

PROJECT ECONOMIC APPRAISAL TECHNIQUES IN CONSTRUCTION INDUSTRY - A COMPARATIVE STUDY

Shruti B. Godbole¹, Dr.Geetha K. Jayraj²

¹Student, Shivajirao S. Jondhle College of Engineering & Technology, Asangaon

²Principal, Shivajirao S. Jondhle College of Engineering & Technology, Asangaon

Abstract - Present worldwide trend in infrastructure development such as smart city development has changed drastically the project economic appraisal methodologies. The significant impact on decision making of government and private organizations has resulted in combination of various project appraisal techniques. There are hybrids as well as new strategies involved to carry out socio-economic and financial analysis as part of appraisal project. This paper attempts to compare the present and past project economic appraisal methodologies for metrics like accessibility improvement, reduction in conjunction, quality of transport improvement, encouragement in use of sustainable modes and significant saving in time etc. It also discusses the methodologies and tools used to carry out the cost benefit analysis with inflation, optimism bias and level of quantification risk. The study discusses necessity of consideration of impacts of infrastructural development on socio economic as well as environmental aspects. The concern of environment pollution and time management is also considered while comparing above metrics. The paper concludes with justification of different project economic appraisal methodologies used in general as well as specific for analysis and decision making.

Key Words: Project economic appraisal, Methodologies, Cost benefit analysis, Socio-economic analysis, Smart city project, Infrastructure development.

1. INTRODUCTION

There is no doubt that the construction industries in built environment today face more challenges than in the past. The modern business environment is operating in a highly turbulent time. Demand for operational activities to achieve effectiveness and efficiency, the environment has increased the need for organizational accountability both in public and private sector. The construction industry is a growing sector and developing day by day. In this case project management and appraisal are viewed as a tool that helps the organization to carry out selected project effectively and efficiently. This project management and appraisal tools, as shown in Figure1, in the built environment do not guarantee the project success but necessarily help to guide the ways and means to avoid failures. Different types of appraisal include technical, economic, organizational and managerial, commercial.

1.1 Technical Appraisal:

It provides the assessment of the status of the technical know-how and design as envisaged in the project. It includes the examination of the project to ensure that the project committing with technology and design only in the preliminary stage should be avoided. To ensure the technical appraisal following points are important.

The details of the designs involved should be attended to minimize the technical risk. Innovative design should be distinguished and recognized as tougher than mere uncertainty. It may appear innocuous and less costly but later on may escalate up to an awkward situation when it is too late. In technically complex and sensitive designs all design proposals should be fully investigated. The appraisal should ensure that the project has minimum of technical uncertainty and resolve uncertainty, if any, on a priority basis. Design should not have unnecessarily burdensome specifications. The technology and design should be one already tested and established. The know-how already available within the country and currently in use should be explored and compared with that envisaged in the project. It is desirable to find the 'state-of-the-art' technology relevant to the project and weigh and measure the same with the technology proposed in the project appraised [1].

1.2 Economic Appraisal:

To ensure the economic appraisal of the project [2] covers the following areas:

(i) The project's compatibility with the macroeconomic environment in the relevant industry and fitting in with the government's concerned policy.

(ii) That the current situation in the industry involved permits such a project, mainly emphasizing the appraisal in respect of the following points:

Existence of a growing market with increasing gap between the demand and the supply of such Product or service as envisaged in the project; when the product is 'intermediate.' in nature and the customer is in particular industry/organisation, which is a stable one; there is reasonable amount of market research/study on the product and the project is having a back-up with reliable support study and report; the possible market share that

can be arrested with the implementation of the project as revealed by the market report.

(iii) An overall appraisal of the competitors fielding in the area with their strength and weaknesses.

(iv) Availability of the resources required for the project. The alternatives for employment of such resources cannot compete with the estimated project profitability. In this regard, the various techniques for financial appraisal of the project, discussed later, are helpful.

(v) Facilities to the extent available, including monetary assistance for such project, such as :

Value based advance licensing (VABAL) for imports required for the project; various duty exemption scheme applicable to the project; government subsidy; helps for procurement of land/space at suitable location; benefits for the export oriented units (EOU)/and for being located at export promotion zones; tax holidays.

The financial and economic analysis is carried out for various phases to help the decision making as shown in Table 1.1.

