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Philip Brach, University of the District of Columbia

Ahmet Zeytinci, University of the District of Columbia

Pradeep Behera, University of the District of Columbia

ENGINEERING ECONOMICS APPLIED TO PUBLIC POLICY ISSUES: A CASE STUDY FOR ENGINEERING STUDENTS

Abstract

The current fiscal crisis confronting American society and the world is due in large part to the inability of a significant part of our society to fulfill their obligation to pay their home mortgages. Many solutions have been proposed. The failure of the home mortgage market is having wide-spread impact on engineering projects, particularly public works. Compounding this situation is the already inadequate funding for addressing the rebuilding of the nation's aging infrastructure.

With the thrust to give more consideration to the social impact of engineering works and the importance of inculcating these aspects into engineering education, this paper articulates a possible case study that could incorporate economy principles and a national fiscal problem into the engineering curriculum in either an economics course or a senior capstone or ethics course. Using a subject from current events can demonstrate to students how engineering economic principles can be used to assess public policy alternatives. An ancillary aspect of this topic could be assistance in alleviating the current home-mortgage difficulties.

In essence the proposed study includes three major components:

1- A new concept of cost to be charged for home mortgages.

2- Establishment of the term of a mortgage loan by tying it to the individual's ability to pay.

3- A proposal to permit the deduction of rent from federal income tax for the purpose of assisting in the accumulation of a down payment for the purchase of a home mortgage.

The students will be involved in evaluating this proposal through qualitative and quantitative methods in their analysis of the impact of such a policy on the current and future fiscal health of the nation.

The content of this paper will not be without controversy. But it will illustrate the potential for engineers to be more involved in public policy and decision making.

Engineering Economy, Public Policy and Engineering Education

Economy is the backbone of engineered works. It is the task and responsibility of the engineer to create (design and build) safe, functional, and efficient projects. Traditional benefit-cost analysis will determine the optimum cost, but in today's economy it is not enough to look only at the

tangible cost of a project; it is necessary to understand the economic situation for the entire economy. A traditional approach from the 1950s used the home mortgage rate of interest (at that time ~ 6%), as the rate of interest to be used in the analysis of engineering projects in the public sector. The reasoning was that since the use of the citizens' money (public funds) meant the citizens would forgo some personal use of the funds and the largest expense for most citizens was their home mortgage, then the economic justification of public projects should at least be based on funds invested at the home mortgage rate. With the current situation in the home mortgage business, this may no longer be an appropriate norm. This being the case it is important for engineering students to understand the application of economic principles in a broader context than their own engineering projects.

The current fiscal crisis has forced governments to cut back in public works drastically. This trend will not only bring awareness to engineering students of the importance of social economics, but will exposes them to broader based economic principles of which they should be familiar for making their future engineering decisions.

A Family's Home May be the Government's Castle

With the current situation in the home mortgage market it looks like the government is going into the loan business. This paper is a description of a proposed basis for dealing with home mortgages under a government-operated and -funded loan program that might make an interesting case study for engineering students. The goal of Americans and of American society has been home ownership. The following proposal would accomplish this goal at virtually no risk to the economy of the country and would maintain to a reasonable degree our free enterprise system.

First, this loan program would be for the domicile (home residence) of a person and his or her family. No other "homes" would be eligible, such as vacation homes. Second, the annual value of the monthly mortgage payments would not exceed 25% of the family income (current accepted norm for home loans). Third, the term of these loans could vary from 20 to 50 years, dependent on the requirement that annual mortgage payments not exceed 25% of family income. Fourth, mortgages would be limited to no more than 80% of the value of the home (this could be modified to accommodate initial underwriting of loans in our current situation). The failure to require that home buyers have equity in the home and be found to be able to fulfill their obligation in meeting loan payments is a major cause of the current rate of home loan foreclosures. Fifth, there would be no interest in the traditional sense on the loans. Rather, there would be a service charge on the mortgage of approximately 0.5% or 1% simple annual interest each year on the total loan. Monthly that would be 0.5% or 1% of total loan divided by 12 months paid every month for term of the loan. This service charge is to cover the cost of administering the program. This concept is consistent with recent prime interest rates from the federal government. The program would be run as a cabinet level agency with government employees or perhaps a quasi public organization similar to a port authority.

