Essays on Government Policy and Macroeconomics

by

William Morris Segal

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Doctoral Committee:

Associate Professor Christopher L. House, Chair
Professor Dennis R. Capozza
Professor Matthew D. Shapiro
Professor Rüdiger Bachmann, RWTH Aachen University

Dedication

To my mother, Sue Ellen Hange, and my father, Jack K. Segal

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I would like to first thank my committee, Christopher House, Matthew Shapiro, Dennis Capozza, and Rüdiger Bachmann, for their advice in preparing my dissertation. I also want to thank Kathryn F. Folio for her help and support.

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Abstract

This dissertation consists of two chapters on the effect of government policy and macroeconomics. Chapter 1 analyzes two aspects of post 1980 United States regulatory regime for commercial banks. Using FDIC historical and bank level data, it finds that risk weighting led to the industry holding more mortgages, mortgage securities, and derivatives while asset concentration is associated with the largest banks maintaining less capital, increased mortgaged lending during the housing boom, and large derivative positions. These findings suggest that allowing asset concentration and managing the risk of banks through risk weighting contributed to the Great Financial Crisis of 2007.

Chapter 2 focuses on how the Great Inflation of the 1970s caused a significant rise in household income taxes. As the tax brackets were not automatically indexed for inflation, average and marginal tax rates increased. Since households could expect that the tax brackets would be adjusted for inflation in the future and inflation was persistently high for several years there was an incentive for intertemporal labor substitution. I simulate a model to estimate the importance of this phenomenon and find that the shock can account for a significant amount of the fall of labor during both episodes of the Great Inflation. These results offer a possible reason for rising inflation and falling employment in the 1970s and that institutional features such as sticky tax brackets can be important sources of monetary non-neutrality.

Chapter 1

The Modern Regulatory Regime and Commercial Banking in the Years before the Great Financial Crisis of 2007

Introduction

From 2007 to 2011 three hundred and fifty-one commercial banks have failed.[1] That is three hundred and twenty-seven more than the number of banks that failed between 2000 and 2006. This understates the number as many impaired banks were sold before they technically failed. A series of unprecedented government programs were launched. The United States Government responded with programs to buy bank assets, inject capital, and issue new guarantees on banks' liabilities. Four years later concerns about the fragility of the United States banking still remain.

The crisis raised serious issues about the recent activities and regulation of banks and their regulation behavior. Banks were seen as being highly exposed to the mortgage market and over the counter securities while having low liquidity. Further, many commentators believe that banks significantly lowered the credit standards for mortgages thus making their mortgage portfolio highly dependent upon rising house prices. Consolidation in the banking industry in the previous decades raised the amount of government assistance targeted to save the largest banks. Banks have also been criticized for heavy use of derivative contracts and other "special purpose vehicles" that hinder the ability of outsiders to monitor their risk. In addition, whether banks had sufficient capital reserves in the years preceding the crisis has been a significant question.

[1] FDIC: Failed Bank List. 2011. FDIC. http://www.fdic.gov/bank/individual/failed/banklist.html (accessed March 1, 2011).

A central focus in the aftermath has been on new regulations to reduce the probability and cost of a future crisis. The approach to bank regulation had changed significantly since the 1970s. Banks were given wider choices in terms of their assets and liabilities and they were allowed to expand their operations and size. On July 15, 2010, the United States Congress passed a major financial reform. The Dodd-Frank Wall Street Reform and Consumer Protection Act will attempt to fix the perceived failures of the past regulatory system. Further, in December 2011 the Federal Reserve used the Act to announce that U.S. banks will be subject to Basel III which is an international agreement on banking regulation that is intended to improve upon previous Basel Accords.[2] However, little attention has been paid to what one can learn from the previous regulatory regime other than that it was unsuccessful.

Understanding the impact of the reforms since the 1980s is crucial to designing proper regulation. If those reforms helped cause the crisis, then we need to learn how they were inadequate. Many aspects of the current proposals do not fundamentally change the current regulatory regime; they are merely focused on improving its basic methodology. Thus, we should develop facts of what exactly has changed in commercial banking over the last twenty years and how regulations have contributed to these changes. This paper analyzes two major changes in the regulatory regime on commercial banks using aggregate and bank level data from the FDIC. The first is how the introduction of risk-weighted assets contributed to increased amounts of capital, mortgages, and derivatives held by banks. The second is on the change to allow larger banks and how the composition of the portfolio varied across banks by the size of their assets.

Section 1: Portfolio Allocation

History

The composition of aggregate commercial bank holdings has changed during the last century. Traditional banking, such as loans to finance business investment or mortgages,

[2] Fed Proposes New Capital Rules for Banks. 2011. New York Times. http://www.nytimes.com/2011/12/21/business/fed-proposes-new-capital-rules-for-banks.html?_r=1 (accessed January 17, 2012).

has seen its profit margins dwindle. Banks have moved from holding vast quantities of government securities towards mortgages, derivative operations, and by 2004 received 45% of their non-interest income from off-balance sheet activities.[3] The regulatory framework has gone from a period of a rules-based approach towards a hybrid-regime that allows banks wider latitude in meeting overall standards. This section will argue that the regulatory approach chosen in the 1980s to govern banking was a major impetus for the move towards mortgages, derivatives, and low holdings of liquid securities.

From the passage of the Banking Act of 1933 through 1980, the United States had a highly regulated commercial banking system. Commercial banks had significant restrictions on their activities, such as a prohibition on insurance and most investment banking, and high reserve requirements. This approach focused on considering only the riskiness of a particular security and not the riskiness of the bank's overall assets. For example, commercial banks were only allowed to hold private debt securities that were approved by regulators and they were not allowed to issue public securities on behalf of firms. However, changes in the marketplace and government policy put an end to this era.

Financial innovation led to money market and mutual funds that competed with banks for financing. It became easier for firms to issue securities to the public such as through the junk bond market rather than through a bank loan.[4] Internationally, banks in other countries began to see significant growth. In particular, Japanese banks in the 1980s saw significant growth and operated under a looser set of restrictions. There was concern that the regulations were putting U.S. banks at a major disadvantage.[5] In the 1980s the authorities began to remove the restrictions on commercial banking. Regulation Q, restricting interest rates on bank liabilities, was removed in 1980. Regulators also began liberalizing the rules proscribing the securities that banks could hold. The removal of these restrictions on the banks' asset and liabilities meant the regime was in need of a new methodology for bank regulation.

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[3] Mishkin, Frederic. 1998. *The Economics of Money, Banking, and Financial Markets*. 5th Edition. Reading, Mass: Addison-Wesley. Page 240

[4] Mishkin, Frederic. 1998. *The Economics of Money, Banking, and Financial Markets*. 5th Edition. Reading, Mass: Addison-Wesley. Page 240

[5] Tarullo, Daniel. 2008. *Banking on Basel: the future of International Financial Regulation.* Washington, D.C.: Peterson Institute for International Economics. Page 46

The post 1970s regulatory regime was to be a supervisory approach. Rather than relying upon strict rules, banks were given wide latitude to make decisions subject to meeting broad overall standards.[6] Two notable motivations were driving this new methodology amongst regulators. One was a philosophical shift towards the belief that market discipline was strong enough to curtail the riskiest behavior. During the committee hearings that led to the Banking Acts in the 1930s, banking was portrayed as a run-away industry focused on short-term profit where unscrupulous behavior was the norm and competition was destabilizing.[7] The new era saw competition as a stabilizing force that drove the banker to maximize the bank's value. A possible empirical reason for this new view of banking was that the banking system had collapsed during the Great Depression but in the recent decades before the 1980s defaults were very low. The second driving force viewed the previous rules-based approach as being very costly. New analyses suggested that the old set of rules missed profitable opportunities and that considering the risk of the entire portfolio rather than the risk of a particular item could reduce risk.

Risk Weighting

These developments led to the Basel Accord in 1988. It was an international agreement amongst the major economic countries through the Basel Committee on Banking Supervision. This was seen as crucial to overcome the fears of a 'race to the bottom' between countries. It accepted the idea that market discipline would be a force to encourage safer banking. Its essence was a set of minimum capital requirements that banks had to meet but they were allowed significant leeway in satisfying. These capital requirements consisted of two standards: one based on assets and the other on a risk weighted asset measure. In the United States, numerous regulators including the FDIC enforce these standards. Failure to meet the minimum requirements grants permission to the FDIC to close the bank.

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[6] Tarullo, Daniel. 2008. *Banking on Basel: the future of International Financial Regulation.* Washington, D.C.: Peterson Institute for International Economics. Page 15

[7] Gart, Alan. 1994. *Regulation, deregulation, reregulation: the Future of the Banking, Insurance, and Securities Industries.* New York: J.Wiley & Sons.

The first solvency standard required banks to have their core capital to assets, the leverage ratio, at least 4%. The previous era of regulation in the United States put little emphasis on capital relative to assets except expecting the bank to have a positive net worth. The focus was on liability restrictions such as reserve requirements though banks did have restrictions on holding certain assets. Regulators used leverage more as a guideline than as an active way to monitor banks. There were two common claims put forth as rationale for the minimum capital requirements.[8] One is that it provided a buffer for losses. If assets declined in value, capital served to reduce the chance of insolvency and the cost of bankruptcy (or a government bailout). The second and more recent argument was that the requirement reduced risk-taking. Some models suggested that if bankers had more of their own 'skin in the game' then they would act prudentially. Further, this type of thought also viewed banks as attempting to maximize their leverage and hence their risk. The view was that bankers would want to hold less capital than is required by regulators if otherwise allowed.[9] In addition, a fall in book equity to assets from over 50% in 1840 to 4% in the 1980s raised concerns that banks' were not holding enough capital.[10]

The second solvency standard required the bank to meet capital requirements in regards to its risk weighted assets. All assets were assigned a weight that purported to convey the degree of risk in the item; the weights acted as a tax on the assets as higher risk weighted assets meant additional capital. Banks must have their Tier 1 capital to risk weighted assets be at least 4% and their total capital (Tier 1 and Tier 2) at least 8%.[11] Risk weighting assets was not a new idea. United States regulators had begun experimenting with the approach in the 1950s and French regulators had implemented a system similar

[8] Tarullo, Daniel. 2008. *Banking on Basel: the future of International Financial Regulation.* Washington, D.C.: Peterson Institute for International Economics. Page 16
[9] Mishkin, Frederic. 1998. *The Economics of Money, Banking, and Financial Markets*. 5th Edition. Reading, Mass: Addison-Wesley. Page 215
[10] Tarullo, Daniel. 2008. *Banking on Basel: the future of International Financial Regulation.* Washington, D.C.: Peterson Institute for International Economics. Page 31
[11] International Convergence of Capital Measurement and Capital Standards. 2010. Bank of International Settlements. http://www.bis.org/publ/bcbsc111.pdf (January 17, 2010). Page 13

to the Basel Accord in 1979.[12] But now risk weighting would be the centerpiece of banking regulation. The risk weights were designed to decentralize the way banks made decisions over assets. Banks would be mostly free to pick assets and the risk weights would be informative of the overall risk of the portfolio. However, the risk weights were assigned by broad categories and with little empirical information. Thus residential housing finance was given a risk weight of .5 and commercial loans a weight of 1. Basel advised nations to consider choosing loan to values requirements or seniority to differentiate the risks in different types of mortgages.[13] In the United States this was implemented by requiring mortgages to be first lien mortgages but not limiting the loan to value, credit worthiness, or interest rate. This meant that commercial loans to the safest firms began to be 'taxed' at a higher rate than the riskiest first lien mortgage. Further, it was not claimed, nor is it clear, that commercial loans were in fact twice as risky as residential finance. Basel acknowledged merely that residential finance had a low record of defaults in most countries not that the number was chosen with regard to an actual risk metric.[14] Another example is assigning the risk weight of 1 to all private securities regardless of any other distinguishing features. A key issue was that the risk weights at best were focused on idiosyncratic rather than systematic risk. Thus the weights did not change based on economic conditions; this meant that the risk-weights have a pro-cyclical impact on the balance sheet. Off-balance sheet items such as loan commitments and derivatives were treated as non-assets in the leverage ratio and there was a system to attempt to include them in the risk weighted assets. This issue is discussed later in the paper. So while the new system was to consider the risk of a portfolio rather than the individual securities, the risk weights were not carefully constructed to reflect the riskiness of the portfolio.

[12] Tarullo, Daniel. 2008. *Banking on Basel: the future of International Financial Regulation.* Washington, D.C.: Peterson Institute for International Economics.
[13] International Convergence of Capital Measurement and Capital Standards. 2010. Bank of International Settlements. http://www.bis.org/publ/bcbsc111.pdf (January 17, 2010).
[14] Ibid.

Table 1: Risk Weights and Example Assets[15,16]	
Risk Weight	Example Assets
0%	• Cash • Government Securities
20%	• Agency Securities • Bonds issued from Banks under one year maturity
50%	• Residential Mortgages of owner-occupied housing
100%	• Private Sector securities and loans

There have been numerous attempts to make slight reforms to the Basel Accord of 1988. One key element has been that it did allow national regulators to set specific definitions and standards. So the implementation between the United States and France was not exactly the same. And thus national regulators have focused on making their own small adjustments over time and have their own unique regimes.

In the United States, the system was implemented through the CAMELs rating system, which stands for Capital Adequacy, Asset Quality, Management, Earnings, Liquidity, and Sensitivity to Market Risk.[17] Problems with Basel were well known from the start and became more apparent over time. Regulatory arbitrage was considered a major issue that was allowing banks to improve their standings via the Basel constraints but not change their actual risk. And as some financial innovations became more popular such as derivatives, U.S. regulators modified the way the procedures accounted for them in 1998.[18]

[15] International Convergence of Capital Measurement and Capital Standards. 2010. Bank of International Settlements. http://www.bis.org/publ/bcbsc111.pdf (January 17, 2010).
[16] Tarullo, Daniel. 2008. *Banking on Basel: the future of International Financial Regulation.* Washington, D.C.: Peterson Institute for International Economics. Page 58
[17] FDIC. 2004. *DSC Risk Management Manual of Examination Policies.*
[18] Ibid.

The Basel Committee on Banking also started a new dialogue to create what would be known as Basel II. The negotiations began in 1998 but it was not published until 2004.[19] Basel II continued the basic Basel I approach but sought to reduce regulatory arbitrage and grant banks further incentives to monitor their own portfolios. It proposed certifying some banks to create their own risk weighting systems and allowing some other banks to use credit ratings from the credit rating agencies to assign risk weights versus using the weights in Basel 1. The incorporation of the new market risk models, such as 'Value at Risk,' would be used to include information on how sensitive the bank would be to a change in market conditions. Some of these ideas were implemented earlier than the actual agreement in the United States. However, the basic regime remained the same: a leverage ratio and a capital to risk weighted assets requirement.

Theory

The economic theory on solvency regulations has been developed using the tools of portfolio analysis. This approach builds upon the Capital Asset Pricing Model developed by Sharpe, Lintner, and Markowitz. A starting assumption is that a quadratic Von Neumann-Morgenstern utility function can describe the bank's objective function or that the risky assets' distribution belongs to particular distributions that can be described by only the first two moments (the mean and variance).[20] If one assumes that banks act as if they are fully liable and that there are no solvency regulations, then their chance of failure (a negative net worth) is falling as their capital ratio is rising. In addition, if one defines the capital ratio as the equity capital divided by their level of risk-weighted assets and that the risk-weights reflect to some degree the riskiness of assets, then their chance of failure is also falling as the capital ratio increases. This is the logic that underpins the solvency regulation approach. However, if the model is extended to where the bank chooses its portfolio in the presence of the constraints, then the logic breaks down. If the risk-weights are not collinear with the expected excess returns, then the banker chooses

[19] Tarullo, Daniel. 2008. *Banking on Basel: the future of International Financial Regulation.* Washington, D.C.: Peterson Institute for International Economics.
[20] Freixas, Xavier and Jean-Chares Rochet. 2008. *Microeconomics of Banking.* 2nd ed. Cambridge, MA: MIT Press.

an inefficient portfolio. The model predicts that the banker will reduce the total value of the risky assets but will also cause a composition bias: substitution towards the riskier assets. [21]

As an example of the composition bias consider the following model adapted from Freixas and Rochet. [22] A bank maximizes the following objective function by choosing s (the risk free asset), x (a risky asset), and y (a second risky asset):

$$r_s s + r_x x + r_y y - \frac{A}{2}(\sigma_x^2 x^2 + \sigma_y^2 y^2)$$

Subscripts denote the returns and variance associated with each type of asset. The role of A is to represent risk aversion on the part of the bank. At the moment, the value of A is assumed to be positive but its value will be discussed below. For simplicity, we can fix the total assets of the bank, by that the risk free asset equals a given value minus the risky assets, and focus on the portfolio allocation issue. Taking first order conditions and re-arranging, the solution for x^* and $y^*$are:

$$x^* = \frac{r_x - r_s}{A\sigma_x^2}$$

$$y^* = \frac{r_y - r_s}{A\sigma_y^2}$$

Note that:

$$\frac{dx^*}{dr_y} = 0$$

The optimal holdings of x^* do not depend on the returns of y^*.

Now, consider adding on a risk-weighting requirement such as:

$$\alpha_x x + \alpha_y y \leq K$$

[21] Ibid.
[22] Ibid.

Where K is a measure of the bank's capital. The alpha terms here are the positive risk weights. This is a general formulation. This could include a simple leverage constraint to a more general version with the alphas being different. Taking first order conditions and re-arranging:

$$x^{**} = x^{*} - \frac{\lambda \alpha_x}{A\sigma_x^2}$$

$$y^{**} = y^{*} - \frac{\lambda \alpha_y}{A\sigma_y^2}$$

Where x^{*} and y^{*} are the unconstrained solutions and the lambda is the Lagrange multiplier on the constraint. Observe the holdings of x^{**} and y^{**} has fallen if the constraint binds. Thus, the "risky portfolio" (x^{**} and y^{**}), decreases. Eliminating the Lagrange multiplier I can show that:

$$x^{**} = x^{*} - \frac{\alpha_x}{\sigma_x^2}\frac{\sigma_y^2}{\alpha_y}(y^{*} - y^{**})$$

If the constraint binds then I can substitute out y^{**}:

$$x^{**} = x^{*} - \frac{\alpha_x}{\sigma_x^2}\frac{\sigma_y^2}{\alpha_y}(y^{*} - \frac{K - \alpha_x x^{**}}{\alpha_y})$$

Differentiating with respect to r_y I can show that:

$$\frac{dx^{**}}{dr_y} \leq 0$$

This shows that if the constraint binds, not only will the size of the risky portfolio changes but the relative holdings within the risky portfolio will as well, shifting in favor of assets with higher returns. This composition bias will result even across assets with the same risk weight as long as the returns differ. In the case of returns being the same or the risk weights being collinear to the excess returns, then the composition bias would not be present. The composition bias effect does not disappear if I add in correlations into the model. While the unconstrained holdings would then depend on the returns of the other

assets, the constrained holdings would increase the sensitivity and shift the risky portfolio towards assets with higher returns. Further, it is also possible for the overall risk of bank to increase.[23]

There are several possible extensions of this approach. One would be to recognize that the bank is not fully liable and thus its losses are capped. A second extension would be to include the sources of the bank's assets such as deposits and other borrowings. Including deposits would notably bring in a discussion of deposit insurance, which the literature often sees as providing the bank with a put option. A third consideration might include a discussion of whether the bank manager is actually risk averse. Perhaps the banker prefers to maximize profits regardless of risk and so a negative value of A would be appropriate or allow a manager who can expect to have moved to a different bank or retire before a risky position shows losses. *A priori* it will not be clear what happens to the overall risk of the bank, but the presence of risk weighting will generally still encourage the bank to move towards the assets where there is a mismatch between the excess returns and the risk weight on them.

These theories suggest that proper risk weights are crucial to the success of solvency regulation. Improper risk weights can encourage banks to actually increase their holdings of some risky assets. The rules become a 'tax' discouraging relatively highly weighted investments in favor of low weighted ones while also encouraging substitution towards assets with higher excess returns. As suggested from the above discussion, the risk weights chosen at Basel were not an attempt to fit them relative to actual excess returns. There was a strong bias towards rating government securities, regardless of the government's credit worthiness, as having a risk weight of zero.[24] Furthermore, residential finance since was considered a social good, there was an interest in subsidizing it via a low risk weight.

[23] Kim, D. and A.M. Santomero. 1988. "Risk in Banking and capital regulation." *Journal of Finance* , 43(5): 1219-1233.

[24] This has been suggested as a reason for European Banks having large holdings of government securities from the most fiscally troubled countries in Europe

The Data

If the introduction of the capital requirements and the risk weights impacted the behavior of banks, then we should expect several changes in the composition of assets held by banks. The leverage ratio should raise the amount of capital that banks have and the assets of banks should shift in favor of items with lower risk weights. I show evidence of these using two data sets: the FDIC Historical Statistics on Banking (HSOB) and the FDIC Statistics on Depository Institutions (SDI). The former is an annual dataset from 1954 through 2008 that reports aggregate statistics on broad categories in the commercial banking system. Using this publicly available data, I show the behavior of the composition of banking assets across time by dividing a particular group of assets held for the entire industry by the aggregate assets. This can be shown to be a weighted average of the individual banks portfolios where the weights are the assets. With this metric, I examine the changes in the portfolio in the years around 1988. The items of interest will be expected to change in the years before and after 1988. One reason is that banks change their behavior in the anticipation of regulatory changes. Secondly, there were lags in implementation and many assets held by banks are essentially stocks.

