CONSUMER CREDIT DELINQUENCY AND BANKRUPTCY FORECASTING USING ADVANCED ECONOMETRC MODELING

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By

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ABSTRACT

This research paper empirically shows that unemployment is significant in determining both consumer bankruptcy filings and delinquency even after controlling for household demographics. Furthermore, I show that unemployment and the debt/wealth ratio also affect the choice of whether to file for bankruptcy under chapter 7 or chapter 13, after controlling for demographics. The paper then points out some of the implications the empirical results have for policy-makers and banking regulators.

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Introduction

During the most recent economic downturn, the consumer credit market has experienced the highest default/bankruptcy rate in history. Gross and Souleles (2001) documented that personal bankruptcy filings in the United Stated rose by 75% in the late 1990s, occurring in more than 1% of U.S households. The delinquency and charge–off rates on credit cards rose almost as sharply (Federal Reserve Board of Cleveland (1998)). There have been some leading academic explanations for these trends. One strand argues that excessive credit has been extended to sub-prime borrowers and that they have accounted for most of the rise in credit defaults. The other strand focuses on the decreasing cost of defaulting, including the social, informational and legal costs. Zywicki (2002) shows that the operations of the credit card market and consumer choices are consistent with rational decision-making subject to real world constraints. Bangia, Diebold and Schuermann (2000) look at the default issue from a different perspective and propose that macroeconomic activity should be a central determinant of credit portfolio quality. Carey (2002) shows that average credit portfolio losses during the early 1990s recession is only equal to the 0.5% tail during the expansion. However, these researchers were not able to empirically test their propositions.

The paper extends the current literature in the following ways: First, it tests the theoretical model by Wang and White (2000) where a risk-averse, utility-maximizing consumer will have maximum probability of filing for bankruptcy when labor income drops to zero due to unfavorable macroeconomic conditions. This paper suggests that

macroeconomic and employment conditions could significantly affect consumer bankruptcy filings even after controlling for household demographics. The bivariate probit model shows that if the state unemployment rate increases by 1%, the probability of a household filing for bankruptcy will increase by 46%, holding other things constant. This is opposed to the literature, which argues that job market conditions driven by macroeconomic conditions will diminish after controlling for demographics using consumer data. The economic theory also predicts that consumers will default on loans when there are unexpected idiosyncratic income shocks, in order to smooth consumption. The paper also tests the effect of unemployment on consumer default, which is consistent with the consumer life cycle theory. If the state-level unemployment rate increases by 1%, the probability of losing a job will increase by 54%, thus increasing the probability of consumer default by almost 34%.

In addition, the paper uses a Heckit-type sample selection model to show that unemployment could also affect consumer's choice of whether to file for bankruptcy under Chapter 7 or Chapter 13, after controlling for the debt/wealth ratio and demographics. This shows that consumers could make a rational, informed choice between Chapter 7 and Chapter 13 filing, once they have decided to file for bankruptcy. This is consistent with the theoretical set up by Wang and White (2000), but opposed to Whitford (1989), who argues that debtors are unable to make an informed choice between the two chapters.

Last, the paper points out that the results will be useful for both policy-makers and banking regulators. Previous empirical tests have concentrated on Chapter 7 filings.

There have been debates in the literature on reform of the bankruptcy codes, especially on whether the current codes should be tightened to reduce bankruptcy and whether Chapter 13 should be made as favorable as Chapter 7. Moreover, the incidence of bankruptcy/defaults could change the general riskiness of consumer loans and consequently could change the risk premium and capital allocation as required by the banking regulators. The results have shown that consumer risk profiles are sensitive to macroeconomics variables such as the aggregate unemployment rate, but consumer credit risk modeling has assumed a constant macro economic environment. This time-homogeneity assumption could be damaging to the efficient operation of financial institutions. Gross and Souleles (2001) use panel data on credit card accounts to show that credit risk models miss some systematic and time-varying factors. More sophisticated measures of credit risk will create a competitive advantage through better risk pricing and capital allocation.

