HELEEN MEES

Changing Fortunes

How China's Boom Caused the Financial Crisis

Changing Fortunes

How China's Boom Caused the Financial Crisis

Changing Fortunes

How China's Boom Caused the Financial Crisis

Changing Fortunes

Hoe de opkomst van China de financiële crisis heeft veroorzaakt

Thesis

to obtain the degree of Doctor from the
Erasmus University Rotterdam
by command of the
rector magnificus

prof.dr. H.G. Schmidt

and in accordance with the decision of the Doctorate Board.

The public defence shall be held on

Tuesday 28 August 2012 at 10 hours

by

Heleen Mees
born in Hengelo

ERASMUS UNIVERSITY ROTTERDAM

Doctoral Committee:

Promotor: Prof.dr. Ph.H.B.F. Franses

Other members: Prof.dr. H.H. van Ark
Prof.dr. G. Bekaert
Prof.dr. C.G. de Vries

Erasmus Research Institute of Management – ERIM
The joint research institute of the Rotterdam School of Management (RSM)
and the Erasmus School of Economics (ESE) at the Erasmus University Rotterdam
Internet: http://www.erim.eur.nl

ERIM Electronic Series Portal: http://hdl.handle.net/1765/1

ERIM PhD Series in Research in Management, 266
ERIM reference number: EPS-2012-266-MKT
ISBN 978-90-5892-311-0

Design: B&T Ontwerp en advies www.b-en-t.nl
Cover photograph: Matthew Niederhauser

This publication (cover and interior) is printed by haveka.nl on recycled paper, Revive®.
The ink used is produced from renewable resources and alcohol free fountain solution.
Certifications for the paper and the printing production process: Recycle, EU Flower, FSC, ISO14001.
More info: http://www.haveka.nl/greening

For Willem

May you live in interesting times

(origin unknown, reputed to be a Chinese curse)

Preface

Pursuing a Ph.D. is one of the best decisions I have made in the past ten years. The rise of China and the financial crisis seem to have been cut out for me as topics for research. In the past 30 months I have had the opportunity to go to China frequently and meet and work with many Chinese. During my travels I became much less critical of the Middle Kingdom, even to the point that I feared Stockholm syndrome. The recent events involving human rights activist Chen Guangcheng and politician Bo Xilai may serve as a fresh reminder that China is not like any other country.

First and foremost I want to thank my parents. My mother gave me my insight in economics and my father my aptitude for writing. I thank Philip Hans Franses for his enthusiasm and generosity, the doctoral committee for the most valuable comments, Louis Kuijs for the wonderful lunches in Beijing and Massimo Giuliodori for his help with the structural VAR. I thank Rick van der Ploeg for his friendship. He disproves the Dutch aphorism "een goede buur is beter dan een verre vriend," even though Justus van Diemen, my Amsterdam neighbor, serves as proof of it.

Quite a few students have assisted me along the way. Many crossed my path with the help of Liesbeth Eelens. I owe gratitude to Bert de Bruijn, Mark Treurniet, Chao Fang, Andy Xiaoyang and especially Margriet Rijff. Raman Ahmed started out working for me as an assistant for the paper on China's household savings rate, but I am pleased that I can call him my coauthor now. Many thanks for the excellent administrative support I received from AE, and the help I got from the Erasmus datateam and library. I could not have wished for a better paranymph than Caroline van Dullemen.

Finally, I want to thank Willem Buiter who was so kind to meet with me in the summer of 2008 in London to discuss possible avenues for a doctoral thesis. Our meeting proved to be the first tangible step towards this thesis.

Heleen Mees

New York City, June 2012

Table of Contents

I Introduction

At the onset of the financial crisis, in 2007 and 2008, the main worry among commentators and economists was the growing purchasing power of sovereign wealth funds of authoritarian states like China and the United Arab Emirates. In a column in *NRC Handelsblad* in July 2007 I reckoned that, if China would keep accumulating foreign reserves the way it did, within 10 years China would be able to acquire all publicly listed companies in Europe. In June 2008 Laurence Kotlikoff predicted that China's foreign reserves, which amounted already to $2 trillion at the time, would multiply within a matter of years. But Kotlikoff had a very benign view of China's hoarding. He predicted that, by becoming the world's saver, China would also become the developed world's savoir, with respect to its long-run supply of capital and long-run general equilibrium prospects (Kotlikoff et al., 2005). Ben Bernanke, who was Fed Governor at the time, had an equally sanguine reading of the global saving glut. In his by now infamous 2005 Sandridge lecture, Bernanke boasted about the "depth and sophistication of U.S. financial markets, which (…) allowed households easy access to housing wealth."

In September 2008 it all started to unravel quickly. Government sponsored enterprises Fannie Mae and Freddie Mac, created in 1938 and 1970 in order to promote homeownership, were placed into conservatorship by the U.S. federal government, and little more than a week later the investment bank Lehman Brothers collapsed. In order to prevent a full domino effect, the U.S. Treasury bailed out insurance behemoth AIG a few days after that. As stock markets tanked, the Dow Jones dropped more than 500 points on September 15, U.S. Congress consented to the Troubled Asset Relief Program (TARP) that authorized expenditures in the order of $700 billion for the purchase of assets and equity from financial institutions to strengthen the financial sector. Images of foreclosed properties and displaced homeowners flooded the TV screens. Before that faithful September month, most people had never heard of credit default swaps, collateralized debt obligations or subprime mortgages.

So it may not come as a surprise that Wall Street has been singled out as the villain in the prevalent narrative of the financial crisis and the ensuing Great Recession. I show, however, that there were even larger forces at work. The build-up of savings in China and oil-exporting nations, which were heavily skewed towards fixed income assets, depressed interest rates worldwide from 2004 on. By the time the Federal Reserve (Fed) wanted to put the brakes on the economy and started to raise its policy rate again in July 2004, it was too late. Long-term interest rates in the United States remained stubbornly low, in spite of the Fed raising the fed funds rate from 1 percent in July 2004 to 5.25 percent in June 2006, adding further fuel to the housing bubble. While the subprime mortgages with exotic features did not help either, my research shows that long-term interest rates are the most important factor driving housing demand (Chapter 2).

In an early column in NRC Handelsblad (February 2005), I put forth that China purposely flooded U.S. financial markets with cheap money to wash away the very foundations on which the United States was built. I drew a parallel with the United Kingdom that lost its empire status after World War II as it succumbed under the burden of foreign debt. John Maynard Keynes always suspected a preconceived plan of the United States. At the time the United States played the role of world banker, just like China does today.

In chapter 3, however, I show that Chinese households have more prosaic reasons than dethroning the United States to save almost 30 percent of disposable income. Rising household incomes and precautionary saving motives are the main explanations for China's high household savings rate. Also, China is not entirely unique; the trajectory of the world's most populous nation over the past 30 years is actually quite similar to the experiences of – for example – Singapore and Malaysia. India's household savings rate is at 32 percent of disposable income even higher than China's. China is only different than other emerging economies because its economy is vastly larger, and has gotten much more scrutiny because of its role in the years leading up to the 2008 financial crisis and ensuing economic recession. It's worth noting that oil-exporting nations' savings, which are equally large as China's, largely escape scrutiny because of the West's oil dependence.

This collection of papers reflects my first foray in academia. All papers relate – one way or the other – to China. Chapter 2 proves the central thesis of this thesis, namely that China's boom caused the 2008 financial crisis and ensuing recession. It builds on the work by Taylor (2008), Obstfeld and Rogoff (2010), Bernanke (2005), Greenspan (2011) and Warnock and Warnock (2009). Its main contribution is that it shows that the built-up of total debt securities, rather than foreign purchases of U.S. Treasuries, depressed 10-year Treasury yields from 2004 on. In addition, I show that the Fed, with its excessively loose monetary policy in the early 2000s, contributed to a large extent to the housing bubble and current debt overload of U.S. households.

The paper on China's household savings rate (Chapter 3) builds on the work of Ando and Modigliani (1963), Modigliani and Cao (2004), Blanchard and Giavazzi (2005), Horioka and Wan (2007), Chamon and Prasad (2010) and Wei and Zhang (2011). We use data that are more recent and cover a longer time span (1960 – 2009) than previous studies. The paper's first contribution is that it disproves many assertions about China's household savings rate, including (1) the claim that China's one-child-policy explains the high household savings rate, (2) the claim that the household savings curve is u-shaped, (3) the claim that the savings rate is high because interest rate are low, and (4) the claim that the so-called competitive savings motive, also dubbed 'keeping up with the Wangs,' is a decisive factor in Chinese households' preference for saving over consumption. Its second contribution is that it supports the conventional Keynesian savings hypothesis over Modigliani's life cycle hypothesis, although habit formation and precautionary saving motives are also important. Disposable income (which is measured by its reciprocal), the average 5-year income growth rate and the old-age dependency rate are the main determinants of the household savings rate.

In chapter 4 we show that individuals in China are susceptible to money illusion, albeit to a lesser extent than their American counterparts. The paper builds on the seminal paper by Shafir, Diamond and Tversky (1997). Although it is tentative to draw conclusions from comparing two not entirely representative samples, our findings suggest that money illusion may be more prevalent in affluent societies, which may therefore be more vulnerable for irrational exuberance (Akerlof and Shiller, 2009). In chapter 5 we look at financial markets' response to U.S., Chinese and German quarterly GDP growth data. Based on a comparison of financial markets reactions, we have found no evidence that China's National Bureau of Statistics 'cooks the books.' As far as financial markets respond less to Chinese growth data compared to U.S. growth data, the difference can fully be attributed to the size of the Chinese economy. Last and also least, in chapter 6 we show that China's Q2, Q3 and Q4 GDP numbers are rather predictable because China's National Bureau of Statistics reports quarterly GDP cumulatively. A keen understanding of the cumulated Chinese data, however, won't bring any privileged knowledge about China's quarterly GDP growth to which financial markets respond.

China will offer a trove of research topics for years to come. What puzzles me most, however, is how the dinner that Kotlikoff et al. (2005) prophesized in “Will China Eat Our Lunch or Take Us Out to Dinner?,” almost turned out to be our Last Supper. Why was the inexpensive capital that was on offer not put to a more productive use? Tobin’s q has gone out of fashion ever since Blanchard and Summers (1993) concluded that fundamentals were driving business investment, rather than stock market valuation as Tobin (1968) would predict. But the precipitous drop in the real forward yield on 10-year Treasuries in the early 2000s coincided with a dramatic increase in the real forward yield on risk capital. This may – at least in part – account for today’s economic woes. So, perhaps it is time to revisit Blanchard and Summers. It would not surprise me if it turns out that, all the while we were agonizing about China’s sovereign wealth fund acquiring too large a stake in Western companies, we should have worried about China buying too little equity instead.

References

Blanchard, Olivier, Changyong Rhee, and Lawrence Summers (1993), “The Stock Market, Profit, and Investment,” *The Quarterly Journal of Economics*, Vol. 108, No. 1 (Feb., 1993), pp. 115-136.

Brainard, William C. and James Tobin (1968), "Pitfalls in Financial Model Building,” *American Economic Review*, vol. 58 (May 1968), p. 104.

Fehr, Hans, Sabine Jokisch and Laurence J. Kotlikoff (2005), “Will China Eat Our Lunch or Take Us Out to Dinner? Simulating the Transition Paths of the U.S., EU, Japan, and China," Working Paper.

Mees, Heleen (2011), “Lost in Transmission,” VoxEU, http://www.voxeu.org/article/lost-transmission.

II U.S. Monetary Policy and the Housing Bubble

1. Introduction

Since the financial crisis in 2008 and ensuing economic recession that rocked the world economy, plenty of blame has been going around. Taylor (2008) claimed that loose monetary policy in the early 2000s fueled the housing boom that eventually went bust. Bernanke (2010), on the other hand, argued that the proliferation of exotic mortgage products was responsible for the housing boom. Still other economists maintained that the global imbalances in trade and capital flows were at fault, with the global saving glut depressing global interest rates and fuelling the housing boom (Greenspan (2010), Obstfeld and Rogoff (2010)).

We show that the Federal Reserve's monetary policy at the start of the new millennium, which resulted in negative real interest rates for a prolonged period of time, did not trigger so much the housing boom, as asserted by John Taylor, but rather the remortgaging boom, spurring personal consumption expenditures through home equity extraction.

The U.S. spending spree in the early 2000s boosted economic growth and savings in China and oil-exporting nations. China's savings are heavily skewed towards fixed income assets. We see total debt securities outstanding rising at a higher rate from 2002 onward, despite the fact that the global savings rate was relatively low at the time. This coincides with a quickening in China's savings, resulting from both an increase in China's savings rate and GDP-growth rate. The buildup of debt securities has an economically large and statistically significant impact on the 10-year U.S. Treasury yield and U.S. mortgage rates.

