Table 3

GROSS DOMESTIC EXPENDITURE (CONSTANT 1958 PRICES),

1963 - 1975

(thousands of Quetzales)

Concept *)	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1. Private Consumption	1 020 974	1 072 693	1 104 925	1 143 360	1 199 619	1 253 538	1 323 269	1 399 544	1 479 974	1 576 589	1 665 547	1 727 178	1 777 895
2. General Government Consumption	73 070	79 875	85 107	90 901	96 584	97 204	112 721	125 551	116 252	128 616	128 732	134 777	148 531
3. Fixed Domestic Investment	128 805	157 790	166 770	165 886	184 262	209 430	212 709	209 627	227 404	226 112	251 898	247 192	270 567
3.1 Private	107 815	125 226	127 421	130 385	143 522	168 393	172 866	170 739	178 855	169 553	186 586	194 626	210 307
3.2 Public	20 990	32 564	39 349	35 501	40 740	41 037	39 843	38 888	48 549	56 559	65 312	52 566	60 260
4. Change in Stocks	8 586	7 999	2 903	- 17 106	- 3 622	23 067	- 34 894	5 283	20 896	- 17 117	- 4 189	87 647	10 318
Gross Domestic Exp (GDX=C+I)	1 231 435	1 318 357	1 359 705	1 383 041	1 476 843	1 583 239	1 613 805	1 740 005	1 844 526	1 914 200	2 041 988	2 196 794	2 207 311
5. Export of Goods & Services	223 030	214 386	242 406	297 952	278 854	313 712	353 881	346 035	360 376	412 085	451 602	461 581	497 495
6. Import of Goods & Services	213 401	234 186	246 955	251 070	267 088	277 748	271 794	293 287	312 070	294 733	324 212	370 700	352 057
Product (Gross Domestic)	1 241 064	1 298 557	1 355 156	1 429 923	1 488 609	1 619 203	1 695 892	1 792 753	1 892 832	2 031 552	2 169 378	2 307 675	2 352 749
7. Terms of Trade Adjustment	- 31 670	- 19 080	- 30 301	- 49 460	- 56 886	- 61 488	- 76 084	- 39 448	- 71 715	-111 263	-116 513	-157 959	-172 631
Gross Domestic Income	1 209 394	1 279 477	1 324 855	1 380 463	1 431 723	1 557 715	1 619 808	1 753 305	1 821 117	1 920 289	2 052 865	2 149 716	2 180 118
8. Net Factor Income	- 15 011	- 17 444	- 16 842	- 29 529	- 32 985	- 38 825	- 44 210	- 41 831	- 46 927	- 50 392	- 42 525	- 38 252	- 46 481
Gross National Income	1 194 383	1 262 033	1 308 013	1 350 934	1 398 738	1 518 890	1 575 598	1 711 474	1 774 190	1 869 897	2 010 340	2 111 464	2 133 637

Source: Bank of Guatemala

*) 1 + 2 = Consumption (C)
3 + 4 = Gross Domestic Investment (I).

Table 4

Gross Domestic Investment. 1970-1979
(Thousands of 1958 Q; 1Q=US $1)

Concept	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Private Investment	176 023	199 751	152 436	182 397	282 273	220 626	296 069	325 409	373 548	303 404
Fixed Gross Capital Formation	170 740	178 855	169 553	186 585	194 626	210 308	276 231	295 787	328 962	289 356
Imports of Capital Goods	84 096	90 743	78 093	87 377	93 086	109 088	148 315	158 808	176 636	135 763
Agriculture	5 493	5 732	6 759	7 270	8 429	8 199	8 574	8 916	8 920	9 209
Land Habilitation	3 928	4 099	4 833	5 199	6 028	5 863	6 131	6 375	6 379	6 585
Private Construction	25 805	24 694	21 444	24 462	25 132	27 332	49 049	53 035	63 732	62 267
Domestic Produced Capital Goods	51 418	53 587	58 424	62 277	61 951	59 826	64 162	68 653	73 295	75 532
Change in Stocks	6 283	20 896	- 17 117	- 4 188	87 647	10 318	19 838	29 622	44 586	14 048
Public Investment	38 888	48 549	56 559	65 312	52 566	60 260	95 161	110 011	106 690	115 085
Machines and Equipment	2 116	10 593	8 771	6 796	5 226	5 350	10 717	10 303	8 484	12 930
Infrastructures and Road Construction	36 911	37 956	47 788	58 516	47 340	54 910	84 444	99 708	98 206	102 155
Total Gross Domestic Investment	214 911	248 300	208 995	247 709	334 839	280 886	391 230	435 420	480 238	418 489