This paper is organized as follows: The first section presents the theoretical model of Wang and White (2000) on consumer bankruptcy and the life cycle model by Lawrance (1995), which explains consumer default behavior. The second section uses PSID data to show that employment conditions are one of the important determinants of consumer bankruptcy filings and delinquencies in paying bills, remaining significant even after controlling for demographics. A sample selection model is also applied in this section to examine the choice between Chapter 7 and Chapter 13 once the consumer has already decided to file for bankruptcy. Previous empirical studies have concentrated on either combined filings or Chapter 7 filings only. This study shows that households filing

for Chapter 7 have a significantly higher debt/wealth ratio and a higher chance of being unemployed, which makes the debt consolidation plan as required by Chapter 13 unfavorable. The third section concludes, pointing out that the empirical results have implications for policymakers in reforming bankruptcy law. The previous discussion attributes the increase in bankruptcy in part to the passage of the current bankruptcy code in 1978, and especially the debt exemptions that it provided in Chapter 7.

I also point out that consumer risk profiles will shift after loan origination if aggregate employment conditions deteriorate. Ignoring this time-varying factor when credit risk is modeled could distort proper decision-making and introduce unexpected credit loss. This will also affect compliance with Basel II capital regulations, as banks will experience abrupt and unexpected loan losses if unfavorable aggregate conditions increase consumer defaults or bankruptcy.

Theoretical Models

The Model on Consumer Bankruptcy Filings

Skyrocketing consumer bankruptcy filings and commercial bank loan defaults have been observed in recent years, and a large academic literature has attempted to explain the phenomenon. Most of the papers have concentrated on explaining the nature of the credit market or the rational usage of credit by consumers. Zywicki (2002) demonstrated that both the operations of the credit card market and consumer choices are consistent with rational decision-making subject to real-world constraints. In this paper, I use a bivariate probit regression model and PSID household survey data to show that

being employed could significantly decrease consumer bankruptcy filings and default behavior, even after controlling for household demographic variables. This is an empirical test of the model presented by White and Wang (2000). In this paper, I present a theoretical model following Wang and White (2000), where the likelihood of consumer filing for bankruptcy increases with decreasing labor income and is maximized when the labor income drops to zero.

This is a two-period model where a risk-averse representative consumer maximizes utility. In the first period, the consumer works for N_1 hours with hourly rate w, her total earnings are $Y_1=w*N_1$, and her wealth is W_1. W_1, Y_1, N_1 and w are known for certain. In this period, the consumer also borrows amount B, with an interest rate r. She does not know her wealth W_2 in the second period at this time; it is uncertain with a distribution function $f(w_2)$. At the beginning of the second period, W_2 is realized; N_2 is determined endogenously. The loan is also due in the second period, and the consumer needs to make a debt repayment decision. If she files for bankruptcy, there is a fixed cost of cW_2, where c is a constant with $0<c<1$. According to bankruptcy law, there is also a wealth exemption of E, which is a fixed dollar amount defined by the state where the consumer files for bankruptcy. The consumer must give up all non-exempt wealth above this threshold. The representive consumer could keep her wealth if $W_2<= E$. This implies that if the consumer files for bankruptcy, her total wealth in the second period will be $W_2(1-c)-\max[W_2-E, 0]$. If she chooses not to file for bankruptcy, her total wealth will be $W_2 – B(1+r)$. Her lifetime expected utility could be represented as:

$$EU = U(W_1 + wN_1 + B, N_1)$$
$$+ \int_0^E U(W_2(1-c) + ewN_2, N_2) f(w_2) dw_2$$
$$+ \int_E^{\tilde{W}_2} U(E - cW_2 + ewN_2, N_2) f(w_2) dW_2$$
$$+ \int_{\tilde{W}_2}^{\infty} U(W_2 - B(1+r) + wN_2, N_2) f(w_2) dw_2$$

In this function, e is the post-bankruptcy earnings exemption, which is a proportion of period 2 earnings Y_2. Under Chapter 7 bankruptcy procedures, all post-bankruptcy earnings can be exempted from debt paying, so we have e=1. Under Chapter 13 procedures, debtors are obligated to repay their debt using a portion of their earnings, so e<1. The borrowers second period earnings will be eY_2 if she chooses to file for bankruptcy, while e<=1. Her earnings will be Y_2 if she chooses not to file for bankruptcy.

The first term is the utility in the first period. The second term is her expected utility if filing for bankruptcy in the second period, and her wealth is fully exempted from repaying. The third term is the expected utility if the consumer's wealth is greater than the exemption and is used for repaying part of the debt after filing for bankruptcy. The last term is the expected utility if the consumer chooses not to file for bankruptcy.

