Default and Aggregate Fluctuations in Growth Economies

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VERY OLD YET EXTREMELY PRELIMINARY

Introduction: The purpose

- We explore the role of consumer credit in shaping the properties of business cycles.

- In our environment consumers can and do file for consumer bankruptcy as they do in the U.S. (Chatterjee, Corbae, Nakajima, and Ríos-Rull (2004)). In recessions credit availability interacts with and difficults economic activity.

- We want to know whether by explicit exploring this channel we get different answers about business cycles than with standard models.

- We want to know what features of business cycles interact the most with credit frictions.

The side bonus: The great moderation and credit

- Since 1984 output volatility is lower (Kim and Nelson (1999), Kahn, McConnell, and Perez-Quiros (2002), Stock and Watson (2002))

- Some have argued that it is **luck** *i.e.,* smaller shocks (Stock and Watson (2002), Kim, Morley, and Piger (2004), Arias, Hansen, and Ohanian (2006) (for the most part)).

- Others Campbell and Hercowitz (2006), Leduc and Sill (2006) Dynan, Elmendorf, and Sichel (2006), propose in a variety of ways that it has to do with wider access to consumer credit. But their evidence is flimsy.

- Jermann and Quadrini (2007) have a model of financial innovation that results in lower real volatility and a more smooth Solow residual. Comin and Mulani (2006), Comin and Philippon (2005) also worry about changing volatility of firms and sectors.

- Storesletten, Telmer, and Yaron (2004) stresses changing cyclical patterns of volatility: **Risk is higher in recessions.** (As in Mankiw (1986)).

Our take on this

- We ask with a model whether enhanced borrowing possibilities have to do with the great moderation.

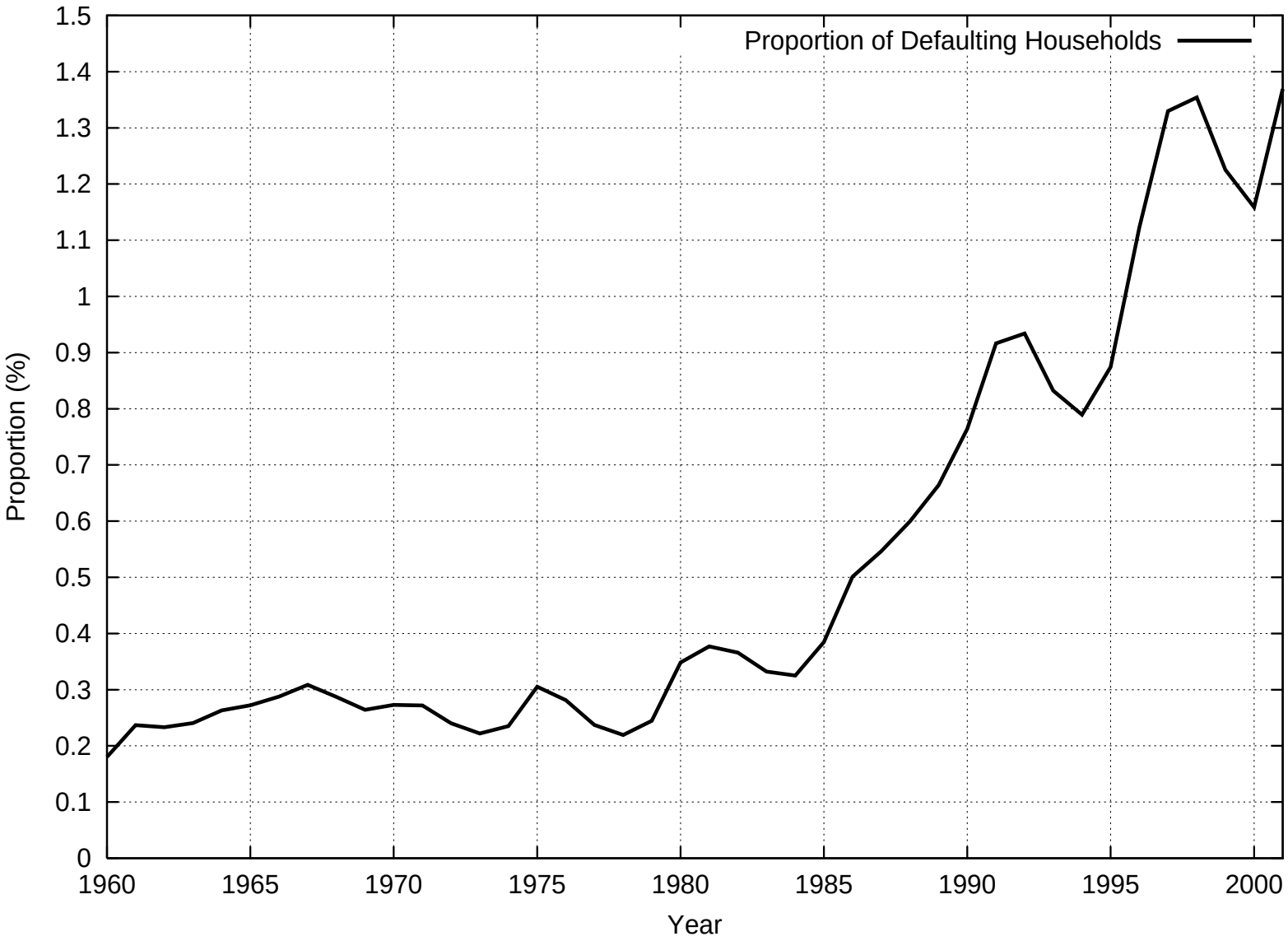
- There is more consumer borrowing in the latter part of the sample.

- Our exploration is limited to unsecure borrowing. But we want to explore notions of cycles that are beyond productivity shocks: *recessions are periods of asset destruction or higher variance*.