Source: Bank of Guatemala, 1980, Boletin Estadistico, Table 53, p. 51.

Table 5: Capital-Output Ratios, by Sector, for the Economy in Kenya

Sector		
2	Modern Agriculture	2.59
3	Mining	2 90
4	Manufacturing	2.58
5	Construction	3.90
6	Electricity & Water	7.88
7	Commerce	1.06
8	Transport	5.75
9	Services	6.08

Source: Bigsten, A. (1978, p. 121). Originally, these ratios have been estimated by the World Bank (1975, p. 136).

Table 6: Sectoral Structure for Kenya's Capital-Output Data

Aggregate sectors	
A) Non-monetary sector	
1. Subsistence	1. Agriculture, fishing, forestry
	2. Watersupply, building, ownership of huts
B) Monetary sectors	
2. Modern agriculture	3. Agriculture, fishing, forestry
3. Mining	4. Prospecting, mining, quarrying
4. Manufacturing	5. M. of food preparations
	6. M. of bakery products, chocolate, sweets
	7. M. of beverages, tobacco
	8. M. of textile raw materials, rope, twine
	9. M. of finished textiles
	10. M. of garments, knitwear, made-up textiles
	11. M. of footwear, leather, fur products
	12. M. of sawmill products
	13. M. of wood products, printing, publishing
	14. M. of rubber products
	15. M. of paint, detergent, soap
	16. M. of petroleum products, other chemicals
	17. M. of misc. non-metallic mineral products
	18. M. of metal products
	19. Building and repair of transport equipment
5. Construction	21. Building, construction
6. Electricity & Water	20. Electricity, water supply
7. Commerce	22. Trade distribution
	26. Financial services
8. Transport	23. Transport, communication
9. Services	24. Restaurant, hotel services
	25. Ownership of dwellings
	27. Misc. services
	28. Government services

Source: World Bank. Quoted from Bigsten, ibid., pp. 58-59.

In chapter 2, we presented the sectoral distribution of the damage that the earthquake caused reproduced from the estimates made by the Bank of Guatemala. In table 7, these figures are reproduced and, in addition, converted to values in terms of 1970 prices.*) This is necessary because all information used so far in the trend analysis is expressed in 1970 prices.

Table 7: Sectoral Distribution of the Damage Caused by the Earthquake of February 1976 in Guatemala. Millions of Q

		Millions of Quetz.	
No	Sector	of 1976	of 1970
2	Agriculture	11.796	7.26
3	Mining	0	0
4	Manufacturing (industry)	23.0	14.16
5	Construction	0	0
6	Electricity & Water	14.861	9.15
7	Commerce	5.7	3.51
8	Transport	70.047	43.13
9	Services	895.596	551.43
	Total (D)	1,021.0	628.64
	GDP_{76}	4,365**)	2,687.60

The sectoral distribution of the damage presented in this table has been obtained and calculated as follows:

- The damage to sector 2, agriculture, is the sum of US $8.7 million reported as damage to rural activities plus US $3.09 million of damage to the agri-

*) For this conversion we have used:

$$D^{70} = \frac{GDP_{76}^{70}}{GDP_{76}^{76}} \cdot D^{76}$$

The original values represent replacement costs in 1976.

**) International Statistics, op.cit.

cultural infrastructure (the latter item is reported as 4 per cent of the total damage (US $77.4 million) to the economic infrastructure).

