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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

SUMMARY AUDIT OF VENEZUELA

FIRST HIGHWAY PROJECT

December 15, 1973

Operations Evaluation Department

PREFACE

This report, dealing with the first Venezuela Highway Project (IBRD Loan 306-VE), is one in a series of individual project audits currently being carried out by the Operations Evaluation Department. As a technique of post evaluation, the audit is intended to focus mainly on the question: were the principal objectives of the project attained and, if not, why not? To the extent possible, answers or impressions are also sought, where relevant, as to whether or not Bank institution-building objectives were met, and whether or not the lending activity itself might have been improved -- with the intent of bettering future Bank project lending.

Projects were chosen for audit on a random basis. The procedure followed by the Department during the past fiscal year was to cover Bank/IDA projects for which disbursements ended during FY1968. However, starting this fiscal year the system for selecting projects has been changed and now all projects will be audited about one year after completion of loan/credit disbursements.

To prepare the audit, relevant Bank files and documents were briefly reviewed and the project discussed with staff involved. A six-day mission to Venezuela was undertaken in June 1973 to update data and to gather impressions about the project from different sources in the country.

The valuable assistance provided by the Venezuelan Government, and especially by the Direccion de Vialidad, is gratefully acknowledged.

Note: Currency Equivalent
1962-1970 US\$1.00 = Bolivares 4.5
1971-1972 US\$1.00 = Bolivares 4.4
1973 US\$1.00 = Bolivares 4.3

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SUMMARY

In December 1961, the Bank lent US\$ 45.0 million to Venezuela (Loan 306-VE) to help finance construction of two sections (102 km) of toll expressway which would complete a system linking Caracas with Puerto Cabello, the country's second largest port, via Valencia, a growing industrial center to the west of the capital. The project resulted from a Bank general survey mission requested by the Government and carried out in late 1959. Construction on the project expressways was begun by the Venezuelans in 1958, but mainly due to Bank urging, original costly and excessive design standards were reduced to levels more suited to actual and anticipated traffic needs.

The major objectives of construction of the two expressway sections, Coche-Tejerias (59 km) and Valencia-Puerto Cabello (43 km), were to relieve congestion on the existing parallel highways -- for which upgrading to desired standards was not feasible -- and to provide for anticipated traffic growth. Secondary objectives were to encourage industrial and residential dispersion away from Caracas, agricultural growth in the Aragua Valley and greater utilization of the port at Puerto Cabello. Quantitative justification of the project was based solely on reduced vehicle-operating costs.

Implementation of the original project by the Highway Division, under advisory supervision of a consultant, went smoothly after initial administrative delays, and the quality of construction was good. Both sections of expressway were opened to traffic in 1965. Savings on the original project works permitted the financing of an access road branching from the Coche-Tejerias expressway and an interchange and extension towards the port on the Valencia-Puerto Cabello section. Total cost of the original project works was \$118.4 million, 2% less than estimated, while total cost of the enlarged project, \$125.9 million, was only 4% greater than estimated for the original project. The original closing date (1966) was postponed until 1968, when the additions to the original project were completed.

The major objectives of the project were accomplished: together, the two expressway sections realized traffic volumes of about 9,000 VPD, 10% less than originally estimated, and vehicle-operating costs were reduced as expected. Economic returns computed by use of the appraisal report's method are estimated at 9% for Coche-Tejerias and 14% for Valencia-Puerto Cabello, both over the original 8% appraisal estimate for each; application of modern appraisal methods, including time savings, yielded rates of return of 11% for Coche-Tejerias and 22% for Valencia-Puerto Cabello. The lower return on Coche-Tejerias was due especially to high costs of repair on a 3 km, two-lane stretch where a severe failure occurred, but also to considerably less than estimated traffic on the 20 km near Tejerias, which was

necessary and worthwhile as the last link in the Caracas-Valencia-Puerto Cabello expressway system but directly yields only about 6% rate of return. The high return on the Valencia-Puerto Cabello section was due to faster than anticipated traffic growth caused mainly by rapid industrial expansion in the Valencia area; in addition, diverted traffic was greater on Valencia-Puerto Cabello, where the alternate route was difficult to negotiate, than on Coche-Tejerias, where the alternate road was good.

Toll revenues were much less than expected largely because many trucks continued to use the old roads. Tolls are higher on loaded than on unloaded trucks and many continue to use the old roads when loaded. The effect of the toll structure on traffic should have been studied in more detail, especially after it became clear that traffic diversion from the old roads was lower than expected.

Regarding the expressways' secondary benefits, much industrial dispersion and residential growth has taken place, especially near Valencia, though, to date, less progress has been made with the intensification of agriculture in the Aragua Valley and the utilization of the port at Puerto Cabello.

Finally, the outcome of the project suggests that the Bank's original emphasis on savings, through reduction of design standards, was correct. It is not clear whether the failure that occurred on one section of the Coche-Tejerias expressway could have been prevented by longer, more expensive engineering studies. And it is clear that, overall, use of the higher standards would have resulted in much lower rates of return.

Audit of Venezuela Expressway Project

A. The Project

On December 31, 1961, the Bank made a loan of \$45 million to Venezuela to help finance the foreign exchange cost of a \$121 million expressway project in the North-Central region of the country. The project comprised two separate sections (see map). The first consisted of 59 km from Tejerias to Coche (a suburb of Caracas), expected to cost \$75.4 million, connecting the Caracas metropolitan road system with a 100 km expressway completed in 1958 between Tejerias and Valencia. The second was a 43 km section expected to cost \$45.2 million linking Valencia to El Palito, a point 10 km from Puerto Cabello, Venezuela's second largest seaport. The El Palito-Puerto Cabello section, though not included in the original loan agreement, was later improved to expressway standards with use of surplus loan funds; in addition, an access road from Los Totumos to La Penita was added to the Coche-Tejerias project. Actual total cost of the modified project was \$126 million (Table 2).