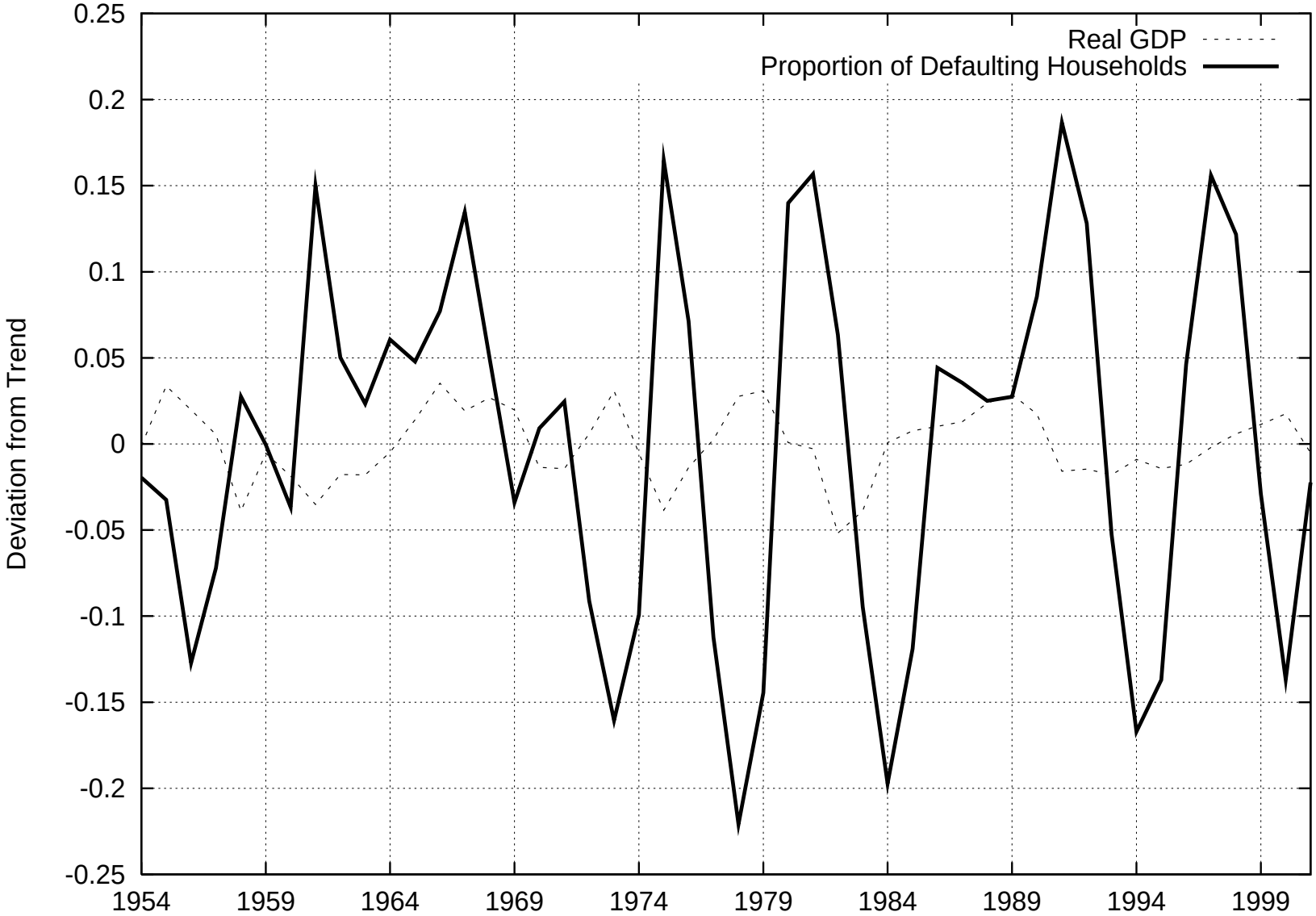
The How

- We build a heterogeneous agents model with
  - U.S. bankruptcy regulations.
  - A competitive loan industry with free entry (where lenders can offer any menu of loan sizes and borrowing rates, and expected profit of any lenders is zero in equilibrium).
  - The production structure of the growth model mapped into a modern economy.
  - A variety of aggregate and idiosyncratic shocks that trigger fluctuations.

Time Series of Number of Bankruptcies



HP-Residual of Number of Bankruptcies



U.S. Economy: Annual Cyclical Statistics (1953-2006), $\lambda = 100$

Variable	SD%	Relative SD%[2]	Auto-corr	Cross-Correlation of Output with				
				x_{t-2}	x_{t-1}	x_t	x_{t+1}	x_{t+2}
Output	1.97	1.00	.57	.05	.57	1.00	.57	.05
Consumption	1.70	0.86	.65	.06	.60	0.88	.48	.05
Durables	5.96	3.02	.65	.24	.69	0.80	.31	-.12
Nondurables	1.41	0.71	.56	-.10	.45	0.84	.52	.14
Services	1.00	0.51	.68	-.01	.49	0.79	.53	.14
Investment	7.54	3.82	.45	.13	.58	0.84	.23	-.33
Labor share	0.95	0.48	.54	-.42	-.43	-0.15	.37	.39
Total hours	2.19	1.11	.59	-.07	.40	0.87	.61	.02
Employment	1.85	0.94	.61	-.22	.24	0.79	.70	.16
Average weekly hours	0.64	0.32	.58	.39	.68	0.70	.08	-.40
Hourly compensation	1.11	0.56	.65	-.22	.09	0.31	.33	.30
All bankruptcies/adult	10.11	5.13	.34	.09	-.22	-0.36	.05	.39
Ch.7 bankruptcies/adult	10.32	5.23	.33	.11	-.14	-0.29	.08	.38
Consumer credit / gdp[3]	4.66	2.36	.46	.04	.11	0.23	.62	.36
Consumer credit / gdp[4]	4.33	2.20	.67	.23	.48	0.54	.26	-.19

Cyclical properties of the U.S. before and after 1983, $\lambda = 100$.