- For sector 3 no damage is reported.
- For sector 4, manufacturing, we have taken the US $23 million reported as damage to the industry.
- For sector 5, construction, no damage is reported. We believe that damage to this sector, if any, is included in those for sector 2 and 4.
- Damage to sector 6 includes damage to electricity and water resource systems. In the report of the Bank of Guatemala damage to water systems is included in the damage to the infrastructure for social services (US $219.9 million), of which US $13.7 million are indicated as damage to water systems. In the same way damage to the electricity generating systems is presented together with damage to railways and is indicated as 3 per cent of the US $77.4 million of the damage to the economic infrastructure. Therefore, damage to electricity has been arbitrarily put to one half of the indicated 3 per cent or US $1.16 million. As a total, the sum of the damages assigned to sector 6 amounts to US $14.86 million.
- Damage to commerce, sector 7, has been taken directly from the estimate given by the Bank of Guatemala for this sector and is equal to US $5.7 million.
- The amount of damage to transport, sector 8, includes the following: 26 per cent (or US $20.12 million) of the damage to the economic infrastructure of the nation that is reported as damage to seaports, 63 per cent of the same amount reported as damage to roads and bridges (or US $48.76 million) plus US $1.16 million which is the remainder of the damage to railways and electricity generating systems discussed in connection with sector 6. This gives a to-

tal of US $70 million.

- Finally, the damage to services, sector 9, includes US $16.9 million for damage to the hotel industry, US $206.2 million for damage to the infrastructure for social services (obtained by subtracting from the total damage to the social infrastructure the US $13.7 million of damage to the water system already included in sector 6), US $669.4 million of damage to the housing sector (or services from the ownership of dwellings) and US $3.09 million of damage to tele-communication and postal services. This amounts to US $895.59 million of total damage to sector 9.

Now, using the sectoral classification presented above, the changes in levels of production (ΔQ_s^D) of the damage (D_s) that the earthquake caused in each sector, would be given by:

$$(5) \quad \Delta Q_2^D = \frac{1}{k_2} D_2$$

$$\Delta Q_3^D = \frac{1}{k_3} D_3$$

$$\vdots$$

$$\Delta Q_9^D = \frac{1}{k_9} D_9$$

where $k_2, k_3, \ldots, k_9$ are the capital-output ratios for the sectors.

Thus:

$$\Delta GNP_{1976}^D = \sum_{i=2}^{9} \Delta Q_i^D + e$$

where e is an error term representing the changes in production in other sectors which have not been explicitly considered in our classification. If one assumes the damage caused to these sectors to be insignificant, so that e tends to zero, then an estimate for the

autonomous development of production in 1976 will be given by:

$$(6) \quad GDP^{*wd}_{1976} = GNP^{*nd}_{1976} - \sum_{i=2}^{9} \Delta Q^{D}_{i}$$

In terms of GDP, using the actual value of the GDP_{1975} plus 5 per cent (the average growth rate for the pre-disaster period) as an estimate for GDP^{*nd}_{1976} and the k's and D's for each sector, we obtain an estimate for the autonomous development of total output given by:

$$GDP^{*wd}_{1976} = 1.05\ GDP_{1975} - \Delta GDP^{D}_{1976}$$

where

$$\Delta GDP^{D}_{1976} = \sum_{i=2}^{q} Q^{D}_{i} = \sum_{i=2}^{q} k_i D_i =$$

$$= \frac{1}{2.59} \cdot 7.26 + \frac{1}{2.58} \cdot 14.6 + \frac{1}{7.88} \cdot$$

$$\cdot 9.15 + \frac{1}{1.06} \cdot 3.51 + \frac{1}{5.75} \cdot 43.13 +$$

$$+ \frac{1}{6.08} \cdot 551.43 = 111 \text{ millions of Q.}$$

Thus:

$$GDP^{*wd}_{1976} = 1.05(2,503) - 111 = 2,517 \text{ millions of Q.}$$

As indicated earlier (in connection with equation 2 and 3) once this fall in production has been obtained we can find the path for the autonomous development of production as one parallel to the historical trend calculated on the basis of 17 observations for 1959 to 1975. This path is represented in figure 3, by the line $\overline{HG}$. In this figure, the autnomous development without disaster (GDP^{*nd}) starts from the 1975 GDP level as do all alternative development paths.

