

UNIVERSITY OF OSLO
Department of Economics

**Keynesianism and
fiscal policy
during the
financial crisis**

Thesis for the degree
Master of Philosophy in
Economics

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Preface

This thesis is written as a completion of the degree Master of Philosophy in Economics at the University of Oslo.

I wish to thank my supervisor Ragnar Nymoen, Professor at the University of Oslo, for providing excellent guidance throughout the process of completing this thesis. In particular, I am grateful for his literature suggestions and valuable advice regarding the econometric methodology applied in chapter 4.

Special thanks are also reserved for Guro Johanson. She has been remarkably patient and encouraging to an author whose mind has for quite some time been primarily occupied with the wonderful world of economics.

All remaining errors and inaccuracies are mine, and mine alone.

Summary

In this thesis I will look more closely at certain major events as they unfolded during the recent financial crisis, before I turn to discuss some of the assumptions underlying the economic models used to guide policy analysis, and see if these assumptions are supported by the data.

Chapter 2 contains a short introduction to the history and development of macroeconomic theory, and provides some background needed to understand why there exists no clear consensus among economists regarding the most effective way to deal with economic slumps.

In chapter 3, I go through what I believe are some of the main contributing factors to the financial crisis. Global trade imbalances and perverse incentives in the financial sector are central to this discussion. I go on to describe the different stages of the current crisis, and how it spread from the financial sector into the real economy. Finally, I devote some time to the various policy measures taken to combat the crisis. Traditional monetary and fiscal policy actions were implemented, as well as more experimental policies like quantitative easing.

In chapter 4 I take a closer look at some of the assumptions made when constructing macroeconomic models, and see if these assumptions seem reasonable when confronted with data. In particular, I look at a traditional Keynesian consumption function and the more fashionable Euler equation approach which implies a random walk for consumption. After testing some assumptions which are vital to both forms of modeling consumption, I implement the results of these tests to form an economic system. This system is then exposed to shocks of different kinds to illustrate how we would expect the economy to adjust over time. All estimations have been carried out using OxMetrics 6 and PcGive version 13.

These findings are then summarized in the conclusion of the thesis in chapter 5.

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1 Introduction

The last couple of years have been an extraordinary time to study economics. The profession has come under attack from the public at large for its failure to predict the financial crisis, while old disagreements and conflicts of theory have been brought to the fore by competing *schools* within the profession. It is quite remarkable that earlier this year Robert Solow, Nobel laureate and one of the most respected economists alive, testified to the U.S. Congress on the state of economics as a science¹.

The global financial crisis, ushered in by the collapse of the investment bank Lehman Brothers on September 15, 2008, highlighted how vulnerable the globalization of banking has left the world economy. New technology and financial innovation has made the world smaller, and allowed risky, highly complex products to be spread across sectors and borders more efficiently than previously imaginable. We have also witnessed how purely financial crises can spread to the real economy, and the long-lasting impact this can have on the unemployment rate.

The ongoing crisis has also revived the debate on the use of fiscal policy as a means for stabilizing the economy. As the crisis materialized, central banks across the globe acted swiftly and slashed interest rates to near the zero lower bound. With rates being so low, monetary policy had very little traction. To combat falling aggregate demand and increasing unemployment levels, governments turned to fiscal stimulus packages of unprecedented sizes to boost demand and in turn stimulate private consumption. This is textbook Keynesianism. John Maynard Keynes [1935] made the observation that in serious economic downturns, if the economy is not at full capacity utilization, the government should intervene to keep effective demand high. This insight was in stark contrast to the contemporary consensus, where the classical economists regarded economic downturns, even recessions, as the economy's efficient response to an unnaturally high price level. As the years have passed, the consensus regarding the role of government and fiscal policy has changed

¹http://democrats.science.house.gov/Media/file/Commdocs/hearings/2010/Oversight/20july/Solow_Testimony.pdf

back and forth and Keynes's teachings have at times fallen from grace, only to reappear with slightly altered interpretations of what Keynes had actually meant.

Though most economists have a pretty clear idea of what Keynesianism is, far from everyone have ever opened Keynes's seminal work *The General Theory of Employment, Interest and Money* (Keynes [1935]), and fewer still make it through the entire book. Its influence on the economic profession has been undeniable, and we often hear politicians across the entire political spectrum resort to Keynesian logic to explain the intended effects of their own policies, or why the hopeless policies of their adversaries yielded so poor results.

It is true that we cannot depend on government alone to create jobs or long-term growth, but at this particular moment, only government can provide the short-term boost necessary to lift us from a recession this deep and severe. Only government can break the vicious cycles that are crippling our economy - where a lack of spending leads to lost jobs which leads to even less spending; where an inability to lend and borrow stops growth, and leads to even less credit.

— *President-elect Barack Obama, Jan 08, 2009*

This quote shows President Obama employing Keynesian arguments in order to explain the need for government deficit spending, and similar arguments were used by his predecessor George W. Bush as he proposed tax cuts after the IT bubble burst at the beginning of the century.

Although most economists are influenced by Keynes in some way, not all economists identify themselves with Keynesianism, and not everyone feels deficit spending is a viable form of fiscal policy. President Obama's speech sparked strong reactions from prominent economists, several hundred signing a petition² opposing increased government spending. Among these were three Nobel laureates. Instead, they called for lower tax rates and a smaller public

²http://www.cato.org/special/stimulus09/cato_stimulus.pdf

sector. Other economists, like John Taylor, have cited Ricardian equivalence as proof that deficit spending has no effect on even short-term demand. Still others have pointed to crowding out of private investment, and reduced long-term growth potential as arguments against large stimulus packages.

Chapter 2 contains a short introduction to the history and development of macroeconomic theory, and provides some background needed to understand why there exists no clear consensus among economists regarding the most effective way to deal with economic slumps.

As the crisis lingers on, many governments find themselves with enormous deficits, and some nations are in real risk of bankruptcy. (Meanwhile, financial institutions are again reporting strong quarterly results.) This has led to increasing demands for fiscal austerity, even in countries still struggling to recover from recession. Some economists, like Paul Krugman and Joseph Stiglitz³, have been vocal in opposing this, while others claim reducing budget deficits is not only necessary, but will even enhance short-term economic growth.

In chapter 3, I go through what I believe are some of the main contributing factors to the financial crisis. Global trade imbalances and perverse incentives in the financial sector are central to this discussion. I go on to describe the different stages of the current crisis, and how it spread from the financial sector into the real economy. Finally, I devote some time to the various policy measures taken to combat the crisis. Traditional monetary and fiscal policy actions were implemented, as well as more experimental policies like quantitative easing.

In chapter 4 I take a closer look at some of the assumptions made when constructing macroeconomic models, and see if these assumptions seem reasonable when confronted with data. In particular, I look at a traditional Keynesian consumption function and the more fashionable Euler equation approach which implies a random walk for consumption. After testing some assumptions which are vital to both forms of modeling consumption, I implement the results of these tests to form an economic system. This system is then exposed to shocks of different kinds to illustrate how we would expect

³<http://www.project-syndicate.org/commentary/stiglitz127/English>

the economy to adjust over time.

These findings are then summarized in the conclusion of the thesis in chapter 5.

2 History of Mainstream Macroeconomics

2.1 The Keynesian Revolution

In order to understand why so many skilled economists differ radically in opinion when it comes to fiscal policy and how to best handle crises and recessions, some familiarity with the history of economic thought is necessary. In this section I've drawn inspiration from the works of N. Gregory Mankiw [2006], Paul Krugman [1994] and Michael Woodford [2008] on economic history, notes from Trygve Haavelmo's lectures (Andvig [1979]), as well as my own impressions from studying economics for the last five years.

One of the most important challenges in economics, perhaps the most important, is understanding the business cycle and what causes economic crises. The events in financial markets during the fall of 2008 quickly spawned skepticism towards the entire economics profession, as its powers of crisis-prediction left a lot to be desired. There were a few economists who predicted the crisis, but many of those who got it right have had very poor track records in the past. That the European Central Bank, and Norges Bank, raised interest rates as late as the summer of 2008, points to concern that things were going a little too well, rather than fear of an imminent crisis. How the economics profession will need to be revised in the aftermath of the crisis remains to be seen, but it's unlikely the revision will be as revolutionary as was the case when John Maynard Keynes published his *General Theory* shortly after the Great Depression of the 1930s. Herein, he challenged the classical economists and their theories. Keynes first-handedly observed markets' inability to correct and clear, as the classical theories postulated: Following falling private demand, prices and wages should fall, thus increasing the real supply of money, and keeping employment around its natural level. This view was hard to reconcile with unemployment rates around 30% in many countries, including the US and Norway.

Keynes brought forth the radical insight that economies can, and often do, suffer from too low aggregate demand, which in turn leads to involuntary unemployment. At such times, government intervention to remedy the fall in

private demand may be the most effective way to reduce unemployment. He proposed several forms of intervention, the most important being that the monetary authorities should increase the money supply (He even provides an example of how this can be achieved: *If the Treasury were to fill old bottles with bank notes, bury them at suitable depths in disused coal mines which are then filled up to the surface with town rubbish, and leave it to private enterprise on well-trained principles of laissez-faire to dig the notes up again ... this would be better than nothing.*(Keynes [1935])) This action was taken both during the Great Depression, and during our current crisis, although slightly more elegant than by filling bottles with bank notes. It should be noted that expansionary monetary policy was Keynes's preferred primary prescription for combatting recessions. However, he also pointed out that when in a liquidity trap monetary policy loses its traction, and the government will need to increase its spending to stimulate aggregate demand both directly through policy measures such as public work programs, and indirectly through resulting multiplier effects.

Government deficit spending, by borrowing from the private sector, is what Keynes's name has become most associated with. Some of these ideas were implemented by President Roosevelt, but not on a large enough scale to have but a mitigating effect on the depression. The definite end of the depression came following World War II, which saw a massive increase in public spending. This certainly helped reduce unemployment levels, but one should not infer from this that large scale wars are generally good for the economy, even though it can be seen as a form of Keynesianism.

The years that followed saw governments enact policies aimed to actively tune the economy, and it was considered a triumph for Keynesianism when the Phillips-curve was introduced in the 60s. This apparently straightforward trade-off between unemployment and inflation implied governments could choose any unemployment level it desired through Keynesian policies. It seemed to fit well with the current data, until the stagflation of the 70s completely broke this relationship down.

2.2 Milton Friedman and Monetarism

Milton Friedman, of the University of Chicago, was among the first to mount convincing arguments against Keynesianism. He was the main proponent of monetarism, advocating a less active role for the government in efforts to control the business cycle. He argued that recessions are caused by a reduction in the quantity of money in circulation, and thus the active role of government could be replaced by mechanical rules for stable, constant growth in the money supply. Simple, elegant rules like this have clear advantages. When discretion is necessary, there will always be room for making mistakes. The monetary authorities can be slow to react to a new recession, since it's seldom easy to pinpoint the exact moments in time when the economy enters a slump. Friedman also observed that monetary policy tends to work with long and variable lags, adding further uncertainty to the proper conduct of discretionary policy, and strengthening the case for mechanical rules like a constant growth in the money supply. A further consequence of Friedman's views was that as stable monetary growth would be sufficient to stabilize the economy, fiscal policy was rendered obsolete. This view of a minimal state and keeping government meddling in markets to a minimum went down well in conservative circles. Even though Keynes was by no means a socialist, his policies seemed to imply a stronger role for government than the right side of the political spectrum cared for. Their fears were understandable, as there were plenty of examples of politicians taking Keynes's message too far, and ending up doing more harm than good. Excessive use of expansionary fiscal policy can lead to crowding out of private productive investments. Fiscal policy is, like monetary policy, also subject to lags, and authorities often ended up boosting the economy well after a recession had ended.