Variable	Percent standard deviation			Late/Early
	53-06	53-83 (Early)	84-06 (Late)	
Output	1.97	2.29	1.46	0.64
Consumption	1.70	1.90	1.41	0.74
Durables	5.96	6.54	5.09	0.78
Nondurables	1.41	1.61	1.11	0.69
Services	1.00	1.03	0.97	0.94
Investment	7.54	7.90	7.14	0.90
Labor share	0.95	0.97	0.94	0.97
Total hours	2.19	2.16	2.29	1.06
Employment	1.85	1.84	1.90	1.03
Average weekly hours	0.64	0.69	0.56	0.82
Real compensation per hour	1.11	0.74	1.48	2.00
Total bankruptcies/adult	10.11	10.56	9.70	0.92
Ch.7 bankruptcies/adult	10.32	10.07	10.88	1.08
Consumer credit / gdp	4.66	3.83	5.67	1.48
Consumer credit / gdp	4.33	3.66	5.13	1.40

Cyclical properties of the U.S. before and after 1983, $\lambda = 10$.

Variable	Percent standard deviation			Late/Early
	53-06	53-83 (Early)	84-06 (Late)	
Output	1.42	1.70	0.96	0.56
Consumption	1.17	1.40	0.78	0.56
Durables	4.10	4.90	2.72	0.56
Nondurables	1.02	1.21	0.72	0.60
Services	0.66	0.73	0.56	0.77
Investment	6.09	6.98	4.71	0.67
Labor share	0.67	0.72	0.61	0.84
Total hours	1.65	1.78	1.49	0.84
Employment	1.39	1.51	1.24	0.82
Average weekly hours	0.44	0.47	0.41	0.87
Real compensation per hour	0.77	0.57	0.99	1.75
Total bankruptcies / adult pop	8.72	9.15	8.26	0.90
Ch.7 bankruptcies / adult pop	8.85	8.89	8.97	1.01
Consumer credit / gdp^2	3.52	3.30	3.87	1.17
Consumer credit / gdp^3	3.07	3.04	3.16	1.04

Cyclical properties of the U.S. before and after 1983, $\lambda = 6.25$.

Variable	Percent standard deviation			Late/Early
	53-06	53-83 (Early)	84-06 (Late)	
Output	1.31	1.58	0.84	0.53
Consumption	1.06	1.29	0.67	0.52
Durables	3.70	4.48	2.30	0.51
Nondurables	0.94	1.12	0.65	0.58
Services	0.59	0.67	0.49	0.73
Investment	5.71	6.63	4.25	0.64
Labor share	0.61	0.67	0.53	0.79
Total hours	1.51	1.67	1.30	0.78
Employment	1.26	1.40	1.07	0.76
Average weekly hours	0.41	0.43	0.38	0.87
Real compensation per hour	0.70	0.53	0.88	1.65
Total bankruptcies / adult pop	8.31	8.77	7.79	0.89
Ch.7 bankruptcies / adult pop	8.44	8.58	8.40	0.98
Consumer credit / gdp[2]	3.26	3.15	3.47	1.10
Consumer credit / gdp[3]	2.76	2.80	2.75	0.98

Bankruptcy is... from Chatterjee, Corbae, Nakajima, and Ríos-Rull (2004)

• We look at Chapter 7 bankruptcies (the most popular by far, a little over a million each year). An indebted person files for bankruptcy, and upon successful completion of the process (a very easy thing that lasts three or four months):

- the person's assets above a certain level (varies by state) are liquidated,
- the person's debts disappear, and creditors lose any rights to recover the debts by future income,
- the person gets to keep its future income, and
- the person cannot file again for seven years,
- after ten years, the bad credit history disappears.

We Interpret Bankruptcy as...

- With a good credit history, an agent can borrow and file for bankruptcy.
- Upon bankruptcy:
  - Its debts disappear; its creditors lose any future claims to debts.
  - In the filing period, the agent cannot save and must consume all of its current earnings.
  - Its credit history turns bad.
- With a bad credit history:
  - The agent cannot borrow but can save.
  - It suffers some inconveniences (bonded credit cards) that we model as a proportional γ loss of earnings.
  - Upon termination of the punishment period (10 years), the agent's credit history turns good.

The Model

- There is a continuum of households that are subject to persistent, aggregate shocks z, as well as to uninsured, persistent, idiosyncratic shocks (the actual model also has demographics).

- There are idiosyncratic shocks to preferences θ, to efficiency units of labor e, to the parameters that govern future distributions of efficiency units of labor ϵ, and to asset destruction λ.

- A household decides:
(i) how much to work, save and consume, and
(ii) (if it is an option) whether to default or not.

- Free entry in the credit market. Firms in the credit industry operate at zero costs. All loans are one–period loans.

- The bankruptcy scheme is that of the U.S.

Household Problem [1]

- Households are infinitely-lived and maximize expected discounted sum of period utilities with idiosyncratic multiplicative shocks θ.
- Aggregate states are:

(i) z: aggregate shock, which follows a Markov process, and
(ii) x: distribution of households over assets and shocks.

- Individual states are:

(i) ϵ: shock that determines the c.d.f of eff units of labor.
(ii) $e \in E = [\underline{e}, \bar{e}]$: eff units of labor which are drawn from the distribution that depends on ϵ. The cdf is then $F(e|\epsilon)$.
(iii) θ: Shock to marginal utility: $\theta\ u(c, h)$.
(iv) λ: Asset destruction shock.
(v) b: credit history, either GOOD (0) or BAD (1)
(vi) $a \in L = \{a_{\min}, \cdots, 0, \cdots, a_{\max}\}$: Asset

- $s = (\epsilon, \theta, \lambda)$ follows a Markov process. The process can depend on aggregate shocks.