In principle, the same procedure could be used to construct a path for the autonomous development of production after the earthquake, i.e. the development that would have occurred in the absence of disaster relief.

Assume, to begin with, that all effects are captured by expression (2'). Then, with our sectors and the amount of the foreign disaster relief provided to each sector affected, we may use expression 4 to obtain an estimate for the level of production that the economy might have had in 1976, as:

$$(7) \quad GNP^{ndr}_{1976} = GNP_{1976} - \sum_{i=2}^{9} \Delta Q^{A}_{i}$$

where ndr stands for no disaster relief and GNP_{1976} for the actual value that total output had 1976.

That is, from the actual 1976 level of production, we may subtract the gains in production that the foreign disaster relief has provided to each sector. However, the information about the disaster relief provided does not correspond to the sectoral classification used here. Therefore, we shall use the following less precise approach.

Firstly, we estimate the aggregate capital-output ratio of the whole economy as a weighted average of the k's for all the sectors. Two alternative approaches may be used here. In the first approach the weights used are the shares of the production of the sectors in total output. Then, with an aggregate k obtained in this way and with the help of (2'), we obtain an estimate of the gains (as defined) in production induced by the disaster relief. That is, using the data on the percentual share of the production of each sector in the GDP in Guatemala (see table 8) and, the sectoral k's from table 5, we obtain a value for the aggregate k equal to 3.11. Thus, disregarding depreciation we obtain the estimates of the increase in total output for each year t (t = 1976,...,1980) as

$$(8) \quad \Delta GDP^{A}_{t} = \frac{1}{3.11} \sum_{\tau=1976}^{t} A_{\tau}$$

Table 8: Gross Domestic Product by Sector (1976-1977) at 1958 Prices (in thousands of Q)

Concept	1976 Abs. value	1976 %	1977*) Abs. value	1977*) %	Variation Abs. value	Variation %
Gross Domestic Product	2 526 536.9	100.0	2 737 494.0	100.0	210 957.1	8.3
Agriculture	689 622.4	27.3	722.816.5	26.4	33.194.1	4.8
Mining	2 700.0	0.1	3 100.0	0.1	400.0	14.8
Manufacturing	393 452.1	15.6	435 579.2	15.9	42 127.1	10.7
Construction	76 304.6	3.0	89 537.6	3.3	13.233.0	17.3
Public Utilities	35 385.3	1.4	40.423.0	1.5	5 037.7	14.2
Transport and Storage	164 944.1	6.5	183 495.6	6.7	18 551.5	11.2
Commerce	704 054.7	27.9	762 756.8	27.9	58 702.1	8.3
Banking, Insurance and Finance	64 983.4	2.6	79 832.7	2.9	14 849.3	22.9
Housing	112 146.3	4.4	121 316.3	4.4	9 170.0	8.2
Public Administration and Defense	132 423.0	5.2	136 656.3	5.0	4 233.3	3.2
Personal Services	150 521.0	6.0	161 980.0	5.9	11 459.0	7.6

*)Preliminary estimates

Source: Bank of Guatemala, 1977, p. 29.