In the utility maximization context, the consumer will choose to file for bankruptcy in the second period if:

$$W_2 <= \tilde{W}_2$$

where $\tilde{W}_2$ is a threshold that depends on the level of income.

$$\tilde{W}_2 = (E + B(1+r) - (1-e)Y_2)/(1+c)$$

There are important implications of this solution function. First, the threshold is decreasing when earnings in the second period increase. The probability of filing for bankruptcy is the highest if $Y_2=0$. In this theoretical setup, having zero income will maximize the probability of filing for bankruptcy. However, due to the limitations of the data in the empirical tests, we will be unable to rank order the probability of filings, given different levels of income, as we could do in a simulation. A practical solution is to test whether unemployment significantly increases bankruptcy filings given a certain set of household characteristics.

The Theory on Which Chapter to File for Bankruptcy

The model in Wang and White (2000) as above does not discuss directly the choice between Chapter 13 and Chapter 7 filings once the consumer has already decided to file for bankruptcy. However, this issue has been a critical question given the totally different nature of the choices under the current bankruptcy codes. According to the current bankruptcy law, Chapter 7 filing can eliminate all or most unsecured debt, which includes debts on credit cards, medical bills and most personal loans. The debtor cannot keep any significant equity in property, however; she must turn over all of her assets above a fixed exemption level to the Bankruptcy Court in return for the discharged debts. In this sense, the debtor gets a "fresh start" by filing for Chapter 7 bankruptcy. A bankruptcy trustee then sells all the debtor's non-exempt assets and uses the proceeds to repay her debts on a pro rata basis. Under Chapter 13 procedures, the consumer consolidates all debts through an interest-free debt repayment plan over the next 3-5

years. Under Chapter 13 filings, borrowers must repay unsecured debts at least in an amount at least equal to that the creditors would have received under a Chapter 7 filing. To file under Chapter 13, the debtor must be working or have a consistent income source in order for the court to approve the repayment plan, but she does not have to give up her current assets. This suggests that the consumer is much more likely to file for Chapter 7 bankruptcy if she is unemployed and has relatively low wealth.

There has been some academic discussion of this issue in the economic literature. Domowitz and Sartain (1999) show that higher levels of equity relative to debt push borrowers into Chapter 13 filing with a probability double that estimated for low-equity households. They also show that other household demographics like higher income and a higher employment rate could encourage Chapter 13 filing over the discharge under Chapter 7. This is because under Chapter 7 filing, the borrower must give up all nonexempt assets in return for being able to keep future income and must maintain minimum consumption level; homeownership is not protected.

Li and Sarte (2004) show that for utility-maximizing consumers, the value function of a Chapter 7 bankruptcy filer is invariant to the level of wealth above the exemption level E, as all assets above this level are surrendered. However, when household wealth is high, Chapter 13 filing could dominate Chapter 7 filing. They also show that the value function of households filing under Chapter 13 decreases as debt holdings increase, as higher debts imply a higher debt burden and reduce the available resources for consumption.

Evaluating consumers' choices between Chapter 13 and Chapter 7 filings have important implications for policy-makers. Many proposals for reform focus on bankruptcy choices, in particular asking whether Chapter 13 filings should be encouraged. The Gekas Bill has proposed forcing all bankrupt consumers with income above the median level to repay debt using their post-bankruptcy earnings above a predetermined threshold. This potential change in bankruptcy code would affect the likelihood that consumers will file for bankruptcy, which in turn could affect credit demand and supply and the overall economy.

The Model and Theories of Consumer Defaults

Over the past twenty-five years, the U.S economy experienced a historical increase in personal bankruptcy and a rise in rate of consumer defaults over the past 25 years. In 1996, bank credit card delinquencies exceeded 3.5 percent – the highest delinquency rate since 1973, when statistics were first collected. By 2001, the default rate on credit card loans was about 5 percent.

The academic literature has attributed the record high in consumer defaults to the cyclical state of the economy and unexpected job loss. Lawrence (1997) shows that credit card defaults and personal bankruptcy filings have exhibited strong countercyclical components, moving upward in recessions and downward in economic booms. Hayashi (1987) observes that defaultable debt provides a mechanism for insuring future income. The borrower will choose to default in the low-income state in return for an actuarially higher payment in the high-income state.

