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Investment Opportunities in Waste Management through the Private Finance Initiative

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Keynote speech to 2nd International Conference on Accounting and Finance, University of Macedonia, Thessaloniki, August 28th-29th 2008.

This paper investigates the potential of a mutually beneficial cooperation between the public and the private sector in the area of waste management. We thereby leave the context of traditional private-public-partnership projects and address the issue of appropriate framework conditions set by the public authorities through directives, acts and ordinances, which then open interesting investment opportunities for private finance and private capital. The paper makes use of the concept of Integrated Waste Management and analyses the interaction of the public and private sector by means of case studies, most of them taken from Germany.

JEL Classification codes: G20, Q28, Q53, Q58

1. Introduction

Public-Private-Partnership (PPP) Projects have played an increasing role in the cooperation between the public and the private sector in most industrialized countries since the early 1990s. When the government of the United Kingdom introduced the **Private Finance Initiative (PFI)** in 1992 as a systematic approach to public private partnerships with a focus on “value for money”, an appropriate allocation of finance and risk should open alternative ways of procuring public sector facilities – so far the idea. Representatives from all parts of society thereafter considered PPP in general and PFI in particular as innovative instruments

to stimulate private investments in infrastructure and participation of the private sector in public projects with a favorable outcome for both the private and the public sector.

Despite numerous successful projects, there nevertheless have been some spectacular failures of PFI projects with serious impacts on, e.g., health services in Scotland (cp. Hellowell and Pollock (2007)). For some health care specialists, PFI meanwhile comes to stand for “Profiting from Illness” and no longer for “Private Finance Initiative”. After some of these PFI projects failed, the public sector had to bail out the private partners, and carry the financial burden including further

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financial risk. The question therefore arises, whether PFI is, in principle, a meaningful instrument for the environmentally sensitive area of waste management with potential hazards for public health. Put in a more general way, should waste management be open for private capital and private finance beyond simple waste collection and perhaps waste segregation and incineration? If so, how can we then establish framework conditions, which allow a fruitful cooperation between the public and the private sector without repeating the mistakes of earlier PPP and PFI projects?

All over the world more and more politicians and engineers concerned with the state of the environment on both a local and a global level, consider waste management today to be of utmost importance for environmental protection and to constitute one of the central fields of environmental policy. After all it is true that quite a few challenging environmental problems in industrialized countries, such as groundwater, air and soil pollution, result from a careless handling of not only hazardous waste often decades ago. Moreover, emerging economies with their high growth rates typically face a rapidly increasing burden of waste in general and of packaging waste in particular. An environmentally sound and economically feasible concept of waste management is therefore in the interest of all countries and their citizens – due to the public goods character of many environmental issues, such as a reduction of the emission of greenhouse gases, for example.

Thus, we have the issue of environmental protection in general and waste management in particular with their public goods character, opposed by private finance and private capital, constituents of a pure market economy. A careful analysis is required to determine the framework conditions for successful PFI projects in this area, with innovative and profitable investment opportunities, which at the same time help to protect the environment.

This is, therefore, the approach followed in this paper: in the context of **Integrated Waste Management**, we consider framework conditions established by public authorities through directives, acts and ordinances, which open the doors for private finance in general and private business companies in particular. The cooperation between the public sector and the private sector emerges then and takes place on a qualitatively new level in comparison to “standard” PPP and PFI proj-

ects. The public sector sets detailed rules in order to protect the environment and to attract private finance and private business; the private sector comes in with innovative, fresh ideas and business plans, which finally support the endeavors of the public sector to protect the environment.

The next sections contain a brief presentation of the fundamental concept of **Integrated Waste Management** followed by an outline on the relative positions of **Integrated Waste Management** and the **Private Finance Initiative** in economics. The sections on reduction, reuse, and recycling strategies for municipal waste – mostly packaging waste – will offer case studies, the majority of them from Germany.

2. Integrated Waste Management

Some twenty years ago, a “new thinking” on “waste” has started and the concept of waste has since then gained considerable interest, not only from an environmental point of view, but also from an economic point of view. Following this new thinking, we should integrate waste into the economic system as part of the fundamental allocation problems. More precisely, waste which we do not produce in the first place, or waste which we reduce by segregating and diverting some fractions to other purposes, helps to save scarce resources. The same is true of formerly discarded materials or commodities, which we now decide to reuse; and, finally, recycling activities can contribute to establishing potentially interesting markets for secondary commodities, such as compost for agricultural purposes or specific construction elements from recycled composites, or markets for energy from renewable sources such as biodegradable components of municipal solid waste.

In this sense, **Integrated Waste Management** (IWM) becomes a proper part of an economic system in general and a market economy in particular. The primary goal is then to identify optimal levels of reducing, reusing or recycling waste, optimal levels of the three “R”. The optimality concept is that of **Pareto Optimality**, governing market oriented economic systems. For practical purposes, IWM then typically means to reduce waste whenever possible, to promote the management of all materials to their highest and best use, to regulate the handling, processing and disposal of solid waste, thereby protecting the environment.

Nevertheless, the resulting solution should and has to respect the local conditions in a particular country, even the “interest” of waste-pickers in various developing countries, who can play an active role in reducing in waste, should not be neglected. Moreover, this solution depends on the current state of the environment, the economic growth process of the country in consideration, the innovative potential of the industry, and the political and economic relations to international partners. It therefore leaves some room for the implementation, and the details of the implementation are then dependent on the characteristics of a particular country or region. Put the other way round, it is, in general, not meaningful to try to implement the detailed concept of IWM of one country in another one, especially if the two countries differ substantially in terms of their economic development.

With respect to packaging waste this is also the framework provided by the **European Directive on Packaging and Packaging Waste** of 1994, amended 9 March 2005, which aims at harmonizing national measures while at the same time stating some fundamental principles concerning waste management. Article 1 (“Objectives”) thus reads:

1. *This Directive aims to harmonize national measures concerning the management of packaging and packaging waste in order, on the one hand, to prevent any impact thereof on the environment of all Member States as well as of third countries or to reduce such impact, thus providing a high level of environmental protection, and, on the other hand, to ensure the functioning of the internal market and to avoid obstacles to trade and distortion and restriction of competition within the Community.*
2. *To this end this Directive lays down measures aimed, as a first priority, at preventing the production of packaging waste and, as additional fundamental principles, at reusing packaging, at recycling and other forms of recovering packaging waste and, hence, at reducing the final disposal of such waste.*

Article 8 of this directive outlines the marking and identification system for packaging material. The “**Green Dot**”, which is meanwhile in use in many countries, facilitates collection, reuse and recovery including recycling of packaging waste. Again, each participating country can, under the framework conditions of this directive, arrange its own system of waste management,

taking thus care of its local economic, geographic or demographic conditions.

3. The Private Finance Initiative and Integrated Waste Management

This section explores and analyses briefly the roles of both the public and the private sector in general, and of both IWM and PFI in particular in a mutually beneficial cooperation in the area of waste management.

On the one hand, waste management with its effect on public environmental commodities is a difficult arena for private business companies. Due to the public goods character, we should not expect the private sector of the economy alone to handle the allocation problem satisfactorily regarding this context. Consequently, private capital and private finance will typically not enter this field without any modifications to the framework conditions. The public sector should therefore issue – as a minimum requirement – appropriate environmental standards and guidelines for waste management.

On the other hand, it is important to note that the public authorities will in general not have the detailed information required to achieve an optimal level of the three “R” right away; it is rather advisable to bring in the private sector with all its detailed information gathered on and disseminated through markets.

The role of the public sector is therefore important, should however be restricted to setting the framework conditions for functioning markets. Of course, the public authorities should respect environmental issues regarding waste management with leaving sufficient room for private finance and private companies. Such a policy will open investment opportunities and attract private capital without requiring holding structures jointly established, or operations run jointly with the private sector or under contract.

Thus, in contrast to the usual meaning, PFI in the context considered here does not refer to any kind of outsourcing or contracting in the broader sense with all the financial risk and the unsolved environmental problems falling back to the public sector, if the private partner goes bankrupt. Nor does the provision of services at substantially higher cost than originally planned pose a serious problem (cp. again Hellowell and Pollock (2007)). It rather refers to establishing appropriate framework conditions, which allow private companies to set up business and contribute thereby

more effectively towards an optimal solution of the allocation problems regarding waste management. In this way, private information available in private institutions and companies will lead to an effective structure and efficient solution of the optimality problem of IWM, the problem of the three “R”.

The next sections will now explore this approach to public-private-partnership projects in waste management by means of case studies.

4. Reduction Strategies

The central question addressed in this section refers to investment opportunities in waste management related to reduction strategies for solid municipal waste, mostly packaging waste. Current strategies often observed and applied in industrialized countries with a high environmental awareness include individualized charges on household or industrial waste depending on composition and weight, surcharges on excessive weight or additional waste bags etc.

The environmental feasibility of these strategies in particular and of monetary punishment and reward systems in general depends critically on environmental awareness in combination with the availability of so-called “avoidance strategies”, strategies to avoid financial payments for waste collection, for example. Low environmental awareness together with relatively high fees for legal waste disposal can lead to the disposal of household waste in forests or in waste containers located on the rest areas along highways. Sometimes, waste “disappears” illegally to developing countries with no guaranty for a treatment, which is appropriate regarding the goal to protect the environment, but probably more expensive than this kind of “export”. This happened, for example, when waste from German households and business companies ended up in South-East Asia a couple of years ago.

In such an unreliable context, it is clearly difficult to define and develop investment opportunities for private capital in the context outlined above. Opportunities for profit-generating entrepreneurial activities will probably remain scarce under such framework conditions.

An attempt to reduce organic household waste in Cambodia through composting biodegradable fractions provides a more concrete, although unsuccessful case. An empirical study conducted in Cambodia by the Royal University of Agriculture (cp. Visalsok

(2008)) demonstrated that a careful analysis of the relevant “potential” markets is necessary in order to allow the successful operation of business companies in this area. The lesson learned from this study is that it is typically not sufficient to fix a “market price” for compost without carefully analyzing demand and supply for compost.

A somewhat different approach in Germany builds upon the “Green Dot” label, which is, as mentioned above, meanwhile in use in many European countries and abroad. The take-back requirement, postulated by the European Directive on Packaging and Packaging Waste, refers to all kinds of used packaging such as cans, composites, cardboard, and glass containers. The German “Packaging Ordinance” of 1991, amended 19 July 2007, repeats in Article 1 the recommendations of the European directive:

“The purpose of this Ordinance is to avoid or reduce the environmental impacts of waste arising from packaging. Packaging waste shall in the first instance be avoided; reuse of packaging, recycling and other forms of recovery shall otherwise take priority over the disposal of packaging waste.”

The “take-back requirement”, the obligation to accept returned sales packaging, follows again the prescriptions of the European directive. Article 6 (1) of this ordinance states:

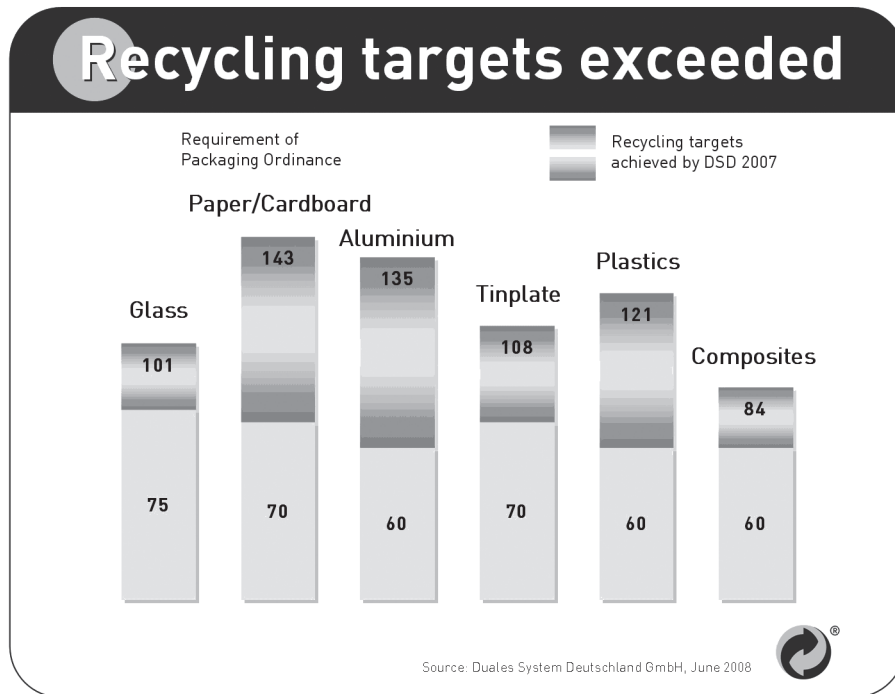
“The distributor shall be obliged to accept free of charge used and emptied sales packaging returned by the final consumer at or in the immediate vicinity of the place of actual transfer, to consign it to recovery... The recovery requirements may also be met by reuse or transfer to distributors or manufacturers ...”

Finally, the regulation, which opens interesting and financially attractive investment opportunities in this context, is formulated in paragraph 3 of Article 6:

The obligations pursuant to paragraphs (1) ... shall not apply to packaging in respect of which the manufacturer or distributor takes part in a system which, to an adequate extent, guarantees the regular collection of used sales packaging from or in the vicinity of the final consumer throughout the catchment area of the distributor subject to paragraph (1)... The system pursuant to the first sentence shall be coordinated with existing collection and recovery systems run by the public authorities responsible for waste management in whose area it is set up. Such coordination shall take place

in writing between the system operator and the public waste management authority. ... ”

The **Duales System Deutschland GmbH (DSD GmbH)**, established in 1990, has since then handled the take-back obligations for sales packages on behalf of its customers from the industrial and retail sectors. The “**Green Dot**” on a package in Germany is also a financing symbol signalling that a licence fee has been paid for collecting and sorting the package concerned. **DSD GmbH** has been quite successful, as a private business company but also in terms of environmental protection. The following diagram (taken from www.gruenerpunkt.de) shows that the recovery and recycling targets stipulated by the Packaging Ordinance were again exceeded in 2007:



Thus, the public sector with the **Packaging Ordinance** has considerably contributed towards the reduction of waste: the annual consumption of sales packaging per German citizen has dropped since 1991 in addition to savings in packaging materials due to the reduction in weight, due to the waiver of secondary packaging, and due to refillable packages. Moreover, the **Packaging Ordinance** has opened investment opportunities for private capital, particularly in the areas of waste collection, segregation and recycling (cp. also

Section 6), including the development of appropriate equipment and machinery and including the necessary services.

DSD GmbH itself turns out to be a profitable investment opportunity for private capital, not to mention the numerous recycling companies operating under the roof of the company: the business figures for 2006 reveal that the company’s turnover was at 1.2 billion Euros with an operating result of 6.5 million Euros after taxes.

There is just one small problem: today the principal shareholder of **DSD GmbH** is the private equity company **Kohlberg Kravis Roberts & Co. (KKR)**, which took over **DSD GmbH** in 2004. Besides **DSD GmbH** there only are few other companies satisfying the re-

quirements of Article 6 (3) of the **Packaging Ordinance**. The **Landbell AG** was founded in 1995 and is today one of the few competitors of **DSD GmbH**. With a total turnover of a little bit over 100 million Euros in 2006 it remains, however, a relatively small competitor. Moreover, in 2006 **Interseroh AG** was granted the right according to Article 6 (3) of the **Packaging Ordinance**. It aimed at a market share of 15% in 2007. As a consequence, **DSD GmbH** is still considered to have an almost monopolistic position in Germany with re-

spect to the handling of the take-back requirement for sales and transport packaging.

This last issue could be taken as a somewhat problematic consequence of the framework conditions set by the public authorities. It is obviously difficult to establish a competitive environment with a multitude of private companies engaged in recovering and recycling packaging waste. On the other hand, the fact that some small competitors could set up and establish their businesses in this area should be interpreted as a development in the right direction.

5. Reuse Strategies

Similarly, the central question addressed in this section refers to investment opportunities related to reuse strategies in waste management. Reuse, of course, means using a product, which is then no longer “new”, more than once, either for the same or for an alternative purpose. Perfect examples are donations of used commodities to charity, markets for used goods in general and markets for used cars for households and companies in Central and Eastern Europe in particular.

We will now study and analyze the case of refillable drinks packages, which fits into the context of reuse strategies, in more detail. The background is again the German Packaging Ordinance, this time, however, the earlier versions enacted in 1991 and the years immediately thereafter. Article 8 (“Obligation to Charge Deposits ...”) of the Packaging Ordinance of 1998 (observe that the “DM” was still the currency in use in Germany at that time) states in the first paragraph:

“Distributors who put liquid foodstuffs into circulation in drinks packaging, which is not reusable packaging, shall be obliged to charge the purchaser a deposit of at least DM 0.50 including turnover tax per drinks pack; a deposit of at least DM 1.00 including turnover tax shall be charged if the net volume exceeds 1.5 litres. The deposit shall be charged by each further distributor at all levels of business until delivery to the final consumer. The deposit shall be refunded on acceptance of the returned packaging”

And paragraph 1 of Article 9 (“Exemption from the Obligation to Charge Deposits ...”) refers to paragraph 3 of Article 6, already mentioned above:

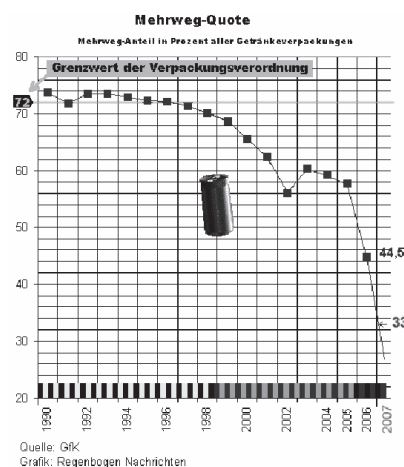
“§ 8 shall not apply to packaging in respect of which the manufacturer or distributor takes part in a system pursuant to Article 6 paragraph. 3...”

And paragraph 2 of this article continues:

“If, for the categories beer, mineral water (...), carbonated soft drinks, fruit juices (...) and wine (...), the combined proportion of drinks packaged in reusable packaging in the area of validity of this Ordinance in a calendar year falls below 72 percent, a new survey of the relevant reusable shares shall be made for the 12-month period following the announcement. If this shows that the reusable share in the territory of the Federal Republic is less than the percentage laid down in sentence 1, the decision pursuant to Article 6 paragraph 3 shall be deemed to be revoked with effect from the first day of the sixth calendar month following the announcement pursuant to paragraph 3 in respect of the drinks sectors for which the reusable share determined in 1991 is not reached.”

In short, these regulations mean that no deposit on one-way drinks containers will have to be charged as long as the combined proportion of drinks packaged in reusable packaging does not fall below 72%, the actual proportion in Germany in 1991; and the idea of these articles and paragraphs was to promote “ecologically advantageous” drinks packaging. Interestingly, if it had worked this way, then these regulations could have created a business environment open for investment opportunities in the context of equipment and logistics for refillable bottles and other reusable drinks containers.

But the actual development of the combined proportion of refillable drinks packages in Germany shows that something went wrong:



Obviously, the incentive structure associated with the framework provided by the earlier versions of the

Packaging Ordinance did not and does not support the goal intended with these regulations. As a consequence, in 2003 the German government had to charge deposits on one-way drinks containers. And since then, the combined proportion of refillable drinks packages has continued to decline to a level probably already below 30% in 2008.