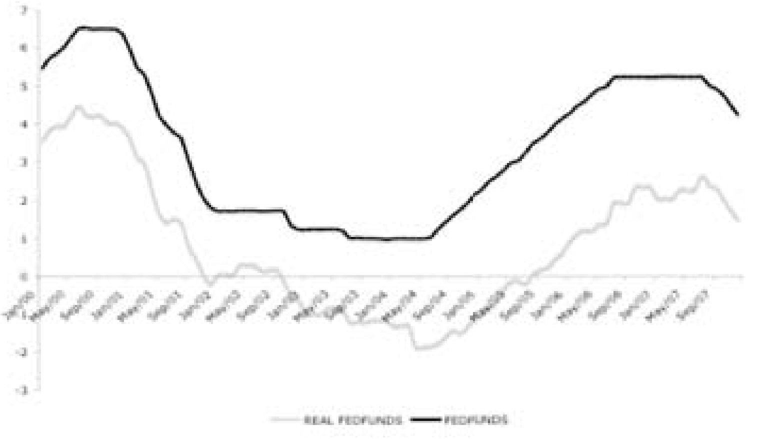
We show that the decline in long-term interest rates accounts for the housing bubble in the United States. Despite popular belief, the proliferation of exotic mortgage products can hardly be faulted for the housing boom and eventual bust. Even if the exotic mortgage products were responsible for the initial banking crisis, they can't account for the ensuing balance sheet recession (Koo, 2009). As a share of total mortgage originations, mortgages with exotic features are less than 5 percent of total mortgages from 2000 – 2006.

The outline of our paper is as follows. We first discuss how U.S. monetary policy in the early 2000s compared to the classic Taylor rule. Next, in Section 3, we show that monetary policy set off the remortgaging boom rather than the housing boom. Section 4 discusses the impact of the remortgaging boom, the Bush era tax cuts and spending on two wars on economic activity in the United States. In section 5 we show how China's economic growth spurred savings. Section 6 deals with what is, probably, the most important contribution of this study. We show that the built-up of total debt securities, rather than foreign purchases of U.S. Treasuries, depressed 10-year Treasury yields from 2004 on. In Section 7 we conclude with a discussion of the main results.

2. U.S. Monetary Policy

After the dot-com bubble burst by the end of 2000, the Federal Open Market Committee (FOMC) began to lower the target for the overnight fed funds rate, the monetary policy rate, in response to the 2001 recession, from 6.5 percent in late 2000 to 1.75 percent in December 2001 and to 1 percent in June 2003.[1] The target fed funds rate was left at 1 percent for a year. From July 2004 on, the FOMC began to raise the target fed funds rate, reaching 5.25 percent in June 2006. The – at the time – historically low fed funds rate resulted in a negative real fed funds rate from November 2002 to August 2005 (see Fig. 1).

Figure 1 Nominal and Real Fed Funds Rate Using the GDP Deflator (%)



Source: Federal Reserve

At the Jackson Hole conference in August 2007, organized by the Federal Reserve Bank of Kansas City, John Taylor delivered a stinging critique of the Fed's monetary policy from 2003 through 2006. In *Housing and Monetary Policy* (2007), Taylor argues that the fed funds rate was on average about 200 basis points below the rate prescribed by the Taylor rule, fueling the housing boom.

The classic form of the monetary policy rule, known as the Taylor rule, is:

$$FFR_t = 2 + 1.5(\pi_t - \pi^*) + 0.5(y_t - y_t^*)$$

π_t = headline CPI as measured at t

π^* = target rate of CPI inflation

y_t = GDP as measured at t

y_t^* = potential output

The Taylor rule prescribes that the FOMC raises the federal funds rate if inflation is above target and/or output is above potential output, and vice versa.[2]

---

[1] The Greenbook that was prepared for the June 24-25, 2003 FOMC-meeting projected real GDP growth of 4-1/4 percent annual rate in the second half of 2003 and 5-1/4 percent in 2004 and headline PCE inflation in the range of 1 to 1-1/2 percent. At the meeting the FOMC decided to cut the fed funds rate from 1.25 to 1 percent.

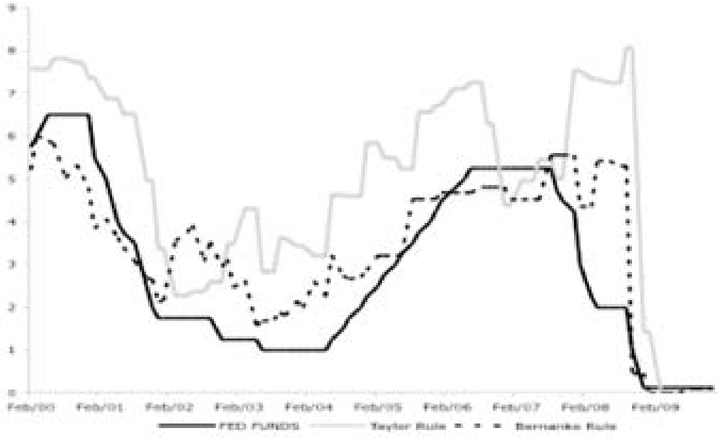
[2] The Taylor rule at its invention was a descriptive rule of monetary policy, but it has gradually evolved into a prescriptive rule. As John Taylor (2007) phrases it: "interest rate decisions (…) in some years did not correspond so closely to such a policy description."

According to Bernanke (2010), the monetary policy rule that the FOMC employs does not differ from the classical Taylor rule with respect to its parameters but solely with respect to the variables that are used.[3] These differences can almost entirely account for the deviations between the classic Taylor rule and the fed funds rate:

- FOMC uses *PCE* instead of *CPI* as a measure of inflation;
- FOMC uses *core* instead of *headline* inflation;
- FOMC uses *forecast* values of inflation instead of *current* values.

The fed funds rate in the period 2000 – 2007 fits the monetary policy path described by Bernanke's version of the Taylor rule indeed more accurately (see Fig. 2). In the remainder of this chapter we will therefore discuss the deviations of Bernanke's monetary policy rule and the classic Taylor rule in more detail.

Figure 2 Classic Taylor rule and Bernanke's Taylor rule (%)



Source: Federal Reserve

2.1 Use of PCE rather than CPI as a measure of inflation

In February 2000 the FOMC replaced headline CPI by the personal consumption expenditures (PCE) measure of inflation, according to Bernanke (2010) because it is less dominated than is the CPI by the imputed rent of owner-occupied housing.[4] At the time that the FOMC shifted from headline CPI to headline PCE inflation, the Beige Book forecasted a headline CPI of 2.4 percent for 2000 and 2001 and headline PCE of 2.0 percent for both years.

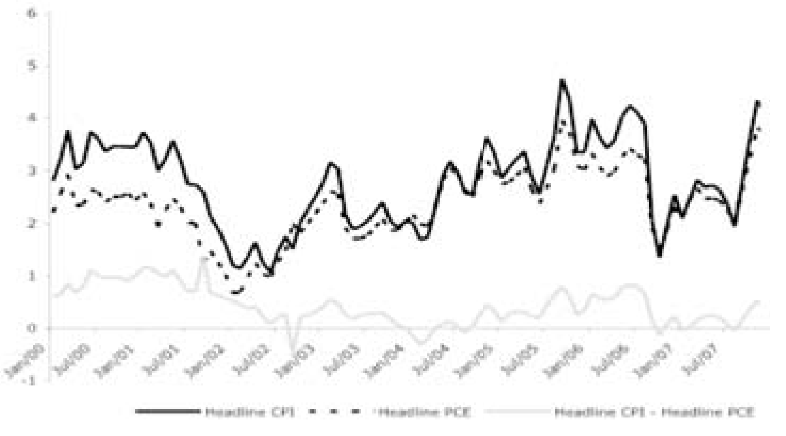
Historically, PCE inflation has been about 0.5 percent per year below the corresponding CPI measure. The PCE uses a chain index, which takes consumers' changing consumption due to price changes into account; the CPI uses a fixed basket of goods with weightings that do not change over time. Current-

[3] Bernanke (2010) de facto appropriates the rule of thumb estimated by Orphanides and Wieland (2008) to match Fed interest rate setting.
[4] Monetary Policy Report submitted to the Congress on February 17, 2000.

weighted price indices like PCE show lower inflation rates than base-weighted price indices like CPI in case there are relative price changes.

The FOMC's own forecast, as shown in the Greenbook part 2 of February 2000, had CPI half a percentage point higher than PCE inflation. Despite the change in inflation concept, the FOMC kept using the same parameters and (implicit) inflation target for its interest rate setting in the 2000 – 2006 period (Fed staff, also Orphanides and Wieland, 2008). Using the identical rule of thumb with projections of headline PCE inflation instead of headline CPI will *ceteris paribus* result in lower interest rate prescriptions on average and, hence, higher inflation.[5]

Figure 3 Headline CPI and headline PCE inflation (%)



Source: Federal Reserve

2.2 Use of core instead of headline inflation

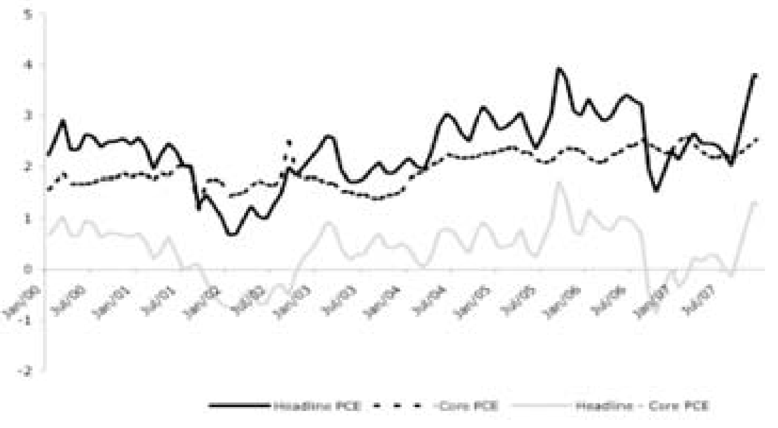
In July 2004 the FOMC replaced headline PCE with core PCE as a measure of inflation, which excludes food and energy prices.[6] According to Bernanke (2010) the FOMC expected any changes in the price of food and energy to be temporary in nature, and therefore these should not be guiding monetary policy.[7] Relying on core inflation instead of headline inflation, as the Fed does, is justified in case core inflation is – historically – a better predictor of headline inflation than headline inflation itself. Core goods and services tend to be subject to nominal price rigidities, while non-core goods, like agricultural commodities, oil, natural gas et cetera, have their prices set in auction markets. For much of the 20th century, core inflation therefore has been both less volatile and more persistent than the inflation rate of non-core goods.

It is essential to differentiate between what price index the Fed 'cares about' (if not 'targets') and what measure of inflation (i.e. CPI/PCE, current/forecast, headline/core) is the best predictor of the price index the Fed cares about (Buiter, 2008). According to then Fed Governor Mishkin (2007), controlling headline inflation, not core inflation, along with maintaining maximum sustainable employment (the second

[5] Both the Bank of England (BoE) and the European Central Bank (ECB) use headline CPI.
[6] Monetary Policy Report submitted to the Congress on July 20, 2004.
[7] On January 25, 2012 the FOMC reverted to headline PCE as its preferred measure of inflation, although it is unclear whether this refers to mid-term or long-term inflation.

leg of the Fed's dual mandate), is the ultimate aim of the Fed's monetary policy since it clearly does not make sense to pretend that people do not eat or drive.

Figure 4 Headline PCE and core PCE (%)



Source: Federal Reserve

The integration of China and India in the global market added more than 2.3 billion consumers and producers to the global economy. They entered as suppliers of core goods and services and as demanders of non-core commodities. The IMF estimates that in 2005 more than 800 million people in the world's labor force were engaged in export-oriented and therefore competitive markets, an almost threefold increase since the fall of the Berlin Wall (Greenspan, 2010). The result has been a major, persistent and continuing increase in the relative price of non-core goods to core goods (Buiter, 2008). A continuing upward movement in the relative price of non-core goods to core goods will *ceteris paribus* cause a permanent increase in the rate of headline inflation, as well as a permanent reduction in the rate of core inflation. Consequently, core inflation ceases to be a better predictor of headline inflation than headline inflation itself. Correlation between headline and core CPI dropped from 90 percent in the period 1990M1 – 1999M12 to a mere 42 percent in the period 2000M1 – 2009M12.[8]

By 2004 the price of non-core goods – notably the price of oil – was rising at an accelerating rate. The Fed's easy monetary stance allegedly contributed to commodities speculation. By 2007 the prices of oil and other raw materials were spiraling, helped by the weakening U.S. dollar. Bernanke (2010) asserts that both the FOMC and private forecasters correctly assumed that the increases in energy prices would subside, and therefore did not much adjust their medium-term forecasts for inflation. While it is true that the financial crisis and the collapse of global trade in the second half of 2008 led to a sharp decline in energy prices and a corresponding drop in headline inflation, energy prices were back to their November 2007 level by January 2010, despite an anemic economic recovery in both the United States and Europe. In January 2011 a barrel of oil cost $91.83 compared to $36.25 in July 2004.

[8] Our own calculations; similar argument made by Lorenzo Bini Smaghi in *The Financial Times*, June 1, 2011.

2.3 Use of forecast values of inflation instead of current values

Bernanke (2010) claims that the use of forecast values of the goal variables instead of current values explains the deviation of the fed funds rate from the classic Taylor rule prescription.[9] Orphanides and Wieland (2008) also conclude that the use of the FOMC forecasts of the goal variables instead of current values explains part of the deviation of the fed funds rate from the classic Taylor rule prescription. The FOMC changing its preferred measure of inflation twice, however, explains a larger part of the deviation of the fed funds rate from the classic Taylor rule prescription (see Figure 2). [10]

In response to Bernanke, Taylor (2010) objects to replacing current values with forecast values because "it is not how the Taylor rule was derived and there are problems with using forecasts, including that they are not objective and or accurate." The deviation reflects both the fact that the Taylor rule was not derived that way, i.e. estimating the Taylor rule with forecast values rather than current values might have yielded different parameters, as well as the fact that inflation forecasts are not objective and/or accurate. Panelists of the Philadelphia Survey of Professional Forecasters (SPF) over-predicted headline CPI inflation during 1982 – 2001 and under-predicted headline CPI inflation during 2002 – 2008. The mean errors (realization minus prediction) are negative over the first period and positive over the second period.[11] From 2002 – 2008 the margin of error – measured by the root-mean-square-error metric (RMSE) – is almost twice as large than from 1982 – 2001. The FOMC's projections during 2002 – 2008 also over-predicted headline and core PCE inflation, but by a smaller margin.