Friedman's next move was to predict the failure of the Phillips-curve, and provide a logical explanation of why one had observed such a smooth relationship between inflation and unemployment. Friedman [1968] and Edmund S. Phelps claimed that it was unreasonable to assume that nominal variables could affect real variables in the long run. They showed through the *natural-rate* hypothesis that this relationship only held in the short-run, and

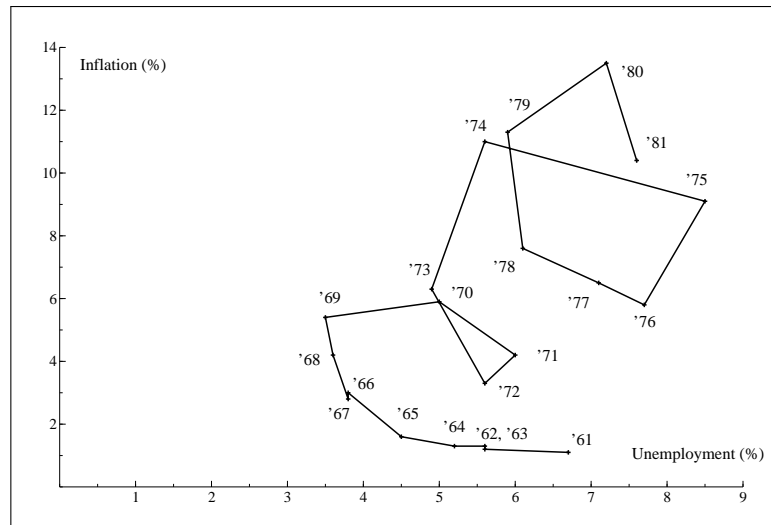


Figure 1: A seemingly smooth relationship broke down in the 70s. (Source: Federal Reserve Bank of St. Louis)

was caused by incorrect inflation-expectations on part of workers and firms, leading to lower unemployment. Friedman claimed people would adjust their expectations after a while, and as people start expecting a somewhat higher inflation rate, Friedman's theory implied the government would have to create even higher surprise inflation to keep unemployment at the same level. What's more, when expectations of high inflation become anchored among the public, you'll end up with persistent inflation and high unemployment. This is known as stagflation, and it occurred shortly after Friedman had made his theory public. Having correctly predicted this major economic event gave further credence to Friedman and the Chicago School of economics. Perhaps most importantly, Friedman highlighted the importance of expectations in economics, especially in macroeconomic policy. This paved the way for the theory of rational expectations.

2.3 Robert Lucas and Rational Expectations

Hailing from the University of Chicago, Robert Lucas expanded upon Friedman's ideas by incorporating the theory of rational expectations into eco-

conomic modeling. Lucas supported Friedman's claim that recessions are caused mainly by people failing to properly understand the current economic situation, leading to poor decision-making when setting prices or wages. When a clothing-store observes a drop in demand for their products, it's initially difficult to conclude whether this decrease in demand applies to their store alone. Perhaps their clothes don't fit the current trends, or perhaps it's an economy-wide drop in demand and their competitors are facing the exact same difficulties. This short-term confusion can lead to uncertainty and sub-optimal actions taken by firms. However, Lucas argued, as soon as the economic situation is understood, the recession will end as firms and workers adjust their prices and wages. Furthermore, he argued that monetary policy could do nothing to speed up this process. Because firms take all available information into account, and this is the same information that's available to the central bank, then firms would be able to predict any logical move by the central bank and adjust their expectations accordingly, thus rendering monetary policy useless. This chain-of-thought, although seemingly logically sound, is a strong hypothesis which one need not accept out of hand. As many critics have pointed out, it rests on several untested assumptions.

Proponents of rational expectations claim that even though most people are not economists, they have access to the same information as the central bank by following the news or reading business papers, where professionals inform them of the economic situation. The problem with this is illustrated by the old economics joke that if you put forth a question to five economists, you'll get five different answers. Six, if one of them has a PhD. The economic pundits in the media often don't even have any background in economics. Jon Elster has given a coherent criticism of the social sciences from a similar perspective, and economics in particular⁴. He warns against mistaking aesthetically pleasing models for relevant models. My personal bias aside, Lucas provided mathematically sound, and dense, arguments for his case.

Mankiw [2006] compares the economists of the Chicago School to scientists. Their models provided a complete system of the economy, with mi-

⁴http://www.idunn.no/ts/nnt/2007/04/formalisme_pa_tomgang_hard_obskurantisme

crofoundations analyzing the individual behavior of economic agents. This closed a gap that had always been a problem in Keynesian models, and united the two disciplines in economics; micro and macro. Keynesians are engineers more than scientists, claims Mankiw. Less concerned with everything being explained by complex mathematical equations (although by no means strangers to complex mathematics), Keynesians have always been more concerned with how the world actually works. If something is observed, even if there's no logical foundation for it in economic models, it shouldn't be ignored. The ad-hoc Phillips-curve was one example of this, and Robert Solow's defense of price and wage rigidities another: *I remember reading once that it is still not understood how the giraffe manages to pump an adequate blood supply all the way up to its head; but it is hard to imagine that anyone would therefore conclude that giraffes do not have long necks.* — Robert Solow, 1980 (Mankiw 2006)

Friedman and Lucas's attacks on Keynesianism were successful, and the years that followed saw Keynes discredited in many circles. Lucas published an article with the telling name *The Death of Keynesian Economics* in 1980, and two years later Carnegie-Mellon University's Edward Prescott declared that his students would never hear Keynes's name (Krugman [1994]). Together with Finn Kydland he helped develop the real business cycle theory (Kydland and Prescott [1982]). In this technology-driven model, recessions merely represent markets' optimal responses to exogenous shocks, and as such leaves little room for government short-term tinkering with the economy. These models, in this simple form, are not taken very seriously by most economists today. But they paved the way for the use of dynamic stochastic general equilibrium (DSGE) models in macroeconomic research, and as such provide the base for The New Keynesian models at work in most central banks and governments today.

2.4 The New Keynesians and Modern Macro

Early New Keynesian research aimed to show how monetary policy could be used to stabilize the economy in spite of rational expectations, and tried

to explain why prices and wages could fail to clear markets. The concept of *efficiency wages* was explored: the hypothesis that firms pay employees above equilibrium wages to increase their efficiency, or productivity.

The more recent New Keynesian research, sometimes called the New Synthesis (Mankiw [2006]), has sought to combine what was seen as the strengths of the two major competing views in macro, and in doing so managed to soothe the somewhat unproductive quarreling between academics of different camps. At the very core of these models one will find a form of a DSGE RBC-model, providing microfoundations and optimizing agents facing intertemporal decisions. The RBC-assumptions of frictionless markets and perfect competition were replaced by nominal rigidities and monopolistic competition. Adding nominal rigidities to this core, such as price and wage stickiness, allows monetary policy to have a real effect in the short run. In the long run, classical dichotomy is assumed to hold. Monetary policy is usually represented by policy rules, such as some form of Taylor-rule, like this one from Galí [2008]:

$$i_t = r_t^n + \phi_\pi \pi_t + \phi_y \tilde{y}_t$$

Here, ϕ_π and ϕ_y are non-negative coefficients set by the central bank, determining how strong the policy response will be to deviations from an inflation-target or the output gap. Simple Taylor-rules have proven quite accurate in describing central bank behavior, especially in times of low economic volatility (Taylor [1993]).

These models also differ between efficient and inefficient economic fluctuations. Real disturbances, like shocks to technology or preferences, merely cause fluctuations in the economy's natural level of output. It's in the presence of distortions arising from sticky prices and wages that inefficient fluctuations occur, and in such cases economic policy can help to move the economy closer to its steady state. At the Society for Economic Dynamics in 2010, Edward Prescott claimed, according to Professor Mark Thoma⁵, that the high

⁵<http://economistsview.typepad.com/economistsview/2010/07/the-obama-shock-hypothesis-seems-ridiculous.html>

unemployment levels experienced in the US during the current recession are caused by real disturbances, mainly a fall in labor supply arising from workers anticipating a future increase in taxes. This is an argument against fiscal stimulus to increase demand, or even the use of monetary policy, during the current financial crisis. Although controversial among economists, some have supported this claim of reduced labor supply⁶, advocating reductions in labor taxation to increase people's incentives to work.

More demand-focused economists on the other hand, have responded by mocking the supply-siders: *Was the Great Depression really the Great Vacation?* — Paul Krugman, 2009. The focus on unemployment is interesting, since it is arguably the single most important economic indicator during recessions. It also represents a weakness in the New Keynesian framework. Galí's *Monetary policy, inflation and the business cycle* [2008], widely-used at the graduate level as an introduction to the New Keynesian models, is symptomatic of this as it neglects to consider the social costs of unemployment, loss of human capital and persistent unemployment. All costs associated with efficient economic fluctuations are ignored. Limitations as severe as these have caused some to question whether it is fruitful to continue developing these DSGE models, or whether they should simply be discarded. Robert Solow [2010] is among those who are highly critical of the current framework, stating to a Congressional Committee: *When it comes to matters as important as macroeconomics, a mainstream economist like me insists that every proposition must pass the small test: does this really make sense? I do not think the currently popular DSGE models pass the small test.* Regarding unemployment, he goes on: *The only way that DSGE and related models can cope with unemployment is to make it somehow voluntary, a choice of current leisure or a desire to retain some kind of flexibility for the future... This is exactly the sort of explanation that does not pass the small test.*

Despite Solow's pessimism, it seems likely that future developments in macroeconomics will revolve around making DSGE models more sophisticated. An obvious criticism after the financial crisis has been the absence of a financial sector in most modern macroeconomic models, in particular those

⁶<http://economix.blogs.nytimes.com/2008/12/24/are-employers-unwilling-to-hire-or-are-wo>

DSGE models used as aid to the conductors of monetary policy. Although there has been progress in this field, the embedding of a rich banking sector into models capable of describing the complex behavior of financial markets is very difficult to accomplish.

In an essay⁷ on the current state of macroeconomic models, Narayana Kocherlakota, President of the Federal Reserve Bank of Minneapolis, touch on some of these concerns, and concludes with an interesting note on fiscal policy: *In terms of fiscal policy (especially short-term fiscal policy), modern macro modeling seems to have had little impact. The discussion about the fiscal stimulus in January 2009 is highly revealing along these lines. An argument certainly could be made for the stimulus plan using the logic of New Keynesian or heterogenous agent models. However, most, if not all, of the motivation for the fiscal stimulus was based largely on the long-discarded models of the 1960s and 1970s.* This statement seems to indicate that although modern New Keynesian models are in widespread use among academics, they still need to be refined to reach the same status among policy makers. Kocherlakota believes that rather than modern models being inadequate for analyzing fiscal policy, the problem is a failure among modern macroeconomists to communicate recent advances in the field to policy makers.