The two project roads completed an expressway system joining Caracas, Valencia and Puerto Cabello, thus serving the country's most industrialized and densely populated area. It resulted from a Bank-organized general survey mission to Venezuela carried out in late 1959 at the request of the Government.^{1/} The mission studied the country's 1960-64 Highway Development Plan and proposed six priority road projects. In August 1960 an appraisal mission was sent to investigate the possibility of Bank participation in the financing of the four highest priority roads. The Government and the mission ultimately selected the two project roads mainly because the technical feasibility studies on them were near completion. As for the two remaining priority roads, the Caracas-Barcelona link was expected to be completed with the country's own funds, and the studies on the Barinas-San Cristobal Highway were not yet ready. The Bank subsequently financed the latter under the Second Highway Project in 1964.

The primary objectives of the project roads were to relieve congestion on the existing roads, which were carrying traffic well above their rated capacity, and to accommodate anticipated traffic growth. The project was justified primarily in terms of savings in vehicle-operating costs. Both roads were expected to yield a return of about 8% over an economic life of 35 years.

The project was also justified in terms of its system effects: completion of the Caracas-Valencia-Puerto Cabello network would maximize the benefits from earlier investments in the already completed Tejerias-Valencia expressway section. Also, the new roads were expected to encourage

1/ IBRD, Economic Development of Venezuela, Johns Hopkins University Press, 1960.

industrial and residential dispersion in order to relieve congestion in Caracas, to induce agricultural intensification in the Aragua Valley, and to encourage the use of port facilities at Puerto Cabello, thus avoiding overcrowding in the nation's largest port, La Guaira.

The Venezuelan authorities considered two alternatives to the proposed investments. One was increasing the capacity of the rail line between Caracas and Valencia, and the other was improving the parallel Pan American Highway between Caracas and Tejerias and the old two-lane highway between Valencia and El Palito. The narrow-gauge railway was carrying in 1959 only 10 million ton-km of the 295 million ton-km transported in the corridor. Improving the railway was ruled out without detailed economic studies because costly major improvements would have been required just to accommodate the 1960 traffic level. Furthermore, though building materials and some goods requiring special hauling moved preferentially by rail, average railway freight tariffs per ton-km were four to five times higher than by truck.^{1/} Finally, the alternative of improving the old highways was also ruled out on the grounds that the geometric alignments of the existing facilities did not lend themselves to improvement to sufficiently high standards for the expected traffic volumes. Analysis of existing traffic volumes indicated that the roads were highly congested, with some sections carrying about 60% over the practical or design capacities.

B. Negotiations and Agreement

Initially, project preparation and appraisal moved very slowly due to a reluctance on the part of some Venezuelan authorities to collaborate with the Bank. It was the first time the Venezuelans had approached the Bank, or any international lending institution, and they were not aware of the many requirements of this type of operation.

The major issue discussed during project preparation was design standards. The Venezuelans had considerable experience in road construction and there were several dozen efficient construction companies in the country. The tendency was to build to very high standards. The original designs for the two project expressway sections envisaged six lanes, a very expensive alignment including three tunnels and a bridge, and rather excessive extras, such as shoulders built and paved to the same standards as the main lanes.

Largely at Bank urging, these designs were considerably modified to reduce costs and adapt the roads to the real needs of the traffic: only one tunnel was retained and road width was reduced to four lanes, though earthworks, bridges and the tunnel were to be constructed to six-lane width.

^{1/} Memoria, Banco Central de Venezuela, 1961.

This arrangement was agreed by the Bank and the Borrower since the nature of the terrain traversed would make future road widening difficult and expensive.

Negotiations began in June 1961 but quickly broke down due to the rejection by the Venezuelans of loan conditions that were standard Bank practice at that time, especially the procedures for arbitration and international competitive bidding, and the negative pledge clause. Agreement was reached only six months later, and the loan was finally signed on December 13, 1961. The problem with acceptance of the negative pledge clause was legal: the Central Bank's Charter did not permit the pledging of its assets for a "single purpose". An acceptable solution was reached five months after loan signature -- as the final condition for loan effectiveness -- whereby no lien on Central Bank assets would be granted except on payments with obligations not exceeding one year.

Main loan conditions were:

- (a) retention of consultants to supervise design and execution;
- (b) use of adequate construction standards, based on AASHO practices;
- (c) allocation of sufficient funds for the construction and maintenance of access and approach roads;
- (d) international competitive bidding.

C. Project Modification and Implementation

The effective date of the loan was May 14, 1962. At first, implementation was delayed by administrative difficulties, including cumbersome procedures for the hiring of contractors and consultants, and by discussions between the Venezuelans and the Bank about the application of international competitive bidding procedures. A firm of consultants was hired and the first contracts awarded only in mid-1962, although parts of the project roads had already been under construction by domestic contractors since late 1958, with Government disbursements amounting to \$15.7 million equivalent. It was agreed that the Bank loan funds would be applied retroactively only to expenditures from January 1, 1961, which amounted to \$3.5 million.

The project was modified on three occasions. By the end of 1963, when Coche-Tejerias was half completed and the Valencia-Puerto Cabello road about 26% finished, Bank supervision missions concluded that a substantial amount of funds from the loan would remain unspent due to economies obtained

through the new, better designs. This discovery triggered a long discussion between Venezuela and the Bank about the use of these extra funds. A final decision was taken only in March 1965, when the list of goods was modified to include construction of the El Palito interchange and upgrading of a 4 km stretch from that interchange towards Puerto Cabello. In 1966, this extension was increased to 7 km. A repaving of the Tejerias-Valencia expressway was dropped from proposals for revision when it became clear that the surplus funds would not be sufficient.

