Non-performing loans ratio	Solvency ratio
BBVA	18	0.99	50.4	1.71	12.60
Banco Popular	27.7	1.78	37.2	0.80	11.33
Totta	19.1	0.70	49.2	2	13.30
CGD	20.7	1.03	50.1	2.45	10.50
BCP	26.2	0.91	56.6	1.70	9.40
BES	15.6	0.55	58.2	1.80	10.75
BPI	14.7	0.54	68.3	1.10	9.20

Source: Alexandre, 2004:61

In 2010, if we examine the same indicators, we can see that the situation does not coincide with that of 2001. As far as the rates of return (ROE and ROA) are concerned, the lowest scores are those recorded by Banco Bilbao Viscaya Argentaria (BBVA), whereas the highest scores are those of BPI and Santander Totta. In the case of the cost to income ratio, it is the Spanish banks that have the highest and the lowest scores, Santander Totta and BBVA, respectively. Analysing the non-performing loans ratio, we can see that it is the Portuguese banks that display the best and the worst values, BES and BPI and BCP, respectively. As was the case in 2001, it was the Portuguese banks that recorded the best solvency ratios in 2010 (using the criteria of the Bank of Portugal and Basel), with CGD recording the highest ratio. However, although the Spanish banks have lower scores for this ratio, they are nonetheless above the 8% limit. The lowest score is presented by BBVA (8.77%) (see Table 5).

---

[16] *Cost to Income* represents the weight of operating costs in relation to the results obtained, i.e. it measures the weight of fixed costs within the profitability generated by the Bank.

[17] The *non-performing loans ratio* corresponds to the degree of development presented by the banking institutions in their use of methods for analysing credit and for measuring risk.

Table 5. Indicators of Portuguese and Spanish Banks (2010) (in percentage).

Banks	ROE	ROA	Cost to income ratio	Non-performing loans ratio	Solvency ratio
Banco Popular	2.33	0.16	58.03	2.54	9.2
BBVA	-4.86	-0.12	80.5	1.22	8.77
Santander Totta	15.3	0.9	45.7	1.3	11.1
BPI	8.8	0.6	73	1.1	11.1
Millennium BCP	6.1	0.4	56.3	3	10.3
BiG	17.28	2.55	39	0.27	36.3
BANIF	5.19	0.30	60.86	n.a	14.5
BPN	n.a	n.a	n.a	n.a	n.a
BES	8.55	0.61	52.3 or 61.9	1.11	11.3
CGD	4.1	0.24	63.3	2.93	12.3
CA	3.59	0.29	n.a	n.a	13.4
MG	5.18	0.29	58.68	3.24	12.74
Finantia	n.a	n.a	38	8.4	13.8

Source: Filipe, 2012: 56-57.
Note: n.a = no available.

Comparing 2001 and 2010, we can therefore state that there is now a greater convergence between banking institutions, since Portuguese banks have generally evolved in terms of the indicators contemplated in this study.

6.   Conclusions

Returning to the question that lay at the origin of this research, the really succinct answer is that the Portuguese banks belonging to the national banking network have gradually implemented the criteria of the Capital Agreements. However, this general picture is not a homogeneous one, which is why we identified three distinct groups of banks in terms of their disclosure of information and their application of risk measurement methods. These conclusions are, however, confined to the criteria of Basel I and pillar 1 of Basel II, since, in the selected sample, the pillars of supervision and market discipline are less explicitly detailed in the Annual Reports and Accounts that we examined. Hence the greater difficulty that we found in deciphering these pillars.

As far as the international comparison is concerned, it can be concluded that there was a convergence between the Portuguese and Spanish banking institutions that comprised the chosen sample, in terms of some economic and financial indicators. However, as far as supervision is concerned, Portugal is to be numbered among those countries that have recorded more positive results, whereas Spain displays some weaknesses.

Basel II may have led to a more sustainable development of the financial system, by focusing not only on pillar 1 of Basel II, but also on pillars 2 and 3, as well as on other areas which previously hadn't been taken into account in the Capital Agreements. Therefore, it is expected that Basel III will fill the gaps arising from the application of the previous agreements, thereby strengthening supervision and market discipline, and monitoring liquidity in a more continuous manner.

Acknowledgments

References

[1] Alexandre, P. M. M. (2004), *Contribuição para o Estudo das Motivações e Estratégias de Actuação da banca Espanhola de Média Dimensão em Portugal*, Master Thesis in Gestão e Estratégia Industrial, School of Economics and Management, University of Lisbon or http://hdl.handle.net/10400.5/633.Chung, P.J. and D.J. Liu (1994), Common stochastic trends in Pacific Rim stock markets, Qua*rterly Review of Economics and Finance* 34(3), 241-259.

[2] Bordo, M. (2003), "Exchange Rate Regime Choice in Historical Perspective", *International Monetary Fund Working Paper*, WP/03/160.

[3] Bordo, M. and Eichengreen, B. (eds.) (1993), *A Retrospective on the Bretton Woods System – Lessons for International Monetary Reform*, The University of Chicago Press.

[4] Crockett, A. (2003), "Exchange rate regimes in theory and practice" in *Monetary History, Exchange Rates and Financial Markets*, Vol II, Paul Mizen (ed.), Edward Elgar Granger, C.W.J. (1969), Investigating causal relations by econometric models and cross-spectral methods, *Econometrica* 37, 424-438.

[5] DeLong, J. B. *et al.* (1996) "The Case for Mexico's Rescue: The Peso Package Looks Even Better Now." *Foreign Affairs,* Vol 75, No. 3, pp. 8–14.

[6] Eichengreen, B. (1996), *Globalizing Capital*, Princeton University Press.

[7] Eichengreen, B. (2012), *Financial Crises – and what to do about them*, Oxford University Press.

[8] Filipe, M. (2012), *Executou o Sistema Bancário Português as Normas Orientadoras dos Acordos de Basileia I e Basileia II?*, Master Thesis in Finanças – Instituições Financeiras, School of Economics and Management, University of Lisbon or https://aquila4.iseg.utl.pt/aquila/getFile.do?fileId=314067&method=getFile.

[9] Freitas, J. F. (2008), *Financial Sector Assessment Program: Portugal*, Banco de Portugal.

[10] Goodhart, C. (2012), *The Basel Committee on Banking Supervision: A History of the Early Years 1974 – 1997*, Cambridge University Press.

[11] Levine, R. (1997), "Financial Development and Economic Growth", *Journal of Economic Literature*, Vol 35, No. 2, pp. 688-726

[12] Reinhart, C. and Rogoff, K. S. (2009), *This Time is Different – Eight Centuries of Financial Folly*, Princeton University Press

[13] Valério, N. *et al.* (2010), *History of the Portuguese Banking System*, Vol II, Banco de Portugal.

[14] The Three Pillars of Basel II: Optimizing the Mix in a Continuous-time Model, http://www.bis.org/bcbs/events/b2earoc.pdf, Last access/19-08-2013.

[15] Basel Committee on Banking Supervision reforms - Basel III, http://www.bis.org/bcbs/basel3/b3summarytable.pdf, Last access/19-08-2013.

Effect of Loan Value and Collateral on Value of Mortgage Default

Rais Ahmad Itoo [#1], Selvarasu Appasamy Mutharasu[#2], José António Filipe[*]

[#]Annamalai University, India

[1]raisitoophd@yahoo.com

[2]aselvarasu@gmail.com

[*]Instituto Universitário de Lisboa (ISCTE-IUL), BRU – IUL

Lisbon, Portugal

jose.filipe@iscte.pt

Abstract: **This study explore the factors influencing mortgage loan default by using the data of mortgage default case from Jammu and Kashmir Bank. To achieve the study objectives sixteen variables are taken. The variables are categorized into three dimensions as borrower's profile, loan value contents and collateral security. The tools used for analysis of data describing mortgage loan defaulter's are chi-square, regression, ANOVA, and logistic regression through SPSS 18.0. The results indicate that the borrower's gender, borrower's age, borrower's marital status, the borrower's income, loan rate, loan type, loan amount, amount repaid, LTV, LTI, form of collateral security, Value of collateral security, purpose of loan and secondary finance on collateral security are significantly positively correlated with the defaulter's outstanding loan amount. While as education qualification of borrower is significantly negatively correlated with defaulter's outstanding loan amount. Logistic regression results indicate that income, secondary finance on collateral security and interest rate are mainly responsible for mortgage default.**

Keywords – *Mortgage Default, Loan value contents, Collateral, LTV, LTI, Logistic regression.*

1.   Introduction

First, in this study, it is necessary to consider some fundamental aspects of the core ideas to be presented. Mortgage system of financial service in general, the mortgage loan market in India and mortgage default will be considered next for the first insights.

Mortgage System of Financial Service - In the beginning, a mortgage was just a conveyance of land for a fee. The buyer paid the seller a set rate, with no interest, and the seller would sign over the land to the buyer. There were usually conditions to be met before the land to become property of the buyer, just as happens today, but usually it was based upon the assumption that the land would produce the money to be paid back to the seller. So, a mortgage was written due to this fact. The mortgage was kept in effect no matter the land was producing or not. This old arrangement was very lopsided once the seller of the property - or the lender who was holding the deed to the land - had absolute power over it and could do whatever he liked, including selling it, not allowing payment, refusing payoff, among other possibilities which caused major problems to the buyer, who held no ground at all. With time, and blatant abuse of the mortgage system, the courts began to uphold more of the buyers' rights, so that they had more to stand on when they came to become owners of their land. Eventually, they were allowed to demand the deed to be free and clear upon the payoff of the property. There were still several steps to be taken to ensure that the seller still had enough rights to keep his interest safe and make sure that his money would be paid.

Although mortgages have changed from one form to another, but still the essentials of contract are same. Now, there are many more laws and regulations to help to protect the buyer, but also the seller and the creditor. There are also many different ways to lock in a low interest rate, borrower just need

to talk to mortgage broker about what the rates are now and what kinds of programs they offer to keep those interest rates low throughout the life of borrower's loan.

A mortgage is an agreement of security so that borrowers have to pay the debt. In many cases, the borrower will give up collateral security if he/she fails to repay the loan as agreed. Mortgage can be used as a verb, meaning "to pledge". Mortgage and "home loan" are often used interchangeably. However, the mortgage is really the agreement that makes home loan to work. The bank would not lend the borrower hundreds of thousands of dollars unless the bank knew that it would be possible to claim collateral security in the event of mortgage default. A loan to finance the purchase of a real estate usually requires specified payment periods and interest rates. The borrower gives the lender (mortgagee)   a lien on the property as collateral for the loan.

Mortgage financing is an essential decision for both, borrowers and lenders. Not only this decision is qualitatively important, it is quantitatively significant, as well. The aggregate outstanding mortgage balances, and thus the capitalization of various mortgage related securities, is in the trillions. No wonder that the various aspects of mortgage contracting have been one of the most extensively researched topics in real estate finance and economics, both theoretically and empirically. Amongst these aspects, mortgage default has been one of the leading topics. Understanding mortgage default is necessary for appropriately valuing mortgages and for borrowers and lenders optimization. In most countries, a mortgage is the primary way that prospective homeowners have of buying a house, flat or land on which to build a property, collectively called real estate. This type of mortgage is called a residential mortgage or home loan. They are most often taken up by individuals or couples.

A mortgage loan is a loan secured by real property through the use of a mortgage note which evidences the existence of the loan and the encumbrance of that realty through the granting of a mortgage which secures the loan. However, the word mortgage alone, in everyday usage, is most often used to mean mortgage loan. A home buyer or builder can obtain financing (a loan) either to

purchase or to secure against the property from a financial institution, such as a bank, either directly or indirectly through intermediaries. Features of mortgage loans such as the size of the loan, maturity of the loan, interest rate, method of paying off the loan, and other characteristics can vary considerably.

In many jurisdictions, though not all, it is normal for home purchases to be funded by a mortgage loan. Few individuals have enough savings or liquid funds to enable them to purchase property outright. In countries where the demand for home ownership is high, strong domestic markets have developed. The word mortgage is a French term meaning "dead pledge," apparently meaning that the pledge ends (dies) when either the obligation is fulfilled or the property is taken through foreclosure.

Mortgage Loan Market: the Indian Scenario - Indian Mortgage Market is one of the largest divisions in the banking financial services and insurance sector. The India Mortgage Market was previously known as the Indian housing finance industry. At present the total worth of the India Mortgage Market is nearly US $ 18 billion. The gross domestic product to mortgage ratio in India is very low in comparison to other developed countries. The ratio in the foreign countries ranges from 25% to 60% whereas in India the ratio is 2.5%. The India Mortgage Market is showing fast growth in the past few years. The foremost players in this sector are the finance corporation but presently the commercial banks are also starting to play an important role in the development and growth of the India Mortgage Market. At present the market leader in the India mortgage market is the Housing Development Finance Corporation (HDFC), with the State Bank of India (SBI) following the leader.

