Emergency Fund Levels of Households: Is Household Behavior Rational?

Sherman Hanna, The Ohio State University[1]
Yu-Chun Regina Chang, The Ohio State University[2]
Xiaojing Jessie Fan, The Ohio State University[3]
Mi Kyeong Bae, The University of Texas-Austin[4]

Empirical studies have found that most households do not have recommended levels of liquid savings. An analysis of the 1990 Survey of Consumer Expenditures confirms previous findings. A three period model of optimal consumption is presented. The results suggest that many consumers who do not have the recommended levels of liquid assets may be acting rationally. The results may be useful for financial counselors and educators, as well as for insight into empirical patterns of savings.

Introduction

"To be prepared for the unexpected, people should have a reserve fund - equal to at least three to six months' living expenses - invested in a combination of low-risk money funds and CDs, plus smaller amounts of riskier but higher-yielding investments, such as short- and medium-term bond funds." (Asinof, 1992).

Emergency funds are usually identified as liquid assets because they are easily and quickly converted to cash for the needs of unexpected expenses (Johnson and Widdows, 1985; Prather, 1990). However, when deciding on a level for adequate saving fund to meet emergencies, family economists and financial counselors vary somewhat -- with recommendations varying from 2 to 6 months of expenses in liquid form (Johnson and Widdows, 1985; Prather, 1990). Garman and Forgue (1991) cite this recommendation, but add that the appropriate amount for a particular family depends on the family situation and job. "A smaller amount may be sufficient if you have adequate loss of income protection through an employee fringe benefit program or a union, are employed in a job that is definitely not subject to layoffs, have an employed spouse, or have a ready source of ample credit." (Garman and Forgue, 1991).

Previous empirical studies have found that most U.S. households do not meet the recommended standards. This paper develops an original three period model of consumption for determining optimal saving in order provide insight into rational levels of emergency savings. A new empirical estimate of the proportion of U.S. households meeting the recommended standards is presented. Implications for consumer education and for further research are discussed.

The Literature

Empirical Studies

Johnson and Widdows (1985) definition of emergency funds included three types of liquidity assets. Smythe (1968) approached the question of emergency funds levels indirectly through the analysis of safe levels for family credit commitments. Smythe presented data on families' emergency saving at four stages in the life cycle, and related these to the average time a family at that life cycle stage could expect to be out of work if unemployment occurred. Average amount of income, expenditures as well as liquid and investment assets were provided for each family type. The study concluded that families at each life cycle stage could have supported their current life style during the average unemployment period.

While Smythe's study laid out a framework for analyzing emergency fund levels, more recent research tried to find adequate levels of emergency fund saving and to explore factors affecting levels of this saving. Lindqvist (1981), in a study of determinants of household savings in 429 Swedish families, found that income, family size and stage of life cycle were not significantly related to stocks of liquid assets, but that variables reflecting socio-psychological attributes of households, such as expectations and economic satisfaction, were significant.

Johnson and Widdows (1985) used three different measure of assets indicating different levels of emergency fund saving (quick emergency fund, intermediate emergency fund, and comprehensive emergency fund) for data of 1977 and 1983 Survey of Consumer Finance. The analysis

[1]Professor and Chair, Family Resource Management

[2]Ph.D Student, Family Resource Management

[3]Ph.D Student, Family Resource Management

[4]Visiting Scholar, Human Ecology Department

revealed that the majority of families had insufficient funds to cover normal total household income for the average time a household could expect to be out of work, should that event occur. In 1983, using the broadest measure of emergency funds, only 19% of households had liquid savings sufficient to cover six months of pretax income. The median level of liquid savings using the broad measure was seven percent of pretax income. In 1982-83, the mean level of consumer spending in U.S. households was 83% of the mean level of pretax income (USBLS, 1986), so the median level as a percent of annual spending was probably somewhat higher than seven percent. Johnson and Widdows(1985) also showed that families, on the average, to be less prepared for financial emergencies in 1983 than in 1977 indicating a macroeconomic effect on emergency fund saving. Moreover, the empirical results suggest a strong and positive relationship between income and emergency fund holdings. In a cross-tabulation of emergency fund levels by stages of the life cycle, the findings showed that in each case of emergency fund measure, families in the young family stage of the life cycle showed greatest concentration of emergency funds in the "less than two months' reserve" category. The concentration of families moves from the lower levels of emergency funds reserve to higher levels as families move through the life cycle (Johnson and Widdows, 1985). One limitation of the Johnson and Widdows study is that income rather than spending was used to evaluate the adequacy of liquid savings. This limitation is inherent in the U.S. datasets available, as the Survey of Consumer Finances contains the best balance sheet information but little information about spending, while the Survey of Consumer Expenditures contains the best expenditure information, but only limited information about household balance sheets.

