FINANCIAL CONSEQUENCES

OF NATURAL DISASTERS

by

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A Discussion of the Financial Sector of the
Community Disaster Model

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I. INTRODUCTION

A community disaster model has been developed at the University of Pennsylvania as part of an NSF-RANN grant ENV-12370, "Mitigation and Recovery Policies for Natural Hazards." The objective of the project is to describe the impact of a natural disaster on a community so as to provide guidance to policymakers in designing mitigation and recovery policies.

One of the more important areas of concern is the financial impact of a disaster. As a result, the community disaster model contains a financial sector which describes the changes which occur in the <u>financial characteristics</u> of households as a result of the disaster and subsequent recovery. The purpose of this paper is to describe this financial sector of the community disaster model, how and why it was developed, and how it may be utilized. First, the need for such a sector is reviewed. Next, the methodology to be used here for analyzing the financial impact of natural disasters on households is outlined. Then, the construction of the elements of the financial sector is discussed followed by an illustrative example. This illustrative example demonstrates the usefullness of the approach developed here for public policy analysis. Finally, the summary and conclusions are presented along with directions for future research.

II. NEED FOR A FINANCIAL SECTOR

In recent years the financial impact of natural disasters on society has been substantial. The havoc wrought by Tropical Storm Agnes in June, 1972, where damage to personal and business assets was a staggering $2 billion, illustrates the problems faced by households and firms in their recovery efforts.

As discussed in several sources (Vinso, 1977; Rawls and Stranahan, 1974, for example) few of the victims were covered by insurance so that most of them turned to the federal government for relief. The response was immediate, compassionate, generous, and, as usually occurs when a response is made without prior planning, somewhat uncoordinated. For example, changes in the Small Business Administration (SBA) program such as increasing the amount of loan forgiveness and maximum aid available were rushed through Congress with little thought as to the long-run effects of these changes. Likewise, the state of Pennsylvania immediately instituted a grant program for flood victims where upwards of three thousand dollars were made available to each victim (household). Some of these benefits were later taxed by the Internal Revenue Service. Furthermore, after a substantial number of homeowners had utilized their own resources and/or incurred additional debt in order to recover from Agnes, the Urban Renewal program began to purchase still damaged homes at preflood market values. This markedly reduced the impact of of the disaster on those people eligible, and at the same time

bred resentment among those that had begun the recovery effort on their own.

Results such as these suggest that an investigation into the financial effects of disasters and the associated recovery period might prove fruitful. This has been one of the tasks of this NSF-RANN project.

PREVIOUS INVESTIGATIONS

The impact of natural disasters on communities has been the subject of considerable analysis. One of the most comprehensive studies involved the Alaskan earthquake of 1964. The role of that disaster in changing the sociological, organizational and economic characteristics of a community has been studied in detail and reported by the National Academy of Sciences (NAS) (1970).

Several other studies have emerged on the long-range influences of disasters and the associated recovery period. For example, Prince (1920) analyzed the long-run changes in Halifax caused by a catastrophic explosion in that community. Studies on Hurricanes Audrey, Carla, and other disasters have also focused on organizational preparation in the community (see, for example, Moore (1964) for detailed discussions). Similarly, much of the work at the Disaster Research Center of the Ohio State University centers on the roles of various community groups in disaster preparedness as well as the response of various organizations during the post-disaster and recovery periods. These studies conclude that disasters can

provide the stimulus for change which may otherwise take an exceptionally long time to accomplish.

While these studies investigate disaster preparedness and the recovery process, many of them do not fully consider the economic consequences of the disaster. That does not mean that economics has been totally ignored. The NAS study of the Alaskan earthquake has reports by Rogers, Kunreuther, and others on the economic impact of that disaster. Furthermore, work by the Social and Demographic Research Institute (SDRI) of the University of Massachusetts under Rossi, a group at Northwestern under Friesma, and other groups are investigating the economic impact of such disasters as the Topeka Tornadoes, Yuba City floods, and the Seattle earthquake. The SDRI study also includes the political impact of the adoption of disaster mitigating policies by various governmental levels. These studies analyze the economic effects for an entire region with respect to employment, income, production, and other macro-economic variables.

The economic impact on a particular element of the community such as the household, has been notable lacking, however. An exception to that is the study by Dacy and Kunreuther (1969) who investigated the economic implications of federal policies toward disaster victims, prevalent in 1969, focusing primarily on households. Since that time, several changes in the disaster recovery programs have been made which are discussed by Kunreuther (1973). While these studies by Kunreuther as well as one by Cochrane (1975) consider the impact of various types

of economic aid to victims such as insurance and SBA loans,
detailed analyses of the impact on household financial character-
istics are not available. The need for further studies in this
area was under-scored in a recent assessment of research needs
by White and Haas (1975). Some recent work by Kunreuther et al
(1978) has begun the investigation of the economic impact on
the household through their work on the role of insurance in
disaster recovery.

Yet for any victim of a disaster, this area is of
prime concern. Previous studies on financial characteristics
of the household have involved decisionmaking under normal
conditions (see, for example, Projector (1968), Projector and
Weiss (1966), Friend and Blume (1976), Dunkelberg and Stafford
(1971), and others). They enable one to study what types of
funds a household utilizes for purchasing a specific item or
items if only a single type of purchase or financing is involved.
A natural disaster, however, is by definition a violent change
from normal conditions. In order to recover from a disaster
households have to acquire a substantial number of items at
approximately the same time, generally in excess of their avail-
able resources.

To assist this recovery process, several plans have
been devised by the federal government to aid the financial
recovery of the households. Little study has been undertaken
to determine whether these plans have provided necessary funds
needed by households, to what extent they are used, and what
their effects have been.

III. METHOD OF ANALYSIS

DESCRIPTION OF FINANCIAL VARIABLES

In order to investigate the financial impact of natural disasters, a consistent method of presenting the financial information of the household is needed. The best method of presenting these data is by using a balance sheet showing what he owns (assets) and what he owes (liabilities). Much of the structure used in the analysis has been developed using tools describing the financial position of the firm.

The asset side of the balance sheet for the household is divided into two sections: financial assets which are cash or assets easily converted into cash and real assets which are more permanent in nature and/or not easily (quickly) convertible to cash.[1] Liabilities are delineated by maturity: current liabilities which come due in the near future and fixed or long-term liabilities which usually require regular fixed payments over long periods of time (e.g. 20 - 30 year mortgages). Table 1 is a balance sheet for a typical household. Appendix A discusses the form of that balance sheet as well as the definitions of the accounts used in determining these financial characteristics of households. The reader unfamiliar with the terminology used here is urged to review that appendix.

For the purposes of this paper, the accounts in the balance sheet are defined as follows:

Financial Assets

Cash - Demand deposits and cash-on-hand.

Table 1: Balance Sheet for TYPICAL HOMEOWNER

ASSETS	$		LIABILITIES + EQUITY	$
Financial Assets:			Current liabilities:	
Cash	500		Unsecured debt	100
			Personal notes	300
Marketable securities	4,000		Insurance borrowing	0
Savings accounts	5,000			
Savings bonds	1,500			
Cash value of insurance	3,000			
Total financial assets	14,000		Total current liabilities	400
Real Assets:			Fixed liabilities:	
Automobiles	2,000		Home mortgages	4,000
House value	24,000		Other mortgages	0
Home furnishings	12,000		SBA-home	0
Other assets	2,000		SBA-other	0
			Bank loans	600
Total real assets	40,000		Total fixed liabilities	4,600
			Total liabilities	5,000
			Personal equity	49,000
Total assets	54,000		Total liabilities and equity	54,000

RATIOS FOR TYPICAL HOMEOWNER

DESCRIPTION		VALUE
Financial assets/ Total assets	---	.259
Financial assets/ Total liabilities	---	2.8
Financial assets -sec./ Total liabilities	---	2.0
Total liabilities/ Total assets	---	0.093

Marketable securities - Corporate stocks and bonds.

Savings accounts - Time deposits (interest earning).

Savings bonds - Government interest bearing bonds.

Cash value of insurance - Total cash value of life

insurance policies.

Real Assets

Automobiles - Market value of all automobiles.

House Value - Market value of structures plus land.

Home furnishings - Market value of all household

contents.

Other assets - The value of any assets not covered in

the above categories, (e.g., boats, furs, etc.).

Other real estate - Real estate owned by the household

but not the principal residence.

Current Liabilities

Unsecured debt - Indebtedness having no security by

way of collateral, (e.g., charge accounts).

Personal notes - Outstanding notes of debt held against

an individual (e.g., loan company or credit

union borrowing).

Insurance borrowing - Any money borrowed against the

cash value of life insurance policies.

Fixed Liabilities

Home mortgages - Total amount of unpaid mortgages on

the residence of the individual.

Other mortgages - Total amount of unpaid mortgages on

any properties other than home.

SBA-home - Outstanding amount of any exising SBA

disaster loans obtained for use in home repair

or contents replacement.

SBA-other - Outstanding SBA disaster loans issued

for purposes other than home repair (e.g. to

retire debt).

Bank loans - All outstanding long-term debts to

banks (e.g. 1 - 10 year loans).