Mortgage Default - The situation in which borrower is not making payments on his or her mortgage loan is called mortgage default and the loan is considered to be "in default," meaning that the agency which holds the note can choose to take over the property. In finance, default occurs when a debtor has not met his or her legal obligations according to the debt contract, e.g. has not made a scheduled payment, or has violated a condition of the debt contract. A default is the failure to pay back a loan. Default may occur if the debtor is either unwilling or unable to pay his or her debt. This can

occur with all debt obligations including bonds, mortgages, loans, and promissory notes.

The term default must be distinguished from the terms insolvency and bankruptcy. Default essentially means a debtor is not repaying the debt which he or she is required to have to pay. Insolvency means that debtor does not have ability to repay the debt and Bankruptcy is a legal finding that imposes court supervision over the financial affairs of those who are insolvent or in default.

Default can be of three types:

1.   Technical default,

2.   Strategic default,

3.   Debt services default.

Technical default occurs when an affirmative or a negative covenant is violated. Affirmative covenants are clauses in debt contracts that require firms to maintain certain levels of capital or financial ratios. The most commonly violated restrictions in affirmative covenants are tangible net worth, working capital /short term liquidity, and debt service coverage. Negative covenants are clauses in debt contracts that limit or prohibit corporate actions e.g. sale of assets, payment of dividends, that could impair the position of creditors. Negative covenants may be continuous or incurrence-based. Violations of negative covenants are rare compared to violations of affirmative covenants.

When a debtor chooses to default on a loan, despite being able to make payments, this is said to be a strategic default. This is most commonly done for non-recourse loans, where the creditor cannot make other claims on the debtor; a common example is a situation of negative equity on mortgage loan in common law jurisdictions such as in the United States, which is in general "non-recourse". In this case, default is colloquially called "jingle mail", the debtor stops making payments and mails the keys to the creditor, generally a bank.

When the borrower has not repaid the interest or principal which he/she was supposed to repay, it is called debt service default. Defaulting on a mortgage can result in the loss of a collateral security and accordingly it must be avoided. Even if the collateral security is not lost to the bank, a mortgage default will drag down a credit score significantly, making it

harder to negotiate with the bank or to secure credit for other loans in the future. When a mortgage loan is issued, a monthly due date for payments is usually specified. Many mortgages include a grace period of from one to two weeks, meaning that payments sent during the grace period will still be considered on time. After the grace period has elapsed, however, late fees will start to be levied. If more than 30 days after the due date go by, the mortgage is considered to be in default. Once the bank determines that the 30 days have elapsed, it sends a notice of mortgage default to a credit agency, impacting the credit score immediately. Within weeks, the bank will usually retain the services of a credit collection agency in an attempt to get the homeowner's past due payments. This adds to the fees associated with mortgage default. Many banks will also insist on a full payment including late fees and collection fees to bring the homeowner current, and they will not accept partial mortgage payments when the mortgage is in default. Within 60 to 90 days of the determination that the mortgage has defaulted, the bank will send a notice of mortgage default to the homeowner. This is the first step in foreclosure proceedings, giving the property owner a chance to make up the missed payments immediately and in full, or to risk having the collateral security taken over by the bank and sold at auction. The bank will also be obliged to post a public notice about the foreclosure, and the property owner will have a chance to buy the property back during the foreclosure auction, if he or she can muster up the funds in cash. Some people choose to default on their mortgages and simply walk away, deciding that the negative impact on their credit scores is better than sinking any more equity into the home. This is most common in areas where property values have declined radically, leaving people with loans which are larger than their homes are worth. Other people may try to sell their homes before their mortgages go into default so that they can wipe the slate and start over again.

For homeowners who think that they may be risking mortgage default, the best thing to do is to talk to the lender. Ignoring payment notices, phone calls, and legal notices is not advisable, because the bank will refuse to negotiate with property owners who have not been proactive. Immediately as a property owner, he thinks that a mortgage payment will be missed, he or she shall contact the lender to

negotiate. Many lenders are willing to offer a longer grace period, or to permit reduced payments due to financial hardship to avoid mortgage default, as the bank would rather not deal with the hassle of a foreclosure auction. A history of paying on time and handling the mortgage responsibly will make the bank more likely to cooperate.

2.   Review of Literature

This section deals with the dependent and independent variables and deals with other category of mortgage outstanding amount and related parameters of the study. The variables in this section are age, marital status, gender, educational qualification, monthly income, value of collateral security, purpose of loan, loan amount, mortgage outstanding balance, interest rate, loan type, type of collateral security, unemployment, loan-to-value ratio (LTV) and loan-to-income ratio (LTI). The studies involving mortgage loan have been reviewed and description of all variables are presented.

2.1 The age of the borrower

Capozza et al. (1997) indicated that the borrower's age was negatively correlated with the default probability. Hakim and Haddad (1999) studied the influences of the borrower's attributes and the loan characteristics on the mortgage loan default using a failure-time model. Their results indicated that the age of the borrower is significantly negatively correlated with the default probability. Jacobson and Roszbach (2003) indicated the applicant's age was significantly negatively correlated with the unsecured loan default. Cairney and Boyle (2004) showed that the age of the borrower was significantly negatively correlated with the default risk of credit loans. Von Furstenberg and Green (1974) and Avery et al. (2004) in their studies they have assessed local situational factors as factors of default risk. They found that inclusion of a situational factor like the age of the borrower improves the performance of the scoring models. Orla and Tudela (2005) found that persistence in mortgage payment problems was greater among households in which the head's age was 35 years old , or over than it was among households headed by younger individuals. The younger households are more capable of getting out of problems than those aged 35 or over. Kumar (2010) found that there is no

significance between the age of the borrower and mortgage defaults.

2.2 Marital Status of borrower

Von Furstenberg and Green (1974), Avery et al. (2004) in their studies they have assessed local situational factors as factors of default risk. They found that inclusion of situational factor like marital status of borrower improves the performance of the scoring models. Cairney and Boyle (2004) showed that the marital status (single, widowed, or divorced) was significantly positively correlated with the default risk of credit loans.

2.3 Gender of borrower

Jacobson and Roszbach (2003) indicated that the applicant's gender was significantly negatively correlated with the unsecured loan default.

2.4 Borrower's Educational Qualification

Liu and Lee (1997) presented that the borrower's education degree was significantly negatively correlated with the mortgage loan default. Cairney and Boyle (2004) showed whether the education level was significantly negatively correlated with the default risk of credit loans.

2.5 Monthly Income of Borrower

Stansell and Millar (1976), Vandell (1978), Ingram and Frazier (1982) have found that payment-to-income ratio is positively correlated with the probability of default i.e. higher the payment to income ratio, greater is the default risk. Clauretie (1987) has also argued that other non-equity factor like sources of income play a larger role in affecting default levels. Capozza et al. (1997) indicated that the income was negatively correlated with the default probability. Hakim and Haddad (1999) studied that the disposable income was negatively correlated with the default probability. Jacobson and Roszbach (2003) indicated that the annual income from wages was significantly positively correlated with the unsecured loan default. Cairney and Boyle (2004) showed that the borrower's income was significantly negatively correlated with the default risk of credit loans. Har and Eng (2004) also showed that the income was negatively correlated with the mortgage loan default. Teo and Ong (2005) indicated that the income was positively correlated with the mortgage loan default.

2.6 Value of Collateral Security

Vandell and Thibodeau (1985) used a simulation analysis to demonstrate several non-equity factors overshadowing the equity effect on default which explained about households with zero or negative equity did not default, while others with positive equity. Clauretie (1987) has also argued that other non-equity factor like property value played a large role in affecting default levels. The default imposes personal costs on borrowers that include limits on occupational and credit opportunities, social stigma and damage to reputation (Kau, Keenan and Kim, (1993) and Vandell and Thibodeau, (1985)). The costs exceed the absolute value of negative equity. The borrower will not default when Paul Bennett et al. (1997) found that the structural change in the mortgage market had increased homeowners' propensity to refinance. Bajari et al. (2008) studied empirically the relative importance of the various drivers behind subprime borrower's decision to default. They emphasize the role of the nationwide decrease in home prices as the main driver of default. Foote et al. (2008) examined homeowners in Massachusetts who had negative home equity during the early 1990s and found that fewer than 10% of these owners eventually lost their home to foreclosure.

2.7 Type of Collateral Security

Teo and Ong (2005) indicated that the collateral type was significantly positively correlated with the mortgage loan default. Yildiary Yildirium (2007) found that loans within the same geographical area and property type tend to exhibit correlation in default incidence.

2.8 Purpose of Loan

Lee (2002) has identified the 'purpose of purchasing real estate property' is one of the key determinants of default risk. Therefore, when the market price of collateral falls sharply or economic performance becomes much worse, the property frequently is abandoned by the owners thereby limiting their loss. Har and Eng (2004) showed that the use purpose of collateral was negatively correlated with the mortgage loan default.

2.9 Loan Amount

Paul Bennett et al. (1997) found that loan size is negatively correlated with the mortgage defaults. Hakim and Haddad (1999) studied the influences of the borrower's attributes and the loan characteristics on the mortgage loan default using failure-time model. Their results indicated that the loan amount was negatively correlated with the default probability.

2.10 Interest Rate of loan amount borrowed

Campbell and Dietrich (1983) showed that the interest rates significantly explain mortgage prepayment, delinquencies and defaults by using logit model. Har and Eng (2004) showed that the loan interest rate was significantly positively correlated with the mortgage loan default. Teo and Ong (2005) indicated that the interest rate was significantly negatively correlated with the mortgage loan default. Danny (2008) indicated that any empirical test of the relation between the LTV ratio and the default risk incorporated the interrelationship among the LTV ratio, credit score and interest rate.

2.11 Loan Type

Smith et al. (1996) found that the default probability was significantly affected by the loan type.

2.12 Loan-to-value ratio (LTV)

Campbell and Dietrich (1983) showed that the LTV ratio explain mortgage prepayment. Lawrence et al. (1992) stated that the default risk was positively correlated with the ratio of loan amount to collateral. Smith et al. (1996) found that the default probability was significantly affected by the loan-to-value (LTV) ratio. Liu and Lee (1997) presented that the LTV ratio were significantly positively correlated with the mortgage loan default. Capozza et al. (1997) indicated that the LTV ratio was an important factor affecting the mortgage loan default. Kau and Keenan (1998) treat the default as a rational decision and their research paper provides the entire distribution of defaults' severity. The distributions of severity are both disperse and skewed. The severity distribution shifts more than in proportion to the rise in the loan to value (LTV) ratio. Further, the researchers have demonstrated that severity of default rises as the LTV ratio increases. According to empirical model, negative mortgage value motivates financial defaults.

The mortgage value is equity (the amount paid by the borrower from his savings to the developer apart from bank loan and some more investments in the house for furniture & fittings, registration cost, etc.), house value less mortgage balance, and the value of prepayment and default options imbedded in mortgage contract. Archer et al. (1999) option-based models of mortgage default posit that the central measure of default risk is the loan-to-value (LTV) ratio. Results show that the mortgages with low and moderate LTVs may be as likely to default as those with high LTVs. Archer et al. (2001) argue that LTV at origination is an endogenous risk measure and therefore no empirical relationship between LTV and mortgage default should exist. Ambrose and Sanders (2001) use a competing risks model to examine default and prepayment behavior using 4,257 commercial loans underlying 33 CMBS deals. They also found no statistical relationship between original LTV and default. In their model, however, no measure of property cash flow is included.

Loan-to-income ratio (LTI)

Campbell and Cocco (2010) showed that mortgage default is triggered by negative home equity, which results from declining house prices in a low inflation environment with large mortgage balances outstanding. The level of negative home equity that triggers default depends on the extent to which households are borrowing constrained. High loan-to-value ratios at mortgage origination increase the probability of negative home equity. High loan-to-income (LTI) ratios also increase the probability of default by making borrowing constraints more severe. Interest-only mortgages trade of an increased probability of negative home equity against a relaxation of borrowing constraints.

3.   Research Methodology

This section includes the statement of the problem, presents arguments for the need for the study, the objectives, data collection, sampling, statistical tools; proposition and the limitations of the study. The description of all these aspects of methodology follows.

3.1 Statement of the Problem

In changing economic conditions customers are not able to foresee their income and value of their own property. It is because of the existence of limited sources of information available to them. When the customer income and their property value decreases, it is likely to result in mortgage default. Companies try to maximize their returns in various means of charges on mortgage loan. The increased charges of banks lead to mortgage default. Mortgage default has an additional cost of transaction for both lender as well as borrower. The different factors which are responsible for mortgage default are payment records, the ratio of loan amount to collateral value and the ratio of the borrower's income to expenditure (Lawrence et al. 1992), loan-to-value ratio, length of loan, the fluctuation rate of housing price, unemployment rate, divorce rate, and the borrower' moving frequency (Capozza et al. 1997; Liu and Lee, 1997) percentage of first loan, the loan interest rate, the floor area, and the borrower's credit risk (Har and Eng, 2004) and whether the borrower's house is owned by himself or rented, the marital status (single, widowed, or divorced), the degree of living pressure, and the borrower's credit risk (Cairney and Boyle, 2004). In effect, the mortgage default is on the rise due to piling up of various reasons in personal risk, loan value and collateral security.