So, what went wrong with these regulations, which were deemed to provide incentives for buying drinks in ecologically advantageous packaging? Well, it seems that we have to blame the requirement of a *combined* proportion of drinks in refillable containers of not less than 72% for these misguided incentives. A particular producer, observing a stable demand for drinks in one-way containers, does not have much of a reason to redirect production to a larger share of refillable packages. Such a change in production would for sure be accompanied by higher costs for new equipment and logistics and might even lead to a reduced demand for drinks in refillable containers. A more detailed analysis of the underlying incentive structure reveals the **Prisoners' Dilemma** and the **Tragedy of the Commons**:

Consider first the situation of a "small" distributor of drinks in a situation with the combined proportion of drinks in reusable packages at or slightly above 72%. The profitability of the investments required for a higher share of drinks in refillable containers is then not all guaranteed if sufficiently many customers prefer drinks in one-way containers. Thus, there is not much incentive to invest according to the provisions of this ordinance and to raise the proportion of drinks in refillables, as the effect of this small distributor on the combined proportion will remain negligible anyway.

Next assume that this "small" distributor faces the situation that the share of drinks packaged in reusable containers is already below 72%. Again, there is no need to care much about modifying the modal split with respect to packaging, because one's own effect on the share will be small and will not raise the combined proportion significantly, and because there will be investments in take-back equipment for one-way containers anyway.

As a consequence, the further development of the combined share of drinks packaged in refillable containers will be driven by outside factors such as demand for drinks in one-way containers. This demand obvi-

ously increased with the well-known consequences for the modal split for drinks packages.

Public authorities in Germany have meanwhile reacted and modified the relevant articles and paragraphs of the **Packaging Ordinance**: Article 8 ("Obligation to Charge Deposits On and Accept Returned One-Way Drinks Packaging") states in the first paragraph:

"Distributors who put drinks into circulation in one-way drinks packaging with a filling volume of between 0.1 and 3 litres shall be obliged to charge the purchaser a deposit of at least 25 euro cents including value-added tax per drinks pack. ... The deposit shall be charged by each further distributor at each distribution level until delivery to the final consumer. The deposit shall be refunded on acceptance of the returned packaging in accordance with Article 6 (1) first and sixth sentence and Article 6 (2) first sentence. Deposits shall not be refunded without accepting returned packaging. For sales from drink vending machines, distributors shall provide a suitable system for accepting returned packaging and refunding deposits within a reasonable distance from the vending machines. ..."

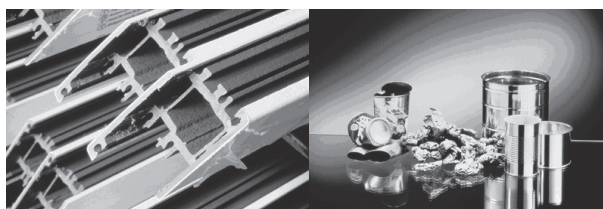
Thus, deposit charges on one-way containers are now standard in Germany. All kind of vending machines and machinery to take back empty one-way bottles and cans are now in use to satisfy the needs of the customers with great potential for private investors. Again, the regulations of the Packaging Ordinance helped to establish an environment which opened investment opportunities for private capital – although in a way different from that originally intended by public authorities.

6. Recycling Strategies

The reformation of waste materials into new or similar products by recycling is typically viewed as a resource conservation activity and – with regard to biodegradable waste or combustible residual waste – an energy savings activity.

In Germany, returned packaging material is for this reason primarily consigned to recycling (cp. **Packaging Ordinance** of 2007, Article 8 (1), last sentence). The **Duales System Deutschland GmbH** organises the collection, sorting and recycling of packages bearing the **Green Dot** – with considerable success. The diagram in section "Reducing Strategies" above shows that DSD GmbH continued to exceed all recycling targets stipulated by the **Packaging Ordinance** and the **European Directive on Packaging and Packaging Waste**,

and the graphics below show construction elements from recycled plastics and products obtained from tin-plate recycling (taken again from www.gruener-punkt.de):



Thus, the framework conditions related to this legislation open interesting investment opportunities for private capital which help at the same time to protect the environment by reducing the disposal of potentially hazardous waste and by conserving resources and saving energy.

There are, of course, some issues which deserve a closer look. For example, paragraph 4 of Article 4 (“Basic Obligations of Closed Substance Cycle Waste Management”) of the German **Closed Substance Cycle Act** stipulates:

“The obligation to recover waste is to be met to the extent this is technically possible and economically reasonable, especially when a market exists, or can be created, for an extracted substance or for extracted energy. Waste recovery is technically possible even when it requires pre-treatment. Waste recovery is economically reasonable if the costs it entails are not disproportionate in comparison with the costs waste disposal would entail”.

These explanations and definitions leave some room for interpretation, especially regarding the issue of the “**economic feasibility**” or “**economic viability**” of waste recovery (cf. Wiesmeth (2003)). The information required to provide a clear answer to these issues is, in general, again not available to single individuals or the public authorities. The private sector with its numerous consumers and producers should be invited to contribute towards an economically and environmentally reasonable solution. And that is exactly what is happening and what is expected to happen if the government establishes framework conditions for favourable investment opportunities in all parts of waste management.

In this sense we shall in the remaining part of this section focus on a rather new development regard-

ing the generation of energies from renewable sources such as biodegradable waste – with interesting investment opportunities. Due to the **Technical Instructions on Waste from Human Settlements (TASi)** the deposition of untreated biodegradable material and of municipal solid waste containing organics is no longer permissible in Germany since June 2005. The practice of dumping untreated waste in inadequately lined landfills leads to soil, surface water and groundwater contamination and to emissions of landfill gas, another contributor to global warming. Despite all technological progress and innovations, experience seems to show that conventional landfilling cannot be made environmentally safe in the long term.

This means that biologically degradable waste must be treated before landfilling the residual waste. Besides waste incineration, mechanical-biological treatment is a process that can be used to dispose of municipal solid waste in an environmentally sound manner. The variants of the mechanical or mechanical-biological waste treatment process differ in terms of their treatment stages and the material streams which they generate (cp. “Municipal Solid Waste Management Report 2006”, p. 12f).

One of these is to pre-treat wastes for their environmentally sound disposal in landfills. In order to prevent biodegradation processes and their associated emissions, the pre-treatment process seeks to biodegrade the bulk of the organic constituents. In the mechanical stages of the process, high calorific value fractions such as plastics are removed for energy recovery, and metals are separated for materials recycling. The biological treatment stages use aerobic (rotting), anaerobic (fermentation) or combined processes. Anaerobic processes produce biogas which can be used for energy production – from renewable sources (cp. again “Municipal Solid Waste Management Report 2006”, p. 12f).

What are, in this context, appropriate framework conditions for private investments? How can the public sector create an environment which attracts private capital while at the same time reducing environmental pollution by treating biodegradable waste and using it for generating energy from renewable sources?

In Germany, the **Renewable Energy Sources Act** of 2004 addresses this issue and helps to bring in private finance into the large-scale generation of energy from renewable sources. Article 1 (1) defines the goal:

“The purpose of this act is to facilitate a sustainable development of energy supply, particularly for the sake of protecting our climate, nature and the environment, to reduce the costs of energy supply to the national economy, also by incorporating long-term external effects, to protect nature and the environment, to contribute to avoiding conflicts over fossil fuels and to promote the further development of technologies for the generation of electricity from renewable energy sources”.

And the Act regulates priority connections to the grid systems for general electricity supply of plants generating electricity from renewable energy sources and the priority purchase and transmission of, and payment for, such electricity by the grid system operators (cf. Article 2).

Paragraph 1 of Article 4 (“Obligation to Purchase and Transmit Electricity”) defines a critical part of a market for electrical energy from renewable sources:

“Grid system operators shall immediately and as a priority connect plants generating electricity from renewable energy sources ... to their systems and guarantee priority purchase and transmission of all electricity from renewable energy sources ... supplied by such plants”.

With this article the government establishes “demand” for electrical energy from renewable sources: the grid system operators have to buy electrical energy from those providers.

In addition to that Article 5 (1) regulates the obligation to pay predetermined fees, to pay a “market price” for electrical energy supplied by renewable sources:

“... the grid system operators shall pay fees for electricity generated in plants exclusively using renewable energy sources ... and purchased in accordance with Article 4(1) ...”

The fees paid for electricity produced from landfill gas, sewage treatment plant gas and from biomass are fixed in the following articles of the Act. Thus, the fees paid for electricity from landfill gas and sewage treatment plant gas is at least 7.67 Euro cents per kilowatt-hour up to and including a capacity of 500 kilowatts (cf. Article 7 (1)); and the fees paid for electricity produced in plants using exclusively biomass is at least 11.5 Euro cents per kilowatt-hour up to and including a capacity of 150 kilowatts (cf. Article 8 (1)).

The graphic above shows a biogas plant in Germany (Source: Dr. Martin Wittmaier, Bremen University of



Applied Sciences). The construction of biogas plants has meanwhile developed into a big success story in Germany. Companies with altogether 10.000 employees deliver such plants to all parts of the world. Observe that in Germany alone we need an additional 1.200 biogas plants such that the share of biogas is 10% of the natural gas consumption.

In a more general context, energy from biomass and organic municipal solid waste can make a significant contribution to the protection of the environment by reducing the landfilling of waste, and to oil-independence and climate protection with clean power, heat, and vehicle fuels. And even more important, the technology opens up new earning potentials and markets, both domestic and international, for the waste management and power generation industry, as well as for new market players such as the agricultural sector, if the framework conditions, the “business environment”, allow and support private investments.

This context is of particular relevance for developing countries: the World Bank is, for example, currently assisting various developing countries to prepare projects to overcome barriers to the update of biomass technology. By installing demonstration plants the use of biomass fuelled energy systems from agricultural waste will be offered as a viable alternative to gas, oil and coal and as a sustainable means of addressing the energy supply problems facing rural communities and agro-enterprises. The projects will also address the issue of financing the gap between the capital cost of biomass and conventional energy systems. This corresponds exactly to the issue of establishing a market for electrical energy from renewable sources by appropriate frame-

work conditions according to the **German Renewable Energy Sources Act** discussed above.

But this context is also of relevance for industrialized countries, for innovators and entrepreneurs and for private capital, looking for investment opportunities. An excellent example is the startup company SunCoal Industries GmbH, which was founded in 2007 by a team of young engineers and managers. The company's vision is the technologically and economically feasible transformation of biodegradable waste into coal on an industrial scale (cp. www.suncoal.com). As the end product is derived from renewable sources and, thus, CO₂-neutral, the regulations of the **Renewable Energy Sources Act** apply and the operation of the company is profiting from the obligation to purchase and transmit electricity at a price fixed and controlled by the relevant public authorities.

7. Conclusion

The sections on reducing, reusing and recycling municipal waste reveal a variety of investment opportunities for private capital. The case studies demonstrate that the public and the private sector can "cooperate" in a way, which is beyond the cooperation in traditional public-private-partnership projects. In these classical PPP-projects the public sector typically invites private companies to provide the infrastructure for or manage public utilities such as waste collection, recovery, segregation and recycling of waste.

In the cases considered here, the public authorities set the framework conditions through directives, acts and ordinances and, thus, create an environment, which invites innovators, private capital and private entrepreneurs to set up and operate new companies. The advantage of this procedure is clear: we bring in the public sector where it is needed to overcome market failure associated with public environmental commodities; on the other hand, however, we open the field for private information to flow in and enrich waste management and thereby environmental protection with a manifold of new and innovative ideas without risking the fall back option of conventional private-public-partnership projects.

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The Death of the Credit Markets: Suicide, Homicide, or Accidental Death?

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■ LAURENCE COPELAND*

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JEL Classification codes: G10, G15

Keywords: credit crisis, liquidity

1. Introduction

At the time of writing (end-August 2008), the credit crisis is just over one year old. At this point, it is as yet unclear whether the worst is over or whether, as some of us fear, there is still a long way to go until the excesses of the past decade unwind. However, I will argue here in favour of the following interpretation of events: that, far from being a 3-, 4-, 5-....sigma event triggering a collapse in the market for asset-backed securities, the crisis actually consisted of nothing more unusual than the bursting of a price bubble – albeit a bubble of unprecedented intensity and of global extent. In statistical terms, we are dealing here not with second, third, or

fourth moments, but with first moments of the distributions i.e. with expected values of prices and returns.

Obviously, the distinction is not purely academic. On the one hand, tail events are, by definition, rarely observed, and therefore difficult to accommodate in risk calculations. It is therefore unreasonable to expect bankers, private investors or regulators not to make errors which will be exposed on those few occasions when extreme shocks occur. On the other hand, if the crisis of the last twelve months is simply a bubble bursting, implying that assets may have been mispriced even in terms of models with normal shocks (or even in the context of a model of risk-neutral investment), then the agents involved cannot be so straightforwardly exoner-

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ated. On this view, the agents who allowed the bubble to inflate could have been expected to anticipate its bursting and to have taken measures to protect themselves and their institutions against the consequences.

Specifically, the bubble I am talking about arose from excess money creation by the US Federal Reserve in the early years of the century. The flood of dollars might have generated excess demand for output and consequent inflation as US manufacturers competed for labour. Instead, however, it simply served to create demand for imports, which could be supplied at more or less constant prices on world markets, largely by Chinese exporters, who then used the proceeds to buy US assets, thereby sustaining the exchange rate of the dollar and preventing it from choking off the process at an early stage. The excess liquidity in the money markets of the USA and other major economies allowed banks to expand lending to consumers and more importantly to housebuyers. The latter were an exceptionally attractive market, because they seemed to offer an unlimited stock of collateral to secure their mortgages in what amounted to a money machine, as increased borrowing inflated the price of houses (along with almost every other asset class), increasing the available collateral and thereby justifying even more borrowing.

This was a process that was inherently unstable, as assets became more and more overpriced on any of the standard yardsticks. In particular, yields were driven down to unprecedented levels. At the same time, financing became ever more problematic as loan-to-value and loan-to-income ratios were pushed to the limit. Insofar as the situation required that house prices kept rising (and possibly at a high or even accelerating rate), this was the purest of bubbles.

Inevitably, much of the discussion has centred on the mechanics involved in actually translating the increased liquidity in US Treasury markets (where the direct effects of the Fed's monetary policy and the indirect effect of Chinese buying were initially felt) to the supply of loans to households: the securitisation of mortgages and other consumer lending, the alleged connivance of the credit rating agencies, the supine complaisance of the regulatory authorities etc

In examining the evidence, albeit casually, I shall look at both the USA and UK more or less interchangeably. For the most part, this is simply a matter of convenience. The evidence is largely interchangeable, since

events in the two countries have followed strikingly similar paths, especially in the key credit and housing markets.

2. Bubble, not risk the setting

Stage 1: Liquidity

Early in the new century, two events occurred which might have been expected to have a negative effect on the level of economic activity in the USA. First, the tech stock bubble burst, ending what had been, by some measures, the greatest bull market in Wall Street history. Within a few months, there followed the terrorist atrocity of 9/11. The Fed's response was unambiguous. Notwithstanding Alan Greenspan's famous comment on the "irrational exuberance" of the US stock market, the Fed supplied liquidity to an unprecedented level, driving short rates down to the lowest levels seen since World War II (see Figure 1).

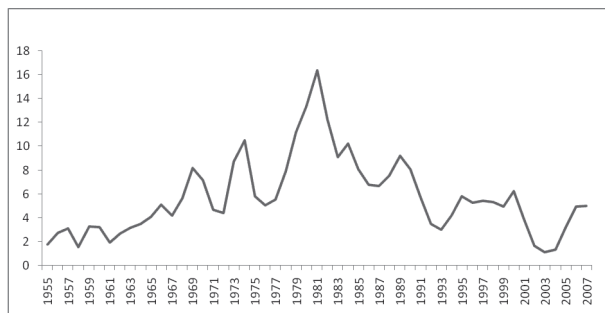


Figure 1: Federal funds Rate - Source: Federal Reserve

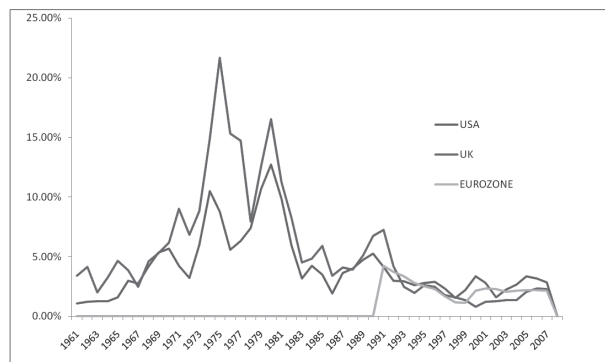


Figure 2: Inflation Rate - Source: Datastream

There may have been very good reasons to expect monetary expansion to result in accelerated inflation, which had been low during the 1990's (see Figure 2), as consumers tried to spend the excess money balances.

Instead, with the US economy already operating at near full-capacity output levels, the outcome was a ballooning trade deficit, as the excess demand for consumer goods was satisfied at more or less constant prices by producers in the rest of the world, especially China (see Figure 3), which had an almost unlimited supply of willing recruits ready to flood out of its countryside and into its urban industrial sector.

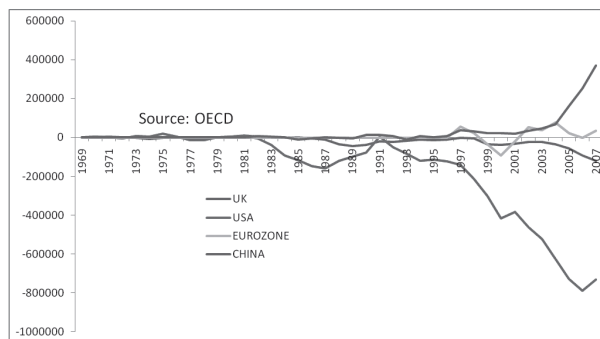


Figure 3: Balance of Payments Current Account \$ US mn - Source: OECD

Again, the process might have been self-limiting, if it had led to a reduction in the external purchasing power of the dollar, and consequent inflation as the dollar value of imported consumer goods rose. This effect appears to have been mitigated, however, by the willingness of foreign wealth-owners to buy dollar-denominated financial assets, in particular US Treasury bonds (see Figure 4).

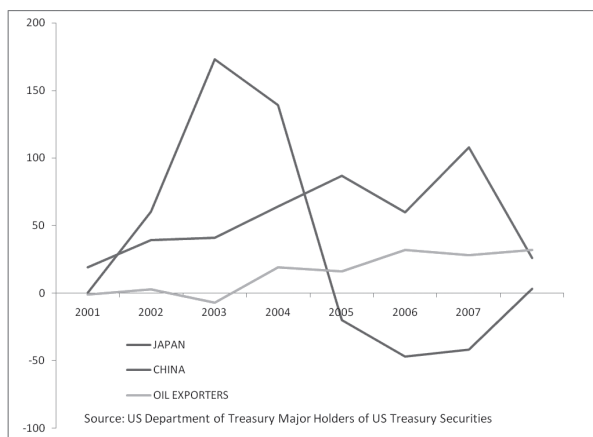


Figure 4: Net Change in Holdings of US Treasury Securities \$billion

In effect, therefore, the dollars being printed in the US were being recycled, with foreign investors (mainly Japanese at first, then Chinese and more recently oil producers) providing American importers with the trade credit needed to buy their exports, only to facilitate the bubble creation. It was also to accelerate it, because recycling the dollars to US money and bond markets could not prevent the expansion of their high-powered money stocks, thereby further expanding the global oversupply of liquidity.

Note that the effect of the Asian monetary authorities' policy stance was not only to facilitate the bubble creation. It was also to accelerate it, because recycling the dollars to US money and bond markets could not prevent the expansion of their high-powered money stocks, thereby further expanding the global oversupply of liquidity.