⁷http://www.minneapolisfed.org/publications_papers/pub_display.cfm?id=4428

3 The Financial Crisis

3.1 Background

3.1.1 The Great Moderation and a Global Savings Glut

The years preceding the financial crisis were dominated by optimism and strong economic growth. One observed a reduction in macroeconomic volatility (Blanchard and Simon [2001]) which led some economists to claim deep recessions to be a thing of the past. At the American Economic Association in 2003, Robert Lucas famously declared the problem of *depression-prevention* to be solved. Claims like these mirrored those made by economists after the introduction of the Phillips-curve some 40 years earlier. Just as the stagflation of the 70s put an abrupt stop to the excellence of the Phillips-curve, it would soon become apparent that the hubris of some economists was somewhat premature. There may be some cause for concern the next time economists claim large recessions things of the past.

At the beginning of the millennium, fear of deflation in the US saw the central bank turn to expansionary monetary policy. This led, in the short-term, to increased housing prices and increased consumption. A worsening of the US trade balance ensued, while oil exporting nations like Norway and low-cost countries like China saw net exports rising fast. A large share of these surpluses were invested in US government bonds, which kept US interest rates low for an extended period of time. Fed Governor Ben S. Bernanke referred to this as a global savings glut⁸, and went on to argue that the worsening of the trade deficit in the US could be explained by the behavior of developing nations. A financial crisis had hit Eastern-Asia in 1997-98, which resulted in rapid capital outflow and ultimately recession. This prompted the nations directly affected by the crisis, like Korea and Thailand, to put in place a safety-net of foreign assets. China did not suffer from the effects of the crisis as much as other countries in the region, but acknowledged the need to be prepared for future crises, and followed similar strategies.

⁸<http://www.federalreserve.gov/boarddocs/speeches/2005/200503102/default.htm>

In 2001 George W. Bush was inaugurated as President, inheriting a solid budget surplus from President Clinton. Forecasts pointed to a debt-free nation within the end of the decade. The advantages of this is mainly lower interest rates, leading to increased investments, and thus, economic growth. Another important factor is that a solid budget surplus allows the government to implement expansionary fiscal policy without incurring additional debt, should the need arise. However, after support from the influential President of the Federal Reserve Alan Greenspan, large tax cuts were implemented instead. It was argued that the government surplus was increasing faster than expected, and as such there would be room for both tax cuts and debt-reduction. The benefactors of the tax cuts were mainly the wealthier segments of the population. The tax cuts are scheduled to expire by the end of 2010, but at this point it seems quite likely they will be extended.

China's entry on the world market, fueled by cheap and plentiful labor, made an impact on most industrialized countries' economies. This represented a huge positive supply shock with their low-cost export goods, which helped keep inflation low in the OECD-countries in spite of strong economic growth. Inflation-targeting central banks kept their policy rates low, which further escalated asset prices. Even before the outbreak of the financial crisis this focus on inflation-targeting came under criticism, particularly for not properly taking asset prices into consideration.

3.1.2 Financial Innovation and Misaligned Incentives

Strong growth and low interest rates combined with a deregulation of financial markets, especially in the United States. President Clinton did more than oversee an improvement in federal budgets, he also encouraged home ownership among the less-creditworthy segment of the population by reforming the Community Reinvestment Act of 1977. Technological advances increased access to information and reduced costs of assessing risk, allowing creative financial institutions to offer mortgage loans to high-risk individuals with imperfect credit, so called subprime mortgages.

Known as ARMs, Adjustable Rate Mortgages, these loans came with

special clauses like interest-only payments for an extended period of time, or with an initial fixed interest rate, usually very low, which would adjust upwards after a few years. Lenders seldom held on to the mortgages until they were repaid, but instead sold the mortgages on to financial intermediaries, like investment banks. The banks would then pool bundles of mortgages together with other assets, for instance credit card debt and auto loans to diversify the risk, creating Asset-Backed Securities (ABS) through a process known as securitization. This enabled the banks to sell these products on to investors.

One particular form of ABS has been the subject of much discussion after the financial bubble burst in 2008, namely Collateralized Debt Obligations (CDOs). CDOs consist of portfolios of underlying assets which are split into different classes according to risk, time to maturity, liquidity etc. Credit agencies then assign different ratings to the products, where an AAA-rating typically is the highest rating attainable. The credit agencies also made profits from consulting investment banks on how to construct CDOs so as to just meet the minimum requirements for AAA-ratings. With a weaker rating came a higher interest rate paid out to investors, but also a higher risk of default.

The emergence of Credit Default Swaps (CDS) allowed for insurance against default. Such insurance allows bond holders to hedge the risk: In case of default, the seller of the CDS would pay the par value of the bond (the initial value of the bond, or the value at the time of maturity) and receive the bond from the buyer. In exchange, the buyer makes quarterly payments similar to an interest rate to the CDS-seller. The market for CDS evolved further, and so-called naked credit default swaps allowed buyers and sellers to speculate on the default-risk of bonds without either party owning the underlying bonds themselves.

The benefits of deregulation included increased access to capital for borrowers, and lower transaction costs for investors. New financial products allowed for greater diversification, and made it possible to tailor-make products according to investor's different tastes for risk. In his paper *Has Financial Development Made the World Riskier* from 2005, Raghuram G. Rajan argues

that investors and investment managers face a misalignment of incentives, ultimately leading to too high risk-taking among managers. Managers are typically compensated according to the return they generate for investors. Since managers can usually increase short-term returns simply by taking on more risk, an effective and easy way of monitoring them can be to evaluate their performance relative to a common benchmark. The S&P500 is often used for this purpose.

Such monitoring is not without its problems, however. When evaluated relative to one's peers, incentives of *herding* are created. Investing in similar or identical products as the competition provides an insurance against underperforming relatively to them. Such behavior can lead to prices failing to convey the proper value of a certain stock, for instance, if managers are investing in the stock simply because their competition is doing the same. Rajan [2005] claims that due to herd behavior stocks can deviate from their fundamental value for a prolonged period of time. This just reinforces the herding, as even a manager who believes a stock is underpriced and considers going against the trend has no guarantee the underpriced stock will adjust back to a fundamentally correct level in the short-run.

Another factor leading to perverse incentives and too high risk taking is the bonus systems affecting the salaries of investment managers. In the event of strong returns, large bonuses are often paid out to managers. These bonuses are not off-set by equivalent decreases in salary when a manager performs poorly. This system encourages managers to take on risk, as this increases the possibility of reaping the rewards as risky investments pay off, while the losses are borne mainly by investors. This is especially true for managers of smaller funds looking to attract investors, and young managers out to make a name for themselves, as they have even stronger incentives to gamble with high risk investments to prove to potential investors they can produce greater returns than their more established competition. Combined with herding, this has led to managers investing in risky assets that are not included in their benchmark, and thus hidden from traditional monitoring.

Finally, low interest rates and search for yield meant many financial firms were highly leveraged. Even though focus is often on the US financial sector

alone when analyzing the causes of the financial crisis, the globalization of banking saw firms in European countries replicate the behavior of the financial institutions across the Atlantic. A McKinsey report⁹ shows increases in debt and leveraging was a global event, and not confined to the US. They also find that much of the growth in debt and leverage took place in the real economy, in housing in particular. Even so, the high degree of leverage in certain financial institutions would eventually cause problems beyond the financial sector.

3.2 Collapse of the Housing Market, Trouble for Banks

3.2.1 The Subprime Mortgage Crisis

The increase in available credit to persons who would normally not be considered creditworthy allowed many more to afford homeownership, and a trend of increasing housing prices combined with initial low interest rates from ARMs meant most subprime borrowers were able to meet downpayments on their loans. But as the steady increase in housing prices reached its peak in 2006 and subsequently started to drop, it became more difficult for borrowers to refinance out of the ARMs to more favorable mortgages.

The federal funds rate had increased from very low levels (Figure 2), and as the interest rates on ARMs adjusted to reflect this, default rates on subprime loans quickly increased. As an isolated event, homeowners defaulting on their loans is bad news for the banks. Even more so when the defaults are a direct consequence of a decline in the value of the house. However, since the subprime loans were also integrated into so many new financial products like Asset-Backed Securities, the value of these securities now plummeted, multiplying the effects of loan-defaults.

In the summer of 2007, rating agencies Standard and Poor's and Moody's downgraded the ratings of over 100 bonds backed by subprime mortgages, and shortly after announced many more were likely to follow. The investment bank Bear Stearns filed bankruptcy for two hedgefunds that were heavily

⁹http://www.mckinsey.com/mgi/reports/freepass_pdfs/debt_and_deleveraging/debt_and_deleveraging_full_report.pdf

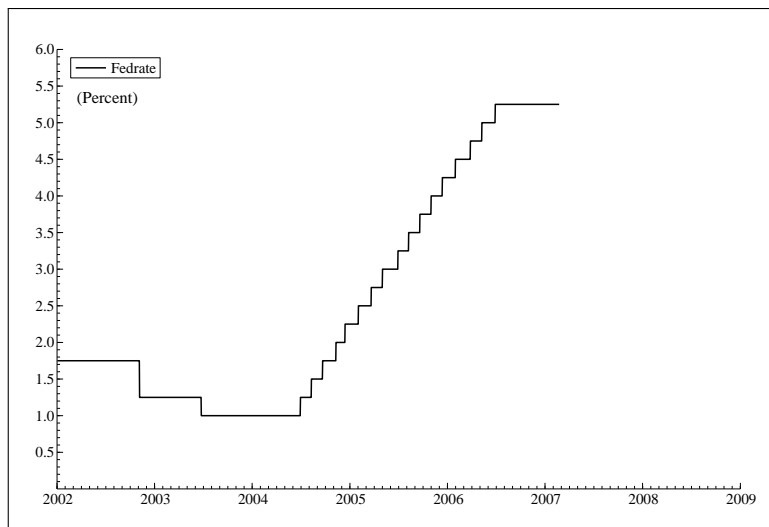


Figure 2: The Federal Funds Target Rate 2002(1)-2007(3) (Source: Federal Reserve Bank of New York)

involved in Mortgaged-Backed Securities.

3.2.2 Uncertainty Leads to Collapsed Credit Markets

At this time, as they hadn't been subject to normal regulation, no-one were certain of how widespread these securities were, and which banks were most exposed to losses. This uncertainty manifested itself in increased stock market volatility, CDS rates sharply increasing, and soaring interbank rates. The interbank rates are the interest rates banks charge for short-term loans to other banks, often represented by a reference rate like the LIBOR. In normal times the interbank rates follow the federal funds rate very closely, usually being only marginally above it. However, when banks are uncertain of the solvency of other banks, they cannot know whether a loan will be repaid. Banks are also likely to increase their own share of liquid assets during crises, both because of short-term uncertainty and the possibility of bank runs. This is exactly what happened during the crisis. The supply of loans decreased, leading to a credit crunch. As firms and consumers were unable to borrow, the lack of credit affected aggregate demand through decreased investment and consumption. This is one of the channels through which the

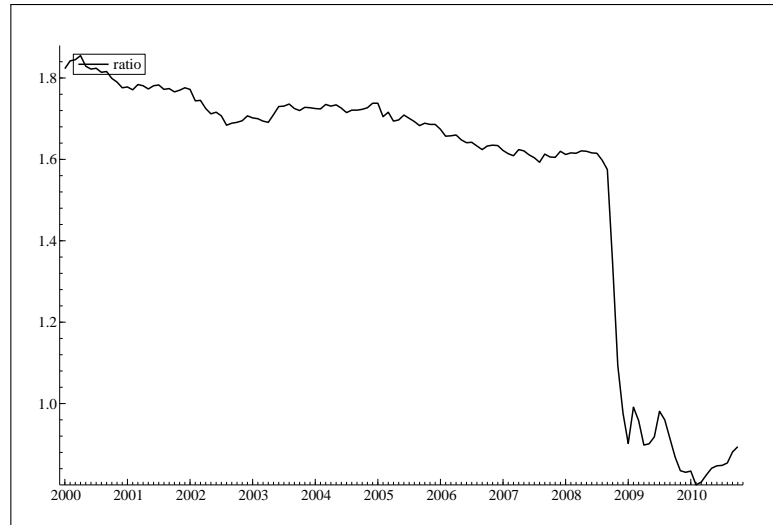


Figure 3: M1 Money Multiplier, the ratio of M1 to the St. Louis Adjusted Monetary Base 2001(1)-2010(10) (Source: Federal Reserve Bank of St. Louis)

crisis spread from the financial sector to the real economy. During the fall of 2007, the Federal Reserve responded to the contraction in supply of credit by announcing it would provide reserves through open market operations to reduce the gap between the Fed's target rate and the interbank rate¹⁰.