Case 1: Non-Delinquent and Non-Defaulting

- Conditional on NOT DEFAULTING, and on V, households solve

$$\xi_n(z,x,s,e,0,a) = \max_{c,h,a'} \left\{ \theta\, u(c,h) + \beta \sum_{z',s'} \Gamma_{z's'|zs}\ V(z',x',s',0,a') \right\}$$

$$\begin{aligned} c + a' Q(a') &\leq a\, R(a) + h\, e\, w(z,x) \\ x' &= \varphi(z,x) \end{aligned}$$

- $R = (1 + r(z,x) - \delta)$ if $a \geq 0$, while $R = 1$ when $a < 0$ (equity).
- $Q = 1$ if $a' \geq 0$, and $Q = q(z,x,s,a')$ if $a' < 0$ (uncontingent debt).

Case 2: Non-Delinquent and Defaulting

- Conditional on DEFAULTING, and on V, households solve:

$$\xi_d(z,x,s,e,0,a) = \max_{c,h} \left\{ \theta\, u(c,h) + \beta \sum_{z',s'} \Gamma_{z's'|sz}\, V(z',x',s',1,a') \right\}$$

$$\begin{aligned} c &\leq h\, e\, w(z,x) \\ x' &= \varphi(z,x) \end{aligned}$$

Case 3: Delinquent

- Delinquent households solve the following concave (as long as V is concave) problem

$$\xi(z,x,s,e,1,a) = \max_{c,h,a'} \left\{ \theta\, u(c,h) + \beta \sum_{z's'b'} \Gamma_{z's'|sz} \pi_{bb'} V(z',x',s',b',a') \right\}$$

$$\begin{aligned} c + a' &\leq a\,(1 + r(z,x) - \delta) + h\; e\; w(z,x) \\ a' &\geq 0 \\ x' &= \varphi(z,x) \end{aligned}$$

Solving the Value Function

$$V(z,x,s,b,a) = \int_E \max_{0,1} \{\xi_d(z,x,s,e,0,a), \xi_n(z,x,s,e,1,a)\} \; dF(e|s)$$

- The solution is (typically, but not always) to default only below certain threshold of earnings that depends on all other variables. Conditional on the default decision, the decision rules are monotonic.

- At this stage, we also obtain the probability of default

$$p(z,x,s,a) = \int_E \operatorname*{argmax}_{0,1} \{\xi_d(z,x,s,e,0,a), \xi_n(z,x,s,e,1,a)\} \; dF(e|s)$$

Unsecured Credit Industry

- The lending firms are competitive, have zero costs and free entry. Their problem is static.

- Firms do offer different prices for each type and each debt level so their expected profits are zero for each loan type.

- More specifically, the prices of bonds satisfy:

$$q(z,x,s,a') = \sum_{z's'} \Gamma_{s'z'|sz} \; r(z',\varphi(z,x)) \; [1 - p(z',\varphi(z,x),s',a')]$$

- Note that actual profits may be positive or negative depending on tomorrow's aggregate state. Recessions may lower relevant rates of return but may increase the likelihood of default.

Equilibrium

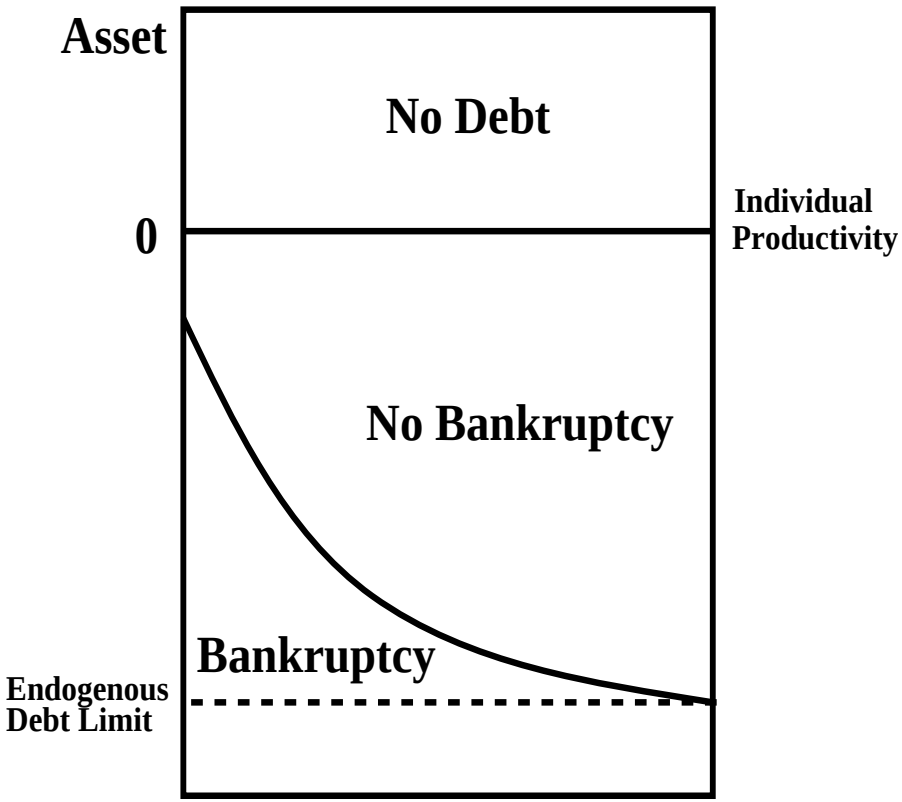
1. Given forecasting function $\varphi(z, x)$ for the distribution of agents, and pricing functions $r(z, x), w(z, x), q(z, x, s, a')$, the value function $V(z, x, s, b, a)$ solves agents' problems.

