Economics 210c/236a
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Christina Romer
David Romer

LECTURE 9

The Effects of Credit Contraction and Financial Crises: Balance Sheet and Cash Flow Effects

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I. Overview and General Issues

The Big Picture

- Many of our baseline models (both Keynesian and classical) assume perfect financial markets—for example, a single interest rate.
- But financial markets are not perfect!

Changes in Financial Market Imperfections Can Affect the Economy

- The changes can be an endogenous response to the state of the economy—financial market imperfections as a propagation mechanism.
- Or the changes can occur for a given state of the economy—financial market imperfections as a source of shocks.

Overview of the Next Several Lectures

- Today: How the state of households and firms affects their ability to get credit and their behavior (balance sheet and cash flow effects).
- Oct. 31: Disruptions to financial intermediation: Aggregate evidence on financial crises.
- Nov. 28: Disruptions to financial intermediation, continued: Microeconomic evidence.

The Nature of Financial Market Imperfections

- In most models, they take the form of asymmetric information between borrowers and lenders creating "agency costs."
- Example: Monitoring and screening costs.
- One implication is that there is likely to be a gap between the costs of internal and external finance.
- There is asymmetric information both between savers and financial intermediaries and between the intermediaries and borrowers.
- Financial market imperfections can affect both AD and AS.

Today's Papers

- How the financial health of firms and households (their balance sheets and cash flows) affects their behavior.

- CH and LM: Evidence about financial market imperfections and firm behavior, and about the nature of the imperfections.

- MRS: The impact of households' balance sheets on their behavior—specifically, their response to changes in housing wealth.

II. Calomiris and Hubbard, "Internal Finance and Investment: Evidence from the Undistributed Profits Tax of 1936–37"

Issues Calomiris and Hubbard Address

- Is there a difference in cost between external and internal finance?
- Is it caused by asymmetric information or by entrenched managers?
- Does the existence of a spread cause investment to depend on cash flow?

Calomiris and Hubbard's Natural Experiment

- Surtax on Undistributed Profits in effect in 1936 and 1937.
- Tax on retained earnings.
- Different rates depending on how much of earnings were retained.

TABLE 1 **Retained Earnings as a Percentage of After-Tax Profits for Corporations with Positive Income, 1931–40**

	Under 50	50–100	100–250	250–500	500–1,000	1,000–5,000	5,000–10,000	10,000–50,000	Over 50,000	All Classes
1931	57.3	47.8	39.1	32.1	26.4	21.5	13.9	11.1	3.7*	9.6
1932	39.9	31.5	31.6	28.8	26.1	20.8	12.6	7.6	8.9*	4.3
1933	64.0	66.5	61.4	61.3	56.5	47.1	39.4	22.2	2.5*	24.0
1934	53.7†	57.1	52.6	45.5	34.9	25.8	28.5	3.5	13.9	19.7
1935	56.4	52.0	48.5	44.5	34.7	28.2	20.5	8.0	19.8	23.0
1936	35.8	28.4	23.8	22.7	25.8	25.9	22.3	15.6	4.9	15.1
1937	30.4	29.4	24.1	22.8	23.2	22.2	20.7	16.0	8.3	15.1
1938	50.6	54.8	48.3	39.3	37.8	29.5	23.7	16.8	7.3	19.2
1939	62.0	63.1	55.6	46.1	44.6	37.8	33.9	24.2	18.3	28.8
1940	62.2	59.2	56.4	51.2	50.1	44.3	39.0	30.1	22.3	33.2
Average	51.1	48.1	44.1	39.4	36.0	30.3	25.5	15.5	8.0	19.2

SOURCE.—Butters and Lintner (1945, p. 66).
NOTE.—Asset size classes are in thousands of dollars.
* Indicates an excess of dividends over net profits after taxes.
† This item represents nonfinancial corporations only, because of the abnormal dividends paid by financial corporations of this size in 1934.