Griffith (1985) proposed 16 ratios with various components of net worth to analyze a family's financial situation. Nine ratios involve with liquid assets and provide insights into the adequacy of emergency fund holdings to cover expenses of unexpected financial crises. Using the ratios recommended by Griffith (1985), Prather (1990) analyzed 1983 Survey of Consumer Finance data and found that only 29% of households had liquid and other financial assets sufficient to cover six months of estimated spending. Prather found that income and age were significantly related to ratios of liquid assets to monthly expenses, to total debt, to non-mortgage debt, to net worth, and to one year's debt payment. These results are consistent with Johnson and Widdows' findings (1985). Prather used an estimate of each household's annual expenditures based on a regression estimate from Survey of Consumer Expenditures data. This is a limitation of her analysis, as the estimate of spending for a particular household might have been much higher or lower than that household's actual spending.

Theoretical Literature

There has been extensive discussion in the literature of theoretical models of optimal saving and consumption behavior under uncertainty either in the context of infinite time horizon or in two-period or multiperiod intertemporal models (e.g., Leland, 1968; Levhari and Srinivasan, 1969; Sandmo, 1970; Mirman, 1971; Dreze and Modigliani, 1972; Hey, 1979; Sibley, 1975; Salyer, 1988). In general, the authors analyzed one or two variables at a time, assuming a value for each of the other parameters. For example, in two-period models the effects of income and interest rate uncertainty on saving decisions are analyzed, given an assumption of a certain lifetime. Infinite horizon or finite horizon models explore effects of the discount factor (lifetime uncertainty) on borrowing (saving) behavior while assuming absence of income and interest rate uncertainty.

In the discussion of income uncertainty and saving behavior, it is assumed that the consumer's beliefs about the value of future income can be summarized in a subjective probability density function; on the basis of this the consumer maximizes expected utility of consumption. Leland (1968) used a two-period model of consumption to demonstrate the effect of uncertainty on saving and concludes that with an additive utility function and the assumption of decreasing absolute risk aversion, the precautionary demand for saving is a positive function of uncertainty. Sandmo (1970) discussed the effects of increased riskiness of future income on present consumption in a two-period model and proves that increased uncertainty about future income decreases consumption (increases saving). Sibley (1975) extended a two-period result of the effects on optimal savings of increased riskiness in the future income due to Leland (1968) to the multiperiod case. He suggested that increased wage uncertainty raises or lowers saving according to whether the third derivative of the utility function is positive or negative. Since the plausible requirement that the consumer's utility function display decreasing absolute risk aversion implies a positive third derivative, this establishes a presumption that optimal saving increases with wage uncertainty (Sibley, 1975). For the case of a constant (but negative) elasticity utility function, Levhari and Srinivasan (1969) showed that optimal savings can increase with increasing uncertainty. However, these authors emphasized the effects of subjective probability density function as a projection of uncertain future income on saving behavior. No study has been done in incorporating possible factors such as level of risk aversion, interest rate, income, and income growth rate into the model to demonstrate the effects of these uncertainties on optimal saving behavior.

The present study includes factors which influence optimal saving decisions in a three period model of consumption. Kinsey and Lane (1978) point out when consumption is accompanied by the use of consumer credit, utility maximization may be viewed in the global sense, thus a life cycle approach to the allocation of income, consumption, and saving (borrowing) is appropriate. While a multi-period model is very complicated and not feasible for this analysis, a three-period models can simulate the life cycle situation better than a two period model by appropriate interpretation. With additional assumptions on certain risk properties of utility functions, a three-period model with uncertainty for determining optimal saving facing consumers is presented and illustrated with numerical analysis. Implications for a life cycle model are then discussed.

Factors affecting optimal saving include the expected growth rate of real income, the variance of future income, the consumer's utility function (e.g., the parameter of risk aversion), the real interest rate and the consumer's personal discount rate. For an exposition of a two period model, see Chang, Fan and Hanna (1992).

