

Financing Road Networks in Developing Countries

March 2006

Word count: 3.950

Roberto D. Agosta

**Director, Department of Transportation,
School of Engineering, Universidad de Buenos Aires.
Profesor, Universidad Torcuato Di Tella
and Universidad Católica Argentina.**

Av. Las Heras 2214 Piso 2, (C1127AAR) Buenos Aires, Argentina

Tel: (5411) 4315-4050

Fax: (5411) 4315-7090

ragosta@acya.com.ar

**This paper was submitted in response to the Call for Papers on Latin America
sponsored by the International Activities Committee A0010**

ABSTRACT

Especially during the sixties and the seventies, developing countries received enormous amounts of money from loans of multilateral credit organizations and funds from developed countries to finance highway projects, essentially paving of highways and opening of natural surface roads to mobilize production.

Traditionally, each loan required a cost-benefit analysis capable of showing that the benefits of the project exceeded its costs in terms of vehicle operating expenditures, time savings, accident reduction, etc.

Unfortunately, many projects have been used as political drivers and once they were inaugurated not enough funds have been allocated for maintenance and reconstruction with the resulting deterioration of the roads, increasing in transportation costs and at the very end, sterilization of the theoretical benefits of the projects.

In this paper it is explained that as important as the “ex ante” estimation of benefits of the projects is that the governments should guarantee the resources for the maintenance and road conservation to close a virtuous circle between the economic benefits foreseen in the “ex ante” evaluation, the use of the highway and its financing through different mechanisms.

FINANCING ROAD NETWORKS IN DEVELOPING COUNTRIES

INTRODUCTION

Especially during the sixties and the seventies, developing countries received enormous amounts of money from loans of multilateral credit organizations and funds from developed countries to finance highway projects, essentially paving of highways and opening of natural surface roads to mobilize production.

Traditionally, each loan required a cost-benefit analysis capable of showing that the benefits of the project exceeded its costs in terms of vehicle operating expenditures, time savings, accident reduction, etc.

Unfortunately, many projects have been used as political drivers and once they were inaugurated not enough funds have been allocated for maintenance and reconstruction with the resulting deterioration of the roads, increasing in transportation costs and at the very end, sterilization of the theoretical benefits of the projects.

In this paper it is explained that as important as the “ex ante” estimation of benefits of the projects is that the governments should guarantee the resources for the maintenance and road conservation to close a virtuous circle between the economic benefits foreseen in the “ex ante” evaluation, the use of the highway and its financing through different mechanisms.

This work is based on a paper submitted to the XIV Congreso de Vialidad y Tránsito, held in Buenos Aires on September 2005.

The author wishes to thanks Mr. Mariano Cermesoni for his valuable comments and suggestions.

THE FINANCING OF HIGHWAYS AND THE DEBATE OVER ECONOMIC DEVELOPMENT

Transport systems and the roll of their investments in economic development is a topic of heavy discussion where seems to be a conflict between two different visions of the world.

As any public initiative, transport can be used to generate jobs and promote public investment. The advantage of doing so through a transportation investment must be weighted respect to other kind of economic policy tools.

On the other hand, transport by itself has economic, social and political objectives.

Transport political objectives include the provision of a public good, the effective political control of the national territory and the proper response in the case of extraordinary situations, such as natural catastrophes, etc.

Social objectives of transportation include the provision of public access, generally by the road network (public streets and roads), helping to guarantee social cohesion and acting as a complement of the system of personal security, preserving what has been called “spatial equity” in the sense of providing basic access for all as a guarantee of equal opportunities for every member of the society.

Even though it should be obvious, and before discussing the economic objectives of transport, it is mandatory to explain that both, social and political targets, must be reached by technologies involving the lower total cost for the economy.

From the economic point of view, transportation is the result of the spatial diversification of activities that makes that goods (and human work) have different values depending of their location.

In the debate about economic decisions, it is possible to distinguish two different moments. A first moment in which the transport system is needed for the development of an economic activity that does not exist (transport “pulls”, in the sense that it goes ahead the process) and a second moment in which the improvement of the transport system reduces the cost of the logistic chain of the existing activities improving their competitiveness (transport “pushes”).