Using the data on the annual provision of relief (see table 15 in chapter 6), we get:

$$\Delta GDP^{A}_{1976} = \frac{1}{3.11}(58.7) = 18.9 \text{ millions (of 1970 US \$)}$$

$$\Delta GDP^{A}_{1977} = \frac{1}{3.11}(20.9 + 58.7) = 25.5 \text{ - " -}$$

$$\Delta GDP^{A}_{1978} = \frac{1}{3.11}(17.9 + 79.6) = 31.3 \text{ - " -}$$

$$\Delta GDP^{A}_{1979} = \frac{1}{3.11} \quad (14.6 + 97.5) \quad = 35.5 \text{ million}$$

$$\Delta GDP^{A}_{1980}{}^{*)} = \frac{1}{3.11} \quad (21.5 + 112.1) = 42.9 \quad "$$

Subtracting these changes from the actual values of the GDP for 1976-80 (see column 1, Table 1) we get the autonomous development of production:

$$GDP^{ndr}_{1976} = 2,687 - 18.9 = 2,668$$

$$GDP^{ndr}_{1977} = 2,897 - 25.5 = 2,871$$

$$GDP^{ndr}_{1978} = 3,042 - 31.3 = 3,010$$

$$GDP^{ndr}_{1979} = 3,186 - 35.5 = 3,150$$

$$GDP^{ndr}_{1980} = 3,297 - 42.9 = 3,254$$

These values are represented by line $\overline{DC}$ in figure 3.

In the second approach, we use another set of weights for calculating the aggregate capital-output ratio. The ratios relevant for the investments embodied in the disaster relief may, of course, differ a great deal from the ratios relevant for ordinary investments in the case of no disaster. As many investments of the first type may eliminate serious bottlenecks resulting from the disaster, the relevant k may be less than that calculated according to the first approach. We will return to that argument shortly. But first, it must be pointed out that there are reasons why the k

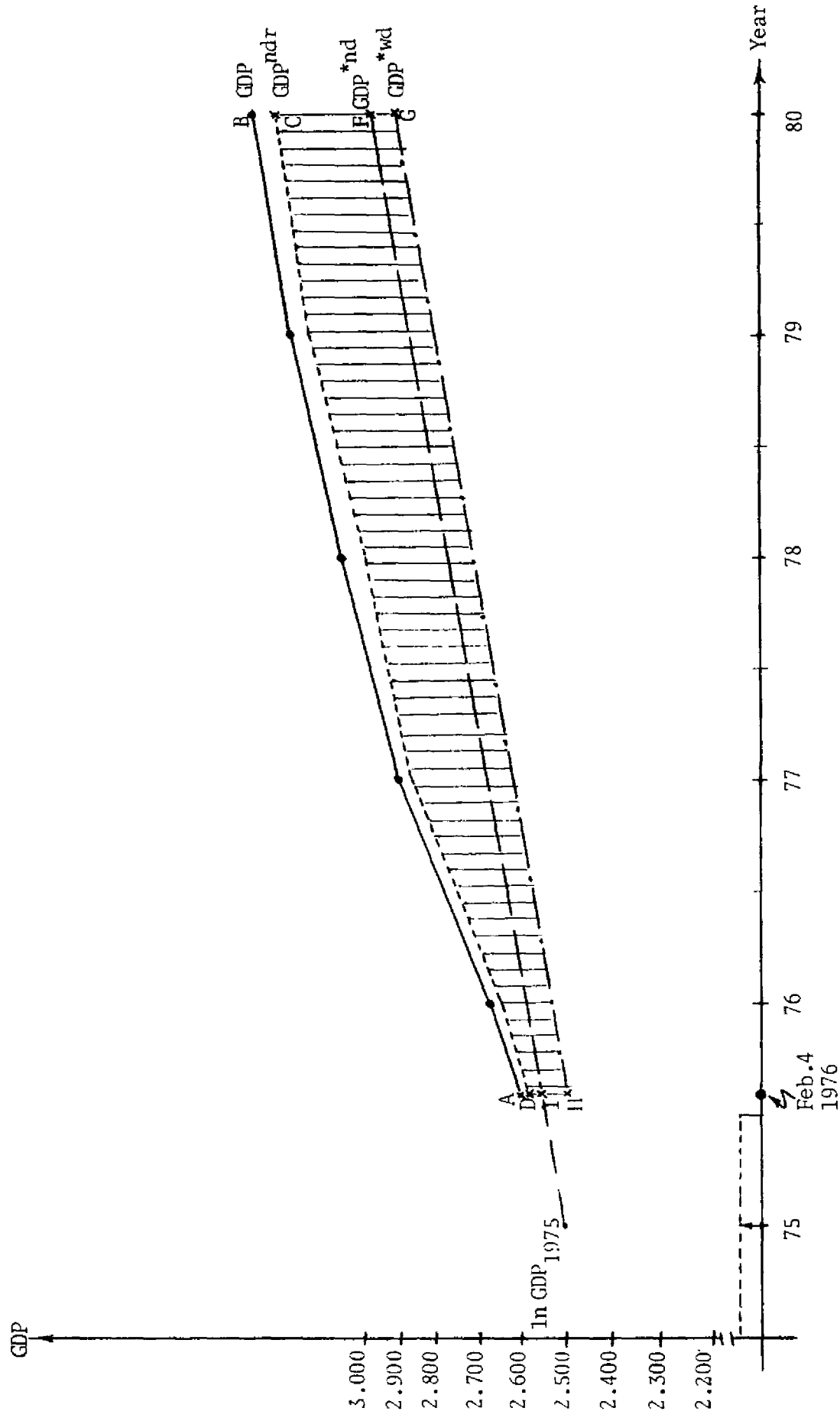
*) The value of A for 1980 is not covered by the information in table 14, (chapter 6) and has been obtained by using the information in table 11 chapter 6 (annual amount of loans utilized) and the information on the agreements established between the NGOs and the CRN for 1980 (Palomo, 1980, ibid). That is, US $6 million of grants for reconstruction approximately, plus US $42,935 million of utilized loans for reconstruction during 1980. This gives US $48,935 million in current prices or, after transformation to 1970 prices, US $21,520 million.