Other debt - Other long-term debt which does not fit

any of the above categories.

Personal equity - Net worth (ie., total assets less

total liabilities); the amount an individual

would be worth if his assets were converted to

cash and all his debts paid off.

STRUCTURE OF ANALYSIS

Now that the elements of the balance sheet have been
specified it is necessary to define how comparisons among house-
holds can be accomplished. For example, if two individuals
have $50,000 worth of assets, they are not necessarily in the
same financial position. One of them may have gone heavily into
debt to acquire his $50,000 while the other did not. By the
same token, if both individuals lose all their real assets in a
natural disaster, they would not necessarily have lost equal
amounts. One may have been a homeowner and lost his car, his
home and its contents, while the other may have been a renter
and lost only his car or apartment contents.

Dealing in absolutes often leads to meaningless comparisons and erroneous conclusions. Ratios on the other hand may be a better comparison. For example, if each individual's assets had been divided by his total debt, it would have been possible to tell which one had a greater claim on his assets by outsiders. In the second case, if real assets were divided by total assets, it would become apparent which individual would suffer most by a substantial loss of real assets in that the higher the ratio, the greater the potential loss.

There are many possible ratios which can be constructed from a balance sheet. The function of these ratios is threefold. One important benefit of using ratios is to enable one to compare among households at any point in time or possibly with some average household. One can group households using such characteristics as age or income and determine how the ratio for a given age or income group differs, say, from the average of all households.

Another use of ratio analysis is to highlight changes in a homeowner's balance sheet between two points in time (e.g., pre-disaster vs. post-recovery). For example, one can examine a ratio for a particular household (or groups of households) and observe to what extent financial position has changed due to the disaster, the recovery, or similar event.

The third purpose is to serve as a recovery barometer. If it is assumed that the pre-disaster balance sheet represents the preferred financial position of the household,

subsequent ratios can be examined to determine the extent to which a particular recovery policy returns a household to his pre-flood financial position.[2]

Several ratios are chosen as potentially being meaningful to the understanding of a household's financial condition: the ratio of a) Financial Assets to Total Assets, b) Financial Assets to Total Liabilities, c) Financial Assets less Securities to Total Liabilities, and d) Total Liabilities to Total Assets. Briefly, the purpose for each of these ratios is as follows:

Financial Assets/Total Assets (F.A./T.A.)

Gives an indication of how much liquidity a homeowner prefers to have; i.e., what percentage of total assets are quickly convertible to cash.

Financial Assets/Total Liabilities (F.A./T.L.)

Can be used to judge the ability of the household to meet outside obligations with cash or easily obtainable cash.

Financial Assets less securities/Total Liabilities (F.A.-s/T.L.)

Same use as F.A./T.L. except it reflects the possible reluctance of a household to take a capital loss on the sale of marketable securities because of all financial assets only marketable securities may be priced below cost of acquisition.

Total Liabilities/Total Assets (T.L./T.A.)

Indicates household's desire and ability to take on debt obligations. It also indicates how much of a

claim on assets creditors will have.

Table 1 also shows the calculation of the various ratios for the typical homeowner. The first ratio shows that financial assets constitute approximately 26 percent of the household's total assets. The second ratio reveals that the household is in little danger of being insolvent in that financial assets are nearly three times total debts. The next ratio shows that the household could easily meet its debts without risking a possible loss in the value of its marketable securities. Finally, the last ratio illustrates that this household preferred to finance slightly less than 10 percent of its assets with debt. One could then compare this household with some average household to determine whether it differs in financing preferences. Likewise, if the age or income of this household were known, comparisons could be made between this household and similar households. Such a comparison is necessary because it appears that this household could afford to acquire more debt since it can meet its current debts with financial assets alone. Yet this conclusion may be inappropriate if the head of this household were 75 with an actuarial expectation of living only a few more years.

Thus, ratio analysis is useful in making comparisons but they must be used with care. After discussing the construction of the financial sector, an illustrative example provides more detail on the utilization of ratios for analyzing changes in the financial characteristics of households.

IV. CONSTRUCTION OF THE FINANCIAL SECTOR

As shown by Borkan and Kunreuther (1977), conceptually one can think of the model as having three stages: pre-disaster generation of household characteristics in Stage 1, generation of a disaster with certain characteristics in Stage 2, and then the generation of the recovery in Stage 3. For each of these Stages, it is useful to generate the balance sheet for each household along with the relevant ratios. The financial impact of the disaster and the subsequent recovery can then be determined by tracing the changes in what each household owns and what it owes through each Stage.

PRE-DISASTER BALANCE SHEET

It has been shown extensively in the literature that certain financial characteristics of households are functions of the socioeconomic characteristics of the household. Dunklebarg and Stafford (1971), for example, show that the desired levels of installment debt and certain real assets are a function of such characteristics as age, education, and occupation of the household head. Similarly, Friend and Lieberman (1974) demonstrate that household savings is also a function of family size, age of household head and other socioeconomic characteristics. Finally, Projector and Weiss (1968) suggest that the total wealth of a household is related to certain of these same socioeconomic characteristics. It seems reasonable that estimates of other balance sheet entries can be made using these same socioeconomic characteristics.

ACCOUNT ESTIMATION

To establish the relationships between these
balance sheet accounts and the relevant socioeconomic variables,
information is used on the financial characteristics of house-
holds gathered by Projector and Weiss (1968) (P-W) through a
survey conducted by the Federal Reserve System. A sample of
1776 households is utilized to estimate the expected level of
each account. Appendix B provides a brief description of the
data base used in this part of the study.

A number of cross-section regressions were estimated
from the P-W data. The following general form is utilized as
suggested by P-W and similar to that used in the Dunklebarg-
Stafford and Friend-Lieberman studies previously cited:

$$\ln Z = a + b (\ln Y) + c (Age) + d (Sex) + e (Education)$$
$$+ f (Children) + g (Adults) + v$$

where: Z = various asset and liability accounts

Y = actual income[3]

Age = Age of household head in years

Sex = Dummy variable for sex of household head

(0 = Female, 1 = Male)

Education = Education level attained by household head
in years

Children = Number of children under 18 in households

Adults = Number of adults in household

a, b, c, d, e, f, g = Coefficients

v = residual

While the P-E data include other socioeconomic characteristics such as race and employment status of family head, region of the country, information on spouse and children, and other data, this set was chosen for several reasons. It was decided that the object is not so much variance reduction as utilizing household attributes which can be reasonably expected to be known. Since Census Data or survey data from the Kunreuther et al (1978) study will initially be the basis for attribute development, such detailed information would not in general be available. In other cases, the available attributes had no explanatory power or were highly collinear with other attributes.

Zero Responses. Initially, all 1776 accounts were used in the estimation equations but it became apparent that for many of the regressions, accounts with zero amounts introduced considerable random variation. When these zero level accounts were removed from the sample, the estimation power of the regressions were significantly increased. The number of households responding that a certain account is zero varies by type of account. Table 2 provides the number and percentage of the total sample of non-zero responses for each account.

The results in Table 2 suggest that a certain percentage of the households in the community should also have zero levels in various accounts. It was beyond the scope of this project to investigate the characteristics of households in the P-W survey which did have zero-level accounts. For purposes of this project the accounts of the households are

Table 2

Non-Zero Observations for Each Account

Account	Number of Non-Zero Responses	Percentage of Total Sample
Cash	1316	74.1
Marketable Securities	666	37.5
Savings Accounts	1248	70.3
Savings Bonds	663	37.3
Cash Value of Insurance	1125	63.3
Other Assets	370	20.1
Automobiles	1470	82.8
House Value	1248	70.3
Other Real Estate	407	22.9
Unsecured Debt	624	35.1
Personal Notes	80	4.5
Insurance Borrowing	155	8.7
Home Mortgage	722	40.7
Bank Loans	561	31.6
Other Mortgage	150	8.4
Other Debt	20	1.1

specified using a random number generator such that the percentage of households in the community being processed had non-zero levels equal to that in Table 2 while the rest were set at zero. For example, 74.1 percent of all households in the community will have a non-zero level of cash while 25.9 percent will have zero for the cash account. Technical details on the distribution of the non-zero accounts is shown in Appendix B. An avenue for extensions of this research is in identifying which characteristics, if any, of households with zero accounts are significant so that a better determination can be made as to which households in a community should have zero values. Such results may be needed in trying to reconstruct an actual community.

Account Level Estimation. For each account, a
regression equation is estimated using the socioeconomic
characteristics previously discussed. The final estimating
equations can be found in Appendix B but some general obser-
vations are in order.

In general, the asset accounts can be estimated
more accurately than the debt accounts. Accounts such as cash,
marketable securities, cash value of insurance and home value
have correlation coefficients over 0.5. Other asset accounts
have correlation coefficients in excess of 0.3 which means
that these have strong explanatory power. On the other hand,
the explanatory power of the debt equations are somewhat less
than for the asset accounts. However, all equations provide
sufficient explanatory power for prediction purposes.