A Three-Period Model of Consumption

To begin, consider the following model: assume that the consumer attempts to maximize the expected value of utility (T) for the three periods. Utility from consumption in each period i is denoted as $U(C_i)$. He/she will make his/her saving decision in conjunction with his/her known first period income. The second and third period consumption will, of course, be random variables, dependent on the actual value of second and third period income which is assumed to be affected by income growth rate (or decrease rate) and the probability of that income growth occurs, and also dependent on the interest rate of saving (or borrowing). It is assumed that there are two states of the world in the second period -- real income either decreases or stays constant, and in the third period, income will keep the level of the second period, no matter whatever happened in the second period. (The analysis could allow for other scenarios, but the discussion is limited to this scenario because it is the most plausible scenario for saving to be rational). There are other motivations for holding liquid assets than to allow for income decreases, such as preparing for accidents or illnesses, or saving to purchase durable goods. Insurance can provide for accidents, although some types of insurance may be very expensive relative to expected benefits (Hanna, 1989). Credit is often available for purchase of durable goods. However, this paper will concentrate on income decreases as a motivation for holding liquid assets. Holding liquid assets is costly, as the real rate of return is typically zero or negative.

Mathematically, the problem can be formulated

$$T=U(C_1)+\frac{PU(C_2)+(1-P)U(C_{2a})}{(1+\rho)}+\frac{PU(C_3)+(1-P)U(C_{3a})}{(1+\rho)^2} \quad (1)$$

The constraints are:

$$C_1 = I - S_1 \quad (2)$$

$$C_2 = (1+g)*I + (1+r)*S_1 - S_2 \quad (3)$$

$$C_{2a} = I + (1+r)*S_1 - S_2 \quad (4)$$

$$C_3 = (1+g)*I + (1+r)*S_2 \quad (5)$$

$$C_{3a} = I + (1+r)*S_2 \quad (6)$$

Variables:
T = Total three period utility
I = Year 1 income
I_2 = (1+g)*I (if income increases in that year), otherwise, Year 2 income = Year 1 income
C_1 = Consumption in year 1
S_1 = The amount of savings in year 1
C_2 = Consumption in year 2 if real income in year 2 increases
C_{2a} = Consumption in year 2 if real income in year 2 does not increase
S_2 = The amount of savings in year 2
C_3 = Consumption in year 3 if real income in year 2 increases
C_{3a} = Consumption in year 3 if real income in year 2 does not increase
g = Growth rate in real income (negative number means decrease rate in real income)
r = Real interest rate (Note that r may be higher for S<0, i.e., borrowing, than for S>0)
P = Probability that real income decreases
ρ = personal discount factor. (This might vary.)

A consumer may discount utility from future consumption because of the possibility that he/she may not be alive then, or because of other possible changes in capacity to derive utility from consumption. Young adults have very low risks of death, so this source of discounting should not be important for them. For analysis of savings/credit, the approximate effect of a nonzero personal discount rate is to reduce the real interest rate in the optimal solutions shown below, so that instead of an interest rate of r, the consumer in effect faces an interest rate of r-ρ. For the remainder of this paper, ρ is assumed to equal zero. If ρ is positive rather than zero, a consumer would save less or borrow more for any given set of values of other parameters.

Most studies of intertemporal consumption have used a constant elasticity utility function (Hurd 1989) which is time separable additively:

$$U = C^{1-x} / (1-x) \quad (7)$$

The elasticity of marginal utility with respect to consumption is -x. The elasticity of intertemporal substitution in consumption is equal to 1/x. When this type of utility function is used for analysis of risk, the parameter x is relative risk aversion. C is consumption per time period.

Estimates of Relative Risk Aversion

Grossman and Shiller (1981) have given x an interpretation as "... a measure of the concavity of the utility function or the disutility of consumption fluctuations." The higher the value of x, the more risk averse is the consumer, and the more rapidly marginal utility decreases as consumption or wealth increases. The analysis of economic behavior under uncertainty uses relative risk aversion extensively. For intertemporal consumption, empirical estimates of x range from just under 2 (Skinner, 1985) to 15 (Hall, 1988). Other estimates were between these two values.

By combining intertemporal consumption analysis with risk aversion, we can obtain the optimal amount of saving in terms of year 1 income, interest rate, income growth rate, and probability of that income increases. To give some intuitive insight into optimal savings levels, optimal savings with perfect certainty will be examined first, then uncertainty will be introduced.