Bear Stearns had previously showed signs of trouble, and the uncertainty surrounding their solvency manifested itself in March 2008, when the investment bank was unable to acquire short-term loans from other banks. They came to an agreement with the Federal Reserve over a very short-term loan in the size of \$25 billion. This agreement was subsequently changed to a \$30 billion loan to the competing investment bank JP Morgan Chase with collateral consisting of Bear Stearns assets, which JP Morgan Chase would use to purchase Bear Stearns. The Fed provided this loan out of fear for the repercussions of the demise of an investment bank as large as Bear Stearns. It seemed to work, and signs of an imminent crisis appeared to weaken. Speaking at a bankers' conference, Fed President Ben Bernanke announced: *The risk that the economy has entered a substantial downturn appears to have diminished.* He went on to worry about the upwards pressure on inflation.

¹⁰<http://www.federalreserve.gov/newsevents/press/monetary/20070810a.htm>

3.2.3 Lehman Brothers' Failure

Lehman Brothers, like Bear Stearns, were among the largest investment banks in the world. They were also involved in similar products, and Lehman suffered substantial losses on mortgage-backed securities. The Federal Reserve were negotiating a similar deal as they had previously done with Bear Stearns and JP Morgan Chase, with the British bank Barclay's interested in purchasing Lehman. Lehman Brothers was by many considered *too big to fail*, so it seemed natural that the Fed would facilitate its rescue, as they had with Bear Stearns. However, the deal fell through. On September 15, Lehman Brothers declared bankruptcy, the largest US firm ever to do so. Widespread panic in the stock markets ensued. The fears were the same as they had been over the past year: No-one knew exactly which banks Lehman Brothers owed money, and when an institution as large as Lehman could collapse, then it seemed anyone else could too. Lehman Brothers shares lost over 90% of their value the same day, and the Dow Jones dropped 500 points. The interbank rates had been more volatile than usual for some time, but now the credit markets completely broke down.

The Federal Reserve had received criticism for the rescue of Bear Stearns earlier the same year. Critics feared the government signalling to banks that they would save them should they run into trouble would create moral hazard problems that would just worsen the kind of behavior which had contributed to the crisis. However, after the bankruptcy of Lehman, the Federal Reserve deemed the risk of the crisis spreading further to the real economy was of greater importance than future moral hazard problems. The very next day it provided an emergency loan to the insurance company AIG. Still, with banks cutting back on their lending and increasing interest rates on corporate bonds, it was only a matter of time before investment and consumption proceeded to fall and send the economy into recession. The reduction in consumption and investment would in turn reduce the profits of firms, making banks even less willing to provide loans. The effects of the collapsed credit markets and the fall in aggregate demand were thus reinforcing each other. It was time for government action.

3.3 Policy Response: The Central Banks

3.3.1 The Federal Funds Rate

As we have seen the Federal Reserve acted as a lender of last resort on several occasions during the crisis. This is but one of the tools in the Fed's tool box. The Federal Reserve's principal tool for conducting monetary policy is setting the federal funds rate through open market operations. This is the interest rate at which depository institutions lend balances at the Federal Reserve to other depository institutions overnight¹¹. The Fed controls the short-term interest rate by buying and selling bonds in the bonds market, thus adjusting the money supply to achieve the target rate. The target rate is set by the Federal Open Market Committee (FOMC), which consists of five presidents of the Federal Reserve Banks, of which the president of the New York branch is the only constant, and also the members of the Federal Reserve's Board of Governors. The open market operations are then carried out by the New York branch.

On September 18 the Fed started to reduce its target rate, from 5.25 percent to 4.75. Subsequent reductions followed shortly.

Table 1: Federal Funds Target Rate, Changes

Date	Target Rate (Percent)
September 17, 2007	5.25
September 18, 2007	4.75
October 31, 2007	4.50
December 11, 2007	4.25
January 22, 2008	3.50
January 30, 2008	3.00
March 18, 2008	2.25
April 30, 2008	2.00
October 10, 2008	1.50
October 29, 2008	1.00
December 16, 2008	0 - 0.25

Source: Federal Reserve Bank of St. Louis

We see from Table 1 that the federal funds rate approached the zero lower

¹¹<http://www.federalreserve.gov/monetarypolicy/openmarket.htm>

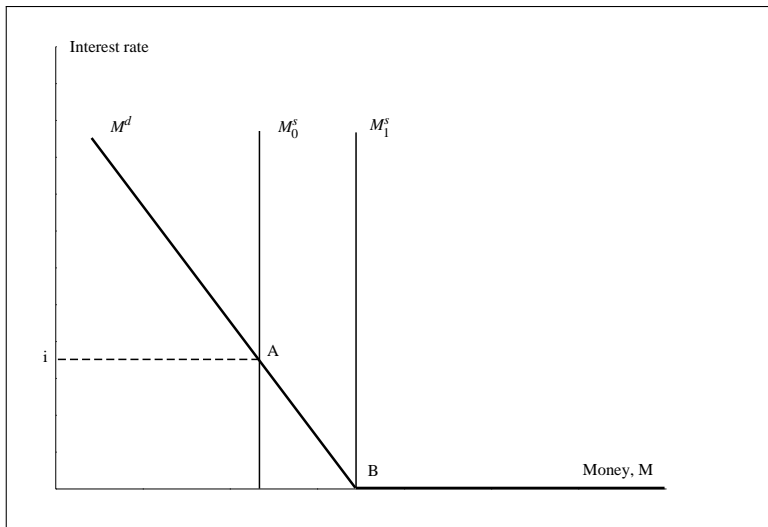


Figure 4: Money Demand, Money Supply. (Source: Blanchard (2006), Fig 22-3)

bound. Effective of December 16, 2008, the Fed reports the target interest rate as a range. The range was at that date set from 0 to 0.25%, where it still remains.

Lower interest rates stimulate the economy in the short run with its positive effects on investment. When at the zero lower bound, the central bank is unable to use conventional monetary policy to stimulate the economy as much as it might like. Combined with aggregate demand being below the production capacity of the economy, this state can be referred to as a *liquidity trap*. As the interest rate declines, the demand for money increases, and the demand for bonds decreases. At the zero lower bound, consumers become indifferent between holding money or bonds: The demand for money becomes horizontal. This is illustrated in Figure 4, where point A shows the market clearing interest rate under normal circumstances. If the money supply is increased to point B, the interest rate is at the zero lower bound, and the demand for money becomes horizontal. Beyond this point, an increase in the money supply will not reduce the interest rate. This is the kind of situation the US finds itself in during the crisis, and the same is true for the EMU-area.

Though the central bank affects the short-term nominal interest rates through its actions, it's the real interest rate that matters for firms and consumers. So even though one would think a very low nominal interest rate would be sufficient to boost the economy in most situations, this need not apply during long-lasting recessions. The reason for this is lower inflation, and lower inflation expectations, ultimately leading to deflation. As has been the case in Japan over the last decades, inflation rates in the US and the EU have declined steadily as the crisis has lingered on, and we've seen the first cases of actual deflation. The problem with deflation is illustrated by its effect on the real interest rate, here represented by the Fisher Equation:

$$r = i - \pi$$

Currently we are in a situation with very low, almost zero, nominal interest rates, as well as very low, almost negative, inflation. From the equation above we see that deflation increases the real interest rate. Meanwhile the nominal interest rate is stuck at zero. Increased real interest rates reduces investment and consumption, which reduces output, in turn leading to even more deflation and worsening the recession. Olivier Blanchard et al. [2010] proposed to increase the inflation targets set by central banks (which are usually quite low, often close to 2 percent) in order to allow for higher nominal interest rates, which would then make it possible to cut nominal interest rates more without hitting the zero lower bound so quickly, and to help minimize the risk of deflation.

In a liquidity trap, as conventional monetary policy has little traction, it seems natural to turn to fiscal policy in order to stimulate the economy. This is also what happened during the crisis, but the fiscal expansion was not only conducted through traditional fiscal stimulus, but also by central banks.

3.3.2 Quantitative Easing

Unable to influence short-term interest rates by further expansion of the money supply, and with credit markets still not functioning normally, the central banks of the US, UK and the European Central Bank have all en-

gaged in quantitative easing (QE), an expansion of the central banks' balance sheets. A term used quite broadly, QE implies increasing the quantity of money by injecting funds directly into the economy. This usually entails "printing money" and using it to purchase not only safe government bonds, but risky private sector assets like mortgage-backed securities.

Both the Fed and the ECB have avoided using the term quantitative easing, possibly because it has become associated with failed attempts by the Bank of Japan to combat deflation, but most likely because they felt the term didn't fit their particular policies. Fed Governor Bernanke has instead used the term *credit easing* to describe the Fed's policies. *Qualitative* easing might be just as fitting: *the Federal Reserve's credit easing approach focuses on the mix of loans and securities that it holds and on how this composition of assets affect credit conditions for households and businesses.*¹² The aim of such policies has been to improve the functioning of credit markets, bring down long-term interest rates and increase the supply of credit to borrowers, as well as decrease the risk of deflation. By transferring newly created money to other banks' balance sheets in return for assets, the central banks hope to induce increased lending through money multiplier effects. Additionally, as a large share of the assets purchased are often government bonds, this large increase in demand pushes the price of government bonds up, thus reducing bond yields. Reduced returns on government bonds makes banks less likely to invest their new money in such bonds, and instead look for investments with higher return, like lending money to firms and households.

Criticism of quantitative easing includes the fact that central banks are taking on risk on behalf of taxpayers. There's no guarantee the central bank will receive a similar price on its assets when it decides it's time to pull some of the money out of the market again, when the economy is recovering. In fact, it might even be likely to take a loss on such transactions. Buying government bonds at a time of crisis, when interest rates are low, and selling the low-interest bonds on the market again when the economy is in better shape and market interest rates are presumably higher may well expose the central banks to some losses. Losses which will have to be covered by government

¹²<http://www.federalreserve.gov/newsevents/speech/bernanke20090218a.htm>

deficit spending. In this manner, the central bank can be said to conduct fiscal policy, and it can do so without going through the ordinary democratic channels of fiscal policy, for better or worse.

Whenever there's talk of central banks printing money, some critics voice concerns over possible hyperinflation. Some inflation is indeed a desired result of QE as it reduces the real interest rate, but central banks must take care to get their timing right when extracting the extra money out of the recovering economy. Even so, the majority of mainstream economists support the unconventional measures taken by the Fed during the crisis.