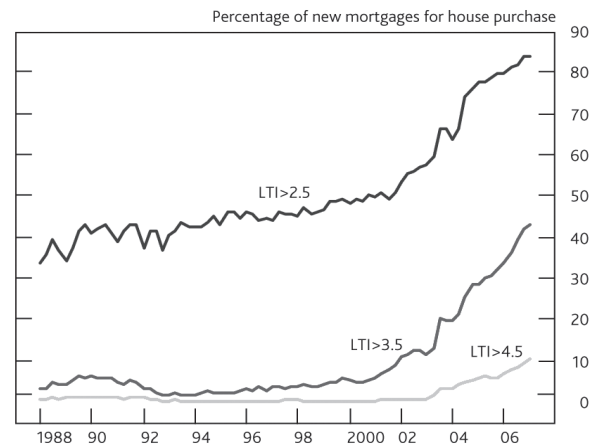


Figure 5: Loan-to-Income Ratios for UK First-Time Buyers Source: Bank of England

Stage 2: The Bubble Inflates

The outcome was inevitably to inflate asset prices and reduce yields, starting with US Government debt, then via the usual portfolio substitution channels to almost every class of financial asset across the world.

This process might on its own have produced a crisis, as the bubble burst. After all, if assets had previously been fairly priced, it is hard to see how substantial increases could be justified with no inflation in output prices and relatively little scope for real growth. For example, in the case of equities, it was never clear why the real dividend stream being priced in the market could be expected to grow more rapidly than previously

thought, nor was there any obvious reason in terms of risk or return why the real discount rate ought to have fallen. Likewise, it was hard to find a justification for the unprecedentedly low yields on real estate on both sides of the Atlantic.

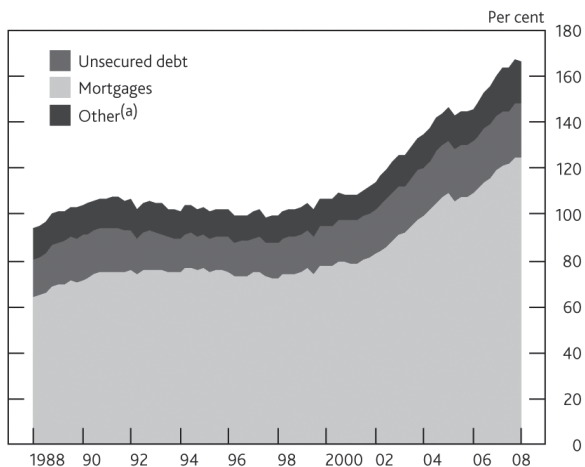


Figure 6A: UK Ratio of household sector debt to annualised post-tax income
Sources: ONS and Bank of England calculation
(a) Households' total financial liabilities excluding secured and unsecured debt (including bills that are due to be paid).

In order to reconcile themselves to these asset prices, investors had to be convinced on five points:

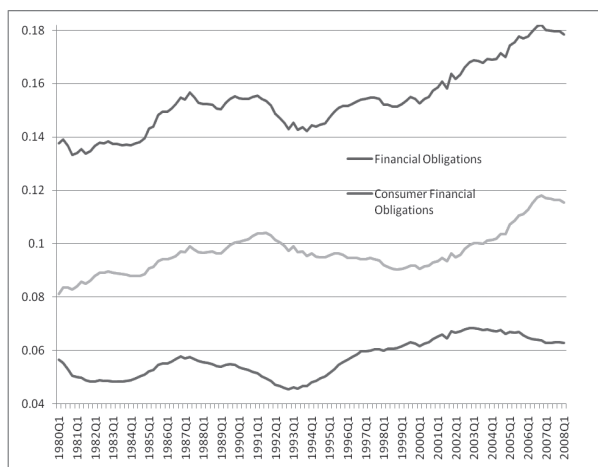


Figure 6B: US Household Debt Service Ratios
Source: Federal Reserve Bank

1. As the Institute of International Finance (quoted in the Financial Times) put it:

“Abundant market liquidity led some firms to overestimate the market’s capacity to absorb risk. The same buoyant environment resulted in market

pressure for high returns ... and high levels of competition among financial firms.”

2. Investors had to believe that the credit rating agencies could be trusted to monitor the quality of debt and the default risk facing lenders.
3. Markets had to accept that by adding high-risk securities in relatively small quantities to packages of prime-quality debt, financial engineering could indeed turn lead into gold. As long as this alchemy worked, a near-zero quality spread could be justified.
4. Investors and regulators had to believe that the normal criteria for assessing the default risk on domestic mortgages could be brushed aside, as lenders pushed loan-to-income ratios to record levels (see Figure 5) with publicly-advertised LTV ratios of up to 125%.

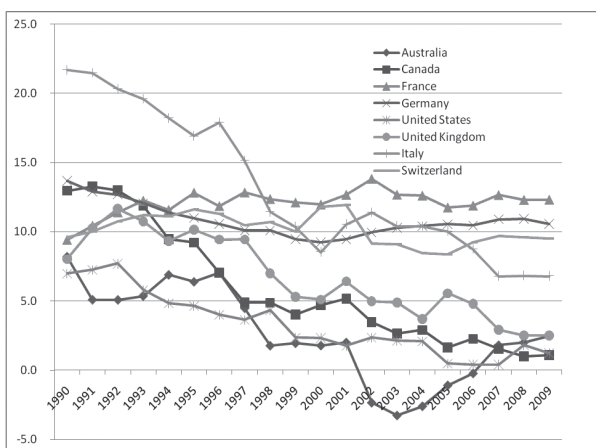


Figure 7: Household Saving Rates as percentage of household disposable income
Source: OECD Statistics

Note: UK gross saving, other countries net (see OECD statistical notes)

5. In terms of overall household budgets, it had to be true that consumers were capable of sustaining and servicing unprecedented levels of debt, in spite of signs that long-term ratios were being exceeded by a substantial margin (see Figures 6A and 6B) and that savings rates were already near-zero (see Figure 7).

The outcome was spectacular levels of debt and leverage. For example, consider the state of the stock of lower grade (Alt-A* and subprime) US mortgages by

* Alt-A is the class between prime and subprime.

mid-2008 (see Table 1). First, note the size of the outstanding balance – in total, more than US GDP – and the fact that two-thirds is variable rate. Moreover, variable rate mortgages are on average somewhat larger than fixed rate. The implied constraint on US monetary policy is clear, especially when we consider the data lower down the table, notably the fact that nearly 30%

Table 1: Lower-quality us mortgages at mid-2008

	Alt-A		Subprime	
	Fixed rate	Variable Rate	Fixed rate	Variable Rate
Outstanding Loan Balance				
Mean	\$ 228,575	\$ 349,194	\$ 144,965	\$ 201,222
Aggregate	\$ 3.0 trn	\$ 5.0 trn	\$ 1.5 trn	\$ 4.3 trn
Current Status (%)				
Current	92%	82%	77%	53%
60+ Days Delinquent	3%	6%	8%	17%
Foreclosure	2%	4%	4%	12%
Loan to Value Ratios				
LTV (first lien)	0.73	0.77	0.78	0.82
% with Multiple Liens	26%	43%	9%	32%
Combined LTV (all loans)	0.95	0.94	0.98	0.99

of variable rate subprime mortgages were either in 60+ day arrears or actually in foreclosure, and barely half qualified as current.

Stage 3: The Bubble Bursts

When the bubble burst at the start of July 2007, prices and yields needed to go further than reversion to the long run mean. In many cases, they needed to enforce a rebuilding of asset levels, a return to long run balance sheet ratios and more normal leverage ratios. Credit spreads on corporate debt widened – but not beyond the levels observed in past credit cycles (see Figure 8).

Asset prices fell more or less across the board (see Figure 9), but notably more for riskier asset classes.

Notice that high yield spreads were first to react, widening from their all-time lows a few days before the end of June. In tandem, sub-prime mortgage values fell precipitately. The associated loss of nerve in financial markets caused liquidity to contract dramatically (see Figure 10), as banks proved increasingly unwilling to lend to each other (see Figure 11). Notice the spectacular rise in Sterling LIBOR overnight rates relative to reference policy rates, by over 100 basis points – essentially from near-record lows to equally unprecedented highs.

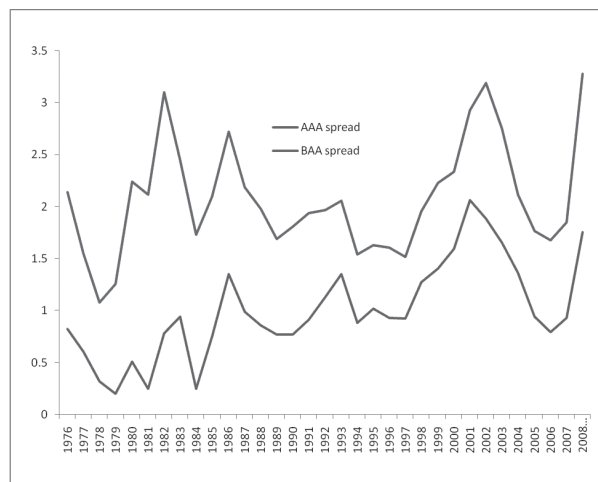


Figure 8: Credit spreads over 10-year US Treasuries
Source: US Federal Reserve Bank

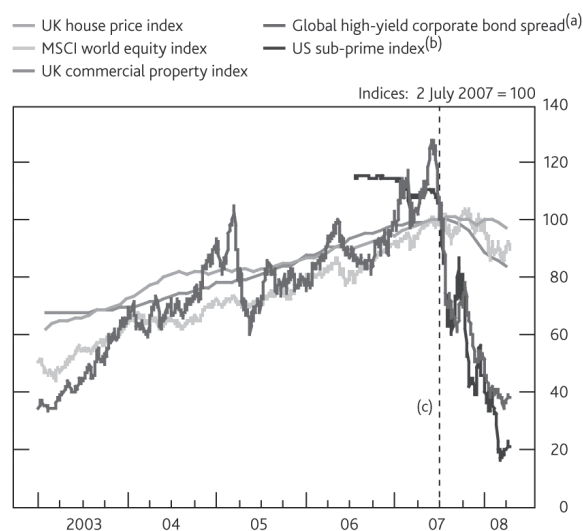


Figure 9: Asset prices
Source: Bank of England, a) Series inverted, b) Sub-prime series is the A-rated 2006 H2 vintage ABX.HE index, c) Dotted line shows start of July 2007

Note also the even more dramatic 200-point rise in the spread on AAA-rated UK residential mortgage-backed

securities – a clear vote of no-confidence by the banks in the rating system as much as in their mutual credit-worthiness.

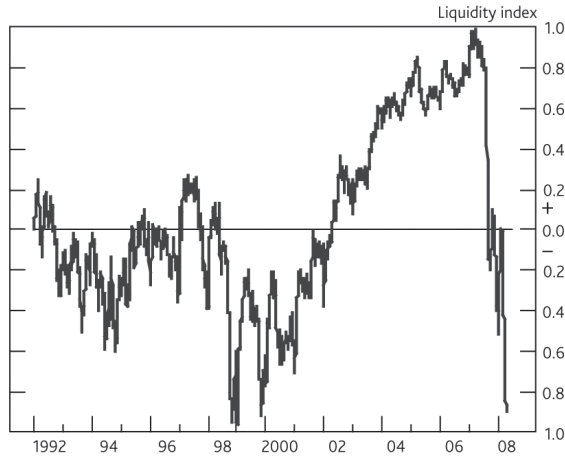


Figure 10: Bank of England Liquidity Index
Source: Bank of England

The liquidity index shows the number of standard deviations from the mean. It is a simple unweighted average of nine liquidity measures, normalised on the period 1999–2004. The series shown is an exponentially weighted moving average. The indicator is more reliable after 1997 as it is based on a greater number of underlying measures.

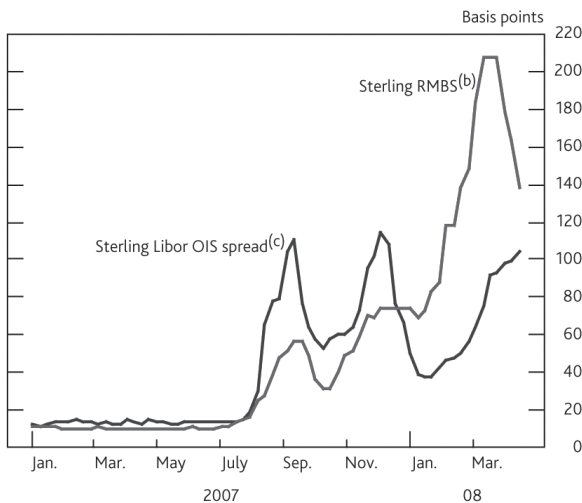


Figure 11: UK Spreads on interbank lending and in residential mortgage-backed securities markets(a)
Source: Bank of England

- (a) Data to close of business on 22 April 2008.
- (b) Weekly five-year spread on AAA-rated UK prime residential mortgage-backed securities over Libor.
- (c) Weekly average spread of three-month Libor to expected policy rates, as implied by three-month overnight indexed swap rates.

The latter appears to have been the critical mechanism translating the initial shock into near-total paralysis in the credit markets, causing the ensuing collapse in liquidity and leading ultimately to the steep falls in asset prices which continue to this day.

It was widely observed at the time that the securitisation of debt, which had been welcomed as a way of dispersing risk more widely than ever before, appeared to have been counter-productive. Instead of increasing confidence in credit markets, dissemination seemed actually to have made banks more wary of potential counterparty risk, since they had no way of knowing who was ultimately bearing the risk of lending originated elsewhere.

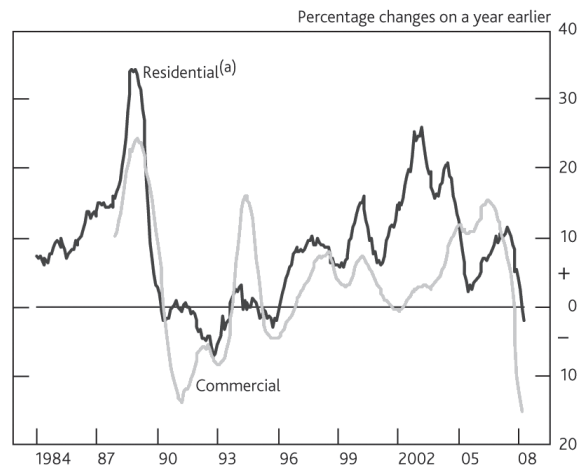


Figure 12: UK Real Estate Prices

Outside the final markets, the major real effect of the bursting bubble was on house prices, initially in Australia and Spain, but real estate deflation only took hold globally after USA house prices began to fall, followed a few months later by UK, the rest of Europe. Figure 12 illustrates the collapse in commercial real estate prices in UK, where the preceding boom had been of relatively modest proportions. Residential property price inflation, which had been at record levels in the previous three years, was slowing down throughout the second half of 2007, but only turned negative during the course of 2008. At the time of writing, the price falls appear to be accelerating. Two self-reinforcing factors drove the housing market down in the UK and USA: reduced expectations of future house price inflation and the accompanying tightening of lending criteria as mortgage providers attempted to raise the quality of their portfolio.

lios by reducing the supply and raising the cost to high loan-to-value borrowers (see Figures 13 and 14).

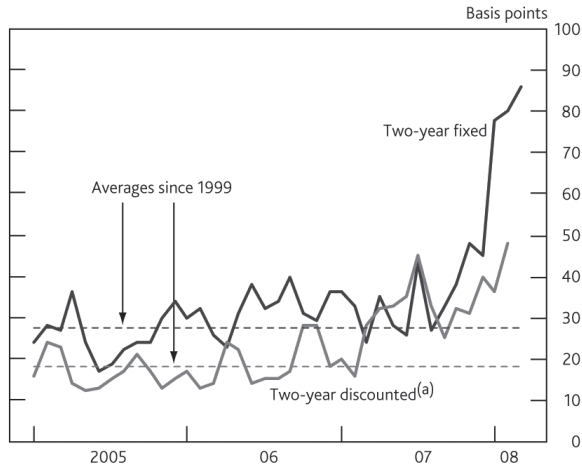


Figure 13: Differences between quoted interest rates on 95% and 75% loan to value (LTV) ratio products in UK
Source: Bank of England

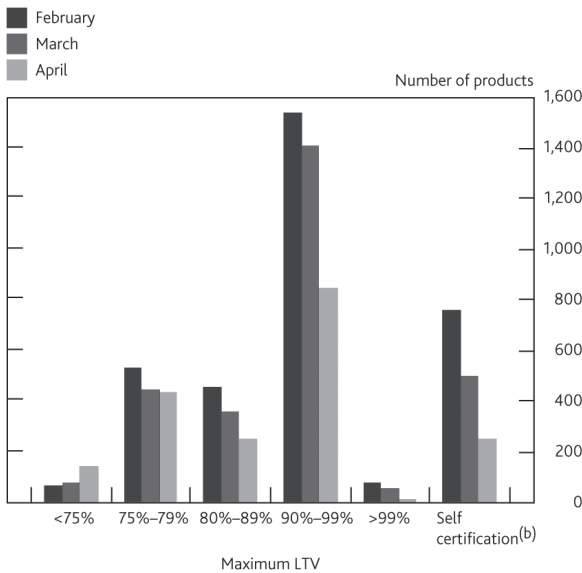


Figure 14: Number of mortgage products offered by maximum loan to value (LTV) ratio(a) in UK in 2008
Source: Bank of England

- (a) Includes products for first-time buyers and those remortgaging. Data are end-month.
- (b) Self-certification mortgages can have a range of maximum LTV ratios, but do not require the borrower to provide proof of income.

The upshot in the wholesale final markets was a classic “flight to quality”, with prime borrowers only slightly affected but lower rated borrowers facing substantially

higher spreads in the UK (see Figure 15) and across the world.

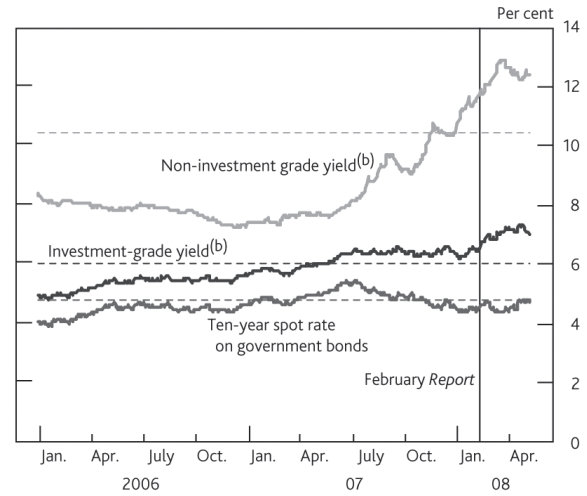


Figure 15: Sterling corporate bond yields and the ten-year spot rate on government bonds^(A)

Who Is to Blame?

Obviously, any episode as painful as the current crisis is liable to spark a search for the culprits. At one level, this may amount simply to a need for scapegoats. But a more important concern is to locate where the mechanism linking the different markets broke down, so as to find a way out of the present impasse and, more optimistically, to try to ensure nothing similar happens again.

If the interpretation mentioned in the introduction is correct i.e. if a crisis was predictable (though probably not its exact timing), then the question arises: why was no action taken to prevent it occurring?

In this context, the Financial Times reports that Deutsche Bank was betting on subprime defaults in 2006, and JPMorgan Chase hedged against a crash in spring 2007, while asset managers such as Pimco and BlackRock stopped purchasing some types of debt instruments in early 2007. In other words, the possibility of a crisis was taken seriously by a significant minority of major institutions. What about the others? And how had the situation been permitted to arise in the first place?

The key point is that financial institutions appear to have bid up asset prices to levels that were far in excess of anything that could be justified by the fundamentals. Ideally, one would like to bring evidence to bear to support this assertion, but this is a task that will no doubt

set a research agenda for years to come. In the meantime, the default position has to be that assets were overpriced. For example, yields on prime real estate were reported as low as 4.5% in 2006,** a full percentage point below the 5-year sterling swap rate traditionally used as the benchmark for property investment. On residential property, we have seen that mortgage quality was systematically reduced in every possible way while yields on mortgage-backed assets were driven down. Moreover, while there was much talk in fund management circles at the time of the search for low correlations, these were assets which must have been expected to covary very highly with the economic cycle.