1.3 Organizational and Managerial Appraisal:

The organizational and managerial appraisal is carried out recognizing that the complexities in project management require a well-knit project organization structure, which again depends upon the volume and nature of the project as well as the culture and motive of the project owner. For example, in case of an owner-managed small project, the structure is simple and the appraisal is limited to the assurance that the owner is assisted whole-time/part-time by other functionaries.

The managerial personnel heading the different functions should be duly skilled in their respective functions to carry out the project implementation and operation. The appraisal is to ensure that the key managerial personnel have been fixed before the start of the work; it is also desirable to appraise the backgrounds of such personnel. As a matter of practice, the financial institutions in the process of project appraisal also look out for the background of the key managerial personnel in the relevant project management. Organization takes care of the technical training required for the production process. The strength of the organization takes care of the project volume with the number of employees. Considering the projected organization, estimated as sufficient to match the project, the payroll is evaluated in terms of money considering the grades, rates and numbers. The additional personnel cost which can be about 30% of the salary (representing P.F., medical benefit, leave with pay, uniform, canteen subsidy, bonus etc.) should also be considered while taking into account the personnel cost in the project [3]. Other key personnel

requiring early recruitments for manning the organization include Plant Manager, Maintenance Engineer, Security Manager, etc.

1.4 Commercial Appraisal:

Appraisal is made about the marketability of the product including the volume considered in the project. The project should be supported by market research/statistics from competent and reliable organization or professional consultants like India Market Research Bureau [4]. The points for consideration are the size of the market and its growth; the gap between the demand and supply and Information about major competitors, their capacities installed, their market share, their strength and weaknesses. Also in some cases the appraisal considers the international market, the possibility of export, international standard quality and international prices.

1.4 Socio-Economic Analysis:

The socio-economic analysis in its widest sense remains a fundamental criterion influencing decisions on tolling either stand-alone projects or a whole infrastructure network. The capital & operating costs, the direct benefits to the users and the indirect benefits to all other entities and community as a whole, together with social and environmental costs, have to be taken into account [5]. These costs and benefits for society evaluated in monetary terms can be converted into a socio-economic rate of return for a given project.

2. PROJECT ECONOMIC APPRAISAL

The main objective of conducting a project economic analysis is to help not only assess the sustainability of investment projects but also to inform the design and select projects that can contribute to a sustainable improvement in the welfare of project beneficiaries, and the country as a whole. There is urgent need for those companies newly entering, or preparing themselves for entry into construction industry in all its facets to have knowledge of some of the basic methods which can be used for effectively increasing productivity, by planning and controlling construction work.

In order to improve production, new methods and new techniques must constantly be used with a view to making improvements in the organizations, planning and performance of construction works. Many of the surveys have reported an increasing use of the discounted cash flow investment appraisal methods [6], [7]. The research is focused on how these companies perform investment appraisal, subsequent follow-up and measurement of project success or failure. The complexity of evaluation process and selection of development investment project imposes the need for a complex approach, i.e. application of estimated dynamic criteria.

The tools of economic analysis can help answer various questions about the project's overall effect on society, on various stakeholders/beneficiaries, its fiscal aspects and about the project's risks and sustainability. For example, economic analysis can help determine whether the rationale for public sector intervention is justified [8]. It can help in estimating the project's fiscal impact and inform government/implementing agency accordingly; it can also determine whether there is scope for cost recovery and that arrangements are efficient and equitable. In addition, it can help in assessing the project's potential environmental impact and contribution to poverty reduction.

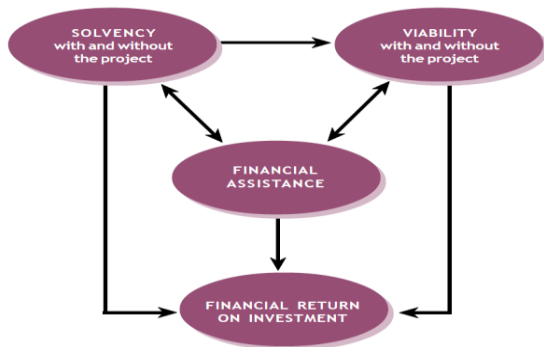


Fig 1. The Principle of Economic Analysis [9].