Most debates about transportation (railroad vs. highways, toll vs. free roads, subway extensions, etc.) can be explained by the fact that one of the interlocutors is looking at the problem standing in the first moment and the other one in the second.

It is clear that economic development needs efficient and proper transport systems, even though as Heymann pointed more than thirty years ago: “...there seems to be the generalized belief that transport has something magical that is fundamentally important for a growing society and that works as a development catalyst...” (1)

When emphasizing the first moment, in a vision that could be called “development economics emphasis”, it is usually given for granted that the existence of highways is itself a sufficient condition to achieve economic development, without taking into consideration the other conditions needed for an economic activity to be properly carried through.

Undoubtedly, the economic development of a region needs investments that can guarantee accessibility, and it is known the fact that a point with high level of accessibility has great attraction for the commercial activities to be installed.

However, the experience points out that the extension of transport capability is a necessary but not a sufficient condition for development; which needs not only objective conditions to allow the productive activities, that includes the basic service access and the availability of the right human and natural resources, but also the existence of administrative, social, educational and legal institutions to configure the dimension of the so called “propensity to growth” of a nation, without which there is no amount of investment in transport capable of creating dynamism in the economy.

Usually, there’s the idea that transportation belongs to the “basic social equipment” that makes possible the productive activity, besides of having a great multiplier effect. The nucleus of truth that exists in this conviction is around the fact that once the Government provides basic infrastructures, the private sector might detect business opportunities that were not clear for planners and that finally, could end up justifying the investments already made.

The risk associated to the generalization of this reasoning is that, so far, it lacks of confident procedures to evaluate objectively the “proper” amount of investment in the transport sector that an economy must do.

This makes possible the predominance of an over-investment tendency at the expense of resources that are taken from other sectors of the economy that usually have important needs and that also offer important multiplier effects, such as education or public health; not to mention the maintenance needs of the infrastructure that have been constructed that, as it is

going to be pointed out in this paper, in case of not being done, ends up building a vicious circle on its own benefits.

A somewhat cynical view, but probably very realistic, could argue that in many developing countries nothing prevent the misallocation of funds that are not invested in transportation infrastructure, providing dilapidation in unproductive current expenses, and that instead of facing this alternate allocation, it is always better to invest in infrastructure.

People who support the debate from the only prospect of the second moment, a vision that could be called “fiscal economics emphasis”, argue instead that transport investments must be justified exclusively over the basis of costs reduction in the logistic chain of real activities and their “reasonable” growth, improving its competitiveness (eventually international if it is about traded goods), “pushing” as a consequence, the economic growth process.

It is natural that most supporters of this prospective are the ones more worried defenders of the fiscal balance and the public expenses reduction.

Actually, both visions are not disconnected conceptually. The proper approach would be to consider as a single project all the investments required by the production system, included those corresponding to the transport system. This analysis, carried out in the right way with the proper economic opportunity costs, should naturally take us to the justification (or not) of the transport investments.

Figure 1 presents an interpretation of the roll of transportation inducing the production of a good in which a transportation infrastructure that implies a transportation cost C_0 is not capable by itself to allow the production of the good, since it leaves its supply over the value “a” of the upper graphic, giving no intersection between the supply and demand curves. By other hand, if it is possible to provide infrastructure facilities to the point to reach transportation cost C_1 , for example, it allows the production of the good in a distant location to be traded in the market of the upper graphic.

THE EVALUATION OF HIGHWAY PROJECTS

In evaluation of projects it is usual to make a difference between economic and financial analysis. The first one, also known as cost-benefit analysis, is the evaluation from the point of view of the economy as a whole, and the second is the analysis from the point of view of the cash-flow required by the project itself to operate.

The financial analysis is not only a matter of the private sector. A highway agency has to analyze not only the public benefits generated by the project that is facing, but also the cash-flow available for the repayment of capital costs, maintenance and operation throughout its economic life.

The evaluation from the economic point of view is done through the comparison between the economic benefits that a project generates and the total cost of inputs that it requires. The measure of wealth generated by the project is given by the increase of the consumer’s surplus (the transport consumer) that results from the difference between his willingness to pay and the price effectively paid.