Investigating the individual equations, income is
the only variable which is significant in all equations
(except for Other Assets which has only the intercept significant)
while age is significant in all asset accounts and such
important debt accounts as home mortgages and short-term
debts. In all cases, increased income leads to higher levels
in an account which is reasonable. Likewise, the older a house-
hold, the higher the asset and short term debt accounts will be.
Other debt accounts are not a function of age except home mort-
gages which decline with age. This finding is consistent with
results reported by Ando and Modigliani(1961), Dunklebarg and Stafford
(1971) and others who suggest that the financial position of
a household is influenced by the age of the household head

(the life-cycle hypothesis). Similarly, the number of children, adults or both were found to have explanatory power in several regressions. It is also interesting to note that education and sex generally have no influence on the explanatory power of the regression.

Thus, the expected level of each account can be determined using attributes generated in other parts of the community disaster model. Since the level of an account cannot be determined exactly, the levels estimated by the regression are adjusted to take into account this inability to estimate with one hundred percent accuracy. The exact adjustment scheme is described in detail in Appendix B.

Special Accounts. The financial sector has several features which must be reviewed. The equation for Home Value estimates the market value of both structure and land. In general, only structures are damaged so the value of the land must be deducted from the total to obtain the structure value. The user may input the fraction of total house value represented by land. If not, a default value of ten percent is used based on results obtained in the Vinso (1977) study.

Contents or home furnishings value are not available from the Projector and Weiss survey and must be estimated separately. Casualty companies generally insure contents at approximately fifty percent of structure value. Vinso (1977), on the other hand, determined that the replacement value of contents averages nearly ninety-five percent of its structure value. If it is assumed that market value is eighty percent

of replacement cost, the preflood market value of contents is
seventy-six percent of structural value.[4] In lieu of contrary
information, contents value in this sector are conservatively
set on a replacement basis at ninety percent of structure
value (to determine damages) and on a market basis at seventy-
six percent of structure value (for balance sheet accounts).

A problem with renters arises, however. The user
has the option to choose the proportion, if any, of renters in
the community. If renters are excluded, no further adjustments
are needed. If renters are included, households renting are
chosen at random using percentages specified by users. If
a household is chosen as a renter, the house, land, contents,
and house mortgage values are then calculated as if the house-
hold were a homeowner after which all of these accounts are set
to zero except contents. While arbitrary, it does allow for
renters to suffer contents damage without concomittant housing
losses. Of course, it assumes that renters provide their own
contents which in general, is true. This subroutine can be
adjusted if a significant proportion of the renters occupy
fully furnished apartments.[5]

Finally, it should be noted that if the data to be
used include information such as house and mortgage values, then
neither account need to be estimated. For example, the
Kunreuther et al (1978) survey include such information. As
a result, the user is offered a choice. If house, land and/or
mortgage values are provided, then the estimation procedures

are by-passed and the values provided are used directly. To
facilitate these arrangements, a separate subroutine is used
to estimate each of these accounts (see Katz and Miller (1977)).

The ratios previously discussed are then calculated
from these balance sheet accounts. The ratios thus obtained
are also assigned as attributes of the household.

POSTFLOOD AND POST RECOVERY BALANCE SHEETS

Postflood Balance Sheet

Once the preflood balance sheet has been produced,
other balance sheets proceed from there. Immediately after a
specific disaster (Stage II), the impact on the household can
be determined.

It is assumed that the flood damages only physical
assets.[6] Thus, the only accounts which are affected are
the house and contents values.[7] The Damage Sector calculates
structural damage in terms of decreased market value of house
excluding land. The postflood value of the house account is,
therefore, the preflood value less the value of the land and the
structural damage.[8]

Contents value is calculated somewhat differently.
The contents value on the balance sheets is based on market
value while contents damage is calculated by the Damage Sector
in terms of reduction in replacement value. As previously
stated, it is assumed that the market value as shown on the
balance sheet is eighty percent of replacement value. The

post disaster contents value is determined as follows. First, the preflood contents account is converted to replacement value. Then, the contents damage is deducted from this replacement value. Finally, market value is assumed to be eighty percent of the replacement cost of the remaining contents.

Finally, net worth or equity is reduced by an amount equal to the asset reduction, as debts remain the same. The postflood financial ratios of the balance sheet are then calculated as before.

Post Recovery Balance Sheet

The balance sheet for the household following recovery is similarly determined. The description which follows assumes that only certain sources of recovery aid are available and that these sources are used in specific amounts. It is not intended to circumscribe all sources of recovery aid or methods of estimating usage of funds.

In the financial sector as it now stands, the only sources of recovery funds are flood insurance and SBA loans. An appropriate extension of this work would be to include such funds as personal bank loans and savings since an analysis of field survey data collected by Kunreuther et al (1978) reveals that a substantial number of victims did not take advantage of available low interest SBA loans, relying on their own savings or even bank loans instead.

In their paper, Borkan and Kunreuther (1977) describe the method for estimating the extent to which each source of

recovery aid is used by a household. In preparing the recovery balance sheets, the results of this analysis is important in that losses covered by insurance alone increase assets and net worth while losses covered by SBA loan alone increases assets and debt levels.

Once the amounts of each recovery source are determined, the postflood balance sheet is adjusted to produce the recovery balance sheet of the household. Fixed assets (structure and contents values) are increased by the amount of insurance paid to the victim and total amount of SBA loans taken out. The SBA loan accounts are increased by the amounts of each type of loan obtained. A new level of net worth is then calculated.

Postflood and Postrecovery Analysis. After the postflood and postrecovery balance sheets have been generated, the same financial ratio analysis previously discussed is used to produce the ratios for the household. By comparing the postflood to the preflood ratios, the financial impact of the flood on the household can be determined. By comparing the postrecovery to the postflood ratios, the extent of the recovery by the household can be observed. Likewise, by comparing the postrecovery to the preflood ratios, changes in the financial status of the household can be ascertained.

For example, if it is assumed that the household in Table 1 suffered losses of $10,000 to the structure and $9,000 to contents, the liabilities to asset ratio would now be 0.1425 or a 53.2 percent increase over preflood value. This

household now has a greater portion of its assets financed by debt than before the flood. Now assume that the entire loss is replaced using insurance. The resulting balance sheet is identical to Table 1 and the liabilities to asset ratio is again 0.093. On the other hand, if the loss were totally replaced by debt, the new liabilities to asset ratio is 0.44, a 378 percent increase over the preflood condition and a 216 percent increase over the immediate postflood condition. The household is in a riskier position after the recovery than even after the flood in that outsiders have a greater claim on assets after the recovery than after the flood.

Similarly, other ratios can be analyzed and other policies tested using the financial sector of the community disaster model. The next section provides an illustrative example of the types of analyses a user might like to consider.

V. ILLUSTRATIVE EXAMPLE

Now that the elements of the financial sector have been discussed, it would be useful to provide an example of the types of information generated by this module. First, the example of a typical household is presented. Then, an example of the application of the information generated to help answer public policy questions is provided.

BALANCE SHEET AND FINANCIAL POSITION GENERATION

Preflood Balance Sheet

Once the attributes of the households under consideration have been specified, the preflood balance sheet for that household is generated and shown in Table 3. The various ratios associated with that balance sheet are also shown. As previously discussed, it can be observed that this household preferred to finance less than ten percent of its assets with debt. Likewise, more than one quarter of total assets are in the form of financial assets. Finally, the household could pay off all its debt using only financial assets; ie., its liabilities could be discharged without having to sell its home or other assets (financial assets are 2.80 times its liabilities). These ratios indicate, therefore, the preferred financial position of this household. Now, one can compare the changes in this preferred financial position caused by the disaster and subsequent alternative recovery programs.

Table 3: Balance Sheet for PRE-DISASTER HOUSEHOLD

ASSETS	$		LIABILITIES + EQUITY	$
Financial Assets:			Current liabilities:	
Cash	500		Unsecured debt	100
Marketable securities	4,000		Personal notes	300
Savings accounts	5,000		Insurance borrowing	0
Savings bonds	1,500			
Cash value of insurance	3,000			
Total financial assets	14,000		Total current liabilities	400
Real Assets:			Fixed liabilities:	
Automobiles	2,000		Home mortgages	4,000
House value	24,000		Other mortgages	0
Home furnishings	12,000		SBA-home	0
Other assets	2,000		SBA-other	0
			Bank loans	600
Total real assets	40,000		Total fixed liabilities	4,600
			Total liabilities	5,000
			Personal equity	49,000
Total assets	54,000		Total liabilities and equity	54,000

RATIOS FOR PREDISASTER HOUSEHOLD

DESCRIPTION		VALUE
Financial assets/ Total assets	---	25.9%
Financial assets/ Total liabilities	---	2.80 X
Financial assets -sec./ Total liabilities	---	2.00 X
Total liabilities/ Total assets	---	9.3%

Postflood Balance Sheet

The only direct and immediate effect that a disaster
can have on a balance sheet is in the real asset section. These
tangible assets are subject to loss or damage from a disaster.
For purposes of this example, it is assumed that the natural
disaster will cause no loss or damage to the automobiles or
assorted personal properties owned by the household. The Damage
Sector as discussed in Wilson, Lepore and Duffy (1977), predicts
that the disaster will cause structural damage to the home
valued at 50% of its original value, or $12,000, and a loss
of $6,000 of home furnishings. The resultant balance sheet
and revised ratios are given in Table 4.