While each sector has a different set of problems that needs to be addressed, the basic principles of economic analysis can still be applied. The analytical approach and data requirements would have to be adapted or tailored to the specific project. The key here is to select the appropriate level of analysis to inform project decision making.

Financial and economic analysis provides a partial view of projects which complements analyses by technical, social and environmental specialists and analyses on consistency with the sectoral policies. A comprehensive methodology one should systematically apply to the stages of analysis proposed for all projects. Analysts generally have insufficient time and resources. Choices must thus be made depending on the specific questions raised by the project and the resources available. Generally speaking:

- 1] A detailed financial analysis of the all participants involved (e.g., enterprises, artisans, public institutions, farmers...).
- 2] A consolidated account analysis (chapter 4) is needed only if the project involves a number of entities whose activities form an inseparable whole.
- 3] Analysis of the projects's effect on economic objectives is necessary when: project size is large relative to the national economy, the project's impact on public finances needs to be known.
- 4] An analysis of the projects's viability within the international economy is necessary: when project size is large relative to the national economy,

For projects directly linked to international markets and which need to be competitive (e.g., import substitution or export projects),

Then the sector or subsector involved is subject to strong government intervention or non-competitive practices (e.g., monopoly).

5] An analysis of projects with non-tangible products (Chapter 8) should be systematically undertaken and be as thorough as possible in respect of budgets and the efficiency with which material and human resources are used.

3. COST-BENEFIT ANALYSIS

The main objective of the investment appraisal is to maximize the organisation's profits and optimizing the return on investment. Cost-Benefit Analysis is procedure for evaluating the desirability of a project by weighting benefits against costs. It is mainly used for economic evaluation of public projects which are mostly funded by government organizations. In addition this method can also used for economic evaluation of alternatives for private projects. The main objective of this method is used to find out desirability of public projects as far as the expected benefits on the capital investment are concerned. As the name indicates, this method involves the calculation of ratio of benefits to the costs involved in a project. In benefit-cost analysis method, the time value of money is taken in to account for calculating the equivalent worth of the costs and benefits associated with a project. The benefit-cost ratio [10] of a project is calculated by taking the ratio of the equivalent worth of benefits to that of the costs associated with that project. Either of present worth, annual worth or future worth methods can be used to find out the equivalent worth of costs and benefits associated with the project.

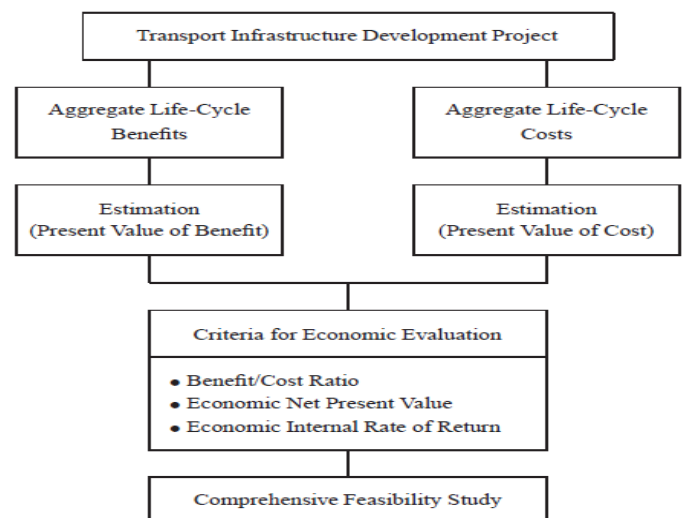


Fig 2. Procedure for cost Benefit Analysis [11]

There are some common difficulties that are playing as a determiner of the success or failure of the project. In a project, capital expenditure decisions are extremely important; they also pose difficulties which stem from three principal sources.

- Measurement problem – Identifying and measuring the cost and benefits of a capital expenditure proposal tends to be difficult. This is more so when a capital expenditure has a bearing on some other activities of the firm (like cutting into the sales of some existing product) or has some intangible consequence (like improving the morale of workers).
- Uncertainty – A capital expenditure decision involves cost and benefits that extend far into the future. It is impossible to predict exactly what will happen in the future. Hence, there is usually a great deal of uncertainty characterising the cost and benefits of a capital expenditure decision.
- Temporal spread – The cost and benefits associated with a capital expenditure decision are spread out over a long period of time. Usually 10-20 years for industrial projects and 20-50 years for infrastructural – culture projects. Such a temporal spread creates some problems in estimating discount rates and establishing equivalence [12].