It is difficult to escape the conclusion that this was a classic case of agency cost. The decision makers in the financial sector often had far more to gain by taking the risks than by avoiding them. Consider the bald facts in Table 2, which gives the outline of remuneration packages paid to principals of a selection of the largest credit crunch casualties, as reported in the press. Whatever the detailed provisions of their contracts, top management had in effect been given a call option on the bank's profits. In a sense, this would appear to be an inevitable consequence of typical incentive schemes based on profit sharing: managers are rewarded with a percentage of earnings, but cannot be penalised by being forced to bear their share of the losses.

However, notice that remuneration schemes based on the value of the firm's shares ought to be immune from this weakness, insofar as an efficient market will discount the equity price to reflect the risk born by any investment strategy. In the present case, the excessively tolerant attitudes of the regulatory authorities and the rating agencies appears to have been sufficient to reassure the markets – at least until the crisis broke.

Considering the figures in Table 2, two questions spring to mind.

First, faced with perfect foresight, how many people would have acted differently? In the absence of perfect foresight, managers ought to have foreseen some of the dangers, but they are hardly likely to have anticipated a worse outcome than the actual outcome – hence the package must have been even more attractive in prospect than the table suggests.

Second, is it plausible that the rewards for behaving responsibly would have been greater than these? The question is almost rhetorical. The tech stock boom of the 1990's witnessed a number of high-profile casualties among fund managers who resisted the pressure to buy shares they believed and in most cases subsequently turned out to be grossly overvalued. The implied lesson in the fund management job market was a neat counterpoint to the introduction of moral hazard into the asset markets mentioned at the start of this article. In essence, decision-makers in financial institutions faced a situation where the risk-reward trade-off in their per-

Table 2: Selected remuneration packages of bank executives

	Firm	Role	Salary	Payoff	Write-off
				\$ MILLION	
Stan O'NEAL	Merill Lynch	CEO/Chmn	45	161	
Chuck PRINCE	Citigroup	CEO	53(over 4 years)	94	58 000
Michael KLEIN	Citigroup	Banker		42	
Martin SULLIVAN	AIG	CEO		47	11 000
Marcel OSPPEL	UBS	Chmn	22	unknown	60 000
Peter WUFFLI	UBS	CEO			60 000
Adam APPLGARTH	N Rock	CEO	3	3	35 000 +(unconfirmed)

sonal accounting was heavily in favour of risk-seeking behaviour, while shareholders either had implicit faith in the regulators and rating agencies or calculated that, even if their faith was misplaced, they could safely rely on the central banks to protect them from losses.

If indeed the incentives were perverse, the issue becomes one of governance. The shareholders' representatives and/or the regulators ought to have ensured that either the incentives were better aligned or that restrictions were placed on management to prevent them maximising the value of their options by risk-seeking behaviour. The rating agencies ought to have provided far more accurate guidance as to the true level of risk in assets like securitised mortgages. Most important of all, overall governance of the banking system was at fault.

** Jones Lang Lasalle figures

In spite of widely-expressed misgivings in academic, policy-making and business circles, monetary policy in USA and UK largely ignored the run up in asset prices in 2003-7, and thus provided the fuel for the conflagration. When the crisis broke, they felt compelled to compound the errors which had created the problem, with bail-outs on a scale unprecedented in modern times. Indeed, I write this a few days after the largest bail-out in history, the rescue package for the mortgage guarantee companies, Fannie Mae and Freddie Mac, whose bankruptcy would have resulted in a default measured in trillions of dollars. At a stroke, the outcome is to provide two hostages to fortune of indeterminate scale, raising moral hazard to a new level, and at the same time making future control of the dollar money stock more or less impossible.

Postscript: the Dogs that Didn't Bark

Consider the following counterfactual question: suppose bank managements had behaved responsibly, what would have happened? Specifically, suppose, at some much earlier point in the last few years, the banks had decided (as we have noted some did) that assets

like securitised mortgages were overpriced, that the risks were too great relative to the rewards and/or that the underlying real estate was overvalued. Given the excess liquidity being supplied by central banks in UK and, especially, by the USA, they would presumably have invested in far lower risk securities, like gilt-edged and AAA-rated debt, thereby driving down long rates even further than we saw in 2004-7. The likely outcome would have been to end the carry trade, whereby investors borrowed cheap yen to buy relatively high-yielding dollar assets, or at least substantially to reduce its attractiveness. As can be seen from the Bank of England computations in Figure 16, during the boom years from 2003 onwards, the carry trade was supported by relatively high US interest rates. Without this, the dollar might have fallen sooner and further, moderating the imbalances in international trade patterns and probably raising the price of consumer goods in the US. The result might have been to bring the boom to an end sooner than mid-2007, with consequently less damage to wealth and to the real economy. But, of course, this is only speculation . . .

Corporate Governance and the Cost of Equity Capital*

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Separation of ownership and control in corporate organizations creates information asymmetry problems between shareholders and managers that on one hand expose shareholders to agency risk; on the other hand companies face the risk of increase in the cost of equity capital; since shareholders try to neutralize the agency risk by demanding more return from managers.

Corporate governance encompasses a broad spectrum of mechanisms intended to mitigate agency problems and the cost of equity capital by increasing the monitoring of managements' actions, limiting managers' opportunistic behavior, and improving the quality of firms' information flows.

This research attempts to study the effect of financial information quality, which is an evidence of corporate governance, on the cost of equity capital. To gain this goal, the related literature was reviewed carefully and two hypotheses were developed by which the influence of earnings transparency and abnormal accruals, as proxies of financial information quality, on the cost of equity capital was studied. The sample of the study were 86 listed companies in Tehran Stock Exchange (TSE).

The hypotheses were analyzed by the use of multi and stagewise regression and f and t tests. The results indicated that the variables, earnings transparency and abnormal accruals, have no effect on the cost of equity capital in the sample of this study.

JEL Classification codes: G38, M41

Keywords: Corporate Governance, Cost of Equity Capital, Financial Information Quality, Abnormal Accruals, Earnings Transparency

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Introduction

Corporate governance is a new issue in management which tries to solve the problem of separation of ownership from management by the use of some basic principles. This is based on the fact that as companies develop and have more complicated performance, the owners lose the ability to manage and control the firm and therefore they entrust experts and qualified people. This creates agency risk and consequently imposes agency cost on shareholders.

Self-interested managerial behavior can take several forms including shirking, pursuing own interests at shareholders expense, over compensation, and empire building that result in increase of agency risk.

When investors cannot discern the true economic value of the firm which is partially an indistinguishable part of performance, the problems of information asymmetry and adverse selection will be created.

The lack of transparent financial information results in greater information risk being imposed on the shareholder. Rational investors will then price-protect against expected agency risk, effectively raising the firm's cost of equity capital. (Bushman and Smith, 2001).

Information asymmetry between informed and uninformed investors makes the uninformed investors face information risk since informed investors due to their superior information can update their portfolios on time (Easley and O'Hara, 2004).

Information risk influences the shareholders' return due to the role of market in optimum capital allocation. Better information improves investment decisions. Investors demand premium for imbalance risk stemming from poor information. This risk will not be removed by making portfolio. Besides the quality of information directly influences the cost of equity capital of the firm and is an additional risk factor (Leuz and Verrecchia, 2004).

Corporate governance encompasses a broad spectrum of mechanisms intended to mitigate agency problem by increasing the monitoring of managements' actions, limiting managers' opportunistic behavior, and improving the quality of firms' information flows (Ashbaugh et al, 2004).

Some of the attributes of corporate governance are as follows (same reference):

1. Financial information quality
2. Ownership structure

3. Shareholder rights, and
4. Board structure

Financial information quality reduces information asymmetries between the firm and its shareholders due to greater disclosure and earnings transparency. Researches done show that financial information quality reduces the cost of equity capital in one of the following ways:

1. Increasing market liquidity, thereby reducing transactions costs or increasing the demand for a firm's securities (Diamond and Verrecchia, 1991; Amihud and Mendelson, 1986).
2. Reducing investors' information risk (Leuz and Verrecchia, 2004; Easley and O'Hara, 2004)

Purpose of the Study

The main purpose of this study is to investigate the relationship between financial information quality and the cost of equity capital.

Increase in the cost of equity capital decreases the competitive power of the firm in commercial environment. In other words, today when companies try to lessen their expenses for survival and continuing activities, increasing the cost of equity capital also increases the expenses of the firm and consequently the firm loses its competitive power and will be removed from the competition circle.

Financial information with high quality leads to reduction of the cost of equity capital. In other words, the more transparent financial information is and the more timely it is disclosed, the more chance shareholders (major and minor ones) have to enjoy equal accessibility to all information. Since corporate governance is recently raised in TSE and is to be implemented, the need for researches in this field is felt.

Research Hypotheses:

1. Increase in the earnings transparency reduces the cost of equity capital.
2. Reduction of abnormal accruals reduces the cost of equity capital.

Review of Related Literature:

Botosan (1997) studied the relationship between the level of disclosure and the cost of equity capital. The

result shows that more disclosure causes reduction of the cost of equity capital.

Botosan and Plummler (2002) carried out a research titled "A re-examination of disclosure level and the expected cost of equity capital" and thereby they divided disclosure into three categories i.e. annual reports, seasonal reports and other published reports. The results indicated that there is a positive relationship between the cost of equity capital and β , while there is a negative relationship between the size of the firm and the cost of equity capital. Also, there is a strong relationship between the size of firm and disclosure level and contrary to primary expectations of the researchers there is not a negative correlation between disclosure level and the cost of equity capital. The results also revealed that there is a direct relationship between the cost of equity capital and interim disclosure level.

Chen, Kevin, Chen and Wei (2003) studied the effect of disclosure and other corporate governance mechanisms on the cost of equity capital in Asia's emerging market (Hong Kong, India, Indonesia, Korea, Malaysia, Philippine, Singapore, Thailand and Taiwan). The results indicated that corporate governance both with respect to disclosure and non-disclosure mechanisms have a significantly negative effect on the cost of equity capital. In addition, the effect of non-disclosure mechanisms is more profound than that of disclosure on the cost of equity capital.

Abbasi (2003) has studied the relationship between the cost of capital and disclosure level in the companies listed on TSE. The results indicated that there is no significant linear relationship between disclosure level and the cost of equity capital, cost of debt and the cost of capital.

Importance of Corporate Governance and the Necessity for its Implementation

In recent years, corporate governance has become a main and dynamic aspect of commerce and there is progressive attention directed to it. Implementation of corporate governance at global level has had a considerable improvement. International organizations like Organization for Economic Cooperation and Development (OECD) provides internationally accepted standards in this regard (Hasas Yeganeh, 2005). There are many reasons for such increasing global welcome of the

issue, some of the most important ones of which will be mentioned below:

1. **Market Driven Economy**
Market driven economy has relationship with economic factors like interest rates, tax rates and new competitors entering dynamic markets. Lower interest rates will lead to reduction of liquidity reserve and there would be a better money supply. This improves and revives financial markets. Besides, the market of second hand products will soon disappear.
2. **Globalization of trade**
3. **The world-wide wave of privatization of the past two decades**
4. **ever and chaotic competition**
In today's world, effectiveness and efficiency are not the vital factors for success; due to the severe and chaotic competition existing, only the companies which act correctly will continue to be successful.
5. **The takeover wave of the 1980s**
6. **Standards for reporting**
7. **Deregulation and the integration of capital markets**
8. **The crisis of the East Asia in 1998 which made the new emerging markets focus on corporate governance.**
9. **Recent financial scandals of American companies**
10. **Amending pension fund and growth of private savings (Becht, Bolton and Mathur, 2005; Rosell, 2004).**

Theories Explaining Corporate Governance

Different theoretical frameworks have been presented for explaining and analyzing corporate governance, each of which has dealt with the issue with different wording and forms which are due to the particular scientific viewpoints existing toward this topic. For instance agency theory has a financial and economic ground whereas transaction cost theory is driven from economic, legal and organizational theories and stakeholder theory stems from social viewpoint. Also it should be noted that cultural and legal grounds have a significant effect on corporate governance (Hasas Yeganeh, 2005).

Financial Information Quality

One of the instances of corporate governance is financial information quality which leads to more disclosure and financial information transparency and as a result reduces information asymmetry between management and shareholders (Ashbaugh et al, 2004). Researches done indicate that financial information quality can lower the cost of equity capital in one of the following ways:

1. Increasing market liquidity:

Public disclosure of private information reduces information asymmetry. This results in the increase of the liquidity of firm's securities and attracts investors for carrying out more transactions, therefore the cost of capital decreases. In other words, the cost of capital reduces as the demands from large investors grow due to the liquidity of its securities increases (Diamond Verrecchia, 1991).

Large firms disclose more information since they benefit most. Disclosure also reduces the risk bearing capacity available through market makers. If initial information asymmetry is large, reducing it will increase the current price of the security. Further reduction of information asymmetry accentuates the effects of exit from market making. (same resource).

2. Reducing Information Risk of Investors:

Leuz and Verrecchia (2004) investigated the reduction of investors information risk which leads to reduction of the cost of equity capital from theoretical aspect. In their belief, the information quality, even if they are private ones and independent from the information of other companies, influence the cost of capital of firm by affecting expected cash flows. In other words, if companies report their investment opportunities to the market, managers would select the projects which maximize the market value of the firm. In this sense, the quality of the report influences investment decisions. As a result the expected cash flow level will be also influenced.

Cost of Equity Capital (The Cost of Financing through Issuing Common Stock)

One of the most important finance sources of economic units is through issuing common stock. Holders of common stock face higher risk as compared with other financiers. Therefore, naturally their expected rate of

return is the highest one (Osmani, 2002). In fact this is the least rate of return that a firm should provide its common stock holders with, so that the market value of that firm would be preserved. (Jahankhani and Parsian, 2005).

Models of Calculating the Cost of Capital:

1. Average Realized Returns Model:

Based on this model, investors of common stock expect to receive the return equal to the ones they have received in pervious period(s). The return of the common stock holders is divided into two ways of cash dividend and the change in stock price with respect to the beginning price.

2. Adjusted Average Realized Returns Model:

This is the same as Average Realized Returns Model which is adjusted with respect to dividend and its growth. Based on this model, the expected return of common stock holders is affected by two other variables which are growth rate of future interests and percentage of dividends.

3. Capital Assets Pricing Model (CAPM):

In this model, the expected return on a security is equal to the return of a risk-free asset plus a risk premium (called β) multiplied by the rate of expected return of the market portfolio to the return on risk-free asset (Parsaiyan, 2005).

4. Accounting Base Assessment Model:

This model is developed by Edward, Bell and Olson and is known as EBO.

5. Dividend Growth Model:

Assumptions of this model are as follows:

- 1) Since dividend is the only cash payment made to shareholders directly by the firm, therefore it is the basis for evaluation of common stock. Thus investors and analysts should try to evaluate the future status of the firm and estimate the future dividend of the firm.
- 2) Dividend is paid annually.
- 3) Dividend growth has a fixed rate.
- 4) The growth rate of dividend is less than the expected rate of return of shareholders (Tehrani, 2003).

Research Method

This research is an applied study focusing on correlations and analytic relationships. What makes this research applicable is the use of its results in adjusting the corporate governance of listed companies in TSE. The results also help the companies to reduce their cost of equity capital.

The variables of this research are the cost of equity capital and financial information quality. Based on the related literature, two measures of earnings transparency and abnormal accruals are considered for financial information quality (Ashbaugh et al, 2004).

The cost of equity capital which is the expected rate of investors out of their investment is considered as dependant variable and earnings transparency and abnormal accruals are considered as independent variables.

Measuring the Variables of the Research

The first step to examine the hypotheses of the research is calculation of earnings transparency which is a market based measure and is derived from the following regression formula (same reference).

$$RET_{it} = \beta_0 + \beta_1 NIBE_{it} + \beta_2 LOSS_{it} + \beta_3 NIBE_{it} * LOSS_{it} + \beta_4 \Delta NIBE + \varepsilon_{it}$$

RET_{it} = market adjusted return for firm i over fiscal year t

$NIBE_{it}$ = the net income before extraordinary items scaled by beginning of period market value of equity for firm i in period t

$LOSS_{it}$ = equals to one if NIBE is negative and zero otherwise

$\Delta NIBE$ = the change in net income before extraordinary items scaled by beginning of period market value of equity

$NIBE_{it} * LOSS_{it}$ = the interaction term that allows for a differential market reaction for loss versus profit firms. In case NIBE is negative, LOSS equals one and the result is therefore negative which reduces RET; but if NIBE is positive, the result will be zero and it has no effect on RET.

ε = squared residual of regression which is an indicator of earnings transparency. The higher it is, the lower transparency exists.

The second measure of financial information quality, abnormal accruals, is an accounting based measure. Abnormal accruals are calculated using the following modified Jones model (Dechow, Sloan and Sweeney, 1995)

$$TA = \alpha_1 (1 / \text{Lag1 asset}) + \alpha_2 (\Delta REV) + \alpha_3 PPE + \varepsilon$$

TA= total accruals equals net income before extraordinary items minus cash flow from operations scaled by beginning of fiscal year total assets

Lag 1 asset= total assets in the fiscal year t-1

ΔREV : the sales in year t less sales in year $t-1$, scaled by beginning of fiscal year total assets

PPE= gross property plant and equipment scaled by beginning of fiscal year total assets.

We use the parameter estimates from equation above to calculate expected accruals (EA) as follows:

$$EA = \alpha_1 (1 / \text{lag 1 asset}) + \alpha_2 (\Delta Rev - \Delta AR) + \alpha_3 (PPE)$$

where ΔAR is equal to accounts receivable in year t less accounts receivable in year $t-1$ scaled by beginning of year.

Thus a firm's abnormal accruals is equal to TA minus EA.

Then the dependant variable of the research which was the cost of equity capital was calculated through the following formula (Abbasi, 2003):

$$TA = \alpha_1 (1 / \text{Lag1 asset}) + \alpha_2 (\Delta REV) + \alpha_3 PPE + \varepsilon$$

TA= total accruals equals net income before extraordinary items minus cash flow from operations scaled by beginning of fiscal year total assets

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Then the dependant variable of the research which was the cost of equity capital was calculated through the following formula (Abbasi, 2003):

$$P_t = b_t + \sum_{i=1}^T (1+r)^{-i} E_t (X_{t+i} - r b_{t+i-1}) + (1+r)^{-T} E_t (P_T - b_T)$$

P_t = market value per share at the end of the fiscal year t

b_t = book value per share at the end of the year t

r = rate of firm's cost of capital

X_{t+1} = true dividend of the firm in the fiscal year $t+1$

b_{t+1} = true book value per share in the fiscal year $t+1$

In this model the market value of each share in the year under study is calculated based on the book value per share (b_t) in the same year plus the present value of future additional (abnormal) interests plus present value of additional expected price to the book value. The expected present value is calculated based on the rate which is the same as cost of equity capital.

Since this research is based on Positive Accounting Theory, therefore x_{t+1} and b_{t+1} were extracted from the financial statements of the year after. T changes based on the periods of study. For example in the year 1999, $T=5$ and $i=1$, in the year 2000 $T=4$ and $i=1$ and so is in the year 2003 when $T=1$ and $i=1$.

Besides the relationship between independent variables and the cost of equity capital, two controlled variables of SIZE and MB also were taken into account in the model.

SIZE: Natural log of fiscal year end market value of equity

MB: Fiscal year end market value of equity divided by fiscal year end book value of equity

Population and Sample

The population of this study, within the time framework of the research, was the listed companies in TSE market enjoying the following characteristics:

1. the firm was among listed companies on 19.03.2000
2. their fiscal year ended in March 19th
3. they had not changed their fiscal year during the research period
4. they were not investment or holding companies or financial intermediaries
5. they had information about the selected variables like operational cash flows, sales, fixed assets, etc.