In May 1967 the Venezuelans presented to the Bank a request for disbursements for an access road from Los Totumos to La Penita. The Bank's first reaction was to reject participation on the grounds that the access road was not part of the project. When the Venezuelans pointed out that the Bank had already disbursed \$865,000 for that road, completed in February 1966, an extensive discussion followed. The Bank had approved disbursements for this access road through extensions of major expressway contracts. Part of the works comprised the financing of the interchange at Los Totumos, but the Bank did not realize at the time that the contracts included works beyond the interchange. The Bank asked for legal opinions from the Venezuelan authorities. After the Attorney General confirmed that the road was indeed part of the project works, which included construction of the two expressway sections and access and approach roads, as indicated in the loan agreement, the Projects Department decided to appraise the already completed work. The appraisal concluded that the access road was well justified and the issue was resolved in February 1968, when the Bank formally accepted the inclusion of this road in the project.

Shown below is the project as originally conceived and as finally modified:

Venezuela Expressways - Loan 306-VE

Estimated and Actual Costs and Actual Completion Dates

(US\$ million equivalent)

	<u>Estimated Cost</u>	<u>Actual Cost</u>	<u>% Actual of Estimated</u>	<u>Actual Completion Date</u>
<u>I. Original Project</u>				
A. Coche-Tejerias (Xway)	75.4 ^{a/}	71.9	95	April 1965
B. Valencia-El Palito (Xway)	45.2 ^{a/}	46.5	103	December 1965
Sub-total	<u>120.6</u>	<u>118.4</u>	98	

a/ Includes 15% construction contingencies after 1961 for both expressways.

Venezuela Expressways - Loan 306-VE (Cont'd.)

Estimated and Actual Costs and Actual Completion Dates

(US\$ million equivalent)

	<u>Estimated Cost</u>	<u>Actual Cost</u>	<u>% Actual of Estimated</u>	<u>Actual Completion Date</u>
II. <u>Project Additions</u>				
A. Los Totumos-La Penita Access	-	4.7	-	March 1967
B. El Palito Inter- change-Puerto Cabello Ext.	-	2.8	-	February 1968
GRAND TOTAL		<u>125.9</u>		

Sources: IBRD Appraisal Report TO-288a; Bank Supervision Reports; Miller, Warden and Western, Final Quarterly Progress Report, June 30, 1967.

The project was fully implemented, after three postponements of the closing date, by February 1968, when the El Palito Interchange and improvements on the 7 km extension towards Puerto Cabello were completed (Table 1). The delays in completing the original expressway projects -- four months for Coche-Tejerias and 12 months for Valencia-El Palito -- were minor, considering the substantial administrative delays incurred during the early implementation period. Part of the delay on Valencia-El Palito was also due to particularly difficult rock excavation on a 7 km stretch. The 14-month delay on the El Palito Interchange and 4 km extension to Puerto Cabello was mainly attributable to slow progress on final designs after Bank acceptance of this addition to the project in 1965.

Throughout implementation loan disbursements continuously lagged, due mainly to complex bureaucratic requirements within the Venezuelan Government. With 90% of physical works completed by 1965, only 60% of the loan had been disbursed. Major disbursements were made during 1964-1966 instead of 1962-1964, as originally planned. The Bank pressed constantly

for the streamlining of disbursement procedures until, by mid-1966, the Ministry was able to report that the length of time between submission and payment of a bill had been reduced from an average of 50-70 days to 20 days through minor modifications in the regulations governing the disbursement procedures, a permanent improvement that has been very helpful in subsequent projects.

The total cost of the amended project was \$125.9 million equivalent (Tables 1 and 2). The actual cost of the two original expressway sections was \$118.4 million equivalent as against the original estimate of \$120.7 million, a saving of 2%. On the Coche-Tejerias road the cost was 5% less than estimated, but on the Valencia-Puerto Cabello there was a 3% overrun. No comparison is possible on the El Palito-Puerto Cabello extension nor on the Los Totumos-La Penita road because no clear original estimates are available. On the expressways, the changes between estimated (before contingencies) and actual (see Table 3) are explained mainly by increased quantities of work in earth-works and drainage, and to a lesser extent by price variations.

All supervision reports concur that the quality of construction, which was carried out entirely by domestic contractors; was generally good, and that supervision by Ministry staff was adequate. The performance of the consultants was not discussed in the supervision reports; however, the Venezuelan authorities in the Ministry of Public Works who were familiar with the project were somewhat critical in retrospect. The consultants reviewed project designs, specifications and applications for disbursements, and advised on supervision and materials testing. The Venezuelans contend that it was possible at the time to foresee the serious slide and "uplift" problems which occurred shortly after completion on the Coche-Tejerias road, where a deficiency appeared just south of the Ocumitos Tunnel on a 3 km stretch, and where two of the four lanes have been permanently closed to traffic for the past five years. The National Guard is on 24-hour duty to prevent overtaking in this winding 3 km section with steep gradients, although this still takes place causing some serious accidents. We have no way to definitely assess whether these slide problems could have been foreseen, but it is obvious that a more detailed -- and costly -- survey would have helped.

The issue of international competitive bidding and procurement permeated project implementation. The Venezuelans continuously awarded contracts, mostly relatively small, without informing the Bank or the consultants, but, more importantly, without following international bidding procedures. In most cases, the Bank judged the size of the contracts too small to have justified international competitive bidding, and in general, it did not raise serious objections to the procedures followed by the Venezuelans. At that time, international bidding procedures had not been formalized.