The SDI dataset is a quarterly dataset of individual banks from December 1992 through December 2008. It contains detailed information that I obtained by a FOIA request. While starting a few years after the Basel era began, it nonetheless should be expected to be relevant as the banking industry takes time to react and will be useful in considering Basel and the Great Recession of 2007. I aggregate the SDI data to the level of bank holding companies, companies that own one or more banks, and screen out banks that are or are very close to being insolvent. The latter are typically in the process of being sold by the FDIC to other banks. I use the December balance sheet data as an annual number. Using other quarters does not qualitatively alter the results.

Rise of Capital Reserves

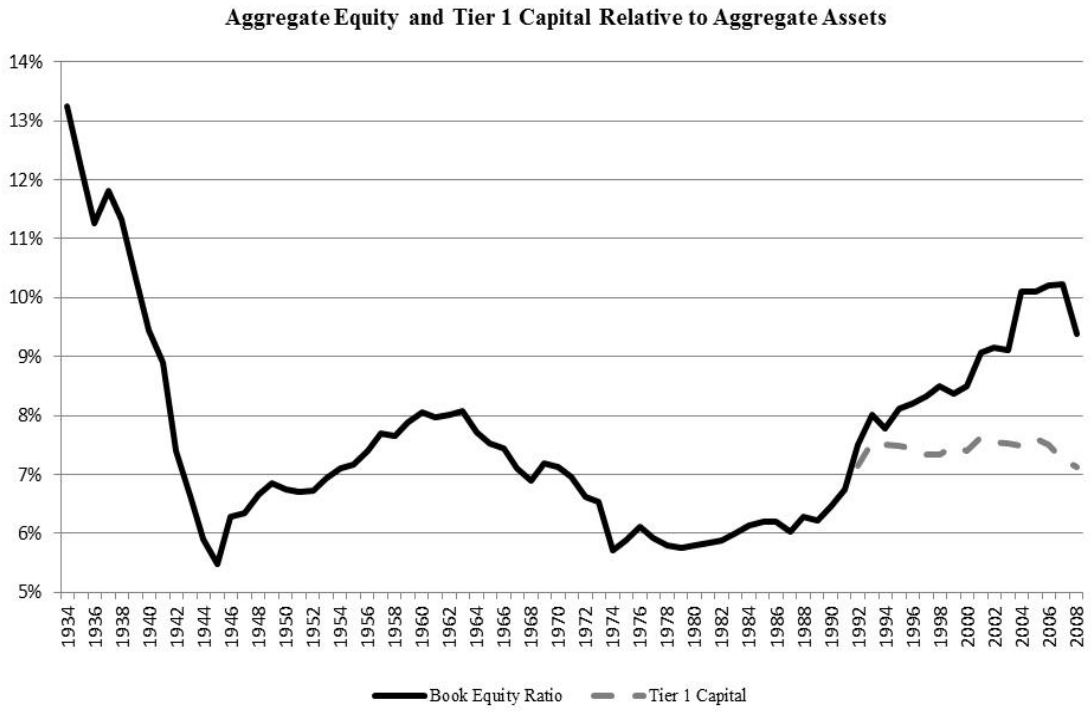
A call for reducing leverage is a common recommendation as part of long-run reform of the banking system. Roger Lowenstein claims, “the surest solution [to reduce risk] is to

limit the leverage of financial institutions."[25] The Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 allows regulators to increase leverage as they see appropriate and let it vary by size of the bank.[26] Anil Kashyap has suggested an elaborate method to artificially create time-varying capital controls under the supervision of a systematic regulator.[27] However, few current discussions have recognized that Basel was focused on raising capital reserves. Thus an analysis of the effectiveness of the initial attempt at raising capital reserves would be beneficial before future attempts at reform are made.

A key point to note is that "equity" and capital are not the same and that there are several measures of capital. I will define equity as the book difference between the bank's recorded assets and its liabilities. Capital is a narrower term that deducts certain types of assets. Further, the system defines 3 important types of capital: Tier 1, Tier 2, and total capital. Tier 1 is considered the highest quality capital and is sometimes referred to as "tangible equity" as it includes equity but subtracts some items such as most intangible assets. Tier 2 is lower quality capital and may even include certain types of debt and tax assets. Total Capital is the summation of the two. The bank must meet certain requirements between its assets, Tier 1, and Total Capital to be rated a sound financial institution by the FDIC. These distinctions make it difficult to casually refer to "leverage" or even "capital" in the banking system as it is possible for the leverage measure to vary based on the measure. I will refer to Tier 1 capital as capital in the following.

[25] Lowenstein, Roger. 2010. "Commentary: First, Slap Limits on Bank Leverage." *Business Week*. March 11. http://www.businessweek.com/magazine/content/10_12/b4171026575784.htm
[26] Bill Text 111th Congress (2009-2010) H.R. 4173.ENR. 2010. The Library of Congress. http://thomas.loc.gov/cgi-bin/query/D?c111:6:./temp/~c111Jr45rg:: (Accessed August 12, 2010).
[27] Kashyap, Anil. 2009. "Where do we go from here?" Remarks at the Federal Reserve of Chicago's 12th International Banking Conference. http://faculty.chicagobooth.edu/anil.kashyap/research/internationalbankingconfremarks.pdf (Accessed May 1, 2010).

Figure 1



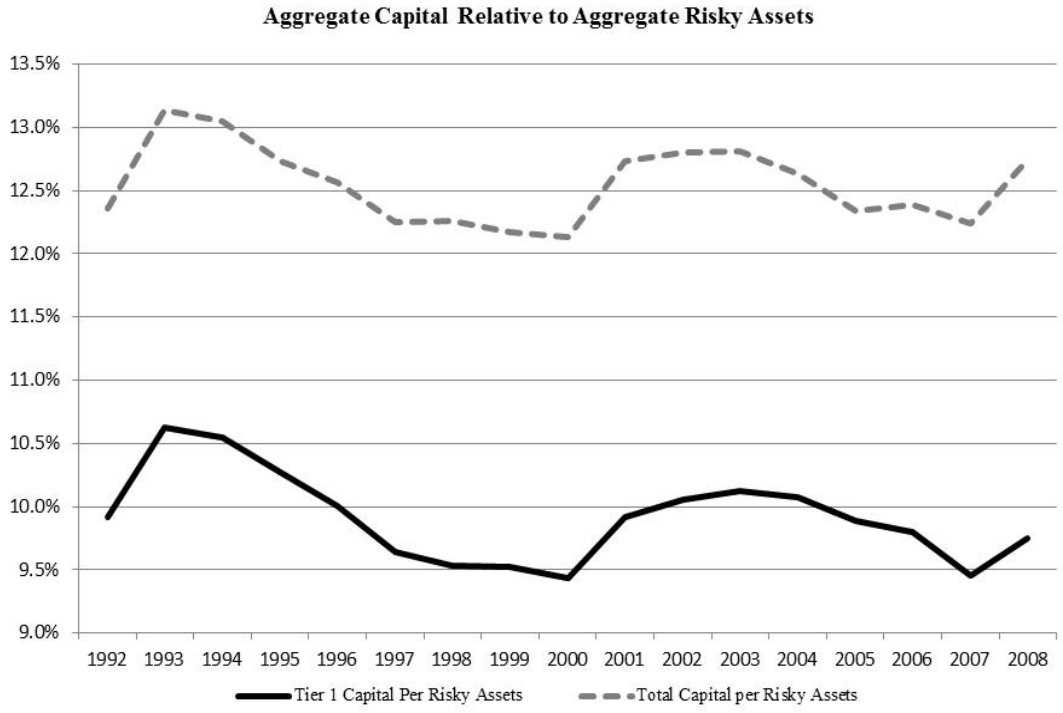
Note: The figure shows aggregate nominal book equity and Tier 1 Capital held by banks each divided by aggregate nominal assets held by banks. The figure's sources are the Historical Statistics on Banking and the Statistics on Depository Institutions.

In Figure 1 I have graphed the book equity ratio and the Tier 1 Capital Ratio. The book equity ratio is the weighted average book equity divided by assets, with the weights being the assets, from 1934 through 2008. I calculated the data using the FDIC Historical Statistics on Banking. In E-1, the equity ratio has risen from 5% in 1945 to 9.3% in 2008 off from a high of 10.2% in 2007. There was steep growth of equity ratio from 1945 to 1963 followed by a period of low equity ratios till 1989. Following that year the banking system's equity ratio quickly increased throughout the 1990s. Since 1995, the equity ratio has been higher than it was during the period of 1945 till 1995. Thus the implementation of Basel is associated with an era of historically low leverage, as measured by book equity, in the post-World War 2 era.

In Figure 1 I have also graphed the weighted average Tier 1 capital ratio. I only have this data from 1992 onwards. Relative to the book equity ratio, Tier 1 capital is mostly flat

during an era of high book equity growth. It rises from 7.2% in 1992 to 7.6% in 2001. It has a slight decline from 7.6% in 2005 to 7.1% in 2008. The major difference between the two series post-1992 is the increase in intangible assets most of which are ineligible for usage as capital. They grow from .4% in 1992 to 3.2% in 2008 through the wave of mergers in the banking industry. One can gain a longer-term perspective on the leverage ratio by noting that Tier 1 is at most book equity. Thus the post-Basel Tier 1 capital is also at relatively high levels in the post-World War 2 era.

Figure 2



Note: This figure shows the aggregate nominal Tier 1 and Total Capital (Tier 1 plus Tier 2) divided by aggregate nominal risky assets. The figure's source is the Statistics on Depository Institutions.

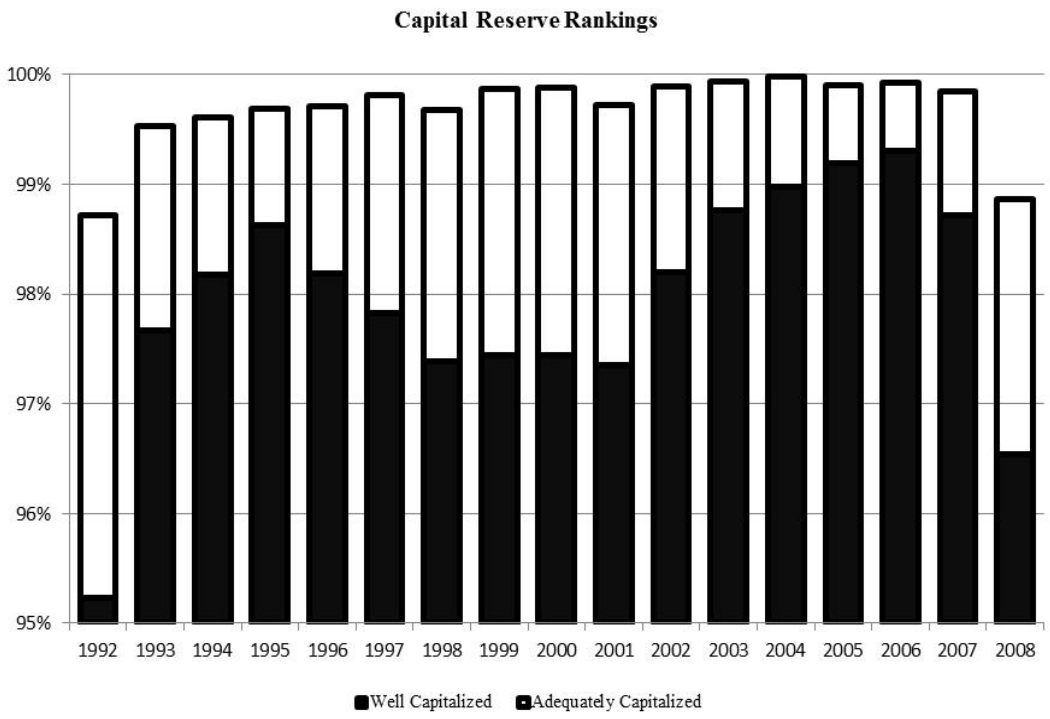
In Figure 2 I examine capital relative to Risky Assets. The solid black line shows Tier 1 Capital relative to the Basel's guidelines on calculating the risky assets of the bank. It is initially higher in the early 90s but only falls to 9.8% in 2008 from 10.6% in 1993. The total capital, including Tier 1 and Tier 2, relative to risky assets offers the same story. There is no significant change in this variable from 1992 through 2008.

Regulators encourage banks to maintain excess reserves. As one can see from Figures 1

and 2, the system had capital well in excess of the Basel Accords. In the FDIC CAMELs rating system, it rates the bank's capital reserves and offers a rating depending on the banks capital reserves across three measures: Tier 1 relative to assets, Tier 1 relative to risky assets, and Total Capital relative to Assets.[28] In Figure 3 I show the percentage of banks that meet the top two ratings: well capitalized (at least 5% of Tier 1 capital to asset, at least 6% of Tier 1 to risky assets, and at least Total Capital 10% of assets) and adequately capitalized (at least 4% of Tier 1 capital to asset, at least 4% of Tier 1 to risky assets, and at least 8% of Total Capital to assets). The ratings not shown are undercapitalized, significantly undercapitalized, and critically undercapitalized. Figure 3 shows that almost all banks maintain significant excess reserves as judged by the FDIC. In 1992, 95.2% of banks are considered well capitalized and this hits a peak of 99.3% in 2006.

[28]FDIC. 2004. *DSC Risk Management Manual of Examination Policies.* 2.1-7

Figure 3



Note: This figures shows the percentage of banks that met the FDIC standard of Well Capitalized (at least 5% Tier 1 Capital to Assets, at least 6% of Tier 1 to risky assets, and at least 10% of Total Capital to assets) and Adequately Capitalized (at least 4% Tier 1 Capital to Assets, at least 4% of Tier 1 to risky assets, and at least 8% of Total Capital to assets). The figure's source is the Statistics on Depository Institutions.

These results are directly opposed to many current discussions of the banking industry. Countering the claim that leverage is high, when measured by book equity it is historically low and by capital it is similar to the peaks in the early 1960s. Contrary to the claim that an era of loose regulations encouraged low capital, we find the decline in leverage is associated with the current regulatory regime. Finally we see that banks exceed the statutory rules on capital.

One reason for the apparently low leverage may be whether assets are being accurately measured. Notably and discussed later, derivatives may not be properly taken into account because they are not reflected in the assets and thus effective leverage could have been rising. A related issue may be whether the risk weights for the calculation of risky assets are incorrect. For example, the risk weights are set to broad categories of assets, such as a first lien mortgage, and not linked directly to risk factors such as loan to value

or the interest rate. Inaccurate risk weights will lead to low estimates of the amount of risky assets and thus give the appearance of high levels of capital relative to risky assets. Thus if the risk of assets is increasing over time the low leverage is an illusion.

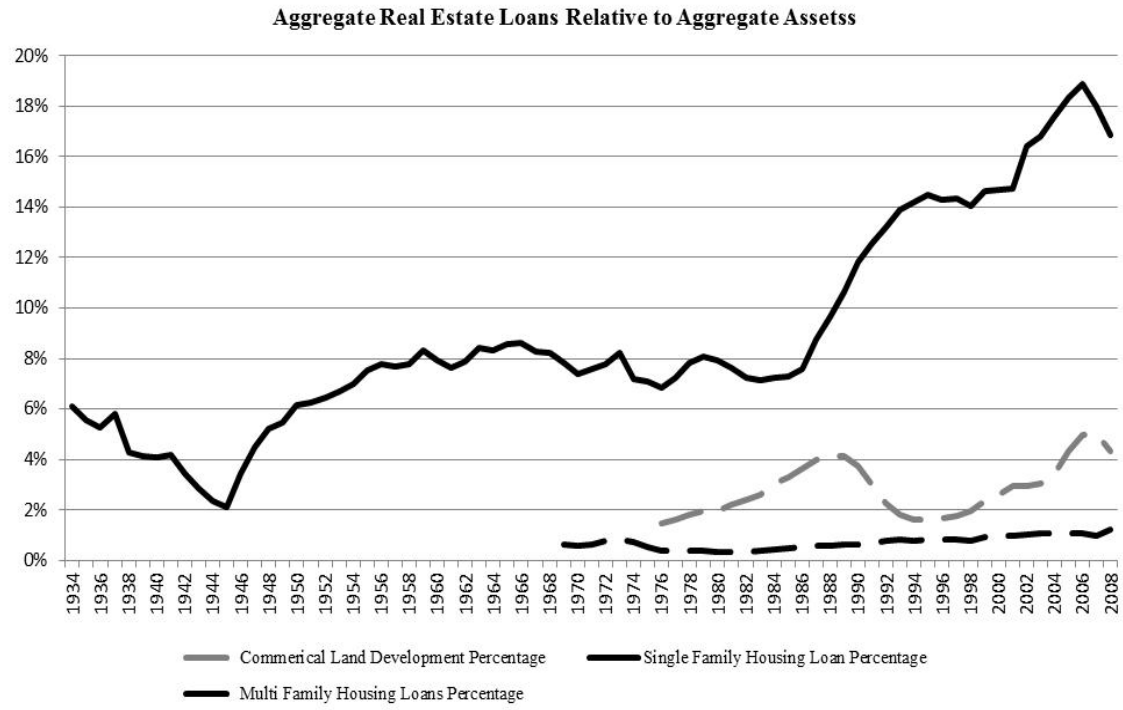
A second reason may concern the proper measurement of capital. If we consider a very simple bank, whose only asset was a $100 bond to be paid off in 5 years and issued one-year $80 bond as liabilities, then its capital would be $20. According to the usual capital standards, this bank would be very well capitalized. The bond could fall 20% in value and the bank would still be solvent. However, in the event of a lending crisis freeze or liquidity crisis this would not be enough to protect the bank from failing. If there were a crisis that prevented the bank from being able to borrow between year 1 and year 2, it would be unable to pay off its first loan of $80. The bank would have to sell the bond but if it could not then it would be insolvent. This would be true even if the bank had a capital reserve of 99%. This issue is particularly relevant for banks because they are supposed to specialize in illiquid, or at the very least, less liquid assets. If it cannot easily transform its assets into a form that can pay off its liabilities, then using those assets for the calculation of its capitalization is irrelevant.

Rise of Mortgages

Housing finance has received significant attention during the financial crisis and its relationship to the Housing bubble. Receiving less attention has been the risk weights on housing finance in the regulations. As mentioned earlier, first lien mortgages received preferential treatment with a risk weight of .5 as opposed to 1 for most other types of non-government loans. While it may be that the average first lien mortgage, a mortgage that has the highest seniority, is less risky than the average commercial loan, it is unlikely that a subprime mortgage with an adjustable interest rate is less risky than a secured commercial loan to a Fortune 500 company. However, the regulations do not distinguish this focusing only on whether it is a “first lien mortgage” thus encouraging the accumulation of first lien mortgages at the expense of higher rated assets. Further, the composition bias effect from the earlier model suggests that if the excess returns of home

equity loans and non-first lien mortgages are greater than those for commercial loans, banks should substitute towards the former as they all have the same risk weight.

Figure 4

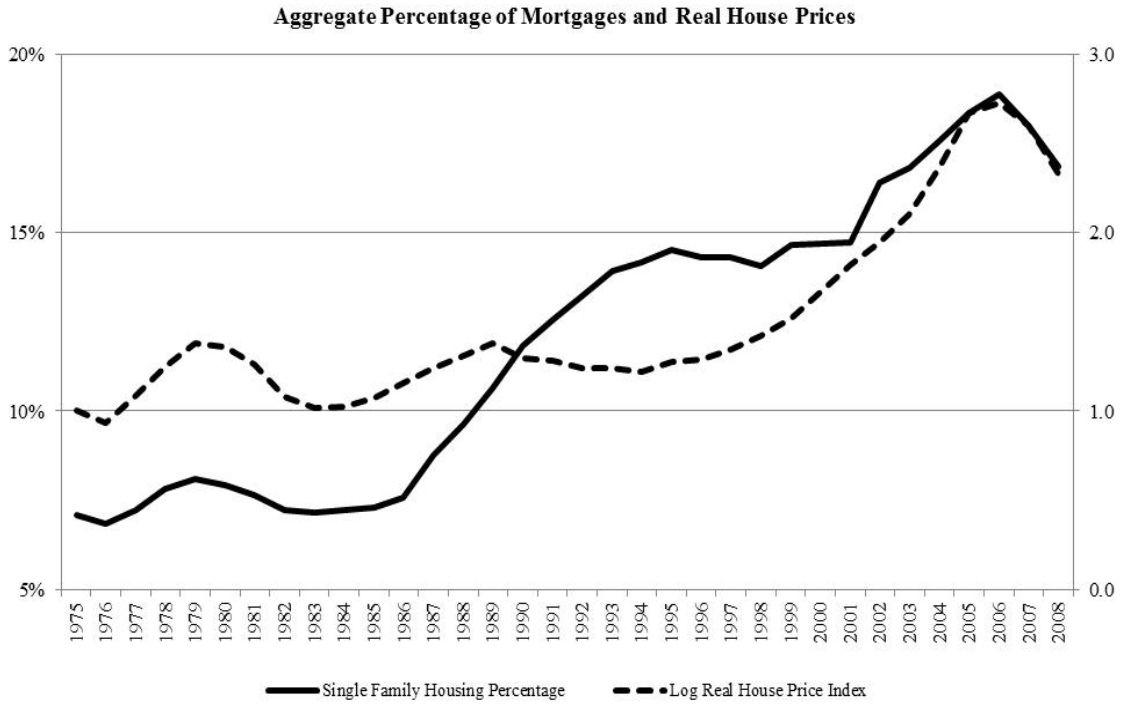


Note: This figures shows the aggregate nominal commercial land development, single family housing, and multi-family housing loans each divided by aggregate nominal assets. The figure's source is the Statistics on Depository Institutions.