Lawrence (1995) use a life cycle model to explain why a consumer chooses to default in the presence of unexpected income loss. In her model, consumers maximize expected life-time utility, and the momentary utility function is of the constant relative risk aversion (CRRA) form with the properties that U' >0 and U'' <0. To simplify the analysis, assume the consumer lives for two periods. Income in the second period is uncertain with an exogenous probability q that income will be zero. The borrower could increase her first period consumption by x_1 through taking a loan, which is due in the second period for x_2, where $X_2 = X_1(1+R)$, R being the interest rate.

In this model, the no-default restriction in the usual life cycle model must be relaxed, the reason is that if banks could legally and easily have claims to all the resources held by the borrower. In this case no consumers would borrow, as there is always a positive probability of earning zero income in the second period, leading to zero consumption.

Within this setup, the consumer maximizes expected lifetime utility, and a zero saving – zero borrowing solution is never optimal. Instead, the risk-averse borrower chooses to borrow a positive amount in the first period. In the second period, if the consumer experiences an unexpected loss of income, he will choose to default on the loan in order to sustain a higher consumption level. The intuition is that consumers with high a idiosyncratic income have lower marginal utility on additional consumption, so they choose to pay back the loan, while consumers with a low idiosyncratic income have to default in order to maintain their minimum consumption level.

The model's result is consistent with some previous observations in the U.S. consumer loan markets. Borrowers with low income do have a higher rate of delinquencies (U.S. National Commission on Consumer Finance (1972)). Sexton (1977) used a segmentation approach to show that low-income families with similar social and demographic characteristics have significantly higher credit card default rates. Rampini (2004) use a one-period model to show that default could allow consumers with unexpected idiosyncratic income shocks to repay less, and thus default acts like insurance. Default penalties thereafter insure that only those consumers will default. He also shows that default rates vary counter-cyclically with macroeconomic aggregations.

It is important to examine consumer defaults from an empirical perspective for two reasons: First, changes in the number of personal bankruptcy filings in the United States follow exceedingly closely with changes in the rate of credit card delinquencies. Lawrence (1997) pointed out that a change in the rate of delinquency leads a similar change in the rate of bankruptcy by about three months. He used aggregate data to show that the 1990s have seen an astonishingly tight relationship between credit card delinquencies and bankruptcy filings. Second, in the face of the current record levels of consumer defaults and bankruptcy, representatives of the retail credit industry have called for changes in the bankruptcy law to limit the dischargeability of credit card debts in bankruptcy filings. Studying the reasons for consumer defaults could help policymakers to evaluate the potential effects of such proposals.

Empirical Tests

The Panel Study of Income Dynamics (PSID), conducted by Michigan University since 1968, is a longitudinal survey of randomly sampled American individuals and the households in which they reside. The survey concentrates on dynamic aspects of household economic and demographic behavior. The 1996 wave of PSID family study has questions on household bankruptcy filing, including “Have you ever filed for bankruptcy?” and “What was the reason for filing bankruptcy?” By looking at the bankruptcy data together with household demographics and state-level unemployment rate, we can use bivariate probit regression to see how job market conditions affect bankruptcy filing while holding demographics constant. The same wave of the PSID core family survey also includes questions on credit delinquency. I use a similar bivariate probit model to estimate how unemployment affects consumer default while holding household demographics constant. Examining consumer default has further empirical implications. First, personal bankruptcy is always preceded by delinquency, so looking at the trend of bill payment delinquency should help us to understand bankruptcy better. In addition, both bankruptcy and delinquency have been of interest to academics, policymakers and banking regulators.

In this section, I use PSID data to empirically test the propositions in the previous section, and I show that unemployment conditions can significantly increase both the probability that a consumer will file for bankruptcy and the probability of bill delinquency. There have been some disputes in the literature about macroeconomic effects on consumer delinquency and bankruptcy filing. Gross and Souleles (2002) argue

that the state unemployment rate should be insignificant after controlling for household demographics. To investigate these issues, I estimate a bivariate probit model using PSID bankruptcy data. In the first equation, both household demographics and state-level unemployment rate affect the probability of the household head being unemployed. In the second equation, household demographics, together with the binary variable of whether the head is unemployed, jointly determine the probability of the household filing for bankruptcy (or becoming delinquent). Instead of using state-level unemployment rate in the second equation directly, this variable serves as an instrumental. The model is as follows:

$$Y_{1i} = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \varepsilon_I$$

$$Y_{2i} = \alpha + \beta_1 X_{1i} + \beta_2 Y_{1i} + \varepsilon_I$$

Where Y_{1i} is the (0, 1) binary variable of whether the i-th consumer was unemployed, X_{1i} is a vector of household demographics, X_{2i} is the state-level unemployment rate in 1996, and Y_{2i} is a binary variable that indicates whether the household head filed for bankruptcy (or whether the household was delinquent in paying bills).