3.2 Need for the Study

In this study, researchers have attempted to evaluate three pronged approach of important dimensions which directly or indirectly affect mortgage default. The effect of borrowers' profile, loan value and collateral security on mortgage default are studied. Therefore the present study is an effort to bring an understanding of the existing situation with respect to mortgage default. This study aims to evaluate the procedure that facilitates the existing mortgage loan borrowers and also in time with bank's policy. Also the suggestions take care of customer in order to manage mortgage defaults.

3.3 Objectives of the Study

This work aims:

1. To study the impact of borrower's profile on mortgage default.

2. To measure the association of borrower profile, loan value and realty of collateral security on mortgage defaulters' outstanding balance.

3. To assess relationship of loan value, collateral security and outstanding balance.

4. To find out the difference between the present market value of collateral security against outstanding balance of mortgage defaulters.

5. To extrapolate the reason for mortgage default due to socio-economic variables, interest rate, loan schemes, use of loan, secondary finance, loan-to-value ratio and loan-to-income ratio.

3.4 Research Design

The study is a descriptive research about mortgage default. A mortgage default is a situation in which borrower is not making payment on his/her loan. The variables used in this study are categorized into three dimensions: borrower profile, loan value and collateral security. Borrower profile includes age, marital status, gender, educational qualification and income of borrower. Loan value includes loan amount, loan amount repaid, outstanding balance, interest rate, loan type, loan-to-value ratio (LTV), loan-to-income ratio (LTI) and purpose of loan. By its side collateral security includes value of security, type of security and secondary finance.

3.5 Data Collection Design

The whole study is based on extracted data collected from Jammu and Kashmir Bank ltd. from secondary sources maintained in bank but not published. The collected data is from those borrowers who have been declared as defaulters from April 2011 up to March 2012. One of the researchers has spent twenty days in the bank in order to understand the problem in depth and to understand suitability and reliability of data. This researcher has recorded the data from the default borrower's file. Details about all the variables for the whole sample size are collected.

3.6 Sampling Design

The systematic sampling methods have been adopted to select sample defaulters. The total number of defaulters was 578, out of which 115 is taken as sample. Every fifth borrower was chosen. Due to more variation of data from average value 15 cases of

the sample were eliminated in order to maintain proper intervals. The study area is Jammu and Kashmir and sample unit is mortgage defaulters. The study period spread from September 2011 to August 2012. Sample size is calculated based upon the scale given by Aaker et al. (2009). Co-efficiency of variance for loan-to-value (LTV) has been computed for 30 cases as a pilot study. The computed value is 0.19 and based on this value sample of 99 was taken.

3.7 Statistical Design

The researchers have adopted relevant statistical tools for analysis of data describing mortgage loan defaulters. The following are the relevant tools used for analysis of data viz., chi-square, correlation, regression, ANOVA, paired 't' test and logistic regression have been selected for the proper of analysis of data. SPSS 17.0 is used for the analysis of all the above statistical tools and tabulation of processed data.

3.8 Propositions

P1: Average amount of default loan is not varying with the loan value, property market value directly and the collateral security, secondary finance, socio-economic variables, marital status, gender and age of both commercial and residential borrowers indirectly.

P2: The amount of default loan is not significantly associated with the loan value, property market value directly and the collateral security, secondary finance, socio-economic variables, marital status, gender and age of both commercial and residential borrowers indirectly.

P3: The amount of default loan has no linear relationship with the loan value, property market value directly and the collateral security, secondary finance, socio-economic variables, marital status, gender and age of both commercial and residential borrowers indirectly.

3.9 Limitations of the Study

Bank kept some of borrower's information confidential. The confidential data maintained by banks, especially contact details were not provided to the researchers. The area of borrower was not available for research and therefore it was difficult to denote the geographic location where there was loan default. Researchers want to study as much data as

possible in order to identify replication of results. This was not supported for completion. Electronic softcopy of data was sought by researcher, but it was not permitted to him. The crosscheck of data collection was done by the researcher and not by the bank.

4.   Analysis and Interpretation

The dimensions viz. borrowers profile, loan value contents and characteristics of collateral security have been tested for relationship with borrowers outstanding loan balance by applying correlation test.

4.1 Correlation Analysis

Correlation test between borrower's profile and outstanding balance

The borrower profile consists of five variables as age, gender, marital status, educational qualification and monthly income of borrower. Correlation method had been applied to find out the relationship between borrower's profile variables and defaulters outstanding balance. The description of correlation results for each pair is given as follows.

The value of correlation co-efficient between outstanding balance and the age of the borrower "r"=0.308 indicates that 30.8% of the variation in outstanding balance is explained by the age of the borrower. And p value is <0.01 so, there exists a positive relationship between the outstanding balance and age at 99% level of confidence. The value of correlation co-efficient between outstanding balance and educational qualification of borrower "r"=-0.088 indicates that 8.8% of the variation in outstanding balance is explained by the age of the borrower. And p value is >0.05 so, there exists a very weak relationship between the outstanding balance and educational qualification at 95% level of confidence. The value of correlation co-efficient between outstanding balance and gender of borrower "r"=0.196 indicates that 19.6% of the variation in outstanding balance is explained by the age of the borrower. And p value is >0.05 so, there exists a very weak relationship between the outstanding balance and gender at 95% level of confidence. The value of correlation co-efficient between outstanding balance and marital status "r"=0.385 indicates that 38.5% of the variation in outstanding balance is explained by

the marital status of the borrower. And p value is <0.01 so, there exists a positive relationship between the outstanding balance and marital status of borrower at 99% level of confidence. The value of correlation co-efficient between outstanding balance and monthly income "r"=0.539 indicates that 53.9% of the variation in outstanding balance is explained by the monthly income of the borrower. And p value is <0.01 so, there exists a positive relationship between the outstanding balance and monthly income of borrower at 99% level of confidence. (Table 1)

Correlation test between loan contents and outstanding balance

The loan content dimension consists of four variables as loan amount, amount repaid, loan-to-value ratio and loan-to-income ratio. Correlation method had been applied to find out the relationship between loan content variables and defaulters outstanding balance. The description of correlation results for each pair is given as follows.

The value of correlation co-efficient between outstanding balance and interest rate "r"=0.424 indicates that 42.4% of the variation in outstanding balance is explained by interest rate. And p value is <0.01 so, there exists a positive relationship between the outstanding balance and interest rate at 99% level of confidence. The value of correlation co-efficient between outstanding balance and type of loan "r"=-0.155 indicates that 15.5% of the variation in outstanding balance is explained by the type of the loan. And p value is >0.05 so, there exists a very weak negative relationship between the outstanding balance and type of loan at 95% level of confidence. The value of correlation co-efficient between outstanding balance and loan amount "r"=0.847 indicates that 84.7% of the variation in outstanding balance is explained by the loan amount. And p value is <0.01 so, there exists a positive relationship between the outstanding balance and loan amount at 99% level of confidence. The value of correlation co-efficient between outstanding balance and loan amount repaid "r"=0.036 indicates that 3.6% of the variation in outstanding balance is explained by the loan amount repaid. And p value is >0.05 so, there exists very weak relationship between the outstanding balance and loan amount repaid at 95% level of confidence. The value of correlation co-efficient between outstanding balance and loan-to-

value ratio "r"=0.557 indicates that 55.7% of the variation in outstanding balance is explained by loan-to-value ratio. And p value is <0.01 so, there exists a positive relationship between the outstanding balance and loan-to-value ratio at 99% level of confidence. The value of correlation co-efficient between outstanding balance and loan-to-income ratio "r"=0.371 indicates that 37.1% of the variation in outstanding balance is explained by loan-to-income ratio. And p value is <0.01 so, there exists a positive relationship between the outstanding balance and loan-to-income ratio at 99% level of confidence. (Table 2)

Correlation test between outstanding balance and collateral security characteristics

The collateral security characteristics consist of three variables as form of security, value of security and secondary finance. Correlation method had been applied to find out the relationship between collateral security variables and defaulters outstanding balance. The description of correlation results for each pair is given as follows.

The value of correlation co-efficient between outstanding balance and type of security "r"=0.209 indicates that 20.9% of the variation in outstanding balance is explained by type of security. And p value is <0.05 so, there exists a positive relationship between the outstanding balance and type of security at 95% level of confidence. The value of correlation co-efficient between outstanding balance and value of property "r"=0.602 indicates that 60.2% of the variation in outstanding balance is explained by value of property. And p value is <0.01 so, there exists a strong positive relationship between the outstanding balance and value of property at 99% level of confidence. The value of correlation co-efficient between outstanding balance and secondary finance "r"=0.099 indicates that 9.9% of the variation in outstanding balance is explained by secondary finance. And p value is >0.05 so, there exists a very weak relationship between the outstanding balance and secondary finance at 95% level of confidence. The value of correlation co-efficient between outstanding balance and use of loan "r"=0.048 indicates that 4.8% of the variation in outstanding balance is explained by use of loan. And p value is >0.05 so, there exists a very weak relationship between the outstanding balance and use of loan at 95% level of confidence. (Table 3)

4.2 ANOVA Analysis

The variables viz. income, loan amount, LTV, value of collateral security and loan amount repaid has been tested for equality of mean with borrower's outstanding balance by applying ANOVA.

Outstanding Loan Balance Based on Monthly Income

Mean and S.D. based on outstanding loan balance and monthly income have been studied. The results of ANOVA tabulation (table 4) consist of two categories of outstanding loan balance 4-44lacs and 44-84lacs. The result of the study shows that there is a significant difference in the mean score for outstanding loan balance for different categories of borrower based on monthly income. In order to test the group variation in mean scores, a null hypothesis was proposed.

H_O: Means of outstanding loan balance is not significantly influenced by monthly income.

H_A: Means of outstanding loan balance is significantly influenced by monthly income.

In order to test the hypothesis, ANOVA test has been applied (Table 5). It has been found that F value is 34.536 and the 'p' value for the level of significance is 0.000. As the 'p' value is less than 0.01, it indicates that alternative hypothesis is accepted as outstanding loan balance is significantly influenced by monthly income at 99% level of confidence.

Outstanding Loan Balance Based on Loan Amount

Mean and S.D based on outstanding loan balance and loan amount have been studied. The results of ANOVA tabulation (table 4) consist of two categories of outstanding loan balance 4-44lacs and 44-84lacs. The result of the study shows that there is a significant difference in the mean score for outstanding loan balance for different categories of borrower based on loan amount. In order to test the group variation in mean scores, a null hypothesis was proposed.

H_O: Means of outstanding loan balance is not significantly influenced by loan amount.

H_A: Means of outstanding loan balance is significantly influenced by loan amount.

In order to test the hypothesis, ANOVA test has been applied (Table 5). It has been found that F value is 65.503 and the 'p' value for the level of significance is 0.000. As the 'p' value is less than 0.01, it indicates that alternative hypothesis is accepted as outstanding loan balance is significantly influenced by loan amount at 99% level of confidence.

Outstanding Loan Balance Based on Loan Amount Repaid

Mean and S.D based on outstanding loan balance and loan amount repaid have been studied. The results of ANOVA tabulation (table 4) consist of two categories of outstanding loan balance 4-44lacs and 44-84lacs. The result of the study shows that there is a significant difference in the mean score for outstanding loan balance for different categories of borrower based on loan amount repaid. In order to test the group variation in mean scores, a null hypothesis was proposed.

H_O: Means of outstanding loan balance is not significantly influenced by loan amount repaid.

H_A: Means of outstanding loan balance is significantly influenced by loan amount repaid.

In order to test the hypothesis, ANOVA test has been applied (Table 5). It has been found that F value is 0.039 and the 'p' value for the level of significance is 0.844. As the 'p' value is greater than 0.05, it indicates that null hypothesis is accepted as outstanding loan balance is not significantly influenced by loan amount repaid at 95% level of confidence.

Outstanding Loan Balance Based on Value of Security

Mean and S.D based on outstanding loan balance and value of security have been studied. The results of ANOVA tabulation (table 4) consist of two categories of outstanding loan balance 4-44lacs and 44-84lacs. The result of the study shows that there is a significant difference in the mean score for outstanding loan balance for different categories of borrower based on value of security. In order to test the group variation in mean scores, a null hypothesis was proposed.

H_O: Means of outstanding loan balance is not significantly influenced by value of security.

H_A: Means of outstanding loan balance is significantly influenced by value of security.