In transportation, the price is represented by the “sensible cost”, composed by all the items of the variable cost of transport that effectively affects the consumer’s decision.

In the case of a highway project the flow of benefits is measured by the increase in the consumers’ surplus perceived by the present users (normal traffic) plus the corresponding to

the new users (induced traffic). This variation comes from savings in vehicle operating cost, users' time, freight immobilization cost and the reduction of the number and severity of accidents.

Alternatively, when it can be assumed that markets are perfectly competitive, producers' and consumers' surplus can be measured in the market of the transported goods. (2)

Figure 2 presents both analyses. The upper graphic represents the market of a good supplied from a certain location corresponding to a fixed distance. The bottom graphic represents the market of transport of the good between the production location and the market.

The transport demand curve is derived from the supply and demand curves in the goods market.

All the values marked with an asterisk refer to the null transport cost situation (price corresponds to the production cost). From a situation with transport cost C_0 , this carries along a consumed quantity q_0 at a certain price p_0 in the market of the transported good. If a cost reduction in transport to C_1 would happen as a result of an investment in highway improvement that reduces operational costs, transported and consumed quantity increases to q_1 and the price of the good in the market is reduced to a certain value p_1 .

The second graphic shows the consumers' surplus variation in the transport market that, as has been already said, constitutes a measure of the benefits of the project for the economy. The supply curve (marginal cost of transport) is considered horizontal without congestion.

The effect of a project in the market of the good (upper graphic) can be measured evaluating the variation of the surplus of its consumers between q_0 and q_1 under the demand curve D_p and the one of its producers over the supply curve S_p^* that corresponds to the marginal cost of the producer.

It can be shown that surplus variations in transport consumers (graphic below) and in goods consumers and producers (upper graphic) are identical due to the assumption of perfect competition in both markets (transport and goods). That is why we usually measure the benefits in the transport market, in which different parameters are easier to estimate through "sensible costs", different kinds of vehicles, etc.

The total benefit increase generated by the project is appropriated by its consumers (consumer's surplus variation) and its producers (producer's surplus variation).

Figure 3 presents the same analysis for a traded good, for instance a farming commodity, which are very common in developing countries, where the price is exogenously fixed, and as a result of it, FOB demand curve is horizontal. In this case, the consumers' surplus variations in the goods market do not exist, assuming that the producers receive the entire surplus generated by the project.

It is obvious that for this entire surplus to exist (and in consequence the corresponding public benefits) a decrease in transport cost must become effective, which requires an initial investment and the effective maintenance of the facility in proper conditions related to the estimated operating costs.

In the case of the paving of a natural earth road without changing its alignment, we have to include the investment (in paving) and the maintenance costs that keeps the road

surface in adequate roughness conditions and other parameters corresponding to the vehicle operating costs and operating speeds according to the new transport cost C_1 .

If that cost reduction is verified, the economy as a whole would increase its value in a magnitude equal to the project's Net Present Value:

$$NPV = B - M - I$$

Where:

B = Present value of the flow of increments of the transport consumers' surplus
 $(\Delta CS_T^0 + CS_T^1)$ or $\left[(\Delta CS_P^0 + CS_P^1) + (\Delta PS_P^0 + PS_P^1) \right]$.

M = Present value of the flow of the incremental costs of the routine and periodical maintenance and rehabilitation with and without the project.

I = Present value of the incremental capital costs, including its residual value at the end of the economic life.

CONDITIONS TO GENERATE BENEFITS OF A HIGHWAY PROJECT

Provided certain transit levels during each year of the economic life of the project, for the economy to increase its value, investments should be produced and maintenance activities at levels corresponding to the cost C_1 should be done.

Both activities depend on the availability of funds, that is why it is necessary to ask where should be the origin of those funds and which are the conditions that make those funds available. This is, in fact, a financial analysis that must be done on the added value of the highway project and how part of it must be assigned to its own conservation and maintenance.

For example, a toll system captures in a direct way part of the benefits of the project. However, a project conceived and implemented on the ground of a healthy public policy must guarantee the cash-flows required for its maintenance, even if there were no direct mechanisms for it.

Figure 4 presents the financial cycle of a highway project benefit. In the case that the financial funds allow to guarantee the public benefits provided for the project and that those are capable to generate enough flow we can talk about the "virtuous" cycle of the financing of highways.