D. Traffic Evolution

Actual traffic on the two expressways has been about 10% lower than anticipated. Between 1965 and 1971, daily traffic averaged 9,000 vehicles as compared to the appraisal estimate of 10,000 (Table 4). Overall traffic volumes, however, do not adequately reflect the traffic variations between sections: for the period 1965-1971, traffic utilizing the 25 km Coche-Cortada de Maturin section was 16% lower than projected, although in absolute terms it was almost twice the level of the section between Cortada de Maturin and Tejerias. On the latter, actual traffic was 36% below the original estimate. Traffic on the Valencia-Puerto Cabello section was about equal to original estimates, but the largest growth took place on the first 20 km near Valencia (Table 4, Valencia-Trincheras) where daily traffic averaged 14,000 vehicles from 1965-1971, about 2.5 times that on the second half of the expressway. This differential is explained by the rapid growth of the Valencia region in the past decade, where a number of large industries, including several automobile assembly plants, have been established. This region offers an attractive alternative to congested Caracas which is less than 160 km away, and where land prices are very high.

The main reason for traffic shortfalls is the lower-than-expected level of diverted traffic. On the Coche-Tejerias section traffic diverted from the old road^{1/} was, on average, 32% of the total actual traffic on the expressway in the 1965-1971 period as against 45% in the four years following its opening but subsequently fell to 30%, as against the estimated 80%. The problem was that the initial estimates on diverted traffic were too high: they were based on the 75-85% diversion previously experienced on the Tejerias-Valencia expressway, much greater than what should have been expected on Coche-Tejerias, where the alternative road was in much better condition. The old Valencia-Puerto Cabello road is somewhat comparable to the old Tejerias-Valencia road, but the level of traffic was considerably higher on the latter; for this reason, traffic diverted to the Valencia-Puerto Cabello expressway was also less than expected.

As a matter of fact, traffic on the old parallel roads grew at an annual rate of 5% between 1967 and 1971, following a temporary decline in the first two years after completion of the project roads (Table 5). A major reason for this growth is that owner-operated trucks (about half of the national fleet) continue to use the old roads, especially the parallel Coche-Tejerias highway, for all trips or, in some cases, they travel on the old road when loaded and return on the expressway when empty, to save toll expenses, as the charges for loaded and unloaded trucks differ substantially. As a consequence, the number of trucks using the expressways is lower than anticipated. The actual vehicle composition on Coche-Tejerias was 77% cars and 23% trucks, close to the estimated 75-25%, but it is 85% and 15% instead of the estimated 65-35% on the Valencia-Puerto Cabello road.

^{1/} This is the Pan American Highway, which is 14 km shorter than the expressway but not exactly parallel to the new road. For instance, traffic destined for the surrounding area of Los Teques would not use the expressway, which bypasses these areas (see map).

E. Economic Returns

In the analysis of direct road user benefits, the original appraisal quantified only savings in vehicle operating costs. Time savings and reduced accident costs were not quantified, although they are mentioned in the appraisal report. Also, the original calculation did not take into account the savings from increasing congestion costs on the old roads nor did it differentiate vehicle operating costs for cars and trucks. In this audit calculations are based on actual traffic data, construction and maintenance costs, up-to-date information on vehicle operating costs, and estimates of time savings.

Coche-Tejerias

In order to make a comparison for the Coche-Tejerias Expressway with the originally calculated rate of return, we adopted the same system of computing savings in vehicle operating costs and assumed a 35-year life. The ex-post return obtained using the appraisal report method is 9% as compared to the original estimate of 8% (Table 6).

In the present audit the appraisal methodology has been revised: cost savings on car and truck traffic have been clearly differentiated and we have assumed a 25-year economic life, a more reasonable period. Also included are the costs and benefits of the Bank-financed access road Los Totumos-La Penita. With ample allowance for the costs of repaving in the tenth year of road operation, and for unusually high maintenance costs, we obtained a return of 10.7% including savings in vehicle operating costs and travel time, and 8.7% without time savings.

There are several explanations for these fairly low returns. First, the combined cost of construction and reconstruction is high relative to the benefits that materialized. The total construction cost was \$1.3 million equivalent per km, but due to the recurring slide problems mentioned previously, about \$29 million will be spent by 1976 to complete repairs and reconstruction in addition to regular maintenance expenditures amounting to about \$700,000 a year. These costs understandably reduced the actual return on the investment, as reflected by sensitivity analysis: if the costs were reduced by 25%, the return would be 13.8%, while a 25% increase in benefits would result in only a 13.0% return.^{1/} Second, there has been since the early 1960s a viable alternative for most of the traffic served by the expressway: a paved undivided four-lane highway for 26 km (Coche-Los Teques) and a two-lane highway with paved shoulders for the remaining 20 km. It is well utilized at present with a traffic volume in 1971 20% higher than on the expressway. Finally, traffic volumes on the section near Tejerias

^{1/} Further sensitivity analysis supports this conclusion. Using the revised method, but increasing to 50% of average wages the basis for calculation of time savings, a 13.3% IRR is obtained (Table 6, III).

have been considerably lower than anticipated, as indicated before.^{1/} The return for this section was only 6.3%, including time savings.

In order to better understand the road's impact, a further analysis was undertaken for the 25 km section closer to Caracas, where traffic was about twice the level of that on the rest of the expressway. The return for this section is 14.0% including time savings and 11.7% without them. This higher return was obtained in spite of allowance for extra costs to road users connected with the closure of two lanes on the 3 km section south of the Ocumitos Tunnel, and for reconstruction and repairs.

