Explaining the Great Moderation: Credit in the Macroeconomy Revisited

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ABSTRACT

This study in recent history connects macroeconomic performance to financial policies in order to explain the decline in volatility of economic growth in the US since the mid-1980s, which is also known as the 'Great Moderation'. Existing explanations attribute this to a combination of good policies, good environment, and good luck. This paper hypothesizes that before and during the Great Moderation, changes in the structure and regulation of US financial markets caused a redirection of credit flows, increasing the share of mortgage credit in total credit flows and facilitating the smoothing of volatility in GDP via equity withdrawal and a wealth effect on consumption. Institutional and econometric analysis is employed to assess these hypotheses. This yields substantial corroboration, lending support to a novel 'policy' explanation of the Moderation.

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Explaining the Great Moderation:

Credit and the Macroeconomy Revisited*

1.   Introduction

A small and expanding literature has recently addressed the dramatic decline in macroeconomic volatility of the US economy since the mid-1980s (Kim and Nelson 1999; McConnel and Perez-Quinos, 2000; Kahn et al, 2002; Summers, 2005; Owyiang et al, 2007). Blanchard and Simon (2001) noted declines in the standard deviation of quarterly growth and inflation by half and by two thirds, respectively, since 1984. Warnock et al (2000) documented strongly declining employment volatility. Bernanke (2004) drew broad attention to these trends by making it the topic of his 2004 Eastern Economic Association speech. While the bursting of the dotcom bubble punctured any belief in a permanent 'end of boom and bust', macroeconomic volatility to date has remained markedly lower than it was before 1984. Many countries, particularly the Anglo-Saxon economies, share this feature. Table 1 below shows that the average annual volatility of GDP growth halved from 0.012 in 1960-1983 to 0.006 over 1984-2007[1].

The evidence is now abundant, and studies have focused on explaining and interpreting the simultaneous decline in volatility of the key macroeconomic variables (see Cecchetti and Kraus, 2006 for an overview). The new stability poses two puzzles. Why did the trade-off between output volatility and inflation volatility break down, as evident in their joint decline for over two decades now? And why that decline itself? A third question taken up in some discussions of the Moderation concerns the link with America's other salient macro features – foremost, the current account deficit (Fogli and Perri, 2006), but also bubbles in the stock markets (bursting in 1989 and 2000) and the real estate, credit derivatives, stock and currency bubbles unwinding at the moment of writing.

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[1] The end data of 2007 is not to suggest that the Great Moderation ended in 2007 (although see Barnett and Chauvet's November 2008 paper entitled 'The End of the Great Moderation?') but for reasons of data accuracy. GDP revisions within a year of publication are often considerable. For instance, GNP announcement made by the US government at the start of quarter t on GDP growth in quarter t-1 were, on average over 1967-1991, 11.6 % lower than the true GDP growth established some years later, after fully correcting for noise and incomplete data (Rodriguez Mora and Schulstad, 2007:1927, table 1).

Some writers argue that the greater stability signifies that the US economy entered a new phase around 1984. The nomer 'Great Moderation', reminiscent of America's Great Depression and Great Inflation episodes, conveys this sense of a new era. The novel element is variously thought to be better monetary policy (Bernanke, 2004), better inventory management (McCarthy and Zakajsek, 2003), financial innovations (Dynan et al, 2005; Guerron, 2007), financial deregulation (Hull, 2003), and fundamental labour market changes as the Baby Boomer generation is aging (Jaimovic and Siu, 2006). Other analysts point to the role of chance and suggest that the volatility decline may well be due to smaller or less frequent shocks to the economy, quite outside the influence of policy makers. Most accounts allow for a mix of good policies, good environments and good luck (Ahmed et al, 2004). Consider each in turn.

Bernanke (2004) offers a sophisticated explanation for the breakdown of the trade-off between output volatility and inflation volatility, as captured by a 'Taylor curve'. He points out that this trade-off only exists *on* the Taylor curve. If policy makers are sub-optimally operating below the curve, then better policies may lead to simultaneous improvements in the stability of both output and inflation, moving the economy *closer to* the curve. Alternatively, if the environment has become more stable since the mid-1980s (which, as Bernanke suggests, may itself be due to more predictable policies), then this would be reflected in a shifting out of the Taylor curve. Again, this creates room for policy makers to move nearer to it, at no cost to stability. In effect, this argument attributes the Moderation principally to better policies. This connects to the suggestion by Gali and Gambetti (2009) who identify the larger weight that monetary authorities gave to inflation stabilization as a cause of the Moderation.

Another approach to detecting the sources of the Moderation is to look for fundamental changes simultaneous to it. Such coincident analyses have established that the start of the Great Moderation coincided with the ballooning of the US current account deficit. Fogli and Perri (2006) suggest that the Moderation was a causal factor for the deficit by weakening incentives for precautionary savings. Their model and evidence explain 20 % of deficit growth. Gali and Gambetti (2009:26) note that the Moderation has been accompanied by "large changes in the patterns of comovements of output, hours [worked] and labor productivity". Stock and Watson (2002) find that the Moderation is principally attributable to smaller shocks, not to different monetary policy construed narrowly in terms of a Taylor rule, where only interest rate is the monetary policy instrument. This would be a 'good environemnt' (or 'good luck') explanation, rather than 'good policy'. The Moderation also coincided with lesser ability of professional forecasters and the Fed to forecast inflation and

real activity (D'Agostino et al, 2006). This suggests a break in the structure of the US economy that renders forecasting models obsolete. It supports that the Moderation is a 'new era' in US economic history indeed.

In addressing the puzzles posed by the Moderation, this paper connects to the 'policy' and 'environment' explanations of the Moderation, and contributes to the coincident analysis literature. Its premise is that monetary policies and financial deregulation created a fundamental shift in the structure of the US economy, more conducive to macroeconomic stability. Because this shift occurred two decades ago and was not reversed, the present study also agrees with Bernanke (2004) that the environment has adapted to the new policies, reinforcing the lower volatility in output, employment and inflation. However, this paper does not represent the familiar position that the decisive change in policy was a combination of greater transparency and predictability by an inflation-targeting Fed.

Instead, the key observation is that the start of the Moderation coincided with the start of other trends. These include a surge in bank credit creation (especially mortgage credit), a rise in property income, a rise in the consumption share of GDP, and a change in correlation (from positive to negative) between consumption and non-consumption GDP components. The suggested explanation is that a redirection of bank credit lending moderated GDP volatility by facilitating a larger role for wealth-based consumption in the US business cycle, cushioning shocks to the productive part of the economy. In short, this paper reconsiders the role of 'credit in the macroeconomy', to paraphrase a paper by Bernanke (1993).

In the next section this explanation is developed in detail and located in the literature. Section provides a narrative account and quantitative assessment of the major trends in credit markets and in the macroeconomy during the Moderation. Section 4 offers an econometric analysis and section 5 concludes with a summing up and discussion.