Let's analyze the cycle from the point of view of the maintenance required to allow the reduction of the transport costs and as a consequence, the induction of new traffic and the existence of benefits for the project.

As it has been seen, those benefits increase the value of the economy, increasing the producers' economic benefits and the available income of the consumers of the transported good (and eventually also the surplus of workers, depending of the market characteristics and other fiscal policies).

Part of this increment must be captured by the tax system, transforming part of the benefits estimated through the surplus in cash-flow variations that increases the available public resources. As it has been pointed, in the case of traded goods, the benefits of every project will provide increases in producers' surplus (coincident with transport consumers'

surplus) due to the fact that the demand function is perfectly elastic and a part of it is captured for example through export taxes.

At this point, resources are conditioned to public policies. In a first moment an assignment between highway and non-highway agencies is produced.

In a second moment, the funds of the highway agencies have to be assigned to highway maintenance, particularly to the project that has generated the benefits (cash-flow as a consequence) and to the repayment of the correspondent investments.

The closure of this cycle can be qualified as “virtuous” if it allows the proper maintenance of the road system, and it is not only a necessary condition for the financing of the highway investment, but essentially it makes possible the right concretion of the economic benefits that justified it.

The deviation of those funds to other governmental agencies or to other uses in the same highway agencies, like building new roads without maintaining the existing ones, does not allow the concretion of the benefits of the investments, sterilizing its effects and reducing or even annulling its added value to the economy.

That is why none of the benefits estimated “a priori” has sense if they cannot be transformed into cash-flows that strictly end up as resources bounded to the highway work maintenance.

To this economic flow to become a cash-flow it needs effective appropriation systems and, at the same time, that the different stages of the public assignment process allows it to reach an effective way to repay the investments and maintenance of highway infrastructure.

Once a fiscal crisis occurs, is very common that the practical behavior of the decision makers quickly distinguish between “hard dollars” (those corresponding to the investments and to transport system maintenance) and “soft dollars” referring to savings in vehicle operation costs, travelers` time, freight immobilization, etc.

As the investments have already been made (usually with soft financing of multilateral organizations), the fiscal crisis forces to allocate resources to other more urgent purposes (sometimes dramatically more urgent), and hard dollars, that should have been allocated to maintenance, suffer immediately cutbacks.

As a consequence of this policy, transport systems are in bad maintenance conditions, not allowing the existence of a big part of the “ex ante” estimated increase in consumers` surplus, and sterilizing the investments already made, not because the projects themselves were bad, but because they maintenance was not financed during their profitable life.

As it has been pointed out before, supposed a good base design for the project, the financial crises of the highway networks are basically the result of failures in the system for converting savings in transport costs.

The main causes of this failure are: (i) unsuitable and not efficient fiscal mechanisms for indirect taxes (e.g. fuel taxes); (ii) long traditions of fiscal evasion or elusion in direct taxes; (iii) wrongly designed tariff systems that do not have the proper incentives; (iv) institutional systems too weak and/or incompetent in public resources assignation.

The consequences of not providing for the funds for maintenance can be severe. In fact, according to the World Bank, the NPV of the operating costs flow without maintenance can be three times the NPV of the operating costs with maintenance, and the cost of restoring a road allowed to deteriorate to the point at which reconstruction is required is three to five times the cost associated with a policy of good maintenance. **(3)**

With some approximate calculations, since the real ones depends heavily of the particular conditions, it is possible to establish that the opportunity cost of the lack of maintenance is greater than 25% and can reach 50% (Figure 5). This kind of rentability in general cannot be afforded by any new road project and just by only few projects in other sectors of the economy.

FINAL THOUGHTS

The transport system in general and the highway system in particular must not only achieve economic sustainability (their public benefits must exceed their costs for the economy), but also must achieve sustainability in financial terms, meaning in practice that public policies have to guarantee the cash-flows required to repay the investments and its proper maintenance.

Otherwise what ends up in crisis is the project's economic support itself, generating a vicious cycle about the system.

The visions of transport as a development catalyst and as a reducer of logistic costs that we have presented before are perfectly compatible with the economic analysis and its implementation depends on the right implementation of financial policies.