The under-prediction of headline CPI inflation during 2002 – 2008 by professional forecasters may indicate that the SPF-panelists did not fully grasp the significance of the integration of China and India in the global market economy. Another explanation may be that the SPF-panelists were not fully aware that the FOMC no longer aimed to control headline CPI inflation, but (core) PCE inflation instead. Also, Bernanke and Woodford (1997) show that – to the extent that targeting the private sector inflation forecast is successful – inflation forecasts become uninformative as there is no longer an incentive for the private sector to gather information.

2.4 Conclusion

The FOMC created room to keep interest rates low by changing the preferred measure of inflation twice in less than 5 years, without a countervailing adjustment in the parameters of its monetary policy rule. At the onset of the housing boom the FOMC switched from headline CPI to headline PCE inflation because the latter is less dominated by the – at that time – rising costs of owner-occupied housing. Headline CPI was on average 0.500 percent higher than headline PCE between January 1, 2000 and July 1, 2004.

Faced with rising energy prices the FOMC switched in July 2004 from headline PCE to core PCE, thus excluding the costs of energy and food from its measure of inflation. Headline PCE was on average 0.525 percent higher than core PCE between July 1, 2004 and January 1, 2008. Between January 1, 2000 and January 1, 2008 headline CPI was on average 0.804 percent higher than core PCE inflation. Headline CPI rose 24.887 percent over that period, on average 2.829 percent per year. The use of forecast instead of current

[9] There was an apparent switch from current values to forecast values in the Paul Volcker period (1979 – 1987) relative to the Greenspan period (Lindsey et. al., 1997).

[10] Using the output gap measured in real time instead of the output gap as measured by the FRB/US model has no significant effect on the policy prescriptions over most of the period (Bernanke, 2010).

[11] The Philadelphia Survey of Professional Forecasters only started collecting data on core and headline PCE inflation per 2007 Q1.

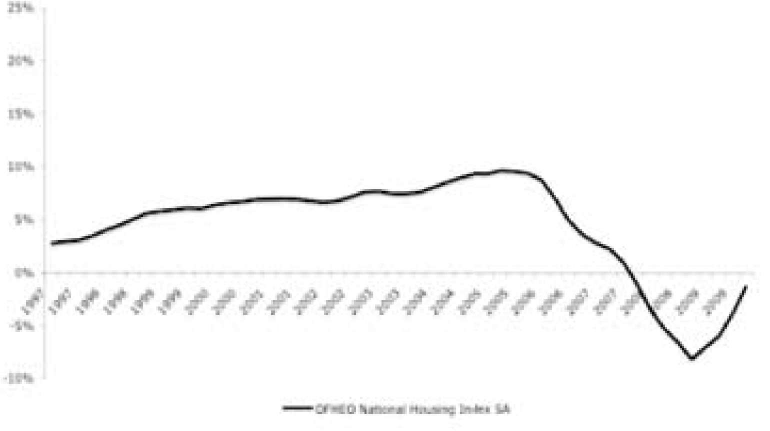
values of the goal variables also contributed to the loosening of monetary policy, as the FOMC's forecasts understated PCE inflation compared to later PCE realizations.

Though the prevailing view is that monetary policy should not be used to tackle asset and commodity bubbles (also dubbed 'lean against the wind'), it is quite something else to replace the preferred measure of inflation twice in the face of rising housing and food/energy prices to mitigate the effect of the price-rises, as the FOMC did.

3. The Housing Bubble

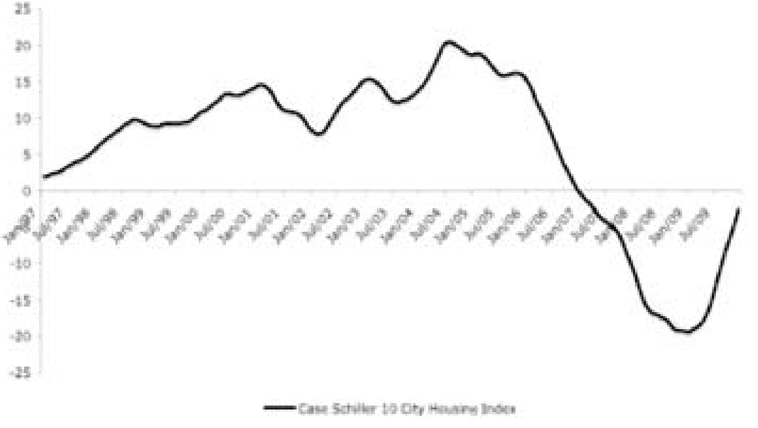
Until 1998, housing prices in the United States had been rising at about the pace of the general price level. From 1998 onward national housing prices began to rise at a level exceeding the general price level, especially in the ten largest cities in the United States. Between January 1, 1998 and January 1, 2008 the OFHEO National Housing Index rose 66 percent (Figure 6). The Case-Schiller 10 City Housing Index, consisting of the top 10 U.S. cities, rose over that same period 144 percent (Figure 7). Both indexes measure nominal price changes. By July 2006 the Case-Schiller Housing Index started declining and in January 2010 prices in the ten largest cities in the United States were on average back at their October 2003 level.

Figure 6 OFHEO National Housing Index SA (% change y-o-y)



Source: OFHEO

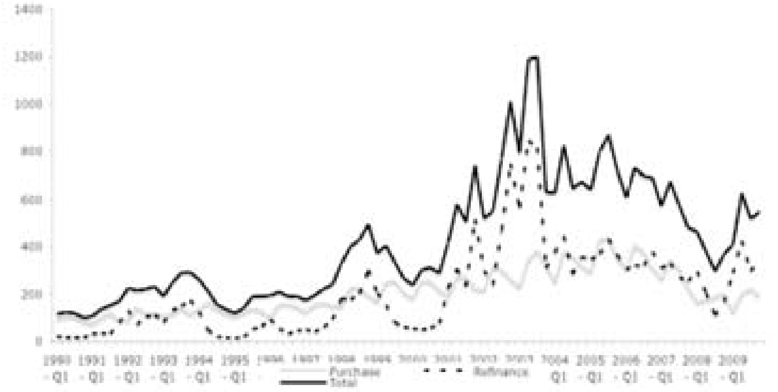
Figure 7 Case-Schiller 10 City Housing Index (% change y-o-y)



Source: Case-Schiller

Taylor (2008) asserts that the fed funds rate caused the housing boom and eventual bust. He establishes a relationship between housing starts and the fed funds rate. Bernanke (2010) argues that not the fed funds rate but the proliferation of exotic mortgage products, which lowered monthly mortgage installments significantly, is the culprit. These mortgage products kept housing prices rising through 2005 and much of 2006, according to Bernanke. Alan Greenspan (2010), on the other hand, blames the prolonged decline in long-term interest rates for the housing boom. According to Greenspan, prices of long-lived assets are determined by discounting the flow of income (or imputed services) by interest rates of the same maturities as the life of the asset, and not by short-term rates like the fed funds rate.

Figure 8 Mortgages for purchase and refinance (billion U.S. dollars)



Source: Mortgage Bankers Association

Figure 9 Fed funds rate, 10-year Treasury and 30-year mortgage rate (%)

Source: Federal Reserve, Freddie Mac

To test the three alternative explanations for the housing boom, we performed linear regression analysis on real mortgage data for purchase and refinance on the fed funds rate, the 10-year treasury rate, real GDP growth and the real OFHEO housing price index in the period 1990Q1 – 2008Q2 and in the period 2000Q1 – 2008Q2 (see also Figure 8 and 9).[12] In the fall-out of the Lehman Brothers failure, credit markets froze for a considerable period of time. Therefore the period 2008Q3 – 2009Q4 is not included in the regression analysis. We make use of the 10-year Treasury rate at constant maturity instead of the 30-year mortgage rate as reported by Freddie Mac. The correlation between the two rates is 0.979 in the period under consideration and the choice for either one should not impact the outcome. Use of real interest rates in lieu of nominal interest rates does not influence the results in a significant way.[13]

We first test both the dependent variables as well as the regressors for unit root. The results of the augmented Dickey-Fuller with 0 lag, trend and constant for Real Refinance and 1 lag, trend and constant for all other variables are presented in Table 1. As all variables are stationary, we proceed with simple OLS regressions to find the main determinants of Real Purchase and Real Refinance (see Table 2 – 5).

Table 1 Augmented Dickey-Fuller test results

	Real Purchase	Real Refinance	10YR TREAS	FED FUNDS	Real GDP growth	Real OFHEO	Δ Real OFHEO
ADF t-stat	-4.01***	-2.71*	-3.77**	-3.69**	-2.87**	-1.43	-4.45***

***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Real Purchase = Mortgage originations for purchase in 1990 U.S. $ billion

Real Refinance = Mortgage originations for purchase in 1990 U.S. $ billion

10 YR TREAS = 10-year Treasury yield measured as 3-months average

FED FUNDS = Effective federal funds rate measured as 3-months average

Real GDP growth = Real GDP y-o-y change seasonally adjusted annual rate

Real OFHEO = OFHEO national housing index seasonally adjusted in constant dollars

Δ Real OFHEO = First level difference of Real OFHEO

[12] Disposable income growth does not have a greater explanatory power than real GDP growth.

[13] Brunnermeier and Julliard (2006) show that the housing price–rent ratio is not affected by the real interest rate, but by the nominal interest rate.

Table 2 Model of mortgages for purchase from 1990 – 2008

Model OLS, using observations 1990:2-2008:2 (T = 73)
Dependent variable: Real PURCHASE
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	306.229	37.1494	8.2432	<0.00001	***
10 YR TREAS	-27.8252	6.11273	-4.5520	0.00002	***
FED FUNDS	-0.246774	3.86653	-0.0638	0.94930	
Δ real OFHEO	-5.48999	9.10834	-0.6027	0.54868	
REAL GDP	2.95318	3.23461	0.9130	0.36447	

Mean dependent var	155.1132	S.D. dependent var	55.02258
Sum squared resid	114076.4	S.E. of regression	40.95844
R-squared	0.476663	Adjusted R-squared	0.445879
F(4, 68)	10.14626	P-value(F)	1.68e-06
Log-likelihood	-372.0095	Akaike criterion	754.0190
Schwarz criterion	765.4713	Hannan-Quinn	758.5829
Rho	0.543855	Durbin-Watson	0.909348

Table 3 Model of mortgages for purchase from 1990 – 2008[14]

Model OLS, using observations 1990:1-2008:2 (T = 74)
Dependent variable: Real PURCHASE
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	316.3	32.0983	9.8541	<0.00001	***
10 YR TREAS	-28.2256	4.83674	-5.8357	<0.00001	***

Mean dependent var	154.2873	S.D. dependent var	55.10429
Sum squared resid	116502.3	S.E. of regression	40.22545
R-squared	0.474418	Adjusted R-squared	0.467118
F(1, 72)	34.05494	P-value(F)	1.42e-07
Log-likelihood	-377.3807	Akaike criterion	758.7614
Schwarz criterion	763.3695	Hannan-Quinn	760.5996
Rho	0.530868	Durbin-Watson	0.941824

[14] This table shows the regression results after backward elimination.

Table 4 Model of mortgages for refinance from 1990 – 2008[15]

Model OLS, using observations 1990:1-2008:2 (T = 74)
Dependent variable: real REFINANCE
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	590.397	80.7631	7.3102	<0.00001	***
10 YR TREAS	-51.5214	8.91127	-5.7816	<0.00001	***
FED FUNDS	-22.9279	7.88429	-2.9080	0.00487	***
REAL GDP	-17.2097	5.64095	-3.0509	0.00322	***

Mean dependent var	145.6074	S.D. dependent var	126.8863
Sum squared resid	365024.7	S.E. of regression	72.21246
R-squared	0.689423	Adjusted R-squared	0.676112
F(3, 70)	13.54699	P-value(F)	4.60e-07
Log-likelihood	-419.6367	Akaike criterion	847.2734
Schwarz criterion	856.4897	Hannan-Quinn	850.9499
Rho	0.489556	Durbin-Watson	0.989574

Table 5 Model of mortgages for refinance from 2000 – 2008[15]

Model OLS, using observations 2000:1-2008:2 (T = 34)
Dependent variable: real_REFINANCE
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	442.992	69.5925	6.3655	<0.00001	***
FED FUNDS	-44.8907	10.5515	-4.2545	0.00018	***
REAL GDP	-22.6423	12.1233	-1.8677	0.07129	*

Mean dependent var	233.6632	S.D. dependent var	132.1523
Sum squared resid	301189.3	S.E. of regression	98.56868
R-squared	0.477392	Adjusted R-squared	0.443676
F(2, 31)	9.385975	P-value(F)	0.000650
Log-likelihood	-202.7592	Akaike criterion	411.5184
Schwarz criterion	416.0974	Hannan-Quinn	413.0800
Rho	0.400583	Durbin-Watson	1.163419

Our analysis shows that mortgages for *purchase* do not respond significantly to changes in the fed funds rate, as Taylor (2007) suggested (see Table 2). Instead mortgages for purchase (measured in billion dollars) respond to changes in long-term interest rates, as suggested by Greenspan (2010) (see Table 3). Mortgages for *refinance*, on the other hand, respond to both changes in the fed funds rate and to changes in long-term interest rates (see Table 4). From 2000 – 2008 mortgages for refinance respond solely to changes in the fed funds rate in our model, and not to changes in the 10-year Treasury (see Table 5). Two thirds of the mortgages between 2003Q1 and 2004Q2, the time when the FOMC held the fed funds rate at 1 percent, were used for refinance (see Table 7 and Figure 8).[15]

Bernanke (2010) argues that the proliferation of exotic mortgage products in 2005 and 2006, rather than the fed funds rate, fed the housing boom. These exotic mortgage features, which lowered initial monthly installments drastically compared to a fed funds rate cut, would have triggered homebuyers and kept home prices rising. His address included a slide showing exotic mortgage features (i.e. interest only, negative amortization, pay-option ARMs and extended amortization) as a share of subprime and Alt-A mortgages spiking from 2003 through 2006.