In order to test the hypothesis, ANOVA test has been applied (Table 5). It has been found that F value is 41.374 and the 'p' value for the level of significance is 0.000. As the 'p' value is less than 0.01, it indicates that alternative hypothesis is accepted as outstanding loan balance is significantly influenced by value of security at 99% level of confidence.

Outstanding Loan Balance Based on Loan-to-Value Ratio (LTV)

Mean and S.D based on outstanding loan balance and LTV have been studied. The results of ANOVA tabulation (table 4) consist of two categories of outstanding loan balance 4-44lacs and 44-84lacs. The result of the study shows that there is a significant difference in the mean score for outstanding loan balance for different categories of borrower based on LTV. In order to test the group variation in mean scores, a null hypothesis was proposed.

H_O: Means of outstanding loan balance is not significantly influenced by LTV.

H_A: Means of outstanding loan balance is significantly influenced by LTV.

In order to test the hypothesis, ANOVA test has been applied (Table 5). It has been found that F value is 13.471 and the 'p' value for the level of significance is 0.000. As the 'p' value is less than 0.01, it indicates that alternative hypothesis is accepted as outstanding loan balance is significantly influenced by LTV at 99% level of confidence.

4.3 Logistic Regression

Strength of relationship between outstanding balance with age, income, educational qualification, LTV, interest rate, purpose of loan and secondary finance has been studied.

Accuracy is measured as correctly classified records in the holdout sample. There are four possible classifications:

1. Prediction of 0 when the holdout sample has a 0 (True Negative/TN)

2. Prediction of 0 when the holdout sample has a 1 (False Negative/FN)

3. Prediction of 1 when the holdout sample has a 0 (False Positive/FP)

4. Prediction of 1 when the holdout sample has a 1 (True Positive/TP)

Precision and recall is calculated as (Table 7)

$$Precision = tp/(tp+fp)$$

$$Precision = 49/(49+5) = \textbf{0.908}$$

$$Recall = tp/(tp+fn)$$

$$Recall = 49/(49+10) = \textbf{0.830}$$

The percent of correctly classified observations in the holdout sample is referred to the assessed model accuracy. Additional accuracy can be expressed as the model's ability to correctly classify 0, or the ability to correctly classify 1 in the holdout dataset.

The regression model is given as: (Table 8)

Outstanding balance= 0.258 - 0.91*age - 4.895*Income + 2.618*LTV + Edu*0.377 - 2.405*Interest Rate - 0.915*Loan Amount + 0.684*Purpose of loan + 3.601*Secondary Finance.

The R square value is 0.643, (Table 6(a)) which means that 64.3% of variation in outstanding balance is due to the variation of LTV, LTI, Income, Loan amount, Interest rate, age, educational qualification, purpose of loan and secondary finance. The precision of the model is 90.8% and its recall percentage is 83%. The level of significance from table 8 shows that Income (0.000), LTV (0.051) and Secondary finance (0.026) are mainly responsible for mortgage default.

The ROC curves (figure 1 & 2) have been drawn for the outstanding balance above and below the average with age, income, LTV, LTI, educational qualification, interest rate, loan amount, purpose of loan and secondary finance on collateral security. The results shows that the age of the borrower, income of borrower and interest rate are the main factors responsible for mortgage default (Table 8). Income has been main factor in both the cases.

5.   Findings

5.1 Impact of borrower profile on Mortgage Loan

Relationship between outstanding balance and borrower's profile

The correlation result shows that outstanding balance has positive relationship with age, which is against the results of Jacobson and Roszbach (2003). The correlation result shows that outstanding balance has positive relationship with marital status which is supported by of Cairney and Boyle (2004). The correlation result shows that outstanding balance has positive relationship with income which is supported by Jacobson and Roszbach (2003). The correlation result shows that outstanding balance has positive relationship with gender which is against the results of Jacobson and Roszbach (2003). While as educational qualification is negatively correlated with outstanding balance which are in line with the results of Liu and Lee (1997), Cairney and Boyle (2004).

5.2 Impact of Loan Value Contents on Mortgage Default

The interest rate shows that higher the interest rate more the defaults. The defaults according to loan scheme are dominated by those borrowers who have opted for term loan. Loan amount borrowed shows that higher loan amount have less defaults compared to the lower loan amounts. Loan amount repaid is dominated by 0-15lacs group.

Relationship between outstanding balance and loan value contents

Correlation between loan value contents and outstanding balance has been studied. The correlation result shows that outstanding balance has positive relationship with loan amount which is against the results of Hakim and Haddad (1999). The correlation result shows that outstanding balance has positive relationship with loan amount which is supported by the study made by Lawrence et al. (1992). The correlation result shows that outstanding balance has positive relationship with LTI which is supported by the results of Campbell and Cocco (2010). The correlation result shows that outstanding balance has positive relationship with loan amount repaid.

Influence of monthly income, loan amount, LTV, value of security and loan amount repaid on mean of outstanding balance amount-ANOVA

Mean and S.D based on outstanding balance and monthly income, loan amount, LTV, loan amount repaid and value of security has been studied. The results show that mean of outstanding balance is significantly influenced by monthly income, loan amount, LTV and Value of security. While as mean of outstanding balance is not significantly influenced by loan amount repaid.

5.3 Impact of characteristics of collateral security on mortgage default

The value of security shows lower the value of property higher the defaults and vice versa. LTV ratio shows that 78% of defaults have LTV value between 0.51-0.75. LTI ratio is dominated by 0.26-0.5 group. The form of security shows that those who has kept "land" as security defaults more. 'Purpose of loan' shows that 48% of defaulters have used loan for business investment. Secondary finance variable shows that 87% of defaulters have not opted for secondary finance.

Relationship between outstanding balance and characteristics of collateral security

Correlation between characteristics of collateral security and outstanding balance has been studied. The correlation result shows that outstanding balance has positive relationship with value of security which is supported by the results of Clauretie (1987). The correlation result shows that outstanding balance has positive relationship with form of collateral security which is supported by the results of Teo and Ong (2005). The correlation result shows that outstanding balance has positive relationship with secondary finance.

Logistic Regression findings

Logistic regression results shows that Income, LTV and secondary finance are mainly responsible for mortgage default. While as ROC curves show Age, Income and Interest rate are responsible for mortgage default. In both the cases **Income** has been the factor of loan default.

6.   Suggestions

The study is about mortgage default and the researcher is intending to propose the following suggestions in order to manage mortgage loan accounts in an effective way.

1. There is need for effective evaluation of borrowers profile especially age, marital status and monthly income. Lesser loan amount should be sanctioned to married people with age group of 37-47years and income level of 66-116k.

2. Loan value contents mainly LTV, LTI & interest rate and Characteristics of collateral security especially value of security and form of security land have direct effect on outstanding balance and should be taken care of, at the time of loan agreement. The LTV and LTI ratio should be kept below 0.5 and 0.25 respectively. The loans with interest rate of 9+4.25 should be given preference.

3. Revenue generating securities should be preferred over idle securities.

4. Borrowers whose property value lies in between 11-70lacs group should be sanctioned loan within 4-42lacs group.

5. Interest rate, secondary finance and income should be given more weightage while sanctioning the loan.

7.   Managerial Implications

The managerial implications of this study have been divided into three categories as borrower's prospective, mortgage loan process and banker's prospective.

7.1 Borrower's Prospective

The borrower's profile consists of age, marital status, gender education and income of borrower. This study has brought out clear picture of mortgage default and borrower's profile. Gender of defaulters shows one sidedness towards male 94% which implies that female defaulters (only 6%) should be appreciated for loan as they don't take more risk of defaulting compared to male borrowers. Income is another big factor which determines mortgage default. Banker and borrower should discuss the temporary problem and come up with a solution

which is acceptable to borrower. Banks should reduce the EMI and increase the tenure so that borrowers outflow can be reduced. Married borrowers are more defaulting compared to unmarried, which brings in concern that less amount of loan should be issued to aged people. In case of collection process RBI has issued clear guidelines that the collection agent cannot harass borrower mentally or physically, cannot call him/her at odd times, and banks are responsible for any misdeeds of recovery agents. Even RBI accepts that delay can occur in order to make payments by a genuine borrower.

7.2 Mortgage loan process

In order to minimize risk, lender should try to keep the LTV value as low as possible. If in case borrower is not able to repay loan, lender is at minimum risk because of low LTV value. Type of security also determines the risk of lender, as negative home equity is risk for lender. Lender should take that type of security where there is less chance of negative equity e.g. land has less chance of negative equity as compared to building. Banker should have discussion with borrower before going for sale of security. Higher interest rates (9+4.75%) have more default compared to lower rates (9+4.25%). If borrower's interest rate is high, he/she should look for other options such as refinancing the loan from other banks, negotiating with your banks to reduce the interest rate.

7.3 Banker's Prospective

Non-performing loans that turn into bad debt or dead loans are a problem for banking industry. Before and during the execution of a loan agreement, the risk should be evaluated in order to reduce future defaults. These risks include the ability of the borrower to repay the loan, and the validity and enforceability of the guaranty. Based on the bank's analysis and evaluation of the potential risks, bank should decide whether to issue the loan. Here the amount repaid by borrower is dominated by 0-15lacs group. The value of mortgage shows that lower the mortgage value higher the defaults and vice versa. For the loans with guaranty such as mortgages and pledges, the mortgaged or pledged property may depreciate, so bank should maintain low LTV ratios. Low LTV ratios indicate minimum risk. Once there is a decision to issue the loan, the bank should

minimize its own risk in the loan agreement by asking borrower to buy insurance. Borrower shall not lease the mortgaged property without the bank's consent.

Bibliography

[1] Aaker, D. A., Kumar, V., Day, G. S. and Leone, R., *Marketing Research*, 6th edition John Wily & sons, Inc. New York

[2] Ambrose, B. and Sanders, A. B. (2001), *Commercial Mortgage-Backed Securities: Prepayment and Default*, Working paper: University of Kentucky.

[3] Ambrose, B. and Sanders, A. B. (2002), High LTV loans and credit risk. Georgetown University Credit Research Center. Subprime Lending Symposium.

[4] Archer, W. R., Elmer, P. J. and Harrison, D. M. (1999), *Determinants of multifamily mortgage default*, working paper 99-2 (electronic copies of fdic working papers are available at www.fdic.gov) Federal Deposit Insurance Corporation.

[5] Archer, W. R., Elmer, P. J., Harrison, D. M., and Ling, D.C. (2002), Determinants of multifamily mortgage default, *Real Estate Economics*, Vol 30, No. 3, pp. 445–473.

[6] Archer, W.R., Elmer, P.J., Harrison, D. M. and Ling, D. C. (2002), Determinants of Multifamily Mortgage Default, *Real Estate Economics*, Vol 30, No. 3, pp. 445–473.

[7] Bajari, P., Chenghuan Sean Chu and Minjung Park (2008), *An empirical model of subprime mortgage default from 2000 to 2007*, NBER working paper No14625.

[8] Bandyopadhyay, A. and Asish, S. (2009), Factors driving Demand and default risk in residential Housing Loans: Indian Evidence. Online at http://mpra.ub.uni muenchen.de/14352/ MPRA Paper No. 14352, posted 30.

[9] Bennett, P., Peach, R. and Peristiani, S. (1997), Structural change in the mortgage market and the propensity to refinance, Federal Reserve Bank of network, research papers no. 9736.

[10] Burrows, R. (1997), Who needs a safety-net? The social distribution of mortgage arrears in England, *Housing Finance* Vol 34, pp. 17-24.

[11] Cairney, J. and Boyle, M. H. (2004), Home ownership, mortgages and psychological

distress, *Housing Studies*, Vol 19, No. 2, pp. 161–174.

[12] Campbell J. Y. and Cocco, J. F. (2010), *A model of mortgage default*, Department of Economics, Harvard University, Littauer Center, Cambridge, MA 02138, US and NBER.

[13] Capozza, D. R., Kazarian, D. and Thomson, T. A. (1997), Mortgage default in local markets, *Real Estate Economics*, Vol 25 No.4, pp. 631–655.

[14] Ciochetti, B. A., Gao, B. and Yao, R. (2001), *The Termination of Lending Relationships through Prepayment and Default in the Commercial Mortgage Markets: A Proportional Hazard Approach with Competing Risks*, Working paper, University of North Carolina.

[15] Clauretie, T. M. (1987), The impact of interstate foreclosure cost differences and the value of mortgages on default rate, *AREUEA Journal*, Vol. 15, No.3, pp. 152-67.

[16] Coles, A. (1992), Causes and characteristics of arrears and possessions, *Housing Finance*, Vol. 13, pp. 10-12.

[17] Danny, B. S. (2008), Default, credit scoring, and loan-to-value: A theoretical analysis of competitive and non-competitive mortgage markets, *The Journal of Real Estate Research*, Vol. 30, No. 2, pp. 161–190.