could be much higher as well. Assuming that the volume of disaster relief was allocated among sectors in proportion to the sectoral distribution of the damages from the disaster - our second approach - we would use the weights given by table 7. As damages are mainly in sector 9, for which the capital-output ratio is above the average (see table 5) we would get an alternative aggregate k almost equal to 6. This means that the reductions of output in (8) would be only half of what we got from the first approach. Consequently, the line $\overline{DC}$ in figure 3 would lie significantly higher up. This may be taken as the minimum effect to be ascribed to the disaster relief. But, we shall continue to use as our main case the development along $\overline{DC}$ in this figure.

6. Estimating the Improvements in Economic Potential: A First Indication of the Development Inducing Effects of Relief

With the help of the paths represented in figure 3 we shall try to identify and estimate the economic impact of the disaster relief to Guatemala for the period 1976-80. As already pointed out, this is done by taking the same starting point for all alternative development paths, ideally the "instant" prior to the occurrence of the earthquake. As we have only annual data for total output, this starting point will have to be the GDP for 1975, i.e., the last predisaster year. Thus, we have the actual development (GDP), the actual development without disaster relief (GDP^{ndr}) for 1975-80, the autonomous development without disaster (GDP^{*nd}) and the autonomous development with disaster (GDP^{*wd}) where the last two paths start from 1975 GDP level with a growth rate equal to that of 1959-75. In addition, the level of the autonomous development with disaster has been raised by about one-third or US $35 million, the fall in production estimated on page 148. This is done in order to take the in-

Figure 3


GDP
3.000
2.900
2.800
2.700
2.600
2.500
2.400
2.300
2.200
ln GDP
1975
A
D
I
II
B
GDP
C
GDP^ndr
F
GDP*nd
G
GDP*wd
Feb.4
1976
75
76
77
78
79
80
Year

creased level of investments that took place during the 1976-79 period into consideration. As already suggested on page 135, the annual investment increase in construction (92 per cent of the US $82 million of total annual increase) may, at most, have replaced one third of what was damaged in 1976 if it had been used to replace what was damaged in 1976.