Bernanke's argument is not quite compelling. Expressed as a share of subprime and Alt-A mortgage originations, as shown in Table 6 (which is identical to slide 8 in Bernanke (2010)), exotic mortgage features indeed do appear to be omnipresent during the years 2003 – 2006. As a share of total mortgage originations, however, mortgages with exotic features are less than 5 percent of total mortgages until and including 2004, and only slightly above 5 percent of total mortgages in 2005 and 2006 (respectively 5.6 and 7.7 percent of total mortgage originations) as shown in Table 8.[16] Moreover, the data include both mortgages for purchase as well as mortgages for refinance, the latter being more responsive to changes in short-term interest rates – and presumably also to changes in monthly mortgage installments – than the former. Hence, exotic features may be even less common in mortgages for purchase than in mortgages for refinance. Lastly, the proliferation of exotic mortgages with teaser rates of 1 percent may just as well be seen as a by-product of the ultra-low fed funds rate.

Despite popular belief, the proliferation of exotic mortgage products can't be faulted for the housing boom and eventual bust. While the subprime mortgages with exotic features did not help, the most important factor driving housing demand is long-term interest rates, as Greenspan (2010) asserted. Why long-term interest rates remained puzzlingly low in 2004 – 2005 despite the increase in the fed funds rate from 1 to 6.25 percent, giving further fuel to the housing boom, will be subject of discussion in the remaining paragraphs.

[15] Bean et al. (2010) find that the deviation from the monetary policy rule explains 26 percent of the increase in housing prices in the U.S.
[16] Using data from LoanPerformance instead of Federal Reserve data yields similar results.

Table 6 Share of exotic features in Alt-A and subprime mortgages (%)

	Interest Only		Negative Amortization		Pay-Option ARMs		Extended Amortization	
	Subprime	Alt-A	Subprime	Alt-A	Subprime	Alt-A	Subprime	Alt-A
2000	0	3	0	0	0	0	0	0
2001	0	8	0	0	0	0	0	0
2002	2	37	0	0	0	0	0	0
2003	5	48	0	19	0	11	0	0
2004	18	51	0	40	0	25	0	0
2005	21	48	0	46	0	38	13	0
2006	16	51	0	55	0	38	33	2

Source: Bernanke (2010)

Table 7 Market share of Alt-A and subprime mortgages, and mortgages for refinance (%)

	Market share		Market share mortgages for refinance
	Subprime	Alt-A	
2000	9.5	5.1	20.8
2001	7.2	5.2	55.7
2002	6.9	5.7	59.0
2003	7.9	5.6	64.8
2004	18.5	11.3	52.7
2005	20	11.7	50.2
2006	20.1	14.4	48.8

Source: Inside Mortgage Finance

Table 8 Market share mortgages with exotic features (%)

	Interest Only		Negative Amortization		Pay-Option ARMs		Extended Amortization		Market share mortgages w. exotic features
	Subprime	Alt-A	Subprime	Alt-A	Subprime	Alt-A	Subprime	Alt-A	
2000	0	0.153	0	0	0	0	0	0	0.038
2001	0	0.416	0	0	0	0	0	0	0.104
2002	0.138	2.1	0	0	0	0	0	0	0.559
2003	0.395	2.688	0	1.064	0	0.616	0	0	1.191
2004	3.33	5.763	0	4.52	0	2.825	0	0	4.110
2005	4.2	5.616	0	5.382	0	4.446	2.6	0	5.561
2006	3.216	7.344	0	7.92	0	5.472	6.633	0.288	7.718

Source: Federal Reserve, Inside Mortgage Finance

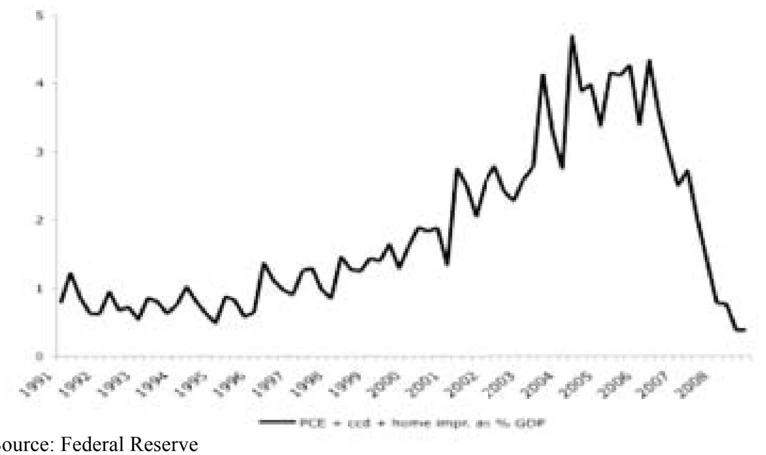
4. Spending out of Home Equity, Consumer Credit and Tax Cuts

In the years running up to the financial crisis, economists often pointed out that Americans were living beyond their means, using their houses as ATMs to prop up personal consumption expenditures – on a micro-level, and running large current account deficits – on a macro-level. Most economists thought the situation to be unsustainable.[17, 18] Many predicted a dollar crisis (among others Krugman, 2007), and some foretold the collapse of the housing market and the financial sector (Roubini, 2004).

According to a paper by Alan Greenspan and James Kennedy (2007), homeowners in 2005 extracted net $750 billion (or 5.9 percent of GDP) of equity from their homes (up from $106 billion in 1996), spending two thirds on personal consumption, home improvements and credit card debt and the rest for the acquisition of assets and other (see Figure 10). A considerable portion of the equity extracted through cash out remortgaging and home equity loans was used to repay non-mortgage debt, largely credit card loans. The non-mortgage debt repaid with those funds can be considered bridge financing for personal consumption expenditures (Greenspan, 2007).[19]

Net home equity extraction is gross equity extraction minus originations to purchase a new home and closing costs. Gross home equity extraction includes equity extraction out of home sales, home equity loans net of unscheduled payments and cash out refinancing. Though equity extraction out of home sales concerns realized capital gains, as opposed to equity extraction through home equity loans and cash out refinancing, the distinction may be subtle, as most home-sellers went on to buy a new home with a higher mortgage.

Figure 10 Spending out of home equity extraction (% GDP)



Source: Federal Reserve

[17] See for example *Financial Times* columnist Martin Wolf (2008) and Robert Skidelsky (2008).

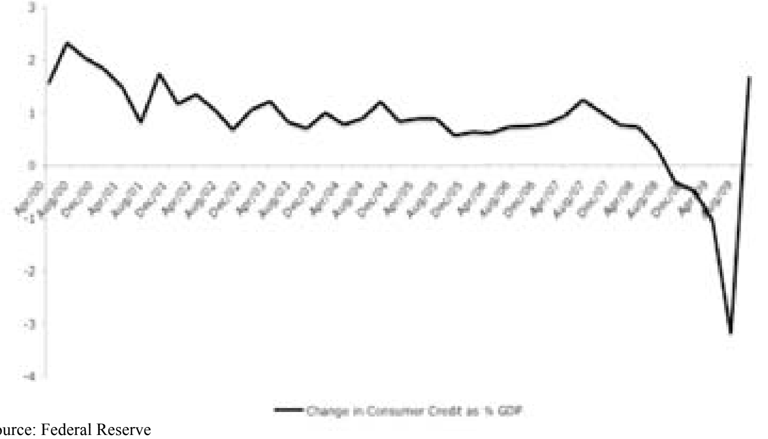
[18] Reinhart and Rogoff (2009) suggest that the general mood in the run-up to the financial crisis of the late 2000s was one of "this time is different", which I don't believe to be true, with the notable exception of the Fed perhaps.

[19] According to a revised estimate, home equity extraction in 2006 was $703 billion. In this paper we make use of the revised estimates.

From the FOMC transcripts in 2003 and 2004 emerges that the FOMC in general looked favorably upon home equity extraction as a source of personal consumption expenditure. In his Sandridge-lecture, Bernanke (2005) boasted of the depth and sophistication of the country's financial markets, which allowed households easy access to rising housing wealth. The fact that, in case the housing boom would go bust, many homeowners would end up ‘underwater’ (with home mortgage loans exceeding the value of the underlying property) apparently did not set off any alarm bells with Bernanke. At the end of 2009 almost 25 percent, or 11.4 million, of all residential properties with mortgages in the United States had negative equity. More than half of these underwater mortgages were the result of remortgaging, given the scale of refinancing/home equity extraction during the housing boom (see Figure 8).[20] Nor did Bernanke seem to appreciate the fact that the credit boom through home equity extraction left the financial sector severely exposed to the U.S. housing market, vulnerabilities that in 2008 turned a housing correction into a financial crisis and deep recession (Palumbo and Parker, 2009).[21]

In addition to home equity extraction, consumer credit rose as well in the years leading up to the financial crisis, albeit at a moderate pace of about 1 percent of GDP per year as many households used home loans to pay off credit card debt (Figure 11). Consumer credit includes credit card debt, car loans and personal loans.

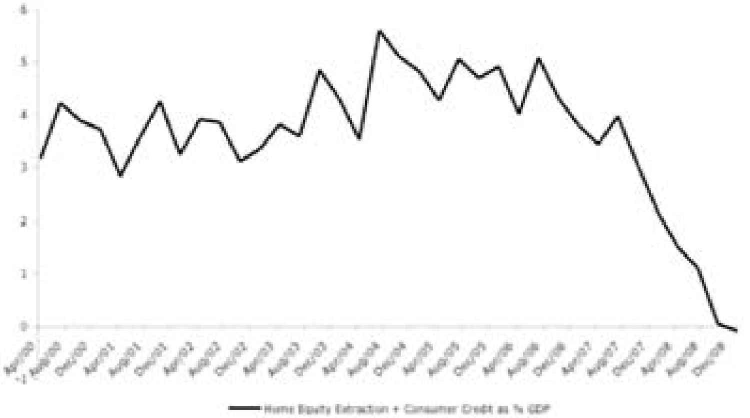
Figure 11 Change in consumer credit (% GDP)



Source: Federal Reserve

[20] Negative equity is being blamed for reduced labor mobility in the U.S., and there is preliminary evidence showing that negative equity is correlated with unemployment.
[21] Reinhart and Reinhart (2010) show that real per capita GDP growth rates are significantly lower and unemployment rates significantly higher during the decade following severe financial crises and the synchronous worldwide shocks.

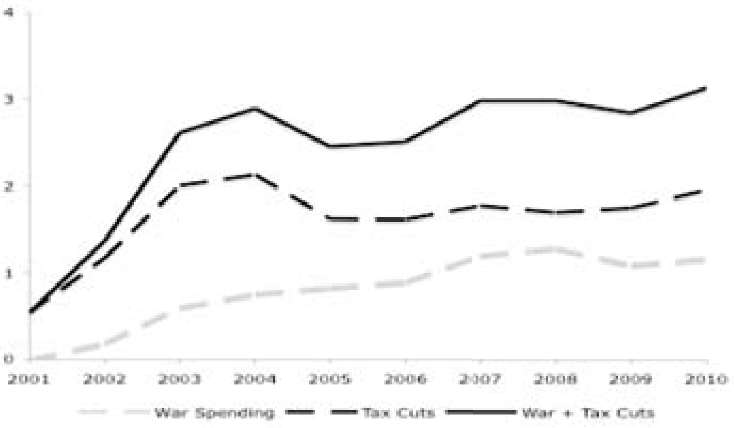
Figure 12 Spending out of consumer credit and home equity (% GDP)



Source: Federal Reserve

Beyond home equity extraction and consumer credit, the U.S. economy got stimulus from the Bush tax cuts, which transformed sovereign debt de facto into consumer credit, and from incremental government spending on two wars (Figure 13).[22]

Figure 13 Tax cuts and war spending (% GDP)



Source: Institute on Taxation and Economic Policy Tax Model, Congressional Research

Figure 14 shows that the overall stimulus from the 2002 and 2003 tax cuts, war spending, consumer credit and spending out of home equity extraction, ran well over 7 percent GDP early 2004. The fed funds rate at the time stood at 1 percent.

[22] During World War II the U.S. economy grew at a double-digit rate.