In the 1996 PSID core family survey, a total of 8327 households were interviewed. Eliminating the 20 households who did not respond to the bankruptcy/delinquency questions, we have 8307 households left in the sample. Of these, 526 households (6.33% of the sample) filed for personal bankruptcy. Of the ever-bankrupt household heads, 32% state that job loss was the most important reason they filed for bankruptcy.

Using Full Information Maximum Likelihood (FIML) estimation of the bivariate probit model, we examine how the employment conditions have affected household bankruptcy filings; results are shown in table 32. As family income and state bankruptcy wealth exemptions could also significantly affect consumer bankruptcy filings per previous discussion in the economic literature, the bankruptcy function controls for total family income, state exemption level and demographics. As expected, higher family income could discourage bankruptcy filing, while higher exemption levels can encourage bankruptcy as the households can have more post-bankruptcy wealth. In this table, we also see that the age, sex, marital status, number of children and being Caucasian are the most important demographic variables in determining the probability of being unemployed. I find that the age of the household head is negatively correlated with probability of bankruptcy filings. This is consistent with the results of Fay, Hurst and White (1998). This is because older household heads have accumulated more wealth relative to their debt level and demand less credit. The race variable is also included, as previous studies have found that African-American households are more likely to be turned down for a loan and have less access to credit. There are also unobservable effects, especially those coming from macroeconomic conditions. Using the state-level unemployment rate as the instrumental variable can capture this. In the second equation, we see that only the age of the household head and his/her employment situation significantly affect bankruptcy filing. For the purpose of identification, the state-level unemployment rate only enters the first equation, but not the second. The correlation coefficient of the disturbance terms is about 78%.

We also estimated consumer default using the same PSID sample. Of the 8,307 households from 1996 core family survey, 2,086 have been delinquent on bills. A similar bivariate probit model shows that unemployment is an important determinant of delinquency.

Given the heated discussion on the financial benefits of Chapter 7 filing vs. Chapter 13 filing, we are interested in testing what motivates consumers to file for Chapter 13 bankruptcy instead of Chapter 7, which could eliminate all unsecured debts. The model is based on Heckit-type sample selection. The first step is the bivariate probit model described above, which gives an estimated probability of filing for bankruptcy for each of the households in the sample. The inverse mills ratio is calculated as one over the probability of filing for bankruptcy. The second step is a probit analysis of those households who actually filed for bankruptcy. The inverse mills ratio is added in the second step as an additional regressor to eliminate sample selection bias.

Shown in table 37, the results indicates that the only significant household demographic variable is the age of the household head. The other determinants that could drive Chapter 13 filing are the debt/wealth ratio and employment status. In this paper, as data on household total equities in year 1996 are not available, I use the value of the house plus total family income as a proxy for wealth. Having a lower debt relative to wealth could significantly increase the probability of Chapter 13 filings. This is because Chapter 13 requires the debtor to consolidate all debts, which would not be financially beneficial if the debt level is very high and the household does not have much equity. The household would be better off eliminating all unsecured debt through Chapter 7 filing.

However, if the household has relatively low debt and substantial wealth (a valuable house), it is better to keep the house by filing for Chapter 13 bankruptcy and to repay the low unsecured debts through the interest-free repayment plan. Further, Chapter 13 also requires the household to have consistent income for the next 3-5 years, in order to pay back the consolidated debts. This will pose a problem for consumers whose income is low and volatile. This type of household would be much better off giving up all assets at the time of filing for Chapter 7 bankruptcy, especially if household wealth is at or below the wealth exemption level E.