The cost-benefit analysis that are usually required by highway agencies and multilateral organisms only make sense under the hypothesis that the proper financing of the project is guaranteed along its economic life, otherwise decisions made based on public benefits estimated "a priori" come inadequate and are not materialized.

The restriction of maintenance funds implies in general significant reductions in economic efficiency and the financial sustainability of a well designed highway system is possible capturing part of its own benefits and it is also the true key of its economic sustain.

This rationale leads to the idea that the resources for the maintenance of highway systems must come from cash-flows generated by its own improvements through the public resources assignation system and should not depend of any specific allocation decision. On the contrary, new highway projects should be the object of a detailed cost-benefit analysis and must compete for public resources as any other project in the different sectors of the economy. This guarantees the equity and, as a consequence, the social sustainability of the system. A non-equitable system finally does not result socially sustainable and a transport system that is economically or financially non sustainable, comes to be poorly equitable because it will imply that the benefits won't be paying its (unavoidable) costs, punishing very usually those social sectors that are not the ones with the highest incomes.

This is the basic justification to provide for financial mechanisms (road funds, toll systems, etc.) that guarantee maintenance funding as direct as possible. These mechanisms, by other hand, should be supported by sound institutions, since there are few technical solutions to bad politics and bad management, and the suppression of maintenance funding replacing it by centralized assignment mechanisms that do not guarantee the preservation of valuable public assets and its public benefits, certainly is not one of them.

REFERENCES

- (1) Heymann, H. “Objetivos del Transporte” in “La inversión en transporte y el desarrollo económico”. Editorial Troquel, Buenos Aires, 1974.
- (2) De Rus, Ginés. “Análisis Coste-Beneficio”. Editorial Ariel, Barcelona, 2004.
- (3) Gwilliam, Kenneth M. – Shalizi, Zmarak M. “Road Funds, User Charges and Taxes”. World Bank Discussion Paper TWU-26. September, 1997.

FIGURE 1: An interpretation of the roll of transportation inducing the production of a good.

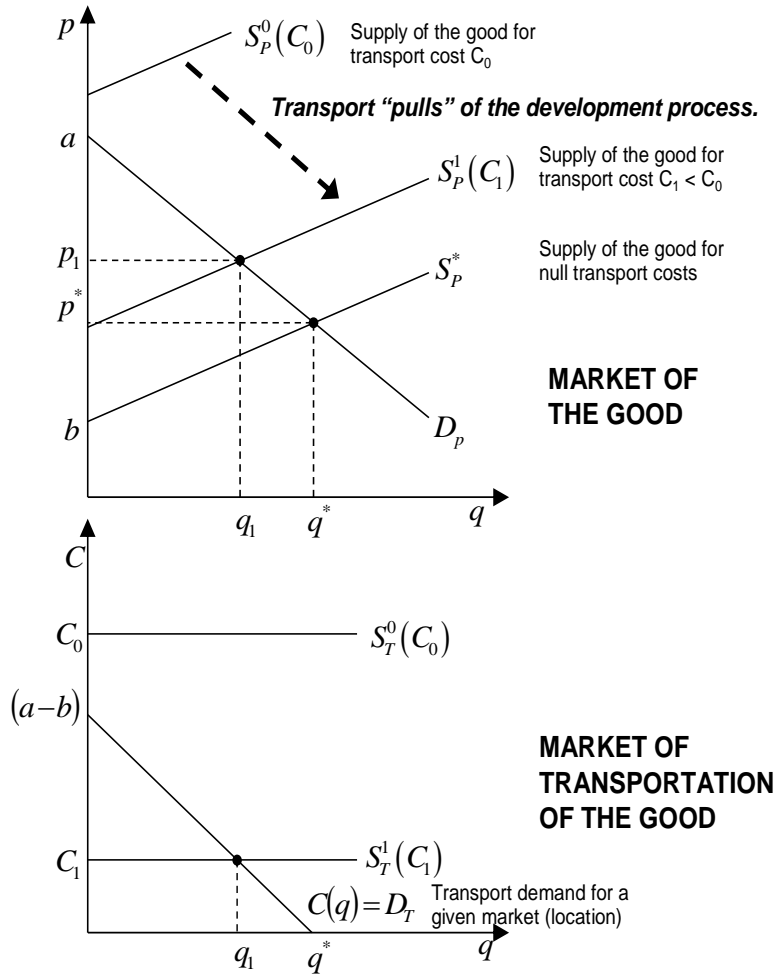


FIGURE 2: Benefits of a highway project in the goods market and in the transport market.