Based on the above-mentioned criteria, out of 314 listed companies of the primary population, 86 companies were selected as the final sample.

Testing the Hypotheses

To figure out the mathematical relationship between dependant and independent variables and fitting model, the hypotheses of the research were tested by Panel Analysis method.

First hypothesis: Increase in earnings transparency reduces the cost of equity capital

Fitting regression for the following hypothesis is:

Model One

$$IMPLIED-CC = \beta_0 + \beta_1 FIN-TRANS + \beta_2 MB + \beta_3 SIZE + \epsilon$$

In this model IMPLIED-CC is the cost of equity capital, FIN-TRANS is the earnings transparency, MB is the fiscal year end market value of equity divided by fiscal year end book value of equity and SIZE is the natural log of fiscal year end market value of equity

To test the above-mentioned hypothesis, first a statistical hypothesis like the following was developed.

$$H_0: \beta_1 = 0$$

$$H_1: \beta_1 \neq 0$$

H_0 indicates that the earnings transparency coefficient is zero and H_1 indicates that the said coefficient is not zero in the regression model. To analyze this hypothesis, the significance test of coefficient of determination (f test) and the significance test of regression coefficients (t-test) were applied in the fitting regression.

However, to analyze the significance of the total model, first the variance method (f test) was used. F value was gained through the following formula:

Table 1- Statistical result of model one

variable	β	t	p	R ²	Adjusted R ²	F	P	Dorbin-Watson
Intercept	0.7	4063	0.00					
FIN-TRANSE	-0.0001	-1.47	0.14	0.32	0.30	22.97	0.00	1.97
MB	-0.0022	-0.83	0.41					
SIZE	-0.11	-4.29	0.00					
Y _{t-1}	0.54	4.50	0.00					

$$F = \frac{ss_r/k-1}{ss_e/n-k}$$

In case the calculated *f* is greater than *f* value of the table with non-systematic error, the hypothesis H₀ is rejected and we can reject the hypothesis stating that there is no linear relationship between *x* and *y*. Confirming the hypothesis H₁ means that at least one of the coefficients of regression model is not zero.

By the use of fitting multiple regression and coefficient of determination, the changes made in the cost of equity capital by controlled and independent variables were studied together

Coefficient of determination of 0.32 indicates a relationship between the cost of equity capital and independent and controlled variables. Its significance was proved by F test and P-value of zero. To get the con-

tribution of each variable in forming the significant relationship, fitting multiple regression coefficients analysis was used and the results indicate that at the significance level of 5 pct, the variables of SIZE and Y_{t-1} have a significant relationship with the cost of equity capital. However the variable FIN-TRANS which has P=0.14 (exceeding the significance level of 0.05) has no significant relationship with the cost of equity capital; therefore the hypothesis H₀:= β₁=0 was confirmed i.e. significant relationship of this variable and the cost of equity capital was not confirmed.

To choose the best explanatory variable of regression, a diminishing stagewise regression was used to prove that lack of significant relationship between earnings transparency and the cost of equity capital gained from multiple regression is correct. The result is indicated in table 2.

Table 2- Results of fitting diminishing stagewise Regression

variable	β	t	p	R ²	Adjusted R ²	F	P	Dorbin-Watson
Intercept	0.62	4.2982	0.00					
SIZE	-0.10	-4.39	0.00	0.29	0.28	43.44	0.00	2.01
Y _{t-1}	0.55	5.56	0.00					

As the explanatory variables left multiple regression model one by one and the best line of fit was selected, the results of table 3-4 was confirmed and showed that the coefficient of determination of the model which was 0.29 can be justified by SIZE and Y_{t-1} and that there is a reciprocal significant relationship between SIZE and the cost of equity capital and there is a direct significant relationship between Y_{t-1} and the cost of equity capital. In diminishing stagewise regression, the independent

variable of the research (earnings transparency) along with the controlled variable MB left the model which shows that there is no significant relationship between these variables and the cost of equity capital.

The relationship between earnings transparency and the cost of equity capital and its significance were studied without taking the effect of controlled variables on the cost of equity capital into account. The result is indicated in table 3:

Table 3- Results of model 1 without considering controlled variables

variable	β	t	p	R ²	Adjusted R ²	F	P	Dorbin-Watson
Intercept	0.58	1,69	0.093					
FIN-TRANS	-0.0001	-0.76	0.45	0.20	0.19	25.71	0.00	1.97
Y _{t-1}	0.46	4.14	0.0001					

The above table shows that there is no significant rela-

tionship between earnings transparency and the cost of

equity capital because the value of p in the table (0.45) exceeds the significance level of 0.05; therefore H0 hypothesis was not rejected. In other words, earnings transparency has no effect on the cost of equity capital.

Second hypothesis: Reduction of abnormal accruals increases the cost of equity capital

Fitting regression for the a/m hypothesis is as follows:

$$IMPLIED_CC = \beta_0 + \beta_1 ABN_ACCRUALS + \beta_2 MB + \beta_3 SIZE + \epsilon$$

In this model ABN-ACCRUALS indicates abnormal accruals (other variables have been already defined). To test the a/m hypothesis, first a statistical hypothesis as follows was developed:

$$H0: \beta_1 = 0$$

$$H1: \beta_1 \neq 0$$

H0 indicates that the abnormal accruals coefficient of variation is zero and H1 indicates that the said coefficient is not zero in the regression model. To analyze this hypothesis, the significance test of coefficient of determination (f test) and the significance test of regression coefficients (t-test) were applied in the fitting regression.

Like model 1, here also the changes made in the cost of equity capital by controlled and independent variables, went under study by the use of fitting multiple regression and coefficient of determination.

The coefficient of determination of 0.32 shows that there is a relationship between the cost of equity capital and controlled and independent variables. Its signifi-

Table 4- Results of model 2

variable	β	t	p	R ²	Adjusted R ²	F	P	Dorbin-Watson
Intercept	0.62	3.73	0.0002					
ABN-ACCRUALS	0.004	0.36	0.97	0.32	0.31	24.25	0.00	1.98
MB	-0.007	-1.51	0.13					
SIZE	-0.094	-3.05	0.003	0.20	0.19	25.71	0.00	1.97
Y _{t-1}	0.057	5.60	0.00					

cance was confirmed by the p-value of zero. The results of the fitting multiple regression coefficients analysis indicate that at the significance level of 0.05, SIZE and Yt-1 have a meaningful relationship with the cost of equity capital. However since the calculated p (0.97) is greater than $\alpha=0.05$, hypothesis H0 could not be rejected; it means there is no significant relationship between

abnormal accruals and the cost of equity capital. Therefore the second hypothesis is not confirmed either.

Diminishing stagewise regression tries to fit the best regression model in this hypothesis and it confirms the results gained from multiple regression. The result is shown in table 5.

The same results of model one is obtained here.

Table 5- Results of a fitting diminishing stagewise regression

variable	β	t	p	R ²	Adjusted R ²	F	P	Dorbin-Watson
Intercept	0.62	4.3	0.00					
SIZE	-0.10	-4.4	0.00	0.29	0.28	43.44	0.00	2.01
Y _{t-1}	0.55	5.56	0.00					

The relationship between abnormal accruals and the cost of equity capital and its significance were studied without taking the effect of controlled variables on the

cost of equity capital into account. The results are indicated in table 6.

Table 6- Results of model 1 without considering variable into account

variable	β	t	p	R ²	Adjusted R ²	F	P	Dorbin-Watson
Intercept	0.06	1.56	0.12					
ABN-ACCRUALS	-0.09	-0.69	0.49	0.222	0.215	30.05	0.00	1.98
Y _{t-1}	0.46	4.52	0.00					

Since the calculated p in the a/m table (0.49) is greater than $\alpha=0.05$, hypothesis H_0 is confirmed; it means there is no significant relationship between abnormal accruals and the cost of equity capital.

As the result both hypotheses of the study are rejected, i.e. the two measures of earnings transparency and abnormal accruals have no relationship with the cost of equity capital. Therefore, no significant relationship was found in this research between financial information quality (taking the measures of earnings transparency and abnormal accruals into account) and the cost of equity capital.

Evaluation and Description of the Results

To test the hypotheses, multiple and stagewise regression, to test the significance of the whole model f test and to test the significance of regression coefficients t test was used. Before dealing with hypotheses it was necessary to make sure the data are normal; otherwise the researcher could not rely on the results and that would have lead the researcher to false inferences about the level of relationship between variables. After ensuring that data are normal, the hypotheses were tested. The results are as follows:

First hypothesis:

Increase in earnings transparency reduces the cost of equity capital

To test the above-mentioned hypothesis, the variable of earnings transparency was considered as independent variable and the two controlled variables under titles Size and MB were also included in the model. The results of the statistical tests indicated that there is no significant relationship between earnings transparency and the cost of equity capital.

Second hypothesis:

Reduction of abnormal accruals increases the cost of equity capital

The results of regression equations and significance test of coefficients indicated that there is no significant relationship between abnormal accruals and the cost of equity capital.

Conclusion:

The research studied the relationship between financial information quality and the cost of equity capital. Based on the literature, two measures of earnings transpar-

ency and abnormal accruals were considered for financial information quality and research hypotheses were developed. The results of the tests indicated that there is no significant relationship between earnings transparency and abnormal accruals and the cost of equity capital i.e. financial information quality, considering aforementioned measures, does not have a significant relationship with the cost of equity capital.

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On this paper, we will examine the interest rate sensitivity of common stock returns of commercial banks to current and unanticipated changes in interest rates as perceived by investors in Greek financial market. Taking into account that interest income accounts for 70%** of the Greeks banks' total operating income, it will be interesting to survey how fluctuations in the base interest rate influence operating performance of Greek banks and consequently investors expectations. We will employ a variant of the capital asset pricing model to analyze the separate effects of market return and current and unexpected interest rate changes on bank stock returns. In order to model interest rate expectations we will use the Box-Jenkins modeling procedure in a three stage model.

JEL Classification codes: G10

Keywords: current interest rate changes, unanticipated interest rate changes, stock returns of commercial banks, Box – Jenkins modeling procedure

Introduction

In that paper many aspects of the financial theory were used: Portfolio theory and particular a two index and a three index version of the Capital Asset Pricing Model which included a term for interest rate risk -current changes in interest rates for a two-index model with an addition of a factor of unexpected changes to a three index model - in order to model the interest rate sensitivity

of common stock returns. Econometric methods such as ordinary least square technique (OLS) by testing the robustness of my results with many statistical tools. Time series modeling by using an analytical three stage method in order to select an appropriate model which captures the data generating process of the “change in current interest rates” time series and use the residuals of it as representing unanticipated interest rate changes.

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Asset liability management (ALM) principles in order to explain the results and especially to the argument of the mismatch (gap), in terms of time and interest rates, between repricing both assets and liabilities.

The empirical evidence on the sensitivity of bank earnings to interest rate surprises is less than clear cut. Flannery (1981, 1983) found a significant long run impact for only 2 of the 15 large banks sampled while Chance and Lane (1980) reported that unexpected interest rates had no effect on banks returns independent of that reflected in market returns. Flannery and James (1984) found on average there was a statistically significant negative relationship between bank stock returns and unexpected interest rate changes while Booth and Officer (1985) arrived at basically the same conclusions but by using different expectation process. Bae (1990) concludes that current and anticipated interest rate changes affect significant adversely stock returns of commercial banks. On the latest survey from Dinenis and Staikouras (1998) these findings are robust while another factor is considered here, the variability of interest rates which is found to have a positive relationship with stock returns of commercial banks. For the Greek Banking Sector a paper from Harissis H. Harilaos (1999) examined, from 1994 -1997, the influence of interest rates changes on stock's returns for a portfolio of 15 banks and found a significant relationship between current and anticipated interest rate changes with stock returns. Of course that period was characterized by low trading volume and also banks didn't use the euribor rates as a base to price their products.

These conflicting findings are attributed to the different method that authors used to model interest rate surprises and also to the choice of a specific maturity debt index. Overall, most of the papers employ the Box-Jenkins methodology to capture the data generating process of the "changes in interest rates" sequence. Also the debt index that employed is the short term debt index, such as 3 month Treasury Bills, since banks and their earnings should be more sensitive to short term rather than long term rates as they typically keep title to the relatively long-term loan portfolios they originate while selling (deposit) contracts of short maturity.

On average, most of the studies found significant relationship between interest rate innovations and common stock returns. There are some theoretical considerations of why this direct relationship exists. Particularly,

conventional wisdom has long viewed financial intermediaries such as banks, as being susceptible to interest rate risk. This arises from the fact that banks undertake an asset transformation or intermediation function by lending long (at fixed rates) and borrowing short (often at variable rates). Such mismatch balance sheet structure leads to different weighted duration of assets and liabilities which means that repricing of assets and liabilities is not matched. So if the duration of assets exceeds that of liabilities, repricing of assets in response to changes in the base level of interest rates is slower and since revenues adjust more slowly than costs, the net worth of banks is affected. If we want to model a framework of how revenues and costs are adjusted to interest rate innovations this will take the below form (Akella and Greenbaum 1992):

λ_L , λ_D denote respectively the speeds with which the revenue rate (from loans) i_L , and the cost rate (from deposits) i_D , adjust to changes in the exogenous interest rate, r .

The adjustment is instantaneous if $\lambda_L=1$ whereas $\lambda_D=0$ implies that the revenue rate is totally insensitive to the changes. The same is valid for λ_D . So if:

- $\lambda_D > \lambda_L$ An unexpected increase (decrease) in the interest rate reduces (increases) the spread between revenues and costs and lowers stock returns.
- $\lambda_D < \lambda_L$ These effects are reversed.

With this method, the duration effects are impounded in the speeds of adjustment of revenues and costs. The same logic is applied in the study of Flannery and James, where the duration mismatch was captured by the gap among rate sensitive assets and rate sensitive liabilities. The sensitivity of net interest income of banks on changes in interest rates is positively related to the difference between short term nominal assets and liabilities. The drawback of this approach is that doesn't explicitly consider the durations of long-term assets and liabilities.

Another theoretical explanation of the interest rate sensitivity of common stock returns of commercial banks is offered by Stone (1977). He proposed a two index model consisting of a debt market index as additional factor to the traditional CAPM. Stone justified the model by arguing that individual equity securities such as banks stocks exhibit considerable interest rate sensitivity and the opportunity to invest in risky debt

securities may represent an attractive alternative to riskless assets and risky equity securities. This insight is robusted by their significant empirical findings. Finally, according to Galai and Masulis (1976) equities can be viewed as a call option on assets with an exercise price equal to the value of its liabilities. So if we assume that changes in interest rates reflect changes in the value of the assets, the value of the call option should change and consequently stock returns will fluctuate.

The remainder of our work is organized in three sections : Section 1 describes the used data, Section 2 the methodology followed to model interest rate sensitivity and Section 3 the results.

Section 1: Data

Data

Our sample consists of 10 commercial banks from the Greek banking sector. All the data derived from Bloomberg. The sample includes 250 weekly observations from 03/01/2003 to 19/10/2007. Expanding the sample by incorporating observations before 2003 wouldn't be useful, because prices of bank stocks in that period were characterized by high volatility. Weekly logarithmic stock returns for all commercial banks were calculated in order to create equally weighted portfolio returns. As a measure of market return index we employed the FTSE all share price index, the widest equity market index in Greece. In order to capture current interest rate changes we used the 1 month Euribor, since, according to the findings of the study of Foyles, John and Tipton (1981), short term interest rates influence mostly commercial bank stock returns, independently of the influence of equity market movements. Also another reason to use the 1 month Euribor as the appropriate short interest rate, was that most of the commercial banks price their products (investment products, mortgage loans, small business loans) using as a base rate the 1 month Euribor, adding to it their profitability spread.

Section 2 : Methodology

Effect of current interest rate changes.

In order to estimate the sensitivity of common stock returns to current interest rates we employed Stone's two index model, by incorporating as a significant factor of explaining commercial bank stock returns, changes in interest rates. The reason that we test if cur-

rent changes influence returns is because a large portion of current changes corresponds to unanticipated changes. The following model is estimated:

$$R_{pt} = \beta_0 + \beta_m R_{mt} + \beta_1 CIC_t + e_t \quad (1)$$

R_{pt} is the weekly return on an equally weighted portfolio of stocks in week t , R_{mt} is the weekly return on market index in week t and CIC_t is the current interest rate change in 1 month Euribor in week t . In order our results to not be affected by the collinearity of market returns with interest rate changes we calculated the correlation among these two variables and we found a low negative correlation of -0.11 for Greek market. Table 1 reports the results of estimating the coefficients (OLS method) for the above model:

Table 1: Effect of current interest rates changes

Market	β_0	β_m	β_1	R ²	DW
Greece	-0.001 (-1,0)	1,14 (27,1)	-0.043 (-1,55)	0.76	2.07

* t statistics in parentheses

The overall fit of the estimated model is good with a coefficient of determination of 0.76 (76% of the changes in stock returns of a portfolio of commercial banks are explained by the variables employed in the model). Durbin Watson statistic is very close to 2 so there is no evidence of serial correlation in the residuals for both models. If we want to comment on the estimated parameters we can see that the coefficient on the market returns is statistically significant with a value of 1, 14. This value indicate an overreaction of commercial banks stocks in market movements (if market rises by 1 %, stock returns will increase by 1, 14%).

More important the value of the coefficient for changes in interest rates is negligible (and insignificant) which shows that changes in the current rates don't have any influence on the stock returns of commercial banks. From these results there is evidence that current interest rates changes don't reflect a portion of unanticipated changes in interest rates in Greek financial market and investors have already incorporated them in their expectations and consequently are reflected in current stock prices.

Effect of unanticipated interest rate changes. Methodology-results.

The next step was to model unanticipated interest rate changes since in an efficient market anticipated

changes should be already embedded in stock prices (in the sense that investors in order to value stocks and form expectations discount future bank cash flows utilizing, as a discount factor, an expected interest rate), thus only unanticipated changes in economic factors should influence stock prices. In order to estimate the effect of unanticipated interest rate changes we followed a two step procedure: First we identified an interest rate expectation equation, then we considered the residuals of this model as interest rate surprises and finally the derived residuals employed as an interest rate factor in the following two factor model:

$$R_{pt} = \beta_0 + \beta_m + R_{mt} + \beta_I UIC_t + e_t \quad (2)$$

where UIC_t : the unanticipated interest rate change in week t.

Model current interest rate changes

Framework

We employed the Box-Jenkins modeling procedure which consists of a three stage method to select an appropriate model which captures the data generating process of changes in 1 month Euribor rate time series.

Identification stage: Appropriate condition to use these models is the data to be stationary (the mean and variance don't change when the time origin changes) in order to use sample mean, variance and autocorrelations to estimate the parameters of the actual data generating process. For this reason we employed the Augmented.

Dickey Fuller unit root test to examine statistically if my data is stationary. The ADF test employs: 1) the time series that we want to examine if it is stationary and 2) lag 1 time series of this, and tests if the mean and variance is constant when the time origin changes. The test shows that our data should be stationary. (Table 2)

Table 2: ADF test for "changes in interest rates" time series

Market	t-value ADF	Critical values (5% / 1%)	Null hypothesis that there is a unity root (no stationary)
Greece	7.8113	(1.943 / 2.583)	Reject null

After ensuring that the data is stationary we plotted the sample Autocorrelation and Partial Autocorrelation function (ACF, PACF) in order to compare them with the theoretical ones and identify some plausible

models. The two graphs show the ACF and PACF for the changes in 1 month Euribor.