Finally, it's still uncertain how effective the Fed's asset purchases will prove to be. Blinder and Zandi [2010] find the combined efforts to stabilize the financial sector highly effective. Goldman Sachs's Jan Hatzius¹³, while discussing whether the Fed would engage in further easing, is concerned the scale of asset purchases needed to have any real effect is so large it will be hampered by monetary policymakers' natural bias towards caution: *So usually what happens is that you're in a liquidity trap and you're at the zero bound and you send the staffers away to try and figure out the optimal policy. They go away and model things and come back with some monstrously large number of the amount that needs to be purchased, and the policymakers say, 'Well, I'm not sure you've properly taken into account all the tail risks of this? How do you account for the tail risk that people will lose confidence?' So then the policymakers take a step back towards caution, and that's why in this kind of situation, stimulus tends to be underprovided compared to what's necessary. I think we'll do quite a lot, but it will still fall short of what we need.*

3.4 Policy Response: Fiscal Stimulus

3.4.1 The Economic Stimulus Act of 2008

The first round of fiscal stimulus during the financial crisis was passed by the US Congress as early as February 2008, several months prior to the fall

¹³http://voices.washingtonpost.com/ezra-klein/2010/10/will_america_come_to_envy_japa.html

of Lehman Brothers. The stimulus, with an estimated cost of \$170 billion, consisted mainly of tax rebates to low- and middle-income taxpayers, which lawmakers hoped would boost consumer and business spending. The increase in disposable income is clearly visible in Figure 5, but there does not seem to be a corresponding jump in consumption.

Taylor [2008] has been among the critics of this stimulus, claiming the tax rebates did not result in any statistically significant increases in consumption. He points out that this result was not unexpected, as it is consistent with the permanent-income hypothesis of consumption developed by Milton Friedman. According to this theory, consumers take not only present disposable income into account when determining their consumption, but also their expectations of future disposable income. The implication is that transitory income, like the one-time tax rebates of the Economic Stimulus Act of 2008, should have little impact on present consumption. This is closely related to Ricardian Equivalence: Consumers expect higher future taxes will be needed to cover the deficit created by the stimulus.

However, the permanent-income hypothesis assumes that consumers can borrow money in order to smooth their consumption. In reality, consumers might be liquidity constrained, which would cause present consumption to be below the desired level when optimizing according to a life-time budget. In this case, even transitory income would increase consumption. Professors Broda and Parker [2008] are among those who disagree with John B. Taylor, and find significant increases in consumer spending after the tax rebates. Blinder and Zandi [2010] attributes the failure of consumption spending to immediately follow the increase in disposable income to the fact that it was the low- to middle-income taxpayers who received the rebates, whereas it was mainly the higher income segment of the population who at the time were affected by sharply falling asset prices, leading them to increase their saving and decrease consumption.

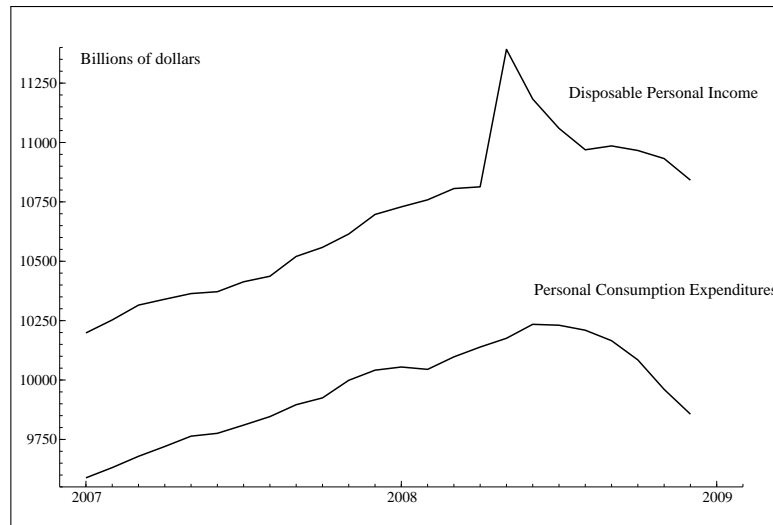


Figure 5: The tax rebates increased disposable income. (Source: U.S. Department of Commerce: Bureau of Economic Analysis)

3.4.2 The Troubled Asset Relief Program

In October 2008, with the world's financial system collapsing, the Troubled Asset Relief Program (TARP) was signed into law. The program allowed the US Treasury to purchase up to \$700 billion worth of "troubled assets", like CDOs, from struggling financial institutions. Although the initial intention was for the program to allow for purchases of illiquid assets, the treasury used most of the money to inject equity into the investment banks by acquiring shares in the financial institutions who struggled. It was an attempt to restore stability to the system, and to complement the actions taken by the Federal Reserve. This made the US government a major shareholder in some of the largest financial institutions in the world, in effect partially nationalizing them.

The effects of TARP are still widely discussed. The program has received a lot of criticism, not only because many US citizens oppose nationalization of companies, but also because it went against a lot of taxpayers sense of justice that their money should be spent saving the same financial institutions that many held responsible for the crisis. However, the interbank interest rates fell

rapidly after the intention to inject equity was announced. Blinder and Zandi [2010] find TARP to be a substantial success, helping to restore stability to the financial sector. They also find the likely cost of TARP to be less than \$100 billion, and the equity injection component of the program likely to be profitable for the government.

3.4.3 The American Recovery and Reinvestment Act

The next round of fiscal stimulus was more conventional, but ironically has been the perhaps most controversial of all policy responses taken during the crisis. The American Recovery and Reinvestment Act of 2009 (ARRA) passed through Congress in February 2009. The package, \$787 billion or about 5% of GDP in size, was composed of increased government spending and tax cuts, with focus primarily on the former. It contained an expansion and extension of unemployment benefits, cash payments similar to those of the Economic Stimulus Act of 2008, as well as health care subsidies and investment in education and infrastructure.

The reasoning behind the stimulus was that although the other policy measures taken by the Fed and the Treasury had helped stabilize the financial sector, the large decline in aggregate demand would eventually lead to a prolonged economic decline. Christina D. Romer, the Chair of the Council of Economic Advisers, was instrumental in designing the stimulus package. Due to the already substantial budget deficit in the US, the President demanded the package be designed to provide only useful spending, spending in areas where there was concrete needs. In Romer [2009] she concludes that the stimulus provided a crucial lift to aggregate demand.

Prior to the stimulus being passed by Congress, its usefulness was hotly debated among economists. Broadly speaking, Democrats and the more Keynesian economists tended to support the stimulus, while Republicans and the supply-side economists tended to oppose it¹⁴. Being at the beginning of

¹⁴There were plenty of exceptions to this generalization, of course. Most economists probably believe some form of deficit spending can be useful, while accepting there are many limitations to fiscal policy in general. The same applies to Democrats and Republicans, although no Republicans in the House of Representatives, and only three Republican Senators voted in favor of the ARRA.

a recession which looked to be long-lasting, while up against the zero lower bound in a liquidity trap, seemed like ideal conditions for fiscal stimulus to be effective. However, others worried about the already large budget deficit and the general impact (or lack thereof) of increased government spending.

So who turned out to be right? It is tempting to suggest that the answer to that question depends entirely on what kind of economic model you believe best describes reality. The data by itself does not seem to give any unambiguous conclusions. Those who claimed the stimulus would not work, like Taylor [2008], claim the data shows they got their predictions right. Those who were in favor of fiscal stimulus, like Krugman and Stiglitz [2008], claim the data shows the stimulus package prevented the economy from plunging into a depression, but that the stimulus was too small to fill the output gap, and that additional stimulus is needed. Indeed, Christina D. Romer reportedly found the stimulus needed to fill the output gap was in the range of \$1.2 trillion. Why the proposed stimulus was substantially smaller is not known. It may have been politically difficult or impossible to pass a package of that size. Another reason might be that it was never the intention of the Obama administration to fill the output gap. In an article in the New Yorker¹⁵, Ryan Lizza describes a memo regarding the stimulus presented to President Obama: *Summers did not include Romer's \$1.2-trillion projection. The memo argued that the stimulus should not be used to fill the entire output gap; rather, it was "an insurance package against catastrophic failure." At the meeting, according to one participant, "there was no serious discussion to going above a trillion dollars.*

The political reality today, with the stimulus regarded mainly as a failure by the general public, makes the additional fiscal stimulus proposed by Stiglitz and others appear unrealistic. Instead there are demands for increased fiscal austerity to combat the mounting budget deficit. Similar demands in Europe has led to several European governments tightening their fiscal policies, even with unemployment rates high above 10% and the economy showing no strong signs of recovering. Jean-Claude Trichet, President

¹⁵http://www.newyorker.com/reporting/2009/10/12/091012fa_fact_lizza?printable=true

of the European Central Bank (ECB) has claimed that fiscal austerity will boost the economy in the short run, because it will improve consumer confidence. This contradicts the traditional Keynesian view that fiscal austerity will weaken economic growth in the short run. It also seems somewhat unlikely that the main concern of a person who's living in a country with mass unemployment, or is unemployed himself, is the long-term budget balance. It seems more likely that his concerns and uncertainty revolve around the short-term, day-to-day situation, and as such large budget cuts would only add to that uncertainty. Indeed, the International Monetary Fund (IMF) reached the opposite conclusion as the ECB did in its World Economic Outlook¹⁶ from October 2010. This highlights the contradicting messages conveyed by powerful economic institutions, and the uncertainty and lack of consensus regarding fundamental macroeconomics.

¹⁶<http://www.imf.org/external/pubs/ft/weo/2010/02/pdf/text.pdf>

4 Consumption Functions

As I pointed out in the previous section, the conclusions one reach when looking at data are easily influenced by which parts of economic theory one holds the most trust in. The confirmation bias is a powerful factor here, as is the framework of economic models chosen to analyze a particular problem. In this section I will look more closely at some of the assumptions made by particular influential models, and see how those assumptions fare when confronted with data. In particular, I will focus on the determinants of consumption and how an Euler equation approach differs from a more Keynesian view.

There are two major macroeconomic modeling traditions which can be said to have an impact when it comes to policy making:

- The large scale macroeconometric models which dominated economic modeling completely until the Lucas critique (Lucas [1976]). These Keynesian models emphasize estimating the relationship between economic variables based on past correlation in the data.
- The Dynamic Stochastic General Equilibrium models with microfoundations, which by including consumers maximizing utility given budget constraints, profit maximizing firms, and other microeconomic aspects of the economy are able to avoid the problems pointed out in the Lucas critique. RBC models and New Keynesian models fit into this category.

4.1 Traditional Consumption Functions and Euler Equations

Central to economic models intended to guide policy analysis is the behavior of consumers. Consumption is the single largest component of GDP. The strong correlation between income and consumption is well documented, and the relationship between these two form the basis for consumption functions.