With the help of figure 3 we can identify the following factors of interest. Firstly, the total amount of the gains in production from the occurrence of the earthquake up to December 31, 1980 will be represented by the difference between GDP and GDP^{*wd}, i.e., by the area ABGH. Secondly, as we have described the gains in production induced by the foreign disaster relief so far, they will be given by the difference between GDP and GDP^{ndr}, i.e., by the area ABCD. Finally, the loss from the disaster is given by the difference between GDP^{*nd}, and GDP^{*wd}, i.e., by area IFGH.

As we can see from the figure, this means that part of the total gains ABGH is left unexplained. This part is represented by the shaded area DCGH. One possible explanation would be that the development without disaster has been underestimated, that there have been other growth factors in the autonomous GDP development that significantly deviate from the growth factors for the 1959-1975 period. If so, perhaps all of the area DCGH should be ascribed to the autonomous growth of the Guatemalan economy. Here, we must point out that we could not identify any such obvious factor. But we also point out that other such factors might have been identified in a more disaggregated and detailed analysis of Guatemala's growth for 1959-80 (see our discussion on pp. 136-138).

Another possible explanation is that the role of disaster relief has been significantly underestimated by the calculations using equation (8). This, in turn, may be explained by the possibility that disaster relief provided conditions favorable to growth that would not have been attainable by Guatemala left on its own. Disaster relief may have introduced new technology, new decision processes, new capital equipment, other regional allocations of capital formation, etc. that would not have been introduced by Guatemala itself at this time. Or, it may have been so that the disaster relief eliminated bottlenecks in the Guatemalan economy which it would not have been possible for Guatemala to eliminate on its own, at least not at the same rate. Thus the second possible explanation would mean that the maximum effect of disaster relief would be equal to the whole area ABGH.

It is more likely, perhaps, that the true explanation is some combination of these two alternatives. This means that, on the basis of this aggregate analysis, we would have to be satisfied with identifying the effects of disaster relief as at least ABCD and at most ABGH.

Moreover, given that the minimum level for this effect is calculated on an assumption about the relevant aggregate capital-output ratio and about disaster relief as replacing only part of the real capital damaged by the earthquake (see the discussion around equation (8)), we may interpret the area ABCD as the compensatory effect of disaster relief. Hence, we would end up with the view that the development-inducing effect of the disaster relief for the period 1976-80 could be anything from zero to the value represented by the area DCGH. Given that we have failed to identify any internal growth factors that could explain the increase in GDP levels from the predisaster to the post-disaster periods, we may even venture to state that we

have found a first indication of the existence of a development inducing component among the effects of the disaster relief provided to Guatemala.

To estimate the effects just mentioned for the 1976-80 period, we proceed as follows.

The total gains in output as illustrated by the ABGH area are given by

$$(9) \quad ABGH = \sum_{t=1976}^{1980} GDP_t - \sum_{t=1976}^{1980} GDP_t^{*wd}$$

$$= \sum_{t=1976}^{1980} GDP_t - \Big(\sum_{t=1}^{5} GDP_{1975}\, 1.05^t - \overbrace{\sum_{t=0}^{4}\sum_{i=2}^{9} Q_i^D\, 1.05^t}^{*)} + \overbrace{\sum_{t=0}^{4} \Delta I_t\, 1.05^t}^{**)} \Big)$$

$$= 15{,}109 - (14{,}520 - 615 + 414)$$

$$= 790 \text{ million.}$$

Here, for simplicity, we have added the differences without discounting to a present value for the period. The brevity of the period provides the justification for this simplification, which is used in the following as well.

The total gains in production obtained from disaster relief is at least that given by

---

*) Total production losses from what was damaged by the earthquake excluding the effects of foreign disaster relief (calculated on the basis of Q_i^D indicated on p. 148).

**) Increases in production from the increases in gross fixed investments, assumed above mainly to have gone to repair what was damaged by the earthquake.

$$ABCD = \sum_{t=1976}^{1980} \Delta GDP_t^A = 18.9 + 25.5 + 31.3 + 35.5 + 42.9$$

$$= 154.1 \text{ million,}$$

calculated on pp. 153-154.