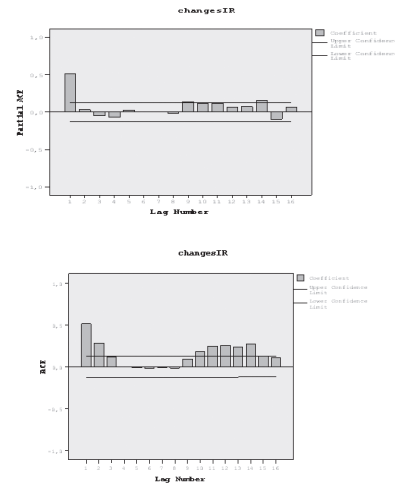


Figure 1: ACF and PACF for "changes in interest rates" time series.

Estimation stage: At this stage we tried to select appropriate models which fit the data well without incorporating any needless coefficients. From the sample ACF and PACF we can observe the followings:

1. Pure theoretical moving average (MA) ACF must cut off to zero at lag q and the theoretical ACF of an AR(1) model theoretically should decay geometrically. Examination of our sample ACF and PACF shows that neither of these specifications seems appropriate for the sample data.
2. The PACF suggests that we should consider models such as p=1 p=14 for modeling 1 month Euribor interest rate surprises because they are significant since the value of the autocorrelations of these lags is more than the sampling variance. (Also because we use weekly data, we were concerned with the significant partial autocorrelation found at lag 14; the economic explanation is that lag 14 represents the influence of changes in 3 months Euribor in the data generating process of current changes in 1 month Euribor). According to Box and Jenkins (1976) and the distribution theory underlying the use of the sample ACF and PACF, if the examined time series is stationary the sample variance of autocorrelations is T^{-1} , where T is the number of observations. So the standard deviation of the sample autocorrelations is $T^{-1/2}$ and if we use a 95% confidence interval is

$2 \cdot T^{-1/2}$. In our case the sampling variance is equal to $2 \cdot 250^{-1/2} = 0.126$

Below we present the appropriate model that captures the data generating process for the 1 month Euribor rate changes.

Model of 1 month Euribor interest rate changes.

The above two points suggest a restricted autoregressive model AR(14) with lag two – thirteen fixed and equal to zero for **modeling 1 month Euribor interest rates**. The coefficients of the model ($a_1 = 0.512$ and $a_{14} = 0.155$) are significant in 95 % level and they satisfy the appropriate stationary restriction of an AR process, that the characteristic root of a_1, a_{14} should be less than unity in absolute value. We considered additional models which all of them had insignificant coefficients. The pattern of our sample ACF with no decay trend and also with no single spike, reject the model of a first autoregression model.

Diagnostic checking for the restricted AR (14) model:

Here we plotted the correlogram of the residuals of the AR(14) model. Any evidence of serial correlation implies a systematic movement in the changes in interest rates sequence that is not accounted for by our restricted AR(14) model. Our model doesn't suffer from serial correlation in residuals as it is obvious from the below ACF correlogram of the residuals since each autocorrelation coefficient is less than the sampling standard deviation of 0.126 (the sampling standard deviation for 95% confidence level) which consequently implies that should be equal to zero.

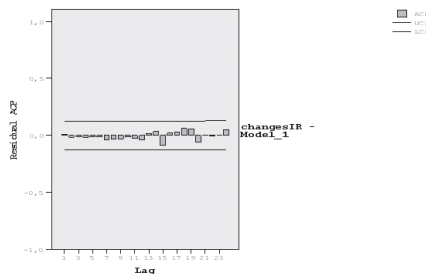


Figure 2: ACF of the residuals for an AR (14) model for modeling interest rates

Taken into account all the findings above, the expectation generating process for 1 month Euribor weekly current interest rate changes is represented by the following restricted autoregressive model:

$$CIC_t = a_0 + a_1 CIC_{t-1} + a_{14} CIC_{t-14} + e \quad (3)$$

The residuals are utilized as unexpected changes in interest rates.

Section 3 - Empirical results

In order to examine the interest rate sensitivity of commercial banks stock returns to unexpected changes in interest rates we will estimate the coefficients of the below model:

$$R_{pt} = \beta_0 + \beta_m R_{mt} + \beta_{UIC} UIC_t + e_t \quad (4)$$

Our model doesn't suffer from collinearity among the two regressors since the correlation of the FTSE all share index and unanticipated interest rate changes is 0,14. Table 3 below shows the results of the estimated coefficients (estimated by OLS) with their t-statistics in parentheses. The Durbin Watson statistic assures no autocorrelation between the successive values of residual terms. The interest rate sensitivity of Greek commercial bank returns, as it is derived by the value of the β_{UIC} , is not significant. The evidence shows that interest rate surprises don't affect market values of Greek commercial banks. This finding suggests that banks don't suffer from maturity imbalance in assets and liabilities as Flannery and James (1984) and Bae (1990) found at their studies in order to explain theoretically the interest rate sensitivity of USA commercial banks returns. This can be attributed to the fact that banks defended against interest rate movements by using financial instruments such as derivatives and they hedged both their assets and liabilities successfully. Also another factor that explains why the changes in interest rates have no influence on banks stock returns is that Greek banks started pricing their products using as a base the 1 month Euribor, applying upon this base their spread. So any change in unanticipated interest rates had the same influence in the revenue rate (from loans) and the cost rate (from deposits), mitigating in that way any imbalances which happened from the different maturity and reprising of assets and liabilities.

Table 3: Effect of interest rate surprises

Market	β_0	β_m	β_{UIC}	R ²	DW
Greece	0.001 (-1,27)	1.155 (27)	0,002 (0,0066)	0.755	2.06

Conclusions

Our attempt was to identify if there was a substantial interest rate sensitivity of commercial banks stock returns to changes in interest rates from 2003-2007, a period with low volatility in bank common stock prices and also a change in the way that bank started pricing their products. We used data from Greek financial market in order to study empirically if investors consider interest rates sensitivity as an additional factor of explaining bank's stock returns.

Taken into account all the results we can conclude that over the sample period the market value of the commercial banks was not affected by the 1 month Euribor interest rates innovations. Banks seemed to have been defended against adverse interest rate movements by exploiting derivatives, such as interest rate swaps and bond futures, and investors seemed to perceive this as our analysis shows. The usage of these products and also the pricing of bank products according to Euribor helped banks to hedge totally interest rate sensitive assets and liabilities leaving their values unaffected by changes in the interest rate levels.

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Incorporation of Foreign Transactions in Input-Output Analysis Approaches and Practices

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This article focuses on the methodology of a particular aspect of input-output analysis, namely the incorporation of imports in the input-output table. The incorporation problem will be examined initially in relation to the development problems of less developed countries, because the way in which incorporation evolved has been important for these countries. Also presented is the evolution of the incorporation of imports in the input-output table firstly of the UN for 1993, with 4 methods of presentation outlined, as well as for 1999 and the changes that have been made in the meantime, along with the corresponding table of Eurostat for 2001 and 2008, in order to track the development of this discussion for all countries and in particular for the European Union member states. The presentation concludes with a comparison of the methods adopted by the UN and Eurostat. According to the Eurostat approach, due to a lack of data and the extensive inter-dependency between European countries, the classification of imports into competitive and non-competitive goods is not feasible. Instead, the adopted method is the classification of imports by geographic area.

JEL Classification codes: D570,O100

Keywords: Input-Output Analysis, Imports-Exports, Economic Development

Introduction

The present paper describes the methodology of a particular aspect of input-output analysis, namely the incorporation of imports in the input-output table. The development problem expresses the link between present and future, as manifested by technological, economic and social progress. The incorporation problem will be examined initially in relation to the development

problems of less developed countries, because the way in which incorporation evolved has been important for these countries. The importance of the input-output matrix for national economic policy and development depends on the forecasting reliability of the sector coefficients. The latter depends to a large extent on the treatment of foreign transactions (imports and exports of commodities and services) in the table. This is criti-

cal in the case of less developed countries with relatively high reliance on foreign transactions and which are undergoing development-related structural changes (infrastructure and direct investment programs).

Also presented is the evolution of the incorporation of imports in the input-output table firstly of the UN for 1993, with 4 methods of presentation outlined, as well as for 1999 and the changes that have been made in the meantime, along with the corresponding table of Eurostat for 2001 and 2008, in order to track the development of this discussion for all countries and in particular for the European Union member states. The presentation concludes with a comparison of the methods adopted by the UN and Eurostat.

This paper consists of seven sections. Section 2 discusses the relevance of the problem. Section 3 present the classification of the methods, the first attempts to include foreign trade in the input-output Analysis, the different ways of treating competitive and non-competitive imports, the variable import coefficients method and imports as negative final demand. Section 4 concerns the less developed countries. Section 5 enumerates the recommendations of United Nations for the treatment of imports and the treatments of imports in the use table according to the United Nations for the year 1999. Section 6 describes the treatments of imports by Eurostat and Eurostat methodology for the year 2008. Finally, concluding remarks follow in Section 7

2. Relevance of the Problem

The relationships between domestic economy and foreign trade create a number of specific problems in the process of constructing an inter-industry model. Some progress has been made toward resolving these problems with respect to terminology (specification of stock-flow problems, methodology, estimation methods, statistical data reliability, etc.)⁽¹⁾. The recent revival of interest in the production side is expected to redirect attention in the major contributions to production theory with the help of input-output techniques.

This paper focuses on the allocation of imports in the input-output model. In fact, part of the imports are nearly identical to similar goods of domestic origin, while others are not produced within a country or are produced only in insignificant quantities⁽²⁾. Experimentation with different methods in certain countries

has shown complications in the allocation of imports. The prevailing opinion regarding imports seems to be that they should be treated in a separate analysis, outside the input-output model, with the results then being incorporated in the matrix by means of the import coefficient⁽³⁾.

The original balance equation of the input-output model in a closed economy is as follows: The economy is divided into n sectors. For each sector i the following holds

$$X_i = \sum a_{ij} X_j + Y_i \quad (1)$$

In matrix form this equation is written as

$$(I-A)X=Y \quad (2)$$

which is solved by matrix algebra. If foreign trade is now introduced into the system, the left hand side of equation (1) will be augmented by imports (M) and Y will contain also exported goods. Therefore, for the i row the following holds

$$X_i = \sum m_{ij} X_j = \sum a_{ij} X_j + Y_i \quad (1')$$

which in matrix form is written

$$(I+M-A)X=Y \quad (2')$$

or equivalently, $[I-(A-M)]X=Y \rightarrow (I-A')X=Y$, $A'=A-M$

X_i : total output (production) of sector i

Y_i : total final demand for sector i

m_{ij} : imported inputs matrix from sector i to sector j

a_{ij} : technological coefficients

A : technological coefficients matrix

$(I-A)^{-1}$: Leontief inverse

M : imported inputs matrix

M_i : imported inputs column vector

No particular problems arise in the solution of the system (2'). The only difference here is the import coefficients, whose addition to an identity matrix leads to their being contained in the resulting diagonal matrix. A slightly different but simpler treatment has to be followed in so far as imports enter final demand as an independent variable in the model rather than as input coefficients. In this case, we have

$$(I-A)X_i = Y_i - M_i \quad (3)$$

Since M_i is given exogenously, no problem arises in the solution of the system. The equation (3) gives a balance equation for each commodity or sector. In this system, there are n equations with n unknown production levels (X_i), n^2 parameters (a_{ij}) describing the input functions and two sets of n autonomous variables Y_i , M_i , whose values are specified for a given problem.

Below, we briefly refer to the methods used for foreign transactions in input-output studies to date and discuss some particular problems within the context of less developed countries.

3. Classification of the Methods

There are various ways to classify imports in an input-output table. However, only a few have been used in applied research, mainly because of lack of data. In fact most of the studies take total imports as a primary factor input. Imports can be classified on the basis of various criteria. One distinction can be made between competitive (also produced domestically) and non-competitive imports produced only abroad. Another criterion is the use of imported goods by final consumers as final commodities and by the producers as intermediaries or raw materials. Imports can also be classified in terms of capital and consumption goods. What should be stressed is that each classification creates different methodological problems in its application. One conclusion that naturally arises is that whatever method is used, certain other considerations must be taken into account. These additional considerations may refer to the time trends in substitution between the two sources of supply (domestic production and imports), expected changes in comparative costs, limitations of domestic productive capacity (where the import coefficients can be raised as this capacity limit is reached), or limitations of foreign supply capacity, in which case the import coefficients can be lowered as this capacity limit is reached. Exports do not seem to create such intricate problems with regard to their treatment in an input-output table, on the assumption that exported goods are similar and use exactly the same inputs as domestically absorbed ones.

3.1. First Attempts to include Foreign Trade in the Input-Output Analysis

Leontief⁽⁴⁾ has proposed that foreign trade be treated as a separate industry with imports representing its output and exports its input. According to the Leon-

tief approach, exports are frequently treated as an exogenous variable, i.e. as part of final demand. Institutional changes after the First World War, government loans to foreign countries and gold imports of unprecedented volume supplemented by various exchange stabilization devices, have weakened the close interrelationship between imports and exports to such an extent that in many cases it may be considered as non-existent.

As long as domestic demand for consumption and capital goods as well as exports constitute independent variables of final demand, an increase in final demand may be caused by increased domestic purchases, by additional exports or by both. This increase will affect output and employment in different branches of the economy in a specific way. As long as both are treated as exogenous variables, the employment coefficients of exports will be identical to the corresponding employment coefficients of domestic demand for consumption and capital goods. However, in the case of an effort to support exports, the employment coefficients of exports will differ from those of domestically consumed products, because in such a case more skilled workers may be used.

3.2. Different ways of treating Competitive and Non-competitive Imports

As noted above, Leontief (1951) has proposed that foreign trade be treated as a separate industry with imports representing its output and exports its input. He considered the problem of allocating imported goods by final use sector to be quite complicated, given the lack of necessary data. This problem is more or less solved for non-competitive imports, which do not and cannot possibly come from domestic resources. The data showing the consumption of such kinds of imports by different industry at the same time indicate the distribution of the imports of these goods. However, data on consumption of imported competitive goods that are also produced domestically leave open the question about what part are imports, since no separate data are usually available on changes in stocks⁽⁵⁾.

Leontief uses an obvious method to take into account the internal logic of the relationship between competitive imports and similar domestically produced commodities. Competitive agricultural imports, for instance, can be charged to domestic agriculture and the same amount can be added to the domestic net

output of agriculture. The total supply of agriculture thus obtained is then distributed between the consuming industries. In such a case, the question is what quantities of imports have been absorbed by other sectors using inputs of the agricultural sector. One possible assumption is that these sectors use imported agricultural (competitive) goods in the same proportion of imports to the total supply of these goods. In fact, all sectors created in this way use a common import coefficient for their agricultural component. Consequently, this “proportionality assumption” constitutes an extreme approach⁽⁶⁾. The meaning of this assumption is, however, rather peculiar since these imports are allocated not to consuming industries, but to the competing domestic industry. These observations suggest an alternative method of entering competitive imports in the input-output table. It consists of direct allocation of competitive imports to consuming industries. It is assumed here that each of these industries absorbs imports in the same relative combination that it also absorbs domestic competitive output. Although this assumption is also fictitious⁽⁷⁾, this treatment has the advantage of greater flexibility, since it allows divergence from the proportional distribution of imports in all those cases in which specific non-proportional allocation is actually possible and thus is obviously preferable.

In a later stage, the classification of imports into competitive and non-competitive has begun to be applied in input-output models⁽⁹⁾. Specifically, non-competitive imports are entered c.i.f. as inputs along one row of the table so that individual entries indicate usage by industries⁽¹⁰⁾. Competitive imports are assigned to the industries and added to their output before allocation among using industries. This is in fact equivalent to Leontief’s proposal for total imports. Competitive imports are treated as an addition to the supply of domestic industry with whose output they compete. They are left as they are allocated among buyers –intermediate or final– and are not separately distinguished in the input-output table. They are, however, deducted from the supply before setting up the coefficient matrix. The underlying assumption is that inputs are determined by home production and that any shortage of the finished product is eventually made up by importing competitive products manufactured abroad. The only thing that remains is that to reach total domestic gross output, these imports must be deducted and hence they are

entered as a column of elements with negative signs in the final demand. In the above model the competitive imports are treated as a negative exogenous element⁽¹¹⁾ and have no place in the calculation of the import content of domestic production, which consists only of non-competitive imports. It is possible, however, to use a variant (different form), which includes competitive imports as an endogenous element, i.e. instead of being treated as negative output of the industry with which they compete, competitive imports can be treated as an input into that industry. Then, the outflow from the industry is considered not as output but as the total of supplies made available through that industry. According to this treatment of imports as an endogenous variable, the procedure set out below is followed:

In the case that the model does not include imports, the equation representing total supply is

$$x = Xi + f \quad (1a)$$

x : vector of domestically produced output

X : matrix of intermediate inputs

f : vector of total final demand (excluding imports)

i : the column unitary vector

In addition, it holds that

$$X = A \quad (1b)$$

A : matrix of technological coefficients

\hat{x} : diagonal form of x

Combination of (1a) and (1b) results in

$$x = A(\hat{x})i + f = Ax + f, \text{ or } x = Ax + f.$$

Solving the latter matrix equation in x we get

$$x = (I - A)^{-1}f \quad (1c)$$

In the case that imports are included in the model, with imports in final demand denoted by f_m , the equation (1a) takes the form $x = Xi + f - f_m$. Now X is the matrix of intermediate products made up of domestic production and competitive imports. Defining $x + f_m = x^*$ (1a) becomes

$$x^* = Xi + f \quad (2a)$$

If B is the matrix of new technological coefficients for (2a), it holds that

$$X = B(\hat{x}^*) \quad (2b)$$

\hat{x}^* : diagonal matrix of the elements of x^* (total supply)

Combination of (2a) and (2b) results in $x^* = A(\hat{x}^*)i + f = Ax^* + f$, or $x^* = Bx^* + f$. Solving this matrix in x^* we get

$$x^* = (I - B)^{-1}f \quad (2c)$$

It results from 1b and 2b that $A(\hat{x})=B(\hat{x}^*) \implies A(\hat{x})(\hat{x}^*)^{-1}=B(\hat{x}^*)(\hat{x}^*)^{-1}=B$, that is

$$A(\hat{x})(\hat{x}^*)^{-1}=B \quad (3a)$$

Defining $\hat{r}=(\hat{x})(\hat{x}^*)^{-1}$ (3a) becomes $A(\hat{r})=B$. Substituting the last equation in (2c) we obtain $x^*=(I-B)^{-1}f=(I-A(\hat{r}))^{-1}f$, hence

$$(I-B)^{-1}f=(I-A(\hat{r}))^{-1}f \quad (3b)$$

In this way, the total content of imports, including both competitive and non-competitive imports, can be expressed as the product of the transpose of the inverse matrix, $(I-B)^{-1}$, multiplied by a vector whose elements are the ratios of total imports to total supplies in each industry.

The above treatment of imports implies that both competitive and non-competitive imports are now endogenous variables. In this model, as mentioned above, total domestic output is replaced by total available supply including all imports and the coefficient matrix B relates inputs to total supply. Imports are treated in the same way as other input, i.e. as a constant fraction of total supply. Using this model, one can project total imports for given final demands⁽¹²⁾. However, as noted by Ghosh (1964), this endogenous treatment of imports does not give a very impressive performance, because in that period (1948 and after) on account of the currency difficulties and balance of payments crises which the UK faced, it would be more reasonable to treat imports as exogenous.

With regard to the above problems, Leontief (1951) observes that to treat the import coefficients of competitive imports as dependent variables⁽¹³⁾ is impractical because of the highly complex nature of casual relationships between competitive imports and the variations in world market conditions.