2.   Credit Flows and the Moderation

The central argument in this paper will be developed by considering a Keynesian-type 'credit multiplier of income', which captures the effect of credit flows on income growth. This is especially appropriate in the context of a study of reduced income volatility during the Great Moderation. Income multipliers were introduced by Keynes into the *General Theory* precisely in order to understand income volatility arising from changes in investment and employment (e.g., 1973 [1936]:118). As Hudson (1992:414) notes, 'Keynes' "multiplier" was a ratio

indicating the income enhancing effect of injections of purchasing power' - but Keynes' analysis paid no explicit attention to how purchasing power is created, namely in the credit creation process. Hudson instead observes that "each country's income multipliers might be increased by … leveraging the general credit superstructure. But Keynes himself did not draw this parallelism." That is, one can define income multipliers not just for investment but also with respect to credit[2], and trace how credit to different sectors may have different effects on income and income volatility. Keynes himself noted that his *General Theory* analysis - while 'valuable in introducing order and method into our enquiry'- should take into account 'complicating factors', among which he notes 'how much of the new money is absorbed into the income and industrial circulations' (1973 [1936]:298). The present analysis explicitly considers such 'complicating factors' by tracing how much of the 'new money' (that is, of fresh credit creation) is absorbed into 'industrial circulations' (that is, used in the real sector) and how much is related to leveraging, or debt creation – specifically, mortgage debt. A focus on leverage is justified also from a policy perspective since "the solution for a troubled economy is to regulate leverage, not interest", as Geneakoplos (2009) notes. This position is detailed below.

Keynesian income multipliers reflect the effect on growth in income (Y) due to (say) one Dollar of purchasing power injected into the economy, via what he generically named 'investment' (I). This effect is captured in the multiplier $\Delta Y / \Delta I$, which is the inverse of the marginal propensity to save out of income ($\Delta S / \Delta Y$). Keynes so recognised that investment is the counterpart of saving. The innovation introduced in this paper is to make explicit that the counterpart of savings can be either real-sector investment which increases GDP and thus Y, or financial-sector investments[3]. These may detract from the credit flow available to support GDP growth via fixed capital formation, but may on the other hand stimulate GDP by facilitating consumption against increased asset values. To the extent that this 'wealth effect

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[2] This multiplier would be different from the common 'money multiplier' which is restricted to some definition of money (M1, M2, M3, etc.) whereas credit includes money but also other forms of liquidity. A focus on the credit supply rather than on the money supply is justified since 'the central means by which the banking systems (and the monetary authorities) affect the level of economic activity is through control of the availability of credit, not through the medium of exchange' (Stiglitz and Weiss, 1988).

[3] The conceptual distinction is that in the real sector, goods and services are produced and traded, while in the financial sector, wealth is managed by the creation and trade of financial instruments and assets (such as mortgages). Real-sector returns are profit and wages, while financial-sector returns are mostly asset price gains. The sectoral distinction parallels the distinction between income and wealth, and is fundamental to all national accounting – see e.g. the *System of National Accounts* standards produced by the OECD, to which all countries adhere in compiling their national accounts. Financial investment is all investment dealt with in the Financial Account, defined and described in chapter XI of the *System of National Accounts.* Unlike all other accounts in the *System of National Accounts,* the financial account does not have a balancing item that is carried forward to another account. In this sense, it is self-contained.

on consumption'[4] runs countercyclical to the non-consumption part of GDP, it may allow for GDP smoothing. This effect may have been the cause of the lower volatility during the Great Moderation. The aim of the present paper is to develop this argument and test its implications.

In analogy to the Keynesian income multiplier of investment, the effect of credit on growth may be traced in a 'credit multiplier of income' $\Delta Y/\Delta K$. This reflects the effect on growth in income (Y) of one dollar of credit (K) injected into the economy in the process of credit creation. The credit multiplier $\Delta Y/\Delta K$ is the inverse of an economy's propensity to lend out of income ($\Delta K/\Delta Y$). As (Werner e.g. 2005) emphasizes, total-credit flows can be decomposed into different types of credit flows (depending on the focus of analysis) and accordingly sectoral credit multipliers can be defined. In this paper the focus is on the case where K=M (for mortgages) and on the mortgage multiplier $\Delta Y/\Delta M$, the inverse of an economy's propensity to convert savings out of income into mortgage credit ($\Delta M/\Delta Y$). The mortgage multiplier $\Delta Y/\Delta M$ quantifies the increase in GDP due to an increase in mortgage debt, i.e. by 'leveraging the credit superstructure' (Hudson, 1992:214). This occurs when an overhead of *financial*-sector wealth reflected in increasing real estate prices (and its mirror image, debt) is superimposed on the real-sector economy through the creation and inflation of financial assets such as real estate and its derivative instruments.

As noted, a positive effect on income and thus GDP of this leveraging runs via the 'wealth effect on consumption', when individuals finance consumption against increased house prices. Catte *et al* (2004), building on other studies, estimate that the marginal propensity to consume out of housing wealth has been in the range of between 5 and 8 per cent in the United States during the Great Moderation years (and lower in most other OECD countries included in their study). During the Great Moderation, nominal US real estate values more than tripled, so that the 'wealth effect' would have induced an increase of consumption by between 15 and 24 per cent (in nominal values). To the extent that this wealth-induced consumption was countercyclical to other GDP components, this could lead to significant GDP smoothing. These figures are only indicative, but they suggest that the consumption effect due to real estate wealth would have been substantial and that the orders of magnitude are sufficient to warrant further exploration of the present hypothesis.

In summary, the explanation suggested in this paper is that during the Great Moderation, changes in the structure and regulation of financial markets have caused a redirection of credit flows, boosting ΔM credit both nominally and as share of total credit

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[4] Apart from the consumption smoothing effect, other financial-sector investments than mortgages also allow for

flows. Further, the claim is that changes in ΔM ran counter-cyclically to other GDP components so that mortgage-driven consumption increased in times of lower growth (or contraction) of other GDP components. Moreover, for this explanation to be specific to the Great Moderation, this dampening effect should have been stronger during the Great Moderation than it was before. The institutional dimension of his explanation centres on financial deregulation. This policy increased both access to mortgage credit, and increased opportunities for equity withdrawal so that mortgage credit could lead to higher consumption levels. Figure one depicts this account in one flow chart. Below we explicitly formulate the hypotheses implied in this account of the Great Moderation

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the smoothing of investment decisions. These fall outside the scope f the present study.