From: Calomiris and Hubbard, "Internal Finance and Investment"

TABLE 2 **Corporations Subject to Surtax on Undistributed Profits, 1937**

Net Income Class ($000s)	Returns with Net Income ($)	No Surtax (%)	7% Rate (%)	12% Rate (%)	17% Rate (%)	22% Rate (%)	27% Rate (%)
Under 5	119,805	19.2	80.8	.0	.0	.0	.0
5–10	18,611	34.7	39.4	8.9	10.4	6.6	.0
10–15	9,150	38.0	32.4	5.6	6.1	7.4	10.7
15–20	5,697	40.0	27.4	7.5	8.3	4.7	12.1
20–25	3,879	39.8	24.1	7.7	11.2	5.4	11.8
25–50	9,282	40.5	18.0	8.7	13.1	8.6	11.1
50–100	6,046	39.8	13.7	9.9	15.7	9.9	10.9
100–250	4,620	38.8	13.0	9.6	15.8	11.8	11.1
250–500	1,819	38.3	13.2	9.2	16.7	13.0	9.6
500–1,000	1,071	36.4	13.8	13.8	17.6	10.2	8.1
1,000–5,000	974	42.2	15.1	11.8	16.5	9.4	4.9
Over 5,000	240	43.3	15.8	17.5	16.7	5.0	1.7

SOURCE.—Figures are derived from U.S. Internal Revenue Service (1937).
NOTE.—Classifications are by highest surtax rate paid.

From: Calomiris and Hubbard, “Internal Finance and Investment”

Evaluation of the Natural Experiment

- Creative and potentially very useful.
- Only tells us about relatively large firms.
- Tax paid could reflect something other than the true difference between the cost of internal and external finance.

TABLE 3 **Cost of Flotation for Common Stock Issues Effectively Registered for Sale to the Public by Asset Size of Issuer, 1938–41**

	1938		1939		1940		1941	
	Number of Issues	Cost as a Percentage of Amount	Number of Issues	Cost as a Percentage of Amount	Number of Issues	Cost as a Percentage of Amount	Number of issues	Cost as a Percentage of Amount
Underwritten issues:								
Under $1	9	27.3	11	22.9	10	22.8	5	20.4
$1–$5	5	20.0	9	19.5	19	15.9	11	19.9
$5–$10	2	19.2	3	11.4	3	12.9	3	12.5
$10–$50	. . .	. . .	. . .	. . .	6	10.4	3	10.2
$50–$100	. . .	. . .	. . .	. . .	1	9.1	. . .	. . .
$100–$200	. . .	. . .	. . .	. . .	1	8.3	. . .	. . .
Over $200	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Best-effort issues:								
Under $1	44	21.7	36	24.1	31	24.4	7	19.1
$1–$5	6	20.9	10	20.3	3	16.5	2	23.6
$5–$10	2	14.8	2	10.9	2	16.4	. . .	. . .
$10–$50	. . .	. . .	1	4.8	. . .	. . .	1	4.4
$50–$100	. . .	. . .	. . .	. . .	1	2.2	. . .	. . .
$100–$200	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Over $200	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

SOURCE.—Butters and Lintner (1945, p. 97).
NOTE.—Asset size classes are in millions of dollars. All data refer to issues proposed for sale by the issuer through investment banking facilities.

From: Calomiris and Hubbard, "Internal Finance and Investment"

Data

- Firm level data for 273 firms.
- Use many sources to get data on dividends, equity, income, investment, cash flow.
- Estimate the top marginal surtax paid.
- Evaluation?
    - Impressive, hard data collection.
    - Lots of inconsistencies, dropped observations, judgment calls, etc.
    - Could there be selection bias?

Classification Based on Top SUP Rate

- Type A: 0, 7, or 12%
- Type B: 17%
- Type C: 22 or 27%

TABLE 4 Characteristics of Firms, by Surtax Margin

	Type A	Type B	Type C	All Firms
A. Ratio of dividends to after-tax profits:				
1935:*				
Mean	1.796	.516	.284	1.061
Median	.705	.512	.051	.530
SD	9.932	.461	.404	6.809
N	124	78	64	266
1936:†				
Mean	.950	.696	.463	.759
Median	.888	.689	.478	.731
SD	.629	.303	.374	.532
N	127	80	65	272
1937:‡				
Mean	1.449	.999	.547	1.102
Median	.855	.747	.516	.762
SD	4.852	1.165	.448	3.392
N	124	79	63	266
B. Total assets:				
1936:				
Mean	119,584	43,344	32,664	76,229
Median	22,622	13,833	6,426	15,393
SD	277,456	115,040	72,687	205,969
N	127	80	66	273
C. Pretax profit divided by book value of net worth:				
1936:				
Mean	.126	.161	.130	.137
Median	.099	.124	.100	.108
SD	.095	.106	.094	.099
N	127	80	66	273