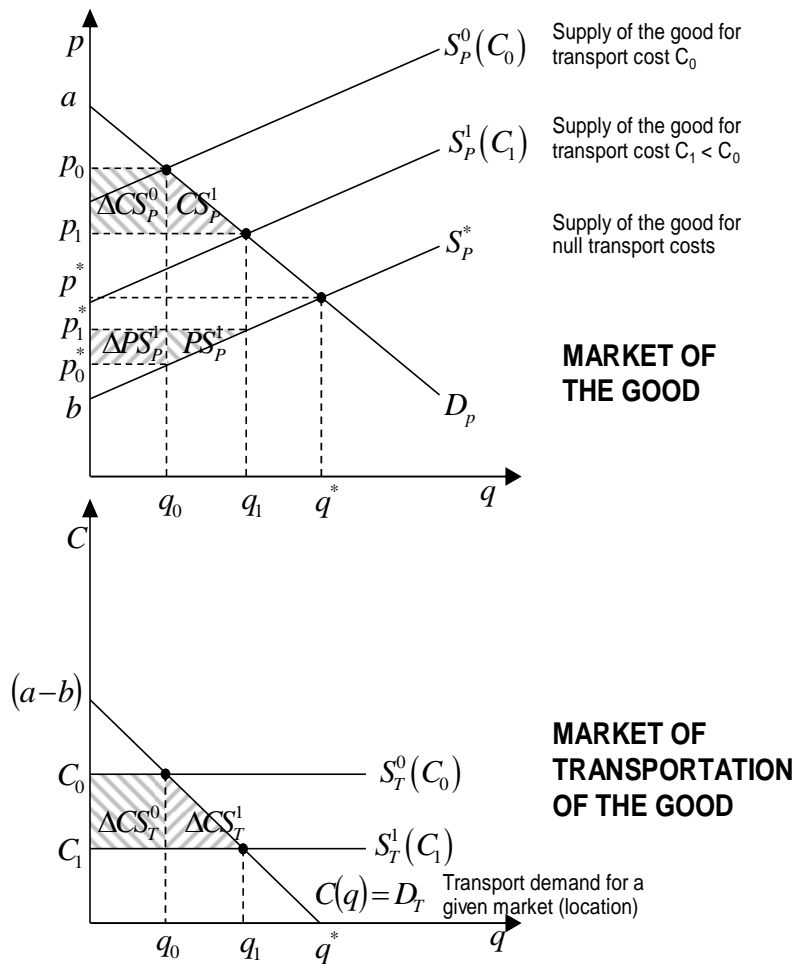


FIGURE 3: Benefits of a highway project in the goods market and in transport market in the case of a traded good.