Optimal Savings With Perfect Certainty

Zero Real Interest Rate

If a consumer is certain that real income will decrease with a negative growth rate g, and the consumer faces a real interest rate of zero (not unrealistic for taxable liquid savings), the consumer will plan to have equal consumption over the three periods. The amount of savings set aside in period one to allow for the income decreases in periods two and three will amount to:

$$\frac{S}{I}=\frac{-2g}{3} \qquad (8)$$

At the end of period one, the liquid savings accumulated as a proportion of period one income would equal the amount shown in Equation 8. For instance, if a consumer is certain that real income will decrease by 50% between period one and period two, then remain at that level, the optimal amount to save out of period one income is 33.3%. If the time period is years, at the end of year one, liquid savings will equal four months income. To express the proportion in the same terms as the usual prescription, it should be converted to a proportion of spending. Year one spending equals two thirds of income, so liquid savings as a proportion of spending equals six months income, which is equal to the typical prescription. The optimal savings as a percent of year one income and consumption is shown in Figure 1, for levels of income decreases ranging from 60% to zero. The real interest rate assumed is zero, so the utility function does not make any difference in the analysis, if the personal discount rate is zero. Only households who were certain that real income would drop 50% between year one and two, then remain at that level, would accumulate savings by the end of year one at the prescribed level to cover six months worth of spending.

Non-Zero Real Interest Rates

The optimal year one savings as a proportion of year one income can be derived by calculus, and is shown in Equation 9.

$$\frac{S}{I}=\frac{1+(1+r)^{\frac{(x-1)}{x}}-(1+g)(1+r)^{\frac{(x-2)}{x}}-(1+g)(1+r)^{-\frac{2}{x}}}{1+(1+r)^{\frac{(x-1)}{x}}+(1+r)^{\frac{2(x-1)}{x}}} \qquad (9)$$

Given that the real interest rate on liquid assets is usually close to zero, the optimal savings/income ratios obtained from Equation 9 will be very close to those obtained from Equation 8. The results for other plausible real interest rates on liquid savings, ranging from -1% to 4%, are virtually identical to the results shown in Figure 1 for a range of levels of relative risk aversion.

Equations (1) through (7) were used with simulations to find the value of S that maximized expected lifetime utility for particular values of the parameters.

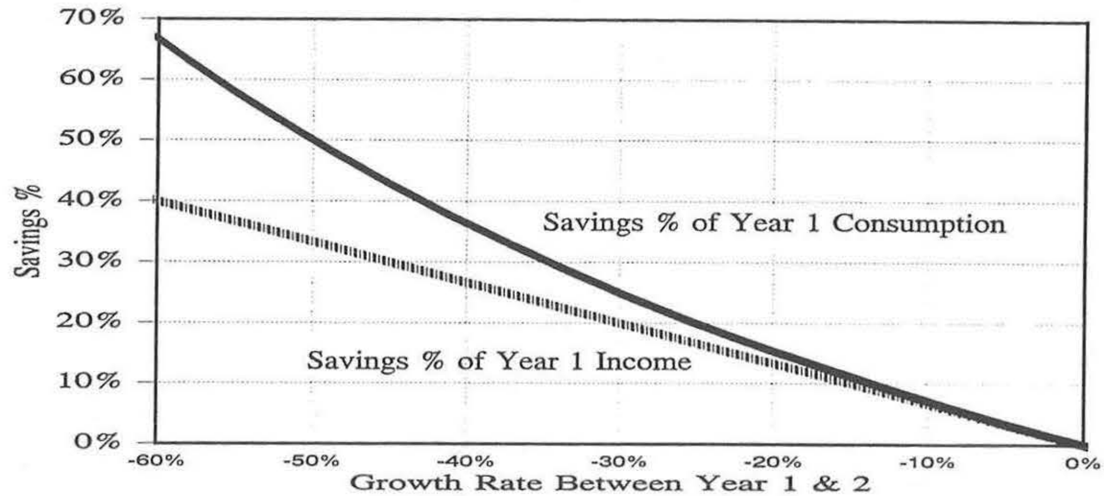
In this section, we discuss and illustrate the impact of the growth rate on optimal savings levels. The value assumed for relative risk aversion is six (Chang, Fan and Hanna, 1992), but results are similar for other plausible values. A graph is produced to help illustrate effects of these parameters by using a numerical simulation technique. In order to focus on scenarios with saving, it was assumed that the consumer faced either constant real income or a negative real income growth rate g with a probability p. The simulations were based on the following assumptions:

- The real interest rate on savings = 1% (e.g., nominal interest rate of 8.4%, subject to 28% tax rate and 5% inflation.)
- The real interest rate on loan = 14.095% (e.g., nominal rate of 19.8% with 5% inflation.)
- Expected utility from all possible borrowing levels (at 14.095%) is compared to expected utility from all possible saving levels (at 1%) and optimal saving/borrowing is that which produces highest expected utility.