[18] Dietrich, C. A. and Campbell (1983), The determinants of default on insured conventional residential mortgage loans, *The Journal of Finance*, Vol. 38, No. 5, pp. 69-81.

[19] Ellis, L. (2008), *The housing meltdown: why did it happen in the United States?* BIS Working paper no. 259.

[20] Follian, J. W, Huang, V. and Ondrich, J. (1999). *Stay pay or walk away: A hazard rate analysis of FHA-insured mortgage terminations.* Draft paper, Freddie Mac and University of Syracuse.

[21] Foote, C., Gerardi, K. and Willer, P. (2008), Negative equity and foreclosure theory and evidence, *Journal of urban economics*, Vol. 6, No. 2, pp. 234-245.

[22] Furstenberg, G. V. and Green, R. (1974), Estimation of delinquency risk for home mortgage portfolios, *AREUEA Journal*, Vol. 2, pp. 5-19.

[23] Gerardi, K., Lehnert, A., Sherlund, S. and Willen, P. (2008), Making sense of the subprime crisis, *Brooking papers on Economic activity fall*.

[24] Goldberg, L. and Capone, C.A. (1998), Multifamily Mortgage Credit Risk: Lessons from Recent History, *Cityscape*, Vol. 4, No. 1, pp. 93-113.

[25] Guiso, L., Sapienza, P. and Zingales, L. (2009), Moral and social constraints to strategic default on mortgage, *Journal of international finance*, preliminary version, http://financialtrustindex.org/images/Guiso_Sapienza_Zingales_StrategicDefault.pdf.

[26] Hakim, S. R. and Haddad, M. (1999), Borrower attributes and the risk of default of conventional mortgage, *Atlantic Economic Journal*, Vol. 27, No. 2, pp. 210–220.

[27] Har, N. P. and Eng, O. S. (2004), Risk sharing in mortgage loan agreements, *Review of Pacific Basin Financial Markets and Policies*, Vol. 7, No. 2, pp. 233–258.

[28] Harrison, D., Noordewier, T. and Yavas A. (2004) , Do Riskier Borrowers Borrow More?" *Real Estate Economics* Vol. 32, No. 3, pp. 385-411.

[29] Ingram, F. J; and Frazier, E. L. (1982), Alternative multivariate tests in limited dependent variable models: An empirical assessment, *Journal of Financial and Quantitative Analysis*, Vol. 17, No. 2, pp. 227-240.

[30] Jackson, R. J. and Kaserman, L. D. (1980), Default risk on Home mortgage loans: A test of competing Hypothesis. *The Journal of Risk and Insurance*, Vol. 47, No. 4 (Dec., 1980), pp. 678-690

[31] Jacobson, T. and Roszbach, K. (2003), Bank lending policy, credit scoring and value-at-risk. *Journal of Banking & Finance*, Vol. 27, No. 4, pp. 615–633.

[32] Kau J., Keenan, D. C. and Kim, T. (1993), Transaction costs, suboptimal Termination, and Default Probabilities, *Journal of the American Real Estate and Urban Economics Association*, Vol. 21, No. 3, pp.247-64.

[33] Kau, J. and Keenan, D. C. (1998), *Patterns of rational default*, working paper, University of Georgia.

[34] Kiff, J. and Mills, P. (2007), *Money for nothing and checks for free: recent development in the U.S. subprime mortgage markets*, IMF working papers no 07/188.

[35] Krainer, J., Stephen, F. L. and Munpyung, O. (2009), *Mortagage default and mortgage*

valuetion, working paper (1999-2000), Federal Reserve Bank. http://www.frbsf.org/publications/economics/papers/2009/wp09-20bk.pdf

[36] Kumar, M. (2010), Demographic Profile As a Determinant of Default Risk in Housing Loan Borrowers –Applicable to Indian Condition, *International Research Journal of Finance and Economics* Vol. 58, ISSN 1450-2887.

[37] Lawrence E. C. and Arshadi, N. (1995), A multinomial logit analysis of problem loan resolution choices in banking, *Journal of Money, Credit and Banking*, Vol. 27, No. 1, pp. 202-216.

[38] Lawrence, E. C., Smith, L. D. and Rhoades, M. (1992), An analysis of default risk in mobile home credit, *Journal of Banking & Finance*, Vol. 16, No. 2, pp. 299–312.

[39] Lee, S. P. (2002), Determinants of default in residential mortgage payments: A statistical analysis, *International Journal of Management*, June, Vol. 19, No. 2.

[40] Lee, S. P., and Liu, D. Y. (2001), An analysis of default risk on residential mortgage loans, International *Journal of Management*, Vol. 18, No. 4, pp. 421–431.

[41] Liu, D. Y. and Lee, S. P. (1997), An analysis of risk classifications for residential mortgage loans, *Journal of Property Finance*, Vol. 8, No. 3, pp. 207–225.

[42] Liu, Day-Yang and Lee Shin-ping (1997), An analysis of risk classifications for residential mortgage loans, *Journal of property Finance*, Vol. 8, No. 3, pp. 207-225.

[43] Luigi Guiso, Paola Sapienza and Luigi Zingales, (2009). Moral and social constraints to strategic degault on mortagage. Jouranal of international finance, preliminary version, http://financialtrustindex.org/images/Guiso_Sapienza_Zingales_StrategicDefault.pdf.

[44] May, O. and Merxe, T. (2005), *When is mortgage indebtness a financial burden to British households? A dynamic probit approach*, Working Paper no.277. ISSN 1368-5562.

[45] Riddiough, T. J. (1991), *Equilibrium Mortgage default pricing with Non-Optimal Borrower Behavior*, Ph.D. Thesis, University of Wisconsin.

[46] Smith, L. D., Sanchez, S. M. and Lawrence, E. C. (1996), A comprehensive model for managing credit risk on home mortgage portfolios, *Decision Sciences*, Vol. 27, No. 2, pp. 291–317.

[47] Stansell, S. R and Millar, J. A. (1976), An empirical study of mortgage payment to income ratios in a variable rate mortgage program, *The journal of Finance*, Vol. 31, No. 2, pp. 415-425.

[48] Teo, A. H. L., and Ong, S. E. (2005), *Conditional default risk in housing arms: A bivariate probit approach*, Paper presented at the 13th American Real Estate Society Conference, Santa Fe, USA.

[49] Tsai, S. L. L. C. (2009), How to Gauge the Default Risk? An empirical application of Structural-form Model, *International Research Journal of Finance and Economics*, Vol. 29, No. 11.

[50] Vandell, K. D and Thibodeau, T. (1985), Estimation of mortgage defaults using disaggregate loan history data, *AREUEA Journal*, Vol.5, No. 3, pp. 292-317.

[51] Vandell, K. D. (1978), Default risk under alternative mortgage instruments, *The Journal of Finance*, Vol. 33, No. 5, pp.1279-1296.

[52] Wiliams, A. O., Beranek W. and Kenkel, J. (1974), Default risk in urban mortgages: A pittsburg prototype analysis, *American Real Estate and Urban Economics Association Journal*, Vol. 2, pp. 101-112.

Table 1: Correlation test between borrower's profile and outstanding balance

		Education Qualification	Gender	Age	Marital Status	Income of Borrower
Outstanding Balance	Pearson	-.088	.196	.308**	.385**	.539**
	Sig. (2-	.385	.052	.002	.000	.000
	N	99	99	99	99	99

**correlation is significant at the 0.01 level (2-tailed)
*correlation is significant at the 0.05 level (2-tailed)

Table 2: Correlation test between Loan value contents and outstanding balance

Factors	Sources of variation	Sum of Squares	df	Mean Square	F	Sig.
Monthly Income (k)	Between	40211.97	1	40211.9	34.536	.000
	Within	111778.5	9	1164.36		
	Total	151990.5 31	97			
Loan Amount (lacs)	Between	18838.45	1	18838.4	65.503	.000
	Within	27609.25	9	287.596		
	Total	46447.71	9			
Amount Repaid (lacs)	Between	5.461	1	5.461	.039	.844*
	Within	13393.05	9	139.511		
	Total	13398.51	9			
Value of Collateral	Between	30981.53	1	30981.5	41.374	.000
	Within	71886.82	9	748.821		
	Total	102868.3	9			
LTV	Between	.157	1	.157	13.471	.000
	Within	1.115	9	.012		
	Total	1.272	9			

**correlation is significant at the 0.01 level (2-tailed)
*correlation is significant at the 0.05 level (2-tailed)

Table 3: Correlation test between collateral security and outstanding balance

		Collateral Security	Property Value	Secondary finance	Use of loan
Outstanding Balance	Pearson Correlat	.209*	.602**	0.099	.048
	Sig (2-tailed)	0.038	0	0.328	.636
	N	99	99	99	99

**correlation is significant at the 0.01 level (2-tailed)
*correlation is significant at the 0.05 level (2-tailed)

Table 4: Descriptive based on outstanding balance

Factors	Outstanding balance groups (lacs)	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Monthly Income (k)	4-44	64.77	37.774	4.650	55.49	74.06	15	175
	44-84	107.97	24.778	4.380	99.04	116.90	80	178
	Total	78.88	39.584	3.999	70.94	86.81	15	178
Loan Amount (lacs)	4-44	26.24	16.493	2.030	22.18	30.29	8	102
	44-84	55.80	17.895	3.163	49.35	62.26	35	115
	Total	35.89	21.882	2.210	31.51	40.28	8	115
Loan Amount Repaid (lacs)	4-44	6.92	13.762	1.694	3.54	10.31	0	80
	44-84	6.42	5.908	1.044	4.29	8.55	0	31
	Total	6.76	11.753	1.187	4.40	9.12	0	80
Value of Collateral Security (lacs)	4-44	46.86	30.203	3.718	39.43	54.28	16	190
	44-84	84.77	20.154	3.563	77.51	92.04	56	134
	Total	59.24	32.565	3.290	52.71	65.77	16	190
LTV	4-44	.5720	.10440	.01285	.5463	.5976	.22	.84
	44-84	.6572	.11456	.02025	.6159	.6985	.49	.97
	Total	.5998	.11450	.01157	.5768	.6228	.22	.97

Table 5: ANOVA

		Loan Rate	Loan Type	Loan amount	Amount repaid	LTV	LTI
Outstanding Balance	Pearson	.424**	-.15	.847**	0.036	.557**	.371**
	Sig. (2-	.000	.126	0	0.361	0	0
	N	99	99	99	99	99	99

Table 6(a): Model Summary

Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	69.620ª	.476	.643

Table 7: Classification table

Classification Table					
	Observed		Predicted		
			Outstanding Balance		Percentage Correct
			0	1	
Step 1	Outstanding Balance	0	35	5	87.5
		1	10	49	83.1
	Overall Percentage				84.8

Table 8: Variables in the Equation

Variables in the Equation							
		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1	Age	-.091	.635	.020	1	.887	.913
	Income	-4.89	1.267	14.928	1	.000	.007
	LTV	2.61	1.3	3.81	1	.0	13.7
	EDU	.377	.64	.341	1	.5	1.45
	Interest	-	1.5	2.50	1	.1	.090
	Loan	-.915	.61	2.21	1	.1	.401
	Purpose	.684	.87	.608	1	.4	1.98
	Second	3.60	1.6	4.98	1	.0	36.6
	Constant	.258	1.570	.027	1	.870	1.294

Figure 1: ROC Curve for values above average of Outstanding Balance

Figure 2: ROC Curve for values below average of Outstanding Balance
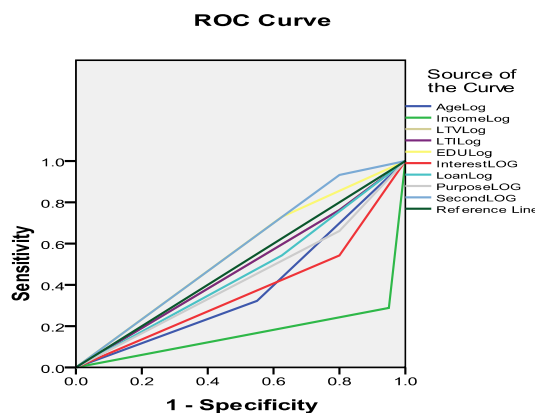
Structural Breaks and Cointegration Analysis in the EU Developed Markets

Nuno Ferreira[#1], Rui Menezes[#2], Manuela M. Oliveira[*3]

[#]*Department of Quantitative Methods, IBS-ISCTE Business School, ISCTE*
Avenida das Forças Armadas, Lisboa, Portugal
[1]`nuno.ferreira@iscte.pt`
[2]`rui.menezes@iscte.pt`
[*] *Centro de Investigação Operacional*
Faculdade de Ciências da Universidade de Lisboa, Bloco C6, Piso 4, Campo Grande, Lisboa, Portugal
[3]`manuelamcoliveira@gmail.com`

Abstract - **The strategic positioning of European economies, namely interest rate fluctuations, stock market crises, regional effects of oil prices and regional political developments make them vulnerable to real and external shocks. First signs of a sovereign debt crisis spread among financial players in the late 2009 were a result of the growing private and government debt levels worldwide. In an established crisis context, it was searched for evidence of structural breaks and cointegration between interest rates and stock market prices in the developed European markets under stress along a 13 year time-window. The results identified significant structural breaks at the end of 2010 rejecting the null hypothesis of no cointegration, and this resulted in its spread from the US to the rest of the world.**

Keywords - *Stock markets, Interest rates, Smooth transition regression models, Nonlinearity, Debt sovereign crisis*

1. Introduction

It has become clear that today's equity markets around the world are no longer national markets. Stock indexes in both the US and worldwide have dropped dramatically; investors and stock traders in different markets around the world wait for new announcements given by listed companies and adjust their portfolio according to news from other markets. This phenomenon revealed how international and interconnected the stock markets have become. It is important for both financial, economic theory and practical asset management to know whether financial markets are cointegrated or not.