Figure 1: Mortgage-Backed Consumption Cushioned of Shocks to GDP
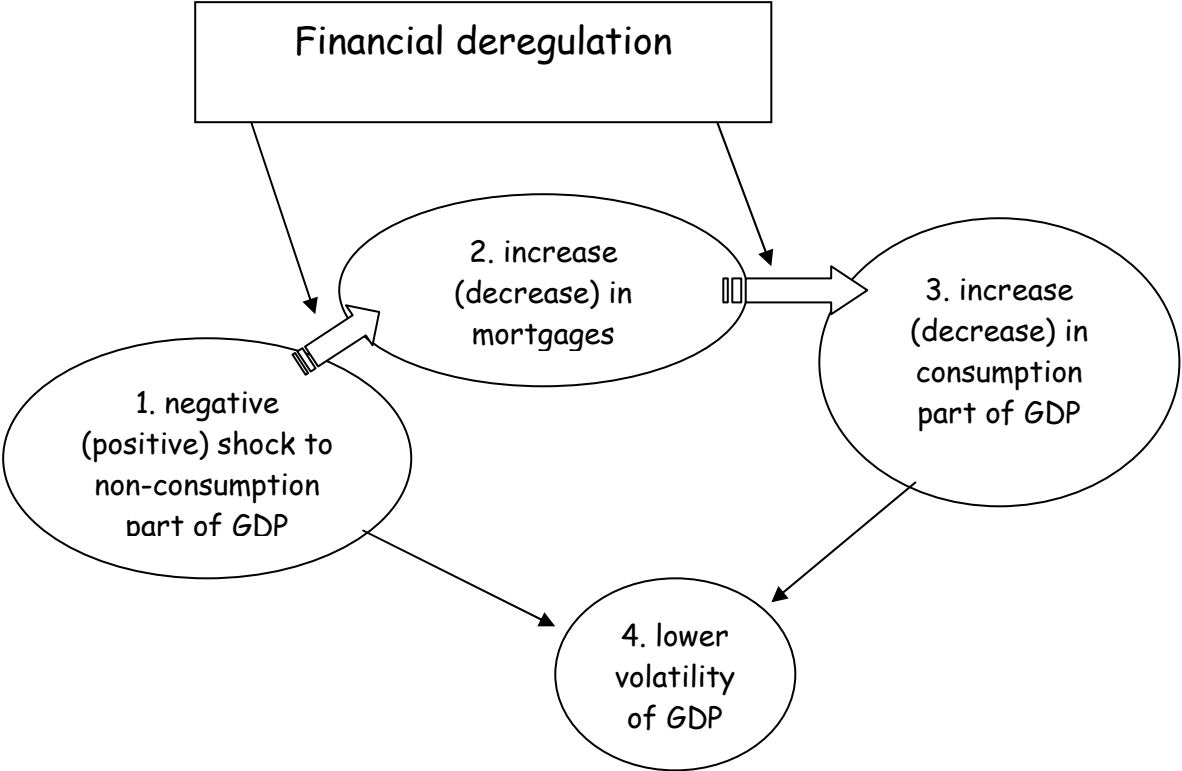
Notes to Figure 1: Fat arrows indicate chronological sequence. Thin arrows indicate causality. Text in ovals indicates variable changes, text in rectangles indicates context

Hypothesis 1: *During the Great Moderation, changes in the structure and regulation of US financial markets have caused a redirection of credit flows, facilitating an increasing share of mortgage credit in total credit flows.*

A second hypothesis is that the economy's propensity to convert savings out of income into mortgage credit ($\Delta M/\Delta Y$) increased during the Great Moderation (denoted t1) compared to the years before (denoted t0), so that the mortgage multiplier of income ($\Delta Y/\Delta M$) declined:

Hypothesis 2: $\Delta Y/\Delta M_{t1} < \Delta Y/\Delta M_{t0}$

A third hypothesis is that growth in private consumption was countercyclical to growth in other GDP components during the Great Moderation, and more so than before. GDP (Y) is defined as

$$Y = C + I + G + E\text{-}M$$

where C denotes private consumption, I denotes investment, G denotes government consumption, and E and M denote export and import, respectively. Let N denote the total of non-private consumption GDP components ($N = I + G + E - M$) so that the correlation coefficient s is

$$s = \text{corr } (C,N)$$

Hypothesis 3: $s_{t1} < 0$ and $s_{t1} < \Delta s_{t0}$

A fourth hypothesis is that the house wealth effect on consumption increased, that is, consumption growth (ΔC) during the Great Moderation was more strongly determined (in some function f) by mortgage growth (ΔM) than was the case before:

Hypothesis 4: $(\Delta C)_t = f_t(\Delta M_t)$ where $f'_{t1} > 0$ and $f'_{t1} > f'_{t0}$

A fifth hypothesis, following from the above, is that GDP volatility (denoted V_{GDP}) was some function g of consumption ΔC - *i.e.* ΔC caused V_{GDP}, - such that V_{GDP} was decreasing in ΔC, more so during the Great Moderation than before:

Hypothesis 5: $(V_{GDP})_t = g_t(\Delta M_t)$ where $g'_{t1} < 0$ and $g'_{t1} < g'_{t0}$

Sections 3 and 4 below are an empirical assessment of these hypotheses. The remainder of this section first locates this explanation in the contemporary literature. This study fits into a strand of literature where credit is a key factor in understanding the macroeconomy, especially cyclicality and volatility (Bernanke 1993; Bernanke and Blinder 1998; Bliss and Kaufmann, 2003). While most contemporary work on credit and the macroeconomy is in the sprit of the Credit View (Bernanke and Gertler, 1993) or some variety of an accelerator model (Kyotaki and Moore, 1997), the present emphasis is on the more traditional notion of credit as the prime source of liquidity, enabling agents to finance expenditures (as also in Borio and Lowe, 2004).

But this study deviates from the mainstream approach by asserting that the credit multiplier can durably affect growth and its volatility. This is *contra* the Credit View, notably its best known proponent Bernanke, who warned against treating 'credit aggregates as an independent causal factor affecting the economy' or a 'primitive driving force' (Bernanke and Gertler, 1995:34,44)[5].

This paper follows the Kocherlakota (2000) argument that credit constraints can create cycles, and extends this to the logically equivalent argument that looser credit policies can create stability. It thus also connects to the literature which views business cycles (partly) as credit cycles (Kiyotaki and Moore 1997; Mendicino, 2007). In support, Benk et al (2005), building on Uhlig (2003), identify credit shocks as candidate shocks that matter in determining GDP. Kyotaki (1998) explains how the credit system intermediates and amplifies technology or wealth shocks into output movements. Caporale and Howells (2001) analyse the interactions between bank loans, bank deposits and total transactions in the economy. They conclude that "loans cause deposits and that those deposits cause an expansion of wealth/GDP transactions" (Caporale and Howells, 2001:555). Note that the present paper has no issue with Moore (1988; 1991) and the Post-Keynesian literature following it on money endogeneity, which argues that the total quantity of credit money supplied should be regarded as endogenously demand-determined. This view is quite independent of the question considered here, whether that credit-money, once created endogenously or otherwise, will then affect GDP movements. Such causality is contested – Koopman et al (2006), for instance, argue that GDP growth causes the credit cycle.