4. COMPARATIVE STUDY

Financial and business projects can be appraised using three measures related to compound interest theory, viz. i) Net Present Value, ii) Discounted Payback Periods, iii) Internal Rate of Return.

The NPV and IRR give a measure of the overall profitability of the project. The DPP gives a measure of the time to profitability of the project. None of these measures should be considered in isolation. Other business considerations are required in addition to these financial measures, for example existing expertise and strategic fit.

4.1 NET PRESENT VALUE:

NPV is an appraisal technique. NPVs can be used to compare the profitability of two or more alternative projects. Under the NPV measure, Project A is more profitable than Project B if

$$NPVA(i1) > NPVB(i1) \quad (1)$$

If an investor is able to compare projects on the basis of overall profitability alone, the NPV can be used as a decision tool. The NPV measure is sensitive to the investor's $i1$.

Example:

Three projects have the following cash flows.

Project A has initial outlay of Rs. 10 Crore in return for an annual income of Rs.1Crore paid 6-monthly in arrears for 12 years.

Project B has initial outlay of Rs.1Crore in return for an annual income of Rs. 20 lacs at the end of each of the next 20 years.

Project C has initial outlay of Rs.5 Crore in return for a continuous payment stream of Rs.2 Crores per annum for 3 years, deferred for 2 years.

If the investor can borrow and invest money at 5% per annum, and as per NPVs computed, Project B is the best under the NPV measure at $i = 5\%$. Project A is not profitable at this rate.

4.2 DISCOUNTED PAYBACK PERIOD:

In many practical problems the net cash flow changes sign only once, from negative to positive. In this case, the balance in the investor's account will change from negative to positive at a unique time $t1$ or it will always be negative (in which case the project is not viable). If $t1$ exists, it is called the discounted payback period (DPP) and is defined as the smallest value of $t1$ such that the accumulation of all prior cash flows is first greater than zero. Although the DPP is defined on the accumulation, it can equivalently be obtained by finding $t1$ such that the present value of prior cash flows is first greater than zero.

A project with a lower DPP starts to generate a profit more quickly and this can be important in project appraisals. If the above example is considered for DPP then the result will be If the investor can borrow and invest money at 5% per annum, and as per DPP computed, Project C is therefore the best under the DPP measure at $i = 5\%$.

4.3 INTERNAL RATE OF RETURN:

The internal rate of return (IRR) of a project y is the annualized yield obtained over the project's lifetime. It can be calculated by solving the equation of value for the rate y ,

$$\sum c_t v^t + \int_0^T \rho(t) v^t dt = 0 \quad (2)$$

The IRR gives the % return on each £1 invested in the project. The IRR is therefore an additional measure of the profitability of a project and can be incorporated into project appraisals.

Assuming that the investor is able to fund the initial outlay from existing funds, the IRR is calculated in each case. Result and Discussion: Putting it together, none of the three measures can be considered in isolation.

For example,

Project B has the greatest IRR (and NPV at 5%), however its DPP is 6 years. Project C has a lower IRR (and NPV at 5%), however its DPP is only 4.96 years. For an investor with unlimited funds, the profitability of his investments will be the primary concern. The IRR and NPV measures are more suitable and Project B preferred.

However, for an investor with limited funds, the time after which the project actually starts to generate a positive return is important. Project C might therefore be preferred. Further considerations (existing expertise, diversification, strategic fit) are always needed in addition to the financial measures.

Difference between NPV and IRR Methods:

NPV and IRR are the species of the same genus, i.e., DCF technique. They are based on the fundamental concept that money has a time value. However, there are certain fundamental differences between these two techniques.

First, the NPV treats the discount rate as a known factor while the IRR treats it as an unknown factor. In most cases the business' known cost of capital is used for discounting under NPV method.

Secondly, the IRR method seeks to find the maximum rate of return at which funds invested in any given project could be repaid with earnings generated by the project. But the present value method arrives at the amount to be invested in a given project so that its anticipated earnings could recoup the amount with the interest at the market rate.

Thirdly, at a particular discount rate, there can be only one NPV, and not multiple net present values of a project. But in the case of unconventional investments, where capital

outlays are incurred at different time periods, a project may have more than one IRR, which may lead to baffling contradictions.