The major benefits of the Coche-Tejerias expressway are savings in operating costs amounting to 71% of total benefits, with the remainder accounted for by time savings (Table 7). The low proportion of benefits from time savings is due to conservatively estimated values given to travel time. Only 20% of the average hourly wage rate of car owners was applied to quantify time savings (Table 6). Moreover, business trip time was also valued at the same rate as non-business trip time. If we assume that 20% of total trips are non-home based and valued at full hourly wage rates, and all other trips are valued at 50% of wage rates, overall benefits would of course rise and the benefit composition would change to 44% in operating costs and 56% in time savings.

Valencia-El Palito-Puerto Cabello

In computing returns on this expressway we have taken the costs and benefits on the entire Valencia-El Palito-Puerto Cabello section, although the last 3 km near the port were constructed with Government funds. The expressway yielded a 14% return using the appraisal method as against the originally projected 8%. Using the revised method, the return is 22% including all direct benefits and 20% excluding time savings.^{2/} Separate returns for shorter sections would be very similar.

The reasons for this high return are, first, that this section did not experience bad slide problems, so that no reconstruction expenditures were required. Also, the alternative road is a two-lane paved highway traversing mountainous terrain and having long steep grades; the reduction in vehicle-operating costs in the mid-1970s on the expressway, relative to the without-project situation, amounts to 45% for cars and 60% for trucks, which would progressively increase to 50% for cars and 70% for trucks by 1985.

^{1/} A separate rate of return was not calculated for the Totumos-La Penita access road; its costs and benefits were included in the calculation for the 34 km section near Tejerias, from which it branched.

^{2/} A 25% IRR was obtained using the revised method and increasing to 50% of average wages the basis for calculation of time savings (Table 6).

By contrast, the comparable cost reductions on the Coche-Tejerias expressway amounted to 35% for cars and 45% for trucks in the mid-1970s, increasing to 48% and 60% by 1985. The current average travel speed on the old road is 20 km/hr for trucks and 35 km/hr for cars; without the project, congestion costs would have been very high. In addition, the road goes through several towns where shops and houses are strung out beside the road, and through traffic must compete with pedestrians.

Another reason for the high return is that traffic growth was faster than anticipated because of the rapid growth of the Valencia area. The higher proportion of truck traffic also means that most of the benefits are savings in vehicle-operating costs. These account for 84% of the total, the remaining 15% being derived from time savings. Sensitivity analysis indicated that if 20% of total trips were for business, and non-working travel time was valued at 50% of hourly wage rates, time savings would comprise 32% and vehicle cost savings 68% of total benefits.

F. Toll Revenues

While the two expressway sections are toll roads, they were not intended to be self-liquidating. In Venezuela, toll highways are operated by the Ministry of Finance, independently from the Ministry of Public Works (MOP). The tolls collected are remitted to national treasury funds as part of the Government's ordinary income.

Total gross revenues from toll charges on the project expressways during 1965-1972 fell far below the projected level (Table 8), amounting to only \$10.1 million equivalent, or 36% of estimated on Coche-Tejerias and \$9.2 million equivalent, 48% of estimated, for the Valencia-Puerto Cabello section.^{1/} The main reason for these lower revenues is the lower than expected truck traffic because trucks continue to use the old roads, especially when they are loaded, to avoid paying the toll. Apparently, toll charges for loaded trucks prevented a considerable diversion to the expressways, especially on Coche-Tejerias. Other reasons are the lower levels of realized traffic on the Coche-Tejerias expressway, and lower than projected toll charges. We have not been able to assess the impact of the toll system on traffic on the old and new roads, but the results suggest that a different structure of toll charges, especially for trucks, might have induced a higher level of diversion to the expressway.

G. Design Standards and Maintenance

The original designs and detailed engineering studies for the two expressways were completed in 1957 by a local engineering firm. After detailed investigations on local topography and geology, this firm came up with route designs for Coche-Tejerias requiring three tunnels and a 600-meter

^{1/} There is no toll charge on the El Palito-Puerto Cabello section.

bridge, at an estimated total cost of \$89 million equivalent. When a new Government came into power in early 1958, major revisions were undertaken in the public works program and a commission was set up to consider less expensive design standards on the Coche-Tejerias section. By 1960, when Venezuela first requested a Bank loan, the Government, with Bank encouragement, had accepted the commission's recommendations. Final designs adopted by the MOP called for \$58 million equivalent, after elimination of the commission's recommended 600-meter arch which would have spanned the section where the serious slide problem has been occurring since 1968. Elimination of the arch resulted in a cost saving of \$8.9 million equivalent.

The main problem in the project is the 3 km section on the Coche-Tejerias road where the slides and uplift problems have occurred. It is only a short section, but it has caused serious and costly problems. Two lanes have been closed since 1968 and will not be opened until reconstruction work is completed around 1975-76. This was the section where the original designs were modified, with Bank concurrence, to avoid a second tunnel and a bridge, by diverting the road around the mountain ridge and supporting it by a 500-ft embankment. This embankment collapsed in one place. Nevertheless, an arch spanning about 200-250 meters is under construction where the slides occurred. Repairs and reconstruction have been expensive. MOP officials estimate that \$24 million equivalent will be spent over the next five years, a large proportion of which can be attributed to this 3 km section; this figure does not include regular maintenance. From the opening of the road in 1965 until 1972, an estimated \$5 million equivalent has been spent for slide clearance and repairs. In addition, negotiating this section increases road user costs. During peak hours, cars stuck behind a slowly climbing truck have to reduce speed causing time loss and higher operating costs.

We have not been able to establish whether this problem could have been avoided by reverting to the original, more expensive design, which was based on extensive surveys. To come to a firm conclusion on the subject would have required detailed engineering analysis of a kind that is beyond the terms of reference of an audit. What is clear is that opinions today seem to be radically different among Venezuelan engineers, the consultants and Bank staff who were involved in the project.