This paper is also focused on loan volumes rather than interest rates; Lown and Morgan (2006) show that loan volumes – determined largely by credit standards and regulation – dominate loan rates in explaining output. Arestis and Sawyer (2006; 2008) likewise question how effective interest rates are. Geanakoplos (2009:9) calls for an end to "the obsession with interest rates" in more attention to the "leverage cycle". All these studies use some measure for the *total* credit supply, without the disaggregation adopted in this paper.

With regard to specification, it connects to work by Werner (1997, 2005) who disaggregated credit flows into real-sector and financial-sector flows in his study of the Japanese boom of the 1980s and the subsequent slump. The key insight was that economic performance measures can be linked to the distribution of bank credit over different sectors of

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[5] Bernanke adds that 'in a previous life, [he] has performed similar exercises. Mea culpa', referring to his (1983) study of the Great Depression.

the economy. This suggests that rather than a 'quantity theory of money' as the workhorse model for studying real-financial interactions, a 'quality theory of credit'[6] may be useful, since 'the central means by which the banking system (and the monetary authorities) affect the level of economic activity is through control of the availability of credit, not through the medium of exchange' (Stiglitz and Weiss, 1988). Likewise, Austrian economists attribute errors in mainstream analysis at root to theorists' "confusing the demand for credit with the demand for money" (Yeager and Greenfield 1997). The present study of the US builds on this by assigning a special role within the total-credit flow to mortgage credit, and by making a connection to the volatility of GDP growth.

Closely related papers are by Campbell (2005) who poses a link between rapid growth and increased volatility in credit flows to financial markets and stability in the real economy; and Lorrain (2006) who finds that the volatility of industrial output is lower in countries with more bank credit. This paper suggests that the ability of banks to pool and diversify shocks helps achieve volatility dampening via countercyclical borrowing. But Lorrain does not distinguish between the uses of credit which, as will be shown below, considerably increases the explanatory power of the model. Another related idea is by Freeman and Kydland (2000) who suggest that the correlation between a variety of monetary indicators and real output results from endogenously determined fluctuations in the money multiplier, rather than from causal influence of money on output. But they do not specify the cause of these fluctuations. The present paper goes further by asserting a causal influence of credit-money on output. It also shows that what Freeman and Kydland (2000) label 'fluctuations in the money multiplier' may well be caused by the changing *composition* of credit flows, expressed in the mortgage multiplier.

3.   The Great Moderation: Trends in Financial Markets and the Macroeconomy

This section provides an institutional account and quantitative assessment of trends in financial markets and the US economy before and during the Great Moderation. This constitutes an empirical assessment of the qualitative Hypothesis 1 that during the Great Moderation, changes in the structure and regulation of financial markets have caused a redirection of credit flows, boosting ΔM credit flows.

From the early 1980s, financial market deregulation in the context of the freeing of the US Dollar from convertibility a decade earlier freed the banking system to step up dollar creation. This was thus an incentive to banks for increased loan extension. But demand for liquidity from the real sector was constrained by the volatile and high interest rates of the period, as policymakers used vigorous interest rate management in the battle against inflation. These high and volatile costs of capital were a drag on real-sector investment and consumption but stimulated lending and financial arbitrage. Additionally, US financial-market deregulation in the early 1980s inaugurated a rise in credit to financial markets generally and to mortgage markets specifically. 'Regulation Q', which capped the interest rates at which banks where allowed to loan funds, was phased out over some years in the early 1980s. Simultaneously in the non-bank financial sector, large institutional changes were opening up new investment opportunities, particularly in the household loans and mortgage market. The newly deregulated Savings & Loans market, for instance, absorbed unprecedented volumes of savings during the second half of the 1980s, directing them into mortgage credit. From the mid-1990s the technology stock bubble attracted large liquidity flows into what, in retrospect and despite appearances, were not real-sector but financial-sector investments, speculating on asset price increases. The dotcom bubble in stock markets also stimulated financial innovations which survived its puncturing, and which would facilitate the fast leveraging processes observed during subsequently maturing bubbles in derivatives, currency trade and housing.

The 1999 repeal of the 1933 Glass-Steagall Act was another milestone in financial-sector stimulation. 'Glass-Steagall' was motivated by the over-leveraging practices that preceded the 1929 stock market crash. Among other things, it aimed to separate banking proper – that is taking in deposits and creating credit– from wealth investment and money management. Glass-Steagall regulation meant that bank loans would stay on the books of the lender bank, which was responsible for loan collection or, alternatively, would have to shoulder default costs. Its 1999 repeal, in contrast, allowed banks to make out loans and then sell them, typically to a pension fund or other institutional investor. This freed banks from much of the loan risk. It also allowed banks to make profits more from fees collected when making out the loan than from safely collecting the loan. Both these changes – lower risk to the lending bank and profits from the number of loan transactions rather than from low risk-corrected returns - induced banks to increase lending volumes. Such deregulation also

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[6] I thank Chris Meakin for suggesting the term.

stimulated the market for credit derivatives which sliced, sorted, repackaged, and insured loans in order to increase their tradability.

These policies and developments brought a marked change in the composition of credit flows and in the relation between consumption and production in the US economy from the mid-1980s, the start of Great Moderation. Capital gains made in financial markets and on house prices compared well to real-sector profitability, rationalising continuous mortgage credit extension. Thus the growth in mortgage lending became self propelled, and continued even after the initial conditions that had started it, had changed (Shiller, 2006). These observations are in line with the suggestion that the decisive shift in monetary policy that inaugurated the Moderation was a new interest rate regime combined with financial deregulation.

The Great Moderation was characterized by six developments that support the above account. They are jointly illustrated in Table 1 (all data are taken from the Bureau of Economic Analysis).

Table 1: Trends in Credit and the Macroeconomy Before and During the US Great Moderation

(decade averages)	1970s	1980s	1990s	2000s*
Consumption** (% GDP)	62.4	64.3	67.0	69.9
correlation of consumption growth with non-consumption growth (coefficient)**	25.4	-35.8	-35.8	-40.4
total credit stock outstanding (% GDP)	147.3	186.1	236.7	297.0
Mortgage credit stock outstanding (% GDP)	14.5	29.1	54.9	96.3
Real-sector credit stock outstanding (% GDP)	0.87	1.02	1.20	1.17
Income from property (% GDP)	30.0	41.7	40.5	38.9
Volatility of GDP growth (annual s.d., '000)	10.5	11.4	5.4	6.3

Note: all decadal figures are unweighted averages calculated from nominal quarterly data.

 * The 2000s include the 8 years of 2000 to 2007.

** The 'non-consumption' part of GDP comprises investment, export and government expenditures; the 'consumption' part includes private consumption. 'Correlation' is a two-year moving average of correlations between quarterly observations.