Conclusion

This paper examines a theoretical bankruptcy model by Wang and White (2000), in which the probability of filing for personal bankruptcy is a decreasing function of income, and this probability is maximized when the income level drops to zero due to unemployment or any other unexpected job loss. The solution to the model also implies that a risk-averse consumers with high unsecured debts, low property and low expected income will prefer filing for Chapter 7 bankruptcy over Chapter 13 bankruptcy. The assumption is that Chapter 7 filing will eliminate most of the unsecured debts, given that the consumer relinquishes all her wealth above a certain exemption level. This is to give a "fresh start" to the debtor. Under Chapter 13 filing, the consumer can keep his/her properties, but s/he must consolidate all debts in an interest-free debt repayment plan, to be paid off out of earnings over the next 3-5 years. The model shows that this will decrease the marginal utility of purchasing power in the future periods. Given that the

consumer can always choose between Chapter 7 and Chapter 13, the model implies that the consumer will prefer filing for Chapter 7 bankruptcy when her debt is much higher relative to the wealth level, or when she is facing a possible post-bankruptcy unemployment situation.

The paper uses bankruptcy and delinquency data from Panel Study of Income Dynamics to empirically test these propositions. Using a bivariate probit model, I show that unemployment could significantly affect the probability of bankruptcy filing, even after controlling for demographics. Using a Heckit-type sample selection model, I also focus the analysis on households who have already filed for bankruptcy. For the choice between Chapter 7 and Chapter 13 filing, the debt/wealth ratio and unemployment dummy variables are the most important determinants of filing for Chapter 7, as predicted by the theory. Household demographics do not significantly affect this choice.

As consumer bankruptcy is usually preceded by delinquency in paying bills, the paper also empirically tests the effect of unemployment on delinquency using PSID data and the bivariate probit model. The consumer life cycle theory (Lawrance (1995)) predicts that consumers choose to default when there is unexpected income shock, in order to smooth consumption. The unemployment rate enters the equation significantly with a positive sign, showing that probability of default is reduced by about 30% if the head of the household has consistent earnings.

The results have important implications for policy-makers. There has been long discussion on bankruptcy code reform. Part of the discussion has centered on whether the 1978 Bankruptcy Code caused the increase in the number of filings observed in recent

years. Previous studies have concentrated on Chapter 7 filings, due to the financial benefit of this part of the code. This paper has been able to study both the bankruptcy decision and the decision on which chapter to file once the household has decided to declare bankruptcy. Controlling for household demographics and assuming consumers are rational decision makers, the results show that the number of filings will increase significantly if the unemployment rate is higher than usual, as was the case during the most recent economic downturn.

There have also been debates on whether to change Chapter 13 codes, as Whitford (1989) argues that debtors are unable to make an informed, self-interested choice between Chapter 7 and Chapter 13. However, the empirical tests in this study show consumers do choose in which chapter to file according to their debt/wealth ratio and employment conditions. Even though Chapter 13 does not give a "fresh start" as Chapter 7 does, it does indeed help debtors to retain assets, which is more favorable if the consumer has relatively less debt in his/her portfolio and also has a consistent income source to accommodate the interest-free debt repayment plan.

The results may also be useful to banking regulators. Currently, most consumer credit risk policies have assumed time-homogeneity and work very well under benign economic conditions. As I have shown in the previous section, consumer risk profiles and default behavior are significantly impacted by macroeconomic conditions. This personal default and bankruptcy issue affects credit markets and becomes more important given that current credit risk methodologies are not sensitive enough to provide a cushion to

unexpected credit loss during an economic downturn. This is mainly reflected in the risk based pricing and credit capital allocation area.

Currently, credit-scoring techniques based on logistic regressions have been widely adopted in credit origination and risk based pricing, but decision-making is dependent only on borrower risk profiles at the time of origination. However, the actual propensity to become delinquent or bankrupt after origination is affected by changes in social and economic factors. Unexpected job loss, a change in interest rate and a change in house price can all make default and delinquencies more or less likely. Even though these factors affect default probabilities through different channels, they are similar in how they are all correlated with business cycles. This challenges the traditional logit model, in which the default probabilities are modeled as a function of risk profiles at the point of origination. The model is thus static and does not reflect how changing macro economic conditions affect risk profiles and default probabilities.

The empirical results in this paper also have implications for bank regulators as they are trying to prepare their standards for new Basel II regulations of capital. In the proposed capital accord, lower-rated assets will require more capital in both the standardized and, especially, the internal-rating-based (IRB) approach as they have higher probability of default. Given the nature of credit scoring models, the assumption seems to be that the proportion of lower-rated assets is a direct estimate of the probability of default. However, the key challenge is a mechanism to align estimated, rank-ordered probabilities from the logistic regression output to the actual probability of default. This challenge still comes from the underlying assumption behind the logistic regression

approach: the scoring model is not truly “forecasting” in nature as the model usually cannot incorporate the changing economic environment over the forecast period, nor can it reflect the changing risk profiles of customers.