In Figure 4 I show the percentage of 3 types of real estate loans as a weighted average percentage of bank assets from the FDIC Historical Statistics on Banking. The "1-4 Family Housing Loan Percentage" shows the importance of family residential housing finance to the commercial banking system. Family housing includes all residential mortgages and home equity loans. Three time periods are noticeable in the data since 1955: a stable era, and two eras of high growth. The stable era was from 1955 till 1986 when it stayed close to 8% of assets. In 1987, an era of high growth period began by obtaining a record of 8.8% and then went on to 14.5% by 1995. Then in 1999, the second high growth era began with a climb from 14.6% to 18.9% in 2006. It has since fallen slightly to 16.9% in 2008. One can contrast this with two other real estate related areas of finance. Loans for multi-family residences only rise from .6% of assets in 1969 to 1.2%

by 2008 during the years which are available. Further, loans for commercial land development are declining from 4.1% in 1988 to 1.6% in 1994. From 1999 to 2007, they rise from 2.4% to 5%. Thus during the first episode of increased bank exposure to mortgages, commercial land development is declining on the banks' balance sheets and during the second boom, it is rising in conjunction with the family housing boom. An explanation may be that when the risk weighting system came into effect, it launched a transition period where banks increased their mortgage holdings as a percentage of assets at the expense of other assets. But during the second expansion episode the positive relationship is governed by a rise in property prices.

Figure 5

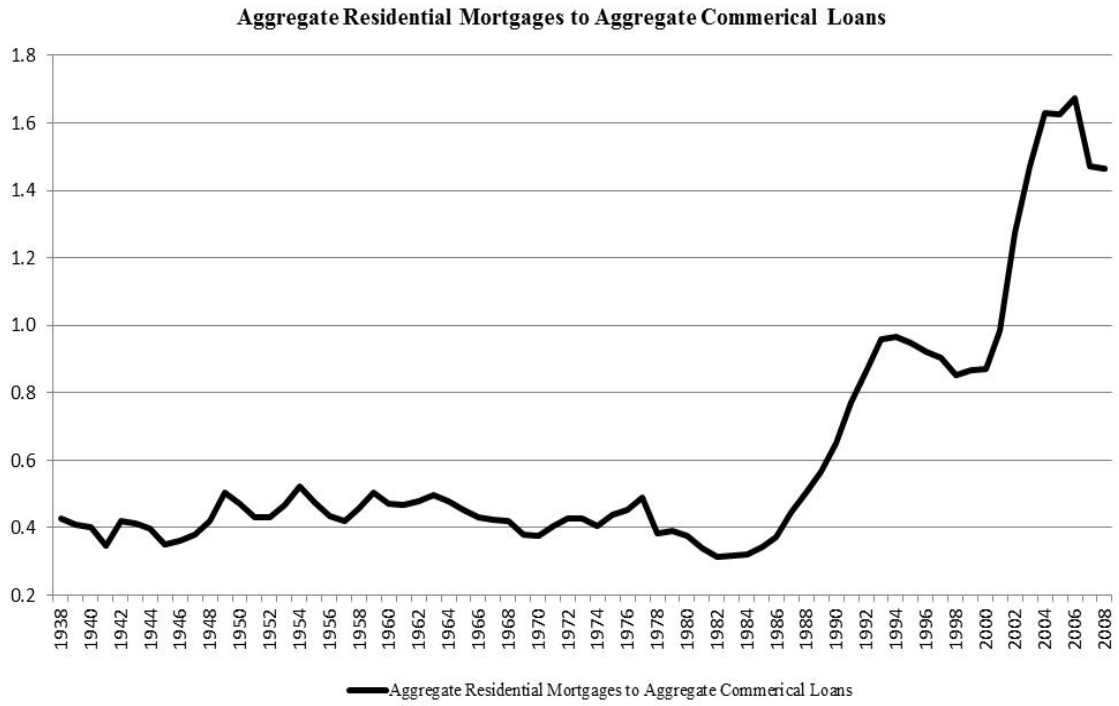


Note: This figure shows the aggregate percentage of single family housing on the left vertical axis and the log of real house prices for the nation on the right vertical axis. The figure's sources are the Statistics on Depository Institutions, the Office of Federal Housing Enterprise Oversight's House Price Index, and Consumer Price Index.

Housing price data supports a hypothesis that a risk-weighting transition explains the expansion of residential lending during the early 1990s. In Figure 5 I show the natural log of the Federal Housing Finance Agency house price index deflated by the GDP deflator during the years it is available from 1975 to 2008. I normalize a real house price index to

1 in 1975. Notably, in the period from 1975 thru 1989, and then 2000 thru 2008, the series tend to peak and decline at the same time. However, real house prices are declining during the first significant expansion in banks' mortgage holdings starting in 1989. This is evidence that the period represents realignment in the banking industry toward mortgages rather than changes in the housing market (or in spite of lower real asset prices).

Figure 6

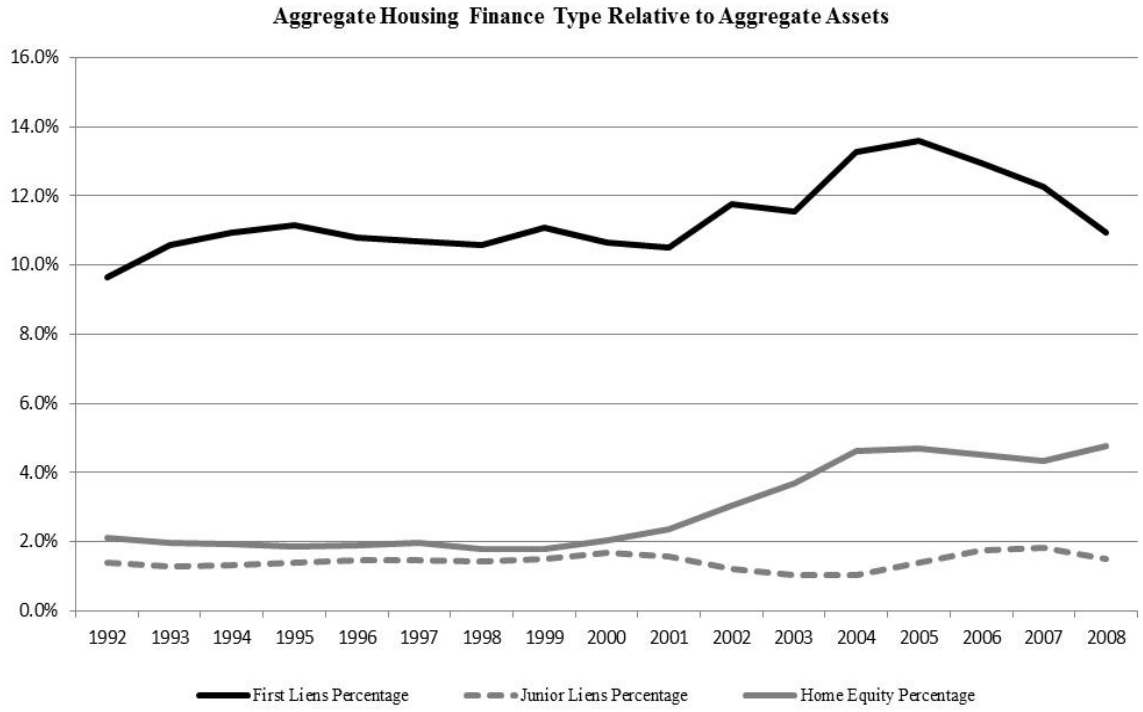


Note: This figure shows the aggregate nominal residential mortgages divided by aggregate nominal commercial loans. The figure's source is the Historical Statistics on Banking.

Further evidence of housing finance crowding out other types of loans is seen in Figure 6. This shows the amount of mortgages relative to the amount of commercial loans on the banks' balance sheets. We see that during the first mortgage boom starting in 1988, commercial loans are falling relative to mortgages as well. During the period between 2000 and 2006, while mortgages held by banks more than doubled from $.9 trillion to $1.9 trillion, commercial loans only grew from $1.05 trillion to $1.14 trillion.

Unfortunately, only the SDI dataset shows the mortgage data by type. In Figure 7, I show the percentage of bank assets that are first lien mortgages, junior liens, and home equity.

Figure 7



Note: This figure shows the aggregate nominal first lien residential mortgages, junior lien mortgages, and home equity loans each divided by aggregate nominal assets. The figure's source is the Statistics on Depository Institutions.

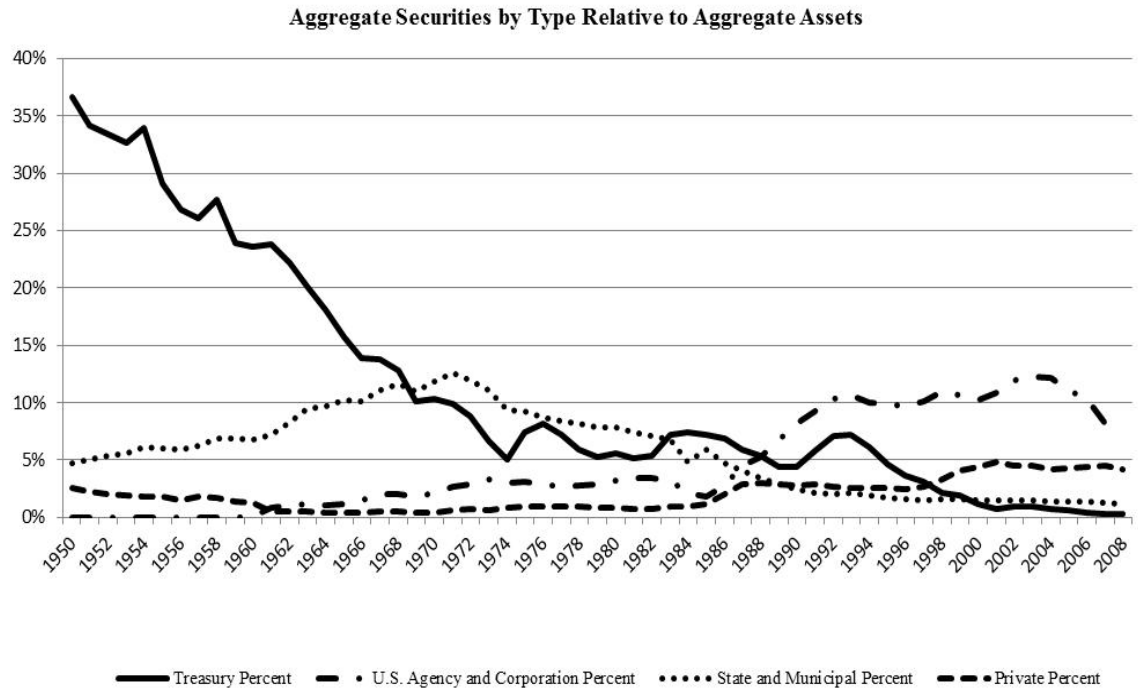
One sees that in 1992, first lien mortgages are the primary family housing asset that banks' own. In addition, it is rising from 9.6% in 1992 to 11.2% by 1995 while the other types remain flat or is declining. Thus during the first boom I observe that first lien mortgages are the primary housing asset and where the growth in lending is occurring. These findings support the risk weighting driven changes in banks' portfolios. During the second housing finance boom, we see that home equity initially leads before first liens rise. Home equity loans more than double on the books from 1.8% in 1999 to 4.7% in 2005 while first lien mortgages rise 2.5% during that time period to 13.6% in 2005. While other factors such as advertising, a new cultural acceptance of home equity loans, and rising home prices may be involved, one explanation is that there was composition bias due to the risk weighting scheme in the reaction to the housing bubble. As excess

returns rose for home equity loans and first lien mortgages, the composition bias effect would have grown, causing more substitution towards riskier assets with the same risk weight.

Rise of Agency

In academic studies, a bank is often seen as a financial institution that deals in illiquid financial items either through offering loans to entities that cannot easily issue securities to the public and/or through holding illiquid securities and issuing liquid liabilities. There are two key elements in understanding banks holding publicly traded securities. One is that if banks primarily held publically traded securities, then banks would no longer be "special" compared to other types of financial institutions. If banks held a portfolio that was collinear with a mutual or bond fund, it would be merely a highly subsided fund, through deposit insurance, and lose much of the rationale for special government protection. Secondly, banks do need some publicly traded securities. The ability of the bank to quickly sell assets to raise capital is crucial particularly due to the perceived problems in issuing stock. Further, a little discussed notion is the need for banks to hold securities that they can profitably sell in the event of a crisis. Particularly during systemic crises, assets that actually increase in value are crucial. The risk weighting system offered low risk weights for many types of government securities.

Figure 8



Note: This figure shows the aggregate nominal bank holdings of securities issued by the Treasury department, U.S. Agencies and Corporations, State and Municipal bonds, and private entities each divided by aggregate nominal assets. The figure's source is the Historical Statistics on Banking.

In Figure 8, securities as a weighted average percentage of assets are shown from the FDIC HSOB. I sum all the banks' holdings of a particular security and divide by the sum of the assets. The most startling aspect is the change in the holdings of Treasuries. Following the rise of Treasury holdings due to World War II, in 1950 Treasuries are 37% of assets but decline to .3% in 2007. Much of this decline is recent as well and is not explained by legacy World War II holdings. Treasuries averaged 6.1% in the 1980s, 4.6% in the 1990s, and .7% in the 2000s. The notable gainer has been U.S. Agency debt. This is debt issued by government-sponsored corporations such as Fannie Mae that lack an explicit, albeit implicit, government backing. These securities received a risk weight of .2 thus making them more attractive than mortgages, commercial loans, or private securities. These begin a rise from 1.8% in 1985, to 5.3% in 1988, 10.7% in 1993, hit a high of 12.3% in 2003, and were 8.2% in 2007. There is also a noticeable decline in the

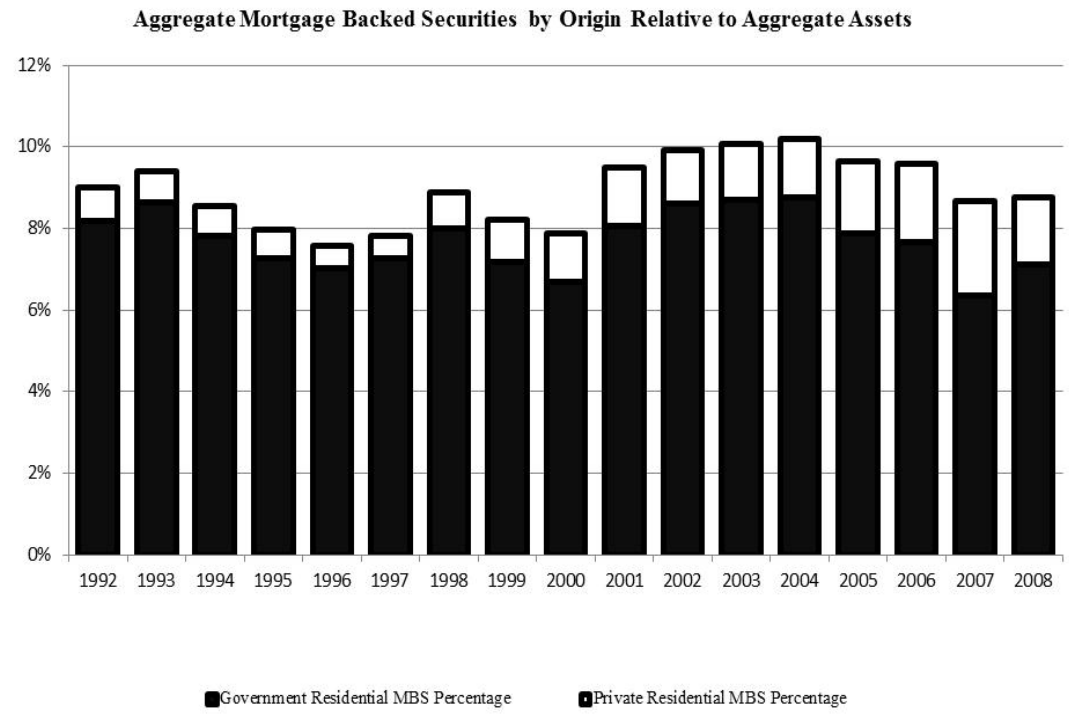
holdings of state and municipal bonds. They fall from 5% in 1986 to 1.3% in 2005.[29,30] Private securities rise from .7% in 1982 to 3.1% in 1998, and hit a high of 4.8% in 2001.

Of significant interest is the fall of Treasuries and rise of Agency shown in Figure 8. Treasuries are a counter-cyclical security. In the event of a crisis, they are likely to rise in value, thus offering gains to a bank that holds them. They are also considered the most liquid item after money. Their disappearance from the portfolio suggests that banks are ill prepared to react to adverse changes in the economy. Their replacement by Agency securities has significant drawbacks. The most notable is that Agency securities lacked an explicit government backing or a transparent method to deal with a crisis in the government mortgage entities. Agencies have often been marketed as being merely higher earning Treasuries even though this is not the official policy. Further, a crisis in the Agency market would presumably occur with a decline in the mortgage market, which we have seen, would be doubly negative since banks have moved so heavily into the housing finance markets. It would seem then that the risk weighting of assets failed to encourage banks to have the safest securities. This may seem odd since the risk weight of Treasuries was zero. However, it may be the case that the risk weights needed to encourage banks to hold Treasuries may be negative or the other risk weights need to be much higher..

Significant attention has also been put upon "toxic assets" in the banking system. These were usually referred to as types of mortgages collateralized mortgage obligation (CMO) bonds that banks had originated and whose market had shut down. The government launched several notable programs to begin purchasing these securities such as the Troubled Asset Relief Program (TARP). Using the FDIC SDI dataset, I am able to calculate the weighted average held of various types of mortgage bonds.

[29] Gart, Alan. 1994. *Regulation, deregulation, reregulation: the Future of the Banking, Insurance, and Securities Industries.* New York: J.Wiley & Sons.
[30] Part of this decline may be explained by changes in the tax code in 1986 that reduced the banks' tax deduction for trading in municipal bonds.

Figure 9



Note: This figure shows the aggregate nominal holdings of mortgage backed securities by origin divided by aggregate nominal assets. The figure's source is the Statistics on Depository Institutions.

As suggested by Figure 8, privately originated mortgage backed securities are not only a small part of the balance sheet but much smaller than the Agency mortgage backed securities. Private MBS does rise from .5% in 1997 to 2.3% in 2007. However, the government sponsored MBS is always above 6.3% from 2001. Except for 2007, government MBS is always more than 80% of the total MBS holdings. The relative risk weights may explain this dominance. As the risk weights on Agency MBS were much lower (.2 compared to 1), they were more attractive. However, as with the deterioration in first lien mortgage quality, there were similar declines in Agency. If a private originator and the Agency securitized identical pools of mortgages, the private originated deal carried a higher risk weight. Thus, there was a lot of interest in allowing Agencies to securitize deals and Agencies began offering subprime (Alt-A) MBS that carried a lower risk weight than the private deal though sometimes higher than standard Agency.

Rise of Derivatives

The regulation of derivatives has received significant attention. Derivatives are a major challenge for several reasons. One, for many contracts it is not *a priori* clear if the bank will pay money out, receive money, how much money is involved, and what the actual probability of these events occurring are. Second, many derivative contracts have very large notional values that may be divorced from being economically meaningful. Consider an interest swap contract for $1 million that requires the bank to payout (or receive) the difference between the Federal Funds Rate and 5% during the course of a year. The notional value of the swap is $1 million. However, only if the Federal Funds rate is 105% or higher, would the bank payout $1 million or more. Thus the number $1 million may not be economically meaningful. If the Federal Funds rate went as high as 20%, slightly higher than its post-World War II high, then the bank would only payout $150,000. Third is that many derivative contracts lack clear pricing. Some, like stock options and futures, are traded on public exchanges. Most are conducted in the over-the-counter market and are highly individualized. Even simple 10-year swaps may differ in terms of the floating rate index, the spread over the floating rate index, the fixed rate, the payment dates, and the credit ratings of the counter-parties. Many swaps even have special floors, caps, or other options built-in making it no longer obvious if a particular contract should be considered a “swap” or a “floor”. Finally, when considered as part of a portfolio, it becomes even less clear as to a derivative’s valuation. For example, if a bank sold two identical swap contracts except that bank took the fixed position in one, and the floating in the other, then the economic value of the portfolio would be zero.