Source: Bureau of Economic Analysis

First, the share of consumption in GDP, which had been virtually stable between 60 % and 63 % from 1953 to 1981, rose from 64 % in 1982 to 70 % in 2001-2007. Historically, this was a rapid increase.

Second, shocks to the investment, export and government expenditures components of GDP (N) were increasingly counterbalanced by opposite movements in private consumption (C). The claim of this paper is that as a result of this balancing act, the average annual volatility of GDP growth halved from 0.012 in 1960-1983 to 0.006 over 1984-2007[7]. This mechanism whereby decreases in N were offset by increases in C (and vice versa) was the more effective in smoothing GDP because of the increase in the consumption share already noted. One way to measure the significance of this balancing mechanism is by the correlation coefficient *s* between N and C growth (in differences). This measure was a positive +0.25 in the 1970s but turned into a negative -0.36 to -0.40 from the 1980s onwards, corroborating hypothesis 3 above. Significantly, most of the decline occurred around the start of Great Moderation in the mid-1980s. As these averages hide great variation, another way to illustrate this difference is to look at the percentage of two-yearly moving average correlation coefficients that was negative in each decade. This was only 30 % in the 1970s, but 77 % in the 1980s, 92 % in the 1990s and 90 % in the 2000s. This demonstrates that for most of the Great Moderation years, declines in the investment, net export and/or government expenditures were balanced by increases in private consumption.

The liquidity that facilitated the increase in consumption was provided by increases in the total bank credit stock, which doubled in relative terms from 1.5 times GDP in the 1970s to 3 times GDP in the 2000s. Thus the credit multiplier of income decreased strongly during the Great Moderation (as in hypothesis 2). The rise in credit creation was largely due to the most important category of credit with regard to the domestic US economy, the stock of mortgage credit. This rose from just 3 % of GDP in the early 1950s to 30 % of GDP in 1985

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[7] The end date of 2007 is not to suggest that the Great Moderation ended in 2007 (although see Barnett and Chauvet's November 2008 paper entitled 'The End of the Great Moderation?') but for reasons of data accuracy. GDP revisions within a year of publication are often considerable. For instance, GNP announcement made by the US government at the start of quarter t on GDP growth in quarter t-1 were, on average over 1967-1991, 11.6 % lower than the true GDP growth established some years later, after fully correcting for noise and incomplete data (Rodriguez Mora and Schulstad, 2007:1927, table 1).

and on to an average 96 % in the 2000s. By the time of the latest observation in 2007Q4, the employment of bank credit for leveraging assets by mortgaging them had become about equally important (111 % of GDP) as its role in supporting real-sector transactions (121 % of GDP). Credit stocks in the real sector also increased at the start of the Great Moderation, but by only about 20 %. This difference with mortgage (and other financial) credit growth reflects the changing structure of the US economy.

The transition to a new growth regime can also be seen in the rise in income from property as a share of GDP: from 25 % in the 1960s and 30 % in the 1970s to around 40 % in the 1980s, 1990s and 2000s. Again, most of that increase occurred at the start of the 1980s. In the four years 1978-1982, income from property rose from 31 % to 42 % of GDP, then stayed at that level. It has since been fluctuating between 35 % and 45 %, with little variation in most years. The shift in the US economic structure is also reflected in the observation that while property income shares increased by two thirds (from 25 % to 40 %) from the 1960 to the 2000s, the share of wage incomes was stable at precisely 57 % of GDP throughout.

In brief, a number of structural changes occurred within a few years in the early 1980s, the start of the Great Moderation: the credit-to-GDP ratio increased in the real sector by 20 %; the growth in the mortgage-to-GDP ratio accelerated; property incomes and consumption levels both moved to a higher plateau; and GDP volatility halved. As will be analysed more rigorously below, the picture that emerges from these explorations is that negative shocks in the non-private consumption (investment, export and government expenditures) components of GDP were systematically accompanied by growth in private consumption, supported by property income growth linked to increases in mortgage credit levels.

4.   Econometric Analysis

In order to assess hypotheses 4 and 5, a model will now be developed reflecting the relations set out in Figure 1 above. These are the mortgage - consumption relation $(\Delta Cons)_t = f_t(\Delta M_t)$ (with $f'_{t1} > 0$ and $f'_{t1} > 0$ f'_{t0}) and the consumption – GDP volatility relation $(V_{GDP})_t = g_t(\Delta Cons_t)$ (where $g'_{t1} < 0$ and $g'_{t1} < g'_{t0}$). The model captures a cointegrated relationship between the volatility of GDP, mortgage credit, and consumption, in a vector autoregression analysis. Such a multi-equation framework is preferable over a single-equation approach as causality between both types of credit and GDP is *a priori* ambiguous; and indeed most

analyses of causes of the Great Moderation employ a cointegration approach such as Vector Auto-Regression (VAR) analysis. GDP volatility is defined as the annual standard deviation of quarterly nominal growth in GDP. Mortgage credit growth and consumption growth are defined as the annual average of quarterly year-on-year growth, in nominal US Dollars. All variables are calculated over non-overlapping intervals of 4 quarters. After differencing once, a Philips-Perron test indicates that the transformed variables satisfy the short term stationarity requirement at the 1 % confidence level (note that this does not exclude any long-term cointegration relationship).

This model so estimates the interrelationship between three variables (mortgage credit flows, consumption growth and GDP volatility, all in differences) in a three–equation Vector Auto-Regression (VAR) framework with 3 lags (as indicated by Akaike and Schwartz information criteria), for the 24 years of the Great Moderation (1984-2007) and the 24 years preceding it (1960-1983). Formally, this model is the reduced form of the dynamic simultaneous equations of GDP volatility y, mortgage credit growth m and consumption growth c in three VAR(3) equations:

$$y_t = v + A_{(1i)}y_{t-i} + A_{(2i)}m_{t-i} + A_{(3i)}c_{t-i} + e_t \qquad (t = 1, 2, \ldots 24; i = 1, 2, 3)$$

where y_t, v and e_t are all 3x1 vectors, $A_{(i)}$ are coefficient matrices of size 3 x 3, and e_t is white noise. The model is dynamic in that it relates each of the three variables GDP volatility, mortgage credit growth and consumption growth in year t to their own lags in years t-1 to t-6, and six lags of the other two variables. This captures that it takes time for credit flows to have their effects on GDP volatility. Lagging allows for assessment of the causality between variables, defined by temporal sequence in the sense of Granger. No parameter restrictions are imposed a priori as in a structural VAR, since such restrictions would lack a clear theoretical basis (although below in defining Impulse Response Functions, orderings will be implicitly imposed, justified by Granger causality patterns). This is the basic model; below additional variables are added to probe the robustness of findings.