While the two ratios relating financial assets to
total liabilities have remained identical to those in the pre-
disaster financial position, the remaining two have increased
by at least 50%. The change in the ratio of financial assets
to total assets simply reflects the fact that there are now
fewer real assets while financial assets have remained the
same. Just as financial assets were unaffected, total liabil-
ities at first remain unchanged, which, when coupled with
the decrease in assets, explains the increase in the last two
ratios. As previously noted, a higher debt-equity ratio means
that more assets were purchased with borrowed money and that,
in turn, creditors have a greater claim on assets.

Table 4:   Balance Sheet for POST-DISASTER HOUSEHOLD

ASSETS			LIABILITIES + EQUITY		
Financial Assets:	$		Current liabilities:	$	
Cash	500		Unsecured debt	100	
Marketable securities	4,000		Personal notes	300	
Savings accounts	5,000		Insurance borrowing	0	
Savings bonds	1,500				
Cash value of insurance	3,000				
Total financial assets	14,000		Total current liabilities	400	
Real Assets:			Fixed liabilities:		
Automobiles	2,000		Home mortgages	4,000	
House value	12,000		Other mortgages	0	
Home furnishings	6,000		SBA-home	0	
Other assets	2,000		SBA-other	0	
			Bank loans	600	
Total real assets	22,000		Total fixed liabilities	4,600	
			Total liabilities	5,000	
			Personal equity	31,000	
Total assets	36,000		Total liabilities and equity	36,000	

RATIOS FOR POST-DISASTER HOUSEHOLD

DESCRIPTION		VALUE
Financial assets/ Total assets	---	.39
Financial assets/ Total liabilities	---	2.80 X
Financial assets -sec./ Total liabilities	---	2.00 X
Total liabilities/ Total assets	---	.14

Post-Recovery Balance Sheet

The balance sheet of the household following the recovery will depend on the sources of funds used to replace assets. It is assumed for illustrative purposes that the household replaces all of the assets lost.[9] Examples of balance sheets for the household assuming different sources of recovery funds are now shown.

Disaster Insurance. Assume that this individual carried adequate disaster insurance and that no other public policies were in effect. Upon suffering the above losses, sufficient money would become available to repair or purchase assets such that the original level was attained. Since no new debts are incurred and the insurance money can be assumed to be immediately converted to real assets, the resulting financial position will be identical to the pre-disaster one as presented in Table 3.

SBA Disaster Loans. In this example, the victim homeowner can borrow $12,000 for structural repairs to his home and $6,000 for repairs and replacement of home furnishings from the SBA after the flood. When this money is used to restore the victim's property the asset side of his balance sheet will be identical to what it was prior to the disaster. While his liabilities will have increased by a comparable amount. This new condition will be reflected in the liabilities side of his balance sheet and in his financial ratios. Table 5 is the balance sheet and financial ratios, respectively, of this household after taking advantage of the public policy.

Table 5: Balance Sheet for SBA RECOVERY

ASSETS			LIABILITIES + EQUITY		
Financial Assets:	$		Current liabilities:	$	
Cash		500	Unsecured debt		100
Marketable			Personal notes		300
securities		4,000	Insurance		
Savings accounts		5,000	borrowing		0
Savings bonds		1,500			
Cash value of					
insurance		3,000			
Total			Total		
financial assets		14,000	current liabilities		400
Real Assets:			Fixed liabilities:		
Automobiles		2,000	Home mortgages		4,000
House value		24,000	Other mortgages		0
Home furnishings		12,000	SBA-home		12,000
Other assets		2,000	SBA-other		6,000
			Bank loans		600
Total			Total		
real assets		40,000	fixed liabilities		22,600
			Total liabilities		23,000
			Personal equity		31,000
Total assets		54,000	Total liabilities and equity		54,000

RATIOS FOR SBA RECOVERY

DESCRIPTION		VALUE
Financial assets/ Total assets	---	25.9%
Financial assets/ Total liabilities	---	0.61 X
Financial assets -sec./ Total liabilities	---	0.43 X
Total liabilities/ Total assets	---	42.6%

Disaster Insurance And SBA Disaster Loans. In the
event that a homeowner had insufficient disaster insurance
coverage, he could, if it existed, take advantage of Federal
disaster loans. Assume that the sample household had a maximum
coverage of $10,000 on the home and $5,000 on the contents.
Given the damages of $12,000 on the home and $6,000 on the
contents, the homeowner would borrow a total of $3,000 to re-
build his assets. The resulting balance sheet and financial
position are presented in Table 6. This represents a great
improvement in financial position from the case in which all
of the money for recovery was borrowed (SBA only) in that the
claims on assets by outsiders is less than when SBA loans alone
are used.

SBA Disaster Loans With Forgiveness. If some amount
of an SBA loan is forgiven (ie. it is not required to be re-
paid), an improvement in the homeowner's financial position
over that shown in Table 5 will occur. The deterioration of
financial position was due to increased debt. This forgiveness
feature reduces the amount of debt needed to effect recovery and,
thereby, improves the ratios. Assuming a $1,000 forgiveness,
the new balance sheet will change to that in Table 7. The
financial ratios show only a slight improvement over those for
recovery without forgiveness. This is to be expected since the
amount of forgiveness is relatively small compared to the SBA
disaster loan. The closer the amount of forgiveness is to the
amount of new debt, the more it will help restore the victim to
his pre-disaster position. This will be illustrated in the next
policy alternative recovery option.

Table 6: Balance Sheet for INSURANCE AND SBA RECOVERY

ASSETS		LIABILITIES + EQUITY	
Financial Assets:	$	**Current liabilities:**	$
Cash	500	Unsecured debt	100
Marketable		Personal notes	300
securities	4,000	Insurance	
Savings accounts	5,000	borrowing	0
Savings bonds	1,500		
Cash value of			
insurance	3,000		
Total		**Total**	
financial assets	14,000	current liabilities	400
Real Assets:		**Fixed liabilities:**	
Automobiles	2,000	Home mortgages	4,000
House value	24,000	Other mortgages	0
Home furnishings	12,000	SBA-home	2,000
Other assets	2,000	SBA-other	1,000
		Bank loans	600
Total		**Total**	
real assets	40,000	fixed liabilities	7,600
		Total liabilities	8,000
		Personal equity	46,000
Total assets	54,000	Total liabilities and equity	54,000

RATIOS FOR INSURANCE AND SBA RECOVERY

DESCRIPTION		VALUE
Financial assets/ Total assets	---	25.9%
Financial assets/ Total liabilities	---	1.75 X
Financial assets -sec./ Total liabilities	---	1.25 X
Total liabilities/ Total assets	---	14.8%

Table 7: Balance Sheet for SBA RECOVERY WITH FORGIVENESS

ASSETS

Financial Assets:	$
Cash	500
Marketable securities	4,000
Savings accounts	5,000
Savings bonds	1,500
Cash value of insurance	3,000
Total financial assets	14,000

Real Assets:	
Automobiles	2,000
House value	24,000
Home furnishings	12,000
Other assets	2,000
Total real assets	40,000

Total assets	54,000

LIABILITIES + EQUITY

Current liabilities:	$
Unsecured debt	100
Personal notes	300
Insurance borrowing	0
Total current liabilities	400

Fixed liabilities:	
Home mortgages	4,000
Other mortgages	0
SBA-home	12,000
SBA-other	6,000
Bank loans	600
SBA Forgiveness	- 1,000
Total fixed liabilities	21,600
Total liabilities	22,000
Personal equity	32,000

Total liabilities and equity	54,000

RATIOS FOR SBA RECOVERY WITH FORGIVENESS

DESCRIPTION		VALUE
Financial assets/ Total assets	---	25.9%
Financial assets/ Total liabilities	---	0.6 X
Financial assets -sec./ Total liabilities	---	0.46 X
Total liabilities/ Total assets	---	40.7%

Disaster Insurance and SBA Disaster Loans with For-
giveness. By referring to the example of recovery with disaster
insurance and SBA disaster loans, one can see a marked improvement
over recovery by loans only. Reasoning along the same lines as
in the previous case, a household's financial position may be
improved by decreasing debt. If the same $1,000 forgiveness is
available, it will, in this example, reduce new debt by 1/3. This
change can be seen in the balance sheet and ratios in Table 8.

Evaluation

The results of the previous analyses have been sum-
marized in Table 9. It can be seen that the disaster and subse-
quent recovery can have a profound impact on the financial position
of the household. For example, it can be observed that using SBA
loans for recovery results not only in a deteriorating financial
position (total debt is 42.6 percent of assets as opposed to 9.3
percent before the flood) but also the household can no longer meet
its obligations using financial assets only (financial assets are
less than total liabilities since the ratio of financial assets is
less than 1 - in this case 0.61). If the debt had to be repaid
immediately, the homeowner would have to sell his home and other
tangible assets. The financial position is not improved much if
there is a forgiveness aspect to the SBA loan, that is, including
the forgiveness provision specified here does not reduce the re-
liance on debt by much. Insurance, on the other hand, returns
the household to its preflood condition. While the object of this
discussion is not to advocate one policy over another, it does
demonstrate how the financial sector of the Community Disaster Model
can be used to investigate the effects of a given policy and then
to compare the impact of various policy alternatives.