Figure 14 Overall stimulus (% GDP)

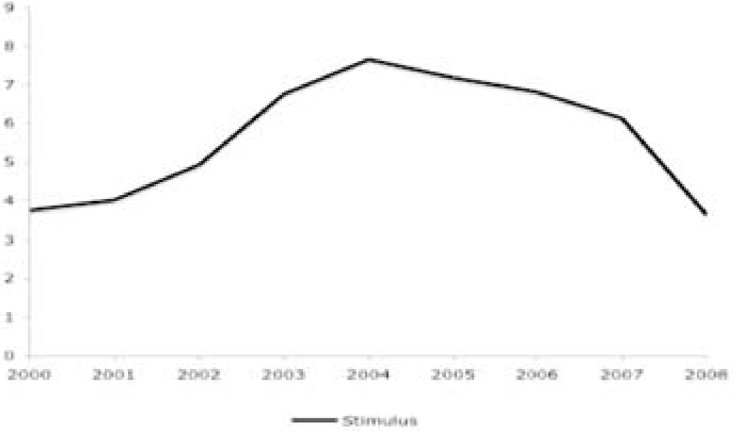
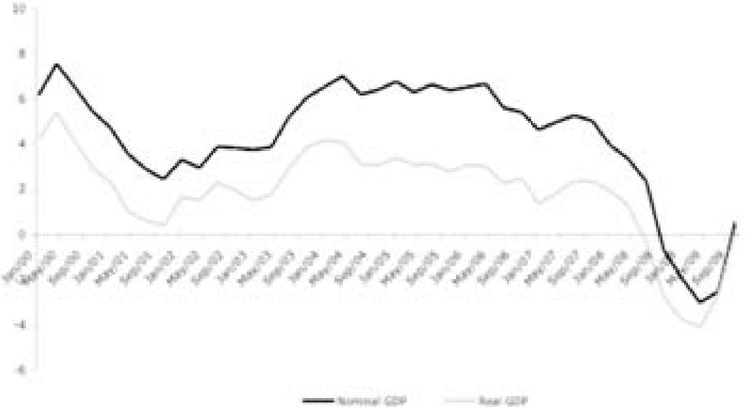
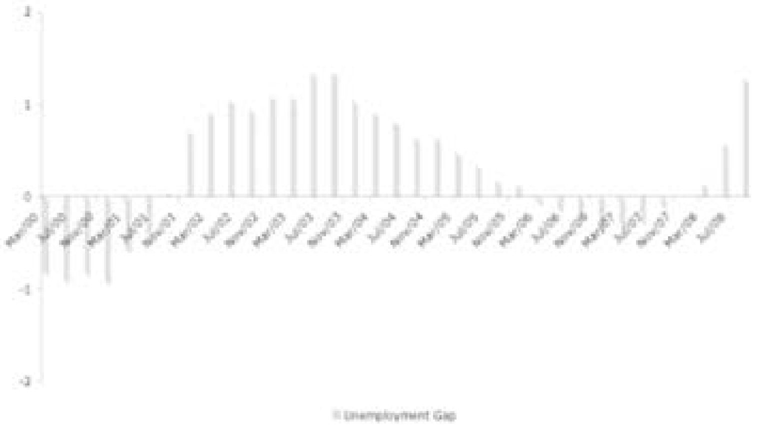


Figure 15 Nominal and real GDP growth (%)



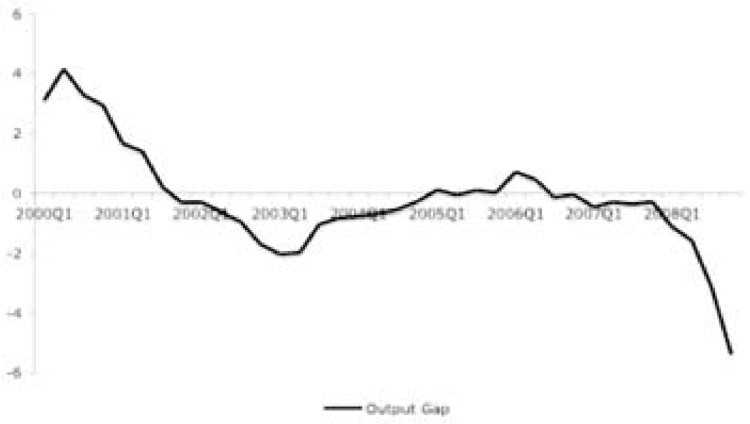
Source: Federal Reserve

Figure 16 The unemployment gap (%)



Source: Rudebusch (2009)

Figure 17 The output gap (%)



Source: CBO

The U.S. economy did not benefit much from the massive stimulus that was administered by various means in the early 2000s. The sum of tax cuts, war spending, consumer credit and spending out of home equity extraction was in the range of 4 to 8 percent of GDP from 2002 to 2008. As shown in Figure 15, nominal GDP growth was on average about two percentage points lower than the overall stimulus, even though the economy was operating below potential and experienced an unemployment gap and output gap during most of those years (Figure 16 and 17). As commodity prices spiked, real GDP growth declined from 4.1 percent in 2004Q1 to 1.3 percent in 2007Q1, despite the overall stimulus.

We apply a structural vector auto-regression (SVAR) model to estimate the dynamic effects of shocks in government spending, home equity withdrawal and taxes on economic activity in the United States. We use quarterly data from 1992Q1 – 2008Q4 since our data set on home equity withdrawal starts in 1992. A drawback of using quarterly data is that it is more likely that decisions on purchases take place in another quarter than when the actual outlays are done (Beetsma and Giuliodori, 2011). This raises the chance that the identified shocks are wrongly dated. Since we are mostly concerned with the question how much each stimulus contributed to actual GDP growth, and less with the exact timing, this objection appears surmountable.

First we look at the response of Y to G. The vector of endogenous variables that we use is X = [*G, Y, IRS, HEW*]′, where G is government spending, Y is real GDP seasonally adjusted, IRS is the fed funds rate, and HEW is home equity withdrawal. We put G first since we assume that within a quarter the government does not react to changes in output, which is also the identifying assumption chosen (and extensively explained) by Blanchard and Perotti (2002).[23]

The model can be described as:

$$\Delta X_t = A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + \cdots = A(L)\varepsilon_t,$$

where Δ is the first differences operator, $\varepsilon_t = [\varepsilon_{G,t}, \varepsilon_{Y,t}, \varepsilon_{IRS,t}, \varepsilon_{HEW,t}]'$, the shocks to the respective variables and

$$A(L) = \begin{pmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) & A_{14}(L) \\ A_{21}(L) & A_{22}(L) & A_{23}(L) & A_{24}(L) \\ A_{31}(L) & A_{32}(L) & A_{33}(L) & A_{34}(L) \\ A_{41}(L) & A_{42}(L) & A_{43}(L) & A_{44}(L) \end{pmatrix}$$

That G is not affected by changes in output or any of the other variables corresponds with:

$$A_{12}(L) = A_{13}(L) = A_{14}(L) = 0$$

As the first panel in figure 18 shows, real output has a negative response to G, which is in contrast with the findings of Blanchard and Perotti. Their results (sample 1960Q1 – 1997Q4) consistently show positive government spending shocks as having a positive effect on output.

Regarding the response of Y to HEW, it is important that HEW is a function of housing prices, which is reactive to economic and financial conditions.[24] We therefore position HEW last in our model [*G, Y, IRS, HEW*]. This ordering implies that Y is not allowed to react contemporaneously to HEW within the same quarter, which corresponds with

$$A_{23}(L) = A_{24}(L) = 0$$

The final restriction we have is that the fed funds rate is not affected by the HEW, which is translated in the model to

$$A_{34}(L) = 0$$

[23] In the model with endogenous variables [*G, Y, IRS and HEW*]′, Y also responds negatively to shocks in G, albeit it to a slightly smaller extent. See the variance decomposition of real output included in Appendix 1.

[24] HEW is not identical to mortgages for refinance as shown in paragraph 3 as HEW also includes home equity withdrawal resulting from the sale of a house.

As the second panel of Figure 18 shows, real output responds positively to HEW, making it the sole driver of economic activity. The home-improvement component of HEW, which amounts to about one third of total HEW, is obviously geared towards domestic goods and services. The variance decomposition is included in Appendix 1.

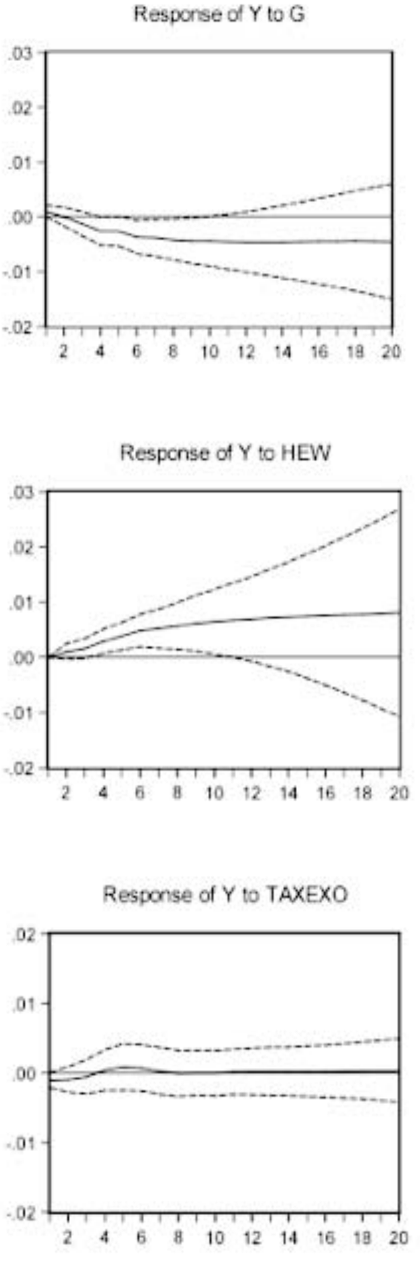
In order to look at the responses of Y to exogenous net taxes we add TAXEXO in the previous model and take away HEW to make the system more parsimonious (otherwise we have to estimate a five variable system which might be too much with 15 years of quarterly data). Again, TAXEXO is positioned first, which implies that TAXEXO is not affected within a quarter by G, Y and IRS. This is also the assumption taken by Romer and Romer (2010) who constructed the exogenous measure of taxation. Quite surprisingly, the response of output to exogenous tax changes, which include the Bush era tax cuts, is close to nil (see panel 3 in Figure 18). This is in contrast with Blanchard and Perotti (2002) who find that positive tax shocks have a negative effect.[25] Romer and Romer (2010), however, suggest that the Bush era tax cuts are an outlier in terms of their effect on real output. Excluding the 2001 and 2003 Bush tax cuts (jointly) from Romer and Romer's sample substantially increases the negative impact of a tax change.

In order to look at the response of economic activity in China to shocks in the United States, we include quarterly real GDP growth in China, seasonally adjusted, in the structural VAR. The vector of endogenous variables we use is [*G*, *Y*, *IRS*, *HEW*, *Y_China_SA*]′, where G is government spending, Y is real GDP seasonally adjusted, IRS is the fed funds rate, HEW is home equity withdrawal and Y_China_SA is real China GDP seasonally adjusted. The first panel of Figure 19 shows that real economic activity in China responds positively to a shock in G. Real economic activity in China also responds positively to a shock in HEW during the first 16 quarters, as shown in the second panel. In order to determine the response of economic activity in China to a shock in taxes in the United States, we include TAXEXO and again drop HEW to make the system more parsimonious. The vector of endogenous variables then becomes [*TAXEXO*, *G*, *Y*, *IRS*, *Y_China_SA*]. In the third panel of Figure 19 we see that economic activity in China responds positively to a negative shock in exogenous taxes in the United States, although the effect is rather limited. The variance decomposition are included in Appendix 1.

Our findings regarding economic activity in China must be considered <u>preliminary</u>. The response of economic activity in China to U.S. shocks will be the subject of a forthcoming paper.

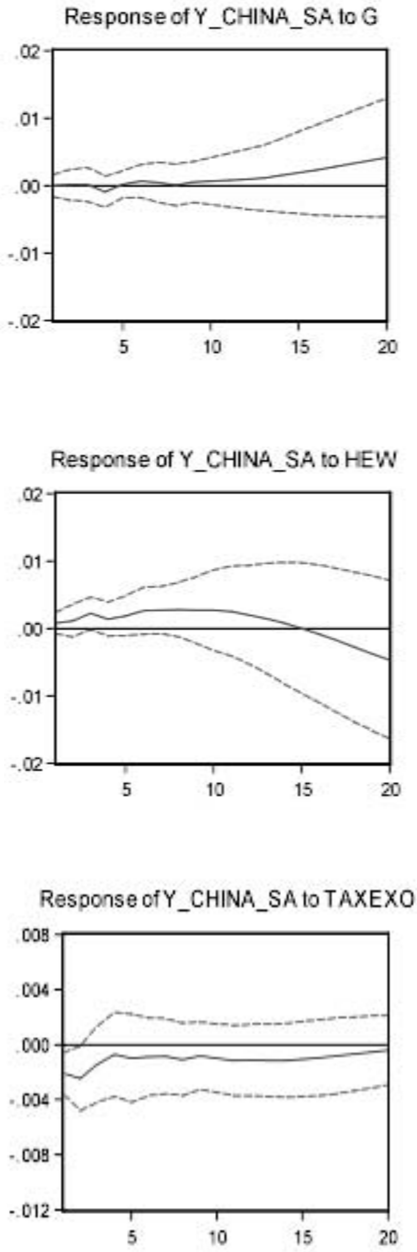
[25] The Bush era tax cuts are obviously not included in Blanchard and Perotti's sample, which runs from 1960Q1 – 1997Q4.