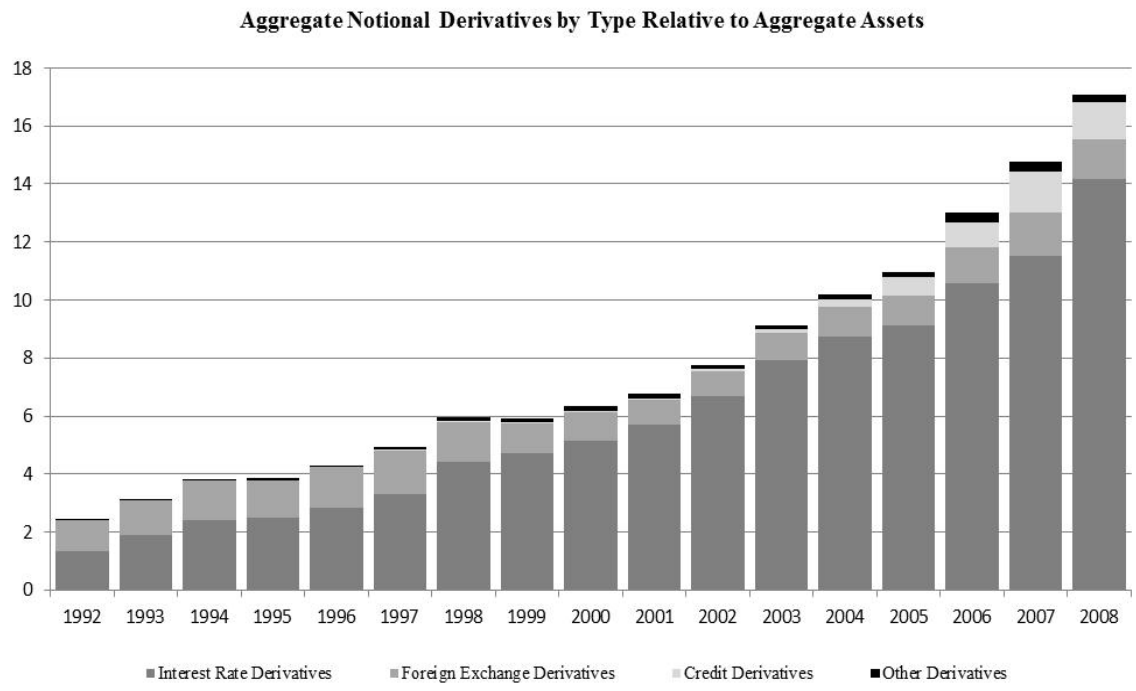
The Basel Accords have a mixed approach on derivatives. The 1988 accord allowed derivatives to be treated as off-balance sheet items. For the calculation of the leverage ratio, this meant that derivatives did not count as part of assets. In the risk weighted assets calculation, the bank first decides the probability the derivative becomes an asset and multiplies it by the notional amount times a “shrinkage” number to make the notional amount “meaningful”. The United States in 1998 changed the accounting standards to include derivatives in the asset calculation using the “fair-value” and “hedge-accounting”. However, as noted above, since most derivatives are sold in the over the

counter market and then are not traded, the current fair value is often a bank risk model's guess. Hedge Accounting is used to capture the notion that two derivatives may actually offset each other. To the extent that they are currently generating non-offsetting income, this cannot be used.[31] But as long as a model predicts that they will produce offsetting income in the future, the hedge account may still be used for the valuation of future cash flows. Thus the current regulations rely heavily on banks self-regulating themselves and producing accurate predictions of the derivative valuation.

Using the FDIC SDI series, one can observe the growth of the derivatives business and its major subareas. The HSOB series does not record the system's derivative contracts. The SDI data only records the notional value of the derivative positions. There are numerous problems with this. As mentioned above, the notional value may not have any economic meaning. And adding the notional value of two perfectly offsetting derivatives is misleading. However, at the very least the notional values reveal the importance of the derivatives business to banks. They also offer some degree of light on the size of potential losses. If extraordinary events occur, it suggests how much the bank could be liable. Further, it is unlikely that there are perfectly offsetting derivatives. For example, due to counterparty risk, even if the bank took the fixed rate part of a swap on half its contracts, and the floating rate contract on the other half, and still assuming the fixed was the same on all and the floating rate the same, the position would not be perfectly off-setting in all possible states of the world. If one assumes that the problems with the metric are the same across the time, one should still be able to gain insight from examining the growth of the derivatives positions.

[31] FASB. 1998. *Statement of Financial Accounting Standards No. 133.* Norwalk, Conn. Financial Accounting Standards Board.

Figure 10



Note: This figure shows the aggregate nominal derivatives by type divided by aggregate nominal assets. The figure's source is the Statistics on Depository Institutions.

In Figure 10, I graph the weighted average notional amounts of the derivative contracts relative to assets for several categories of derivatives. In 1992, derivatives were 2.4 times assets and by 2008 they were 17.1. Thus this off-balance sheet activity appears to be growing far faster than the traditional asset side of the banking system. The largest type of derivative are the ones related to interest rates: forwards, futures, floors, caps, and options. This suggests an intriguing question: have the derivatives increased or decreased the system's exposure to interest rate risk? If rates went outside of their recent levels, would the derivatives aid the banks or hurt them? The fastest growing line of derivatives has been the credit derivative. Credit derivatives in the data are only available from 1997 onwards. This is because in that year regulators decided that credit derivatives may be used to change the risk weighting of assets held by the bank and thus improve the banks solvency ratios. By 2007, the notional value of credit derivatives is over 1.4 times the assets of the banking system. Derivatives related to equities, part of the Other Derivative category, only have a peak of .32 of assets.

A key problem with understanding the role of risk weighting and the growth of derivatives is whether the risk weights on derivatives are “low” or “high” relative to other assets. A bank calculates a fair value and then assigns a risk weight. The fair value may be significantly off of the true value. Hedge accounting further complicates the procedure. However, the most telling element of the approach is that it is a multi-layered, complex, non-transparent method that relies highly upon the prudent behavior of bankers and the use of opaque financial models that are well known to have serious flaws. Through the use of model generated fair values and lower risk weights, assets may be converted into derivatives whose risk weights are lower but the risk remains the same. Bankers may insure similar assets for each other lowering their respective risk weights but not changing their risk. Further, as banks may generate different model predictions, the risk-weighted asset for the same contract may differ across banks giving an advantage to banks that use models that underestimate the risk.

Section 2: Asset Concentration

History

The United States banking industry has seen tremendous changes in the market structure over the last century. A century ago, American banks operations were confined to small geographic areas and were highly segmented based on region. Except for New York City banks, a bank usually did not have any notable operations outside of its county and rarely outside of the state. When the Federal Reserve was created, the Districts were each allowed, and often did, have a district specific discount rate due to the lack of financial connectedness. The main explanation for this system was regulation designed to keep banks small and local. However, primarily since the 1980s, the new regulation regime began to allow banks to become larger and increase their geographic scope. This section will demonstrate that larger banks were the most leveraged, expanded mortgage lending the most during the housing bubble, and had significant derivative operations.

Traditionally the United States regulatory regime was not favorable towards large banks. Going back to the start of the country, there were policy debates between “state-chartering” and “national-chartering” of banks. Thus banks usually operated in a climate

where they had multiple overseeing Federal and State regulators with different regulations.[32] The climate was generally hostile towards large banks. The public often viewed allowing banks to become large as reducing competition in the industry and hence bad for the banks' customers. Alternatively many small banks often advocated in favor of restrictions to protect themselves from competition. The government set interest rate ceilings on the banks' liabilities and had notable restrictions on bank branching. Finally, firms seeking financing had few options besides commercial banks. Raising funds publicly was expensive and there was little liquidity in those markets and due to a lack of publicly available information on firms, banks had private information on their banking clients making it expensive for firms to change banks or raise funds publicly.

Thus commercial bankers enjoyed low competition and significant market power over their clients. A common restriction was to restrict the number of branches a bank could have in a state. A notable law, the McFadden Act of 1927, made it Federal policy to keep banks from crossing state lines. One could create a banking holding company that held banks in different states. But in 1956, the Douglas Amendment was passed to put further restrictions on that activity.[33] By the 1970s, the US banking industry was characterized by its heavy Federal and State regulations restricting banks, it's very high number of banks, and that it had a few large regional bank holding companies but no national bank holding company. While comparable countries such as Canada, Japan, France, and the United Kingdom had fewer than 100 banks, the United States had over 14,000.[34]

However, views on the costs and benefits of large banks began to change in the 1970s and 1980s. One viewpoint shift was to think of competition as raising consumer welfare. A competitive banking industry was no longer seen as leading to monopoly power and thus to higher rates of borrowing and lower rates of return. There was also a larger focus on the costs of the small, local banks. Discussions shifted to focusing on how geographically concentrated assets were riskier and thus lead to more risk and lower rates

[32] This even understates the issue because in the last 70 years, banks have had to also contend with a variety of different Federal Agencies simultaneously supervising them including the FDIC, the Federal Reserve, the Office of the Comptroller of the Currency, etc.
[33] Mishkin, Frederic. 1998. *The Economics of Money, Banking, and Financial Markets*. 5th Edition. Reading, Mass: Addison-Wesley. page 244
[34] Ibid.

of return. A second viewpoint shift was to think that mergers in the industry would be less costly for the government. Particularly due to interest rate volatility in the 1970s but also competition from non-bank financial institutions, many small banks were in great distress. A rash of bank failures occurred in the 1980s. More than 100 a year failed between 1985 till 1992 not including the collapse of the Savings and Loans .[35] Allowing large banks to take them over and infuse capital was cheaper than government takeovers. Another viewpoint change was towards seeing international banking as more important. As mentioned in the first section, Japanese banks in the 1980s had seen tremendous growth, as had French banks, making American banks look tiny in comparison. These elements helped lead to substantial reform in the industry.

In 1980, the Depository Institutions Deregulation and Monetary Control Act reduced numerous restrictions on bank activities and increased competitiveness by increasing the uniformity of regulations banks faced in different states. The Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 removed the restrictions on interstate branching. The Gramm-Leach-Biley Financial Services Modernization Act of 1999 removed the Banking Act of 1933 restrictions on commercial banks entering the security industry.[36] All of these acts allowed banks to become larger and the industry more competitive. Some reforms were also biased in favor of large banks. The Basel II Accord of 2004 offered reforms to the problems of the risk weighting system. One proposal was to allow the more 'sophisticated' banks the options of choosing their own risk weights and other parameters in the risk estimate procedures.[37] Due to the high fixed cost nature of creating dedicated risk research units for this, it is only profitable for the largest banks to do so. Further, regulators also used their discretionary authority in many cases to remove restrictions. For example, while Glass-Steagall was not removed till 1999 the regulators had already granted permission to some of the largest commercial banks, such as JP Morgan, to enter the public security investment banking market in the 1980s or to

[35] Mishkin, Frederic. 1998. *The Economics of Money, Banking, and Financial Markets*. 5th Edition. Reading, Mass: Addison-Wesley. Page 246
[36] Mishkin, Frederic. 1998. *The Economics of Money, Banking, and Financial Markets*. 5th Edition. Reading, Mass: Addison-Wesley. Page 271
[37] International Convergence of Capital Measurement and Capital Standards. 2010. Bank of International Settlements. http://www.bis.org/publ/bcbsc111.pdf (January 17, 2010).

the Citibank-Travelers Group merger. In addition, elements of Basel II, allowing larger firms to use their own research departments to determine responsible behavior and regulate themselves, were already being introduced in the 1990s.

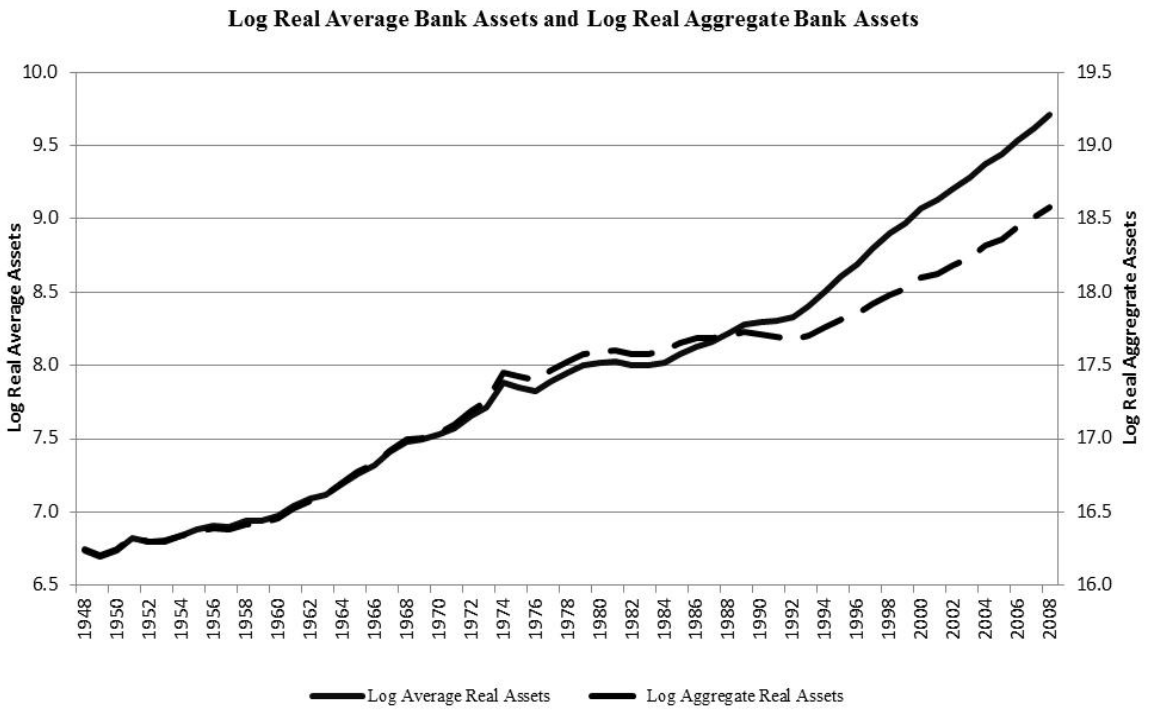
Larger banks have received attention due to the "too big to fail" issue. This has several implications. One sees a larger bank as being more likely to receive government assistance (either to stock or debt holders). Perhaps as the size of the bank increases, the chance of aid is increasing as larger banks are more connected and thus their failure may cause more disruption or greater political pressure is brought to bear on the government. Second, if larger banks see themselves as being more likely to receive aid than smaller banks, then larger banks will take more risk act than smaller ones. Third, if investors believe that even their uninsured debt with a bank is more likely to be protected if it is from a large bank, then investors will offer the larger bank a discount on the cost of borrowing. This will further encourage the bank to be larger.

This section will focus on the changes in the banking industry since the removal of the size restrictions. First, It will document the increase in asset concentration amongst the largest banks. Second, it will demonstrate that the largest banks chose to hold less capital, increased their mortgage lending during the boom years, and maintain significant derivative positions. Finally, it will separate whether the rise in asset concentrations or changes in individual bank portfolio composition accounts more for the changes in the aggregate portfolio.

Rise of the Large Bank

In Figure 11, I show the natural log of the real assets of the average and aggregate bank using data from the HSOB and the GDP deflator. From 1948, through almost 1990, the average bank's asset growth and the aggregate asset growth were almost identical. After 1990, the growth of the average bank's assets was significantly faster than that of the banking industry. During the period of 1990 through 2008, the average bank's assets grew 140 log points while the industry only grew by 90 log points.

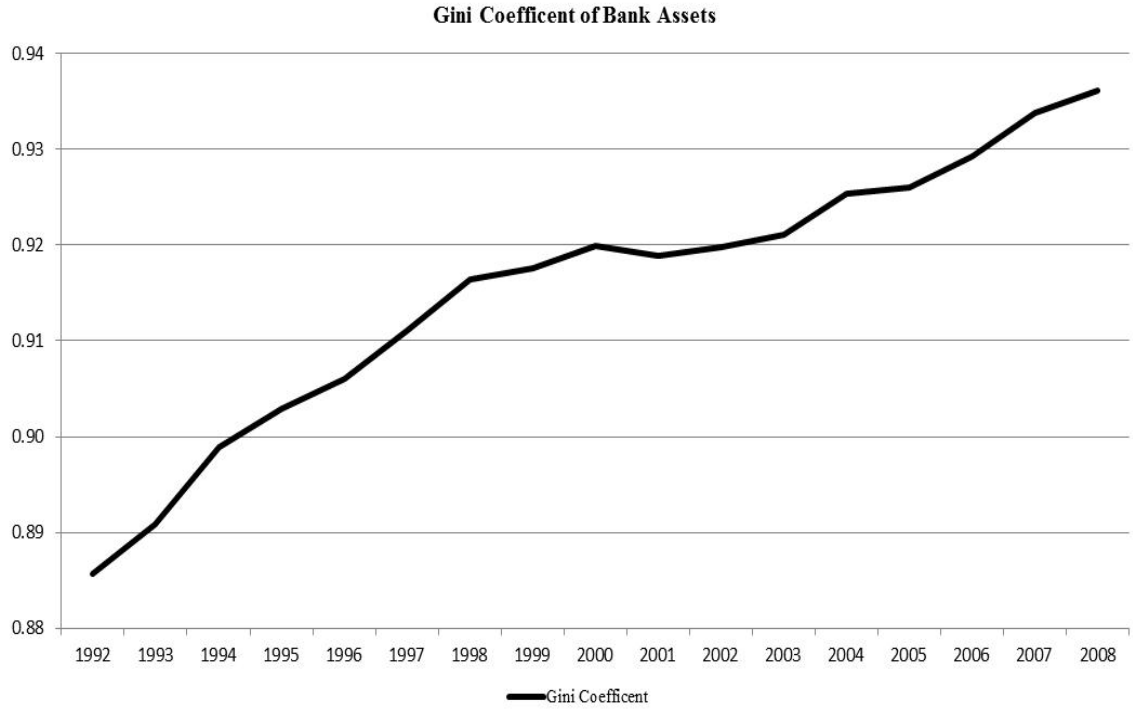
Figure 11



Note: The figure shows on the left vertical axis the natural log of the real average bank assets and on the right vertical axis the natural log of the real aggregate bank assets. The figure's source is the Historical Statistics on Banking.

However, the growth of the average relative to the aggregate masks the distribution of the changes. The median is growing slower than the average and the larger banks control an increasing amount of the assets of the industry. In Figure 12 and 13, I use the SDI data to examine the distribution of assets in the industry from 1992 through 2008. I use the December quarterly data as an annual figure, aggregate to the level of bank holding companies, and screen out bank holding companies that are or are close to insolvent. In Figure 12, I show the Gini Coefficient, a popular method to show inequality in a system where a '1' represents that one bank controls all the assets. Even in 1992, the industry was concentrated and its concentration only increased during this time frame.

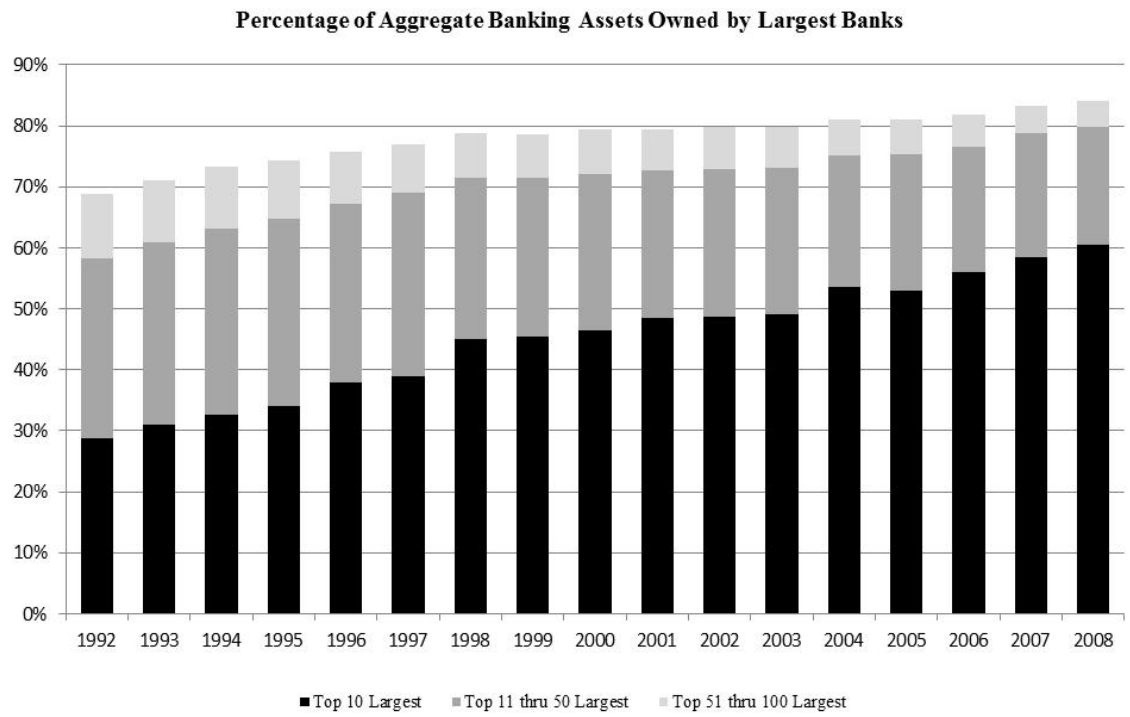
Figure 12



Note: This figure shows the Gini coefficient, a measure of dispersion, for the banking industry's distribution of assets. The figure's source is the Statistics on Depository Institutions.

In Figure 13, I show the percentage of aggregate assets the largest banks control. The Top 10 largest banks in a given year have increased the amount of assets they account for from 29% in 1992 to 60% in 2008. Interestingly, this is in sharp contrast to the assets of the 11th through 50th banks who go from being 29% in 1992 to 19% in 2008. Or the 51st through 100th declined from 10% to 4%. It is also important to keep in perspective just how many banks exist in America. In 1992, according to my bank holding company aggregation and data screening, there are 8982 banks and still 6134 banks in 2008. Thus in 1992, 8882 banks account for 31% of the assets and by 2008, 6034 account for 16%.

Figure 13



Note: This figure shows the percentage of aggregate nominal assets owned by the Top 10, Top 11 thru 50, and Top 51 thru 100 largest banks. The figure's source is the Statistics on Depository Institutions.