Table 8: Balance Sheet for INSURANCE AND SBA WITH FORGIVENESS

ASSETS	$		LIABILITIES + EQUITY	$
Financial Assets:			**Current liabilities:**	
Cash	500		Unsecured debt	100
Marketable securities	4,000		Personal notes	300
Savings accounts	5,000		Insurance borrowing	0
Savings bonds	1,500			
Cash value of insurance	3,000			
Total financial assets	14,000		Total current liabilities	400
Real Assets:			**Fixed liabilities:**	
Automobiles	2,000		Home mortgages	4,000
House value	24,000		Other mortgages	0
Home furnishings	12,000		SBA-home	2,000
Other assets	2,000		SBA-other	1,000
			Bank loans	600
			SBA Forgiveness	- 1,000
Total real assets	40,000		Total fixed liabilities	6,600
			Total liabilities	7,000
			Personal equity	47,000
Total assets	54,000		Total liabilities and equity	54,000

RATIOS FOR INSURANCE AND SBA WITH FORGIVENESS

DESCRIPTION		VALUE
Financial assets/ Total assets	---	25.9%
Financial assets/ Total liabilities	---	2.00 X
Financial assets -sec./ Total liabilities	---	1.43 X
Total liabilities/ Total assets	---	13.0%

Table 9

Summary of Financial Ratios

	Financial Assets / Total Assets	Financial Assets / Total Liabilities	Financial Assets less Securities / Total Liabilities	Total Liabilities / Total Assets
Preflood	.26	2.80 x	2.00 x	.09
Post Flood - Pre Recovery	.39	2.80 x	2.00 x	.14
Recovery Options:				
a) Disaster Insurance	.26	2.80 x	2.00 x	.09
b) SBA Loans	.26	0.61 x	0.43 x	.43
c) Insurance and SBA Loan	.26	1.75 x	1.25 x	.15
d) SBA Loan with Forgiveness	.26	0.64 x	0.46 x	.41
e) Insurance and SBA Loan with Forgiveness	.26	2.00 x	1.43 x	.13

IMPACT ON SOCIOECONOMIC GROUPS

While it is important to illustrate the use of the
disaster model to observe the impact of a disaster on an individual
household, it is also important to illustrate the power of the
model to analyze the financial impact on socioeconomic classes
in the flood-prone community. In this way, it is possible to
observe differences among various segments of the community
as well as under various policy alternatives.

To illustrate the flood model in action, an hypo-
thetical community of 427 households was constructed (see Borkan
and Kunreuther (1977) for an in-depth description of community
characteristics as well as methods of construction). It would be
of interest to determine the impact of the disaster on households
with different ages and income levels. Likewise, it would be
useful to see the impact of a given policy alternative. In this
case, we will explore the role of flood insurance.

Preflood Financial Characteristics

Once the socioeconomic characteristics of each house-
hold in the community has been established, the balance sheet
accounts for each household are calculated. The pertinent
ratios are then determined. Finally, households are grouped
by age, income, and whether or not they have flood insurance.

Tables 10 and 11 summarize the pre-flood financial
characteristics by age and income. It is interesting to note that
low income and high income households tend to have a larger per-
centage of their total assets in the form of financial assets.[10]

Such a result is not surprising in that Projector and Weiss (1968) suggest that low income households generally have more variable income streams so they need financial assets to smooth out such variabilities. High income households tend to invest in securities and financial assets more than other households.

Post-Recovery Effects

Finally, the impact of the recovery is reviewed. For purposes of illustration, it is assumed that those who are insured have flood insurance at 80% of the value of the structure and contents. SBA loans at 6-5/8 percent are available to cover any uninsured losses sustained by victims. After utilizing the recovery subroutines, the balance sheets and associated ratios for the households are generated.

The differential impact of having insurance is graphically illustrated in Tables 10 and 11. The insured households not only have lower debt to asset ratios than uninsured households but they are close to the preflood position. Uninsured households, on the other hand, have a higher debt to asset ratio after the recovery than even after the flood. Thus, the recovery caused their financial position to be more precarious than even after the flood. By depicting such consequences on portions of the population, decision-makers can evaluate the impact that a given recovery policy has in a way that could not be undertaken using traditional models.

Table 10

Changes In Financial Characteristics by Income

	Preflood		Postflood		Post Recovery	
	*F/A to **T/A	Debt to T/A	F/A to T/A	Debt to T/A	F/A to T/A	Debt to T/A
Low Income						
Insured	.251	.256	.337	.316	.250	.262
Uninsured	.183	.221	.225	.298	.170	.325
Medium Income						
Insured	.150	.216	.197	.312	.150	.239
Uninsured	.175	.281	.220	.387	.165	.529
High Income						
Insured	.257	.328	.300	.404	.258	.361
Uninsured	.227	.234	.270	.314	.210	.583

* Financial Assets

** Total Assets

Table 11

Changes In Financial Characteristics by Age

	Preflood		Postflood		Post Recovery	
	*F/A to **T/A	Debt to T/A	F/A to T/A	Debt to T/A	F/A to T/A	Debt to T/A
Low Age						
Insured	.093	.304	.125	.472	.110	.346
Uninsured	.121	.333	.157	.463	.105	.556
Medium Age						
Insured	.196	.299	.246	.375	.196	.340
Uninsured	.192	.246	.233	.334	.175	.423
High Age						
Insured	.355	.149	.436	.223	.350	.150
Uninsured	.282	.146	.344	.187	.260	.415

*Financial Assets

**Total Assets

V. SUMMARY AND FUTURE RESEARCH

SUMMARY

Natural disasters have far-reaching and long-ranging effects, one of which is a sudden change in the financial position of households. Previous investigations have, in general, ignored this aspect of the problem. This paper shows how the Community Disaster Model can analyze the financial consequences of natural disasters.

The appropriate vehicle for analyzing this impact is the household balance sheet. After specifying the preparation of these statements, it is shown that comparisons between households is best facilitated using ratios of the various accounts.

The financial sector essentially generates these balance sheets and ratios for each household in the community prior to the disaster, immediately after the disaster, and following recovery. The estimation procedure for the pre-disaster balance sheet is based on a national survey conducted by the Federal Reserve Board. The specification of the balance sheet accounts are then adjusted for the unexplained variance in the regressions. Subsequently, the post-disaster and post recovery financial statements are specified. An illustrative example is provided to show the types of information generated by the module and how such information can be utilized.

FUTURE RESEARCH

While the module as it now exists is useful for studying the financial impact of disasters, several avenues are open for future research.

Extending the Module

Income Statement. The present module analyzes in detail how disasters and subsequent recovery programs impact on what a household owns and what it owes. This information is valuable in designing suitable recovery programs. The balance sheet, however, is not the entire story. Disasters will also influence what proportion of a household's income goes to which claimants. If loans are used for recovery, less discretionary income is available to sustain economic activity. If insurance is used, premiums must be paid from current income. It is, thus, quite important to analyze the impact on the income statement as well as the balance sheet.

Recovery Phase. As of now the recovery phase is based on estimations using the results of the Kunreuther et al (1978) survey. This survey investigated what households would do when recovering from a disaster assuming a fixed set of alternatives. An important question has not been answered, though. To what extent will a household prefer to accept reduced livability so as to reduce the level of indebtedness of the household. Kunreuther et al (1978) determined that households did not fully utilize SBA loans. It is thus interesting to determine to what extent a household will substitute private sources such as

bank loans and savings for SBA loans and to what extent a household might prefer to not replace assets lost in the flood. For example, if the house had four bedrooms before the flood the family may decide to rebuild only three of them in order to reduce the funds needed for recovery. In any case, investigating this element of household decisionmaking is a critical requirement in studying the recovery phase.

Community Relationships. Finally, it would be of interest to determine the impact of the disaster and recovery on the community as a whole. Simply summing households is not sufficient. Disasters will impact on business, financial institutions, local governments and other institutions. It would be useful to obtain an indication of the role which these elements of the community have in the economic recovery of a region following a disaster.

FOOTNOTES

1. While values are provided in this paper for real assets, it is realized that it is difficult to unambiguously determine these values since secondary markets in real assets are not very efficient. For the purposes of this paper, it is assumed that best estimates are provided while realizing that such estimates will be subject to measurement error.

2. This use assumes that households were at their preferred financing levels prior to the disaster. While any particular household may not have been, assuming that in the aggregate they were should not lead to error. A more serious problem involves the assumption of asset replacement. Households may prefer to have fewer assets if these assets must be financed by debt. For the purposes of this paper, such possibilities are ignored but they provide an avenue for future research.

3. Many writers suggest the use of the concept of normal income which is defined as that expected by a household for a given set of socioeconomic characteristics. Tests using two-stage least squares provided inferior (higher variance) estimations to those utilizing actual incomes. As seen later, these variance estimates are important so that it appears preferable to use actual income in this regression.