Kurov (2010) found that the monetary policy actions in bear market periods that have a strong effect on stocks can be revealing of greater sensitivity to

changes in investor sentiment and credit market conditions.

Overall, the results showed that the investor sentiment plays a significant role in monetary policy's effect on the stock market. Previous studies (e.g. Baker et al., 2007; Kumar and Lee, 2006) revealed that the investor sentiment predicts cross-section and aggregate stock returns indicating that it moves stock prices and, therefore, affects expected returns. This raises the question of whether the effect of monetary news on stocks is at least partially driven by the influence of FED or ECB policy on investor sentiment.

In the current context of crisis, the present study analyzes structural break unit root tests in a 13 year time-window (1999-2012) for three European markets under stress namely: France (FR), the United Kingdom (UK) and Germany (GE) using the United States of America (US) as benchmark.

Considering the problems generated by structural breaks, the unit root test Lumsdaine and Papell, 1997 (henceforth LP) was employed to allow for shifts in the relationship between unconditional mean of the stock markets and interest rate. A new approach to capture structural breaks was introduced by LP with the argument that a unit root test which identifies two structural breaks is much more robust. LP uses a modified version of the ADF test by incorporating two endogenous breaks. These two tests were chosen because they have three main advantages. Firstly, their properties are easily captured as they are ADF based tests. Secondly, the timing of the structural break is determined endogenously, and lastly, their computational implementation is easily accessible.

A limitation of the ADF-type endogenous break unit root tests, e.g. LP test, is that critical values are derived while assuming no break(s) under the null. Nunes et al. (1997) and Lee and Strazicich (2003) showed that this assumption leads to size distortions in

the presence of a unit root with one or two breaks. As a result, one might conclude when using the LP test that a time series is trend stationary, when, in fact, it is nonstationary with break(s), i.e. spurious rejections might occur.

To address this issue, Lee and Strazicich (2006) suggest a two-break LM unit root test as a substitute for the LP test. In contrast to the ADF test, the LM unit root test has the advantage that it is unaffected by breaks under the null. These authors proposed an endogenous LM type unit root test which accounts for a change in both the intercept and also in the intercept and slope. The break date is determined by obtaining the minimum LM t-statistic across all possible regressions. More recently, several studies started to apply the LM unit root test with one and two structural breaks to analyze the time series properties of macroeconomic variables (e.g. Narayan, 2006; Chou, 2007; Lean and Smyth, 2007a, 2007b).

Structural changes or "breaks" appear to affect models based on key economic and financial time series such as output growth, inflation, exchange rates, interest rates and stock returns. This could reflect legislative, institutional or technological changes, shifts in economic policy, or even be due to large macroeconomic shocks such as the doubling or quadrupling oil prices of the past decades. A variety of classical and Bayesian approaches are available to select the appropriate number of breaks in regression models. Their diversity is essentially based on the type of break (e.g. breaks in mean; breaks in the variance; breaks in relationships; single breaks; multiple breaks; continuous breaks and some kind of mixed situations better described by smooth switching models).

The conventional stability and unit root tests are often associated with the concept of "persistence" of innovations or shocks to the economic system. In this context, the debate has been centered on whether shocks to macroeconomic time series have temporary or permanent effects. While Nelson and Plosser (1982) suggested that most macroeconomic time series are best characterized by unit root processes implying that shocks to these series are permanent, Perron (1989, 1990) challenged this by providing some evidence that the null hypothesis of a unit root test may be rejected for many macroeconomic time series if we allow for a one-time shift in the trend function. Thus, it would be preferable to describe and characterize many macroeconomic time series as having temporary shocks (stationary) around a broken deterministic trend function. In essence, if there is a break in a deterministic trend, then the unit root tests (which

implicitly assume the deterministic trend as correctly specified) will incorrectly conclude that there is a unit root, when, in fact, there is not.

The policy effects can vary depending on both the nature of the non-stationarity associated with the macroeconomic variables, and the econometric modeling. Since the main focus of this paper is on the demand for money (interest rate) and stock markets, we could state that this relationship was subject to serious parameter instabilities (especially during periods of economic crises, institutional arrangements, wars, financial crises, etc.), which had a strong impact on capturing of policy changes effects. Many aggregated economic time series (consumption, income, interest rates, money, stock prices, etc.) display strong persistence with sizable fluctuations in both mean and variance over time. The classical approach to hypothesis testing is based on the assumption that the first two population moments (unconditional) are constant over time (covariance stationary) and hence unit roots pose a challenge for the usual econometric procedures.

Cointegration theory is very dependent on the existence of unit roots and is focused on the (long-run) equilibrium relationships. This relation, known as the cointegration relationship between the economic variables, shapes some economic equilibrium. It is well-known that some economic variables should not move freely or independently of each other; thus these connections persuade some econometricians to test for cointegration relationships within unit root tests by unconventional methods.

Different theories on phases of economic development and growth postulate that an economic relationship changes over time. In the last three decades, the impact of structural changes on the result of econometric models has been of great concern. In this context, Perron (1989) argued that if a structural break in a series is ignored, unit root tests can be erroneous in rejecting the null hypothesis; on the other hand, if there is a break in the deterministic trend, unit root tests will mistakenly conclude that there is a unit root when, in fact, there is not. In short, an undetected structural break in a time series may lead to rejecting of the null hypothesis of unit roots. Andreou et al. (2006, 2009) pointed out that ignoring the presence of structural breaks can have costly effects on financial risk management and may produce faulty inferences regarding credit risk.

Unfortunately, the extant literature provides substantial evidence that the financial time series may display structural changes (e.g. Andreou et al., 2009,

2010). There is a vast number of studies applying tests estimating structural breaks. Initially, this kind of test was restricted to cases of a single break in a regression equation model cases. Later, Bai and Perron (1998, 2003a, 2003b, 2006) among others, incorporated the multiple change points in a univariate regression.

Basically, there are two points of view on structural change modeling. The first assumes the structural change modeling as a known break point, and the other as unknown break points. Modeling structural changes by setting the break points in advance allows potential break-dates to be identified ex ante and the parameter constancy to be tested via the inclusion of interactive-dummy variables into the econometric models. In such cases, the hypothesis of a structural break can be tested by applying standard tests of significance with respect to estimated coefficients of these dummy variables.

However this kind of test was subject to severe criticism due to the arbitrary nature of selected break-dates and the inability to identify when exactly the structural breaks had occurred. Therefore, another approach was proposed to model the structural breaks by assuming that the break date(s) are ex ante unknown.

Each approach had several applications in the literature and presented different implications. A large number of papers derived asymptotic distributions for the null hypotheses of the structural change tests using different econometric approaches.

The best known works in the enormous literature produced hitherto include Perron (1989), Zivot and Andrews (1992), Banerjee et al. (1992) and Gregory and Hansen (1996). All these papers address unknown structural breaks procedures.

In this study, the authors carried out the LP and LS (1 break) tests in order to capture different structural breaks approaches in the relationship between stock market prices and interest rates.

2.   Data Analysis
2.1   Lumsdaine and Papell test

Considering only one endogenous break may not be sufficient and lead to a loss of information, particularly when there is in fact more than one break. Lumsdaine and Papell (1997) introduced a new approach to capture structural break with the argument that a unit root test that shows two structural breaks is much more robust. They contently reverse conclusions of many studies which fail to reject the null with the presence of one break. The LP test extends the tests for two structural breaks; models which consider two breaks in the intercept are known as AA, and those with two breaks in the intercept and slope of the trend are designated CC (also known as "crash-model"). The LP CC model can be specified as:

$$\begin{cases} H_0: x_t = c + x_{t-1} + \varepsilon_{1t}, \\ H_A: x_t = c + \beta t + d_1 D_{1t} + d_2 D_{2t} + \varepsilon_{2t}. \end{cases} \quad (1)$$

where $D_{1t}=1$ for $t > TB1 + 1$ and 0 otherwise, $D_{2t}=1$ for $t > TB2 + 1$ and 0 otherwise and TB1 and TB2 are the dates corresponding to the break points (mean shifts). The testing strategy employed in LP is similar to ZA, which implies following the ADF regression tests. The LP procedure generates a final t-statistic which is the greatest in absolute value (the most favorable for rejecting the null hypothesis). Consequently, the estimated breakpoints (TB1 and TB2) correspond to the minimum t-statistic.

The crucial effect of the trend property of the variables for the structural break estimation was recognized by several authors. Ben-David and Papell (1997) showed that the test power was affected by the inclusion of a trend variable where there is no upward trend in data. Otherwise it is inconvenient since the model may not capture some important patterns of the data without trend.

With this subjacent, Ben-David and Papell (1995) and Ben-David et al. (2003), used tests for a unit root against the alternative of broken trend-stationarity allowing for one and respectively two endogenous break points. This procedure, developed by Zivot and Andrews (1992) and Lumsdaine and Papell (1997), rejects the unit root null in favor of broken trend-stationarity for long-term US GDP. In all cases, the estimated breaks coincide with the Great Depression and/or World War II.

In accordance with this different conception of the distinct unit root tests allowing structural breaks, some more recent papers have combined several approaches to efficiently capture any sign of structural change (e.g. Marashdeh and Shrestha, 2008; Narayan and Smyth, 2005; Ranganathan and Ananthakumar, 2010).

2.2   Lee and Strazicich test

The first part of this empirical analysis ends with the LS test also known as LM test due to Langrage multipliers. The main advantage over previous tests is that they are not affected by structural breaks under the null hypothesis because the critical values of the ADF-

type endogenous break unit root tests (such as ZA and LP) were derived while assuming no break(s) under the null. The test employed in this paper (model A, known as the "crash model") could be briefly described considering: $Z_t = [1, t, D_{1t}, D_{2t}]'$ where $DT_{jt} = t - T_{Bj}$ for $t \geq T_{BJ} + 1, j = 1,2$ and 0 otherwise. Consequently, it could be evidenced that DGP incorporated breaks under the null ($\beta=1$) and alternative hypothesis ($\beta>1$) as already noted. Making the value of β uncertain, we could rewrite the both hypotheses as:

$$\begin{cases} H_0: y_t = \mu_0 + d_1 B_{1t} + d_2 B_{2t} + y_{t-1} + v_{1t}, \\ H_A: y_t = \mu_1 + \gamma_t + d_1 D_{1t} + d_2 D_{2t} + v_{1t}. \end{cases} \quad (2)$$

Where and are stationary error terms with for and 0 otherwise. The LM unit root test statistic is obtained from the following regression Arghyrou (2007) designed this component as the LM score principle. The LM test statistic is determined by testing the unit root null hypothesis that The LM unit root test determines the time location of the two endogenous breaks, whereas represent each combination of break points] using a grid search as follows: The break time should minimize this statistic.

Critical values for a single break and two-break cases are tabulated from Lee and Strazicich (2003, 2004) respectively. Another approach to searching for unit roots with breaks by allowing nonstationarity in the alternative hypothesis is adopted in several studies following the Lee and Strazicich (2003, 2004) procedure testing.

2.3 Gregory and Hansen test

The Gregory and Hansen (1996) test examines whether there has been a one-time shift in the cointegration relationship by detecting any cointegration in the possible presence of such breaks. The authors of the G-H procedure derived asymptotic distribution of the test statistic; it is free of nuisance parameter dependencies other than the number of stochastic and deterministic regressors. In their words, "the distribution theory is more involved than the theory for the conventional cointegration model, due to the inclusion of dummy variables and the explicit minimization over the set of possible breakpoints". They developed a single-equation regression with structural change starting with the standard model of cointegration and no structural change:

Model 1: Standard Cointegration: $y_{1t} = \mu + \alpha^T y_{2T} + \varepsilon_t, t = 1, \dots, n$ (3)

In this case, if there is stated a long-run relationship, μ and α are necessarily defined as time-invariant. The G-H approach consider that this long-run relationship could shift to a new long run relationship by introducing an unknown shifting point that is reflected in changes in the intercept μ and/or changes to the slope α defining Model 2 and 3 in the following form:

Model 2: Level Shift (C): $y_{1t} = \mu_1 + \mu_2 \alpha^T y_{2T} + \varepsilon_t, t = 1, \dots, n$ (4)

This model represents a level shift in the cointegration relationship, and is modeled as a change in the intercept μ variable. μ_1 and μ_2 represent the intercept before and at the time of the shift. In order to account for the structural change, the authors introduced the dummy variable definition:

$$\varphi_{t\tau} = \begin{cases} 0 \ if \ t \leq [n\tau], \\ 1 \ if \ t > (n\tau). \end{cases} \quad (5)$$

where the unknown parameter $\tau \in (0,1)$ represents the relative timing of the change point and [.] denotes integer part.