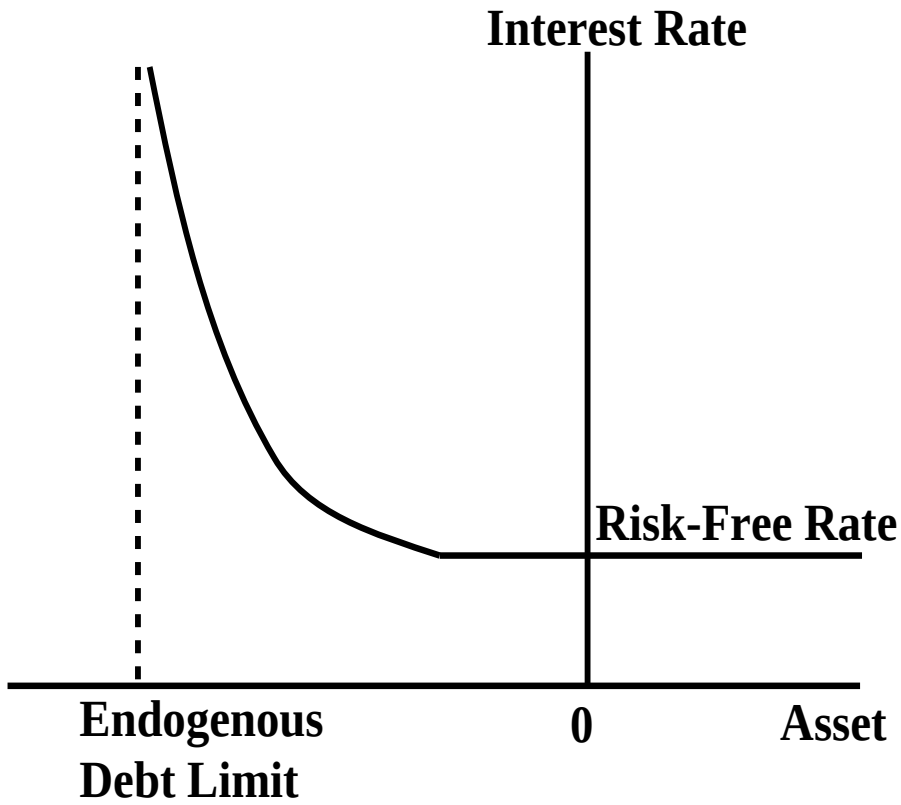
2. Given forecasting function $\varphi(z, x)$, the bond price function $q(z, x, s, a')$ satisfies the expected zero profit condition of lending firms.

3. Given forecasting function $\varphi(z, x)$, pricing functions $r(z, x), w(z, x)$ are generated by marginal productivities of factors of production which as in growth models come from CRS technology.

4. Forecasting function $\varphi(z, x)$ is generated by the optimal choices of households.

Typical Bankruptcy Set and Interest Rate





Approximation Method and Computation Method

- We follow the insight of Krusell-Smith-98 and especially Krusell-Smith-97 to approximate forecasting functions. Specifically:

1. We pick a set of statistics $S = \{K, B^-, \mu^-\}$ that forecast prices and future aggregate states accurately enough.
2. We substitute $x' = \varphi(z, x)$ by $S' = \tilde{\varphi}(z, S)$.
3. We set an initial guess for $\tilde{\varphi}(z, S)$, solve the optimal decisions of households and firms, run a simulation and update the guess with a new regression.
4. We continue this procedure until we find a fixed point of the forecasting functions.

Putting the Model to Work

- First, we calibrate the deterministic version of the model to U.S. non cyclical data:
  - Average Macroeconomic Statistics
  - Distributional Statistics
  - Recent Bankruptcy Facts

Mapping the Model to Data

Statistic	Target	Model
Basic Aggregate Targets		
Wealth to Output Ratio	3.32	3.32
Labor Share	0.64	0.64
Prop of Hours Spent on Working	0.31	0.32
Distribution Related Targets		
Population Turnover Rate	2.5%	2.5%
Earnings Gini	0.61	0.62
Wealth Gini	0.80	0.71
Default Related Targets		
Households filing Bankruptcy	0.54%	0.46%
Average Length of Punishment	7 years	7 years
Households with Zero or Negative Assets	9.9%	11.8%
Debt to Output Ratio	1.2	0.8

Distributional Statistics

Statistic	U.S. Economy	Model Economy
Earnings Gini	0.61	0.62
Earnings Held by 1st Quintiles	-0.002	0.02
Earnings Held by 2nd Quintiles	0.04	0.04
Earnings Held by 3rd Quintiles	0.13	0.08
Earnings Held by 4th Quintiles	0.23	0.20
Earnings Held by 5th Quintiles	0.60	0.65
Wealth Gini	0.80	0.71
Wealth Held by 1st Quintiles	-0.003	0.003
Wealth Held by 2nd Quintiles	0.01	0.05
Wealth Held by 3rd Quintiles	0.05	0.09
Wealth Held by 4th Quintiles	0.12	0.14
Wealth Held by 5th Quintiles	0.82	0.72

Aggregate Shocks

- We specify the aggregate shocks and calibrate the parameters associated with aggregate shock to match U.S. business cycle statistics (output volatility and the fact that recessions are shorter).

- As our baseline model, we use only shocks to TFP, which means that there are (barely) no distributional effect of aggregate shocks.