Figure 18 Baseline with G, Y, IRS and HEW (1992Q1 – 2008Q4) in panel 1 and 2
Baseline with TAXEXO, G, Y and IRS (1992Q1 – 2007Q4) in panel 3[26]



[26] Response to Cholesky One S.D Innovations ± 2 S.E.

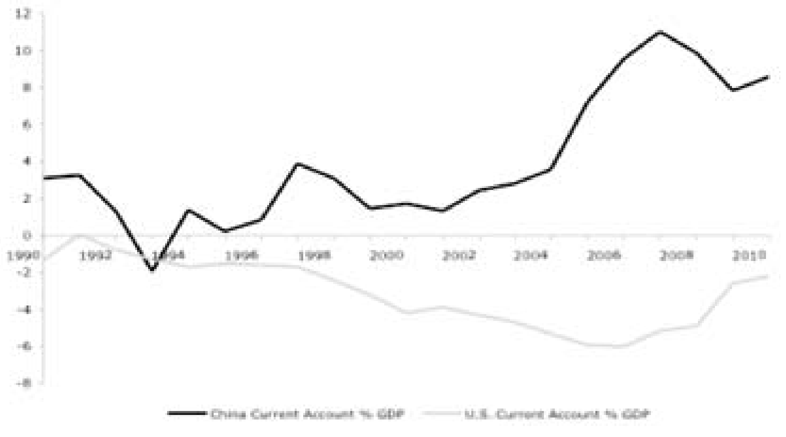
Figure 19 Baseline with G, Y, IRS, HEW and Y_China_SA (1992Q1 – 2008Q4) in panel 1 and 2
Baseline with TAXEXO, G, Y, IRS and Y_China_SA (1992Q1 – 2007Q4) in panel 3[26]



5. China's Current Account, GDP Growth and Savings Rate

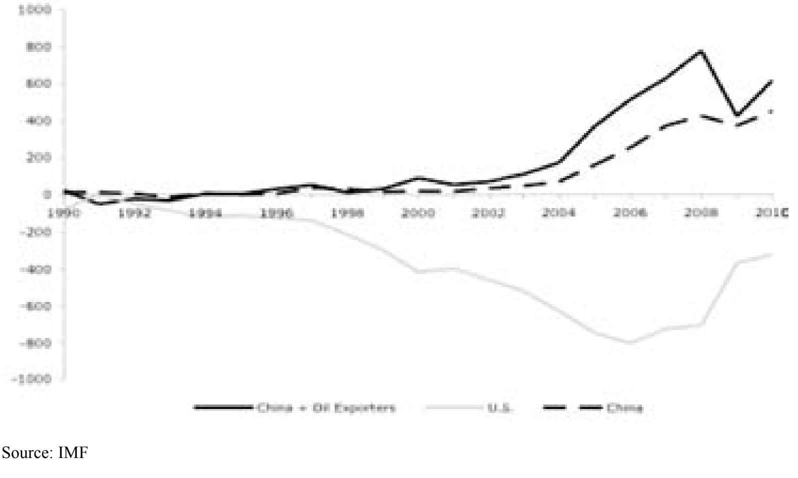
If economic activity in the United States did not get a huge boost from the Bush era tax cuts, the spending out of home equity withdrawal, consumer credit and the spending two wars the United States was involved in, then who did? The rather unsurprising answer is China (as figure 19 also suggests) and the oil-exporting nations. Between 2001 and 2006 the bilateral trade deficit between the United States and China tripled (see Figure 20 and 21). China's double-digit economic growth was accompanied by an increase in China's savings rate (see Figure 22 and 23).

Figure 20 U.S. and China's current account balance (% GDP)



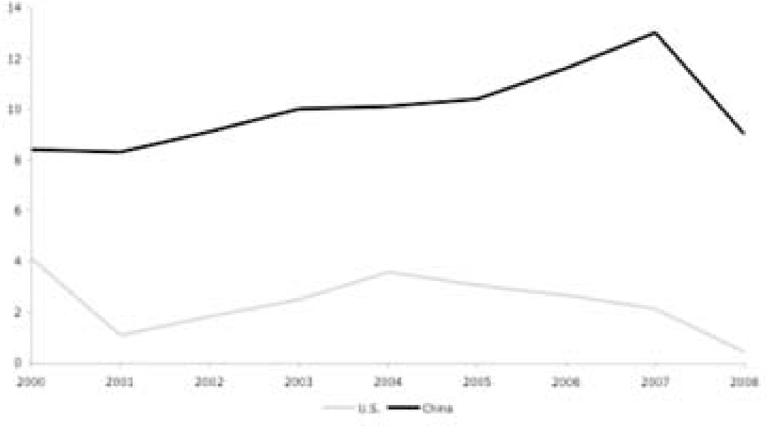
Source: IMF

Figure 21 U.S., China and oil-Exporters' current account (billion U.S. dollars)



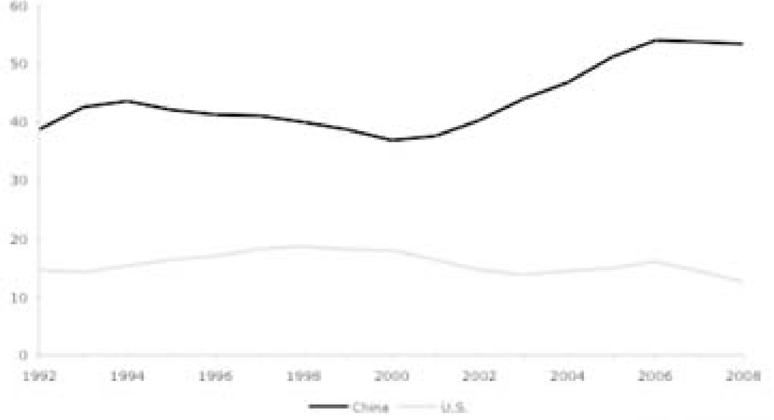
Source: IMF

Figure 22 U.S. and China real GDP growth (%)



Source: IMF

Figure 23 U.S. and China savings rate (% GDP)

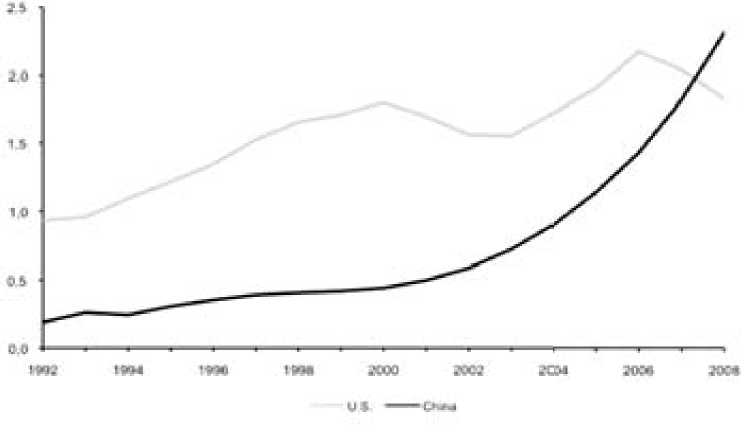


Source: IMF, World Bank

In 2006 China's savings rate hit 55 percent of GDP. According to Louis Kuijs (2006), China's savings rate is much higher than what would be expected on the basis of the country's characteristics. While the household savings rate increased from 17 percent in 1995 to 27 percent in 2008, household savings declined as a percentage of national income, mainly because of a fall in the share of household income in national income (Chamon and Prasad, 2008). At 16 percent of GDP household saving in China is, though significantly higher than in OECD countries, less than in India. Rather, China's high savings rate is due to unusually high enterprise and government saving. Rising enterprise savings can account in full for the increase in saving in the 2000s. The increase in enterprise savings in the last 10 years is associated with a steady rise in the profits and profitability of enterprises.

In a paper for the Conference Board, Pieter Bottelier and Gail Fosler (2007) show that the profitability of enterprises in China in the 2000s is mainly driven by a strong productivity growth of about 6 percent per year, especially in the manufacturing sector. There is no equivalent rise in labor costs, which is conform Arthur Lewis' prediction in "Economic Development with Unlimited Supplies of Labor" (1954).[27] Retained earnings in China rose between 2000 and 2005 by an estimated 5 percentage points from 15 percent of GDP to around 20 percent of GDP. Weak corporate governance structures and underdeveloped financial markets are often cited as reasons that in China few dividends get distributed (Kuijs, 2006).

Figure 24 U.S. and China savings (trillion U.S. dollars)



Source: IMF, World Bank Estimates

[27] The role of the renminbi and its (under)valuation fall outside the scope of our paper.

6. The Interest Conundrum

In 2010 more than 40 percent of global GDP resided in jurisdictions running fiscal deficits of 10 per cent of GDP or more, overwhelmingly in the advanced economies (Buiter, 2010). In spite of the explosion of sovereign debt, long-term interest rates were declining instead of rising.[28] The flailing economic recovery and dim inflation expectations in 2010 and 2011 surely accounted in part for the exceptionally low yields. However, the vast and continuous demand for fixed income assets seems also to be part of the equation.[29]

On February 16, 2005, the then Chairman of the Federal Reserve Alan Greenspan, in his testimony before the Committee on Banking, Housing, and Urban Affairs in the U.S. Senate, said: "(…) the broadly unanticipated behavior of world bond markets remains a conundrum." In a speech to the International Monetary Conference in Beijing (via satellite) on June 6, 2005, Greenspan elaborated further on the interest conundrum: "The pronounced decline in U.S. Treasury long-term interest rates over the past year despite a 200-basis-point increase in our fed funds rate is clearly without recent precedent. (…) The unusual behavior of long-term rates first became apparent almost a year ago."

According to Greenspan (2010), the failure in 2004 and 2005 of the 400 basis point rise in the funds rate to carry the yield on the 10-year Treasury note along with it (as it historically almost invariably did), dramatically changed the long held view that U.S. long-term interest rates were significantly influenced, if not largely determined, by monetary policy (see Figure 25 and 26). The correlation coefficient in the United States between the fed funds rate and the 30-year mortgage rate from 1963 to 2002 had been a tight 0.83. In the early 2000s, however, the 30-year mortgage rate clearly delinked from the fed funds rate with the correlation between the funds rate and the 30-year mortgage rate falling to an insignificant 0.17 during the years 2002 to 2005.

The correlation between the fed funds rate and the 10-year Treasury yield was 0.87 from 1982 to 2001 and fell to an insignificant 0.24 during the years 2002 to 2005. From 2002 – 2008 the correlation was at 0.51 still much smaller than during the period dubbed the Great Moderation.

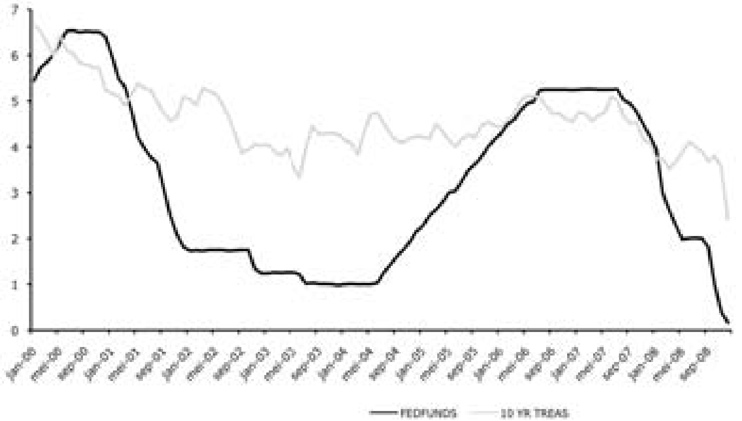
In the United Kingdom we see a similar decoupling of the monetary policy rate and long-term interest rates. The correlation between the Bank Rate (the monetary policy rate of the Bank of England) and the yield on 10-year Gilts was 0.79 from 1982 – 2001 and 0.30 from 2002 – 2008. In Germany the correlation between the discount rate and the yield on 10-year Bunds was 0.61 from 1982 – 2001.[30] Both the reunification of East and West Germany in 1990 and the introduction of the single currency impacted the term structure during this period.[31] From 2002 – 2008 the correlation between the European Central Bank's monetary policy rate (the so-called Main Refinancing Minimum Bid Rate) and the yield on 10-year Bunds was 0.40.

[28] Only countries facing immediate risk of default, like those in the eurozone periphery in the first half of 2010, have seen a steep rise in treasury yields.
[29] The German economy grew quite robust and still the yield on 10-year Bunds was at a historical low in 2010 and 2011.
[30] We used the discount rate plus 0.50 percent and the ECB's monetary policy rate from 1999 M1 on. Use of the repo-rate of the Bundesbank yields a similar result.
[31] The discount rate went from 4 percent in early 1989 to 8.75 percent in the summer of 1992 to choke off the additional demand created by spending on East Germany while long-term rates remained relatively low. In the second half of the 1990s the forthcoming introduction of the euro seems to have lifted long-term rates in Germany.

Figure 25 Fed funds rate and the yield on the 10-year Treasury (%)

Source: Federal Reserve

Figure 26 Close-up of the conundrum (%)



Source: Federal Reserve

Ben Bernanke, who was Fed governor at the time, in March 2005 advanced in the Sandridge lecture the theory of a global saving glut. He argued that there was an excess of world savings – a global saving glut – and that the United States was the consumer of last resort. Both Taylor (2008) and Obstfeld and Rogoff (2009) have pointed out that the global savings rate – that is world savings as a fraction of world GDP – was actually low in the 2002 – 2004 period.[32] According to Obstfeld and Rogoff the increase in global saving plays out largely after 2004.