This analysis is conducted separately for the Great Moderation and for the pre-Great Moderation years. The start of the Great Moderation in this time series is defined to be in 1984 as in most studies (though variations in this starting date are explored below). As no one has yet announced the end of the Great Moderation (though see Barnett and Chauvet, 2008), the full time series from 1984 to 2007 is utilized. The analysis is conducted separately for the Great Moderation and the years preceding it. The pre-Great Moderation period is defined to

be the 24 observations preceding 1984, from 1960 to 1983, so as to preserve symmetry in the number of observations in the pre- and post-1984 analyses.

Individual estimated coefficients and tests for Granger causality were studied and, while of the expected size and significance, they give only an initial indication of the effects of interest since these are the net results of interactions in the system. These effects are better explored in graphs of the orthogonalized impulse response functions resulting from the VAR analyses, for the relations of interest. This requires Choleski decomposed vectors which imply an ordering in the VAR. E.g. with an x-over-y Choleski vector, it is implied that x drives y, so that a structure is imposed on the VAR. This may be misleading if in reality causality between x and y is unclear, or runs in reverse direction. Sims (1980) suggested that an implicit ordering may be justified by Granger causality from x to y. A second check on correct ordering is by model averaging. Orthogonalized impulse response functions from x to y and from y to x are estimated, and the net effect calculated to suggest the correct ordering[8].

We first study causality patterns. Before the GREAT MODERATION, no causality at all can be detected (using a 1 % level of significance for the Chi-square statistic of the Granger causality test). During the GREAT MODERATION, there is unidirectional causality from mortgages to consumption, from consumption to GDP volatility, and from mortgages to GDP volatility. The first two relations are as expected. The latter suggests that mortgages may have affected GDP volatility also in other ways than through consumption; but below we will see that this is not confirmed by impulse response graphs. It is noteworthy that mortgages are not Granger caused within the system. This is in line with the institutional description of mortgage growth as exogenously caused by policy choices. These causality patterns motivate the formulation of impulse response functions in the GREAT MODERATION from mortgages to higher consumption (graph 2), from higher consumption to lower GDP volatility (graph 3), and directly from mortgages to GDP volatility. The latter relation turned out to yield no significant effects and is not shown here (but available on request). For purposes of comparison, in each graph these relations are also estimated for the pre-GREAT MODERATION years. Figure 2 captures the wealth effect on consumption, showing the effect on consumption growth of a one-unit shock in mortgage growth in the eight years following it. Figure 3 report the effect on GDP volatility of a one-unit shock in consumption

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[8]. I thank Kelvin Balcombe for drawing my attention to this point

growth in the eight years following it.. The black lines are forecasts based on parameter point estimates; the grey areas are 99 % confidence intervals.