An ancillary aspect that the students could consider in their analysis of this case would be the administration of the program. Perhaps an agency called the Federal Domicile Mortgage (FDM)

program could be established. The head of this agency would be paid at the level of other cabinet officers and the operating staff would be government employees paid at an appropriate GS salary scale. This removes the exorbitant cost of the current brokerage system for financing home mortgages. The funds in this program could be used only for domicile loans and would be protected by law. Another problem that has plagued the home mortgage business is that of co-mingling mortgage funds such that sound loans end up with bad loans, an unstable situation that is similar to the old adage of "one rotten apple spoils the whole barrel." If a home owner sold the home before the term was up the outstanding balance on the mortgage would have to be paid first.

Demonstration of the Concept

The following Table 1 illustrates the proposed solution for the home mortgage problem. Three examples are considered with mortgage loan amounts varying between $150,000 and $1,000,000: (1) the lower amount of $150,000 represents an average single family home in a rural and/or low-cost American city; (2) the higher amount of $1,000,000 represent the typical home value in high-cost urban metropolis such as New York and Washington DC areas; (3) a median loan of $600,000 represents suburban home prices near high cost urban cities. The loans are repaid over a period of 20 to 50 years. The serve fee for a loan is 1% simple per year paid monthly.

Table 1: Estimation of Payments using a Service Fee of 1 % of Loan Amount

Loan Period	Service Fee	Payment	Loan $150,000	Loan $600,000	Loan $1,000,000
20 Year	1%	Principal per month	$625	$2500	$4167
		Service fee per month	$125	$500	$833
		Total Payment per month	$750	$3000	$5000
30 Year	1%	Principal per month	$417	$1667	$2778
		Service fee per month	$125	$500	$$833
		Total Payment per month	$542	$2167	$3611
50 Year	1%	Principal per month	$250	$1000	$1667
		Service fee per month	$125	$500	$833
		Total Payment per month	$350	$1500	$2500

It may be seen from Table 1 that a family at the lower-end of the socio-economic scale, living on the daily wage, could afford a monthly mortgage of $350 per month, assuming an hourly wage of $8.40 and approximately 2000 hours of employment a year. Gross annual wages would be $16,800 or $1,400 a month

It may be possible to operate the program on less than a 1% service fee. A determination of the optimum fee would be an exercise for the students in the case study. The service fees for ½% are shown in Table 2. This reduces the monthly cost of a $150,000 home to $313 a month for 50 years. This would reduce the hourly wage for low income earners to about $ 7.50 an hour to be able to afford their own home. With the cost of managing the program considered as a fee, there would be no interest deductions on one's federal income tax, which would offset a portion of the cost to the government

Table 2: Estimation of Payment using a Service Fee of 0.5 % of Loan Amount

Amortization Period	Service Fee	Payment Calculation	Loan $150,000	Loan $600,000	Loan $1,000,000
20 Year	0.5%	Principal per month	$625	$2500	$4167
		Service fee per month	$63	$250	$417
		Total Payment per month	$688	$2750	$4583
30 Year	0.5%	Principal per month	$417	$1667	$2778
		Service fee per month	$63	$250	$417
		Total Payment per month	$479	$1917	$3194
50 Year	0.5%	Principal per month	$250	$1000	$1667
		Service fee per month	$63	$250	$417
		Total Payment per month	$313	$1250	$2083

The FDM program might also include a renter's home purchase program that encourages home ownership. The renters home purchase program would make the cost of rent tax deductible on one's federal income tax. However this would have restrictions. The money saved by having a tax deduction would have to be deposited in an escrow account that could only be used as the down payment for the purchase of a home. If used for other purposes it would become taxable,

similar to the tax protection afforded IRA's. The early implementation of this concept would require start up funding, but in due time it would be a self sustaining program assuring home ownership for virtually each family in America.