From: Calomiris and Hubbard, “Internal Finance and Investment”

TABLE 5 Characteristics of Firms, by Surtax Margin

	Type A	Type B	Type C	All Firms
A. Ratio of market-to-book value of assets:				
December 1935:				
Mean	1.472	1.545	1.306	1.453
Median	1.216	1.260	.980	1.247
SD	.977	.913	.897	.944
N	127	80	66	273
B. Percentage change, ratio of market-to-book value of assets:				
1935–36:				
Mean	.341	.274	.388	.333
Median	.228	.151	.365	.268
SD	.605	.406	.334	.496
N	127	80	66	273
C. Ratio of debt to market value of equity:				
1935:				
Mean	.226	.213	.359	.255
Median	.068	.075	.177	.088
SD	.434	.353	.428	.413
N	127	80	66	273
1936:				
Mean	.178	.188	.255	.199
Median	.077	.089	.149	.097
SD	.272	.287	.267	.276
N	127	80	66	273
D. Ratio of debt to book value of equity:				
1935:				
Mean	.193	.237	.283	.228
Median	.109	.112	.209	.138
SD	.278	.353	.236	.294
N	127	80	66	273
1936:				
Mean	.220	.260	.334	.259
Median	.146	.164	.242	.168
SD	.252	.316	.274	.280
N	127	80	66	273

From: Calomiris and Hubbard, “Internal Finance and Investment”

TABLE 6 Tests of Differences in Medians across Firm Types

	Median		*t*-Statistic for Difference in Medians of Types A and C
	Type A	Type C	
Dividends/aftertax profits, 1935	.705	.051	8.7
	(.074)	(.012)	
Total assets, 1936	22,622	6,426	4.0
	(3,962)	(581)	
Net operating profits/sales, 1935	.097	.063	3.6
	(.005)	(.008)	
Net operating profits/sales, 1936	.119	.090	3.7
	(.006)	(.005)	
Change in net operating profits, 1935–36/total assets 1935	.029	.046	0.3
	(.0002)	(.058)	
Change in ratio of market-to-book value, 1935–36	.228	.365	2.0
	(.050)	(.050)	
Debt/market value of equity, 1935	.068	.177	2.6
	(.009)	(.041)	
Debt/book value of equity, 1935	.109	.209	2.5
	(.019)	(.034)	

NOTE.—Standard errors are in parentheses.

From: Calomiris and Hubbard, "Internal Finance and Investment"

Calomiris and Hubbard's Specification

(2) $(I/K)_{it} = a_i + bQ_{it} + c(CF/K)_{it} + e_{it}$

(2') $(I/K)_i = a_0 + a_B D_{Bi} + a_C D_{Ci} + b_0 Q_i + b_B Q_i D_{Bi} + b_C Q_i D_{Ci}$
$+ c_0(CF/K)_i + c_B(CF/K)_i D_{Bi} + c_C(CF/K)_i D_{Ci} + e_i,$

where D_B and D_C are dummies for Type B and Type C firms.

TABLE 8 Fixed Capital Investment Regressions, 1936

	Regressions	
	(1)	(2)
A. Summary statistics:		
Dependent variable	I_{1936}/K_{1935}	I_{1936}/K_{1935}
Number of observations	244	244
Adjusted R^2	.063	.217
B. Coefficients:		
Constant	−.019	.015
	(.022)	(.021)
Type B	. . .	−.037
		(.036)
Type C	. . .	−.112
		(.051)
Q_{1935}	.044	.024
	(.016)	(.011)
Q_{1935} × type B	. . .	.024
		(.019)
Q_{1935} × type C	. . .	.039
		(.051)
$[(CF_{1935} + CF_{1936})/K_{1935}$	.018	−.004
	(.016)	(.014)
$[(CF_{1935} + CF_{1936})/K_{1935}]$ × type B	. . .	.003
		(.018)
$[(CF_{1935} + CF_{1936})/K_{1935}]$ × type C	. . .	.248
		(.100)

NOTE.—Heteroscedasticity-consistent standard errors are presented in parentheses.