Cyclical Properties of the Baseline Model Economy

Variable	SD%	SD%/ SD%Y	Cross-Correlation of Y with X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)
Output	2.13	1.00	-0.17	0.33	1.00	0.33	-0.17
Consumption	0.56	0.26	-0.52	-0.06	0.77	0.70	0.34
Investment	5.78	2.71	-0.09	0.39	0.99	0.23	-0.26
Earnings	2.14	1.00	-0.17	0.33	1.00	0.33	-0.17
Total Asset	0.73	0.34	-0.55	-0.54	-0.18	0.63	0.77
Labor Share	0.01	0.00	0.00	0.00	0.24	0.03	0.09
Net Capital Return	0.25	0.12	-0.01	0.46	0.95	0.10	-0.39
Hours	0.32	0.15	0.20	0.55	0.82	-0.13	-0.57
Labor Input	0.17	0.08	0.24	0.56	0.77	-0.18	-0.60
Filing HHs	1.50	0.70	0.31	0.12	-0.61	-0.27	-0.43
HHs in Debt	0.82	0.39	0.56	0.53	0.11	-0.64	-0.79
Productivity	2.11	0.99	-0.12	0.37	1.00	0.26	-0.24

U.S. and Model Economy: Cyclical Statistics

Variable	SD%/ SD%Y	Cross-Correlation of Y with X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)
U.S. Economy (48 Periods: 1954-2001)						
Output	1.00	0.02	0.52	1.00	0.52	0.02
Consumption	0.59	-0.07	0.46	0.88	0.63	0.24
Investment	3.32	0.11	0.51	0.89	0.23	-0.32
Earnings	1.05	-0.16	0.39	0.91	0.71	0.23
Aggregate Hours	1.11	-0.25	0.28	0.91	0.57	-0.11
Filing HHs	4.99	0.05	-0.11	-0.26	0.06	0.47
Hours per Worker	0.20	0.08	0.37	0.58	-0.25	-0.68
Baseline Model Economy (48 Periods)						
Output	1.00	-0.17	0.33	1.00	0.33	-0.17
Consumption	0.26	-0.52	-0.06	0.77	0.70	0.34
Investment	2.71	-0.09	0.39	0.99	0.23	-0.26
Earnings	1.00	-0.17	0.33	1.00	0.33	-0.17
Hours	0.15	0.20	0.55	0.82	-0.13	-0.57
Filing HHs	0.70	0.31	0.12	-0.61	-0.27	-0.43
Labor Input	0.08	0.24	0.56	0.77	-0.18	-0.60

Standard business cycles features

- Consumption fluctuates less than output and is procyclical.
- Investment is much more volatile than output and highly procyclical.
- Hours fluctuate much less than output and is procyclical, perhaps even more than data (Kydland and Prescott, Hansen). Productivity is more procyclical than the measured Solow residual.

- Business cycle properties of the number of bankruptcies:
  - Number of bankruptcies fluctuates much more than output. The volatility in the model is similar to that in the data.
  - Number of bankruptcies is countercyclical as in data.

What Affects Cyclical Properties of Bankruptcies?

- Agents receive higher labor income in expansions (uniformly in our baseline model).

- But agents look forward. So it could be better to be delinquent in expansions than in recessions (as in Nakajima and Ríos-Rull (2003)).

- Now to our bonus question, about the great stabilization that can be answered by answering whether the existence of loans matter for business cycles.

A Straight Comparison to a No Loans Economy

Variable	SD%/ SD%Y	Cross-Correlation of Y with X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)
With Loans						
Output	1.00	-0.17	0.33	1.00	0.33	-0.17
Consumption	0.26	-0.52	-0.06	0.77	0.70	0.34
Investment	2.71	-0.09	0.39	0.99	0.23	-0.26
Earnings	1.00	-0.17	0.33	1.00	0.33	-0.17
Hours	0.15	0.20	0.55	0.82	-0.13	-0.57
Labor Input	0.08	0.24	0.56	0.77	-0.18	-0.60
Filing HHs	0.70	0.31	0.12	-0.61	-0.27	-0.43
Without Loans						
Output	1.00	-0.17	0.33	1.00	0.33	-0.17
Consumption	0.28	-0.47	-0.06	0.75	0.69	0.35
Investment	2.76	-0.10	0.38	0.99	0.22	-0.27
Earnings	1.01	-0.17	0.33	1.00	0.32	-0.17
Hours	0.16	0.16	0.50	0.78	-0.14	-0.54
Labor Input	0.08	0.20	0.51	0.74	-0.20	-0.58

- Without Loans Consumption seems slightly more volatile. But that is all.

Different Types of Business Cycles

- Non-uniform aggregate shocks: Recessions hit particularly hard on some. Two ways to implement this idea.

- Countercyclical Earnings Variance as reported by Storesletten, Telmer and Yaron (2000)

- Recessions are periods of asset destruction (small business failures and other).

Cyclical Properties of an Economy with Countercyclical Earnings Variance as Storesletten, Telmer and Yaron

Variable		SD%/	Cross-Correlation of Y with				
	SD%	SD%Y	X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)
Output	2.34	1.00	-0.31	0.22	1.00	0.22	-0.31
Consumption	0.69	0.30	-0.48	-0.03	0.88	0.52	0.04
Investment	6.01	2.57	-0.26	0.27	0.99	0.14	-0.38
Earnings	2.34	1.00	-0.31	0.22	1.00	0.22	-0.31
Total Asset	0.70	0.30	-0.34	-0.51	-0.21	0.68	0.71
Labor Share	0.00	0.00	-0.03	0.14	0.06	0.20	-0.35
Net Capital Return	0.27	0.12	-0.19	0.33	0.96	0.02	-0.48
Hours	0.74	0.32	-0.18	0.34	0.96	-0.00	-0.49
Labor Input	0.09	0.04	0.48	0.39	-0.27	-0.71	-0.58
Filing HHs	27.81	11.89	0.28	0.25	-0.28	-1.00	-0.09
HHs in Debt	2.05	0.88	0.04	0.05	-0.12	-0.43	-0.44

- Hours are much more volatile, but Labor Input Countercyclical !!!

Countercyclical Earnings Variance as in Storesletten et al

Variable	SD%	SD%/ SD%Y	Cross-Correlation of Y with X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)
			With Loans				
Output	2.09	1.00	-0.15	0.22	1.00	0.22	-0.15
Consumption	0.68	0.33	-0.37	-0.06	0.77	0.60	0.29
Investment	5.62	2.69	-0.08	0.28	0.99	0.10	-0.26
Hours	1.76	0.84	-0.05	0.30	0.97	0.05	-0.31
Labor Input	0.23	0.11	0.28	-0.07	-0.92	-0.48	-0.14
Filing HHs	65.62	31.39	0.16	0.06	-0.31	-0.98	-0.00
HHs in Debt	13.69	6.54	0.15	0.06	-0.27	-0.98	0.03

- Hours are much more volatile, but Labor Input Countercyclical !!!