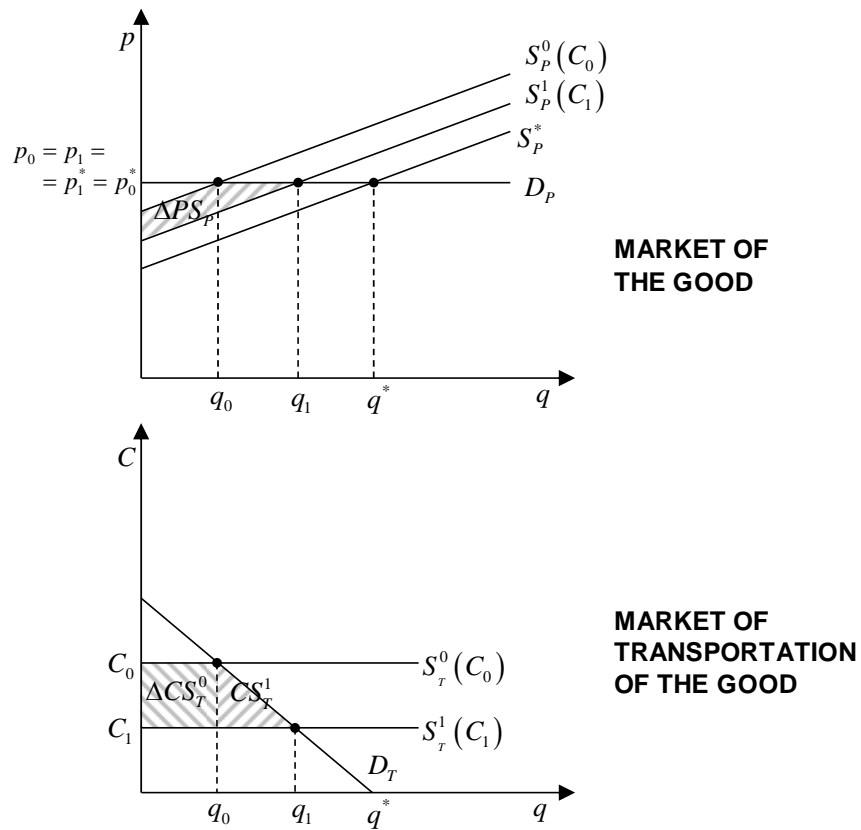


FIGURE 4: Financial cycle of the benefits of a highway project.

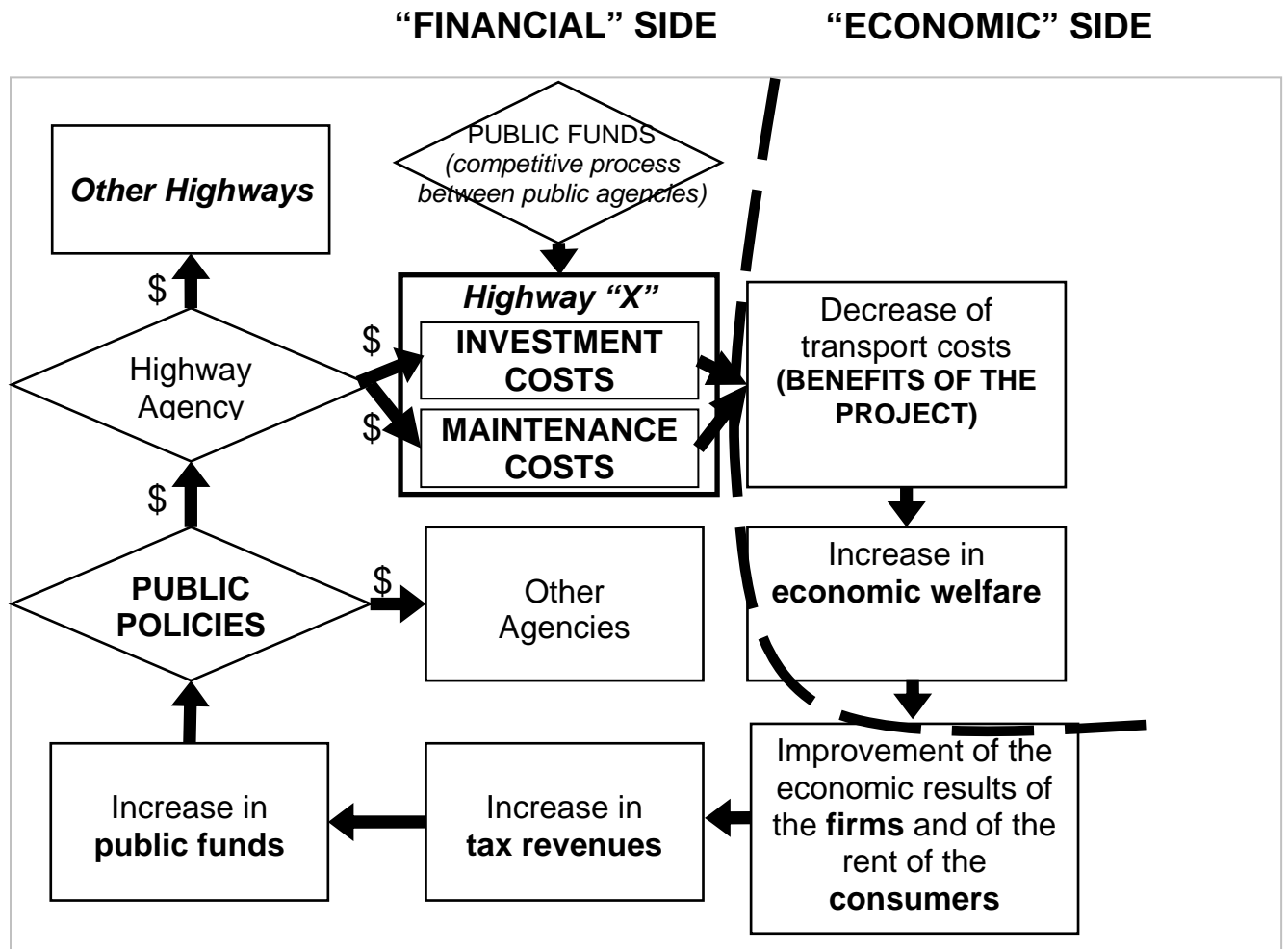
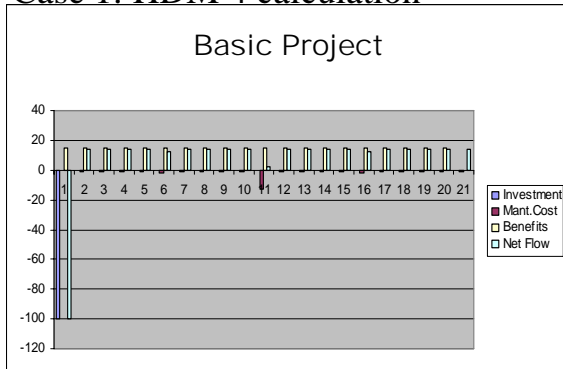
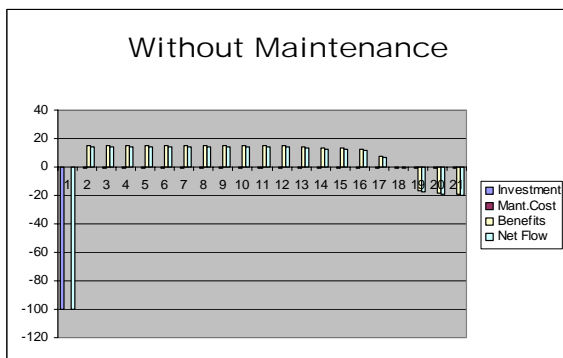