The traditional Keynesian consumption function holds that consumption is determined mainly by current disposable income, meaning there is a causal

relationship from income to consumption. This can be expanded to include broader measures of wealth. In Moody's Macroeconomic Model for instance, they use *real household cash-flow*: The sum of personal disposable income, capital gain realizations on the sale of financial assets, and net new borrowing. Additionally, they also include housing and financial wealth in their consumption functions. (Zandi and Pozsar [2006])

As was evident from Figure 5, there are other factors influencing consumption than just disposable income. Milton Friedman's permanent-income hypothesis is consistent with fluctuations in current disposable income not manifesting itself in increased consumption. He proposed that it is permanent, not current, income which is the main determinant of consumption. It follows that an increase in disposable income only increases consumption to the extent that it is permanent income which has increased, and not transitory income. To illustrate this we can assume utility functions and notation similar to those found in Romer [2006], to show how a consumer is assumed to maximize under uncertainty:

$$E[U] = E\left[\sum_{t=1}^T \left(C_t - \frac{a}{2}C_t^2\right)\right], a > 0$$

subject to the budget constraint:

$$\sum_{t=1}^T C_t \leq A_0 + \sum_{t=1}^T Y_t$$

where A_0 is initial wealth.

The Euler equation approach is used to describe how individuals make intertemporal choices regarding consumption. We see from the above that the marginal utility of consumption in period t is $1 - aC_t$. So if present consumption C_1 is decreased by dC in order to increase future consumption by an equal amount, the utility cost of this is $(1 - aC_1)dC$. The expected utility benefit of increased future consumption is $E_1[1 - aC_t]dC$. For an optimizing consumer, we will have:

$$1 - aC_1 = E_1[1 - aC_t]$$

It follows from this, that:

$$C_1 = E_1[C_t]$$

From this we see that the period-1 expectation of consumption in period 2, equals period-1 consumption. So for every period, we expect the next period's consumption to be equal to current consumption. An implication of this is that changes in consumption are unpredictable. This is the conclusion in the famous paper *Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence* by Robert E. Hall [1978]. In this paper Hall shows that consumption follows a random walk with a trend, a martingale. The consequence of this hypothesis is as previously mentioned that economic policy affects consumption only to the extent that it affects permanent income.

4.2 Data

All of the data used in this section was obtained from Federal Reserve Economic Data¹⁷, a database of US economic time series available online from the Federal Reserve Bank of St. Louis. Unless specified otherwise, the data is of monthly frequency and seasonally adjusted. My data set covers the period 1959(1)-2010(8).

Consumption and disposable income are two variables which we know tend to increase over time, so estimates from a regression on these non-stationary variables can be spurious. We would also expect the logs of these variables to be non-stationary. A variable x_t can be said to be stationary when its mean value and variance are constant and independent of t , $E[x_t] = \mu$, $Var[x_t] = \sigma^2$. Time series data which can be shown to be integrated of order one, or I(1), can be made stationary and I(0) by taking the first differences of the logs. We can use unit root tests to verify whether we need

¹⁷<http://research.stlouisfed.org/fred2/>

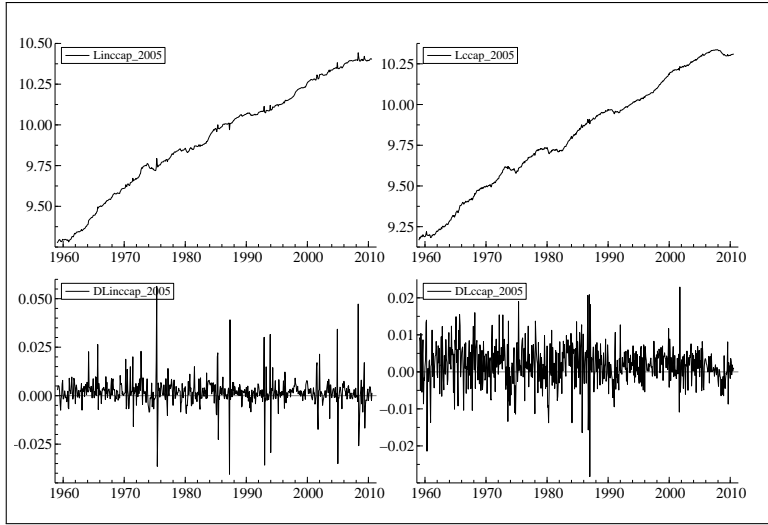


Figure 6: Log, and first differences of the log, of disposable income and consumption.

to take differences to solve for non-stationarity.

Table 2: Unit Root Tests

Variable	Level	First difference
log Income	-1.75	-29.20***
log Income, test with trend	-2.22	-29.30***
log Consumption	-1.25	-29.37***
log Consumption, test with trend	-1.24	-29.51***

Note: *** significant at 1% critical level.

We apply the augmented Dickey-Fuller test with three lags to test the null hypothesis of a unit root, and in the case of log of income y and log of consumption c , find that we fail to reject the presence of a unit root. This indicates that the data needs to be differenced to be made stationary. As we would expect, when testing the first differences we can reject unit roots at the 1% significance level. Including modifications for time trends does not alter the conclusions of the tests.

4.3 The Model

Given the results of the unit root tests, we use the first difference of the logs of income and consumption to solve for non-stationarity. Let y be log of income, and c be log of consumption. The statistical model for the two variables can be written as

$$\Delta y_t = \alpha_{y1}\Delta y_{t-1} + \alpha_{y2}\Delta c_{t-1} + \alpha_{yecm}(y_{t-1} - \beta c_{t-1} - s^*) + \varepsilon_{yt} \quad (1)$$

$$\Delta c_t = \alpha_{c1}\Delta y_{t-1} + \alpha_{c2}\Delta c_{t-1} + \alpha_{cecm}(y_{t-1} - \beta c_{t-1} - s^*) + \varepsilon_{ct} \quad (2)$$

It is important for the relevance of this model that $y_{t-1} - c_{t-1} - s^*$ is a so called stationary series, which means that we can interpret s^* as an equilibrium value. Even though y_t and c_t are individually integrated of order one, $I(1)$, it is possible that for some $\beta \neq 0$ $y_t - \beta c_t$ is a stationary process $I(0)$. If this β exists, we say that y_t and c_t are cointegrated, and there exists an error correction term which should be included in the model. The error correction term moves the independent variable towards the long run value following lagged deviations from equilibrium. Note that we do not need to “see” s^* in the estimation, since it is subsumed in the intercept in the estimated dynamic equations. In Figure 7 we can clearly see how the savings rate has increased sharply in response to the financial crisis.

We can test the stationary assumption of the savings rate $s_t = y_t - c_t$ by conducting an augmented Dickey-Fuller test.

Table 3: Unit Root Tests

Variable	Level
Savings rate, $s_t = y_t - c_t$	-4.04***
lag 1	-3.20**
lag 2	-2.71
Test with trend	-5.26***
lag 1	-4.21***
lag 2	-3.62**

Note: ***, ** significant at 1%, 5% critical level.

The cointegration of consumption and income is consistent with both the

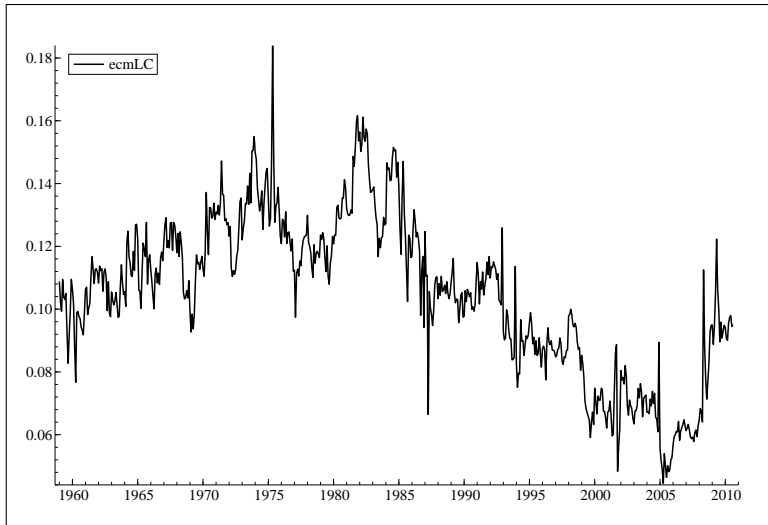


Figure 7: $y_t - c_t$, The approximate savings rate.

traditional macroeconomic consumption functions, and the permanent-income hypothesis. However, according to the permanent-income hypothesis, the error correction does not take place by consumption adjusting to the lagged difference between consumption and income. Rather, the correction comes through adjustment of disposable income (Deaton [1992]). The intuition behind this is that low current consumption relative to disposable income is a sign that the consumer expects income to decline in the future, and is therefore increasing his current saving in preparation to this decline. This is sometimes referred to as the *saving for a rainy day* hypothesis. If this is true, then $\alpha_{cecm} = 0$ in the model. Given cointegration, then α_{yecm} must be $\neq 0$.

The traditional consumption functions take an opposing view to the causality between consumption and income. They assume that the causality goes the other way: Increases in income is followed by increases in consumption, and it is consumption which error-corrects. That corresponds to $0 < \alpha_{cecm} < 1$ in our model. Clearly, in the Keynesian interpretation two-way causation (error correction in both income and consumption) is a possibility. Indeed, if that is the case then the error correction taking place in y might be seen as a result of "demand determined" GDP.

A main point however, is that according to the Keynesian interpretation we should have error correction in consumption as a more general and time-invariant mechanism. In particular, that mechanism should hold even in instances where $\alpha_{yecm} = 0$ as a result of eg. full capacity utilization or very high import leakage. The Euler equation / permanent-income interpretation of the cointegration does not allow for such contingencies. The reason is that according to this interpretation consumption is *always and everywhere* a random walk ($\alpha_{cecm} = 0$), and therefore there is no way to explain the savings rate being I(0) without $\alpha_{yecm} \neq 0$.

So, for the dynamic system (1)-(2) to be logically consistent with stationarity of s_t , then either $\alpha_{yecm} \neq 0$, or $\alpha_{cecm} \neq 0$, or both. We can test these hypotheses. We estimate by OLS and use Autometrics in PcGive on the empirical counterparts of (1)-(2), allowing for outlier detection. We initially include 12 lags of Δc_t and Δy_t in the general unrestricted models (GUM), and let Autometrics filter out the insignificant lags. Autometrics found 15 impulse dummies for the income equation, including two dummies that correspond to the tax rebates given during the financial crisis. In the consumption equation 21 dummies are included, mainly from the 70s and 80s. The quite large number of dummies is not very surprising considering the use of monthly data. The dummy coefficients are not reported in the estimated equations 3 and 4 below.

$$\begin{aligned}
\widehat{\Delta y_t} = & \quad 0.001647 \quad - \quad 0.1165 \Delta y_{t-2} \quad - \quad 0.1038 \Delta y_{t-3} \quad + \quad 0.08513 \Delta c_{t-2} \\
& \quad (0.00079) \quad \quad (0.026) \quad \quad (0.0258) \quad \quad (0.0346) \\
& + 0.1414 \Delta c_{t-3} \quad + \quad 0.06917 \Delta c_{t-8} \quad + \quad 0.1145 \Delta c_{t-11} \\
& \quad (0.0355) \quad \quad (0.0331) \quad \quad (0.0332) \\
& + 0.09373 \Delta c_{t-12} \quad - \quad 0.005808 ECM_{t-1} \\
& \quad (0.0329) \quad \quad (0.00724)
\end{aligned}
\tag{3}$$

The values in parentheses are the standard errors, so the t-value of α_{yecm} is -0.802 , which means we do not reject $\alpha_{yecm} = 0$. The reason for this might be that our simple model omits important factors for explaining disposable

Table 4: Diagnostics for the Income Equation

$\sigma = 0.0044$, 607 observations	
AR 1-7 test:	$F(7,576) = 0.87951$ [0.5223]
ARCH 1-7 test:	$F(7,593) = 3.7038$ [0.0006]**
Normality test:	$\chi^2(2) = 55.148$ [0.0000]**
Hetero test:	$F(26,570) = 1.2635$ [0.1738]
RESET23 test:	$F(2,581) = 2.6427$ [0.0720]

income.