Model 3: Level Shift with Trend (C/T): $y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \beta_t + \alpha^T y_{2t} + \varepsilon_t, t = 1, \dots, n$ (6)

In this model, the authors extended the possibilities by introducing a time trend βt into the level shift model.

Model 4: Regime Shift (C/S): $y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha^T y_{2t} + \alpha^T y_{2t} \varphi_{t\tau} + \varepsilon_t, t = 1, \dots, n$ (7)

The last model integrates a shift in the slope vector, which permits the equilibrium relation to rotate and a parallel shift. For this case, $\alpha 1$ is the cointegrating slope coefficient before the regime shift, and $\alpha 2$ is the change in the slope coefficients, whereas $(\alpha\_1 + \alpha\_2)$ is the cointegrating slope coefficient after the regime shift.

Gregory and Hansen derived their statistical test showing the null of no cointegration against the

Table 1 - Unit-root tests (variable Pi). (**) indicates critical values at 1%.

Variable	LP[a]		LS (1 break)	
	TB1	Statistic	TB1	Statistic
Pi_Fr	Sep-03	-3.203	Oct-08	-2.232
Pi_Ge	Sep-08	-3.012	Aug-02	-2.209
Pi_UK	May-08	-2.777	Jul-02	-2.277
Pi_US	May-03	-2.217	Sep-01	-2.004

Note: [a] Both Intercept and Trend

alternative in models 2-4. They then computed the cointegration test statistic for each possible regime shift where $\tau \in T$ must be chosen. This was performed by estimating the model by OLS and capturing the model's residual component. From this residual, they proceed with the calculation of the first-order serial correlation coefficient. After determining all statistics, the authors examined the smallest values as these are evidence against the null hypothesis.

The following works are some of the most recent using Gregory and Hansen cointegration: Ibrahim, 2009; Rao and Kumar, 2010; Karunaratne, 2010; Demez and Ustaoglu, 2012; Esteve et al., 2013.

Concerning the software, all routines applied were run with WinRATS Pro 8.0 and are available in Estima website.

2.4   Dataset

The variables under study cover daily data from April 1999 to December 2012 and are expressed in levels after a logarithmization procedure. The stock market price (Pi), the (Y1) and (Y10) are the government bond yield and the interest rates at 1 year and 10 years, respectively. All the three variables have been collected for each selected market (FR, GE and UK) from the strongest European countries under most stress in the recent years. We also included the US market as a benchmark. All data have been collected and are available online from Datastream database.

3.   Results and discussion

The results of the unit root testing procedures, implemented using both the intercept and trend options, are presented in the tables below, starting with the price index (Pi variable) (Table 1). The corresponding time of the structural break (TB1) for each variable is also shown in each test. For the Pi variable in the established crisis period, the LP tests fail to reject the null hypothesis of a unit-root at the 1 percent significance level in all analysed countries meaning that the price index series are non-stationary.

For the 1 year interest rate (variable Y1) series (Table 2), the LP tests fail to reject the null hypothesis of a unit-root at 1 percent significance level in three countries – GE, US and UK, revealing that the interest rates at 1 year of FR is stationary. The analyses of the 10 year interest rate (variable Y10) series reveal that all countries are (Table 3).

In light of these results, the cointegration hypothesis was tested with the Pi variable of the European countries against the Y1 variable of US (Table 4). The three most economically developed countries (GE, UK and US) revealed a similar pattern in the interest rate series (Y1), which could suggest a strong contagious phenomenon between them. The structural break points defined through the different

Table 2 - Unit-root tests (variable Y1). (**) indicates critical values at 1%.

Variable	LP[a]		LS (1 break)	
	TB1	Statistic	TB1	Statistic
Y1_Fr	Sep-07	-16.770**	Sep-07	-44.846
Y1_Ge	Feb-06	-2.048	Feb-02	-4.271
Y1_UK	Feb-06	-2.048	Feb-02	-4.271
Y1_US	Feb-06	-2.048	Feb-02	-4.271

Note: [a] Both Intercept and Trend

Table 3 - Unit-root tests (variable Y10). (**) indicates critical values at 1%.

Variable	LP		LS (1 break)	
	TB1	Statistic	TB1	Statistic
Y10_Fr	Dec-10	-18.352**	Mar-11	-55.576
Y10_Ge	Nov-10	-17.990**	Oct-10	-44.003
Y10_UK	Nov-10	-19.551**	Nov-10	55.155
Y10_US	Nov-10	-19.195**	Sep-10	-46.077

Note: [a] Both Intercept and Trend

tests consistently coincide with important dates through the time-window analyzed, with special emphasis on the US.

The structural break points identified by the LS test (one break), reveal the economic impact of the September 11 2001 attacks on the US, and the repercussions in the following years with the concerted military action against Iraq.

By late 2003, the US was in the midst of the most serious world economic setback, originated by the credit boom (interest rates were at a 50-year-low and mortgage credit stood at an all-time high) and the housing bubble (prices had exceeded all previous levels).

The first half of 2004 was characterized by a trend towards gradual economic recovery. In the US, 1.2 million new jobs were created, and core inflation rose from 1.1% to 1.9%, leading the Federal Reserve to raise interest rates by 25 basis points to 1.25 %. However, the European Central Bank kept the interest rate on the main refinancing operations at 2%. The Nasdaq rose 2.22% and the Dow Jones and S&P 500 showed variations of 0.18% and 2.60%. In the Eurozone, the Paris CAC 40 and IBEX 35 went up

4.92% and 4.41%, while the DAX in Frankfurt rose 2.64%.

During 2005, major equity markets continued their upward trend and the longer term interest rates declined. As a result of concerns about the potential inflationary consequences of the ample liquidity supply and possible lagged effects of the sharp rise in energy prices on price and wage setting, the ECB raised interest rates by 25 basis points in early December 2005. Despite this, the monetary policy remained accommodated. This partly offset the easing of overall monetary conditions due to the weakening of the euro; the ECB had taken this step in an attempt to bring short-term rates to a neutral position, as the United States Federal Reserve had done since July 2004.

Meanwhile, when the downturn in housing prices finally began in 2006, everyone had difficult in repaying their mortgages as home equity loans shrank. Subprime borrowers were, by definition, more prone to default on their mortgages than the average person. In addition, they were more likely to be poor and unemployed so had painfully few alternatives to defaulting. The tendency of increasing prices (to enable increased subprime lending) was another dangerous feedback loop of the housing bubble. As housing prices rose, banks became more inclined to increase subprime lending, which in turn spurred greater housing demand, thereby accelerating the price increase. While such cycles seemed to enable the bubble to inflate itself, they still depended on adherence to the irrational belief that housing prices would rise indefinitely. Bankers who allowed rising prices to overshadow the risks of subprime lending did so in this belief. Mimicking and reinforcing homebuyers' representativeness heuristic (i.e. the belief that recent trends would continue unabated), the behavior of such bankers further challenges the assumed rationality of key economic actors.

Having plateaued in 2006, housing prices in 2007 stood on the edge of a precipice. They plummeted from the second quarter of that year until the first quarter of 2009, and fell 5% every three months i.e. faster than they had climbed. Housing prices continued to decline more gradually after 2009, sinking steadily through 2012 when they approached the pre-bubble, century-long average.

By 2008, developments took a turn for the worse, and the growth slowdown became acuter. In early 2009, the conclusion was that this would be a deeper

recession than the average of "Big Five" (those in Spain, 1977; Norway, 1987; Finland, 1991; Sweden, 1991 and Japan, 1992). The conjuncture of elements is illustrative of the two channels of contagion: cross-linkages and common shocks.

For instance, German and Japanese financial institutions sought more attractive returns in the US subprime market. Due to the fact that profit opportunities in domestic real estate were limited at best and dismal at worst. Indeed, in hindsight, it became evident that many financial institutions outside the US had considerable exposure to the US subprime market. Similarly, the governments of emerging markets had experienced stress, although of mid-2009 sovereign credit spreads had narrowed substantially in the wake of massive support from rich countries for the IMF fund. European banks began to face liquidity problems after August 2007, and German banks continued to lend heavily to peripheral borrowers in the mistaken belief that peripheral countries were a safe outlet. Net exposure rose substantially in 2008. Speculators focused on Greek public debt on account of the country's large and entrenched current account deficit as well as because of the small size of the market in Greek public bonds. Greece was potentially the start of speculative attacks on other peripheral countries – and even on countries beyond the Eurozone, such as the UK – that faced expanding public debt.

By August 2011 a sharp drop in stock prices took place in markets across the US, Middle East, Europe and Asia, essentially due to fears of contagion of the European sovereign debt crisis to Spain and Italy, as well as concerns over France's current AAA rating, as well as slow economic growth in the United States and the downgrading of its credit rating. Severe volatility of stock market indexes continued for the rest of the year. In April, the S&P rating agency lowered the US credit rating to 'negative' from 'stable'. Most developments in global financial markets between early September and the beginning of December were driven by news on the euro area sovereign debt crisis. In the midst of evaluation downgrades and political uncertainty, market participants demanded higher yields on Italian and Spanish -government debt. Meanwhile, difficulties in meeting fiscal targets in a recessionary environment weighed on prices for Greek and Portuguese sovereign bonds.

The contagion phenomenon quite evident in the results; reveal that the US/UK/GE trio are often the "head" of the problem followed by the remaining emergent markets (IR, FR, SP, PT and IT).

Table 4 - Cointegration results

Variables Pi (market) and 1Y (US):	Cointegration models	Minimum T-Statistic	Critical Values 1%	5%
	C	-3.244	-5.130	-4.610
Pi_Fr	CT	-3.515	-5.450	-4.990
	CS	-3.410	-5.470	-4.950
	C	-4.253	-5.130	-4.610
Pi_Ge	CT	-4.079	-5.450	-4.990
	CS	-3.119	-5.470	-4.950
	C	-4.493	-5.130	-4.610
Pi_UK	CT	-3.671	-5.450	-4.990
	CS	-2.647	-5.470	-4.950

Note: the critical values from Gregory-Hansen (1996a)

The cointegration hypothesis was tested by performing the relationship between the stock market prices and interest rates (Table 4). Bivariate cointegration was considered for this purpose, allowing for structural break tests between the price indexes of each European stock market and the interest rate at 1 year of USmarket benchmark.

(US). This test detects regime-shift as well as stable cointegration relationships. Thus, the rejection of the null hypothesis does not entangle the instability of the cointegration relationship. The differentiation of these situations is made using stationarity tests and with the structural breaks previously presented. It is possible to infer the US influence on the European equity markets through the timing of structural breaks (Tables 1 to 3) and because both variables show prolonged upward and downward movements (resumed in Table 4). An examination of the crisis reveals that economies are already quite integrated, and this resulted in its spread from the US to the rest of the world.

References

[1] Andreou, E., Ghysels, E., 2006. Monitoring disruptions in financial markets. *Journal of Econometrics,* 135(1–2), 77-124.

[2] Andreou, E., Ghysels, E., Kourtellos, A., 2009. *Should macroeconomic forecasters look at daily financial data?* University of North Carolina. Mimeo.

[3] Andreou, E., Ghysels, E., Kourtellos, A., 2010. Regression models with mixed sampling frequencies. *Journal of Econometrics*, 158(2), 246-261.

[4] Arghyrou, M.G., 2007. The price effects of joining the Euro: Modeling the Greek experience using non-linear price-adjustment models. *Applied Economics*, 39(4), 493-503.

[5] Bai, J., Perron, P., 1998. Estimating and testing linear models with multiple structural changes. *Econometrica*, 66, 47-78.

[6] Bai, J., Perron, P., 2003a. Computation and analysis of multiple structural change models. *Journal of Applied Econometrics*, 18, 1-22.

[7] Bai, J., Perron, P., 2003b. Critical values for multiple structural change tests. *Econometrics Journal*, 6, 72-78.

[8] Bai, J., Perron, P., 2006. *Multiple Structural Change Models: A Simulation Analysis* in Econometric Theory and Practice: Frontiers of Analysis and Applied Research, D. Corbea, S. Durlauf and B. E. Hansen (eds.), Cambridge University Press, 212-237.