FIGURE 5: Opportunity cost of the lack of maintenance.

Case 1: HDM 4 calculation



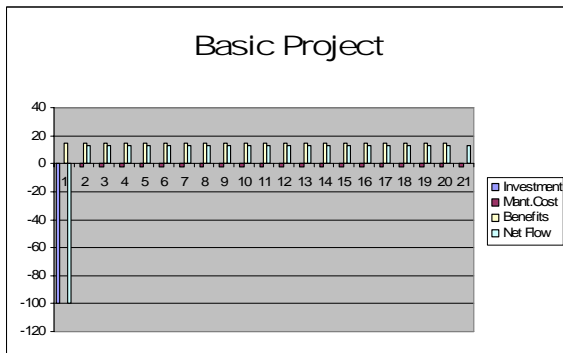
IRR = 12%



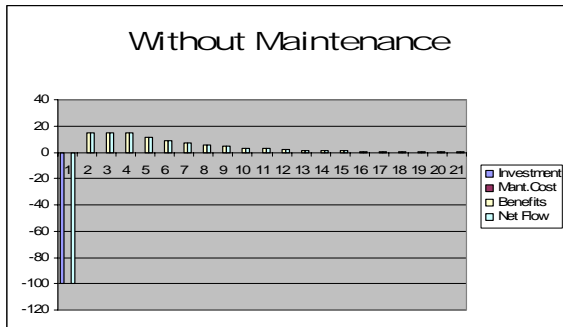
IRR = 9%

IRR of the Incremental Flow > 25%

Case 2: Approximated deterioration function



IRR = 12%



IRR = 0%

IRR of the Incremental Flow > 50%