The first line of the diagnostics in Table 4 refers to a test for autocorrelation, AR 1-7. It tests the null hypothesis of absence of autocorrelation. We reject this null hypothesis if the observed value is high compared to the reported p-value. In this case, the observed value of 0.87951 compared to a p-value of 0.5223. This leads us to keep the hypothesis of no autocorrelation. The next line is an AutoRegressive Conditional Heteroscedasticity test of order 7, proposed by Engle [1982]. The *Jarque-Bera test* (Jarque and Bera [1980]) for normality tests whether the residuals' skewness and kurtosis (fat tails) correspond to a normal distribution. Next follows the White-test (White [1980]) for constant variance of the error terms. We reject the null hypothesis of homoscedastic error terms if the observed value, here 1.2635, is high compared to the p-value of 0.1738. In our case we do not reject the null. The final test is the Regression Specification Test (RESET). As the name implies, this tests for functional form misspecification, and it does so by adding non-linear functions of the independent variable to an alternative model to see if this better fits the data. The null hypothesis is that our current specification is correct, and if the F-test gives us a high observed value compared to the p-value, we reject the null. In our case we keep the hypothesis that we've used a correct specification.

We observe that two null hypotheses are rejected: The ARCH test and the normality test. This is probably related to the fact that the use of monthly data with quite high volatility leaves us with some outliers not taken care of by dummies. These outliers could cause heteroscedasticity, as well as lead to issues with normality. However, the most important test for us to be able

to regard the estimators as consistent is the autocorrelation test. And as we see from Table 4, we do not reject the null hypothesis of no autocorrelation.

$$\begin{aligned}
\widehat{\Delta c}_t = & - 0.00132 & - 0.1864 & \Delta c_{t-1} & + 0.05182 & \Delta c_{t-5} & + 0.1694 & \Delta c_{t-6} \\
& (0.000765) & (0.0336) & & (0.0322) & & (0.0331) & \\
& + 0.1544 & \Delta c_{t-7} & + 0.1898 & \Delta c_{t-8} & + 0.09486 & \Delta c_{t-9} \\
& (0.0335) & & (0.0334) & & (0.0331) & & \\
& + 0.07281 & \Delta c_{t-11} & + 0.05009 & \Delta y_{t-1} & - 0.05018 & \Delta y_{t-9} \\
& (0.0321) & & (0.0247) & & (0.0245) & & \\
& + 0.02181 & ECM_{t-1} \\
& (0.007) & & & & & &
\end{aligned} \tag{4}$$

Table 5: Diagnostics for the Consumption Function

$\sigma = 0.0042$, 607 observations	
AR 1-7 test:	F(7,568) = 0.72305 [0.6525]
ARCH 1-7 test:	F(7,593) = 0.96505 [0.4559]
Normality test:	$\chi^2(2) = 5.1704$ [0.0754]
Hetero test:	F(27,562) = 1.9884 [0.0024]**
RESET23 test:	F(2,573) = 0.95204 [0.3866]

The t-value for α_{cecm} is 3.12, so we can reject $\alpha_{cecm} = 0$. This is consistent with the consumption function interpretation, and shows that one premise for an income multiplier is present: Consumption does error-correct departures from equilibrium savings. The value of α_{yecm} does not alter this result. Another implication of our failure to reject $\alpha_{yecm} = 0$ is that the *saving for a rainy day* hypothesis is not supported. We note that we fail to reject the absence of heteroscedasticity. We attribute this to the volatility in the monthly data.

Given the outcome of these tests, we can argue that the structural model is not a simultaneous equation system. Note that this does not mean there is no income multiplier, only that the multiplier process is "drawn out" in time.

4.3.1 Conditional Consumption Function

Based on the results above we can estimate a system made up of a conditional consumption function (5), and a marginal equation for income (6). As error correction only takes place in consumption, the coefficient in front of the error correction term in (5) is the same coefficient as in the reduced form estimated above. However, the coefficients in front of Δy_{t-1} etc are new, due to the conditioning on Δy_t . As a result of this, we introduce new symbols for these coefficients.

$$\Delta c_t = \gamma_{c0} \Delta y_t + \gamma_{c1} \Delta y_{t-1} + \gamma_{c2} \Delta c_{t-1} + \alpha_{ccm} (y_{t-1} - \beta c_{t-1} - s^*) + \varepsilon_{ct} \quad (5)$$

$$\Delta y_t = \alpha_{y1} \Delta y_{t-1} + \alpha_{y2} \Delta c_{t-1} + \varepsilon_{yt} \quad (6)$$

Estimating the empirical version of these equations gives us the following:

$$\begin{aligned} \widehat{\Delta c}_t = & -0.001433 \quad -0.2212 \Delta c_{t-1} \quad -0.09091 \Delta c_{t-2} \quad -0.07642 \Delta c_{t-3} \\ & (0.000756) \quad (0.0345) \quad (0.0346) \quad (0.0341) \\ & +0.1112 \Delta c_{t-6} \quad +0.1371 \Delta c_{t-7} \quad +0.1726 \Delta c_{t-8} \quad +0.09824 \Delta c_{t-9} \\ & (0.0318) \quad (0.0326) \quad (0.0329) \quad (0.0329) \\ & +0.06268 \Delta c_{t-11} \quad +0.2097 \Delta y_t \quad +0.1358 \Delta y_{t-1} \quad +0.1105 \Delta y_{t-2} \\ & (0.0315) \quad (0.0247) \quad (0.0259) \quad (0.0258) \\ & +0.09431 \Delta y_{t-3} \quad -0.03329 \Delta y_{t-9} \quad -0.04171 \Delta y_{t-12} \\ & (0.0259) \quad (0.024) \quad (0.0232) \\ & +0.02057 ECM_{t-1} \\ & (0.00691) \end{aligned} \quad (7)$$

We note that the coefficient α_{ccm} has not changed much in the conditional version of the consumption function, and also note that Δy_t is highly significant with a t-value of 8.48. The coefficient we estimate for Δy_t is quite large indeed. We still observe similar results as previously from the diagnostics.

Table 6: Diagnostics for the Conditional Consumption Function

$\sigma = 0.0041$, 607 observations, $R^2 = 0.47$	
AR 1-7 test:	F(7,567) = 1.6028 [0.1318]
ARCH 1-7 test:	F(7,593) = 1.5979 [0.1331]
Normality test:	$\chi^2(2) = 4.8168$ [0.0900]
Hetero test:	F(36,556) = 2.1868 [0.0001]**
RESET23 test:	F(2,572) = 0.56183 [0.5705]

$$\begin{aligned}
 \widehat{\Delta y_t} = & \quad 0.001043 \quad - \quad 0.1186 \Delta y_{t-2} \quad - \quad 0.1049 \Delta y_{t-3} \quad + \quad 0.08789 \Delta c_{t-2} \\
 & \quad (0.00023) \quad \quad (0.0259) \quad \quad (0.0258) \quad \quad (0.0346) \\
 & \quad + \quad 0.1397 \Delta c_{t-3} \quad + \quad 0.07249 \Delta c_{t-8} \quad + \quad 0.1151 \Delta c_{t-11} \\
 & \quad (0.0356) \quad \quad (0.0333) \quad \quad (0.0331) \\
 & \quad + \quad 0.09526 \Delta c_{t-12} \\
 & \quad (0.033)
 \end{aligned} \tag{8}$$

Table 7: Diagnostics New Income Equation

$\sigma = 0.0044$, 607 observations, $R^2 = 0.66$	
AR 1-7 test:	F(7,576) = 0.77902 [0.6051]
ARCH 1-7 test:	F(7,593) = 3.9531 [0.0003]**
Normality test:	$\chi^2(2) = 56.455$ [0.0000]**
Hetero test:	F(27,572) = 1.3870 [0.1127]
RESET23 test:	F(2,581) = 2.3512 [0.0962]

4.3.2 Dynamic Equation System

We can form a system of these two equations, which would allow us to expose our model to shocks, and see how income and consumption evolve over time in response to these shocks.

First we need to identify the system. Through our previous tests we have concluded that we can form a recursive system, where current period Δy_t affects Δc_t , but where Δc_t has no effect on Δy_t . We therefore omit

the error correction term from our equation for Δy_t . Finally, we omit the consumption break dummies from the Δy_t equation, and vice versa for the income break dummies. Our choice of estimation method for the system is Full Information Maximum Likelihood (FIML). We expect the estimates of the system to follow the previous estimations quite closely.

$$\begin{aligned} \widehat{\Delta y_t} = & 0.001041 - 0.1186 \Delta y_{t-2} - 0.1047 \Delta y_{t-3} + 0.0888 \Delta c_{t-2} \\ & (0.000231) \quad (0.026) \quad (0.0259) \quad (0.0348) \\ & + 0.1384 \Delta c_{t-3} + 0.0717 \Delta c_{t-8} + 0.116 \Delta c_{t-11} \\ & (0.0357) \quad (0.0334) \quad (0.0333) \\ & + 0.09723 \Delta c_{t-12} \\ & (0.0329) \end{aligned}$$

$$\begin{aligned} \widehat{\Delta c_t} = & -0.001385 + 0.1688 \Delta y_t + 0.1263 \Delta y_{t-1} + 0.1024 \Delta y_{t-2} \\ & (0.000757) \quad (0.0315) \quad (0.0262) \quad (0.0261) \\ & + 0.08702 \Delta y_{t-3} - 0.03286 \Delta y_{t-9} - 0.03775 \Delta y_{t-12} \\ & (0.0261) \quad (0.0238) \quad (0.0232) \\ & - 0.2223 \Delta c_{t-1} - 0.08678 \Delta c_{t-2} - 0.06535 \Delta c_{t-3} \\ & (0.0343) \quad (0.0349) \quad (0.0349) \\ & + 0.1123 \Delta c_{t-6} + 0.1326 \Delta c_{t-7} + 0.1741 \Delta c_{t-8} \\ & (0.0316) \quad (0.0324) \quad (0.0329) \\ & + 0.09948 \Delta c_{t-9} + 0.003524 \Delta c_{t-10} + 0.06777 \Delta c_{t-11} \\ & (0.0335) \quad (0.0323) \quad (0.0321) \\ & + 0.02078 ECM_{t-1} \\ & (0.00686) \end{aligned}$$

Table 8: System Diagnostics

607 observations	
Vector SEM-AR 1-7 test:	F(28,1126) = 1.3962 [0.0830]
Vector Normality test:	$\chi^2(4) = 64.935$ [0.0000]**
Vector Hetero test:	F(201,1611) = 1.3632 [0.0011]**

These diagnostics are the system versions of the same tests previously conducted under the single equation systems.