[9] Banerjee, A., Lumsdaine, R.L., Stock, J.H., 1992. Recursive and Sequential Tests of the Unit Root and Trend-Break Hypothesis: Theory and International Evidence. *Journal of Business and Economic Statistics*, 10, 271-287.

[10] Baker, M., Nagel, S., Wurgler, J., 2007. *The Effect of Dividends on Consumption*. Brookings Papers on Economic Activity, Economic Studies Program, The Brookings Institution, 38(1), 231-292.

[11] Ben-David, D., Papell, D., 1995. *Slowdowns and Meltdowns: Post-war Growth Evidence from 74 Countries*. CEPR Discussion Papers 1111.

[12] Ben-David, D., Papell, D.H., 1997. International trade and structural change. *Journal of International Economics*, 43(3-4), 513-523.

[13] Ben-David, D., Lumsdaine, R.L., Papell, D.H., 2003. Unit roots, postwar slowdowns and long-run growth: Evidence from two structural breaks. Empirical Economics, 28(2), 303-319.

[14] Chou, W.L., 2007. Performance of LM-type unit root tests with trend break: A bootstrap approach. *Economics Letters*, 94(1), 76-82.

[15] Demez, S., Ustaoglu, M., 2012. Exchange-Rate Volatility`s Impact on Turkey`s Exports: An Empirical Analyze for 1992-2010. *Procedia - Social and Behavioral Sciences*, 41, 168-176.

[16] Esteve, V., Ibáñez, M.N., Prats, M.A., 2013. The Spanish term structure of interest rates revisited: Cointegration with multiple structural breaks, 1974–2010. *International Review of Economics & Finance*, 25, 24-34.

[17] Gregory, A.W., Hansen, B.E., 1996. Tests for cointegration in models with regime and trend shifts. *Oxford Bulletin of Economics and Statistics*, 58, 555-560.

[18] Ibrahim, S., 2009. East Asian Financial Integration: A Cointegration Test Allowing for Structural Break and the Role of Regional Institutions. *International Journal of Economics and Management*, 3(1), 184-203.

[19] Karunaratne, N.D., 2010. The sustainability of Australia's current account deficit – A reappraisal after the global financial crisis. *Journal of Policy Modeling,* 32, 81-97.

[20] Kumar, A., Lee, C.M.C., 2006. Retail Investor Sentiment and Return Comovements. *The Journal of Finance*, LXI (5), 2451-2486.

[21] Kurov, A., 2010. Investor sentiment and the stock market's reaction to monetary policy. *Journal of Banking & Finance*, 34, 139-149.

[22] Lee, J., Strazicich, M.C., 2003. Minimum Lagrange multiplier unit root test with two structural breaks. *The Review of Economics and Statistics*, 85(4), 1082-1089.

[23] Lee, J. and Strazicich, M.C., 2004. *Minimum LM unit root test with one structural break.* Appalachain State University, Department of Economics, Working Paper No 17.

[24] Lee, J., List, J.A., Strazicich, M.C., 2006. Non-renewable resource prices: deterministic or stochastic trends? *Journal of Environmental Economics and Management*, 51(3), 354-370.

[25] Lean, H.H., Smyth, R., 2007a. Do Asian stock markets follow a random walk? Evidence from LM unit root tests with one and two structural breaks. *Review of Pacific Basin Financial Markets and Policies*, 10(1), 15-31.

[26] Lean, H.H., Smyth, R., 2007b. Are Asian real exchange rates mean reverting? Evidence from univariate and panel LM unit root tests with one and two structural breaks. *Applied Economics*, (39), 2109-20.

[27] Lumsdaine, R.L., Papell, D.H., 1997. Multiple Trend Breaks and the Unit Root Hypothesis. *Review of Economics and Statistics*, 79 (2), 212-218.

[28] Marashdeh, H., Shrestha, M.B., 2008. Efficiency in emerging markets - evidence from the Emirates securities market. *European Journal of Economics, Finance and Administrative Sciences*, (12), 143-150.

[29] Narayan, P.K., Smyth, R., 2005. Electricity consumption, employment and real income in Australia: evidence from multivariate granger causality tests. *Energy Policy*, 33, 1109-1116.

[30] Narayan, P.K., 2006. The behavior of US stock prices: evidence from a threshold autoregressive model. *Mathematics and Computers in Simulation*, 71, 103-108.

[31] Nelson, C. and Plosser, C., 1982. Trends and Random Walks in Macroeconomics Time Series: Some Evidence and Implications, *Journal of Monetary Economics*, 10, 139-162.

[32] Nunes, L.C., Newbold, P., Kuan, C.M., 1997. Testing for unit roots with breaks: Evidence on the Great Crash and the unit root hypothesis reconsidered. *Oxford Bulletin of Economics and Statistics*, 59(4), 435-448.

[33] Perron, P., 1989. The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. *Econometrica*, 57(6), 1361-1401.

[34] Perron, P., 1990. Testing for a Unit Root in a Time Series with a Changing Mean. *Journal of Business & Economic Statistics*, 8(2), 153-162.

[35] Ranganathan, T., Ananthakumar, U., 2010. *Give it a break.* 30th International Symposium on Forecasting, San Diego, USA.

[36] Rao, B.B., Kumar, T.A.S., 2010. Systems GMM estimates of the Feldstein-Horioka puzzle for the OECD countries and tests for structural breaks. *Economic Modelling*, 27(5), 1269-1273.

[37] Zivot, E., Andrews, D.W.K., 1992. Further Evidence on the Great Crash, Oil Price Shock and the Unit Root Hypothesis. *Journal of Business and Economic Statistics*, 10, 251-270.

[38] Baker, M., Nagel, S., Wurgler, J., 2007. The Effect of Dividends on Consumption. Brookings Papers on Economic Activity, Economic Studies Program, The Brookings Institution, 38(1), 231-292.

[39] Kumar, A., Lee, C.M.C., 2006. Retail Investor Sentiment and Return Comovements. The Journal of Finance LXI (5), 2451-2486.

[40] Lumsdaine, R.L., Papell, D.H., 1997. Multiple Trend Breaks and the Unit Root Hypothesis. Review of Economics and Statistics 79 (2), 212-218.

[41] Nunes, L.C., Newbold, P., Kuan, C.M., 1997. Testing for unit roots with breaks: Evidence on the Great Crash and the unit root hypothesis reconsidered. Oxford Bulletin of Economics and Statistics 59(4), 435-448.

[42] Lee, J., Strazicich, M.C., 2003. Minimum Lagrange multiplier unit root test with two

structural breaks. The Review of Economics and Statistics 85(4), 1082-1089.

[43] Lee, J., List, J.A., Strazicich, M.C., 2006. Non-renewable resource prices: deterministic or stochastic trends? Journal of Environmental Economics and Management 51(3), 354-370.

[44] Narayan, P.K., 2006. The behavior of US stock prices: evidence from a threshold autoregressive model. Mathematics and Computers in Simulation 71, 103-108.

[45] Chou, W.L., 2007. Performance of LM-type unit root tests with trend break: A bootstrap approach. Economics Letters 94(1), 76-82.

[46] Lean, H.H., Smyth, R., 2007a. Do Asian stock markets follow a random walk? Evidence from LM unit root tests with one and two structural breaks. Review of Pacific Basin Financial Markets and Policies 10(1), 15-31.

[47] Lean, H.H., Smyth, R., 2007b. Are Asian real exchange rates mean reverting? Evidence from univariate and panel LM unit root tests with one and two structural breaks. Applied Economics (39), 2109-20.

[48] Nelson, C. and Plosser, C., 1982. Trends and Random Walks in Macroeconomics Time Series: Some Evidence and Implications, Journal of Monetary Economics 10, 139-162.

[49] Perron, P., 1989. The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. Econometrica 57(6), 1361-1401.

[50] Perron, P., 1990. Testing for a Unit Root in a Time Series with a Changing Mean. Journal of Business & Economic Statistics 8(2), 153-162.

[51] Andreou, E., Ghysels, E., 2006. Monitoring disruptions in financial markets. Journal of Econometrics 135(1–2), 77-124.

[52] Andreou, E., Ghysels, E., Kourtellos, A., 2009. Should macroeconomic forecasters look at daily financial data? University of North Carolina. Mimeo.

[53] Andreou, E., Ghysels, E., Kourtellos, A., 2010. Regression models with mixed sampling frequencies. Journal of Econometrics 158(2), 246-261.

[54] Bai, J., Perron, P., 1998. Estimating and testing linear models with multiple structural changes. Econometrica 66, 47-78.

[55] Bai, J., Perron, P., 2003a. Computation and analysis of multiple structural change models. Journal of Applied Econometrics 18, 1-22.

[56] Bai, J., Perron, P., 2003b. Critical values for multiple structural change tests. Econometrics Journal 6, 72-78.

[57] Bai, J., Perron, P., 2006. Multiple Structural Change Models: A Simulation Analysis in Econometric Theory and Practice: Frontiers of Analysis and Applied Research, D. Corbea, S. Durlauf and B. E. Hansen (eds.), Cambridge University Press, 212-237.

[58] Zivot, E., Andrews, D.W.K., 1992. Further Evidence on the Great Crash, Oil Price Shock and the Unit Root Hypothesis. Journal of Business and Economic Statistics 10, 251-270.

[59] Banerjee, A., Lumsdaine, R.L., Stock, J.H., 1992. Recursive and Sequential Tests of the Unit Root and Trend-Break Hypothesis: Theory and International Evidence. Journal of Business and Economic Statistics 10, 271-287.

[60] Gregory, A.W., Hansen, B.E., 1996. Tests for cointegration in models with regime and trend shifts. Oxford Bulletin of Economics and Statistics 58, 555-560.

[61] Ben-David, D., Papell, D.H., 1997. International trade and structural change. Journal of International Economics 43(3-4), 513-523.

[62] Ben-David, D., Papell, D., 1995. Slowdowns and Meltdowns: Post-war Growth Evidence from 74 Countries. CEPR Discussion Papers 1111.

[63] Ben-David, D., Lumsdaine, R.L., Papell, D.H., 2003. Unit roots, postwar slowdowns and long-run growth: Evidence from two structural breaks. Empirical Economics 28(2), 303-319.

[64] Marashdeh, H., Shrestha, M.B., 2008. Efficiency in emerging markets - evidence from the Emirates securities market. European Journal of Economics, Finance and Administrative Sciences (12), 143-150.

[65] Narayan, P.K., Smyth, R., 2005. Electricity consumption, employment and real income in Australia: evidence from multivariate granger causality tests. Energy Policy 33, 1109-1116.

[66] Ranganathan, T., Ananthakumar, U., 2010. Give it a break. 30th International Symposium on Forecasting, San Diego, USA.

[67] Arghyrou, M.G., 2007. The price effects of joining the Euro: Modeling the Greek experience using non-linear price-adjustment models. Applied Economics 39(4), 493-503.

[68] Lee, J. and Strazicich, M.C., 2004. Minimum LM unit root test with one structural break. Appalachain State University, Department of Economics, Working Paper No 17.

[69] Ibrahim, S., 2009. East Asian Financial Integration: A Cointegration Test Allowing for Structural Break and the Role of Regional

Institutions. International Journal of Economics and Management 3(1), 184-203.

[70] Karunaratne, N.D., 2010. The sustainability of Australia's current account deficit – A reappraisal after the global financial crisis. Journal of Policy Modeling 32, 81-97.

[71] Rao, B.B., Kumar, T.A.S., 2010. Systems GMM estimates of the Feldstein-Horioka puzzle for the OECD countries and tests for structural breaks. Economic Modelling 27(5), 1269-1273.

[72] Demez, S., Ustaoglu, M., 2012. Exchange-Rate Volatility`s Impact on Turkey`s Exports: An Empirical Analyze for 1992-2010. Procedia - Social and Behavioral Sciences 41, 168-176.

[73] Esteve, V., Ibáñez, M.N., Prats, M.A., 2013. The Spanish term structure of interest rates revisited: Cointegration with multiple structural breaks, 1974–2010. International Review of Economics & Finance 25, 24-34.

International Journal of Latest Trends in Finance & Economic Sciences

Call for Papers

The journal welcomes high quality original research papers, survey papers, review papers, tutorial, technical notes as well as discussion papers.

- International Economics
- Monetary and Fiscal Policy Decision-Making
- Financial Economics
- Financial Analysis
- Financial Risk Analysis
- Corporate Finance
- Forecasting Financial Markets
- International Finance
- Pricing and Risk of Financial Instruments
- Public Finance Decision-Making

- Economic Development
- International Banking and Portfolio Management
- International Political Economy
- Financial Market Regulation
- Transition Economies
- Exchange Rate Modelling
- Economic Policy
- Portfolio and Asset Management
- Advances in Financial Econometrics and Statistics