Figure 2 shows the result of the simulations based a range of probabilities that real income drops by 50% between year one and two, then remains at the new level during year 3. For a probability of 100% that real income drops by 50%, the results are virtually identical to the analysis illustrated in Figure 1. As the probability decreases, the optimal amount of savings drops rapidly. If the probability of real income dropping by 50% is 15%, then the household's savings should amount to 25% of annual spending. In a recession, this is possible for some occupational groups, but for many households, the probability of such a drastic decrease in real income is lower than 15%.

Figure 1.

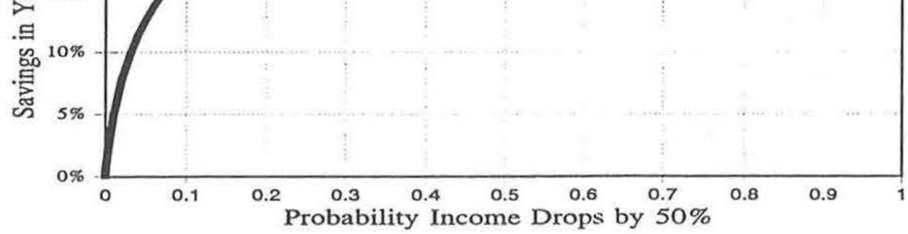
Optimal Savings as % of Year 1 Income & Consumption
Three Period Certainty Model, Relative Risk Aversion=6



Real interest rate=0%.

Figure 2.

Optimal Savings as a % of Year 1 Income, by Probability Income Drops



Three period model, relative risk aversion=6, real interest rate on savings=1%, Income either remains constant for 3 periods, or drops by 50% between year 1 and year 2, then remains at that level for year 3.

Empirical Analysis

A dataset was created with households who had interviews in all four quarters of 1990 in the BLS Survey of Consumer Expenditures tape (for details of the process, see Bae, 1992). With various exclusions, the sample size was 872 consumer units. Incomplete income information was supplied by 11% of the households. There were 774 consumer units with complete reporting of income. The mean income after taxes and Social Security & pension contributions ("takehome" income), was $29,849, and the median level was $24,653 (Table 1). One percent of the households with complete income reporting had takehome income less than zero. The BLS definition of expenditures included Social Security and pension contributions, so the variable "spending" was created by subtracting Social Security and pension contributions. The spending variable was also adjusted for the transportation category, as the BLS includes net vehicle purchases, regardless of how a vehicle was purchased. Net vehicle purchases were subtracted, and annual vehicle loan payments were added, to obtain the spending variable. The mean level of total expenditures was $28,863 and the median level was $24,291. Seven consumer units had takehome income less than zero, and 50% had annual spending greater than takehome income.

A measure of liquid assets was constructed using the following variables on the BLS expenditure tape:
CKBKACTX: Amount in checking accounts, brokerage accounts, etc.
SAVACCTX: Amount in savings account of banks, savings & loans, credit unions, etc.
SECESTX Amount in stocks, bonds, mutual funds etc.
USBNDX Amount in US savings bonds

Table 1 shows the distribution of income, spending and liquid assets. The mean level of liquid assets for all households was $12,893, and the median level was $1,000. Seventy five percent of the households had less than $9,056 in liquid assets. The percent meeting the six months criterion was approximately the same for pretax income, takehome income and spending. The percent of complete income reporters having sufficient liquid assets to cover six months of pretax income was 19%, the same result reported by Johnson and Widdows (1985) using a similar measure.

A dummy variable, MON6, was created for adequate liquid savings, equal to 1 if the household had liquid assets to cover six months spending, and equal to 0 otherwise. Spearman correlations between MON6 and selected demographic variables are shown in Table 2. There was a positive relationship between MON6 and age, income and education, and a negative relationship between MON6 and household size.