From: Calomiris and Hubbard, "Internal Finance and Investment"

Discussion

III. Lian and Ma, "Anatomy of Corporate Borrowing Constraints"

Overview

- Lian and Ma are especially interested in the nature of financial market imperfections affecting firms, and in the implications for what can cause those constraints to change.

Background

- A large empirical literature finds evidence that cash flow has a causal effect on investment.

- A large theoretical literature is built on the assumption that the value of collateral is important to borrowing constraints.

Aggregate Facts

- The distinction between "asset-based lending" and "cash flow-based lending."
- "[A]sset-based lending accounts for roughly 20% of debt by value …. [C]ash flow-based lending accounts for about 80% of debt by value."
- "[I]n the context of cash flow-based lending, a common form of borrowing constraint stipulates debt limits based on … EBITDA (earnings before interest, tax, depreciation, and amortization)."

Disaggregate Facts

- Cash flow-based lending is less common:
  - For firms with assets that are less specialized (airlines, utilities).
  - For firms with lower cash flow (small firms, low-profit large firms).
  - In legal environments less supportive of continuing operation of bankrupt firms (Japan).

The Behavior of Investment and Debt

- Lian and Ma examine how investment and debt vary with cash flow and/or debt for various types of firms.

- Motivation is similar to Fazzari-Hubbard-Petersen: Comparisons of how outcomes vary with cash flow across different types of firms are especially informative.

- Lian and Ma argue that how outcomes vary with EBITDA controlling for cash flow is also especially informative.

Framework

- Notation: I investment, b borrowing, CF cash flow, π EBITDA, A value of assets, C marginal cost of borrowing.
- $b = \max\{I - CF, 0\}$.
- FHP view: $C = C(b)$, $C'(b) > 0$.
- Collateral view: $C = C(b,A)$, $C_b > 0$, $C_A < 0$, $C_{bA} < 0$.
- Lian-Ma view: $C = C(b,\pi)$, $C_b > 0$, $C_\pi < 0$, $C_{b\pi} < 0$.

Table 3: Debt Issuance and Investment Activities: Large Firms w/ EBCs

Panel A. Debt Issuance

	Net LT Debt Iss.	
	(1)	(2)
EBITDA	0.216***	0.273***
	(0.030)	(0.034)
OCF		-0.111***
		(0.033)
Q	0.010**	0.011**
	(0.005)	(0.005)
Past 12m stock ret	-0.003	-0.003
	(0.003)	(0.003)
L.Cash holding	-0.033	-0.033
	(0.043)	(0.044)
Controls	Y	Y
Firm FE	Y	Y
Year FE	Y	Y
Obs	15,642	15,642
R^2	0.114	0.116

Panel B. Investment Activities

	CAPX	
	(1)	(2)
EBITDA	0.129***	0.101***
	(0.017)	(0.019)
OCF		0.053***
		(0.013)
Q	0.011***	0.011***
	(0.002)	(0.002)
Past 12m stock ret	0.004*	0.004*
	(0.002)	(0.002)
L.Cash holding	0.015	0.015
	(0.013)	(0.013)
Controls	Y	Y
Firm FE	Y	Y
Year FE	Y	Y
Obs	16,907	16,907
R^2	0.156	0.160

From: Lian and Ma, "Anatomy of Corporate Borrowing Constraints"

Table 4: Debt Issuance and Investment Activities: Firms w/ Low Prevalence of EBCs

Panel A. Net LT Debt Issuance

	Large w/o EBCs		Small		Low Margin		Air & Utilities	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EBITDA	-0.059***	0.023	-0.019***	0.001	-0.025***	-0.001	-0.093**	-0.059
	(0.021)	(0.027)	(0.007)	(0.009)	(0.008)	(0.010)	(0.045)	(0.061)
OCF		-0.127***		-0.033***		-0.039***		-0.050
		(0.027)		(0.011)		(0.010)		(0.079)
...								