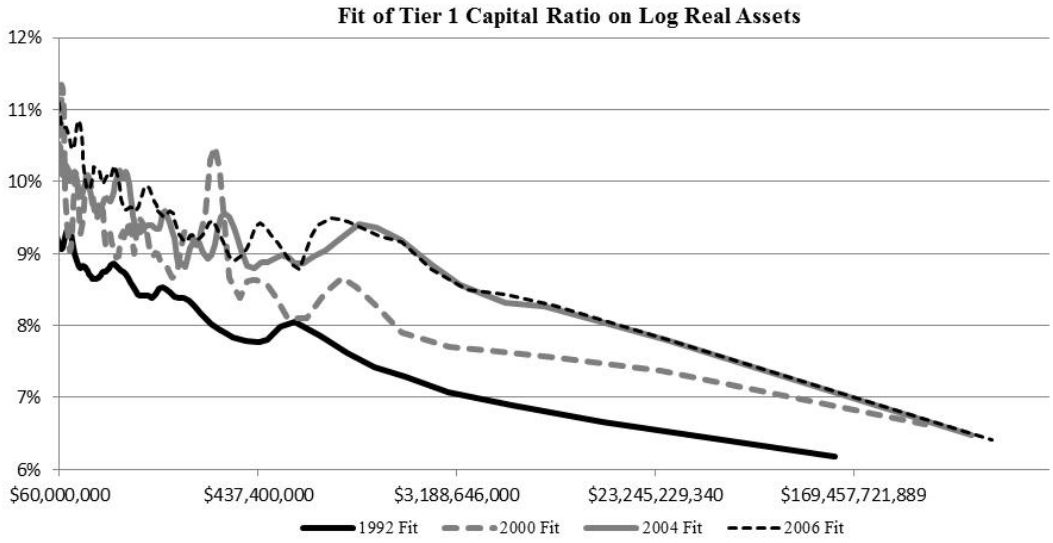
These results make clear the difficulty in referring to the "typical bank". The modal bank is a small local bank of $130 million in assets. These banks are in active in operation and new small local banks continue to open. For example, Ann Arbor State Bank opened in 2008 and has $80 million in assets.[38] However, for the industry has a whole, even thousands of these small local banks account for small percentage of aggregate assets. The important or meaningful banks consist of the top 100 and even then the top handful is the most significant. In 2008, there were over $12 trillion in banking assets and Bank of America, Citigroup, and JP Morgan each have close to $2 trillion in assets. Thus when one refers to "banks" or the "typical bank" did that, it is unclear as to what kind of bank one is referring to. If the largest 5 banks increased mortgage lending while the five thousand smallest banks discontinued mortgage lending, it is still possible for aggregate mortgage lending to have increased.

[38] Ann Arbor State Bank. 2010. http://www.a2sb.com/about-us/ (Accessed July 2, 2010).

Increasing Leverage as Size Increases

To analyze the relationship between size and capital policy is difficult. One reason is the heterogeneity in assets mentioned above. The largest banks are orders of magnitude larger than most banks and the number of banks similar in size is decreasing as the assets increase. The second reason is that there is also heterogeneity in bank behavior particularly for the small banks. Some small banks have very high capital levels. Even though these differences decline as the size increases there are still many outliers amongst the largest banks. Thus parametric analysis is very problematic. I chose instead to use the nonparametric technique of local regression. This method creates a grid of points along the dependent variable's values and then uses a kernel smoother subject to constraints that the results between vertices are consistent to produce a fit for the independent variable. As opposed to simple moving averages, this method puts more weight on observations nearer the point it is fitting. I used a bias corrected Akaike Information Criterion method to determine the smooth parameter that specifies which percent of the data the kernel uses to create its local prediction. SAS was used to generate the results. Finally, I chose to study the relationship of the capital ratio to the natural log of the assets. This allows one to see how the capital policy changes as the relative size of the bank changes and avoids the aforementioned problems with using the level of assets.

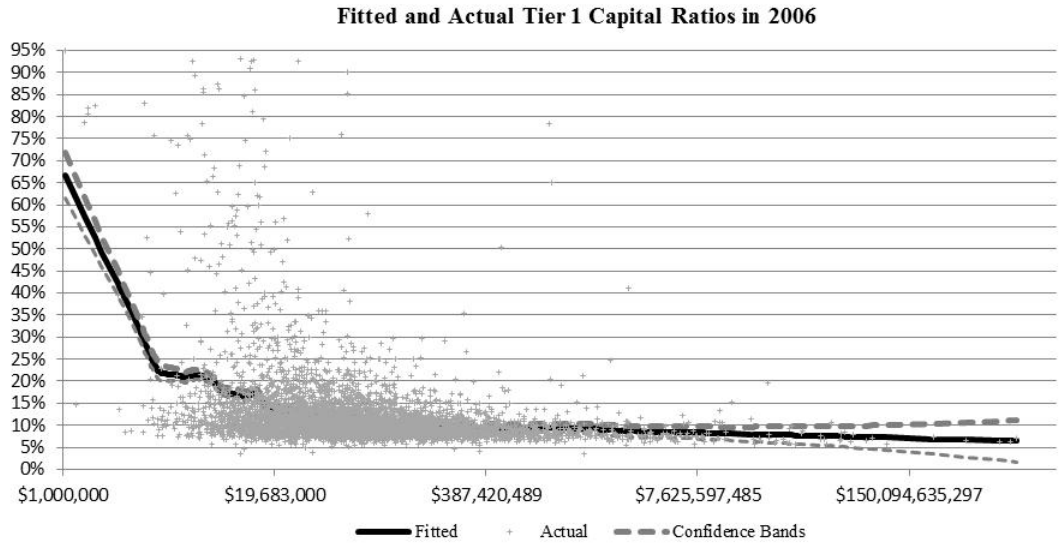
Figure 14



Note: This figure shows the fitted Tier 1 capital ratio, Tier 1 capital divided by assets, based on the natural log of the bank's real assets for selected years. The fit was created using a kernel regression by year. The figure's source is the Statistics on Depository Institutions.

In Figure 14, I show the fit of the Tier 1 capital ratio against the log real assets for the years 1992, 2000, 2004, and 2006. I used 257 grid points. I choose the year 2006 instead of 2007 or 2008 because it shows the industry's position right before the crisis began and does not have the effects of the crisis on capital. I show the fit the banks that are roughly above the size of the median bank ($60 million in 1983 dollars) but the fit was constructed using all of the data. In terms of quality of the fit, there is evidence of under smoothing for the smaller banks. All the fits are consistent with the proposition that as the bank's size increases, its Tier 1 Capital ratio is generally falling. Though all along the size measure banks maintain the well-capitalized Tier 1 standard. Across years, there seems to be evidence that capital is rising and then flattens out which is consistent with the earlier evidence that overall Tier 1 rose from 1992 and then flattened. One sees that for the median bank in 2006 (a value of $66 million in 1983 dollars), the capital ratio is around 11%. But for the largest banks, those at $450 billion in 1983 dollars and above, or $900 billion in 2006, capital is only 6.5%. For banks below the median, the results suggest steeper increases in capital because the small banks are very highly capitalized.

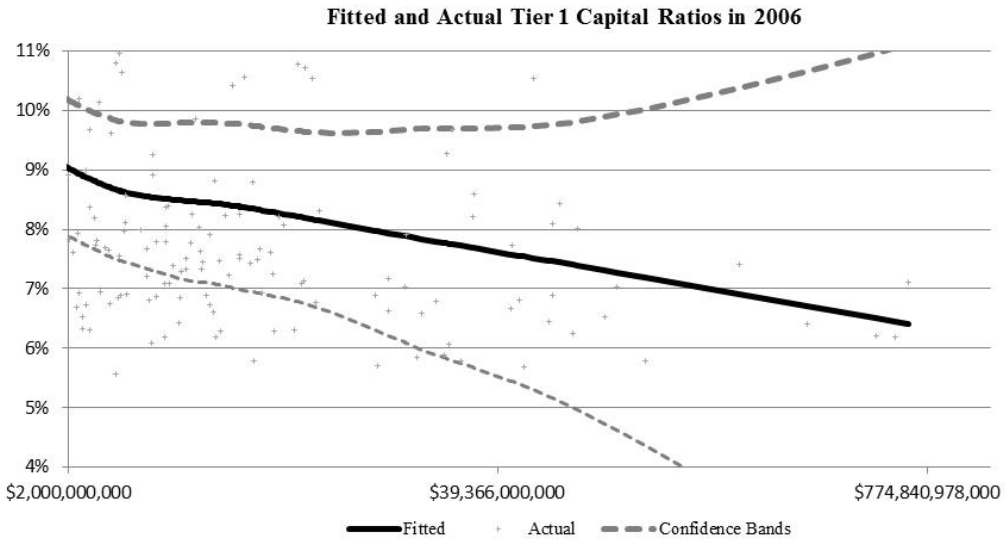
Figure 15



Note: This figure shows the fitted Tier 1 capital ratio, Tier 1 capital divided by assets, based on the natural log of the bank's assets and the actual Tier 1 capital ratio for 2006. The fit was created using a kernel regression. The figure's source is the Statistics on Depository Institutions.

In Figure 15 and 16, I show more detail on the fit in 2006. For these results, I used every data point as a grid point as a way to guarantee that the choice of grid points used by the estimation procedure are not driving the results. I also show the actual data and the 95% confidence bands to check how robust the results are. This graph shows the heterogeneity in the capital policies. There are many below median size banks that have capital in excess of 35%. Alternatively, there also appear to be many below 10%.

Figure 16



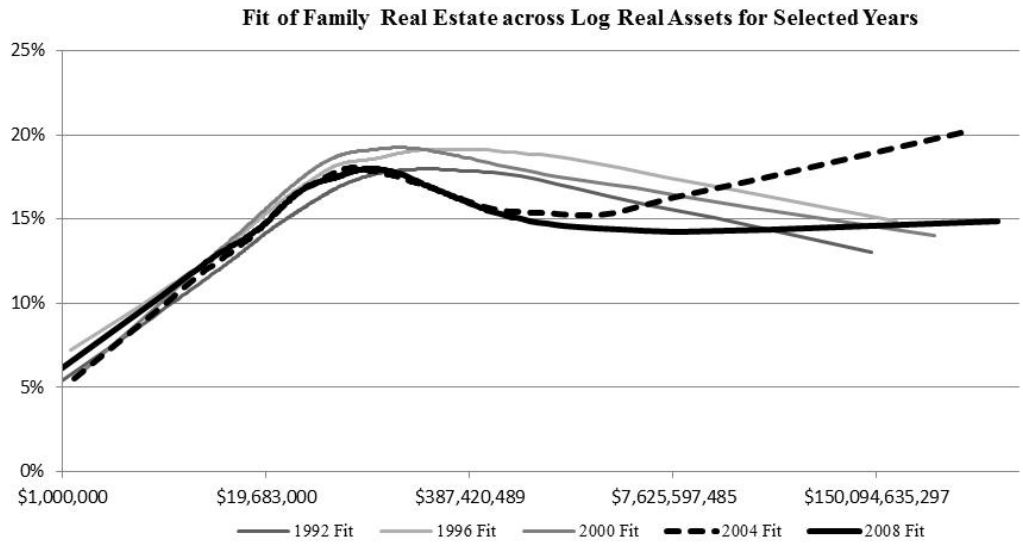
Note: This figure shows the fitted Tier 1 capital ratio, Tier 1 capital divided by assets, based on the natural log of the bank's assets and the actual Tier 1 capital ratio for 2006. The fit was created using a kernel regression. The figure's source is the Statistics on Depository Institutions.

In Figure 16, I focus on the largest 134 banks with the results generated using all the data in 2006 in 1983 dollars. One still sees the heterogeneity and that the fit seems to be over-estimating the amount of capital these banks have. However, the fall in capital as the bank becomes larger does seem to be present until one is talking about the largest 15 banks that are close to 6.5% capital.

Rise of Housing Finance

As mentioned in the previous section, residential finance was on a significant rise during the last two decades. Two high growth periods were identified; an early 1990s rise and then a later rise starting at the end of the 1990s and lasting to approximately 2006. However, the earlier discussion did not distinguish if the rise in housing finance was common among all banks.

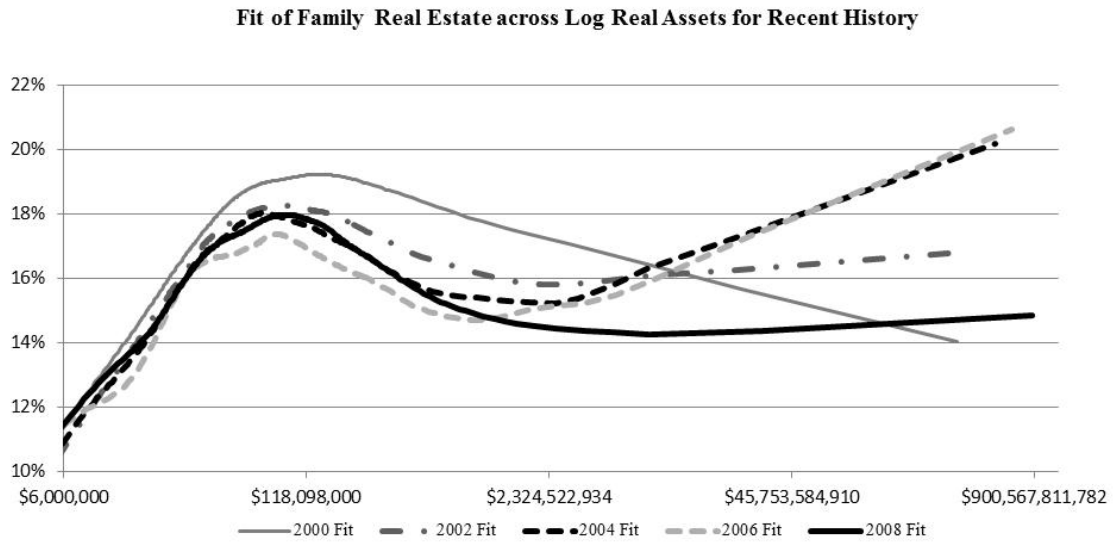
Figure 17



Note: This figure shows the fitted residential mortgages divided by the bank's assets based on the natural log of the bank's assets for selected years. The fit was created using a kernel regression. The figure's source is the Statistics on Depository Institutions.

In Figure 17, I show the fitted distribution for the percentage of family real estate the bank holds across the asset distribution. Using the local regression procedure outlined above, I show the estimate for the percentage of total of first lien, junior lien, and home equity loans the banks have on their balance sheets for the years 1992, 1996, 2000, and 2004. One fact is the hump shaped pattern; in most years, the median banks (approximately a value of $60 million in 1983 dollars), offer the most mortgages. Above median banks, have less residential finance assets than the median bank. One implication of this is that the typical bank is more focused on the housing market and thus suffers more risk from this area. A second implication is that larger banks appear, in regards to housing finance, more diversified. A second fact concerns the changes between 2004 and 2008. These fits suggest that larger banks during those years increased their residential finance assets more during the housing bubble. Relatedly, it seems the median banks actually declined in their holdings of these assets.

Figure 18



Note: This figure shows the fitted residential mortgages divided by the bank's assets based on the natural log of the bank's assets for selected years. The fit was created using a kernel regression. The figure's source is the Statistics on Depository Institutions.

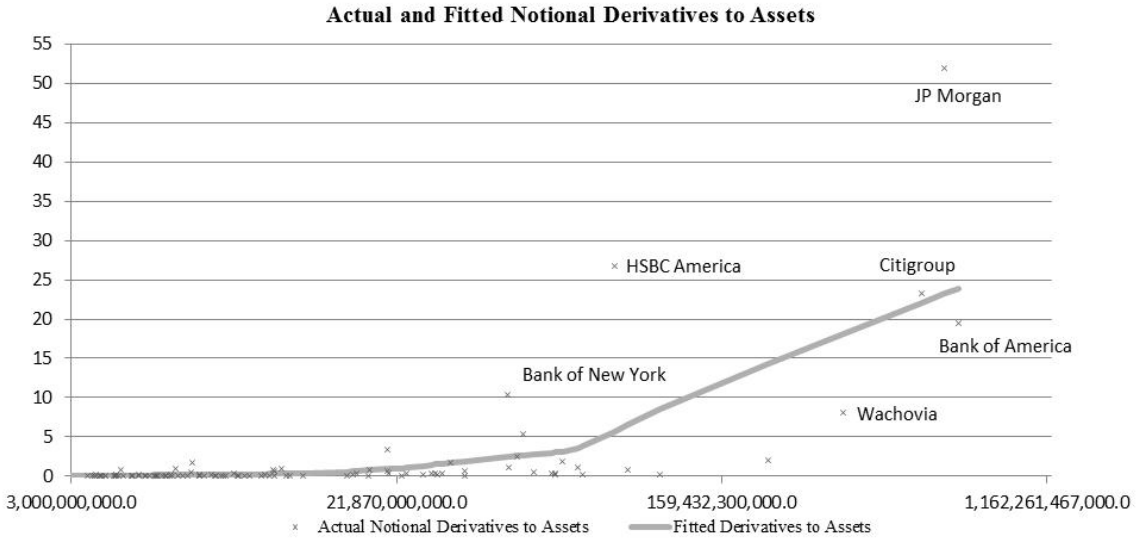
In Figure 18, I investigate these hypotheses and check the robustness by examining more years and varying the grid. These fits support the initial finding. Larger banks tended to increase their mortgage assets after 2000. This continued through the peak of the bubble in 2006 and then fell to almost the 2000 values. The largest banks increased their exposure from 14% to over 20%. Smaller banks tended to reduce their mortgage holdings. The median bank exposure fell from 19% to 17%. Part of this may be accounted for by industry consolidation. If the larger banks are focusing their bank acquisitions on smaller banks with large mortgage portfolios, then due to selection bias, it may not be the case that small banks actually decrease their mortgage lending policies. As lending was rising in this area, from 16% in 2000 to 19% in 2006 for the industry-weighted average, the large bank's acquisitions are not the entirety of their increase. As a source for funding the boom, then the largest banks become the engine even though for much of the distribution the smaller banks have relatively more mortgages. An important point to note is the actual levels involved in the mortgages. In 2006, a median bank held around $23 million in mortgages. When a very large bank increases its mortgages by 1% that is approximately $1.3 billion in new mortgage assets. Thus as larger banks took a

more aggressive position in the housing bubble years they had a major impact on the availability of financing.

Rise of Derivatives

The crisis has focused significant attention on derivative securities. In 2002 Warren Buffet called them "financial weapons of mass destruction" heralding the fall of even non-bank institutions such as AIG in 2008.[39] Much of the recent debates over the financial reform are focused on the regulation of derivatives such as the suggestion to remove them from the banking industry entirely. The opacity of bank derivative positions can also lead to bank runs.

Figure 19



Note: This figure shows the fitted nominal derivative book divided by the bank's assets based on the natural log of the bank's assets for 2006.. The fit was created using a kernel regression. The figure's source is the Statistics on Depository Institutions.

In Figure 19, I show the fitted and actual notional derivative amounts relative to assets for the year 2006. I only show the data here for the largest banks. This is because very few banks outside the largest banks are involved in derivatives. Amongst the small banks only

[39] Buffet, Warren. 2002. Berkshire Hathaway Inc. "Letter to Shareholders." http://www.berkshirehathaway.com/letters/2002pdf.pdf (Accessed May 15, 2010).

a handful has notable derivative books. These banks are almost all foreign subsidiary banks of very large foreign banks thus their "American Banking Assets" make them just seem small in the data. And even then, only the very largest banks have any significant derivative books. In 2006, the bank with the largest notional value derivative book was JP Morgan followed by HSBC America (a foreign bank whose non-American assets would make the bank much larger in terms of size). Between the 6 largest derivative books, this accounts for almost all derivatives in the banking industry. Thus an important fact is that only a handful of banks are in the derivative business but they are in by a lot. If they make errors in pricing, or turn out very unlucky, in their derivative portfolio, those financial contracts would wipe out almost all the banking assets in the country. Another fact is that the derivative books of the largest banks are actually contracts between them and non-bank entities. Derivatives are not increasing the inter-connectedness between banks but between the largest banks and investment funds and firms. It is problematic to understand what it means that JP Morgan has, in terms of notional derivatives, $65 trillion dollars in derivatives and only $1.2 trillion in assets. It may be the case that the economic value of this is zero (or one hopes, slightly positive). But this uncertainty does make clear that if JP Morgan's management of its derivative book took a wrong turn, the losses are astronomical even relative to the assets of the entire banking industry ($12 trillion).

Due to the failure of AIG, credit derivatives have also received attention as a specific form of derivative that brings moral hazard and counter-party risk. They also may be used as a way to improve one's capital ratios as a way to change the risk weight on securities. The distribution of credit derivatives is actually even more skewed than the data on all derivatives. Only 4 banks have notable derivative positions relative to assets of over 1 and only 40 banks have any credit derivatives. This may also be an indication that the decline of capital as the bank size increases is even greater than the earlier results suggested because it does not reflect counter-party risk in the insurance of its lower quality assets.

An Experiment

A useful experiment would be to find an estimate of the importance of the rise of large banks and the composition of the portfolio. Since the distribution of bank size in 1992 was skewed, it is possible that increased skewness post-1992 does not matter very much in terms of capital, mortgages, and derivatives. Therefore, I calculate predictions under the assumption that the relative holdings of banks did not change between 1992 and 2006 but assume the relationships between size and portfolio holdings would have been the same. I use the 1992 distribution of banks and their assets and forecast their size in 2006 assuming that average and aggregate asset growth is the same. Thus there is no skewed shift of the asset distribution. I then use my fitted estimates of the relationship between items of interest and the size of the bank to obtain a prediction of the holdings of my forecasted distribution.

Table 2: Impact of Asset Concentration

Risk Measure	Value in 2006	Prediction using 1992 distribution	Prediction using 1993 distribution
Tier 1 Capital Ratio	7.2%	8.1%	8.1%
Residential Finance Percentage	19.7%	17.2%	17.3%
Derivatives to Assets	13.01	3.53	3.77
Credit Derivatives to Assets	0.89	0.27	0.29

In Table 2 I show the results of this counter-factual for four items of interest. All four results are consistent with the proposition that asset concentration was an important factor in explaining the aggregate banking industry in 2006. The Tier 1 capital ratio would have been almost 1 point higher while holdings of residential finance would have been 2.5

points lower if the industry had not consolidated. These results also suggest that derivatives would have been 25% of their actual 2006 holdings highlighting that derivative operations are almost exclusively an occupation of the largest banks. As a robustness check, I also ran this simulation using the 1993 distribution. All the results are qualitatively the same.