4. Assuming a market value equal to 80 percent of replacement cost is equivalent to assuming an average age of approximately six to ten years, not an unrealistic assumption.

5. Most renters will not occupy fully furnished apartments except in resort locations. In areas such as coastal zones, adjustment would be needed.

6. An exception to this generalization is when a financial asset is secured by a physical asset which is destroyed in the disaster. For example, if a household held a mortgage on another piece of property which was destroyed by the flood, the value of that mortgage would be reduced. While important for financial institutions, few households lend to others by writing a mortgage. As a result, such exceptions are relatively unimportant here.

7. It is assumed for the present that automobiles are not damaged as estimation of such damages are beyond the scope of the present model.

8. The loss described here does not include losses which may be due to the unattractiveness of the area immediately after the flood. No attempt is made to determine if factors other than damages reduce market value.

9. It is not clear to what extent households will replace assets lost, be satisfied with less livability of house and contents, or even take advantage of the situation to upgrade assets. Such an investigation into the behavioral characteristics is beyond the scope of this study but provides an interesting avenue for future research.

10. Slight variability between insured and uninsured households in the same age and/or income category is not statistically significant.

REFERENCES

Ando, Albert and F. Modigliani, "The 'Life Cycle' Hypothesis of Saving: Aggregated Implications and Tests," American Economic Review, 1961.

Borkan, Brad and H. Kunreuther, "Community Disaster Model: A Tool for Policy Analysis," Decision Sciences Working Paper, University of Pennsylvania, 1977.

Cochrane, Harold C. Natural Hazards and Their Distributive Effects. Institute of Behavioral Science, University of Colorado, 1975.

Dacy, D. and H. Kunreuther, The Economics of Natural Disasters: Implications for Federal Policy. New York: The Free Press, Macmillan, 1969.

Dunkelberg, W. C. and F. P. Stafford, "Debt in the Consumer Portfolio: Evidence from a Panel Study." American Economic Review, September, 1971, pp. 598-613.

Friend, I. and M. Blume, "The Demand for Risky Assets by Households and Other Investors," American Economic Review, Vo. LXV, No.5, December, 1975, pp. 900-922.

Friend, I. and C. Lieberman, "Short-Run Asset Effects on Household Saving and Consumption," Rodney L. White Center for Financial Research Working Paper No. 6-74, University of Pennsylvania, 1975.

Glejser, H. "A New Test for Heteroscedasticity," Journal of the American Statistical Association, 64, No. 325 (1969), 316-23.

Katz, N. and L. Miller, "An Interactive Modeling System," Working Paper No. 77-09-02, Department of Decision Sciences, University of Pennsylvania, 1977.

Kunreuther, Howard. Recovery from Natural Disasters. Washington, D. C.: American Enterprise Institute for Public Policy Research, 1973.

Kunreuther, H., R. Ginsberg, L. Miller, P. Sagi, and P. Slovic, Limited Knowledge and Insurance Protection: Implications for Natural Hazard Policy.

Moore, Harry, ..., And the Winds Blew. The Hagg Foundation for Mental Health, University of Texas, Austin, 1964.

National Academy of Sciences. The Great Alaska Earthquake of 1964. Washington, D. C. 1970.

Prince, Samuel, "Catastrophe and Social Change," <u>Studies in History, Economics, and Public Law</u>, Vol. 94, No.1, Columbia University, New York, 1920.

Projector, D. S. <u>Survey of Changes in Family Finances</u>. Washington, D. C.: Board of Governors of the Federal Reserve System, 1968.

Projector, D. S. and Weiss, G. S. <u>Survey of Financial Characteristics of Consumers</u>. Washington, D. C.: Board of Governors of the Federal Reserve System, 1966.

Rawls, Wendell, Jr. and Stranahan, Susan Q. Series on Wilkes-Barre flood recovery. <u>Philadelphia Inquirer</u>, 10-14 November 1974.

Vinso, J., "Financial Implications of Natural Disasters: Some Preliminary Indications," <u>Mass Emergencies</u>, (Elsevier - North Holland), December, 1977.

White, G. E. and Haas, J. F. <u>Assessment of Research on Natural Hazards</u>. Cambridge, Mass.: MIT Press, 1975.

Wilson, J., J. Lepore, and B. Duffy,"The Community Disaster Model -- The Damage Sector," Department of Civil and Urban Engineering Working Paper, University of Pennsylvania, 1977.

APPENDIX

APPENDIX A

DETERMINATION OF FINANCIAL CHARACTERISTICS

In order to analyze the impact of natural disasters on households one needs a systematic way to present their financial status. While a uniform format has not been developed for households, we can borrow the methodology used for determining the financial position of business firms.

Balance Sheet Construction

The standard form for presenting the financial status of a firm at a point in time is the balance sheet. This statement provides a listing of what is owned (assets) and what is owed (liebilities). Since what is owned must be equal to what is owed, assets must equal liabilities (hence a "balance sheet"). However, assets can be differentiated with respect to ease of conversion to cash. Those assets which are easily converted to cash are classified as current <u>assets</u> while those which it is difficult to realize the cash values are defined as <u>fixed assets</u>. Likewise, liabilities can be classified with respect to the relative proximity of claims on funds. Claims which will come due within a prescribed period (generally one year) are termed <u>current liabilities</u>. Claims which come due past one year (generally paying a fixed return for their life) are classified as <u>long term liabilities</u>. The residual belongs to the owners (or stockholders) and is termed <u>equity</u>. A typical balance sheet for a firm is shown in Table A.1a.

In a similar fashion, the financial position of the household can be determined at a point in time by preparing a personal balance sheet. A typical household balance sheet is shown in Table A.1b. It can be seen that the form these financial statements take are slightly different from those of the firm. It would be instructive to look somewhat closer at each of the accounts. The various accounts can be broken down into two classifications: financial and real assets.

Financial Assets

<u>Financial assets</u> are claims which the household has on others, are not physical or tangible assets, and can be converted into cash relatively easily. While one could group all of these assets together, some information would be lost as each financial asset has different characteristics.

There are three basic types of financial assets each with a separate rationale for being included in the household's portfolio. Cash and demand deposits are primarily for transaction purposes. Since these deposits are non-interest bearing,

TABLE A.1

TYPICAL BALANCE SHEETS

Assets	Liabilities

a. For a Firm

Assets	Liabilities
Current Assets	**Current Liabilities**
Cash	Notes Payable
Marketable Securities	Accounts Payable
Inventory	Wages Payable
Accounts Receivable	Other Current Payables
Other Current Assets	
Fixed Assets	**Long-Term Liabilities**
Plant & Equipment	Long-term Debt
Less: Depreciation	
Equity in other firms	Equity
Goodwill	
Total Assets =	Total Liabilities & Equity

b. For a Household

Assets	Liabilities
Financial (Current) Assets	**Current Liabilities**
Cash & Demand Deposits	Notes Payable
Securities	Unsecured Credit
Savings Accounts	
Savings Bonds	
Cash Value of Life Insurance	
Real (Long-term) Assets	**Long term Liabilities**
Automobiles	Bank Loans
Market Value of Home	Mortgages
Market Value of Contents	SBA Loans
Other Assets	Other Loans
	Equity (Net Worth)
Total Assets =	Total Liabilities & Net Worth

most households attempt to minimize the amount they have tied up in these funds. The second type of financial asset is broadly defined as savings and is composed of savings accounts and savings bonds. These assets are kept primarily for precautionary motives; that is, to provide a source of funds quickly if income is less than expenditures but, unlike cash it still provides some interest. These accounts are not only readily available but also can be converted to cash with no loss of capital because they do not decline in value below the price at which they were obtained.

Securities, on the other hand, generally provide a higher return than savings but are far more speculative. Stocks and bonds are included in this account. While the returns are greater, there exists the possibility of a capital loss if one is forced to sell at less than cost. Thus, these accounts can be converted to cash but with the potential for loss. As a result there will be more reluctance to liquidate these securities than savings as sources of recovery funds. Finally, the cash value of life insurance is a source of funds but would again be used as a last resort - as most individuals buy insurance for protection rather than for its potential cash value.

Real Assets

The real assets are similarly divided by major decision area. Generally, the most important purchase for a household is its investment in a home. Its second single most important investment is the ownership of automobiles. The contents of the house are treated separately from the property itself, since insurance and disaster recovery programs separate the contents of the house from the structure itself. Finally, any other assets such as boats, furs, etc., are grouped without further disaggregation.

Liability Accounts

In a similar fashion, liabilities are disaggregated. Those debts which come due in full within a short period of time such as charge accounts, medical and dental bills are designated as current liabilities. Short term loans such as bank or finance company loans, which are due within a year are also included in this category. It is necessary to identify separate current liabilities from long-term liabilities as these are claims on assets which must be satisfied in the very near future. As a result not only is there a limit to the extent that this type of debt can be used for disaster recovery but it also effects the amount of other debt such as SBA loans which can be obtained.