Panel B. CAPX Investment

	Large w/o EBCs		Small		Low Margin		Air & Utilities	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EBITDA	0.053***	0.033*	0.001	-0.002	0.002	-0.004	0.079	0.025
	(0.012)	(0.019)	(0.004)	(0.004)	(0.005)	(0.004)	(0.049)	(0.046)
OCF		0.024**		0.005		0.011**		0.158***
		(0.011)		(0.004)		(0.005)		(0.038)
...								

From: Lian and Ma, "Anatomy of Corporate Borrowing Constraints"

Lian and Ma's Natural Experiment

- "[A]n accounting rule change .. [that] contributes to changes in EBITDA that are not related to changes in economic fundamentals or internal funds."

Table 5: Changes in EBITDA: Accounting Natural Experiment

Panel A. First Stage

	$EBITDA_i^{06}$		
	Large w/ EBCs	Large w/o EBCs	Small
Avg. option comp expense 02-04	-0.857***	-0.721***	-0.520**
	(0.212)	(0.134)	(0.208)
Obs	686	435	727

Standard errors in parentheses

Panel B. IV

	Net LT Debt Iss			CAPX		
	Large w/ EBCs	Large w/o EBCs	Small	Large w/ EBCs	Large w/o EBCs	Small
$\widehat{EBITDA_i}^{06}$	0.869**	-0.327	0.225	0.497**	0.014	0.002
	(0.451)	(0.344)	(0.366)	(0.225)	(0.169)	(0.136)
1st stage F	16.39	23.42	9.08	16.39	23.42	9.08
Obs	686	435	727	686	435	727

Standard errors in parentheses

From: Lian and Ma, "Anatomy of Corporate Borrowing Constraints"

Conclusions

- In most developed economies, for the firms that do most of investment, borrowing limits are determined by cash flow, not collateral.
- Implications:
  - A different interpretation of the cash flow–investment link.
  - Collateral values (and propagation of shocks through collateral values) may be less important than previously thought.
- These findings may have implications for policy.

IV. Mian, Rao, and Sufi, "Household Balance Sheets, Consumption, and the Economic Slump"

Subject

- Impact of the fall in household wealth in 2006–2009 on consumption.
- Especially: Heterogeneity in MPCs out of housing wealth (from either credit constraints or a consumption function that is concave in wealth).
  - Such heterogeneity would likely be due largely to financial market imperfections and borrowing constraints.
  - So, closely related to “asset-based lending” and collateral effects.
- Focus is on regional variation.

Taking a Step Back: Some Bigger Picture Questions about the Run-Up in House Prices and the Great Recession

- Was the explosion of mortgage debt driven fundamentally by overoptimism about house prices or by a shift in credit supply?
- To what extent was the expansion of mortgage availability concentrated in "low quality" borrowers?
- How important was the health of the banking system to the Great Recession and (especially) to the slow recovery?

Organizing Framework

$$\Delta log C_t^i = \alpha_t + \beta * \Delta log X_t^i + \varepsilon_t^i.$$

(X_t^i is the wealth of household *i*.)

$$\Delta C_t^i = \alpha_t + \beta_1 * \Delta NW_t^i + \beta_2 * NW_{t-1}^i + \beta_3 * \Delta NW_t^i * NW_{t-1}^i + \varepsilon_t^i.$$

(NW_t^i is the net worth of household *i*.)

Data and Measurement

- Consumption data:
    - County-level data on MasterCard purchases.
    - Zipcode-level data on auto purchases.
- Change in housing wealth: $\Delta log p^{H,i}_{06-09} * H^{i}_{2006}$,

where H^i is the value of owner-occupied houses and $\Delta\log(p^{H,i})$ is the percent change in house prices.

- Concerns about data and measurement?

Estimation

- OLS (potentially with controls).
- IV using a geography-based estimate of housing supply elasticity from Saiz (2010).
- Concerns about the estimation?