Literature Review

Several papers have studied similar issues in the banking industry as this one. This paper builds upon theoretical work to understand the role of risk weighting using the portfolio return model by Koehn and Santomero and later Kim and Santomero.[40] ,[41] More recent theoretical work by Keppo, Kofman, and Meng suggest the risk weighting may also delay recapitalization.[42] Several other papers have examined the role of risk weights in bank portfolios. Of particular note are Jacques and Nigro who examine the impact of risk weighting in the U.S. and find that it raised capital ratios and reduced risk while Ediz, Michael, and Perraudin examine the impact in weighting scheme in the U.K. and argue that banks increased their capital in reaction and that it did not encourage composition bias. [43],[44] However, both of those papers have the same two significant flaws. First, they are only able to examine the impact for a few years after the introduction as opposed to twenty years. Second, they essentially test for the existence of composition bias by whether the bank increased its holdings of assets with a high-risk weight. This paper has argued that high-risk assets such as subprime first lien mortgages were assigned low risk weights and thus encouraged their accumulation. Thus testing for whether banks began to increase their holdings of assets with high-risk weights will miss a significant aspect of

[40] Koehn, M. and A.M. Santomero. 1980. "Risk in Banking and capital regulation." *Journal of Finance*, 35(5): 1235-1244
[41] Kim, D. and A.M. Santomero. 1988. "Risk in Banking and capital regulation." *Journal of Finance* , 43(5): 1219-1233.
[42] Keppo, J., L. Kofman and Xu Meng. 2010. "Unintended Consequences of the Market Risk Requirement in Banking Regulation." *Journal of Economic Dynamics & Control.* 34. 2191-2214.
[43] Jacques, K. and P. Nigro. 1997. "Risk-Based Capital, Portfolio Risk, and Bank Capital: A Simultaneous Equations Approach." *Journal of Economics and Business.* 49(6): 533-547.
[44] Ediz, Tolga, Ian Michael and William Perraudin. 1998. "The Impact of Capital Requirements on U.K. Bank Behavior." Paper presented at Financial Services at the Crossroads: Capital Regulation in the Twenty-first Century at the Federal Reserve Bank of New York, New York

composition bias. Therefore, this paper use of a longer time horizon and connection to the Great Financial Crisis to examine the risk-weighting system is an advantage.

In addition, several authors have examined the impact of more concentrated banking sectors and that large banks behave differently than small banks. Rajan and Zingales, as well as Cetorelli and Gambera, find that bank concentration has a negative impact on growth. [45] [46] Kashyap and Stein use commercial bank data from the 1970s and 1980s to show that large banks and small banks behave differently as monetary policy changes.[47] However, neither focuses on the important differences in large bank and small bank portfolios. It offers a systematic picture of the industry and its increased concentration in the last two decades and how the portfolio of banks varied across size and their relationship with the Great Financial Crisis.

Conclusion

This paper establishes several important facts on the post-1980s regulatory regime that are important for policymakers and economists. I find that the regime increased capital standards amongst banks and that the larger banks hold less capital than smaller banks. The former is at odds with the popular story of recent increases in bank leverage and the latter is not being discussed. Policymakers need to understand that lowering leverage in and of itself is not an adequate method to restrain risky banking. More attention should be focused on what should constitute capital; capital should be a measure of the banks' ability to respond both to a decline in assets and sudden changes in its access to funding.

For researchers, these results suggest the need for a better understanding of the role of capital in banking. Do leverage restrictions actually reduce the riskiness of the bank? In addition, why do banks hold excess capital? Traditionally, the belief is that the bank would hold less capital than is socially desirable. Thus leverage restrictions should be binding. While one can understand that perhaps the advisory CAMEL rating system

[45] Rajan, R and L. Zingales. 1998. "Financial Dependence and Growth" *American Economic Review*. 88: 559-586

[46] Cetorelli, N. and M. Gambera. 2001. "Banking market structure, financial dependence, and growth: international evidence from industry data." *Journal of Finance.* 56(2)

[47] Kashyap, Anil. and J. Stein. 2000. "What do a Million Observations on Banks say about the transmission of monetary policy?" *American Economic Review*. 90(3).

actually is binding, banks still maintain capital in excess of its highest rating. This may suggest an intriguing possibility on the current capital standards: If the market is demanding a capital standard higher than the regulatory one, this is evidence that the statutory standard is too low.

The concerns over the availability of the calculated capital in a crisis were not unknown to the regulators. However, the Basel regulations were not focused on financial crises. The regulations were conceived with the intention of reducing idiosyncratic credit risk. The view was that requiring capital would reduce the banks willingness to offer risky loans as it would be the first to lose and by offering a buffer to governments before they had to bail out banks. In addition, there was disagreement amongst policy makers as to whether regulators should require banks to have additional or more liquid capital. Former Federal Reserve Chairman Alan Greenspan advocated that "banks should not be required to hold capital against the possibility of financial breakdown."[48] Thus a key question of reform should be whether or not regulators should care whether or not the banking system should be ready for a liquidity crisis.

This paper's results show that banks behaved as a model of risk weighting with the wrong risk weights would predict. It is an open question whether regulators are willing or able to design a set of correct risk weights. They would also have to be more detailed to avoid banks classifying assets with a large range of expected default rates, such as mortgages with different down payments, as having the same risk weight. This suggests that the entire risk weighting system may be flawed.

The most noticeable development in banking has been the rise of the large banks' derivative operations. The fact that this paper uses a crude measure of derivatives merely shows the difficulty in the treatment of derivatives. For derivatives such as futures and options that have liquidity, transparency, and a history of trading, the problems are less severe. But for the over the counter, highly specialized, and exotic derivatives the attempt to value them using financial models that even before the crisis had very poor reputations

[48] Tarullo, Daniel. 2008. *Banking on Basel: the future of International Financial Regulation.* Washington, D.C.: Peterson Institute for International Economics. 27

is a risky decision. Notably this paper shows that a complete ban of derivatives would not directly impact most banks; only the very largest banks have significant exposure to derivatives. Thus, derivatives are the most significant challenge for banking reform and represent a risk particular to the large systematically important banks.

This paper provides evidence against the decision to allow large, super banks without more government monitoring. Large banks chose the policies most associated with the Great Financial Crisis of 2007. During the crisis, the government chose to increase asset concentration. It encouraged the 'super banks' to buy other banks using government guarantees for the investment and capital injections while also denying aid to smaller banks to encourage them to merge with larger ones. New financial reforms are in place to develop rules specifically for the largest entities, and this paper's results suggest that regulators should use the new tools to decrease leverage and restrict activity amongst the systemically important banks. However, as of writing, it is unclear what course regulators will pursue. The Federal Reserve has announced its commitment to Basel III but has not published the specific regulations banks will have to comply though it has made clear the many regulations such as a higher capital requirement will not take hold for several years.

Chapter 2

Nominal Bracket Creep and Labor Supply in the 1970s

Introduction

The Great Inflation caused a significant rise in income taxes. This tax increase occurred through three channels. Two of these channels have received a great deal of attention in the literature. One was the fall in the real worth of firm deprecation allowances. Second was the fall in the after-tax real return due to taxing the nominal return. Receiving less focus has been the steep rise in the real tax rate on labor income during this period. As the tax brackets were not automatically indexed for inflation, as inflation increased the real value of the tax brackets fell increasing taxes.

This nominal bracket creep has three key features. First, is that it was very large and broad based. Not only does the marginal effective rate rise by 25%, but also the average tax rate rises by 20% during the decade. Taxation in the 1970s standouts not only for having the highest taxes since World War 2 but also for having such high taxes during peacetime. Second, the rise differs across households. Households close to the next bracket were more likely to face higher marginal rates. Higher income households will also have larger increases in their average tax rate even if their marginal rate remains constant. Third, was the temporary nature of the tax increase. Households could expect based on past experience and political discussions at the time that the brackets would be adjusted to eliminate the rise due to inflation. This causes a predictable, temporary variation in taxes during the Great Inflation.

However, the response to this tax shock is *a priori* unclear. The affect will depend strongly on the labor supply elasticity, the perceived length of the tax shock, and where the household is located along the tax schedule. A household with a higher elasticity of

labor is more willing to reduce its labor supply. The longer the time till the tax code is re-indexed will cause a larger fall in after-tax wealth reducing a household's willingness to reduce labor supply and to substitute it across time. The location of the household to the tax brackets will determine how much of a tax rise it will receive from inflation. For instance, if the household is far from the next bracket, then the tax code is effectively indexed on the margin. The household's average labor tax rate will rise but not their marginal rate. Other households might see rises in their average and marginal rates.

I perform a quantitative analysis to analyze the impact of the tax changes due to the Great Inflation. Using data on the tax code and the income distribution, I examine the labor response of agents to inflation in an environment where prices are fully flexible but the progressive tax system is not immediately indexed for inflation. Feeding in the historical tax shocks, the model generates predictions for the path of aggregate labor. The rest of the paper is laid out as follows: Section (2) provides a historical overview, Section (3) presents an economic model, Section (4) simulates the model using historical data, Section (5) concludes.

Historical Background

Nominal bracket creep occurs as inflation lowers the real value of the tax brackets causing households to face higher tax rates. This influences the household through several channels depending on its location on the tax schedule. One it may raise the real effective marginal rate for working. This occurs if the nominal income increases enough to cross into the next bracket. Two is that it will raise the real average tax rate as long as the household is above the first bracket. Three, is that if the previous two effects cause any aggregate effect that changes the real wage then this will also impact the household. As an example, consider three households whom face the following non-indexed tax schedule.

Nominal Income	Marginal Rate
$0.00	10%
$100.00	25%

The three agents, Pauline, Mary, and Richard respectively receive a nominal wage of $90, $99, and $150 per hour. Assume for the moment that the price level is $1 and that each of them work for 1 hour.

Agent	Nominal Income	Real Income	Marginal Rate	Average Rate
Pauline	$90	$90	10%	10%
Mary	$99	$99	10%	10%
Richard	$150	$150	25%	15%

Now assume that the nominal wage and price level increases by 4% and they each continue working for 1 hour.

Agent	Nominal Income	Real Income	Marginal Rate	Average Rate
Pauline	$93.60	$90	10%	10%
Mary	$102.96	$99	25%	10.4%
Richard	$156	$150	25%	15.4%

In this example, Pauline is unaffected by the inflation. Mary and Richard have both seen their taxes increase even though their real income is unchanged. Because Mary was close to the next bracket, her marginal rate increased. Richard's marginal rate is unchanged but his average rate increased so he is worse off. In the case of Mary and Richard, inflation has acted as a negative shock, penalizing them for working.

As to what our agents might choose to do facing this supply shock is not clear. For one, the length of the shock is an important element. If the tax schedule is "re-indexed" back to its original state after one year, Mary and Richard both have strong incentives to reduce working in the year of inflation. If this is a permanent shock, then there is no incentive to reallocate leisure across time. The longer the time till readjustment will cause a larger negative wealth shock and reduce an agent's willingness to make large changes in their labor. Second, the elasticity of labor will also play a significant role. Third, a general equilibrium effect might be that due to changes in agent's labor decisions, real wages might change which further complicates the analysis. Finally, are the tax changes even meaningful? Nominal bracket creep may cause rises in taxes but of such a small amount that the impact is negligible. In addition, it might take a lot of inflation, or several years of inflation without re-indexation to generate sufficient supply shocks to change behavior. To begin to answer these questions will require more knowledge concerning the severity of the bracket creep, how often the tax schedule was re-indexed, and finally an explicit model.

The United States income tax system in 1972 had 15 tax brackets. The tax brackets had marginal rates ranging from 14% to 50%. A higher bracket often increased the marginal rate by 3%. See Table 2 for an example of brackets from 1972. Before 1968 while there were several tax brackets, the vast majority of Americans paid the same rate (20%) making the tax system effectively a flat rate except at the very tails of the income distribution.[49] In the 1970s, households were spread out across the brackets. The majority of households faced effective tax rates from 19% to 25%. However, there was also a strong rightward skewness such that the top 5% of households face effective rates of 50%.[50]

[49] Steuerle, Eugene. *The Tax Decade: How Taxes Came to Dominate the Public Agenda*. The Urban Institute Press, Washington D.C., 1992.
[50] Current Population Survey. *Historical Income Tables of American Families*. U.S. Census Bureau, Housing and Household Economic Statistics Division, 1972-1981

Table 3: Taxable Income and Marginal Tax Rate in 1972 Dollars

Over	Under	Marginal Rate
$0	$1,000	14%
$1,000	$2,000	15%
$2,000	$3,000	16%
$3,000	$4,000	17%
$4,000	$8,000	19%
$8,000	$12,000	22%
$12,000	$16,000	25%
$16,000	$20,000	28%
$20,000	$24,000	32%
$24,000	$28,000	36%
$28,000	$32,000	39%
$32,000	$36,000	42%
$36,000	$40,000	45%
$40,000	$44,000	48%
$44,000		50%

The Great Inflation consisted of two episodes: 1972-75 and 1978-1980. In current dollars, during both spikes of inflation the tax brackets were very similar from year to year. From 1972 to 1976, the tax brackets remained the same in terms of nominal income.[51],[52] However, due to inflation, the real value of the tax brackets fell significantly. The CPI rose 31% during those years causing a fall in the real value of the tax brackets by

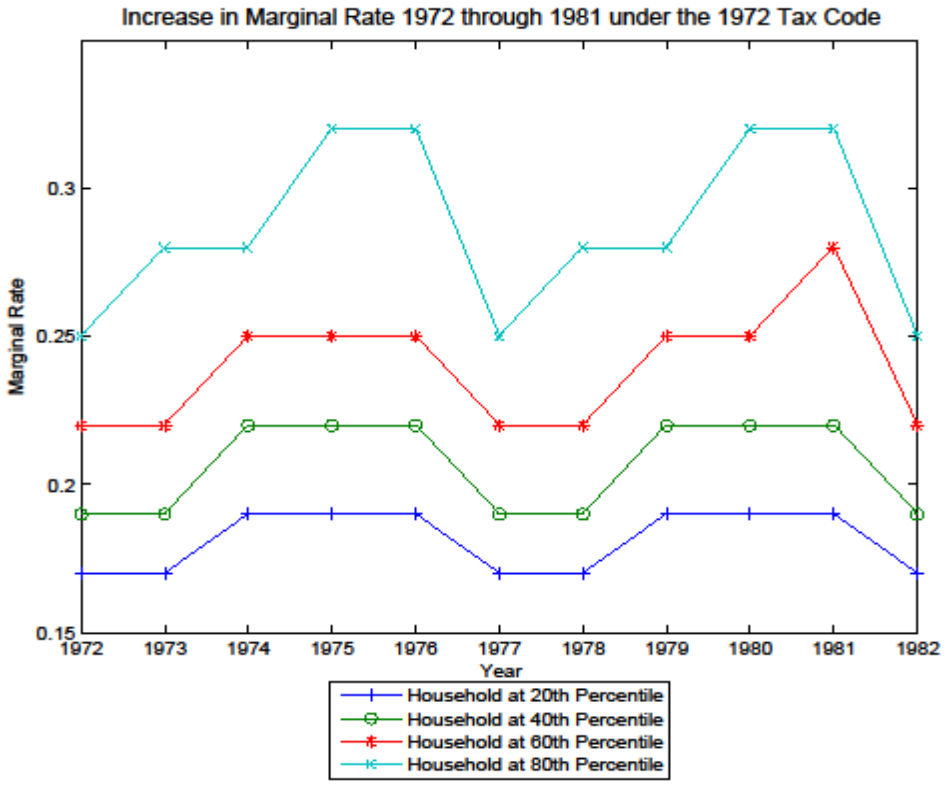
[51] IRS. *Your Federal Income Tax 1972*. The United States Government, 1972
[52] IRS. *Your Federal Income Tax 1976*. The United States Government, 1976

thousands of dollars. In 1972 dollars, the tax bracket for the 17% marginal rate fell from $3,000 to $2,206, the bracket for the 22% rate fell from $8,000 to $5,884, and the 42% from $32,000 to $23,534 over the next four years. See Figure 1 and 2 for examples of the rise in tax rates. In 1976 and 1978 reform packages were passed to alleviate this problem. While there were some changes to the distribution of taxes, the primary purpose was to return the tax brackets to their real values before the rises in inflation. The 1976 tax reform that set the rates for 1977 and 1978 reduced some of the tax burden caused by the previous inflation. Other than creating a new zero bracket, it mostly retained the same structure. But the increases in the kink points were skewed. For example, the 17% bracket in 1972 dollars rose from $3,000 to $4,273, but the 22% bracket fell from $8,000 to $7,720 in 1977. For households below the median income, the tax burden generally fell, but for those above the median kink points fell and their effective rates rose. Another year of inflation in excess of 7% saw the real value of the 1978 kink points across the income distribution fall eroding to some extent the reduced burden even on the poorest households. A new 1978 tax reform package was passed which not only tried to correct for the inflation but also reduced the number of brackets from 23 to 16 in 1979 thru 1981.[53] It retained the zero bracket created by the 1976 tax reform, changed marginal rates, and increased tax brackets. However, once again the increases in the kink points were skewed slightly towards the poor. For comparison, in 1972 dollars, the kink point from the 16% bracket rose from $2,000 to $2,534 but all the brackets above that rate saw significant erosion. The second wave of the Great Inflation arrived and saw inflation of 13% and 9% the next two years. The 32% rate fell from $20,000 in 1972 dollars to $11,335 in 1979 meaning households only slightly above the median would now face that rate. In 1972, households at that nominal income faced a rate of only 22%. For households at more than twice the median income, their rates doubled over the previous decade.[54] The households at the median saw their rates increased 25%. Rates on the poorest households had declines particularly for those in the new zero bracket (a decrease from 14% to 0%). But even a family of four in poverty saw their rates rise from 0% to

[53] Steuerle, Eugene. *Contemporary U.S. Tax Policy*. The Urban Institute Press, Washington D.C., 2004.
[54] Steuerle, Eugene. The Tax Decade How Taxes Came to Dominate the Public Agenda. The Urban Institute Press, Washington D.C., 1992.

2.85%.[55] In addition, as deductions were also not indexed for inflation, the real value of the typical household deductions fell by more than half from 1968 to 1980. Real household income growth was very small over the era and almost the entire rise in nominal household income was caused by inflation.[56]

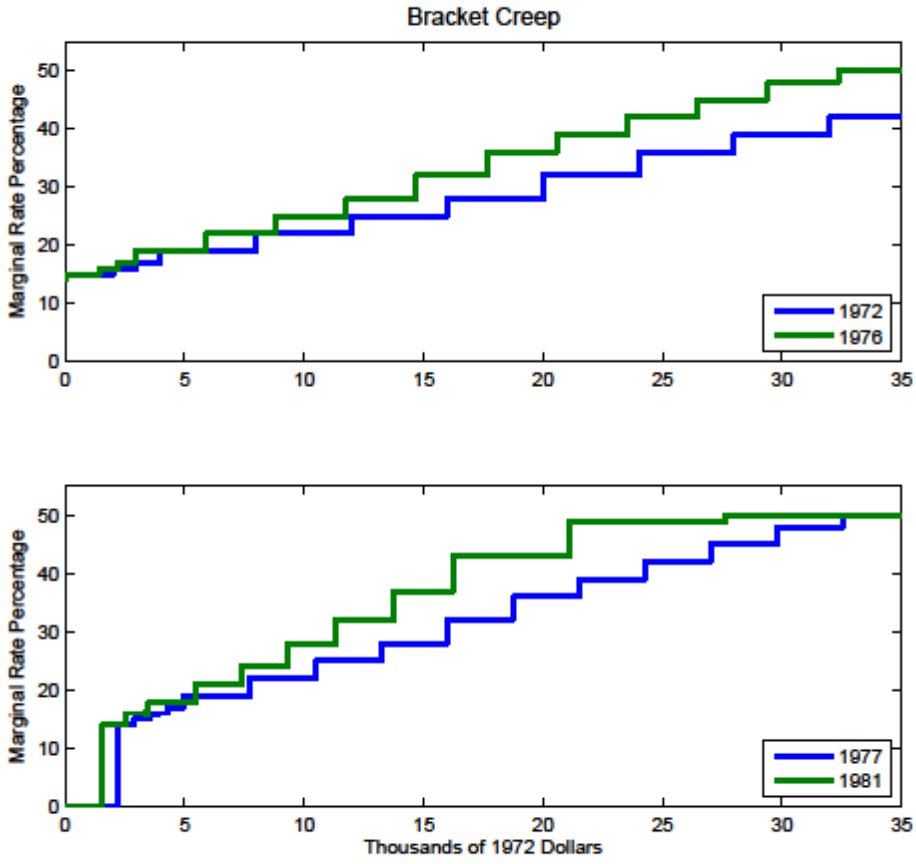
Figure 20



Note: This figure shows the marginal tax rate paid by a household for taxable income across time holding labor supply fixed while increasing household income by the rate of inflation. The figure's source is the IRS.

[55] Ibid
[56] Ibid

Figure 21



Note: This figure shows the change in the marginal rate for a given income in 1972 dollars as bracket creep occurs during the decade. The figure's source is the IRS.

The non-automatic indexation of the tax code for inflation was a long running feature. The reason for this phenomenon is not entirely clear. In the 1970s two prominent discussions for the lax adjustment of the tax system can be identified. One, government insurance programs such as Social Security, saw their payouts indexed to inflation, which increased the sensitivity of government expenditure to inflation. Thus a non-indexed tax system could provide the extra revenue needed to pay for the automatic rise in expenditure.[57] Second, part of the perceived solution to high inflation, particularly in the

[57] Brownlee, Elliot, editor. *Funding the American State, 1941-1995, The Rise and Fall of the Era of Easy Finance.* Woodrow Wilson Center Series. Press Syndicate of the University of Cambridge, New York, 1996b.

first spike, was an income-based policy predicated on the belief that the inflation was due to cost-push pressures. Policy-makers considered that inflation would only increase if a tax cut were approved and that higher taxes were needed to combat the inflation. They perceived rising taxes with inflation to be an automatic stabilizer.