There was an additional minor problem concerning type of pavement. During project preparation there was a long discussion on the subject, with the Bank arguing for flexible pavement on the grounds of economy, and the

Venezuelans arguing for the use of rigid pavement. Contrary to the recommendations of the Bank and the consultants, the Venezuelans went ahead and paved several sections of the two highways with rigid pavement without informing the consultants as had been agreed. It was later found out that the Ministry was under heavy pressure to help the local cement industry, which was going through a bad recession. In view of the good quality of maintenance in Venezuela and, in retrospect, the lighter-than-expected traffic, the use of flexible pavement was appropriate.

Regarding maintenance, the original appraisal mission noted that it was very expensive and the organization overstuffed, but the loan agreement did not include special conditions other than a general clause calling for adequate maintenance on the project roads. Actually costs have further increased while the productivity level has decreased. The system-wide annual average highway maintenance cost in Venezuela is about \$4,000 per km. The expressways in mountainous areas such as Coche-Tejerias and Valencia-El Palito normally require about \$8,500 per km for regular maintenance. A large number of maintenance employees hired in the 1950s under an unemployment relief program caused a sharp climb in costs, and throughout the 1960s the number of people on the public payroll continuously increased; an estimated 10,000 to 20,000 workers are presently employed by the Maintenance Division of MOP. Consequently the labor component is 75-85% of maintenance expenditures, despite the capital-intensive techniques employed. In addition, an inordinate number of people are hired as clerks, accountants, and in other overhead positions.

The Bank did not tackle this problem; no further mention was made of the maintenance issue after an initial discussion during the appraisal stage. It is unclear to us how much could have been done by the Bank on this issue, given the fact that this was the Bank's first operation in Venezuela, that other major issues were under discussion, and that changing the maintenance organization implied a serious impact on employment. However, maintenance should have been discussed more extensively in subsequent loans.

H. Conclusions

The original loan project, comprising construction of the Coche-Tejerias and Valencia-El Palito expressway sections, was implemented smoothly and with little delay after the initial administrative problems were resolved. The additions to the project -- the Los Totumos-La Penita access road and the El Palito interchange and extension toward Puerto Cabello -- were completed later with use of surplus loan funds. Although the project was enlarged, the actual total cost, \$126 million, was only 4% above the original estimate of \$121 million.

The major objective of the original project, as stated in the appraisal report, was to relieve growing congestion on the existing roads and to accommodate anticipated traffic growth. Secondly, the project roads were expected to encourage industrial and residential dispersion (to relieve congested Caracas), agricultural intensification in the Aragua Valley and increased utilization of the port at Puerto Cabello. The project roads were justified in terms of reduced vehicle operating costs. Our analysis indicated that the project has generally more than accomplished its primary objectives: in the absence of the project, the old roads could have accommodated traffic growth only with heavy congestion costs. The two expressways realized overall traffic volumes close to original estimates and helped to reduce vehicle-operating costs both on the old and new roads. Although the volume of diverted traffic was only half the projected level, the level of generated traffic exceeded original estimates by about 30%, thus bringing the overall volume to only 10% below the appraisal estimates. As regards secondary project benefits, much industrial dispersion and residential growth has taken place especially near Valencia, though, to date, less progress has been made with the intensification of agriculture in the Aragua Valley and the utilization of Puerto Cabello.

The economic return for the project roads, calculated in the same way as in the appraisal report, was 9% for Coche-Tejerias and 14% for Valencia-Puerto Cabello, both exceeding the 8% original estimate. If modern appraisal methods are considered, the returns improve somewhat on Coche-Tejerias, to almost 11%, and substantially on Valencia-Puerto Cabello, to 22%. The Cortada de Maturin-Tejerias section had a lower return, of 6.3%. However, this section had to be built at about the same time as the others in order to complete the Caracas-Valencia-Puerto Cabello network.

In spite of the serious technical problems found on one stretch of the Coche-Tejerias expressway, the Bank's original emphasis on cost reduction seems justified. The roads originally proposed would have had low returns and would have raised serious questions as to whether or not Bank funds should have been invested. It has not been possible to establish whether the technical problems on the 3 km section which has had to be partially closed could have been solved by longer, more expensive engineering studies. The general principles of road planning promoted by the Bank seem to have had an important positive influence on other road investments in the country. The impact of the toll system on the level and structure of traffic is an issue on which the Bank should have played a larger role; for example, a monitoring of the traffic evolution on the expressways would have detected the lower-than-expected levels of diverted traffic, raising questions about the impact of the toll system.

Table 1

Venezuela Expressways: Loan 306-VE
Costs and Completion Dates, Actuals vs. Estimated
 (Bs millions)

	<u>Length (km)</u>		<u>Total Cost</u>			<u>Aver. Cost per km</u>		<u>Completion Date</u>		
	<u>Est.</u>	<u>Actual</u>	<u>Est.^{a/}</u>	<u>Actual</u>	<u>% Act. of Est.</u>	<u>Est.</u>	<u>Actual</u>	<u>Est.</u>	<u>Actual</u>	<u>Months Overrun</u>
1. Coche-Tejerias Expressway	59	59	339.4 ^{b/}	323.5	95 ^{b/}	5.8	5.5	12/1964	4/1965	4
Los Totumos-La Penita Access ^{b/}	10	10	21.0 ^{b/}	21.0 ^{b/}	100 ^{b/}	2.1	2.1	12/1964 ^{b/}	3/1967	-
Subtotal	69	69	360.4	344.5	96	5.2	5.0			
2. Valencia-El Palito Expressway	35	43	203.6	209.5	103	5.8	4.9	12/1964	12/1965	12
El Palito-Puerto Cabello Extension ^{c/}	4	7	7.8 ^{c/}	12.7 ^{c/}	-	2.0	1.8	12/1966 ^{c/}	2/1968	14
Subtotal	39	50	211.4	222.2	105	5.4	4.4			
Grand Total	108	119	571.8	566.7	99	5.3	4.8			

^{a/} Bank Appraisal estimate including 15% construction contingency after 1961 for Coche-Tejerias and Valencia-El Palito.