The total gains from the disaster relief is at most all of ABGH, i.e., US $790 million. This means that the development inducing component of the effects of disaster relief is at least zero and at most:

$$DCGH = ABGH - ABCD = 790 - 154 = 636 \text{ million.}$$

So far the discussion has been limited to the 1976-80 period, as we only have data for that period. Although the disaster relief continues beyond 1980, as we have pointed out, the effects of the disaster relief will eventually peter out. Moreover, moving ahead we would have to take into account the effects of depreciation of the addition to real capital that the disaster relief has provided. Here, we shall abstain from any specific speculation about developments beyond 1980. Suffice it to say that if the compensating effects of disaster relief had ended in 1980, we would approach either the GDP^{*wd} path or the GDP^{ndr} path as possible extremes. In the latter case, the growth beyond 1980 would be due to Guatemala's own growth capacity or that of the remaining development-inducing effects of the disaster relief once provided to the country or a combination of the two. However, to base our calculations of the disaster relief effects on the available data only we will have to be satisfied with the effects as already calculated for the period 1976 to 1980.

These computations leave us with a considerable degree of uncertainty about the effects of the disaster relief even for the period up to 1980. Thus it adds to the need for complementary approaches to the estimation of these effects as we have mentioned earlier in this chap-

ter. An attempt to meet these needs through a more disaggregate analysis is made in chapters 6 and 7.

7. Concluding Remarks

Analyzing the development of total aggregate output for the period 1959-80 in Guatemala we found that the rate of growth increased after the earthquake. From 5.1 per cent on the average for the predisaster 1959-75 period to about 5.7 per cent for the post-disaster years 1976-80. For the whole 1959-80 period (pre- and post-disaster levels of production included) the average rate of growth of production is around 5.3 per cent. This has given us the idea that the production of the Guatemalan economy improved after the 1976 earthquake.

The improved economic potential of the nation is interesting in the light of the amount of damage caused by the earthquake and its effects. Using the official estimate of the physical capital damaged, about US $628 million (in 1970 prices), we calculate that during the 1976-80 period, in the absence of foreign disaster relief, and given the historical conditions of production, the production capacity of the economy would have had to be reduced by about US $615 million. But, instead, we find that the higher output levels achieved stand for about US $1,204 million of gains in production.*)

Given that in our aggregate analysis it has not been possible to identify any explicative factor for US $790 million of the increased economic potential during the post-disaster period other than foreign disaster relief, we have taken this figure to be the upper bound of the total gains in production induced by the foreign disaster relief. The lower bound has been estimated to be

*) The US $790 million of gains in real output (area ABGH) plus the US $414 million increase in production from extra own investments as indicated in the preceding section.

about US $154 million. From this we calculate that the development inducing component of foreign disaster relief is at least zero and at most US $636 million.

This large variation points to a significant uncertainty as to the accuracy of the methods used here. Underlying such a lack of precision we may point out the following factors:

1) It is most likely that the official estimates of the physical damage (D) is excessive due to a significant underestimation of the degree of capital depreciation. (As indicated in Chapter 2, these estimates are based on replacement costs only.) Consideration to this factor will surely reduce the difference between the actual development (GDP) and the autonomous development with disaster (GDP^{*wd}).

2) Our estimate of the foreign disaster relief given (A) may be an underestimate. For example, in many cases the money value for services by foreign technicians engaged in planning, management training and the transmission of know-how has not been available and hence, has not been included in these estimates. Taking this into account would raise the value of what we have taken to be the lowest bound of the gains in production from the disaster relief.

3) Data are available for a too short period to permit any precise conclusion about the different aspects treated. Owing to this our analysis could, even if it has not provided any interesting numerical result, be seen as an attempt to provide a method with which appropriate data and a sufficiently long period of analysis would provide more precise information.

4) Such a short period as five years (1976-80) can very easily be dominated by temporary changes that are likely to diminish the degree of certainty as to the gains in real output that underlie what we have taken to be the upper bound of the development component.