Scope of the Home Mortgage Problem

Based on 2008 census data, there are approximately 112 million households in the United States. A conservative estimate would have 75% of these households representing home ownership or 84 million households. A 2001 study by the Census Bureau of HUD stated that approximately 40% of all residential properties in the United States are not mortgaged but are free and clear. This would leave approximately 50.4 million homes with some form of mortgage. Using this figure as a base and assuming an average mortgage of about $200,000 then the total value of all current mortgage loans in the US would be about 10 trillion dollars. As a conservative estimate, if all loans were for 20 years, you would need an initial funding of about 500 billion dollars to underwrite the program. This would be similar to a revolving account, necessary to initiate this program, after which it would be self sustaining. A 1% annual service fee for the use of this mortgage fund would produce about 5 billion dollars a year for operating expenses.

Funding for the FDM program might come from the hundreds of billions of dollars of "bail out" funding recently passed by Congress to assist Wall Street and other industries during the economic downturn. Government is supposed to handle those things that the market is not well suited to provide and Wall Street has demonstrated that it is unable to handle the home mortgage business, so a sound government plan is a viable alternative. Of course adequate oversight and controls will be necessary.

For years engineers have been criticized for failing to consider or be cognizant of social and humanistic values. A case study like the one proposed would assist in changing this image of the engineer and create awareness in engineering students of the importance and significance of social issues as well as traditional technical aspects when considering the engineering economy of their projects. In terms of priorities in life, cost of shelter is almost always the most expensive, transportation, food and clothing follow. These entire human needs imply a demand for engineering; if homes are made affordable to virtually every tier of society, the need for new infrastructure will also increase.

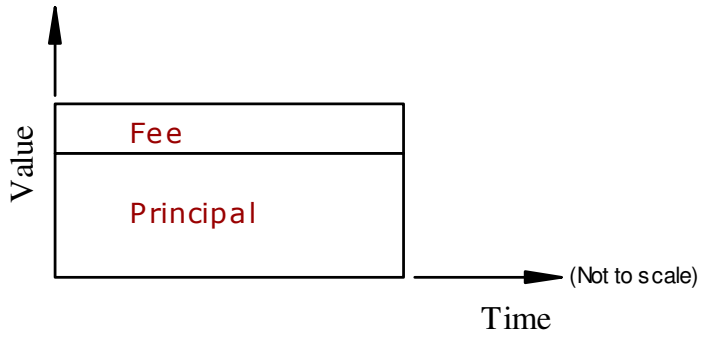
Loans and Usury

Charging interest for the use of money has a long history. However, arguments have been made for no interest on loans; the use of excessive rates of interest (usury) on loans led to the "truth in lending" laws in the later part of the last century that required all loans to have their rate of interest expressed on an annual basis. This made it possible to compare different arrangements for borrowing money. The case study in this paper is also ideal for looking at various arrangements for recovering the value of a loan. The proposed method actually has no interest charged, but rather a fee for servicing the loan. For the purpose of comparison the fee will be considered as interest.