^{b/} Added to the project only after completion in 1967.

^{c/} Added to the project in 1965; estimated cost for 1965 for El Palito Interchange plus 4 km construction towards port; actual cost for Interchange plus 7 km extension towards port.

Source: IBRD Appraisal Report TO-288a; Bank Supervision Reports; Miller, Warden and Western, Final Quarterly Progress Report, June 30, 1967.

Table 2

Venezuela Expressways: Loan 306-VE
Total Costs (Bs millions) a/

	<u>Prior to 1961</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>Actual Total</u>	<u>Actual Total US\$mil. equiv.</u>
<u>I. Coche-Tejeras</u> ^{b/}											
a. Construction	49.3	20.6	9.5	93.1	65.2	21.1	43.1	13.9	3.2	319.0	70.9
b. R.O.W.	3.2	3.2	3.2	-	-	-	-	-	-	9.6	2.1
c. Engineering Services	2.5	1.0	0.5	4.6	3.3	1.0	2.1	0.7	0.2	15.9	3.5
<u>Subtotal</u>	55.0	24.8	13.2	97.7	68.5	22.1	45.2	14.6	3.4	344.5	76.6
<u>II. Valencia-Puerto Cabello</u> ^{c/}											
a. Construction	9.1	9.1	4.0	49.7	52.7	12.9	45.8	5.7	4.9	193.9	43.1
b. R.O.W.	6.2	6.2	6.2	-	-	-	-	-	-	18.6	4.1
c. Engineering Services	0.5	0.5	0.2	2.5	2.6	0.6	2.3	0.3	0.2	9.7	2.2
<u>Subtotal</u>	15.8	15.8	10.4	52.2	55.3	13.5	48.1	6.0	5.1	222.2	49.4
<u>Grand Total</u>	70.8	40.6	23.6	149.9	123.8	35.6	93.3	20.6	8.5	566.7	125.9

a/ Conversion Rate: Bs 4.50 = US\$1.00

b/ Includes Los Totumos-La Penita access, included in amended project.

c/ Includes El Palito Interchange and 7 km connection towards Puerto Cabello, included in amended project.

Table 3

Venezuela Expressways: Loan 306-VE
Breakdown of Construction Costs by Type of Work
Actuals vs. Appraisal Estimates (Bs millions)

	<u>Coche-Tejerias</u>		<u>Valencia-Puerto Cabello</u>			
	<u>Est.a/</u>	<u>Actual b/</u>	<u>Est.a/</u>	<u>Actual c/</u>		
Earth Works & Drainage	100.2	187.2	38.4	112.7		
Bridges & Viaducts	21.4	9.6	20.1	10.8		
Tunnels	19.1	10.8	28.6	0.0		
Paving	42.6	47.0	28.2	34.7		
Interchanges	36.2	0.0	18.2	0.0		
Toll Stations	3.3	4.1	5.9	3.4		
Complementary and Compensatory Works ^{d/}	56.3	60.3	11.5	32.3		
<u>Total Cost</u>	<u>279.1</u>	<u>319.0</u>	<u>150.9</u>	<u>193.9</u>		
			<u>% Overrun</u>			<u>% Overrun</u>
<u>Total Cost</u> (excluding additions to original project described in <u>b/</u> and <u>c/</u> below)	<u>279.1</u>	<u>298.0</u>	7	<u>150.9</u>	<u>181.2</u>	20

a/ Excluding 15% construction contingencies after 1961.

b/ Includes the cost of the Los Totumos-La Penita access road added to the project after appraisal; total cost: Bs 21.0 million; breakdown within categories of work not available.

c/ Includes the El Palito Interchange and 7 km extension towards Puerto Cabello added to the project after appraisal; total cost: Bs 12.7 million; breakdown within categories not available.

d/ Includes: relocation of existing roads and services, construction of agricultural underpasses and service tracks, access roads, etc.

Source: IBRD Appraisal Report T0288a; Miller, Warden and Western, Final Quarterly Report, June 30, 1967.

Venezuela Expressways: Loan 306-VI
Average Daily Traffic: Actual vs. Projected
(thousands)

Table 4

	Coches-Cortada de Maturin		Annual Actual Growth Rate (%)	Cortada de Maturin-Telmerias		Annual Actual Growth Rate (%)	Valencia-Puerto Cabello ^{a/}		Annual Actual Growth Rate (%)	Valencia-Trinchera ^{a/}		Annual Actual Growth Rate (%)
	Projected	Actual		Projected	Actual		Projected	Actual		Projected	Actual	
ADT ^{a/} All Traffic												
1965	13,400	9,600	7	10,500	4,811	36	7,000	5,000	20	n.a.	n.a.	
1966	14,110	10,250	23	11,050	6,600	17	7,100	6,000	20	n.a.	n.a.	
1967	14,811	12,570	10	11,620	7,770	12	7,200	7,200	7	n.a.	n.a.	
1968	15,620	13,830	4	12,220	8,641	1	8,411	8,550	19	n.a.	12,319	5
1969	16,411	14,311	4	12,860	8,580	4	8,911	9,170	17	n.a.	13,060	11
1970	17,300	15,411	7	13,500	9,000	3	9,500	10,711	9	n.a.	14,511	12
1971	17,980	16,111	5	13,970	9,290		9,960	11,611		n.a.	16,311	
Annual Average ^{b/}	15,617	13,116		12,211	7,820		8,411	8,320		n.a.	14,080	
ADT ^{a/} Passenger Car Equiv. ^{c/}												
1965	20,110	13,960		15,150	7,411		11,900	6,412		n.a.	n.a.	
1966	21,115	14,900		16,157	9,490		12,560	7,711		n.a.	n.a.	
1967	22,226	18,280		17,413	11,313		13,111	9,250		n.a.	n.a.	
1968	23,413	20,111		18,311	12,613		14,370	10,980		n.a.	n.a.	
1969	24,660	20,811		19,290	12,711		15,260	11,780		n.a.	n.a.	
1970	25,995	22,410		20,250	13,211		16,200	13,775		n.a.	n.a.	
1971	26,990	23,417		21,011	13,611		16,960	14,995		n.a.	n.a.	
Annual Average	23,500	19,111		18,380	11,418		14,139	10,690		n.a.	n.a.	