An important issue is to what extent did households perceive the tax increases to be temporary or permanent. As noted above, as inflation slowed, Congress essentially re-indexed the brackets.[58] A proposed amendment in 1975 by the Republican Party for automatic nominal indexation failed to pass.[59] These inflation induced tax increases have been cited as a significant factor in the rise of the anti-tax revolution.[60] Even if one wants to be cautious on believing households during the 1973-1975 fully understood their rate increases were temporary, by the time of the 1978-1980 inflation households had had explicit experience with this phenomena. Saez suggests that due to the steep increase in taxes caused by inflation, "it is unlikely that a large fraction of taxpayers were unaware" nominal bracket creep. In 1980, Ronald Reagan was elected on a anti-tax platform and in 1981 passed a dramatic tax reduction. However, the tax reduction only reduced the tax burden effectively to its level in 1978.[61] But the 1981 Reform did introduce automatic nominal indexation of the labor income tax brackets starting in 1984.

Besides this paper's analysis of the actual tax tables, other research has noted the significant rise in taxes due to inflation in the 1970s. Feldstein documents the rise in capital income taxes due to inflation and its impact on business investment.[62] Other work argues that the abnormally low performance of the stock market during the 1970s was due to the tax on nominal gains.[63] Summers uses a model of asset prices to analyze the distortion caused by a tax system that allows the deduction of mortgage interest but taxes

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[58] Ibid
[59] Witte, John. *The Politics and Development of the Federal Income Tax*. The University of Wisconsin Press, Madison, Wisconsin, 1985
[60] Ibid
[61] Saez, Emmanuel. "The effect of marginal tax rates on income: a panel study of 'bracket creep'" *Journal of Public Economics*, 87:1231–1258, 2003.

[62] Feldstein, Martin. "Inflation, tax rules, and investment: Some econometric evidence" *Econometrica*, 50(4), July 1982.
[63] Feldstein, Martin. "Inflation and the Stock Market" *American Economic Review*, pages 809-20,1976.

capital gains.[64] Auerbach and Feenberg use data on actual filed returns to note the steep rise in taxes. They find that the highest average marginal taxes on labor are at the end of this era and believe inflation to be the cause. They also develop a measure of the increase in aggregate taxes due to an aggregate increase in income, to measure how much one's tax burden rises with additional income, and find that this metric rises with the 1973-75 inflation hump, falls, and then rises to the series high during the 1978-81 inflation episode before returning in the 1980s to its 1960s level.[65] Saez uses micro level data on tax returns and the 1978-81 inflation episode to estimate the response of income to the change in taxes. His analysis relies on using households far from crossing a kink point to compare to households closer to the next bracket. He finds that households close to kink points have abnormally low-income gains compared to similar households in the same tax bracket but further from the kink point. The paper estimates the elasticity for taxable income to be .4 but finds statistically insignificant results for the response of just wage income.[66] In a similar methodology to this paper, Altig and Carlstrom use an overlapping generations model to examine the effect of taxing nominal capital income in an otherwise fully flexible price economy. Their model suggests that the primary effect is a fall in labor supply.[67] Heer and Maußner use an overlapping generations model with sticky prices, sticky pensions, and an imperfectly updated progressive tax system to study the wealth effects on different groups from inflation during the business cycle.[68] Their model predicts that households facing higher marginal tax rates will reduce their labor supply.

This paper adds to this previous literature in several ways. One is by embedding the nominal bracket creep into a general equilibrium model. Thus the paper provides quantitative predictions for the response of labor. Two it takes into account that re-

[64] Summers, Lawrence. "Inflation, the stock market, and owner-occupied housing" *American Economic Review*, pages 429-34, 1981.
[65] Auerbach, Alan and Daniel Feenberg. "The significance of Federal taxes as automatic stabilizers" *The Journal of Economic Perspectives*, 14(3):37-56, 2000.
[66] Saez, Emmanuel. "The effect of marginal tax rates on income: a panel study of 'bracket creep'" *Journal of Public Economics*, 87:1231–1258, 2003.
[67] Altig, David and Charles Carlstrom. "Inflation, personal taxes, and real output: A dynamic analysis" *Journal of Money, Credit, and Banking*, 23(3):547-571, 1991.
[68] Heer, Burkhard and Alfred Maußner. "The Burden of Inflation: Analysis of an Overlapping Generations Model with Progressive Income Taxation and Staggered Prices" *Macroeconomic Dynamics*, 16,278-308, 2012

adjustment of the tax code and the predictable time variation in the labor taxes. Saez and this paper are similar in the analysis of nominal bracket creep and the role of the income distribution and the location of the kink points, but this paper emphasizes the distortion from lagged indexing and the cumulative impact of bracket creep. If households see the tax increase as being temporary, then the income effect is diminished and one should expect a larger response of labor. As opposed to the model of Altig and Carlstrom, this paper examines the nominal bracket creep in regards to labor rather than capital. While Heer and Maußner uses a continuous function to approximate bracket creep, this paper uses a more realistic tax code with non-continuous changes in the marginal tax rate. Further, this paper focuses solely on the 1970s and allows no demand role for inflation.

Finally, this paper relates to the role of inflation and monetary policy in two important ways. First it uses an institutional feature that causes inflation to have real effects even if market prices are perfectly flexible. Institutional frictions provide an alternative channel to understanding apparent monetary non-neutraility without relying on sticky prices, menu costs, or information problems. Second is analyzing the economic importance of a supply shock introduced by monetary policy. If the Federal Reserve caused a significant supply shock transmitted through the tax system, this could provide insight into the conduct of monetary policy and the design of tax systems.

Economic Model

In order to quantify the rise in marginal taxes, I develop a model that builds in three important features of the tax code. One is to introduce differentiated labor so that there is an income distribution. Second is a tax code that is not indexed automatically for inflation and has 'jump' points where the marginal rate rise discretely rather than continuously. Third is a process for inflation and re-indexing the nominal tax brackets. I modeled the first two explicitly and the last exogenously.

I use a representative agent model with multiple types of labor. The household chooses its consumption, savings, and its supply of several types of differentiated labor. Each type of labor has a different disutility of labor for the household and a different productivity for the firm. Further, the tax code taxes each type of labor separately. Therefore the

average and marginal tax rate for each type of labor. A motivation for this structure would be a set of households that are insuring each other from the shocks to the tax code. Households could receive a constant fixed fraction of aggregate consumption, reducing their idiosyncratic consumption risk and agreeing ahead of time to a contract specifying their labor supply based on the wage and tax shocks. The key implication of this structure is to reduce the income effect of tax shocks and precautionary savings.

The representative household chooses consumption and hours to work to solve the following problem:

$$\max \sum_{t=0}^{\infty} \beta^t E_t[\frac{c_t^{1-\frac{1}{\sigma}} - 1}{1-\frac{1}{\sigma}} - \sum_{i=1}^{d} \varphi_i \frac{n_{i,t}^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}}]$$

with respect to consumption and hours worked of each type of labor such that,

$$P_t(c_t + i_t) = P_t\zeta_t + R_t k_{t+} \sum_{i=1}^{d} (W_{i,t}n_{i,t} - T(W_{i,t}n_{i,t}, b_t))$$

$$i_t = k_{t+1} - (1-\delta)k_t$$

where σ is the intertemporal elasticity of substitution, η is the Frisch labor supply elasticity, φ_i the disutility of labor, P_t is an exogenously specified nominal price level, $W_{i,t}$ the flexible nominal wage on labor type i, R_t the flexible nominal rental rate of capital, and ζ_t is a transfer from the government the household takes as exogenous. $T(W_{i,t}n_{i,t}, b_t)$ is the tax assessed on labor type i which is discussed below. Households own all capital and rent competitively to firms. I do not consider capital taxes.

Firms in the economy competitively produce a common good and seek to maximize profits by choosing production, renting capital, and hiring the various types of labor according to the following modified neoclassical production function:

$$\max P_t y_t - R_t k_t - \sum_{i=1}^{d} W_{i,t} n_{i,t}$$

with respect to capital rented and labor hired such that

$$y_t = A k_t^{\alpha} N_t^{1-\alpha} = i_t + c_t + g_t$$

where

$$N_t = \sum_{i=1}^{d} a_i n_{i,t}$$

$$1 = \sum_{i=1}^{d} a_i$$

N_t is an aggregation of the individual types of labor based on their efficiency units. Conditions for profit maximization will generate $d + 1$ demand curves for capital and the types of labor. The nominal demand for capital will be equal to the price level times the marginal productivity of capital. The nominal demand for labor type i is:

$$W_{i,t} = P_t a_i (1 - \alpha) A k_t^{\alpha} N_t^{-\alpha} = P_t a_i \widehat{w}_t$$

where $\widehat{w}_t$ is the real 'aggregate wage.' Holding the marginal productivity of labor and capital fixed, changes in P_t will have no impact on the firm's demand for labor as the nominal wage and rental rate are perfectly flexible.

The tax is levied on the labor income of each type separately. The system is progressive, not indexed directly to inflation, and has m number of kink points that have jumps in the marginal tax rate. The tax rates τ_s assessed for income above the bracket s, can be re-written as $\tau_s = \tau_1 + \sum_{l=2}^{s} \gamma_l$ where $\gamma_l = \tau_l - \tau_{l-1}$. The nominal value of the "l" kink points is $\hat{P}_t b_l$. $\hat{P}_t$ is the current nominal price used to determine the nominal kink points. The government chooses $\hat{P}_t$ according to a policy rule. If $\hat{P}_t = P_t$ at all times, then the tax system is indexed for inflation (the real value of the kink points is unchanged by increases in the price level). Thus, to the extent that $\widehat{P}_t$ is below the current price level,

the real value of the kink points falls and the effective tax rates households face rise. Restricting attention to a tax system where the relative location of the kink points is fixed across time, the nominal value of a kink point is re-defined as $\hat{P}_t j_l b$ where $b_l = b j_l$. The tax function is then defined as

$$T\left(W_{i,t}n_{i,t}, b_t\right) = \tau_1 W_{i,t}n_{i,t} + \sum_{s=2}^{m} \gamma_s (W_{i,t}n_{i,t} - j_s b\,\hat{P}_t) H(W_{i,t}n_{i,t} - j_s b \hat{P}_t)$$

where $H()$is the heavyside function (or step function) which is 1 if non-negative and zero otherwise. It acts as an indicator function for whether the nominal income is above a kink point.

Using the firm's profit maximization conditions, the tax function can be written as:

$$T\left(W_{i,t}n_{i,t}, b_t\right) = P_t(\tau_1 a_i \hat{w}_t n_{i,t} + \sum_{s=2}^{m} \gamma_s (a_i \hat{w}_t n_{i,t} - j_s b \frac{\hat{P}_t}{P_t}) H(a_i \hat{w}_t n_{i,t} - j_s b \frac{\hat{P}_t}{P_t}))$$

$$T\left(W_{i,t}n_{i,t}, b_t\right) = P_t \hat{T}\left(a_i \hat{w}_t n_{i,t}, \hat{b}_t\right)$$

where , $\hat{b}_t = b\frac{\hat{P}_t}{P_t}$. Note that as the price level rises, $\hat{b}_t$ falls, which lowers the real income level associated with the higher tax rate. In addition, the nominal tax burden can be decomposed into three parts: the nominal price level, the real labor income for type i, and the current real value of the nominal kink points. An increase in P_t causes two effects: one it raises the nominal tax burden directly, and two it lowers the worth of the kink points and that impact is summarized by $\hat{b}_t$

The government policy is to balance the budget every year by lump sum taxes, ζ_t. Therefore, $P_t g_t = T\left(W_{i,t}n_{i,t}, b_t\right) + P_t \zeta_t$. Using our reduced form for the tax function, we can re-write the government budget constraint as $g_t = \hat{T}\left(a_i \hat{w}_t n_{i,t}, \hat{b}_t\right) + \zeta_t$. This allows the problem to be re-expressed without explicit reference to P_t

$$\max \sum_{t=0}^{\infty} \beta^t E_t[\frac{c_t^{1-\frac{1}{\sigma}} - 1}{1-\frac{1}{\sigma}} - \sum_{i=1}^{d} \varphi_i \frac{n_{i,t}^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}}]$$

$$(c_t + k_{t+1} - (1-\delta)k_t) = \zeta_t + \hat{r}_t k_{t+} \sum_{i=1}^{d} (a_i \hat{w}_t n_{i,t} - \hat{T}(a_i \hat{w}_t n_{i,t}, \hat{b}_t))$$

$$\hat{w}_t = (1-\alpha) A k_t^{\alpha} N_t^{-\alpha}$$

$$\hat{r}_t = \alpha A k_t^{\alpha-1} N_t^{1-\alpha}$$

$$y_t = A k_t^{\alpha} N_t^{1-\alpha} = k_{t+1} - (1-\delta)k_t + c_t + g_t$$

$$g_t = \hat{T}(a_i \hat{w}_t n_{i,t}, \hat{b}_t) + \zeta_t$$

$$\hat{T}(a_i \hat{w}_t n_{i,t}, \hat{b}_t) = (\tau_1 a_i \hat{w}_t n_{i,t} + \sum_{s=2}^{m} \gamma_s (a_i \hat{w}_t n_{i,t} - j_s \hat{b}_t) H(a_i \hat{w}_t n_{i,t} - j_s \hat{b}_t))$$

To close the model a process for $\hat{b}_t$ needs to be specified. Returning to the definition, $\hat{b}_t = b\frac{\hat{P}_t}{P_t} = b\frac{\hat{P}_t}{P_t}\frac{P_{t-1}}{P_{t-1}}\frac{\hat{P}_{t-1}}{\hat{P}_{t-1}} = \hat{b}_{t-1}\frac{1+\hat{\pi}_t}{1+\pi_t} = b\prod_{s=0}^{t}\frac{1+\hat{\pi}_s}{1+\pi_s}$ where π_t is the inflation rate from t-1 to t and $\hat{\pi}_t$ is the change in the nominal price associated with the kinks. Two features become clear to understanding the process of $\hat{b}_t$. One is that the entire past of inflation shocks influence the value and cause $\hat{b}_t$ to fall which raises the effective tax rates. Second is that for a stationary distribution for the economy to exist, the political process needs to eventually correct all past inflation. For simplicity, a perfectly indexed tax system would set $\hat{\pi}_t = \pi_t$ and then $\hat{b}_t = b$. Alternatively, a non-indexed system may only adjust every three periods.

This model allows no stimulative role for inflation; all inflation is 'bad' for the household as it only increases the distortionary aspects of the tax code. In addition, while the representative household assumption greatly eases the analysis, it significantly reduces the income effect of tax shocks on the individual types of labor. Increases in taxes are

primarily a substitution effect as excess tax revenue is returned to the household and other households insure agents.

I use the previous economic model to analyze the rise in effective tax rates during the 1970s. There were two eras of the tax brackets during the 1970s, one I will call the 1972 System and the other the 1978 System. I use the 'Married Filing Jointly' tax tables from the IRS Personal Income Tax Instructions to create the nominal kink points and marginal rates. The economic differences are relatively small between the two eras except for the larger zero bracket introduced for the later era. But since nominal deductions were not re-indexed for inflation, this feature causes only a small difference. And as mentioned in the historical background, the latter era reduces the marginal tax rates faced by the lowest income households but raises them on households above the median income. However, the economic impact of the zero bracket in this model is small because the new zero bracket changes the average tax burden rather than the marginal rates most households face. And as to whether the lower rates on the less efficient households are important will depend on the income distribution. I have to effectively extend the zero bracket in both eras due to the personal exemptions. For each era, I average the household personal exemption that I calculate from data on average children per household and the personal and marriage deductions. Then using the Consumer Price Index, I construct a time series for $\hat{b}_t$. I present simulations for each historical episode under its respective tax regime. I also present the entire decade under the 1972 regime.

I use data from the Census Historical Tables on U.S. Married Household to obtain a sample of the income distribution. I use 25 households in my model and fit them into the income distribution aligning them with their respective percentile.[69] Using the set of efficiency units a_t's I can fit the model's labor types to each of those points based on the relative total labor income received by labor type. Assuming that each household works the same number of hours in equilibrium, a normalization, I can finish calibrating the model's deterministic steady state to the empirical income distribution using A to uniformly scale the model's distribution and φ_i's to scale the hours worked to be the

[69] Current Population Survey. *Historical Income Tables of American Families*. U.S. Census Bureau, Housing and Household Economic Statistics Division, 1972-1981

same across households. I set the intertemporal elasticity of substitution to .2, $\beta = .97$, $\alpha = .36$, $\delta = .05$. I analyze the response of labor under three different values for the Frisch elasticity of labor equal to .1, .2, and 1. The first two estimates are typical estimates from research based on household data. Estimates greater than 1 have been suggested based on an extensive margin model and also through a consolidated job-search model.[70] Kimball and Shapiro estimate the elasticity to be 1 because that the long run trend in hours worked per person is zero and survey evidence on the wealth effect is income elasticity is 1.[71]

I construct a stochastic process for inflation using the annually averaged CPI. I fit a time series to either the 10-year or 20-year of date before the inflation episodes. The main difference across the two models is the 10-year era has a higher mean of inflation. For the political process, I consider both models where the nominal tax rates are re-set with a constant Poisson rate and models where the rate increases as the bracket creep becomes worse. Since in both episodes, congress re-set the rates approximately 3 years after the initial rise in inflation, the benchmark case will be a process with a 3 year mean till reset.

Finally, I solve the model using value function iteration. The model only has two states, k_t and $\hat{b}_t$ but has 26 control variables. I first discretize the state space for k_t and $\hat{b}_t$ and then solve for the optimal amount of each labor at each combination over all possible choices of k_{t+1}. Then I can use value function iteration to find the optimal choice of k_{t+1}. I used a state space of 69 points for k_t and 15 for $\hat{b}_t$ and fit the end points of the respective spaces such that the household never moved into those areas after converging to the stationary distribution. To obtain a discretized probability transition for $\hat{b}_t$ I simulate the process under the estimate inflation process and assumed political process. I then use a conditional kernel density estimation method to construct the discrete transition process.

Results

[70] Hall, Robert. "By How Much Does GDP Rise if the Government Buys More Output" Brookings Papers on Economic Activity, 2009,2

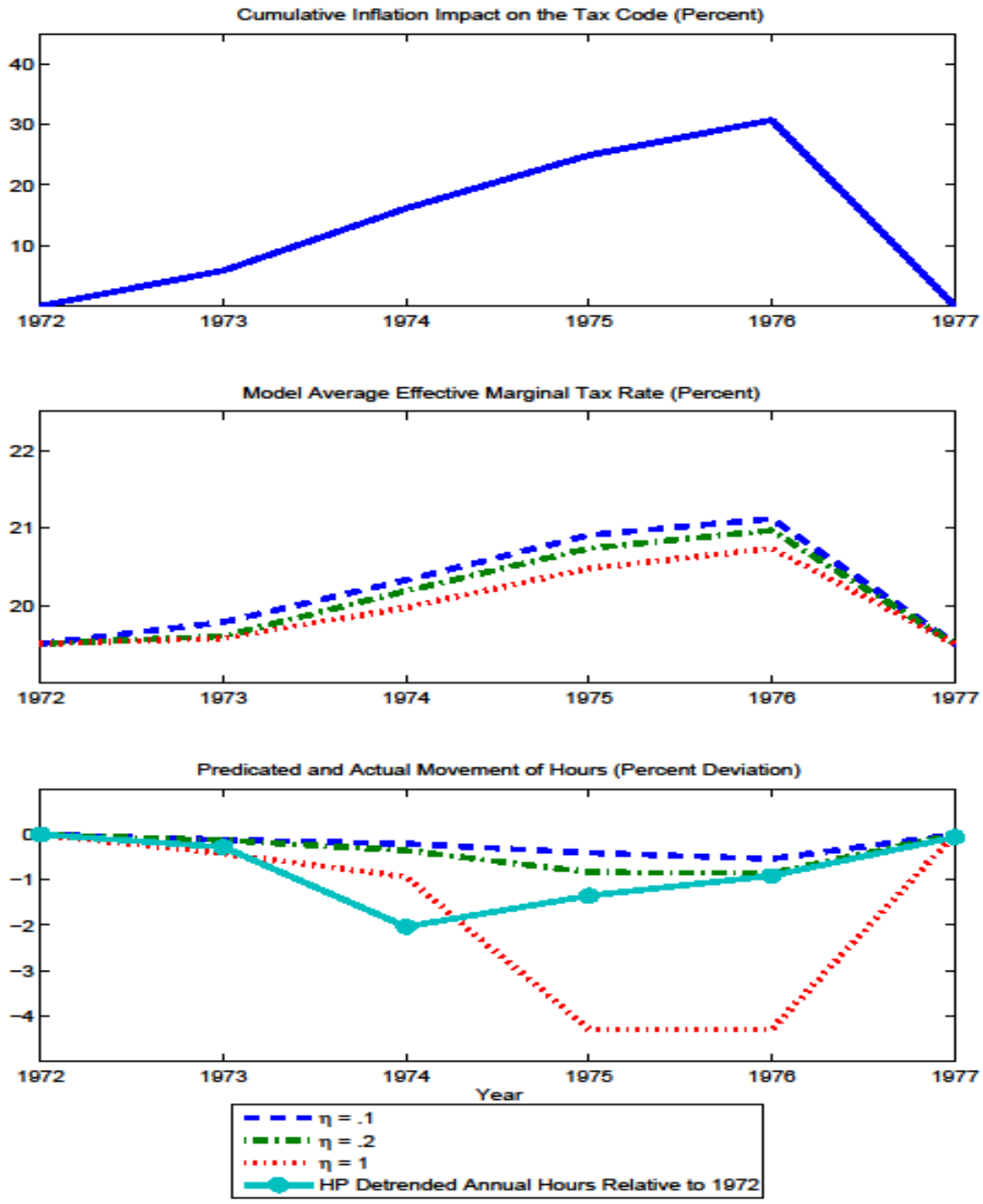
[71] Kimball, Miles and Matthew Shapiro. "Labor Supply: Are the Income and Substitution Effects Both Large or Both Small?" University of Michigan Working Paper, 6/29/10