Fourthly, the present value method explicitly recognizes availability of a market for funds and assumes that business will use the market rationally to enhance its earnings; but IRR method does not recognize the existence of such a capital market.

In other words, the NPV method assumes mostly the cost of capital, which is based on the market rate of interest, as the discount rate. But the IRR method tries to find out a discount rate, which has no direct bearing on the market rate of interest [13].

Although the traditional investment appraisal methods are commonly applied across all firms, their role is diminishing. For instance, CO-02 uses the threshold approach in spite of the uses of DCF methods. Furthermore, the use of EVA and SVA, by CO-03, to support the project decision making shows a trend shift in the traditional investment appraisal techniques.

The application of modified models such as VIR and NNPV, based on the DCF methods, indicate the need for an alternative model that can help to solve the demerits of the traditional techniques [14].

Although presence of immense literature supporting the use of quantitative models, R&D and ICT projects are found appraised using non-quantitative models, particularly, open approaches. The consequence of this approach is extremely serious, specially, if it falls into the wrong side of project decision making. Hence, the effect may reduce the value of shareholders, or even cause a bankruptcy depending on the size of the investment. This result is also similar to the previous findings [15], [16].

Table -1. Checklist comparing economic and commercial appraisal [13]

Sr. No.	Description	Economic Appraisal	Commercial Appraisal	Remarks
COSTS				
I	Capital Costs			
1	Land purchases	√	√	
2	Land already owned	√	√	
3	Fixed Capital purchases	√	X	
4	Fixed Capital already owned	√	X	
5	Depreciation on Fixed capital purchases	X	√	
6	Depreciation on Fixed capital already owned	X	√	
7	Interest payments, capital charges	X	√	
8	Change in Working capital requirement	√	√	
9	Capital subsidies/grants	√1	√	
II	Current Costs			
1	Cost of inputs & outputs (excluding capital)	√	√	
2	Insurance costs	√2	√	

3	Corporation Tax	x3	√	
4	VAT	x3	√	
5	Import Duties	x3	√	
6	Redundancy payments By NI public bodies	X	√	
7	Redundancy payments By NI firms	X	√	
8	Revenue grants	√1	√	
9	Repatriated profits	√	X	
III	Wider Quantifiable Costs			
1	On individuals and firms (except transfer payments)	√	X	
2	On other public sector bodies	√	X	
3	Increase in transfer payments to individuals and firms	X	X	
IV	Unquantifiables			
1	Distributional Impact	√	X	
2	Image & social conscience of firm/organization	√	√	
3	Working environment	√	√	
4	Other effects such as pollution, health, etc	√	X	
BENEFITS				
I	Capital Benefits			
1	Residual value (RV) of land	√	√	
2	RV of fixed capital	√	√	
3	RV of working capital	√	√	
4	Capital subsidies/grants from abroad	√	√	
II	Direct Benefits			
1	Sales revenue	√	√	
2	VAT (GST)	x3	√	
3	Cost savings	√	√	
4	Redundancy Payments from abroad	√	√	
5	Revenue grants from abroad	√	√	
III	Wider quantifiable benefits			
1	On individuals and firms (except transfer payments)	√	X	
2	On other public sector bodies	√	X	
3	Decrease in transfer Payments	√	X	
IV	Unquantifiables			
1	Distributional impact	√	X	
2	Image	√	√	
3	Working environment	√	√	
4	Other benefits such as reduced pollution, Improved Health, etc.	√	X	

Notes: 1 Strictly speaking, it is the use of the resources funded by the grant/subsidy that represent an economic cost, rather than the grant/ subsidy itself.

2 Government has tended to bear risk centrally rather than purchase insurance. However, some public bodies do carry insurance.

3 In practice, adjustment of market prices for taxes is only undertaken in economic appraisal where it may make a material difference to the decision e.g. when comparing

options that attract different GST rates, or when comparing public and private options.

The risk treatment experience of companies is more or less similar. Most of them apply both qualitative and quantitative methods. However, none of them evaluates the intensity of project risk after project execution. Certainly, this will have significant effect on the end value of the project if one assumes the worst scenario.

Companies don't apply uniform methods from the start to the end of the project life cycle. Under this approach, it is

difficult to interpret, at any point in time, whether a project adds value to shareholders or not. It is also very hard to reconcile the output generated by various models such as DCF, time-cost-schedule and success criteria, and frame into a single metric value for analysis.