Long term liabilities are those which do not come due in the near future but generally have periodic fixed payments and require some form of collateral. Bank loans are intermediate loans (1-10 years) used primarily for home improvements. Mortgages, on the other hand, are utilized for purchase of

homes. Generally, they extend for twenty to thirty years and
have interest rates lower than bank loans. SBA disaster loans
are the primary form of relief provided by the federal government
for recovery. These loans frequently are long (up to thirty
years) and at interest rates much lower than the prevailing
rates. This form of relief is separated in Table A.1b from other
loans which include financing for such assets as automobiles
or appliances. The sum of the current and long-term liabilities
represents the total liability of the household unit as viewed
by outside creditors.

As was done for the firm, total liabilities (what is
owed) is subtracted from total assets and the residual reflects
the equity or net worth of the household. If all assets were
liquidated for cash and all liabilities paid off, that is what
if left for the household.

Determination of Account Levels

Finally, the dollar values of the accounts must be deter-
mined. Because of various statutes, regulations of the Internal
Revenue Service, Securities and Exchange Commission, and the
states of incorporation, the assets and liability accounts in a
business balance sheet are expressed in book values (costs at
the time of acquisition). Financial decision-making is not
based on original costs, however, but rather on market or re-
placement values. For example, if a firm must replace a machine
that today costs one million dollars, it is immaterial that the
same machine cost five hundred thousand dollars ten years ago.
Likewise, if a bond issue must be replaced, it is immaterial that
the interest rate twenty years ago was three percent. Since
interest rates are higher now, the firm must either pay more of
its income in the form of interest payments or else issue less
debt for the same amount of interest.

In a similar fashion it is expected that the decisions
made by the household would also be based on a market or re-
placement value as opposed to original cost. For example,
assume a household owned a refrigerator which it has purchased
ten years ago for one hundred dollars. It still performs the
same service, cooling food to prevent spoilage. But what is the
value of that refrigerator? If the household has to sell it to
satisfy a debt, it might bring fifty dollars. On the other hand,
if the refrigerator had to be replaced, a unit performing the same
service might cost three hundred dollars. What then is the value
of the refrigerator? In analyzing the financial decision-making
process, the value is either fifty or three hundred dollars de-
pending on whether it is currently available or must be replaced.
In any case, the one hundred dollar cost is obviously irrelevant.
The values of the various assets owned by the household will be
at the current market value of that asset.

Ratio Analysis of the Balance Sheet

The financial impact of a disaster on households can be analyzed by investigating changes in the market values of the various accounts. While one might compare individual components of the balance sheet, such comparisons in general are inappropriate. Since some households have larger amounts of assets than others, a twenty percent reduction in assets can mean tens of thousands of dollars for one household while for others it can mean only a few thousand. The usual method for making comparisons of financial characteristics among units of different magnitudes is to construct financial ratios.

The analysis of these ratios involves three types of comparisons. First, the present ratio can be compared to past ratios. When these ratios are displayed over time, one can study the types of changes and determine whether there has been an improvement or deterioration in the financial condition of the household. The second method involves comparing the ratios of one household with either other households or some average of other households at the same point in time. The third method is the most important of all. Most households acquire assets slowly over time and adjust their financial statements to the variability of income and preferred levels of cash, savings, etc. Thus, the preflood levels of a ratio for a given household provide information on the preferred composition of financial assets, debt, etc. In this way, the preflood ratios provide benchmarks which define how far the disaster moved the household away from the preferred financial condition as well as an estimate as to how debt and personal funds can be used for recovery to return the household to its preflood financial position.

An example of this type of analysis might be to construct the following ratio:

<div align="center">

Financial Assets
Total Assets

</div>

This ratio describes what percentage of the assets owned by the household are in the form of financial assets. It gives an indication of the level of financial assets as opposed to real assets. The first type of comparison might be to look at how the ratio or percentage after the flood (but before recovery) differ with that before the flood. Since financial assets, in general cannot be destroyed by a natural disaster while real assets can, this ratio should increase. After the recovery phase has progressed for some time, the ratio can indicate to what extent financial assets have been liquidated to provide real assets.

Second, they can be compared to other similar households. Projector and Weiss (1966) found that older residents with

high incomes had a higher proportion of financial assets to total assets than younger and lower income households. Thus, the preferred level of financial assets for a given household will be different depending on the income and age of the household. A standard of reference can be established as a function of these variables when designing disaster relief policies.

Finally, one can determine to what extent the recovery process has been completed by comparing the ratio at a given point in time to the preflood ratio of that household and for similar households. Although no definitions currently exist to suggest how close to the preflood condition one must come to justify the assumption that recovery is complete, analysis of ratios can help provide such a definition.

Choosing the Relevant Ratios

Now that the form of the analysis has been developed, which ratios are to be used here? Many ratios are possible. Some look at the relationship among components of the balance sheet, some look at the relationship between income and expenses, while still others relate balance sheet items to income and expenses. In this paper, we are concerned only with the relationships among the elements of the balance sheet.

To analyze the financial condition of the disaster victim, four ratios in addition to the one previously discussed are reviewed: the current ratio, the quick ratio, the debt to total assets and the debt-equity ratios. It should be re-emphasized that there is no absolute level for any of these ratios for all households but only with respect to the comparisons previously discussed. Each is now reviewed.

The current ratio is the ratio of financial assets to liabilities. This ratio is used to judge the ability of the household to meet outside obligations with cash or easily obtained cash. One can gain insight into the ability of the household to remain solvent in the event of adversity. The more variable current income, the higher this ratio should be. Abstracting from income, the higher this ratio, the greater should be the ability of the household to pay its bills.

However, the current ratio is a crude measure in that it does not take into account the ease of converting the individual components of financial assets into cash. Reviewing the components of financial assets shows that all are convertible easily and quickly to cash without loss of capital (although the opportunity to earn interest is foregone) except for marketable securities. Since marketable securities can lead to capital loss is converted to cash at a price less than cost, the household will be much less eager to utilize securities as a source of cash.

One way to alleviate the shortcomings of the current ratio is to use the quick ratio. This ratio is the same as the current except that it excludes marketable securities from the numerator. Of course, if the household were faced with the situation where financial assets had to be liquidated to pay its debts and there was no possibility of further borrowing, the household would certainly sell these securities, even at a loss, rather than sell real assets or go bankrupt. It will, however, be a last resort, so the quick ratio provides a more penetrating measure of the liquid position of the household.

Finally, it is necessary to obtain an indication of the household's desire and ability to take on debt obligations. The usual ratios used for this purpose are total debt to net worth (equity) and debt as a percent of total assets. As a household increases the proportion of debt fixed claims on income increase. All other things being the same, the probability that the household will be unable to meet these fixed charges also increases. These ratios will vary then with the variability of income.

There is another aspect to debt besides fixed charges, however. Debt also represents a claim on assets. If the head of the household dies, debts must be satisfied before anything goes to the heirs. The larger the debt carried, the more assets which must be liquidated to satisfy these debts. Younger households generally use debt to acquire assets like homes because it takes far too long to save enough to pay cash. To overcome this problem with a claim on assets, life insurance is purchased, as it is relatively cheap because the probability of death is low. If the head of the household dies, the insurance pays off the bulk if not all of the debts. As a household ages, however, the probability of death increases. Insurance becomes a very expensive way to guard against the possibility that assets may have to be liquidated to satisfy debts. As a result, households tend to reduce the amount of debt they carry as they get older. Therefore, the debt-net worth (equity) and debt to total asset ratios will be a function not only of variability of income but also the age of the household. It also shows why it is important to compare debt ratios with similar households as a comfortable amount of debt for a young household can be a crushing burden for an elderly household.

APPENDIX B

TECHNICAL APPENDIX

Several aspects of the construction of the financial sector require further amplification. The purpose of this appendix is to provide details in the development of the sub-routine used to generate the preflood balance sheet for the household.

Preparation of Data

The primary data source to develop the financial characteristics of a household is a survey conducted by the Board of Governors of the Federal Reserve Board and reported by Projector and Weiss (1968). It was a nation-wide study so as not to introduce regional biases. It also is large enough so that characteristics of the sample will approximate the characteristics of the population within acceptable statistical accuracy. In conducting their survey, Projector and Weiss obtained minute details of the financial attributes of households. For example, not only was the amount of cash in a household determined but the amount in each checking account for each member of the household was determined. Similarly information on savings, housing, debts and every other element on the balance sheet is measured. Likewise, data on the socio-economic characteristics of the household are obtained. It should be noted that this survey oversampled upper income households so that a sufficiently large sample of units with wealth over $100,000 would be obtained. Details of the survey are provided by Projector and Weiss (1966).

While the detail obtained by Projector and Weiss is not needed for the financial sector of the Community Disaster Model, interrelationships among various accounts and socio-economic characteristics can be determined if the elements of each account are aggregated. For example, Projector and Weiss found that total wealth was a function of income, age of head of household, and several other attributes. In a similar fashion, the interrelationship between such accounts as savings, cash, etc. and these attributes will allow the construction of a household balance sheet. Of course, for our purposes all of the detail on a given account was aggregated to obtain a single value for the household as such detail is unnecessary here. For example, information on cash and all demand deposit accounts are aggregated to obtain a value for cash.