Figure 2: Effect of a shock in mortgage credit growth on consumption growth during the Great Moderation (1984-2007, top) and before (1960-1983, bottom).
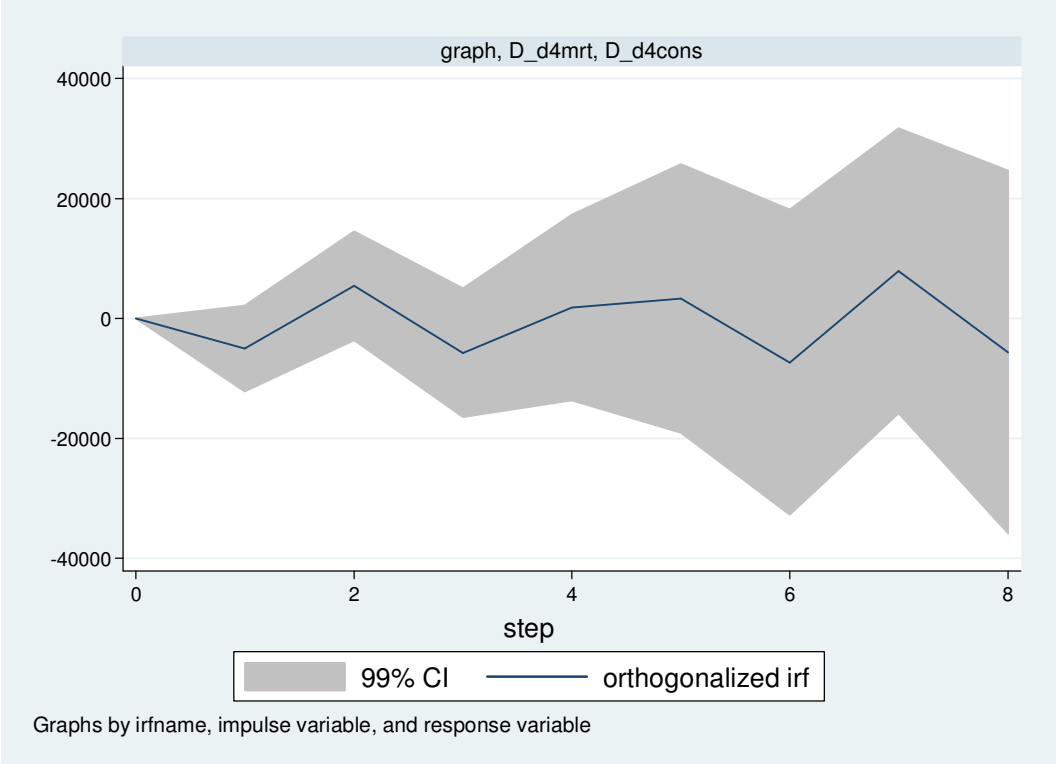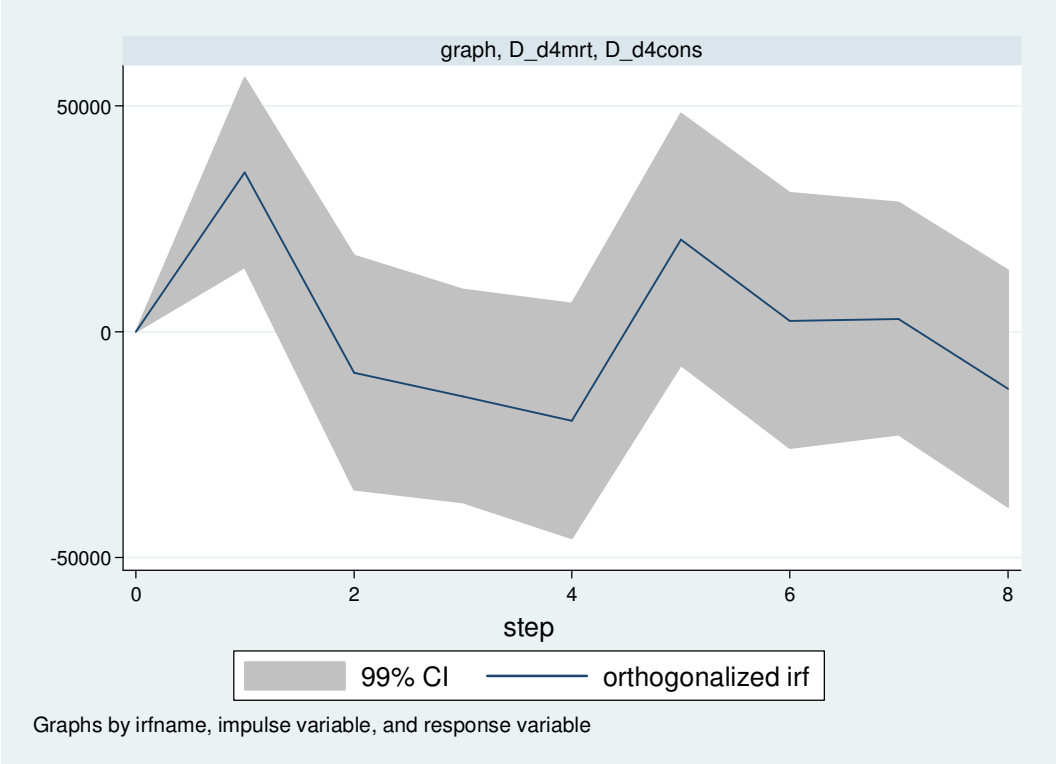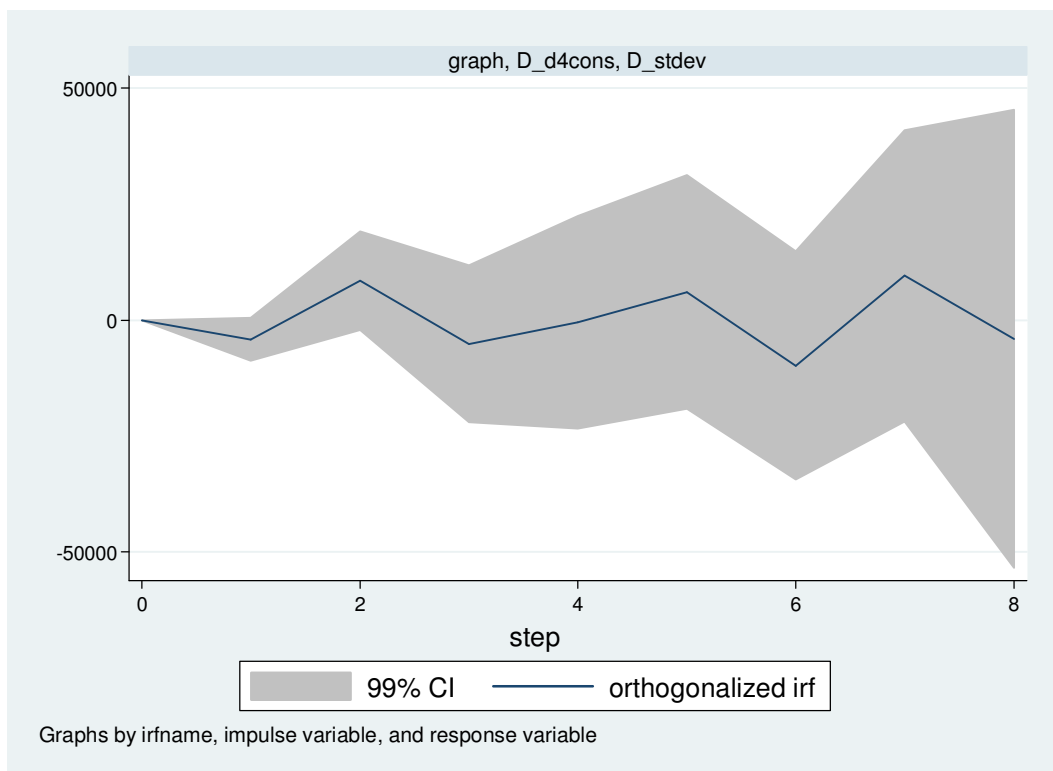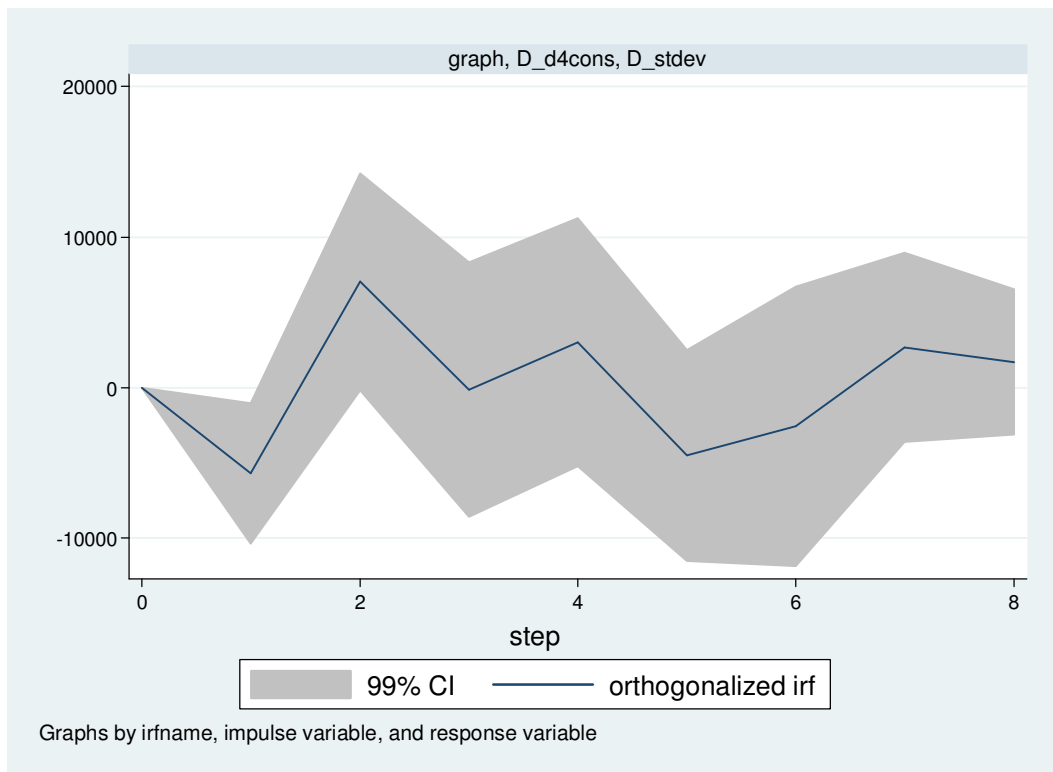
Figure 3: Effect of a shock in consumption growth on GDP volatility during the Great Moderation (1984-2007, top) and before (1960 -1983, bottom).

The Graph results are as hypothesized. The wealth effect on consumption via mortgaging is positive during the Great Moderation but insignificant before the Great Moderation. A positive shock to consumption growth caused no significant increase in GDP volatility before the Great Moderation but a significant, immediate and short-term decrease in volatility during the Great Moderation – just as the simple correlation coefficients in Table 1 would lead one to expect.