CONCLUSIONS

This paper is an introductory contribution towards improving the methodology applied to investigations on valuation of effects of construction or reconstruction of different types of Civil Engineering Projects, which includes sustainable development, in which social and environmental issues are considered next to economic aspects. The methodologies presented in this article helps to categorize and classify economic and social effects, which is a good starting point for any further analytical work on complex assessment and planning of road transport infrastructure.

Due to the complex character of investments into construction work, each project should be approached individually by defining specific effects, quantifiable in monetary units, which subsequently can be incorporated into a complex profitability study. Valuation of the effects at the stage of planning and designing a project will improve the decision- taking process and rule out any misunderstandings regarding the assessment of the effectiveness of a given project. Based on the performed analyses, it can be concluded that the construction is profitable and will generate a series of indirect effects, among which economic benefits are evidently dominant.

REFERENCES:

- [1] Jaynie Whinnery, "A Well Construction Cost-Benefit Analysis (CBA): For Water Supply Well Guidelines for use in Developing Countries," October 5, 2012. www.seidc.com/pdf/Hydrophilanthropy_Well_Guidelines.pdf.
- [2] Min Ho Shin, Hye Kyung Lee and Hwan Yong Kim, "Benefit-Cost Analysis of Building Information Modeling (BIM) in a Railway Site," Sustainability 2018, 10, 4303; doi:10.3390/su10114303, October 2018 www.mdpi.com/journal/sustainability.
- [3] Robert E. Chapman, "Benefits and Costs of Research: A Case Study of Construction Systems Integration and Automation Technologies in Commercial Buildings," U.S. Department of Commerce Technology, Administration National Institute of Standards and Technology, Applied Economics Building and Fire Research Laboratory, Gaithersburg. Dec 2001.
- [4] Akalu, M.M., "Re-examining Project Appraisal and Control: Developing a focus on Wealth Creation," International Journal of Project Management, 2001, 19(7), 375-383.
- [5] Mehari Mekonnen Akalu and Rodney Turner, "The practice of investment appraisal: An empirical enquiry," Project Management at the Faculty of Economic Sciences, Erasmus University, the Netherlands.
- [6] Kumar Neeraj Jha, "Evaluation of Construction Projects in Terms of Cost, Schedule and Safety Performances," Conference Paper, September 2012.
- [7] Waldemar Kozłowski, "A Model Valuation Of Economic And Social Effects – A Case Study Of The Olsztyn Ring Road Construction," University of Warmia and Mazury in Olsztyn Oczapowskiego 4, 10-957.
- [8] Cecilia P. de Castillo and Raúl Lema, "Economic Analysis of Social Investment Fund Projects: Case Studies and Minimum Requirements Proposal," La Paz, Bolivia, October 1998.
- [9] W. Olthof, "Financial Aspects' Of Project Appraisal," Department of Rural and Urban Planning University of Zimbabwe, April 1990.
- [10] Arnold C. Harberger, "Techniques of Project Appraisal," URL: <http://www.nber.org/chapters/c1421>, pp. 131 – 152.
- [11] Elias Ikpe1, Felix Hammond, David Proverbs, "A Cost-Benefit Analysis (Cba) Of Construction Health And Safety Management: A Theoretical Discussion," Procs 24th Annual ARCOM Conference, 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, 1035-1043.
- [12] Binbin Peng 1 and Jie Song, "A Case Study of Preliminary Cost-Benefit Analysis of Building Levees to Mitigate the Joint Effects of Sea Level Rise and Storm Surge," www.mdpi.com/journal/water, Water 2018, 10, 169; doi:10.3390/w10020169.
- [13] Website: <http://www.finance-ni.gov.uk/publications>, "A checklist outlining the differences between economic appraisal and commercial appraisal", 23-06-2015.
- [14] Prud'homme R., 2005. Infrastructure and development. Annual bank conference on development economics. World Bank and Oxford University Press, Washington
- [15] Directions concerning methodology translation analysis cost and benefits, 2006. Commission for Affairs Regional Policy. General Board of Management. UE, Brussels.
- [16] Akalu and Turner, Investment appraisal process in Banking & Finance industry. Working paper 2001.