Second, even though the increased risk sensitivity brought in by the Basel II model has important benefits for capital allocation within and across banks, it also raises significant problems when considered across different economic regimes. Capital volatility over time is increased materially under the new accord. Ervin and Wilde (2004) noted that the impact of the capital ratio under the new regulation is approximately six times the impact under the previous guidelines, a major increase in capital volatility. They also observed that similar effects occurred in all rating grades and different years where adverse credit conditions were present. This could have important effects on the overall economy if banks in aggregate are forced to change their lending behavior to maintain their capital ratios at times of economic stress. If banks respond by restricting new lending, the supply of available credit will be reduced during the adverse part of the credit cycle. This could amplify, not reduce, credit cycles and potentially exacerbate economic swings. Ervin and Wilde (2004) proposed to flatten the IRB curve, which essentially reduces risk sensitivity, the guiding philosophy of the new accord. The choice of how to address the volatility of capital in response to credit risk is ultimately is a question of how to achieve a balance between these issues and is an important topic for further research.

In summary, developments in consumer credit are influencing, and are being influenced by, the efforts to comply with the New Capital Accord. This paper uses

household survey data to show that consumer delinquency and bankruptcy filings are significantly affected by employment conditions, and the results remain significant even after controlling for household demographics. The results are useful to both policymakers and credit risk regulators. The results demonstrate that ignoring changing macroeconomic factors and the related changes in consumer risk profiles in credit risk modeling can affect proper risk pricing of consumer loans and mis-specify the capital allocations required by Basel II regulations.

APPENDIX A

	Count	Percentage
Ever BK	526	6.33%
Never BK	7781	93.67%
Total	8307	100%

Table 0. Ever Bankruptcy Distribution in 1996 PSID Core Family Survey

	Count	Percentage
Ever delinquent	2086	25.11%
Never delinquent	6221	74.89%
Total	8307	100%

Table 1. Ever Default Distribution in 1996 PSID Core Family Survey

	Mean
Age of household head	44
If household head is male	0.69
If household head is married	0.52
If household head is college-educated	0.21
If household head is Caucasian	0.56
Number of kids	0.91
If household head is unemployed	0.33

Table 2. Mean Values of Independent Variables in the Regression

	Estimate	Standard Error
State unemployment rate	0.1260	0.0086
If head is college-educated	-0.3909	0.0403
Age of head	0.0221	0.0009
If head is male	-0.3245	0.0407
If head is married	-0.4526	0.0417
If head is white	-0.2893	0.0318
Number of kids	-0.0610	0.0131

Table 3. Bivariate Probit Regression: Unemployment Equation

	Estimate	Standard Error
If head was unemployed	1.4207	0.1156
Family income ($00,000)	-0.1550	0.0467
State property exemption ($0,000)	0.1802	0.0284
If head is college-educated	-0.4677	0.0532
Age of head	-0.1541	0.0023
If head is male	-0.3354	0.0537
If head is married	-0.0693	0.0606
If head is white	-0.1838	0.0389
Number of kids	0.0401	0.0152

Disturbance Correlation: Rho(1, 2)=0.7238

Table 4. Bivariate Probit Model: Bankruptcy Filing Equation

	Estimate	Standard Error
If head was unemployed	0.7127	0.1151
Family income ($0,000)	-0.1928	0.0031
If head is college-educated	-0.0046	0.0411
Age of head	-0.2595	0.0014
If head is male	-0.1373	0.0403
If head is married	-0.1616	0.0434
If head is white	-0.1021	0.0309
Number of kids	0.0986	0.0136

Disturbance Correlation: Rho(1, 2)=0.1683

Table 5. Bivariate Probit Model: Bill Delinquency Equation

	Count	Percentage
Chapter 7	264	50.29%
Chapter 13	261	49.71%
Total	525	100%

Table 6. Chapter of Bankruptcy Filing

	Estimate	Standard Error
Age of household head	0.0088	0.0050
Debt/wealth ratio	-0.0010	0.0003
If head was unemployed	-0.4204	0.1721
Inverse Mills ratio	-0.6802	0.3097

* wealth is approximated by house value plus family income.