I begin by considering the first tax episode under the 1972 tax cut. I consider the economy to start in steady state in 1972. I feed in my generated series $\hat{b}_t$ for each year till the reset year of 1976 and after that I assume that $\hat{b}_t$ = b. I then generated the predicted movements of the model's hours, the sum of the different types of labor not the aggregate effective labor, for the three elasticities that I consider. In Figure 22's top panel, I show the cumulative inflation impact on the tax code from 1972 thru 1976 (the additive inverse of the $\hat{b}_t$ series). In Figure 22's middle panel, I show the rise in the average effective marginal tax rate paid by the labor types which is a mixture of bracket creep and labor substitution. In Figure 22's bottom panel, I show the predicted response of hours and the actual response of HP Detrended Annual Hours, with a penalty of 6.25, for the U.S. Economy relative to 1972.[72]

[72] Raven, Morten and Harold Uhlig. "On adjusting the Hodrick-Prescott Filter for the frequency of observations" *Review of Economics and Statistics*, 84(2):371-380, 2002

Figure 22

1972 Results



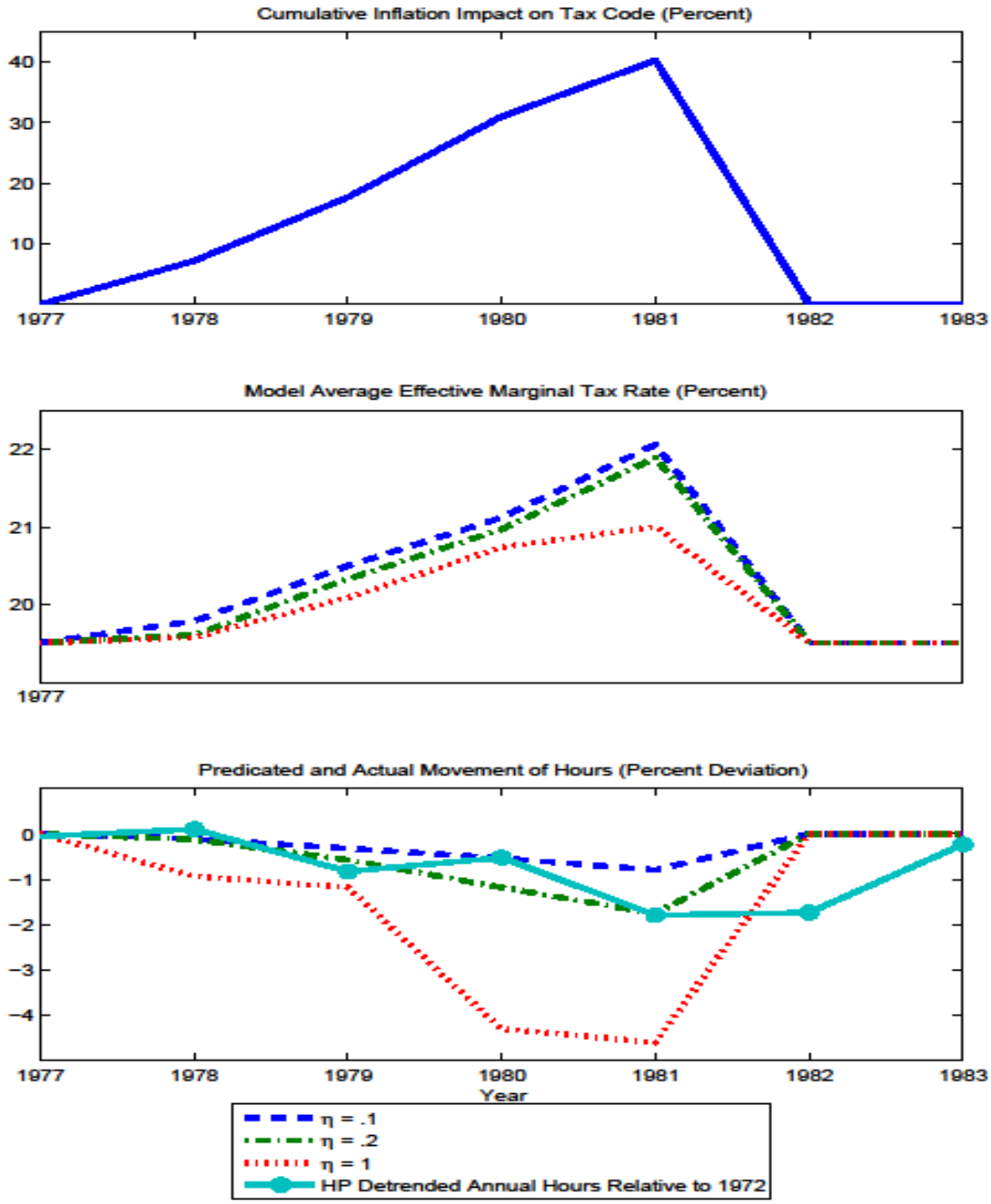
Note: This figure's top panel shows the cumulative inflation impact on tax code between 1972 and 1976 and then re-setting in 1977. The figure's middle panel shows the average effective marginal tax rates faced by the labor types in the economy as a result of the bracket creep and labor substitution. The figure's bottom panel shows de-trended hours relative to 1972 and the model's predicted aggregate labor supply reaction. The figure's sources for the data are the CPI and the BEA.

The graph shows the decline in hours in the model as nominal bracket creep increases. For $\eta = .1$, the model predicts that 30% increase in bracket creep causes a .52% drop in aggregate hours while $\eta = .2$ causes a larger drop of .8%. The difference between the two elasticities is mostly one of magnitude. For the larger elasticity, the model predictions are highly accurate for the initial decline and the recovery. However, it does not account for the significant drop of hours in 1974-75. One initial explanation might be that the model does not account for supply shocks other than nominal bracket creep. The 1973 OPEC oil embargo occurs over those two years and might provide an explanation for the drop in hours. With $\eta = .2$, the model under-predicts the movement in hours by .5%.

Next, I consider the 1978 tax simulation. In Figure 23, I present an analogous graph to Figure 22 where the differences are in the slightly different placement of the tax brackets and a $\hat{b}_t$ which I construct from the latter era's tax tables and CPI. In 1982, the rates are re-adjusted to the 1978 ones (I do not model the Reagan tax cuts, though as mentioned they reduced the tax burden to 1978 levels). The bracket creep during this latter episode is more severe and the predicted movement for hours reflects that. I make the assumption that the nominal brackets rates in 1978 are the same as in 1977. This is not literally true due to a tax reform, but it has little impact on the process and allows us to view a greater window of the response of hours. The elasticity of .1 predicts a drop of .8% while for .2 it shows a fall of 1.25% for a 40% increase in bracket creep. The hours measurement falls by 1.7%. Overall, the model predicts that nominal bracket creep could account for a substantial part of the drop in hours though it is less successful in predicting the slow recovery of hours.

Figure 23

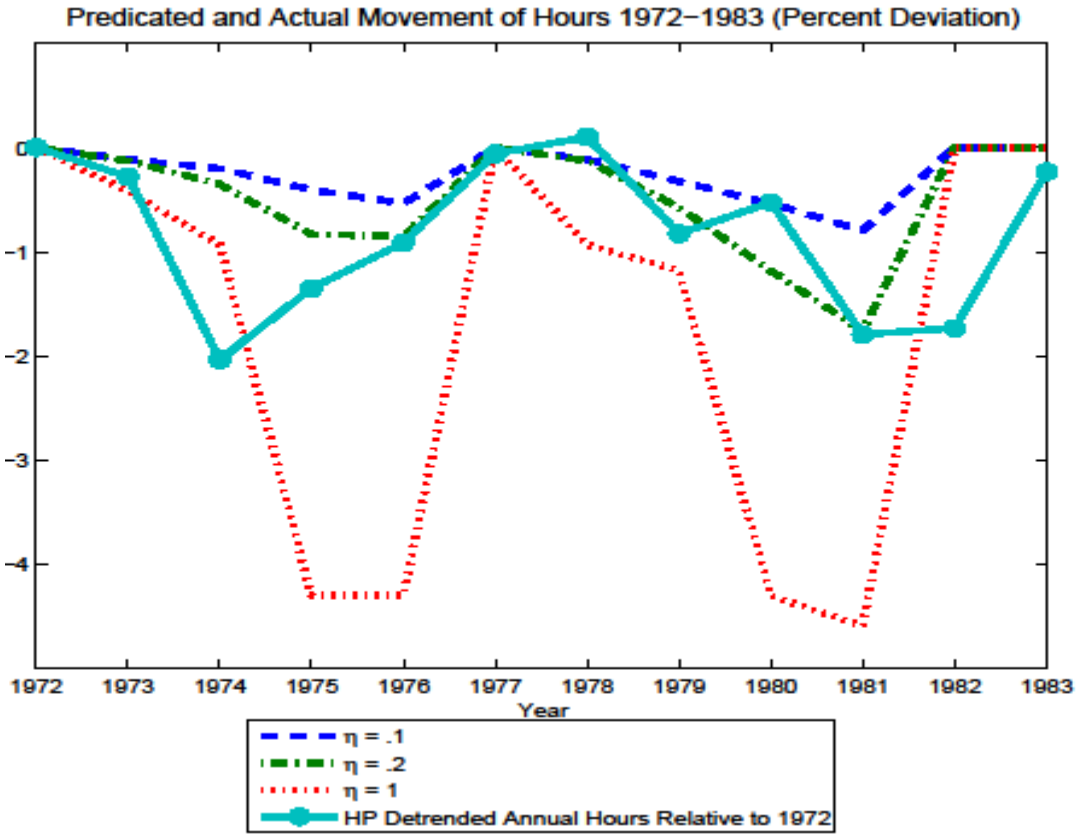
1977 Results



Note: This figure's top panel shows the cumulative inflation impact on tax code between 1977 and 1981 and then re-setting in 1982. The figure's middle panel shows the average effective marginal tax rates faced by the labor types in the economy as a result of the bracket creep and labor substitution. The figure's bottom panel shows de-trended hours relative to 1972 and the model's predicted aggregate labor supply reaction. The figure's sources for the data are the CPI and the BEA.

Before going forward with the analysis of the individual types of labor and sensitivity analysis, I simulate the entire period, 1972-81. I allow the 1972 tax system to replace the 1977 brackets, as mentioned above they are not very different, and assume that in 1981 the system returns to the 1972 brackets. Note, that this era will have a reset of the nominal bracket creep due to Congress adjusting the tax code the first inflationary episode. In Figure 24, I present the labor supply figure as before except from 1972 till 1981. The magnitude of the predicted movement of hours is roughly the same as in Figures 22 and 23. The key insight from Figure 24 is that the method the model is using to generate the predicted 'W' shape in hours is the reset by Congress to the old tax brackets. This re-set mechanism helps generate the drop in labor for the even a low labor supply elasticity. The reset of the bracket creep also conforms to the time that aggregate hours are above the 1972 values. However, the model still fails to exhibit the 1974-75 drop and the slow recovery after 1981.

Figure 24



Note: This figure shows the decline in aggregate hours worked from the model compared to the actual detrended data assuming no changes to the statutory rates across periods. The figure's source is the BEA.

I perform robustness checks for the exogenous process for $\hat{b}_t$. Moving from assuming that the expected time till Congress updates is 3 years to 4 years, causes hours process to change little except during the 1979 episode when with η = .2, hours drop by 2.4% and even overshoot the data. However, for a mean increase time from 4 years to 6 years, the model generates qualitatively the same results as the 4 year mean time to adjust. Lowering the mean time till increase to just one year, changes the labor supply response to roughly what it was under a mean time of 3 years. I also consider processes such that the if $\hat{b}_t$ falls to more than 45% below b, the probability of the system being re-indexing is one. This specification did not change the magnitude of the largest decline in labor or significantly alter the time path.

One can also examine the predictions for individual types of labor. The kinked tax system causes several non-linearaties in the response of hours. Even though the lowest rates see a 5%-15% increase in their effective tax rates, their labor response is very shallow. It is not till the labor types get paid above median wages that their labor significantly falls in response. Therefore, the main fall in labor is predicted to be amongst above median income wage earners. This response is not known *a priori* as it heavily depends on the income distribution its relation to the kink points. Recalling, that these workers are the ones by assumption to be the highest marginal productivity workers, their reduction of labor supply has a corresponding larger shock to the output of the economy.

Conclusion

The model is able to generate economically significant moves in aggregate hours that also correspond to the overall time trend of hours. The path of nominal bracket creep, measured directly from inflation and the tax brackets, could potentially account for both the empirical decline in hours and the recovery in the middle of the decade. For relatively low 'macro' estimates of the elasticity of labor supply, a supply shock caused by inflation can produce sizable in hours as compared to the empirical changes in hours. Due to the low elasticity, a very large supply shock is needed to generate movement in hours. As shown in the paper, nominal bracket was a very large shock which causes on average a 15% rise in the effective tax rates the household faces on working. The temporary nature of the tax cut also reduces the income effect of not working which increases the negative response.

There are important time periods the model does not match well. It under predicts the drop in hours during 1974-75 and predicts a stronger than experienced recovery in 1980. Unfortunately for the model, there are well known suggestions for the drop in employment during these time frames. Supply shocks such as the rise in oil and slowdown in growth would probably aid the ability of a plausible economic model to explain these events. Combining the oil shock with the simultaneous shock of nominal bracket creep would reduce the need to choose high elasticities of labor supply to generate the empirical movements in labor. Demand shocks pose a greater difficulty in

understanding what role they would add to the model. It is unclear how much of a negative shock that nominal bracket creep would cause if inflation also stimulated the economy. However, that suggests the possibility the impact of inflation on employment could be 'hump shaped.' For low levels of unexpected inflation it stimulates the economy and the amount is greater than the nominal bracket creep supply shock. But as inflation accumulates, and the tax code is not re-indexed, nominal bracket creep becomes a strong negative force that could cause even normal inflation levels to cause falls in employment. This provides a possible channel to explain the breakdown of the Phillips Curve in the 1970s. Future research could extend the basic nominal bracket creep model to include supply shocks, demand shocks, and non-insured agents to increase the income effect of the tax shocks and become more realistic.

Finally, even if the nominal bracket creep is important, it is unclear why the mechanism had a significant impact in the 1970s and not earlier. Bracket creep caused significant rises in effective tax rates over the last two decades. Even though inflation was abnormally high in the 1970s, policy makers increased inflation steadily over the previous decade and were sluggish in adjusting the tax rates. One suggestion is that before the 1970s, the tax system was effectively indexed since almost all households paid the same rate. It was a combination of real growth, inflation, some tax increases, and a widening income distribution that spread out households along the tax system. A second suggestion is that nominal bracket creep has to be considered explicitly with real bracket creep. If inflation and real growth were both high, such as in the 1960s, output and employment might expand. But in an environment where inflation was high and real growth was low such as in the 1970s, the negative impact on output and employment might dominate. This complicates the link between how inflation and growth are related because the Federal Reserve may use inflation to improve real growth without understanding the institutional frictions that may cause nominal bracket creep to cause a contraction.

Bibliography

Altig, David and Charles Carlstrom. "Inflation, personal taxes, and real output: A dynamic analysis" *Journal of Money, Credit, and Banking*, 23(3):547–571, 1991.

Ann Arbor State Bank. 2010. http://www.a2sb.com/about-us/ (Accessed July 2, 2010).

Auerbach, Alan and Daneil Feenberg. ''The significance of federal taxes as automatic stabilizers." *The Journal of Economic Perspectives*, 14(3):37–56, 2000.

Bill Text 111th Congress (2009-2010) H.R. 4173.ENR. 2010. The Library of Congress. http://thomas.loc.gov/cgi-bin/query/D?c111:6:./temp/~c111Jr45rg:: (Accessed August 12, 2010).

Brownlee,W. Elliot. *Federal Taxation in America, A Short History*. Woodrow Wilson Center Series. Press Syndicate of the University of Cambridge, New York, 1996a.

Brownlee,W. Elliot, editor. *Funding the American State, 1941-1995, The Rise and Fall of the Era of Easy Finance*. Woodrow Wilson Center Series. Press Syndicate of the University of Cambridge, New York, 1996b.

Buffet, Warren. 2002. Berkshire Hathaway Inc. "Letter to Shareholders." http://www.berkshirehathaway.com/letters/2002pdf.pdf (Accessed May 15, 2010).

Cetorelli, N. and M. Gambera. 2001. "Banking market structure, financial dependence, and growth: international evidence from industry data." *Journal of Finance.* 56(2)

Current Population Survey. *Historical Income Tables of American Families*. U.S. Census Bureau, Housing and Household Economic Statistics Division, 1972-1981.

Ediz, Tolga, Ian Michael and William Perraudin. 1998. "The Impact of Capital Requirements on U.K. Bank Behavior." Paper presented at Financial Services at the Crossroads: Capital Regulation in the Twenty-first Century at the Federal Reserve Bank of New York, New York.

FASB. 1998. *Statement of Financial Accounting Standards No. 133.* Norwalk, Conn. Financial Accounting Standards Board.

FDIC. 2004. *DSC Risk Management Manual of Examination Policies.*

FDIC: Failed Bank List. 2011. FDIC. http://www.fdic.gov/bank/individual/failed/banklist.html (accessed March 1, 2011).

Feldstein, Martin. " Inflation and the stock market." *The American Economic Review*, pages 809–20, December 1976.

Feldstein, Martin. "Inflation, tax rules, and investment: Some econometric evidence." *Econometrica*, 50(4), July 1982.

Freixas, Xavier and Jean-Chares Rochet. 2008. *Microeconomics of Banking.* 2nd ed. Cambridge, MA: MIT Press.

Gart, Alan. 1994. *Regulation, deregulation, reregulation: the Future of the Banking, Insurance, and Securities Industries.* New York: J.Wiley & Sons.

International Convergence of Capital Measurement and Capital Standards. 2010. Bank of International Settlements. http://www.bis.org/publ/bcbsc111.pdf (January 17, 2010).

IRS. *Your Federal Income Tax 1972*. The United States Government, 1972.

IRS. *Your Federal Income Tax 1976*. The United States Government, 1976.

Hall, Robert. "By How Much Does GDP Rise if the Government Buys More Output" Brookings Papers on Economic Activity, 2009, 2.

Heer, Burkhard and Alfred Maußner. "The Burden of Inflation: Analysis of an Overlapping Generations Model with Progressive Income Taxation and Staggered Prices" *Macroeconomic Dynamics*, 16,278-308, 2012

Jacques, K. and P. Nigro. 1997. "Risk-Based Capital, Portfolio Risk, and Bank Capital: A Simultaneous Equations Approach." *Journal of Economics and Business.* 49(6): 533-547.

Kashyap, Anil. 2009. "Where do we go from here?" Remarks at the Federal Reserve of Chicago's 12th International Banking Conference. http://faculty.chicagobooth.edu/anil.kashyap/research/internationalbankingconfremarks.pdf (Accessed May 1, 2010).

Kashyap, Anil. and J. Stein. 2000. "What do a Million Observations on Banks say about the transmission of monetary policy?" *American Economic Review*. 90(3).

Keppo, J., L. Kofman and Xu Meng. 2010. "Unintended Consequences of the Market Risk Requirement in Banking Regulation." *Journal of Economic Dynamics & Control.* 34. 2191-2214.

Kim, D. and A.M. Santomero. 1988. "Risk in Banking and capital regulation." *Journal of Finance* , 43(5): 1219-1233.

Kimball, Miles and Matthew Shapiro. "Labor Supply: Are the Income and Substitution Effects Both Large or Both Small?" University of Michigan Working Paper, 6/29/10

Koehn, M. and A.M. Santomero. 1980. "Risk in Banking and capital regulation." *Journal of Finance*, 35(5): 1235-1244

Lowenstein, Roger. 2010. “Commentary: First, Slap Limits on Bank Leverage.” *Business Week.* March 11. http://www.businessweek.com/magazine/content/10_12/b4171026575784.htm

Mishkin, Frederic. 1998. *The Economics of Money, Banking, and Financial Markets*. 5th Edition. Reading, Mass: Addison-Wesley.

Rajan, R and L. Zingales. 1998. “Financial Dependence and Growth” *American Economic Review*. 88: 559-586

Ravn, Morten and Harold Uhlig. “On adjusting the Hodrick-Prescott filter for the frequency of observations.” *Review of Economics and Statistics*, 84(2):371–380, 2002.

Saez, Emmanuel. “The effect of marginal tax rates on income: a panel study of ’bracket creep’” *Journal of Public Economics*, 87:1231–1258, 2003.

Steuerle, C. Eugene. *The Tax Decade How Taxes Came to Dominate the Public Agenda*. The Urban Institute Press, Washington D.C., 1992.

Steuerle, C. Eugene. *Contemporary U.S. Tax Policy. The Urban Institute Press*, Washington D.C., 2004.

Summers, Lawrence. “Inflation, the stock market, and owner-occupied housing.” *The American Economic Review*, 71(429-34), 1981.

Tarullo, Daniel. 2008. *Banking on Basel: the future of International Financial Regulation.* Washington, D.C.: Peterson Institute for International Economics.

Witte, John. *The Politics and Development of the Federal Income Tax*. The University of Wisconsin Press, Madison, Wisconsin, 1985.