We observe low t-values on some of the lagged variables in both the income and the consumption equation, and remove these from our system. Doing so does not change the major results of exposing the model to shocks. This new estimation gives us:

$$\widehat{\Delta y_t} = 0.001134 - 0.1219 \Delta y_{t-2} - 0.1054 \Delta y_{t-3} + 0.1075 \Delta c_{t-2}$$

(0.000225) (0.026) (0.0259) (0.0344)

$$+ 0.1477 \Delta c_{t-3} + 0.1108 \Delta c_{t-11} + 0.0999 \Delta c_{t-12}$$

(0.0354) (0.033) (0.0328)

$$\widehat{\Delta c_t} = -0.00148 + 0.1502 \Delta y_t + 0.1172 \Delta y_{t-1} + 0.08396 \Delta y_{t-2}$$

(0.000753) (0.0303) (0.026) (0.0249)

$$+ 0.06961 \Delta y_{t-3} - 0.2082 \Delta c_{t-1} + 0.1116 \Delta c_{t-6} + 0.1225 \Delta c_{t-7}$$

(0.025) (0.0331) (0.0319) (0.0325)

$$+ 0.151 \Delta c_{t-8} + 0.07296 \Delta c_{t-9} + 0.02101 ECM_{t-1}$$

(0.0322) (0.0316) (0.0069)

Table 9: System Diagnostics

607 observations	
Vector SEM-AR 1-7 test:	F(28,1134) = 1.3238 [0.1213]
Vector Normality test:	$\chi^2(4) = 66.567$ [0.0000]**
Vector Hetero test:	F(201,1611) = 1.4029 [0.0004]**

Before we start looking at the dynamics of the model it would be interesting to see how well the model would forecast the past year.

The solid line in Figure 8 shows the actual development of Δy_t and Δc_t , while the bars show the corresponding 95% confidence intervals. The model seems to predict the actual values quite well, and we observe no large forecast errors for this time interval.

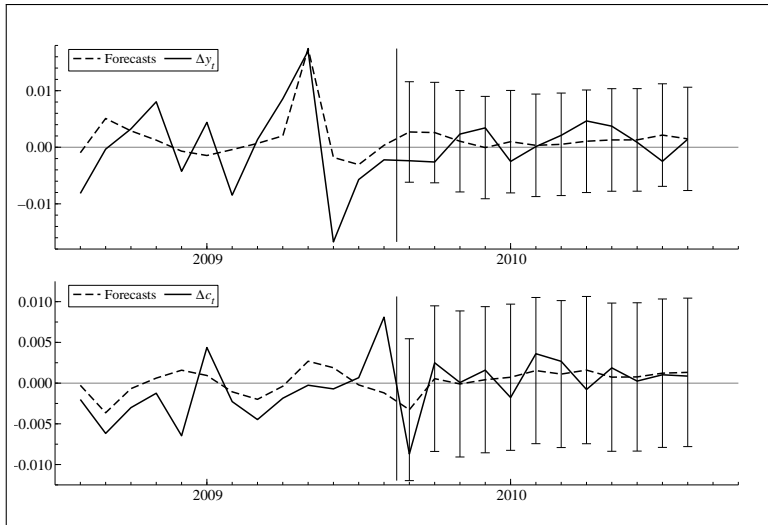


Figure 8: 12 month forecast of Δy_t and Δc_t .

4.3.3 Dynamics

We can now expose this system to shocks of various kinds, and observe how the economy responds to these shocks. The manner of shocks used enables us to emulate certain traits of the financial crisis, and might give us an indication of the effects of economic policies like the American Recovery and Reinvestment Act of 2009.

We begin by examining the effects of a temporary positive shock to Δy_t , which could for instance be caused by fiscal policy. The size of the shock isn't important here, it would only affect the scales and we're more interested in the dynamics involved. We shock Δy_t by 0.4, which would translate into an increase in income of 0.4%.

Figure 9 provides us with some interesting information. We see that the effects of a single monthly shock linger on for a very long time, even though the shock itself dissipates quickly. The figure also indicates that fiscal policy needs quite some time after implementation to be effective. It takes several years for the positive shock to income to have its full effect on c_t . It is also very interesting to see that the long-term effect is that the percentage change in y_t is larger than the initial value of the shock. This seems to indicate the

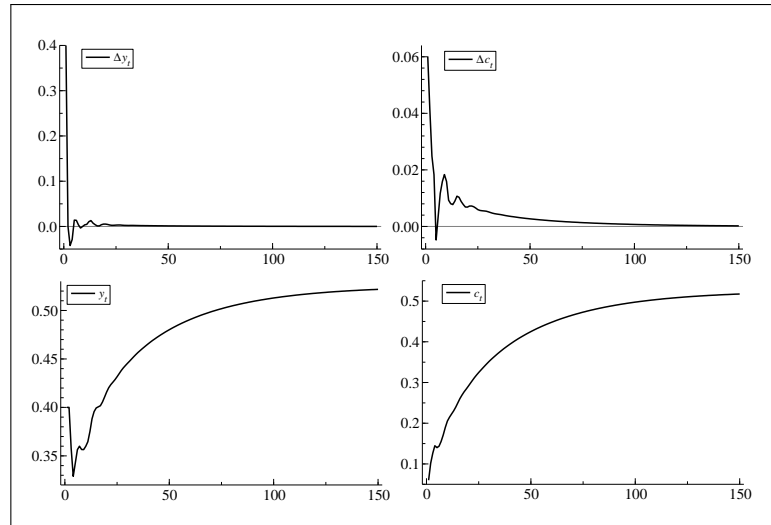


Figure 9: The effects of a positive shock to income.

existence of a multiplier effect, which is essential to fiscal policy and has been the subject of much debate as U.S. unemployment continued to rise after the implementation of the ARRA.

In the case of a similar shock to consumption we see that the effects start wearing off after approximately two years. The difference in magnitude compared to when the shock took place in income is larger than we expected to see before modeling the dynamics. We also observe the error correction taking place in consumption. An increase in consumption means that the savings rate is below its long-run equilibrium. This adjusts consumption down towards the value consistent with the long-run relationship of the savings rate.

Finally, Figure 11 shows a simultaneous decrease in income and consumption. One interpretation of this can be the onset of the financial crisis and a loss of consumer confidence, although there were more complex forces at work in reality than we can hope to capture in our simple model.

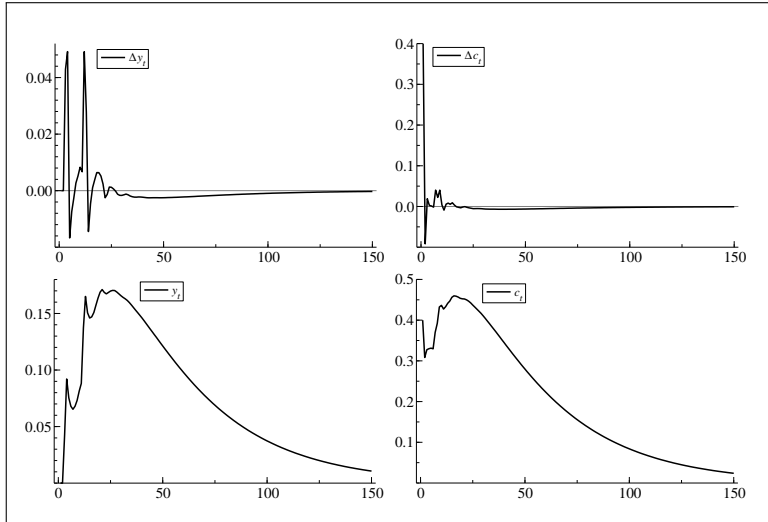


Figure 10: The effects of a positive shock to consumption.

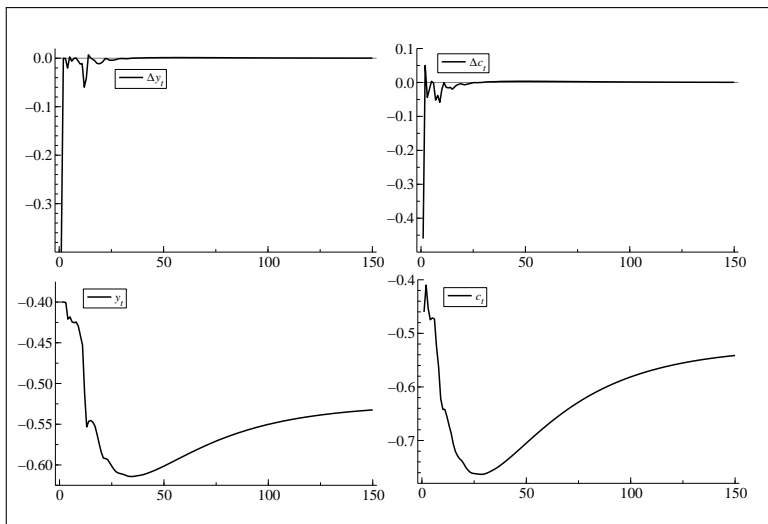


Figure 11: The financial crisis in our model.

5 Conclusions

It has been the ambition of this thesis to provide some background regarding the causes of the financial crisis, and to highlight the lack of consensus in modern macroeconomic theory. I have attempted to single out some of the factors I believe have been of the greatest importance both in causing and contributing to the financial crisis. It is interesting to note that at the time of writing, November 2010, little has been done to change many of the underlying factors which helped create a global financial crisis. The global trade imbalances remain, made evident by the United States recently accusing the Chinese of mercantilism. Little has been done to regulate the U.S. financial sector, and though there were substantial short-term gains by rescuing institutions which were deemed too big to fail, these rescues will have done little to dampen any moral hazard problems present in financial institutions. The potential problems connected to high bonuses and investors and investment managers having misaligned incentives were covered in chapter 3, and when Yngve Slyngstad, CEO of NBIM, defends¹⁸ paying out bonuses of several billion NOK to investment managers, it would seem somewhat of an exaggeration to say that these problems are taken very seriously by the financial sector as a whole. To round up the summary of the descriptive part of the thesis on a gloomy note: It seems highly unlikely that the current financial crisis is the last of its kind.

In chapter 4 I estimated consumption functions with U.S. data in an attempt to test whether the Keynesian consumption functions used in macroeconomic models, or consumption following an Euler equation like the DSGE models assume, could find their respective assumptions backed up by the data. From the estimated equations the conclusion was that the Keynesian view was supported by the data. We found no support for consumption following a random walk. Constructing a dynamic system and exposing it to shocks revealed a possible multiplier effect, and showed the quite long time span one must allow for before seeing the full effects of fiscal policy. Without reading too much into the findings of such a simple model, these

¹⁸Article in Dagens Næringsliv, October 30, 2010.

results are nevertheless interesting. Time constraints prevent me from refining the model before the deadline for submitting this thesis, but it might be interesting to look further into this in the future.

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A Variable Description

All data used for estimations in this thesis has been extracted from FRED, Federal Reserve Economic Data. The database is available at <http://research.stlouisfed.org/fred2/>.

`inccap_2005` is disposable income per capita, in chained 2005 dollars. The data has been seasonally adjusted, and is of monthly frequency. Consumption data was not available in in monthly, per capita, chained 2005 dollars. To obtain this I downloaded personal consumption expenditures in billions of dollars, seasonally adjusted and of monthly frequency. I then divided this with an implicit price deflator to obtain the series in 2005 dollars, and also divided the series by population data to obtain per capita numbers. The measure for population used, Total Population: All ages including Armed Forces Overseas, was obtained from the same database. The resulting variable was named `ccap_2005` in the data set. The logs of `inccap_2005` and `ccap_2005` were denoted `Linccap_2005` and `Lccap_2005`, and were presented as y and c in the text, estimations and graphs. The differences of these logs were named `DLinccap_2005` and `DLccap_2005`, and were presented as Δy and Δc .

The data set and batch files used in PcGive are available on request, from the author of this thesis.