Countercyclical Earnings Variance as in Storesletten et al

Variable	SD%	SD%/ SD%Y	Cross-Correlation of Y with X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)
With Loans							
Output	2.09	1.00	-0.15	0.22	1.00	0.22	-0.15
Consumption	0.68	0.33	-0.37	-0.06	0.77	0.60	0.29
Investment	5.62	2.69	-0.08	0.28	0.99	0.10	-0.26
Hours	1.76	0.84	-0.05	0.30	0.97	0.05	-0.31
Labor Input	0.23	0.11	0.28	-0.07	-0.92	-0.48	-0.14
Filing HHs	65.62	31.39	0.16	0.06	-0.31	-0.98	-0.00
HHs in Debt	13.69	6.54	0.15	0.06	-0.27	-0.98	0.03
Without Loans							
Output	2.01	1.00	-0.16	0.15	1.00	0.15	-0.16
Consumption	0.94	0.47	-0.29	0.03	0.93	0.36	0.05
Investment	4.47	2.22	-0.10	0.19	0.99	0.05	-0.25
Earnings	2.01	1.00	-0.16	0.15	1.00	0.15	-0.16
Hours	1.47	0.73	-0.10	0.21	0.99	0.02	-0.27
Labor Input	0.21	0.11	0.24	-0.06	-0.97	-0.33	0.01

Economies with Countercyclical Earnings Variance

Variable	SD%	SD%/ SD%Y	Cross-Correlation of Y with X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)
With Loans							
Output	2.34	1.00	-0.31	0.22	1.00	0.22	-0.31
Consumption	0.69	0.30	-0.48	-0.03	0.88	0.52	0.04
Investment	6.01	2.57	-0.26	0.27	0.99	0.14	-0.38
Earnings	2.34	1.00	-0.31	0.22	1.00	0.22	-0.31
Hours	0.74	0.32	-0.18	0.34	0.96	-0.00	-0.49
Labor Input	0.09	0.04	0.48	0.39	-0.27	-0.71	-0.58
Filing HHs	27.81	11.89	0.28	0.25	-0.28	-1.00	-0.09
HHs in Debt	2.05	0.88	0.04	0.05	-0.12	-0.43	-0.44
Without Loans							
Output	2.33	1.00	-0.31	0.22	1.00	0.22	-0.31
Consumption	0.69	0.30	-0.46	-0.04	0.87	0.55	0.04
Investment	5.90	2.53	-0.26	0.27	0.99	0.13	-0.38
Earnings	2.33	1.00	-0.31	0.22	1.00	0.21	-0.31
Hours	0.73	0.32	-0.19	0.34	0.96	-0.01	-0.48
Labor Input	0.09	0.04	0.49	0.31	-0.43	-0.77	-0.43

- Existence of Loans matters Dramatically

Conclusions

- The details of modeling how recessions affect different households have different implications for aggregate business cycle statistics (in particular for hours worked).
- Modelling borrowing opportunities with default does change our answers to some business cycle questions, especially the volatility of consumption that is smaller than without borrowing opportunities.

Computation [1]

• Prices (w, r, and q for each type of households and level of debt) are no longer independent of x, so households do need to use the information to forecast prices, a much harder problem.

• We follow the insight of Krusell and Smith (1998) and especially Krusell and Smith (1997) and we approximate forecasting functions for:

- Capital stock in the next period,
- Debt stock in the next period,
- Average discount price of debt in the next period,
- Amount of defaulted debt
- Prices of bonds for each type.

• These are sufficient information to forecast prices. We iterate on these functions.

Computation [2]

- Iterating on these things involves among other things solve for market clearing of many commodities each period a very long problem.

- We use piecewise linear and/or splines to interpolate and integrate value functions. Interpolation is very useful.

- It turns out that simulating large samples of agents is not too good because of sampling error, so we approximate densities.

- We use f90 and a 64 node Beowulf cluster.

Default Options

- Household credit history, $b \in \{0, 1\}$.
- Default decision, $d \in \{0, 1\}$.
- If $h = 0$ (good credit history), choosing $d = 0$, implies a standard problem.
- If $b = 0$ (good credit history), choosing $d = 1$, implies
  - $a = 0$ (debt is wiped clean)
  - $a' = 0$ (cannot save in same period you default).
- If $b = 1$, (the household has a bad credit history).
  - $a' \geq 0$ (cannot borrow).
  - $b' = 0$ with probability $1 - \eta$.
  - $b' = 1$ with probability η.