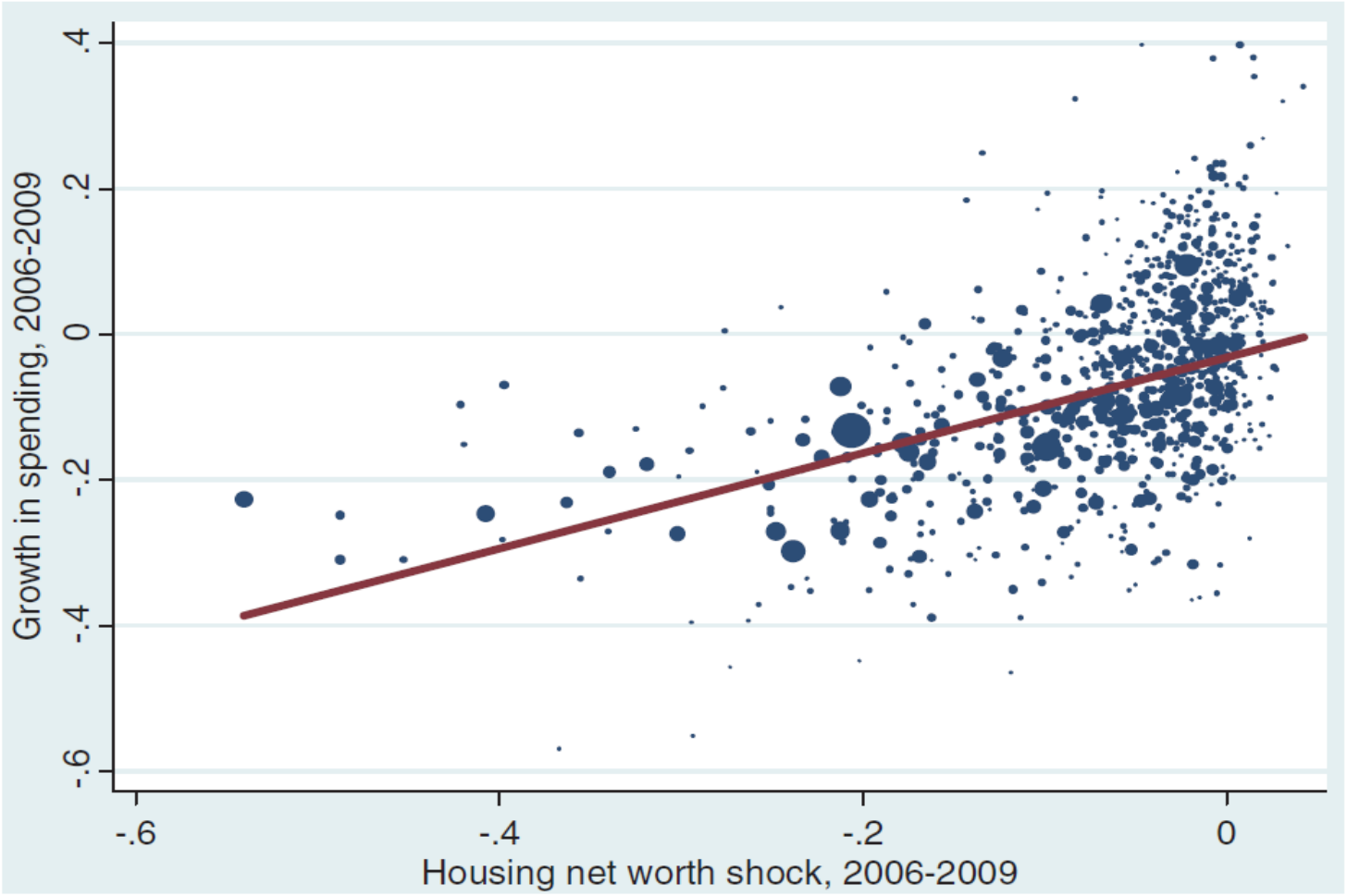

FIGURE III

Elasticity of Spending with Respect to Housing Net Worth Shock

From: Mian, Rao, and Sufi, "Household Balance Sheets"