3.3. Variable Import Coefficients Method

Some research on input-output tables has already begun treating competitive imports by introducing a variable import coefficient for each sector⁽¹⁴⁾. The values adopted for this coefficient are an explicit estimate of the fraction of “requirements” for an industry’s products, which will be met by imports, as opposed to domestic production. Thus, variable input coefficients are estimated for sectors that have competitive imports. It

should be stressed that the estimation of this coefficient presupposes a separate task outside the model itself. Hence, in estimating import requirements one should allow for time-trends in substitution between the two sources of supply, expected changes in comparative costs, limitations of domestic productive capacity (in which case the import coefficient can be raised as this capacity limit is reached) or limitations of foreign supply capacity (in which case the import coefficient can be lowered as this capacity is reached). Only by taking into consideration all these factors could adequate evidence be provided of the substitution possibilities that exist in the specific country. The respective analysis indeed appears to be a very complex –though necessary– task, particularly in the case of economies with a rapidly changing structure.

3.4. Imports as negative final demand

When governments seek an extensive rapid readjustment in productive machinery for a certain purpose (for instance preparation for war), they must investigate the possibilities of domestic resources apart from the foreign sector. This is the case of the so-called “emergency models”⁽¹⁵⁾ in which total imports are treated as negative final demand. This approach may be viewed as another extreme in the treatment of imports (compared with the original method of considering total imports as an endogenous variable). There is no problem for exports as long as they too are treated as an element of final demand in the model. Evidently this approach simplifies things by entirely avoiding the use of input coefficients for competitive imports. This simplification is not however likely to work well for many important imports in countries highly dependent on foreign trade⁽¹⁶⁾.

At least in the first stages of development, underdeveloped countries import from abroad most of the intermediaries or raw materials and capital goods, even if we leave aside imported consumer commodities. Given the low degree of integration of these countries, the import requirements involved in any rapid readjustment of productive machinery may be considerably higher. The emergency model is of course of more general interest, because it represents one kind of application of inter-industry analysis in the event that the economy must readjust its productive structure within a short period of time. Moreover, a national emergency will al-

most surely prompt government policies to guide and accelerate the desired reallocation of resources⁽¹⁷⁾. In other words, over a short period of time, it is mainly changes in final demand, rather than technical change, that will affect the technical coefficients of the model, given that changes in technology are considered to take place over the long term.

Making the final demand projections conceptually consistent with the basic inter-industry matrix is a difficult technical problem. A great deal of research effort had to be put into constructing special price indices for deflating the final outputs of each industry in a specific year. Moreover, adjustment has to be made for numerous definitional points.

4. Less developed Countries

A number of considerations are presented here on the criteria used for the treatment of imports in input-output models. Reference is then made to the particular problems in less developed countries. Generally speaking, imports have attracted more attention, since in many countries successful treatment of import problems is a necessary condition for the success of input-output as an analytical tool. The treatment of imports may be viewed as one of the most important problems that the input-output model must face when it is applied.

In practice, given the availability of data, the most common classification is, as we have already seen, into competitive and non-competitive imports. This general classification of imports, which is based on narrow technological criteria, tends not to work in practice. Being artificial, the distinction tends to be ambiguous in its economic context, where changes in relative prices between domestically and foreign produced commodities, low elasticity in domestic supply in the short term, as well as import and currency controls, can transform a competitive product into a non-competitive one. Conversely, in a world of rapid technological change, what really matters is potential substitutability rather than actual supply resources (a non-competitive natural product can become an import competitor for new domestically produced synthetics). The critical question is: under what circumstances is it permissible to treat an import as an addition to home supply (competitive) and when not?

Since inter-industry analysis is more relevant in situations where the composition of output is expected to change rapidly, particular attention must be given to its application in countries on the path to industrialization. As with the treatment of foreign transactions, much more emphasis must be placed on these countries, given the limitations imposed by their balance of payments. In all these countries, a high proportion of capital goods –and sometimes of raw materials– are imported. Miscalculation of import requirements is likely to result in bottlenecks for further progress. But this is not the only problem concerning the relative interdependence of the domestic sectors as compared with their dependence on foreign transactions. There may be important exporting sectors (extractive industries) and other sectors may be more heavily reliant on imports than on the domestic economy. In such a case, interdependence in the economy is very low and the usefulness of the input-output table is doubtful⁽¹⁸⁾.

Studies in less developed countries do not treat external transactions in significantly different ways to those adopted for advanced countries. Generally speaking, total imports are taken as inputs either in a separate row or as distinct import content in each cell⁽¹⁹⁾. Choosing not to combine competitive imports with domestic inputs is justified by the complications that would result, particularly for calculating the savings, for example, that would accrue from a policy of import substitution. A process of rapid substitution results not only from a decrease in the import content of competitive imports in favour of local industry, but also probably entails the installation of new domestic activities, particularly for non-competitive imports, and a decrease in the number of such imports. In both cases, a shift in input coefficients from imports to domestic production will occur.

In the initial stages of economic development, all imports have no technical relationship with the domestic economy. Consequently, these are non-competitive and the respective products are given directly to final demand. Thus, the introduction of a new activity in the economy requires a row and a new column, showing deliveries to and purchases from other sectors of the economy respectively. This new industry will affect the previously existing technical coefficients, the frequency of change in which is closely connected with the country's rate of development. The relevant imported com-

modity thus becomes an alternative source of domestic supply. This may be viewed as the process by which the non-competitive imports of small underdeveloped countries become competitive.

Certain qualifications of this process appear to be necessary here. Indeed, when the less developed economy begins foreign transactions, it starts importing not only final commodities that are not produced domestically, but also materials and equipment for improving technical methods in already existing sectors (e.g. tractors, weaving machines). Clearly, these imports are closely connected with the output of the respective sectors. So these imports are treated as inputs in these sectors. However, this does not appear to apply in the case of imported final commodities, which are not produced domestically. There is no row or column for those sectors in the original input-output table. In such a case there are two possibilities: either these products can be entered in total as a unique number in a separate row in final demand, or they can be distributed by corresponding sector along with the raw materials and machinery of those sectors. The second case is the most usual way of treating inputs in input-output studies to date. This merging of non-competitive⁽²⁰⁾ final commodities with raw materials and services leads to a misleading estimation of the import requirements in raw materials and final goods for these sectors. For example, the question as to how much imports must change as the result of establishing a new industry that substitutes the final commodities but were imported in the past cannot be answered directly by such a table. But in the case of a developing country this is of great importance. Another problem concerns the treatment of competitive imports of materials and final commodities together and their total to be used in estimating the ratio of imports to domestic supply⁽²¹⁾. The distribution of imports among consuming sectors may give a wrong distribution of imports by consuming industry and an inaccurate estimate of the impact of the substitution process on import savings (balance of payments as an investment criterion). Many of these errors would probably disappear if imports of final competitive goods were taken as negative final demand.

One possible conclusion regarding exports is that they should not be considered as autonomous, as an element of final demand. In the case of underdeveloped countries, exported agricultural products are in fact of

low (income and price) elasticity demand, while export potential sometimes derives more as a residual of domestic demand to be absorbed by external demand. The elasticity of supply of manufacturing goods in the world market is around zero. Indeed, the decline in the share of agricultural products in total world trade is connected with a widening of the gap in per-capita incomes, which is a measure of productivity and production in both underdeveloped and advanced countries.

One direct conclusion could be that the above-described methods of import allocation imply different models of how an industrial system reacts to imports. Although the import distribution methods do not lead to identical results, adjustments can be made to bring them into closer proximity. The question arises as to which method is preferable. There is no clear-cut answer, but the trend is for competitive imports to be classified as negative final demand and for imports of intermediate goods to be treated separately from imports – the latter being allocated directly to the final user⁽²²⁾.

Another recommendation with regard to the distribution of imports in input-output models derives from a debate⁽²³⁾ indicating that all possible efforts should be made to arrive at the compilation of two separate matrices: one showing the allocation of imports originating in the corresponding foreign countries, and one for domestic production.

One further observation should be made here: leaving relative prices out of the analysis may be excused in an input-output study of a closed economy. But such an omission may be considered quite unsatisfactory, if not inconsistent, in the study of an open economy. The usual assumption for a closed economy is that due to the high degree of complementarity among inputs, changes in relative prices will affect their proportions only slightly. The high complementarity assumption tends to be confirmed more in the short term, when equipment cannot expand significantly as happens in the long term. Technical progress attained over longer periods may not be inconsistent with the stable input-output coefficients. But this does not imply that a number of assumptions in Leontief's system do not require discussion (such as, for example, the assumption that the relative prices of commodities depend only on their direct and indirect labour content, and real wages express true social costs)⁽²⁴⁾, particularly in a changing environment. The position here is that in an open economy –and par-

ticularly in less developed countries– omitting relative prices from the input-output model is not justifiable. This assertion can be supported by the fact that the prices of imported goods, and more or less the prices of exported ones, are given, i.e. they are determined by the world market outside of the input-output system. Consequently, changes inevitably affect the technical coefficients of the model as an “exogenous” factor. This aspect, of course, requires further investigation.

5. Recommendations of United Nations for Treatment of Imports

According to Holub and Schnabl (1985), several proposals have been advanced in the Input-Output Matrix (IOM) literature concerning the embedding of imports in the IOM. The authors present some methods proposed by the United Nations (UN, 1973, pp. 53-63), along with some comments on the advantages and weak points of each method. According to the UN approach, imports can be registered according to four methods, which are labelled as methods A, B, C and D. Here we discuss each method separately. It is convenient, however, to present these methods in a different sequence to the one indicated in the UN approach.

Method D: Split Import Matrices (as per UN ‘Split matrices for imported and domestic products’)

Given the importance of imports for the economy, it is necessary for them to be registered in every possible detail. This is best obtained by pairing domestic production and imports in the aggregate matrix. Imports, in turn, are classified by use and by origin. Such an import matrix includes all information needed to investigate the structure, level and volume of the imports. Therefore, the import matrix is as a rule the starting point for the classification of imports in the IOM (this is the case even when this method is not explicitly mentioned by the matrix compilers, mainly for reasons of doubtful accuracy of the data). This characteristic of method D allows for the complete embedding of the import matrix in the IOM and offers a high level of generality to the presentation, so that methods A and B can be considered as an aggregation of the elements in D, or as rearrangements of its components (method C). According to method D, the IOM matrix has the following arrangement, showing paired domestic production and imports, X_{ij}^d and X_{ij}^m .

$$\begin{matrix} X_{ij}^d & E_{ik}^d & X_i^d \end{matrix}$$

$$\begin{matrix} X_{ij}^m & E_{ik}^m & X_i^m \end{matrix}$$

$$PA_{ij}$$

$$X_j^d$$

- X_{ij}^d domestic intermediate products (matrix $n \times n$)
- $X_{.j}^d, X_i^d$ total domestic production
- E_{ik}^d final demand for domestic products
- X_{ij}^m imported intermediate products (matrix $n \times n$)
- X_i^m total value of imported products
- E_{ik}^m imported products for final demand
- PA_{ij} initial expenditure

The advantage of this method is that it allows import origin to be conceived as overseas suppliers and use areas as domestic buyers. Furthermore, the method allows for extended searching through substitution effects. However this method demands a wealth of statistical information, which is indispensable for the satisfactory classification of imports, regardless of the method used to compile an IOM - at least on a national level. The information provided by importers does not usually contain data on the origin of imported products, especially when the product is not purchased directly from the manufacturer.

Method B: Classification of imports by purchaser

Method B, which the UN refers to as ‘Inputs classified by purchaser’, treats imports according to sector of use (purchaser). From a technical viewpoint, transactions in the IOM are shown as sums of the elements X_{ijm} and E_{ikm} of the matrix built according to method D. Thus, the elements of the IOM show only domestic transactions. Imported products and services are presented in a row, which belongs to initial input, in the sectors of domestic production and final demand (regardless of whether the imports come directly from the manufacturer or indirectly from other traders). The arrangement in this method is as follows:

$$\begin{matrix} X_{ij}^d & E_{ik}^d & X_i^d \end{matrix}$$

$$\boxed{X_{\cdot j}^m} \quad \boxed{E_{\cdot j}^m} \quad \boxed{M}$$

$$\boxed{PA_{ij}}$$

$$\boxed{X_{\cdot j}^d}$$

The advantage of this method is that it changes the IOM technique back into its standard form, which allows for only domestic transactions. In addition, an analysis using method B can identify the effects of interdependency in aggregate domestic production. However, the method has several weaknesses: it hides important information relating to the origin and to the type of imported products. Moreover, it does not show the intermediate transactions for each separate sector and the role of imports is not shown. There again, in the case that the imported product is a substitute of a domestic product, an increment of domestic demand can be obtained as a cost of the imported product. In such a case however, a significant modification takes place regarding the coefficients of production for domestic products, which cannot be detected in the form of the IOM constructed by method B.

Method A: Classification of imports by commodity

Method A, referred to by the UN as ‘Imports classified by commodity’, gives all imports a commodity classification, i.e. it allocates imports to those sectors of domestic production which manufacture the same or nearly the same products and distributes them along with their outputs to purchasers. According to this method, the total outputs of the sectors are shown in the fields of the IOM. Because of this treatment of imports, the IOM is termed a matrix of technological interrelations. The method is obtained from method D by adding the matrix of intermediate imports X_{ijm} to the matrix of domestic intermediate transactions X_{ijd} and by adding the matrix of final demand for domestic products E_{ijd} and the matrix of final demand for imported products E_{ijm} . But the result of this method is that the horizontal aggregate is greater than domestic output in terms of value of imports. For this reason, the horizontal aggregate of production in a given sector is not equal to the aggregate of supplied values, but equal to the aggregate value of domestic production and the value of those imported products that are similar or quite similar to the products of that sector. This results

in the violation of the identity of the sums of the rows and columns of the IOM. To avoid this perverse result two corrections are used, denoted as correction A1 and correction A2.

Correction A1

$$\boxed{X_{ij} = X_{ij}^d + X_{ij}^m} \quad \boxed{E_{ik} = E_{ik}^d + E_{ik}^m} \quad \boxed{-X_{i\cdot}^m} \quad \boxed{X_{i\cdot}^d}$$

$$\boxed{PA_{ij}}$$

$$\boxed{X_{\cdot j}^d}$$

where $-X_{i\cdot}^m$ is the negative column of imports classified by commodity

Correction A2

$$\boxed{X_{ij} = X_{ij}^d + X_{ij}^m} \quad \boxed{E_{ik} = E_{ik}^d + E_{ik}^m} \quad \boxed{X_i^{d+m}}$$

$$\boxed{PA_{ij}}$$

$$\boxed{X_{\cdot j}^d}$$

$\boxed{X_{i\cdot}^m}$ ← Positive row of imports, classified by commodity

$$\boxed{X_{\cdot j}^{d+m}}$$

In both corrections the identity of the sums is obtained through the use of a vector, which is classified by commodity. In correction A1 the correction vector is added to the matrix of final demand as a negative vector, so that the identity of the row sums and column sums $X_{i\cdot}^d$ and $X_{\cdot j}^d$ in the IOM is preserved. Because it takes into account the technological interrelations resulting in the usual values of gross production, method A1 is well suited to the purposes of the input-output analysis. The second method A2 classifies imports by commodity. The imports are placed under the initial row of expenditures. This arrangement differs from that of method B, in which the imports row contains the imports by region of user. Method A2 allows for a correction row vector of imports, consisting of imports by origin of production. Since the correction vector –negative column as per method A1 and positive row as per A2– has the same content, in the above schema the row vector is denoted as $X_{i\cdot}^m$, unlike the usual symbol for row vectors. As an input-output analysis tool, Method A2 has the disadvantage that the sums of the rows and the col-

umns no longer reflect the values of gross production, but rather the aggregate receipts $X_{\cdot j}^{d+m}$ and $X_{i\cdot}^{d+m}$.

Method C: Separation into complementary and competitive imports

For analytical reasons, imports must sometimes be divided into complementary and competitive products and services. In the framework of this method, competitive imported products are also supposed to be manufactured in the domestic economy, while competitive products are manufactured only abroad. Competitive imports are shown together with domestic production, allocated to purchasers and treated in the same way as all imports in Method A. Complementary imports are separately allocated to different purchasers.

This method, referred to by the UN as ‘*complementary and competitive imports*’, is built in such a way that the intermediate products matrix includes only domestic products and competitive imports ($X_{ij} = X_{ij}^d + \hat{X}_{ij}^m$, where \hat{X}_{ij}^m denotes the matrix of competitive imports). When the correction vector is applied in the ‘by commodity’ method, the IOM acquires the following arrangement:

$X_{ij} = X_{ij}^d + \hat{X}_{ij}^m$	$E_{ik} = E_{ik}^d + \hat{E}_{ik}^m$	$-\hat{X}_{i\cdot}^m$ (competitive imports)	$X_{i\cdot}^d$
${}^c X_{\cdot j}^m$ (complementary imports)	${}^c E_{\cdot j}^m$ (complementary imports)		
PA_{ij}			
$X_{\cdot j}^d$			

In order for the row and the column aggregates to present the values of gross production, it is necessary for competitive imports, which are included in the main matrix \hat{X}_{ij}^m , to be corrected with a negative $-\hat{X}_{i\cdot}^m$. Furthermore, since the central matrix includes only competitive imports, it is necessary for the complementary imports, which are omitted in method B, to be registered in an imports row by commodity. In practice, however, it is usually very difficult to separate competitive and complementary imports. Therefore, as a rule, the more detailed the registration of complementary products in the IOM, the more they appear with higher values. For example, when only the ‘Food and entertainment’

row exists, this is a competitive product. But when this item is further divided into subcategories there appear products that are complementary to those contained in the initial competitive row. When domestic production of a product is very low and the rest of its consumption comes from imports, then the product is usually labelled as a complementary import for its total value. A further difficulty emerges in comparing IOMs of different countries, since the same product can appear in one country as a competitive product, while in one other as complementary.

Treatment of imports in the use table according to the United Nations for the year 1999

Valuation of imports

In input-output analysis, imports must be incorporated as part of the use table. To do this, the use table must be at basic prices while imports must be entered as negative values and become part of net final demand.

Types of imports

As noted above, imports are usually classified into two types, namely competitive and non-competitive, the latter also being called complementary imports. Competitive imports are imported products that are also produced by the domestic economy. Non-competitive imports are those products that either cannot be produced or are not yet produced in the country.

- a) Non-competitive imports

In use tables, non-competitive imports are treated as a separate row. They have no corresponding column since no equivalent products are produced domestically.
- b) Competitive imports

The total value of non-competitive imports is now considered as the import of only one product. The imported product is treated in the same fashion as its domestic counterpart.

Alternative presentation of imports in the use table

This section will discuss alternative ways of presenting imports in the use table so as to provide information for economic analysis by using I/O models.

In the case of non-competitive imports, there is no alternative to the treatment set out above. In other

words they must be included in the use matrix as either a single row, each of its elements representing all non-competitive imports used by an industry, or as a number of rows, each row representing a non-competitive imported product.

However, there are two different ways to show competitive imports in the use table, i.e. uses of domestic and imported goods and services shown together or separately.

The first is to show all inputs consumed in the intermediate demand matrix and in final expenditures

Table 1. Input-Output table with total input presented in the intermediate and final demand matrices

Products	Intermediate consumption		Net final demand	Net final demand	Product Output
	1	2	Final demand	Imports	
1	18.0	36.0	80.0	-34.0	100
2	42.0	36.0	62.0	-38.0	102
Non-competitive imports	5.0			-5.0	0
Value added	35.0	30.0			
Industry output	100.0	102.0			

Table 2. Input – Output table with domestic and imported resources separated

Products	Intermediate consumption of domestic products		Final demand		Product Output
	1	2			
1	10.0	20.0	70.0		100.0
2	30.0	16.0	56.0		102.0
Non-competitive imports					
Import of product 1	8.0	16.0	10.0		
Import of product 2	12.0	20.0	6.0		
Value added	35.0	30.0			
Industry output	100.0	102.0			

regardless of origin of supply. This method is shown in table 1.