A number of robustness checks were undertaken. First, models with fewer and more lags, anmd with different lag structures, were estimated. This yielded qualitatively similar results, but with larger loss of information as indicated by Akaike and Schwartz information criteria. Second, the cut off date of the Great Moderation is debatable, as several of its key trends started already in 1982. But varying the starting data between 1981 and 1984 did not change the findings. Third, control variables which are likely to additionally influence GDP volatility were added to the model; this were GDP growth and growth in total credit (both in first differences. The assumption that we so test is that higher GDP growth levels, or more credit available generally may also smooth consumption variations, so reducing GDP volatility, without a special role for mortgage-backed consumption. But including either or both in the system (so estimating 4 or 5 equations, respectively) did not change the key findings that during the Great Moderation, GDP volatility significantly decreases with a positive shock in consumption and that consumption significantly increases with a positive shock to mortgages. This is a finding in line with the conventional contention that 'credit aggregates are no independent causal factor affecting the economy' (Bernanke and Gertler, 1995:34,44); but as noted this ignores the possibility that categories of credit do have causal effects on the economy. A generalist approach to studying credit aggregates simply is not fine grained enough.

Another check was to include as control variables other categories of the total credit flow than mortgage credit. This was undertaken for: credit to the real sector (i.e. all credit extended to non-financial firms and households, excluding mortgages) and credit to the financial sector other than mortgages (i.e. all credit extended to non-financial firms). The real-sector credit measure excludes a wealth effect on consumption through collateralized lending, but it includes consumption credit to households. The assumption that is so tested is that consumption credit rather than mortgages was a driving force in moderating GDP volatility. The financial-sector measure tests the assumption that others financial assets than real estate

have been supporting consumption and moderated GDP volatility. In both these specifications, the positive effect of a mortgage credit shock on consumption during the Great Moderation remains positive but is insignificant; and there is a significant positive effect of a shock in real or financial credit on consumption, with a two-year lag. This finding is robust to including GDP growth as control variable and to varying the starting year of the Great Moderation. However, when omitting mortgage credit growth variable from the system (i.e. replacing it with real-sector or financial-sector credit growth rather than adding real-sector credit growth) there is a significant stimulus to consumption from real-sector credit but not from (non-mortgage) financial-sector credit. Also, the negative effect of consumption on GDP volatility completely disappears in both specifications. Moreover, real-sector credit (but not financial-credit) flows also significantly stimulated consumption in the 1960-1983 years before the Great Moderation. This exercise suggests that both real-sector, non-collateralised credit flows and credit flows to financial asset markets (other than real estate) sustained consumption levels during the Great Moderation alongside mortgage credit flows, but that the moderating effect on GDP volatility ran uniquely though mortgaging. This is understandable in light of the flexibility in timing of house equity withdrawals, which can more easily be made to run counter-cyclically to shocks to other GDP components. Also, the role of mortgages in moderating GDP volatility was apparently specific to the Great Moderation while the effect of real-sector credit was not.

Finally, it may be argued that taking 1961-1983 as the 'pre-Great Moderation' era is wrong, as it includes structural breaks in US monetary policy, especially around 1969-1973. One way to probe this is to restrict the analysis to the post-1969 years and dividing them equally in 1970-1988 and 1989-2007. The drawbacks are that this allows for only a much smaller set of observations; it also times the start of the Great Moderation incorrectly. Still, analyses using this periodization give identical results to the periodization with 1984 as break point. The results are not sensitive to the choice of periodization.

5.   Discussion and Conclusions

In this study of the Great Moderation in the US it was suggested that volatility in GDP and inflation originating from supply side shocks has increasingly been cushioned by contributions of rising asset prices to purchasing power. This development is reflected in the

changing composition of credit aggregates and linked to wider macroeconomic developments. This explanation is presented in terms of a 'mortgage multiplier of income', which decreased as mortgage credit flows relative to GDP rose, so moderating GDP fluctuations. Testable hypothesis following from this account were developed and empirical evidence in support was presented, both in terms of institutional description and quantitative explorations and in the form of a formal test in a VAR framework.

Theoretically, this research supports an approach to studying credit and monetary problems which focuses on not just the money supply but the broader credit supply, and on specific categories of credit within it. In understanding the macroeconomic effect of credit, it matters what the additional liquidity is used for. This study also demonstrates how the economy responds differently, over time, to that liquidity supply, owing to changes in the institutions underpinning it. A more generalist approach lacking these features and studying aggregate credit flows or time invariant relations is found to be unhelpful.

One loose end to this analysis is the relation of this analysis to other features of the US economy during the Great Moderation. The rise in consumption was sustained by increasing trade deficits, and a natural question for follow-up research is to what extend the deficit was supported by mortgage credit flows. Another question relates to the decreased inflation characteristic of the Great Moderation. This is somewhat of a puzzle as the Moderation was an era of an unprecedented rise in liquidity, yet unusually low and stable inflation. Most liquidity led to asset inflation not inflation in the consumer price index. While some observers have pointed out that this may have been artificial to some degree due to redefinitions of the consumer price index (e.g. using hedonic pricing methods), this is unlikely to fully account for low inflation. A question for future research is therefore who the structure of financial markets have facilitated asset price inflation without large spill-overs into prices of goods and services. A link with the deficit is plausible, as increasing imports may have helped keep prices low.

Finally, how does the present analysis alter the assessment of the Great Moderation? In this account the reduced volatility in GDP of the Great Moderation was an (unintended?) consequence of a new growth regime (more heavily dependent on consumption and the financial structures supporting it), rather than a specific policy. It was therefore pervasive rather than specific, and not easily pinned down. It also created tranquility alongside mounting imbalances in household balance sheets. One may speculate that such sedative collateral effects constitute one reason why the downsides of this growth mode were not widely appreciated during the Great Moderation. Keynes (1973[1936]:118), in a discussion of

employment multipliers and the fluctuations in employment resulting from changes in investment, complained that '[u]nfortunately the fluctuations have been sufficient to prevent the nature of the malady from being obvious, whilst its severity is such that it cannot be remedied unless its nature is understood.' Likewise, the *lack of* fluctuations, the tranquility in GDP that characterized the Great Moderation, may have prevented a more critical attitude to the sustainability of the growth regime that underpinned it. Instead, it led to self-congratulatory assessments by policy makers that the lower volatility was due partly to 'good policy'. Even the apparent breakdown of that tranquility during 2007-2008 in the so-called global 'credit crisis' triggered debate on specific aberrations in financial markets rather than a broad based discussion on the growth regime that had channelled resources away from the real sector and into asset-backed consumption over the preceding quarter century. Yet just as Keynes wrote in the above quote, 'it cannot be remedied unless its nature is understood.' This study has sought to support the development of this understanding, and to demonstrate its use in assessing recent economic history.

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