Estimation Equation Development

As discussed in Section III, cross-section regressions were estimated from the Projector and Weiss data using the following general form:

$$\ln Z = a + b\ (\ln Y) + c\ (\text{Age}) + d\ (\text{Sex}) + e\ (\text{Education})$$
$$+ f\ (\text{Children}) + g\ (\text{Adults}) + v$$

where: Z = various asset and liability accounts

Y = actual income

Age = Age of household head in years

Sex = Dummy variable for sex of household head
(0 = Female, 1 = Male)

Education = Education level attained by household
head in years

Children = Number of children under 18 in households

Adults = Number of adults in household

a, b, c, d, e, f, g = Coefficients

v = residual

Before reviewing the results, it should be noted
that all estimating equations are examined for multicollinearity,
normality, and homoscedasticity (using Glejser's (1969) test).
Where multicollinearity existed, the variables which contri-
buted the most explanatory power was retained. None of the
estimating equations showed heteroscedasticity.

Table B.1 presents the estimating equations for the
various asset and liability accounts in log form. The actual
value is obtained by taking the antilog of the result.
The coefficients shown in Table B.1 are the final estimates after
removing insignificant or colinear independent variables.
Likewise, the correlation coefficients are those of the final
reduced form. In general, the asset accounts can be estimated
more accurately (less residual variance) than the debt accounts.

Thus, the expected level of each account can be deter-
mined using existing attributes. However, even for the best
estimating equation, more than forty percent of the total
variation is unexplained which means that we must not lose the
information contained in the variance. To prevent this, each
account must be adjusted using the following scheme.

Variance Adjustment. Since it is shown that the
residuals from the regressions satisfy the assumptions, the
variance of these residuals is an unbiased estimate of the
variance of the associated account. Thus, the expected value

Table B.1

Estimating Equations

Equation	R^2

1. $\ln(\text{Cash}) = -5.62498 + \underset{(0.0418)}{1.02811} \ln X_2 + \underset{(0.0036)}{0.04104} X_3$ 0.501

   $\underset{(0.01268)}{+0.06014} X_5 \quad \underset{(0.03228)}{-0.11936} X_6 \quad \underset{(0.05658)}{-0.18448} X_7$

2. $\ln(\text{Marketable Securities}) = -8.45478 + \underset{(0.06943)}{1.50357} \ln X_2$ 0.590

   $\underset{}{+0.07045} X_3 \quad \underset{(0.28587)}{-0.69559} X_4 \quad \underset{(0.02084)}{+0.4681} X_5$

   $\underset{(0.09904)}{-0.33177} X_6$

3. $\ln(\text{Savings Accounts}) = -2.90425 = \underset{(0.04391)}{0.84498} \ln X_2$ 0.383

   $\underset{(0.0041)}{+0.05156} X_3 \quad \underset{(0.03766)}{-0.24881} X_6$

4. $\ln(\text{Savings Bonds}) = -0.93539 + \underset{(0.06036)}{0.58021} \ln X_2$ 0.300

   $\underset{}{+0.05497} X_3 \quad \underset{(0.05302)}{-0.12882} X_6 \quad \underset{(0.09195)}{-0.24386} X_7$

5. $\ln(\text{Cash Value} - \text{Insurance}) = -3.17341 + \underset{(0.03608)}{0.78922} \ln X_2$ 0.578

   $\underset{(0.00275)}{+0.04125} X_3 \quad \underset{(0.12836)}{+0.29505} X_4 \quad \underset{(0.00996)}{+0.08829} X_5$

6. $\ln(\text{Other Assets}) = -2.11094 + \underset{(0.07708)}{0.85266} \ln X_2$ 0.292

   $\underset{(0.00753)}{+0.03861} X_3$

7. ln (Automobiles) = 2.04376 + 0.50324 $\ln X_2$ 0.321
                (0.02764)

        − 0.00538 X_3 + 0.03438 X_5 − 0.04838 X_6
        (0.0022)   (0.00763)   (0.0179)

        + 0.13496 X_7
        (0.03365)

8. ln (Home Value) = 4.58131 + 0.49786 $\ln X_2$ 0.597
                (0.01696)

        + 0.00438 X_3 + 0.04332 X_5 − 0.07710 X_7
        (0.0013)   (0.005)   (0.02215)

9. ln (Other Real Estate) = 2.02904 + 0.74237 $\ln X_2$ 0.340
                      (0.0542)

        + 0.01968 X_3 − 0.31884 X_7
        (0.00557)   (0.0835)

10. ln (Unsecured Debt) = −3.0978 + 0.86476 $\ln X_2$ 0.322

        + 0.01604 X_3 + 0.04986 X_5
                (0.01727)

11. ln (Personal Notes) = 1.05385 + 0.96406 $\ln X_2$ 0.425
                   (0.12911)

        − 1.95508 X_4
        (0.75031)

12. ln (Insurance Borrowing) = −2.84937 + 0.96479 $\ln X_2$ 0.466
                        (0.1058)

        + 0.0564 X_5
        (0.0307)

13. ln (Bank Loans) = 1.82534 + 0.49486 $\ln X_2$ + 0.0288 X_5 0.117
              (0.07241)   (0.01387)

14. ln (Home Mortgage) = 5.71032 + 0.41544 $\ln X_2$ 0.272
                  (0.04031)

        − 0.01757 X_3 + 0.03692 X_5 − 0.14554 X_7
        (0.00284)   (0.00968)   (0.04410)

15. ln (Other Mortgage) = 0.08174 $+0.99749$ ln X_2
        (0.10584)   0.377

         -0.33408 X_7
         (0.13825)

16. ln (Other Debt) = 9.33332   0.116

where variables are as defined:

X_2 = Income, dollars

X_3 = Age, years

X_4 = Sex where 1 = Male
                    0 = Female

X_5 = Education, years

X_6 = Number of children under 18

X_7 = Number of adults

of the distribution is determined from the appropriate estimating
equation. Then, a random number is drawn from a normal distri-
bution with mean zero and variance equal to that of the resi-
duals from the estimating equation. The expected value is
then adjusted by this variance to obtain the final value of the
account. Table B.2 provides the values of the standard
deviation for each account.

Several problems arise with this approach which must
be recognized. First, it is now possible that the financial
characteristics of an individual household may be somewhat
different from what may be expected even though the character-
istics of the households will be correct in the aggregate.
This can be remedied in several ways. Since it is assumed that
each account is independent of other accounts on the balance
sheet, joint distributions of various sets of accounts may
be determined. While this is the most appropriate way, such
a determination is beyond the scope of this project but provides
an avenue of future research.

Another way is to set certain limits on each account.
For example, it is assumed that cash can never be less than zero.

Table B.2

Standard Deviation Adjustments for Various Accounts

Account	Standard Deviation**	Limit***
Cash	1.46993	$0
Marketable Securities	1.73438	0
Savings Accounts	1.68467	0
Savings Bonds	1.65657	0
Cash Value - Insurance	1.07505	0
Other Assets	1.84744	0
Automobiles	0.92773	25
House Value	0.56921	5000
Other Real Estate	1.36978	100
Unsecured Debt	1.37618	0
Personal Notes	1.24872	0
Insurance Borrowing	1.26390	0
House Mortgage	0.80805	500
Bank Loans	1.08498	0
Other Mortgage	1.34336	500
Other Debt	1.32210	0

NOTES: ** In terms of logs
        *** Lower limit in dollars

Likewise, the limit on the market value of autos is assumed to

be $25.00 (after taking logs). If the procedure outlined here
produces a value of autos less than $25.00, it is set to zero.
While several of these limits are arbitrary, they are not only
much more realistic but also are low enough that they should,
in general, not be violated. Again, as better information is
developed these limits can be revised or abandoned in favor of
joint distributions.

The other problem is sample size. Since the distri-
butions of the accounts in the aggregate will have the distribu-
tion of the population, it is important that any subgroup have
sufficient observations so that small sample problems do not
arise. In general, that means at least twenty observations
but less may be tolerated under certain conditions. In any case,
any user of the sector must be diligent about the sampling
problems.

Distribution of Non-Zero Accounts. Finally, the
distribution of non-zero accounts must be discussed. As previously
noted, the estimating equations used here were developed from
only non-zero accounts. Essentially the levels estimated
are conditional; i.e., they are determined assuming the level
is non-zero. While for such accounts as cash and automobiles
nearly seventy-five percent or more of the sample is included,
for such accounts as Notes and Other Debt less than five percent
had non-zero levels. Thus, a percentage of all accounts will
be zero. To reflect this, prior to estimation of a given account,
a random number is drawn from a uniform distribution. If that
number exceeds a given hurdle, the account is set to zero.
For example, if the distribution of random numbers is from 0 to
1000, the percentages in Table 2 are used, and the number 500 were
drawn, such accounts as marketable securities, savings bond,
other assets, other real estate and all debt accounts would be
set to zero. All other accounts would be estimated using the
scheme previously outlined. It should be noted that a new
random number is drawn for each account since independence is
assumed.

Currently, the financial sector is constructed using
the percentages outlined in Table 2. While it is recognized
that the original survey over-sampled upper income groups,
there appeared no compelling reason to adjust the percentages
at this time. However, if any other distribution is desired
such as one which is more characteristic of the national pop-
ulation, these percentages can be easily adjusted.