^{a/} The El Palito-Puerto Cabello Section of Valencia-Puerto Cabello Expressway was completed only in 1968.

^{b/} Weighted averages for all sections: 10,000 VPD; Actual 9,000 VPD.

^{c/} In accordance with Appraisal Methodology, one truck has been given the value of three cars.

Note: % of total vehicles:

	Coches-Cortada de Maturin Projected	Actual	Cortada de Maturin-Telmerias Projected	Actual	Valencia-Puerto Cabello Projected	Actual	Valencia-Trinchera Projected	Actual
cars	75	77.3	75	76.6	65	85.8	65	85.8
trucks	25	22.7	25	23.4	35	14.2	35	14.2

Source: Appraisal Report FO-288a and Direccion de Viabilidad.

Table 5

Venezuela Expressways: Loan 306-VE
Actual Average Daily Traffic on Old Highways (thousands)

	<u>Coche-Tejerias</u>		<u>Valencia-El Palito</u>	
	<u>Coche-Los Teques</u>	<u>Los Teques-Tejerias</u>	<u>Valencia-Naguanagua</u>	<u>Naguanagua-El Palito <u>a/</u></u>
1961	14.0	9.2	10.2	n.a.
1962	14.2	10.3	10.2	n.a.
1963	15.1	10.3	11.2	3.8
1964	15.5	11.4	11.5	4.2
1965	13.7	8.4	9.1	0.7
1966	14.0	7.5	9.7	1.7
1967	15.4	7.0	11.0	1.9
1968	16.2	6.5	11.2	2.0
1969	17.9	6.5	12.5	2.0
1970	18.3	7.4	13.4	2.2
1971	19.2	7.6	15.1	2.2

a/ El Palito-Puerto Cabello not included; project road was superimposed on existing road for that section.

SOURCE: MOP: Direccion de Vialidad.

Table 6

Venezuela Expressways: Loan 306-VE

Internal Rates of Return (%)^{a/}

I.	<u>Appraisal Report Method</u>	<u>Projected</u>	<u>Actual</u>
	A. Coche-Tejerias	8	9.3
	B. Valencia-Puerto Cabello	8	13.9
II.	<u>Revised Method^{a/}</u>	<u>Direct Benefits^{b/}</u>	<u>Without Time Savings^{c/}</u>
	A. Coche-Tejerias ^{d/}	10.7	8.7
	1. Coche-Cortada de Maturin	14.0	11.7
	2. Cortada de Maturin-Tejerias	6.3	4.8
	B. Valencia-Puerto Cabello	21.9	19.6
III.	<u>Revised Method</u>	<u>Direct Benefits^{e/}</u>	
	A. Coche-Tejerias ^{d/}	13.3	
	B. Valencia-Puerto Cabello	24.9	

a/ See Annex A for methodology.

b/ Includes savings from reduced vehicle operating costs and travel time, the latter based on 20% of average hourly wage rates of road users (see Annex A).

c/ Savings from reduced vehicle operating costs only.

d/ Includes costs and benefits of the 10 km access road, Los Totumos-La Penita.

e/ Includes savings from reduced vehicle operating costs and travel time, the latter based on 50% of average hourly wage rate of road users (see Annex A).

Table 7

Venezuela Expressways: Loan 306-VE
Breakdown of Road User Benefits (%)

<u>I. Road User Benefits</u>	<u>Coche-Tejerias</u>	<u>Valencia-Puerto Cabello</u>
Vehicle Operating Cost Savings	71	84
Time Savings ^{a/}	29	16
<u>II. Road User Benefits</u>		
Vehicle Operating Cost Savings	49	68
Time Savings ^{b/}	51	32

a/ Time savings calculated on basis of 20% of average hourly wage of all road users. (See Annex A, Methodology).

b/ Time savings calculated on basis of 20% of total trips (business) at full hourly wage rates and 80% of trips at 50% of hourly wage rates.

Table 8

Venezuela Expressways

Loan 306-VE: Toll Revenues on Project Roads
Actuals vs. Estimated
(Bs millions)

	<u>Coche-Tejerias</u>		<u>Valencia-Puerto Cabello</u>	
	<u>Est.</u>	<u>Actual</u>	<u>Est.</u>	<u>Actual</u>
1965	13.1	5.1	8.7	-
1966	13.8	5.4	9.2	4.4
1967	14.5	5.7	9.8	4.5
1968	15.3	5.8	10.4	4.9
1969	16.1	5.8	11.1	5.6
1970	16.9	5.9	11.8	6.9
1971	17.6	5.9	12.4	7.0
1972	18.3	6.0	13.0	8.0
Total:	<u>125.6</u>	<u>45.6</u>	<u>86.4</u>	<u>41.3</u>

Source: Dirección de la Renta Interna, IBRD Appraisal, TO-288a

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