[32] Smith and Taylor (2009) have an alternative theory for the interest conundrum, deriving a formula that links the coefficients of the monetary policy rule for the short-term interest rate to the coefficients of the implied affine equations for long-term interest rates. They show that an increase in the coefficients in the monetary policy rule will lead to an increase in the coefficients in the affine equations.

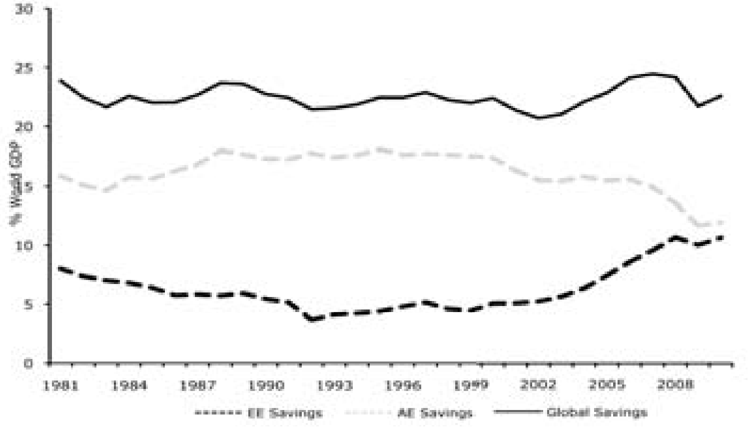
By focusing on the global savings rate as a fraction of world GDP, Taylor, Obstfeld and Rogoff overlook the changing composition of world savings. In 2000 advanced economies accounted for 78 percent of global savings. By 2008 the share of emerging economies in global savings had doubled to 44 percent, while advanced economies accounted for a mere 56 percent of global savings (see Figure 27).[33]

Emerging economies' savings have been heavily skewed towards fixed-income assets, either because emerging economies' investors are genuinely more risk averse, and/or because they are institutionally constrained to invest in equity capital. Institutional constraints include emerging economies' underdeveloped financial markets and the reluctance of most Western countries to allow emerging economies' sovereign wealth funds to invest in equity capital of Western companies. Of China's holdings of U.S. dollar assets, for instance, a mere 7 percent is invested in equities (Setser, 2008). Daley and Broadbent (2009) point out that the 2000s saw a sharp increase in the global return on physical capital and a rise in the yield on quoted equity, which can only be explained by emerging economies' portfolio 'preferences.'

We see total debt securities outstanding rising at a higher rate from 2002 onward, despite the fact that the global savings rate was relatively low at the time (see Figure 28). It corroborates Greenspan's statement in June 2005 that "the unusual behavior of long-term rates first became apparent almost a year ago" (Greenspan, 2005).

The data on total debt securities outstanding are compiled by adding up domestic and international debt securities as reported by the Bank of International Settlements (BIS). Though there may exist some overlap and inconsistencies between both datasets, according to BIS-staff it is save to assume that the overestimation is minimal and that any overlap in the data on domestic and international debt securities would result in a similar error over time, so the data should reflect the trend correctly.

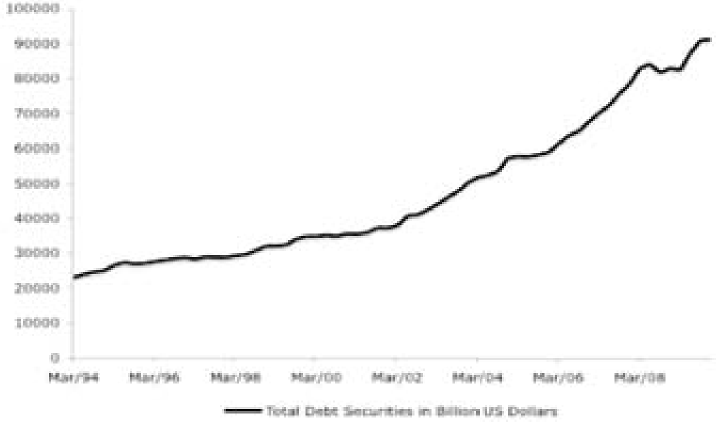
Figure 27 Advanced, emerging economies and global savings (% world GDP)



Source: IMF

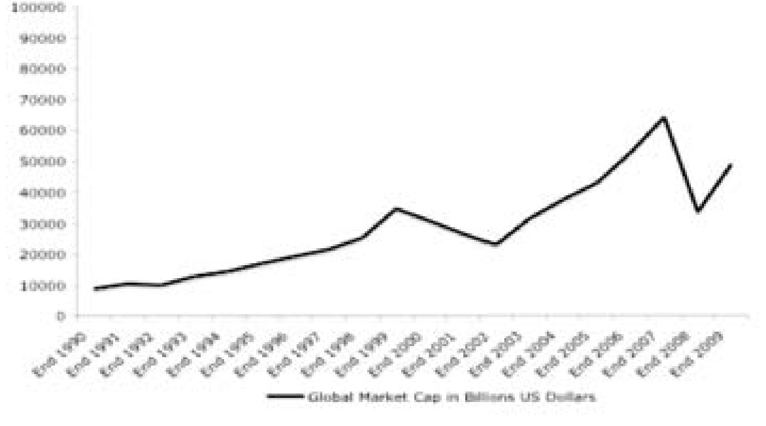
[33] Emerging economies includes developing economies.

Figure 28 Total debt securities outstanding (billion U.S. dollars)



Source: Bank of International Settlements

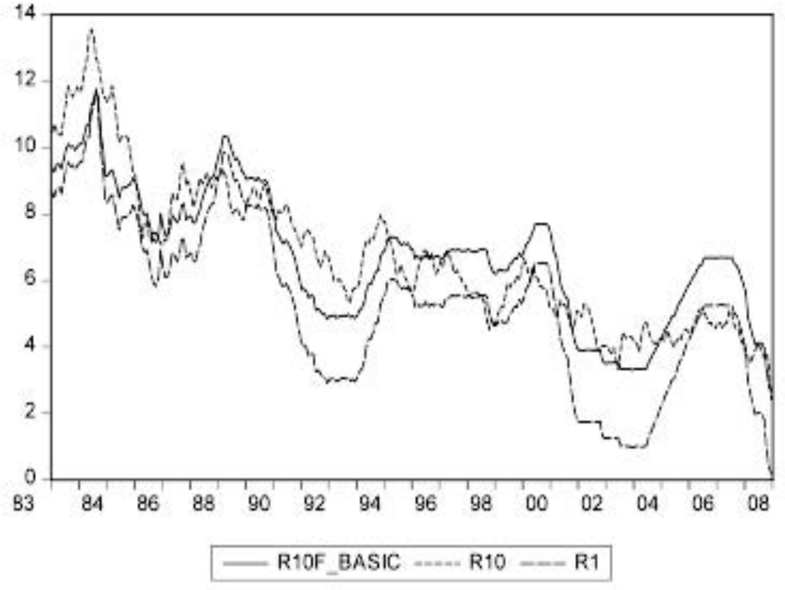
Figure 29 Global market capitalization of stock exchanges (billion U.S. dollars)



Source: World Federation of Exchanges

According to Alan Greenspan (2010), the FOMC in the early 2000s assumed that "the term premium was a relatively stable, independent variable (…) as it had been through the latter part of the 20th century." This can be stylized in a straightforward level model (affine term structure), wherein the 10-year Treasury equals the fed funds rate plus a constant.

MODEL I 10-YEAR TREASURY = C + α FED FUNDS



From 1983 M1 – 2008 M12 the relationship between the 10-year Treasury and the fed funds rate is significant at the 1 percent level. The fed funds rate explains 74 percent of the 10-year Treasury. The same model applied to two sub-samples, shows that the impact of the fed funds rate on the 10-year Treasury is much larger, with a coefficient α of 0.83, in the period from 1983 M1 – 2001 M12 than in the period from 2002 M1 – 2008 M12, when the coefficient α is a mere 0.15. The R^2 is 0.67 in the period from 1983 – 2001 versus a mere 0.26 in the period from 2002 – 2008, supporting Greenspan's conundrum claim (the full output tables are included in the appendix).[34]

This basic model, on which Greenspan based his expectations, shows that from 2001 – 2003 the yield on the 10-year Treasury note, though declining, was actually higher than was to be expected given the fed funds rate.[35] This would be consistent with the low rate of global saving at the time and a minimal increase in global debt securities outstanding from 2001 – 2003. That long-term interest rates remained relatively high in the early 2000s after the FOMC had cut the federal funds interest rate 13 times was also the perception at the time. In a *New York Times*-column "Eleven And Counting" on December 14, 2001 Paul Krugman complained that the Fed was getting little 'bang for its bucks' as long-term interest rates weren't coming down.

The transcript of the FOMC meeting on 16 September 2003 includes the following excerpt (emphasis ours):

> **The Committee may be especially inclined to keep policy unchanged**, at least for now, if it thinks that there are other sources of impetus to economic growth that may make it difficult to restrain

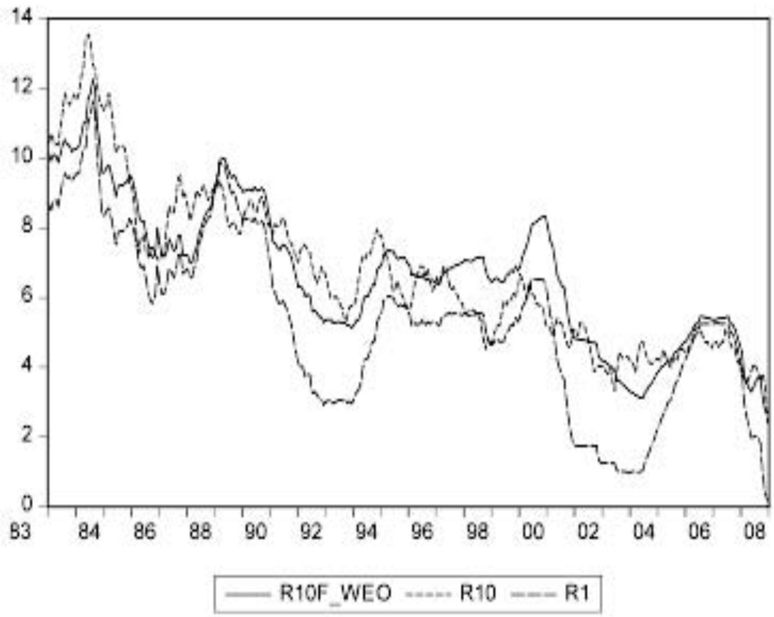
[34] We adjusted for autocorrelation using Newey-West HAC Standard Errors & Covariance.
[35] The notable exception was in the run-up to the June 24-25, 2003 FOMC-meeting when the financial markets expected the FOMC to cut the fed funds rate by more than 25 basis points.

inflation to its current pace. In particular, as shown in the middle panel, **the term structure of nominal yields is unusually steeply sloped, at least by the experience of the past twenty-five years**.

In addition to the often cited deflation-scare (Rudebusch, 2006; Bernanke, 2010), the fact that long-term interest rates weren't coming down as much as expected was a reason for the FOMC to keep the fed funds rate at 1 percent for an extended period of time, thereby setting the stage for the subsequent interest conundrum.

By adding the global savings rate to the basic model, we are better able to explain the 10-year Treasury rate. The R^2 in MODEL II for the period 1983 – 2008 is 80 percent (compared to 74 percent in MODEL I). The same model applied to two samples, shows that the global savings rate is not significant in the period from 1983 – 2001. From 2002 – 2008 the global savings rate is significant at the 5 percent level and the R^2 is 0.44 (compared to 0.26 in Model I).

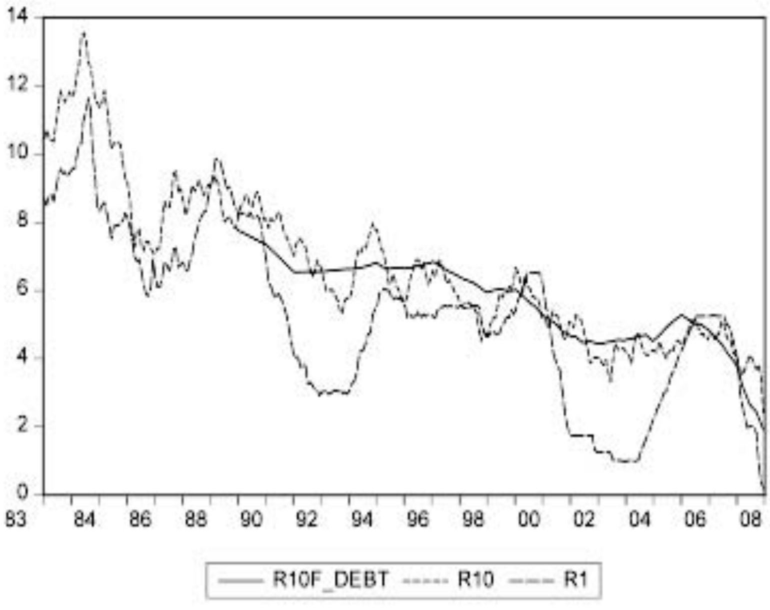
MODEL II 10-YEAR TREASURY = C + α FED FUNDS + β GLOBAL SAVINGS RATE



Adding debt securities, which reflects not only the increase in global savings but also the change in composition, instead of the global savings rate, to the basic model results in an R^2 of 0.79 for the 1989M12 – 2008M12 period.[36] Judging by the sum of the squared residuals (SSR), MODEL III provides a much better fit than MODEL I or MODEL II. Debt securities is statistically significant at the 1 percent level both in samples 1 and 2. The R^2 is 0.74 in 1989M12 – 2001M12 (compared to 0.26 in MODEL I and 0.27). The R^2 is 0.52 in 2002M01 – 2008M12 (compared to 0.26 in MODEL I and 0.44 in MODEL II).