The sum total of consumption in each row is the supply of a product. The total product output produced by the economy is then obtained by subtracting imports from total supply. This method has the advantage of showing the technical requirements of each industry.

The other method (uses of domestic and imported goods and services separately) presents competitive goods and services in the same manner as the treatment of non-competitive imports, that is, imported inputs are shown separately from domestic ones.

This method is shown in table 2.

The second method is used by many countries. It will provide information for the basic I/O model.

6. The treatment of imports by Eurostat

According to Eurostat (2001) one input-output technique treats import matrices from the use side. The supply of imports as shown in the supply table are allo-

cated to the different use categories of intermediate and final use. This treatment consists in separating the use of imported goods and services from the use of goods and services from domestic production. These matrices include the intermediate use part of the import matrix, which shows the use of imported goods and services by industry in the columns, and by products in the row, while the final demand part of the import matrix shows the use of imported goods and services by category of final use in the columns and by product in the rows. This separation of domestically produced and imported goods and services is necessary for analytical purposes. The use table of imports constitutes the basis for constructing the symmetric import matrix. Although it is not necessary to separate the use of domestically produced products from that of imported products in the supply and use technique, it is necessary in the case that the link between the supply and the use of goods and services within the national economy is relevant, as for example in the analysis of the impact of changes in

exports or final consumption expenditures on imports, domestic production and related variables such as employment.

Eurostat offers a detailed description of the concepts and definition of imports with emphasis on products as part of total supply. Also described are the valuation of imports, the main problems concerning the compilation of the supply of imports (data sources, coverage, etc.). Imports are shown as a vector by product, subdivided between goods and services. In addition, imports can be subdivided by region, or by EU and non-EU, transforming the import supply vector into a matrix of import supply.

The data in the use table of imports must be subtracted from the use table at purchasers' prices in order to arrive at the use table showing domestic products only. A further step would be to subtract and reallocate the trade and transport margins and deduct taxes less subsidies on products in order to achieve the final supply and use system at basic prices. Moreover, the use table of imports can show supplementary classifications, e.g. distinction between competitive and complementary imports or imports subdivided by geographical breakdown, separation of the use of imports coming from within or intra-EU or according to any other required classification.

The distinction between competitive imports, which are products that are also domestically produced and complementary imports, which are products that are not domestically produced, is of analytical interest as both types of imports can have different relationships and importance for the national economy: competitive imports can be analysed in the framework of substitution policies and effects, while complementary imports are indispensable in the short run. For the determination of this distinction, the product level of disaggregation is important. But while the distinction between competitive and complementary imports is clear in principle, a number of ambiguous cases must be resolved in practice. Classifying the products as competitive or complementary is difficult even when working with a very detailed product list. Furthermore, any classification changes over time. Besides, the large increase in inter-industry trade diminishes interest in such a distinction, with the exception of certain mining or energy products. Due to these difficulties, as shown by the experience of countries that tried to implement such a

distinction in their national supply and use framework, the results are not satisfactory. However, Eurostat does not require treatment of import matrices by distinguishing between competitive and complementary imports. A geographical breakdown of the use table of imports is relatively easier to compile, as there may be data problems but no basic conceptual problems. In the case of goods, information about the geographical origin of products can be obtained from foreign trade statistics. However, problems arise in the case of services with regard to the geographical origin of imports. Besides, when compiling use tables on imports in a geographical breakdown, there is the problem of how to allocate an identical product imported from two geographical regions to the respective use categories. There is also the question of whether one should allocate it in proportion to the assumed users. Similar questions already arise when compiling the use table of imports without geographical breakdowns. Therefore, any geographical breakdown needs additional assumptions in order to allocate the imports.

The practice adopted by Eurostat is to compile an aggregated EU-input-output table on the basis of national input-output tables, which has separate import matrices for EU and non-EU imports. However, a multi-regional input-output table with the member states as regions would have to distinguish the imports of each country from the imports from all other member states.

Table 1 below shows the use table for imports along with the entire system of supply and use. The table has the same format as the use table at basic prices and distinguishes two main submatrices: one for intermediate use and one for final uses. This table also shows the use of imported goods and services by product and by industry and final use categories. The total use of imports (column 5) is equal to the total supply of imports as shown in the supply table. The equality holds for each of the products distinguished in the supply and use system.

Compilation of a symmetric use table of imports

A use table of imports is also necessary for the symmetric use table of imports. Table 2 shows such an import matrix. The final use part is unchanged as the data are already classified by product. Direct information on the use of imported goods and services by industry is

usually not available, so the elaboration of this matrix needs to be based on certain assumptions and indirect estimation methods. This also holds for the final demand part of the use table. Only in exceptional cases where a certain product is obviously only imported and not domestically produced can one conclude the respective use of these imports.

Having transformed the use of imports into the product by product dimension, the final input-output system is achieved as shown in Table 3. The table shows the symmetric input-output table for domestic output and is the basis for input-output analyses. According to Eurostat (2001) the use table of imports will have to be compiled on the basis of plausible assumptions based on the nature of the imported goods and services.

From a theoretical point of view the question arises to whether imported products should be treated as fully homogeneous with domestically produced products, in which case there will be no preference on the part of a user regarding whether a domestic or an imported product is purchased. In practice, this means that the import share of a product could be assumed to be the same in all uses. So, in the case where there is no specific information, imports would be allocated to users in the same proportion. Even if this consideration is not accepted in theory, in practice there is no other way to construct the use table of imports due to the lack of specific data.

Eurostat methodology for the year 2008

Table 1. Input-Output table with total input presented in the intermediate and final demand matrices

		Industries (NACE) 123...n	Σ (1)	Final uses a) b) c) d) e) f)	Σ (3)	Σ (1) + Σ (3)
		(1)	(2)	(3)	(4)	(5)
1	(1)	For imported products: Intermediate consumption at c.i.f. values by product and by industry		For imported products: Final uses at c.i.f. values: Final consumption expenditure: a) by household b) by NPISH c) by government Gross capital formation: d) gross fixed capital formation and valuables e) changes in inventories f) exports- re-exports		
2						
3						
-						
-						
-						
Products (CPA) m						
Σ (1)	(2)	Total intermediate consumption of imported products by industry		Total final uses of imported products by type		Total imports

NACE: Nomenclature generale des activites economiques dans les Communautés europeennes.

Table 2 A symmetric table of use of imports at c.i.f. values

		Products (CPA) 123...n	Σ (1)	Final uses a) b) c) d) e) f)	Σ (3)	Σ (1) + Σ (3)
		(1)	(2)	(3)	(4)	(5)
1	(1)	For imported products: Intermediate consumption at c.i.f. values by product and by product		For imported products: Final uses at c.i.f. prices: Final consumption expenditure: a) by household b) by NPISH c) by government Gross capital formation: d) gross fixed capital formation and valuables e) changes in inventories f) exports/re-exports		
2						
3						
-						
-						
-						
Products (CPA) n						
Σ (1)	(2)	Total intermediate consumption of imported products		Total final uses of imported products		Total use of imported products

CPA: Classifications of Products by Activity

Table 3: A symmetric input-output table for domestic output (product by product)

	Products (CPA) 1 2 3 ... n	Σ (1)	Final uses a) b) c) d) e) f)	Σ (3)	Σ (1) + Σ (3)
	(1)	(2)	(3)	(4)	(5)
1 2 3 : - - Products (CPA) - - - r	(1) For domestic output: Intermediate consumption at basic prices by product and by product		For domestic output: Final uses at basic prices: Final consumption expenditure: a) by household b) by NPISH c) by government Gross capital formation: d) gross fixed capital formation and valuables e) changes in inventories f) exports		
Σ (1)	(2) Total intermediate consumption of domestic output at basic prices by product		Final use of domestic output at basic prices		Total domestic output at basic prices
Use of imported products	(3) Total intermediate consumption of imported products by product		Final use of imported products at basic prices		Total imports
Net taxes on products	(4) Net taxes on products for intermediate consumption by product		Net taxes on products for final use		Total net taxes on products
Σ (1)+(3)+(4)	(5) Total intermediate consumption at purchasers' prices by product		Total final uses by type at purchasers' prices		Total use at purchasers' prices
	(6) Components of value added by product				
Compensation of employees Other net taxes on production Consumption of fixed capital Operating surplus, net	(7) Value added by product				
Σ (6)	(8) Output at basic prices by product				
Σ (1)+(3)+(4)+ Σ (6)					

The ideal breakdown of the import matrix involves three components:

- Imports classified into goods and services, as their conceptual and empirical characteristics are completely different.
- Geographical breakdown of imports and exports, according to intra-EU trade and extra-EU trade.
- There is also the theoretical traditional classification of imports into products that are also domestically produced ("competitive imports") and products that are not domestically produced ("complementary imports").

This breakdown is important in terms of theoretical extensions of the input-output framework, as in the case of analyzing the impact of increasing prices of im-

ported goods (for instance, an increase in the price of oil). Another more frequently discussed example is the traditional policy of substituting imports with national production.

The analytical potential would be enhanced if the use table of imports also showed supplementary classifications, such as a distinction between competitive and complementary imports, or imports subdivided by regions, e.g. a separation of imports coming from within the EU and from outside the EU.

In theory, the distinction between competitive and complementary imports appears to be clear. In practice however, a number of borderline cases must be resolved. For the validity of this distinction, the product level of disaggregation is of the utmost importance.

Even on a very detailed product level it is sometimes quite difficult to classify products as competitive or complementary. Furthermore, this classification may not be stable over time.

Because of these practical difficulties, the experience of countries which attempted to apply such a distinction in their national supply and use framework is not very encouraging. Moreover, the large increase in inter-industry trade in recent decades due to globalization may have reduced the interest in such a distinction, perhaps with the exceptions of certain mining or energy products. However, it should be noted that ESA 1995 does not require the compilation of import matrices that distinguish between competitive and complementary imports.

Compared to the distinction between competitive and complementary imports, a geographical breakdown of the use table of imports is easier to compile, as there may be data problems but no basic conceptual problems.

7. Concluding Remarks

The prevailing method for inserting imports in the input-output table –particularly in EU countries– is essentially the one suggested by Eurostat, taking into consideration all the problems mentioned above.

According to the Eurostat approach, due to a lack of data and the extensive inter-dependency between European countries, the classification of imports into competitive and non-competitive goods is not feasible. Instead, the adopted method is the classification of imports by geographic area.

In theory, the distinction between competitive and complementary imports appears to be quite clear. In practice, however, a number of ambiguities must be resolved. Even if working on a very detailed product classification, it would still be difficult to classify products as competitive or complementary. In view of these problems, in its treatment of import matrices Eurostat does not require a distinction to be made between competitive and complementary imports and instead opts to compile tables based on a geographical breakdown of the use table of imports, which is easier to compile.

The above analysis also leads to the conclusion that in an open economy – and particularly in less developed countries – the omission of relative prices in the input-output model is not justifiable. This assertion can

be supported by the fact that the prices of imported goods, and to some extent also the prices of exported goods, are given, i.e. they are determined by the world market outside of the input-output system. Consequently, changes inevitably affect the technical coefficients of the model as an “exogenous” factor. Naturally, this aspect requires further investigation.

It emerges from the comparison of Eurostat and the UN that in 1993 the UN had 4 methods of presenting imports and although it had fewer methods in 1999, it retained the distinction between competitive and complementary imports. In 2001 and 2008 Eurostat used the UN’s method B but did not make any distinction between competitive and complementary imports. However, Eurostat cannot be criticised for this, since – as already noted – most methods in practice have a data problem and the distinction between competitive and complementary imports is of interest to developing countries, not the EU member states, the majority of which are developed countries.

Notes

- (1) Luigi L. Pasinetti, *Lezioni di Teoria della Produzione*, Soc. Ed. il Mulino, Bologna 1975, Greek translation A.S. Korkotsidis, *Παραδόσεις θεωρίας της Παραγωγής*, Kritiki Publications, Scientific Library, Athens 1991 – Chenery H., Clark P., “Interindustry Economics”, New York: John Wiley and Sons, 1959, p. 153.
- (2) Leontief W.W., “The Structure of the American Economy 1919-39”, N.Y. 2nd Edition Oxford University Press 1951, p. 164 – Evans W.D. and Hoffenberg M., “The interindustry relations study for 1947”, *Review of Economics and Statistics*, May 1952, pp. 108-9. – Piero Sraffa, *Production of Commodities by means of Commodities*, Cambridge: Cambridge University Press, 1960, Luigi L. Pasinetti op. cit.
- (3) Chenery H., Clark P., op. cit., p. 154.
- (4) Leontief W.W., op. cit., pp. 24, 164-8.
- (5) The changes in stocks should be treated as an element of final demand (autonomously determined in the model).
- (6) Chenery H., Clark P., op. cit., p. 154.
- (7) Leontief W.W., op. cit., p. 165.
- (8) They are defined as exports of domestic merchandise only. So re-exports are excluded.
- (9) Ghosh A., “Experiments with Input-Output Models”, U.P. Cambridge 1964, Table B1, pp. 7-8, 77-8, 134, 136.

- (10) Usually non-competitive imports include net private and governmental unilateral payments abroad and personal, governmental and business expenditures in foreign countries. See Abraham W.I. and Hoffenberg M., "Some problems of Standardization of Input-Output Statistics". T. Barna (ed.), pp. 352-3.
- (11) Ghosh A., op. cit., pp. 13-15 – Stone R., "Input-Output and National Accounts", OECE, Paris 1961.
- (12) Ghosh A., op. cit., pp 39-43.
- (13) Leontief W.W., op. cit., p. 168.
- (14) This approach has been favoured by European Input-Output Workers, Chenery H., Clark P., op. cit. p. 154 – Barna T. (ed.), "Structural Interdependence and Economic Development", 1963, pp. 195-6.
- (15) Such a model was constructed during the Second World War in the USA, Chenery H., Clark P., op. cit., pp. 154, 271-6.
- (16) Certainly the USA did not have to tackle such a problem.
- (17) Government direct control is justified here because of inelasticities in demand, high time horizon of entrepreneurs and imperfections of markets.
- (18) However, this has not been found to be the case in underdeveloped countries, in which input-output analysis has been carried out to date. These fears are justified for a very primitive economy.
- (19) The most detailed analyses for these countries have been made by UN, ECLA for Colombia (1957), Argentina (1958), by Eleish G.E. for Egypt (1954) in Barna T. op. cit. and by Chenery H., Clark P., Cao-Pina V., for Italy (1950).
- (20) Reference here is made to the existence of a purely technical problem regarding the specific commodities to be included in non-competitive imports. Evidently, competitiveness must be taken into consideration and separate sectors included for products which have possibilities for expansion, irrespective of their present magnitude in the total supply of domestic production.
- (21) Regarding different methods of treating competitive imports and the estimation of the relevant ratios, one could cite the separate matrix method (employed in the USA) and the iterative method (employed in Italy and Norway). Barna T., op. cit., p. 355.
- (22) Abraham W., Hoffenberg M., "Some Problems of Standardization" in Structural Interdependence and Economic Development, Barna T. (ed.), pp. 341-56.
- (23) Cao-Pina V., Roelants B. Du Vivier and others, "Problems of Standardization of Input-Output Statistics: a Debate" in Barna T. (ed.), 1963, op. cit., chapter 11, pp. 333-41.
- (24) Dorfman R., Samuelson P., Solow R., "Linear Programming and Economic Analysis", The RAND Series, McGraw-Hill Book Co. Inc., 1958, pp. 224-9, 234-7, 248-9. A real system such as Leontief's can only hope to determine relative prices, although the absolute level of prices is completely indeterminate.

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ΤΑ «ΑΝΟΙΧΤΑ ΜΕΤΩΠΑ» ΤΗΣ Δ.Ε.Η.
Πώς οι κυβερνητικές προθέσεις και παραλήψεις επηρεάζουν τον τιμή της μετοχής της

Μηνί περίοδοι, παράγοντες της Δ.Ε.Η. διατηρούν στους αναλυτές των διεθνών ορίων ότι η τιμή των μερισμάτων θα αυξάνεται για το επόμενο μήνα, χρόνια με ρυθμούς όμοιους σκεπάζοντας τον πληθωρισμό, γιατί σε διαφορετική περίπτωση, ούτε η προέλευση νέων επενδύσεων στο χώρο της ενέργειας θα μπορούσε να γίνει ούτε οι επενδυτές, όπως οι κίνησης θα αποτιμούσαν ουσιαστικά. Αντί αυτού, τόσο στο προέλευση 2003 όσο και φέτος, είχαν αυξήσει τη ροή των κεφαλαίων του πληθωρισμού... Δεν είναι τυχαία η τελευταία έκθεση της ΕΙΣΤΡΑΠ, όπου η μετοχή της Δ.Ε.Η. θεωρείται ως «απόλυτα κερδοφόρα» και υποστηρίζεται ότι θα συνεχίσει να κερδίζει, αν η κυβέρνηση καθόριζε από τώρα την πολιτική προέλευση της Δ.Ε.Η. για το επόμενο χρόνο. Και επειδή ολόκληρο γνωστό πως θα ελεγχθούν τα τιμήματα, οι Έλληνες αναλυτές (αφού μάλλον έχουν κλείσει κατά το παρελθόν) χρησιμοποιούν στις εκτιμήσεις τους τα κερδοφόρα στοιχεία. Η ΕΙΣΤΡΑΠ, για παράδειγμα, προβλέπει για τον περίοδο 2004-2010 ετήσιες αυξήσεις κατά 1% κεφαλαίων του πληθωρισμού. Και η Μάρτιν μετράει προσεγγίσεις των τιμή-συντάξης για τη μετοχή της Δ.Ε.Η.

Απλά υφίσταται-λε οικονομικό κόστος υπάρχει και μια σειρά άλλων αβεβαιοτήτων, γύρω από την επένδυση: θα υπάρξει τυχόν ανταγωνισμός και από πόσο θα προωθηθούν προγράμματα παραγωγής κόστους ή θα προληφθεί επιπλέον προσωπικό. Η αναγκαστική επένδυση στα μέγιστα της αναμενόμενης της ενέργειας - μεταξύ άλλων - κερδοφόρα και το μακροπρόθεσμο σκεπάζει της Δ.Ε.Η.: η επένδυση σπάσει τη μείωση του προσωπικού της από 25.000 άτομα στο τέλος του 2007, με δεδομένο ότι το μάρτιο αγοράς της θα είχε υποκαταστήσει (λόγω των νέων επενδύσεων) στο 82%. Η τελευταία όμως εκτιμήσεις αφήνουν ανοιχτό το ενδεχόμενο, το μάρτιο αγοράς τη συγκεκριμένη περίοδο να μην είναι κάτω από το 70% και έτσι να κρατήσει η προέλευση 1.000 επιπλέον εργαζομένων. Η θα γίνει όμως, αν πρόκειται η υποκαταστήσει του μάρτιου αγοράς της Δ.Ε.Η. μειωθεί στο 82%, αλλά το 2008 και για το 2007 θα μπορούσε να ολοκληρωθεί (στην Ελλάδα είναι...) η εκ νέου μείωση του προσωπικού κάτω από τις 25.000 θέσεις εργασίας. Πάλι, ένα ακόμη ανοιχτό μέτωπο είναι αυτό της μεγαλύτερης παραγωγής των διατάξεων που φυσικά δε θα λάβει τις διατάξεις που επιθυμεί ο κ. Βασιλείδης για τον Ο.Π.Ε., αλλά τριπλαστών θα πρέπει να περάσει τους έξι μήνες θεωρείται ότι, μέσω της εξοικονόμησης διατάξεων, μπορούν να αντισταθμιστούν οι επιπτώσεις από τις κεφαλές αυξήσεις στα τιμήματα.

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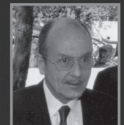
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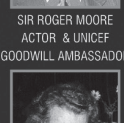
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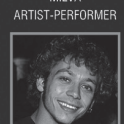
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