Table 7. Probit Analysis of Filing for Chapter 13 Bankruptcy

APPENDIX B

The Panel Study of Income Dynamics (PSID) is a longitudinal survey data conducted by the University of Michigan since 1968. Over its life, it has been funded by several government agencies, foundations and organizations. Their current major funding sources are the National Science Foundation and the National Institute on Aging.

The PSID data is a panel study of representative U.S. individuals (men, women and children) and the household they reside in. Its emphasis is the dynamic aspects of economic and demographic behavior. But the actual coverage is much broader than these. In the recent years, special topics include extensive questionnaire on wealth and credit background, which has been very useful for the purpose of this dissertation.

The survey project has been very successful in re-interviewing families previously in the study and following new families as young adults "split off" from their parents. The sample households included in the study is about 7000 now. Previous research has shown that PSID is a good source of information on the distribution of basic economic variables such as income, wealth, homeownership and employment in the larger population. One of the important features of PSID data is its comparability of data quality and structure over time. The general design and content of certain important income and demographic variables have remained unchanged, which makes it easy to construct a clean and consistent time series of income dynamics for each individual or household.

This paper is a study on the preference of general household investment, it is important to have a data set representative of American households. PSID is the only longitudinal representation of families and individuals of all ages. National Longitudinal Survey (NLS) and Health and Retirement Study (HRS) also provide data of panel features. However, the samples are tilted toward either young cohort or older cohort, who have represented different investment behavior as pointed out in the literature.

As one of the most important measures in this paper is labor income risk over the 15 year period, PSID provides the best estimation. Income measures in PSID include taxable income, transfer income, social security, asset income, and business income. And the measures are mostly available for head, "wife" and other family members. Each wave's report also has the 3-digit Census code on the head's and wife's occupation and industry.

Gouskova and Schoeni (2002) compared the annual income observations from PSID with March Current Population Survey, which is a cross-sectional national survey, and is the basis for the government's official estimates of income and poverty. They compared income estimates for the PSID history 1968-1999. The results show that the distributions match closely in the range between the 5^{th} and 95^{th} percentile through the entire 30-year history of PSID. And the differences slowly disappeared during the 1980s and early 1990s. As this dissertation uses data PSID data from 1980s to early 1990s, we should thus be able to infer that the income risk measures in this paper are representative of U.S. household.

The active savings file and the wealth supplements provide rich sources on flow of money in and out of different assets. Curtin, Juster and Morgan (1988) examined the quality of PSID wealth data and found it representative of total wealth and the distribution of wealth in the great bulk of the U.S. population. They also found the overall potential of examining wealth using PSID data is comparable to using Survey of Consumer Finance data on a cross-sectional basis. However, we did not use SCF data due to the fact that it does not provide the unique panel feature essential for measuring income risk. The general descriptive statistics from PSID are also closer to the actual population than that provided by SIPP. The PSID data also has a much lower non-response rate than SIPP, and is much less necessary to impute certain values, which reduces potential estimation error.

The 1996 wave of core family data in PSID also provides questions on bill payment delinquency and bankruptcy filings, which enabled the study of the third essay in this dissertation. This feature will be otherwise unavailable in the other panel data sets.

For the sample used in the first and second essays in this dissertation, I use data from 1979-1996. I drop the Latino over-sample in 1990-1992. I then use 1979 as my base year, treating all families in this year as main families, and subsequent split off families are dropped from the sample. A family is also dropped if it did not respond in any year. Finally, I drop the two cases in which total asset income of other family members is top-coded. This leaves a balanced panel of 4884 households.

Table 2 shows the sample selection criteria for the first two essays. Table 3 shows the variables used in the regressions and their mean values. The mean family labor

income in 1994 from my sample is about $42,000. And the mean family total income from PSID 1994 total sample is about $47,000. We can see that the level of labor income after my sample selection remains comparable and representative as in the original PSID sample.

Table 6 shows that the percentage of stock ownership ranges from 20% to 30% in the sample periods, which is also comparable to the literature during the same time span.

Overall, the important input variables for this dissertation include family demographics, labor income dynamics, the self-reported house value, the amount of stock ownership and the value of checking and savings account. Careful examination of each of the component shows that they are comparable to other major household survey data on a cross-sectional basis, representative of the general households and could provide panel features as well, which won't be available other wise. In no ways, this data set could be perfect. However, we are trying to use the best information possible and the available resources from PSID are rich enough for us to examine income risk profiles and household stock participation preferences on a panel basis.

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