TABLE IV

AVERAGE MARGINAL PROPENSITY TO CONSUME OUT OF HOUSING WEALTH

	(1)	(2)	(3)	(4) IV	(5) State FE	(6) Excluding AZ, CA, FL, NV
Change in home value, $000, 2006–9	0.054**	0.119**	0.051**	0.072**	0.051**	0.094**
	(0.009)	(0.015)	(0.011)	(0.021)	(0.013)	(0.017)
(Change in home value, $, 2006–9)^2		0.432**				
		(0.076)				
Construction employment share, 2006			−9.748	−2.915	−7.449	−2.305
			(5.479)	(7.800)	(5.379)	(5.818)
Tradable employment share, 2006			2.034	0.438	1.516	−0.795
			(2.235)	(3.783)	(2.190)	(2.496)
Other employment share, 2006			−1.568	−3.037	−2.186	−2.629
			(1.459)	(1.850)	(1.418)	(1.466)
Nontradable employment share, 2006			−1.797	−3.256	−3.341	−4.106
			(5.438)	(5.983)	(5.048)	(5.349)
Income per household, $000, 2006			−0.056*	−0.019	−0.043	−0.022
			(0.023)	(0.032)	(0.030)	(0.029)
Net worth per household, $000, 2006			0.003*	0.002	0.002	0.002
			(0.001)	(0.001)	(0.002)	(0.001)
Constant	−0.830	0.263	3.311**	3.211**	3.396**	3.415**
	(0.536)	(0.554)	(0.678)	(0.928)	(0.861)	(0.837)
N	944	944	944	540	944	833
R^2	0.362	0.423	0.421	0.347	0.573	0.336

Notes. Dependent variable: change in spending 2006–9 ($000). This table presents coefficients from regressions relating the change in household spending to the change in home value between 2006 and 2009. Both the change variables are in thousands of dollars. All regressions are at the county level. Standard errors are heteroskedasticity robust, clustered at the state level. All regressions are weighted by the number of households in the county. **,* Coefficient statistically different than 0 at the 1% and 5% confidence levels, respectively.

From: Mian, Rao, and Sufi, “Household Balance Sheets”

TABLE V

HETEROGENEITY IN THE MPC BY WEALTH AND INCOME

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable: ΔTotal Spending ($000), 2006–9		*Dependent variable: ΔAuto Spending ($000) 2006–9*		*Dependent variable: ΔAuto Spending ($000) 2006–9*		
	County-level analysis		County-level analysis		ZIP code–level analysis		
Δ Home value, $000, 2006–9	0.076**	0.065**	0.034**	0.047**	0.018**	0.023**	0.025**
	(0.012)	(0.015)	(0.005)	(0.005)	(0.001)	(0.002)	(0.002)
Net worth, $millions, 2006	−4.289*		−1.81**			−0.354	
	(2.132)		(0.665)			(0.243)	
(Δ Home value)*(Net worth, 2006)	−0.038		−0.024*			−0.007**	
	(0.024)		(0.009)			(0.001)	
Income per household, $ millions, 2006		−64.042*		−31.814**			−4.020
		(28.158)		(7.819)			(3.136)
(Δ Home value)*(Income per household, 2006)		−0.180		−0.432**			−0.095**
		(0.332)		(0.100)			(0.022)
Constant	1.247	2.829*	−1.30**	−0.361	−2.075**	−1.883**	−1.809**
	(0.679)	(1.212)	(0.20)	(0.332)	(0.170)	(0.121)	(0.117)
N	944	944	944	944	6,263	6,220	6,263
R^2	0.462	0.478	0.427	0.440	0.153	0.161	0.163

Notes. This table presents coefficients from regressions relating the change in household spending to the change in home value between 2006 and 2009. Regressions in columns (1) through (4) are at the county level, and regressions in columns (5) through (7) are at the ZIP code level. The dependent variables is the change in total spending in columns (1) and (2), and the change in spending on autos in columns (3) through (7). Throughout, Δ signifies change in thousands of dollars. Standard errors are heteroskedasticity robust, clustered at the state level. All regressions are weighted by the number of households. **,* Coefficient statistically different than 0 at the 1% and 5% confidence levels, respectively.