Only 6% of consumer units under age 25 had at least six months worth of liquid assets, while 39% of those age 65 and older did. The proportion meeting the recommended level increased with education, from 14% for those with less than a ninth grade education, to 41% for those with post-BS education. The proportion meeting the recommended level increased with pretax income, although not monotonically. Three percent of those with incomes under $5,000 met the level and 30% of those with incomes over $50,000 met the level.

There was a significant relationship between having at least six months worth of liquid assets and tenure status. Only 9% of renters and 20% of homeowners with mortgages had the recommended levels, compared to 38% of homeowners without mortgages. Consumer units with a white reference person had 23% meeting the six month standard compared to 1% for Blacks.

Table 1.
Distribution of Income, Spending, and Liquid Assets, and Percent Meeting Guidelines, for All Households and Complete Income Reporters, 1990 BLS Interview Survey, Households with 4 Quarters of Interviews.

	All Households	Complete Income Reporters
n	872	774
Takehome Income		
Mean	$26,925	$29,849
90th %tile	$56,185	$59,476
75th %tile	$37,898	$40,943
median	$21,938	$24,653
25th %tile	$10,742	$13,760
10th %tile	$2,496	$6,824
% <=0	6%	1%
Spending		
Mean	$29,005	$28,863
90th %tile	$55,712	$55,816
75th %tile	$38,650	$38,243
median	$24,468	$24,192
25th %tile	$14,818	$14,686
10th %tile	$9,061	$9,154
Liquid Assets		
Mean	$12,893	$13,938
90th %tile	$40,000	$42,450
75th %tile	$9,056	$11,050
median	$1,000	$1,500
25th %tile	$0	$20
10th %tile	$0	$0
% > 0	70%	76%
Liquid assets cover 3 months pretax income		
% meet	26%	28%
Liquid assets cover 3 months takehome income		
% meet	29%	31%
Liquid assets cover 3 months spending		
% meet	27%	29%
Liquid assets cover 6 months pretax income		
% meet	18%	19%
Liquid assets cover 6 months takehome income		
% meet	21%	22%
Liquid assets cover 6 months spending		
% meet	19%	21%

Table 2
Spearman Correlations between Dummy Variables for Adequate Liquid Savings and Age, Family Size and Income Category. Income and education are in categories.(n=872, except for income, n=774.) All correlations significant at the 0.01 level or better.

	Age	Size	Pretax Income	Education
MON6 (=1 if liquid savings >= 6 months spending)	0.26	-.12	0.13	0.18

Among occupational groups, the retired had the highest proportion meeting the six month standard, with 40%. Self-employed households had 37% meeting the standard, managers/professionals had 25%, and operatives/laborers had 10%. Those in the category "precision production, craft, repair" had only 8% meeting the standard. Amount household types, married couples with no children had the highest proportion meeting the standard, with 33%, one person households had 24% meeting the standard, and single mothers with children under 18 at home had only 2% meeting the standard.

The empirical patterns seem related mostly to the availability of resources and the accumulation of resources over the life cycle. There definitely does not seem to be a relationship between popular notions of the "need" for liquid savings and the likelihood of holding adequate levels of liquid savings.

Conclusions

The implicit assumption of previous empirical research on emergency fund holdings of households was that the typical prescription of having liquid assets equal to three to six months worth of spending was valid for most households. One might then conclude that most U.S. households were mistakenly not holding adequate levels of liquid assets. The empirical analysis presented in this paper shows that 81% of U.S. households did not have enough liquid assets to cover six months of spending. However, the original theoretical analysis presented in this paper suggests that only those who are certain that household income will drop by at least 50% should hold that level of liquid assets. The empirical patterns of households meeting the six month standard suggest that holding liquid assets is related to household resources rather than need. This paper ignores other motives for holding liquid assets, so the results should be interpreted cautiously. A multivariate analysis would provide more insight into the patterns.

Consumer education related to holding emergency funds should focus on specific motivations for holding liquid savings. Garman & Forgue (1991) provide a good approach to this issue, but the analysis should be taken further. The fact that 80% of households do not follow a common prescription might suggest vigorous efforts at education, but further research to refine that prescription and tailor it to the situation of a specific household would be useful. In the future, perhaps computer expert systems could help individual consumers decide on optimal levels of emergency funds.

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