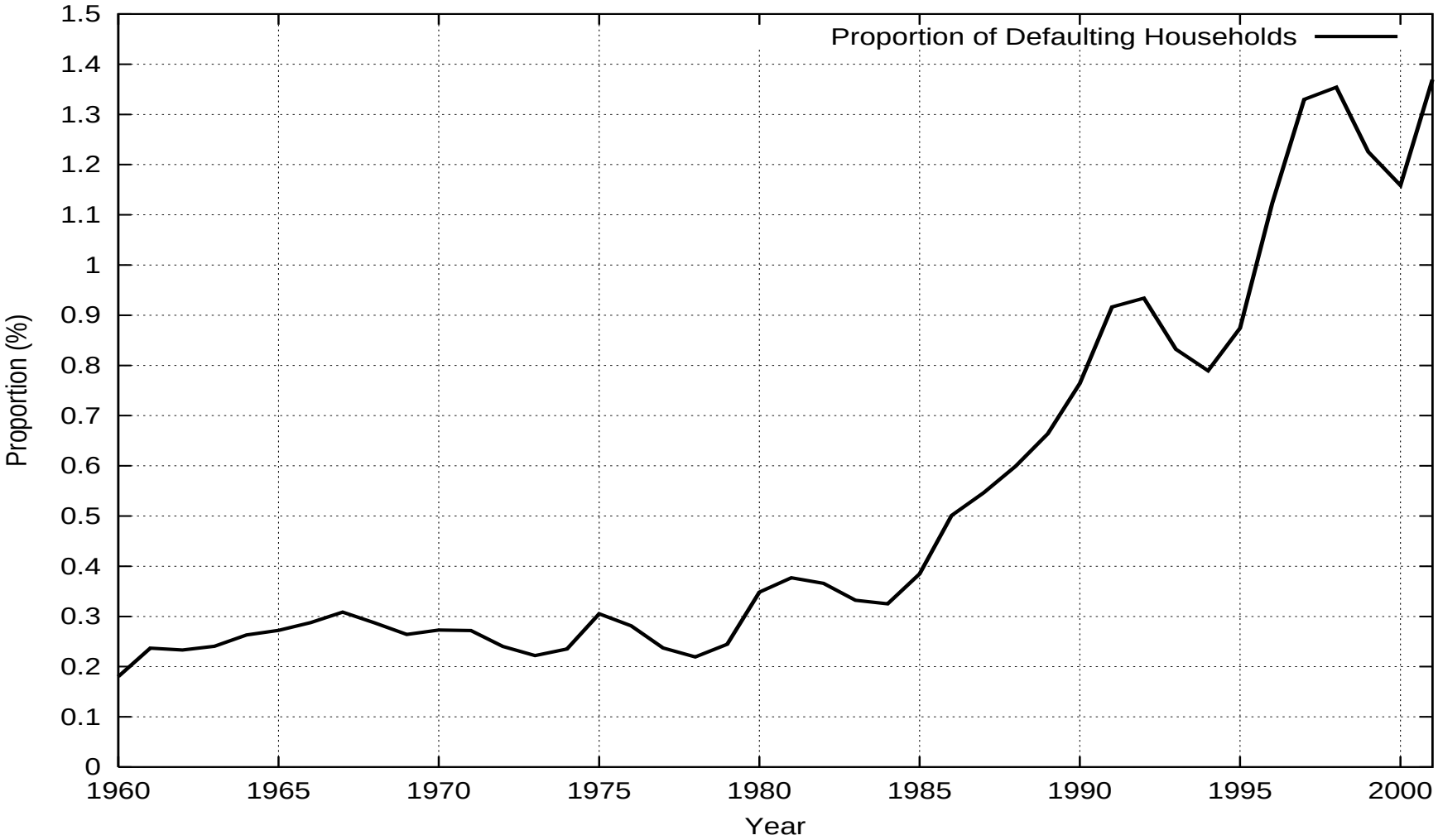
Cyclical Properties of the Economy with Smaller Countercyclical Earnings Variance

Variable	SD%	SD%/ SD%Y	Cross-Correlation of Y with X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)
Output	2.04	1.00	-0.17	0.33	1.00	0.33	-0.17
Consumption	0.57	0.28	-0.49	-0.04	0.80	0.67	0.31
Investment	5.40	2.64	-0.10	0.39	0.99	0.23	-0.27
Earnings	2.04	1.00	-0.17	0.33	1.00	0.33	-0.17
Total Asset	0.69	0.34	-0.55	-0.54	-0.16	0.64	0.77
Labor Share	0.00	0.00	-0.07	0.05	-0.23	0.20	-0.07
Net Capital Return	0.24	0.12	0.01	0.46	0.95	0.11	-0.39
Hours	0.48	0.23	0.08	0.50	0.91	0.02	-0.47
Labor Input	0.09	0.05	0.60	0.40	-0.28	-0.72	-0.69
Filing HHs	18.36	9.00	0.64	0.08	-0.40	-1.01	-0.22
HHs in Debt	1.19	0.58	0.12	-0.51	-0.51	-0.36	-0.36

Cyclical Properties of the Economy with Smaller Countercyclical Earnings Variance and without Loan/Default

Variable	SD%	SD%/ SD%Y	Cross-Correlation of Y with X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)
Output	2.21	1.00	-0.31	-0.02	1.00	-0.02	-0.31
Consumption	0.55	0.25	-0.37	-0.24	0.89	0.30	-0.10
Investment	5.72	2.59	-0.29	0.02	1.00	-0.08	-0.34
Earnings	2.21	1.00	-0.31	-0.02	1.00	-0.02	-0.31
Total Asset	0.56	0.25	-0.15	-0.41	-0.34	0.68	0.51
Labor Share	0.00	0.00	-0.15	-0.11	-0.00	-0.42	-0.02
Net Capital Return	0.26	0.12	-0.24	0.07	0.98	-0.18	-0.39
Hours	0.48	0.22	-0.22	0.12	0.95	-0.24	-0.42
Labor Input	0.08	0.03	0.37	0.35	-0.60	-0.58	-0.14

Surge in Bankruptcies



U.S. Economy: Annual Cyclical Statistics 1979-2001

Variable		SD%/	Cross-Correlation of Y with				
	SD%	SD%Y	X(t-2)	X(t-1)	X(t)	X(t+1)	X(t+2)
Output	2.02	1.00	0.06	0.52	1.00	0.52	0.06
Consumption	1.39	0.69	-0.17	0.41	0.87	0.70	0.35
Investment	6.93	3.42	0.36	0.59	0.86	0.15	-0.35
Earnings	2.16	1.07	-0.06	0.39	0.91	0.72	0.30
Labor Share	0.90	0.44	-0.28	-0.24	-0.07	0.56	0.59
Aggregate Hours	2.19	1.08	0.03	0.46	0.94	0.52	0.00
Hours per Worker	0.40	0.20	0.27	0.38	0.50	-0.36	-0.60
Filing HHs	11.89	5.87	-0.31	-0.18	-0.05	0.46	0.65

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