From: Mian, Rao, and Sufi, "Household Balance Sheets"

TABLE VI

HETEROGENEITY IN THE MPC: THE ROLE OF HOUSING DEBT

	(1)	(2)	(3)	(4)	(5)
	Dependent variable: Housing leverage ratio, 2006		*Dependent variable: ΔAuto spending ($000), 2006–9*		
Δ Home value, $000, 2006–9			0.006**	0.010**	0.011**
			(0.002)	(0.002)	(0.002)
Housing leverage ratio, 2006			−2.112**	−2.146**	−2.191**
			(0.228)	(0.232)	(0.230)
(Δ Home value)*(Housing leverage ratio, 2006)			0.021**	0.020**	0.020**
			(0.003)	(0.004)	(0.003)
Net worth, $millions, 2006	0.004			−0.153	
	(0.013)			(0.158)	
(Δ Home value)*(Net worth, 2006)				−0.005**	
				(0.001)	
Income per household, $ millions, 2006		0.327			0.022
		(0.233)			(1.627)
(Δ Home value)*(Income per household, 2006)					−0.059**
					(0.015)
Constant	0.595**	0.576**	−0.786**	−0.667**	−0.705**
	(0.011)	(0.016)	(0.150)	(0.150)	(0.157)
N	6,385	6,448	6,222	6,182	6,222
R^2	0.000	0.003	0.272	0.272	0.279

Notes. This table presents coefficients from regressions relating the change in household spending to the change in home value between 2006 and 2009. All regressions are at the ZIP code level. The housing leverage ratio is defined to be the ratio of mortgage and home equity debt to home value in a ZIP code as of 2006. Throughout, Δ signifies change in thousands of dollars. Standard errors are heteroskedasticity robust, clustered at the state level. All regressions are weighted by the number of households in a ZIP code. **,* Coefficient statistically different than 0 at the 1% and 5% confidence levels, respectively.

From: Mian, Rao, and Sufi, "Household Balance Sheets"

Implications and Discussion

- "the aggregate impact of wealth shocks depends not only on the total wealth lost but also on how these losses are distributed …. [L]everage in combination with asset price shocks can translate into demand-driven recessions."
- "The drop in value of housing between 2006 and 2009 is equal to $5.6 trillion …. An MPC of 0.06 implies that the [resulting] drop in consumption … is equal to $336 billion," or about 2.3% of GDP.
    - What is this an estimate of?
    - Concerns?

V. A Little about GLS, Heteroskedasticity-Consistent Standard Errors, Clustering, and All That

The Big Picture

- We spend much of the course worrying about the possibility that coefficient estimates (or other estimates of economic relationships) may be biased.
- But standard errors can also be biased – sometimes greatly.
- Just as there is no mechanical way to solve the problem of potential bias in point estimates, there is no mechanical way to solve the problem of potential bias in standard errors.

Basics

- Consider $Y = X\beta + \varepsilon$. The standard errors of the OLS estimates of β are the square roots of the diagonal elements of $(X'X)^{-1}X'\Omega X(X'X)^{-1}$, where Ω is the variance-covariance matrix of ε.
- Thus, standard errors can be computed using $(X'X)^{-1}X'\hat{\Omega}X(X'X)^{-1}$, where $\hat{\Omega}$ is an estimate of Ω.
- The basic idea of corrected standard errors is to use information from the estimated residuals to construct $\widehat{\Omega}$.

The "Original Sin" of Corrected Standard Errors

- Since $\Omega \equiv \mathrm{E}[\varepsilon\varepsilon']$, it is tempting to estimate Ω as $\hat{\Omega} = \hat{\varepsilon}\hat{\varepsilon}'$, where $\hat{\varepsilon}$ is the vector of regression residuals.
- With this choice of a $\widehat{\Omega}$, our estimated variance-covariance matrix for $\hat{\beta} - \beta$ is $(X'X)^{-1}X'\hat{\varepsilon}\hat{\varepsilon}'X(X'X)^{-1}$.
- We can write this as $(X'X)^{-1}(X'\hat{\varepsilon})(X'\hat{\varepsilon})'(X'X)^{-1}$.
- Since $X'\hat{\varepsilon} = 0$, this gives us standard errors of zero.
- Oops!

For More on These Issues

- See the handout.