Capital Recovery Schemes

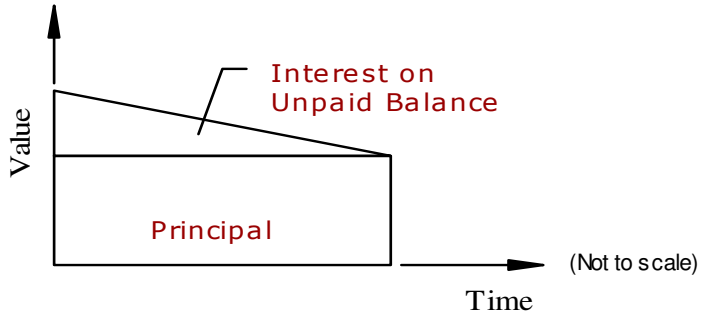
In Figure 1, Diagrams A, B, & C illustrate three ways of recovering the value of a loan (capital recovery). Diagram A is the method proffered by this paper. The principle would be paid back in equal installments. There would be no interest in the traditional sense; there would be a fee of either 1% or 0.5% annually of the total value of the loan paid monthly with the principle. Diagram B represents the payment of a constant amount of the loan paid back with interest each month on the unpaid balance of the loan. Diagram C represents the traditional equal monthly payments loan (amortized).

(A)



Uniform Payment of Principal with Fixed Fee

(B)



Uniform Payment of Principal with Interest
on the unpaid Balance

(C)

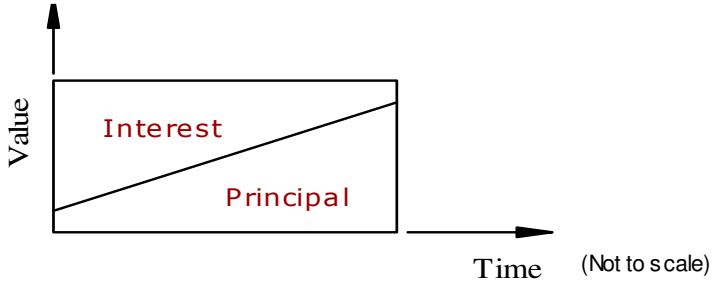


Figure 1 Capital Recovery Schemes

Table 3 compares total costs of the different means of recovering capital and demonstrates that charging interest makes the cost of borrowing money a problem. This proposal is not intended to claim that money does not have value with time, nor does it wish to suggest that a fair rate of return on the use of some one's money is inappropriate. It does suggest that in the case of providing shelter for all citizens, we might wish to consider a different model such as the one proposed in this paper.

Table3: Capital Recovery Schemes

Capital Recovery Scheme	Fee or interest %	Term Years	Total "cost" of $150,000 Loan	Total "cost" of $600,000 Loan	Total "cost" of $1,000,000 Loan
(A) Fee	1	30	$45,000	$180,000	$300,000
(A) Fee	1/2	30	$22,500	$90,000	$150,000
(B) Interest on unpaid Balance	1	30	$22,500	$90,000	$150,000
(C) Amortized Interest	1	30	$23,686	$94,741	$157,902
(B) Interest on unpaid Balance	4	30	$90,000	$360,000	$150,000
(C) Amortized Interest	4	30	$107,803	$431,217	$718,695
(A) Fee	1	20	$30,000	$120,000	$200,000
(A) Fee	1/2	20	$10,000	$60,000	$100,000
(B) Interest on unpaid Balance	4	20	$15,000	$240,000	$400,000
(C) Amortized Interest	4	20	$68,153	$212,612	$454,352
(A) Fee	1	50	$75,000	$300,000	$500,000
(A) Fee	1/2	50	$37,500	$150,000	$250,000
(B) Interest on unpaid Balance	4	50	$150,000	$600,000	$1,000,000
(C) Amortized Interest	4	50	$197,136	$788,545	$1,314,242

Conclusion

As we prepare this paper, the nation's economic situation is in free-fall. The stock market has lost over 30% of its value. The federal government has passed into legislation a near trillion dollar stimulus package to stem the tide of economic catastrophe and is considering an additional trillion dollar recovery package. Every day thousands of people become unemployed. Premier American institutions have had their stock fall to single digit value. Products and projects that are the mainstay of the engineering community's viability are being cut or postponed. We cannot leave the consideration and proposal of solutions to our economic strife to the business and political world. Engineers must contribute our insights to the nation's economy and management. It is for this reason that we think this topic is relevant and deemed not only appropriate but essential to engineering economics education.

References:

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