[36] Data on total debt securities outstanding are only available starting in 1989.

MODEL III 10-YEAR TREASURY = C + α FED FUNDS + δ DEBT SECURITIES



Adding both debt securities and the global savings rate to the basic model, improves the fit further to 84 percent (80 and 53 percent respectively for sample 1 and 2). The coefficient for the global savings rate turns positive, however, suggesting that the model uses the global savings rate as a proxy for factors that have not been included in the model, such as inflation expectations.[37] We therefore won't give this model further consideration.

Table 9 and 10 present a recapitulation of the output of MODEL I – III. The full output tables for MODEL I - III can be found in Appendix 2. In the 1st column of table 9 all observations available are used for the estimations, which means that MODEL I AND II begin in 1983M1 and model III begins in 1989M1. The 2nd and 3rd column show sub-samples of column 1. Since a larger sample size generally leads to a better fit, we also run MODEL I - II with the same sample size as MODEL III beginning in 1989M1 (see Table 10).[38]

[37] The global savings rate is insignificant in sample 1 and 2.
[38] The 3rd column in Table 9 and 10 and the corresponding output tables in the Appendix are identical.

Table 9 Recapitulation of output with different sample sizes

	1983M1/89M12-2008M12*		1983M1/89M12-2001M12*		2002M1-2008M12	
	R^2	SSR0	R^2	SSR1	R^2	SSR2
I	0.737430	433.9901	0.674940	310.7148	0.261749	14.95703
II	0.796248	336.7728	0.687246	298.9520	0.440086	11.34390
III	0.785274	93.70908	0.746084	42.76092	0.529646	9.529415

* Model I and II begin in 1983M1, model III begins in 1989M12

Table 10 Recapitulation of output with same sample sizes

	1989M12-2008M1		1989M12-2001M12		2002M1-2008M12	
	R^2	SSR0	R^2	SSR1	R^2	SSR2
I	0.497034	219.5002	0.255793	125.3287	0.261749	14.95703
II	0.629883	161.5234	0.273669	122.3183	0.440086	11.34390
III	0.785274	93.70908	0.746084	42.76092	0.529646	9.529415

An econometric issue that needs to be addressed is whether the variables are stationary. The augmented Dickey-Fuller (ADF) test indicates that both the fed funds rate and debt securities may have a unit root, and therefore be non-stationary. Wu and Zhang (1997), however, show that due to sample size ADF-tests often indicate interest rates to be non-stationary while they are in fact stationary. We assume that here to be the case with regard to the fed funds rate as well.[39, 40]

With regard to debt securities it is important in our static model that we can think of total debt securities as exogenous. The share of U.S. debt securities – which is most likely to be affected by the 10-year Treasury yield – in total debt securities has been falling steadily from 18 percent in 1989 to 8 percent 2009. It's not evident that portfolio decisions in the rest of the world to invest in domestic debt securities are triggered by the U.S. Treasury yield. Firstly, at the time U.S. debt securities were still a relatively large share of total debt securities, financial markets had not yet been liberalized. Secondly, the 10-year Treasury yield has not been very indicative for the yield on foreign governments' bonds. Lastly, the drifting lower of (real) interest rates during the past two decades coincides with an increasing appetite for debt securities, which suggests that causality runs from the latter to the former, and not the other way around.

Warnock and Warnock (2009), using data on foreign capital flows until and including May 2005, conclude that foreign purchases of U.S. government bonds have an economically large and statistically significant impact on the U.S. Treasury yield.[41] They find that foreign purchases of U.S. government bonds have a similar impact on other interest rates such as corporate bond yields and 30-year mortgage rates, which suggests that the increase in foreign purchases of U.S. government bonds is rather a manifestation of a broader phenomenon, namely the global saving glut.

We performed an OLS-regression identical to the one in Warnock and Warnock (2009), which includes inflation expectations, interest rate risk premium, expected real GDP growth and the structural budget deficit. We find that debt securities explains the 10-year Treasury yield considerably better than foreign purchases of U.S. government bonds (see Table 11).

[39] Also, from an economic-theoretical perspective it should not be possible for interest rates to be non-stationary (Van Dijck, 2012).
[40] In Table 1 the fed funds rate (1990Q1 – 2008Q2) is actually stationary but that may be due to small sample size.
[41] Sack (2004) and Rudebusch et.al. (2006) find that foreign capital flows had only a small or no impact on U.S. long-term rates. They made however use of a partial measure of foreign flows from the FRBNY. Warnock and Warnock (2009) use an estimate of total foreign capital flows (see also Bertaut and Tryon, 2007)

Table 11 Model of the 10-year Treasury yield[42]

	(1)		(2)		(3)	
π^E_{T+10}	0.733***	(22.50)	0.619***	(18.60)	0.608***	(17.42)
$\pi^E_{T+1} - \pi^E_{T+10}$	0.055	(0.27)	–0.033	(–0.15)	0.070	(0.29)
rp_t	2.262	(1.49)	0.855	(0.50)	–0.286	(–0.16)
y^e_{t+1}	0.218***	(2.90)	–0.039	(–0.52)	–0.044	(–0.54)
$i_{t,3m}$	0.267		0.381		0.399	
deficit $_{t-1}$	–0.037	(–1.24)	–0.213***	(–7.52)	–0.205***	(–7.09)
debt $_t$	–4.00E-05***	(–9.26)				
foreign $_t$			–0.180***	(–5.37)		
foreign off $_t$					–0.230***	(–2.79)
observations	186		186		186	
r-squared	0.912		0.889		0.877	

This table presents the results of OLS regressions explaining the 10-year Treasury yield using domestic variables and total debt securities outstanding. The specification is as follows:

$$i_{t,10} = a + b\pi^e_{t+10}\,(1 - b)i_{t,3m} + c(\pi^e_{t+1} - \pi^e_{t+10}) + d(rp_t) + e(y^e_{t+1}) + f(deficit_{t-1}) + g(debt_t) + \varepsilon_t$$

where $i_{t,10}$ is the nominal 10-year Treasury yield, $\pi^e_{t+1} - \pi^e_{t+10}$ are 10-year- and 1-year-ahead inflation expectations; $i_{t,3m}$ is the 3-month Eurodollar rate; rp_t is an interest rate risk premium; y^e_{t+1} is expected real GDP growth over the next year; $deficit_{t-1}$ is the structural budget deficit (scaled by lagged GDP); $debt_t$ is total debt securities and $foreign_t$ is 12-month aggregate foreign flows into U.S. Treasury and agency bonds. Column 2 and 3 include total foreign flows ($foreign_t$) and official foreign flows ($foreign\_off_t$), respectively, instead of total debt securities. Short-term expectations of future output and inflation are from the Blue Chip survey. Long-term inflation expectations are from the Philadelphia Fed's Survey of Professional Forecasters. In all columns, t-statistics, computed using standard errors that are robust to heteroskedasticity and serial correlation, are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Constants are included but not reported. The sample is monthly from 1989 M12 to 2005 M5.

Our findings are consistent with recent research into the effectiveness of the Fed's quantitative easing or asset purchase programs, which shows that the impact of the Fed's asset purchase programs is determined primarily by the quantity of securities that the Federal Reserve holds, measured in U.S. dollars, rather than by the pace of new purchases. In other words, it is stock rather than flows that explain the 10-year Treasury rate ((Gagnon 2010 and Krishnamurthy 2011).[43] This implies that there is no actual "financial balance of terror" as Larry Summers suggested. After all, if China or Japan were to cease buying U.S. government bonds other investors would step in, drawn by rising bond yields. [44]

Our data show that in the early 2000s U.S. long-term interest rates largely delinked from the Fed's monetary policy. We see a similar outcome in the U.K., and to a lesser extent in Germany, where the term structure was not as stable to begin with. Total debt securities outstanding, instead of foreign flows into U.S. Treasury and agency bonds, can explain the interest conundrum in the United States.

[42] The ADF-test indicates that in Warnock and Warnock's OLS-regression most variables (short-term interest rates, GDP, the budget deficit, the volatility of the 10-year interest rate as well as foreign purchases of U.S. government bonds) may contain a unit root. For a discussion of the implications we refer to Warnock and Warnock (2009).

[43] Since Operation Twist does not affect the quantity of Treasuries that the Fed holds, but only (the composition of) its maturity, Operation Twist may be effective only in as far as long-term and short-term Treasuries are not perfect substitutes.

[44] It does, however, not preclude 'sovereign risk', i.e. that the market suddenly perceives the debt of a sovereign as 'risky', perceptions that may in part be driven by Keynesian 'animal spirits'.

7. Conclusion

When the dot-com bubble burst by the end of 2000, the FOMC started cutting the fed funds rate – 13 times in total – until it reached 1 percent in June 2003. Though the FOMC stuck to a monetary policy rule similar to the classic Taylor rule using inflation forecasts instead of current values, it did change the preferred measure of inflation twice in the early 2000s without a countervailing change in the parameters, thereby effectively loosening the rule.

We show that the Fed's easy monetary policy did not trigger so much the housing boom, as asserted by John Taylor, but rather the refinancing boom and ensuing spending spree. Contrary to popular belief, the housing boom had little to do with the proliferation of exotic mortgage products. The decline in long-term interest rates accounts mostly for the housing boom.

The Fed's easy monetary stance, together with the Bush tax cuts and the spending on the wars in Iraq and Afghanistan, did not boost the U.S. economy to the extent that might have been expected from such a massive stimulus at a time when the economy was operating below potential. Instead, China and oil-exporting nations reaped most of the fruits of U.S. spending. These countries invested a major part of the proceeds in fixed income assets, resulting in – what Alan Greenspan dubbed – the interest conundrum.

Our data demonstrate that in the early 2000s U.S. long-term interest rates largely delinked from the Fed's monetary policy. At first, in 2001 – 2003, interest rates did not come down as much as was to be expected based on the experience in the past two decades. Subsequently, in 2004 – 2005, the 200-basis point rise in the fed funds rate failed to lift long-term interest rates. Our model shows that the increase in total debt securities outstanding accounts for the interest conundrum in the United States.

References:

Bean, Charles, Matthias Paustian, Adrian Penalver and Tim Taylor (2010), “Monetary Policy after the Fall,” http://www.bankofengland.co.uk/publications/speeches/2010/speech444.pdf.

Beetsma, Roel and Massimo Giuliodori (2011), "The Effects of Government Purchases Shocks: Review and Estimates for the EU," *The Economic Journal*, Vol. 121 (550), F4-F32, 2011.

Bernanke, Ben, and Michael Woodford (1997), “Inflation Forecasts and Monetary Policy.” *Journal of Money, Credit, and Banking*, Vol. 29, no. 4, part 2, (November 1997): pp. 653-684.

Bernanke, Ben S. (2002), “Asset-Price "Bubbles" and Monetary Policy,” http://www.federalreserve.gov/boarddocs/speeches/2002/20021015/default.htm.

Bernanke, Ben S. (2002), “Deflation: Making Sure "It" Doesn't Happen Here,” http://www.federalreserve.gov/BOARDDOCS/SPEECHES/2002/20021121/default.htm.

Bernanke, Ben S. (2005), “The Global Saving Glut and the U.S. Current Account Deficit,” The Sandridge Lecture, http://www.federalreserve.gov/boarddocs/speeches/2005/200503102/default.htm.

Bernanke, Ben S. (2010), “Monetary Policy and the Housing Bubble,” http://www.federalreserve.gov/newsevents/speech/bernanke20100103a.htm.

Bertaut, Carol, Tryon, Ralph W. (2007), “Monthly Estimates of U.S. Cross-Border Securities Positions. Federal Reserve International Finance,” Discussion Paper 910.

Blanchard, O. and Perotti, R. (2002). ‘An empirical characterisation of the dynamic effects of changes in government spending and taxes on output’, *Quarterly Journal of Economics*, vol. 117, pp. 1329-1368.

Bottelier, Pieter and Gail Fosler (2007), “Can China’s Growth Trajectory Be Sustained?,” The Conference Board.

Brunnermeier, Markus K. and Christian Julliard (2006), Money Illusion and Housing Frenzies, http://www.econ.berkeley.edu/~webfac/malmendier/e218_sp06/Brunnermeier.pdf.

Buiter, Willem H. (2008), “Central Banks and Financial Crises,” http://www.kansascityfed.org/publicat/sympos/2008/Buiter.08.16.08.pdf.

Chamon, Marcos and Eswar Prasad (2008), “Why Are Savings rates of Urban Households in China Rising?,” Brookings Institute, Working Paper 31.

Daly, Kevin and Ben Broadbent (2009), "The Savings Glut, the Return on Capital and the Rise in Risk Aversion," Goldman Sachs Global Economics Paper No: 185.

Dollar, David and Aart Kraay (2006), "Neither a Borrower Nor a Lender: Does China's Zero Net Foreign Asset Position Make Economic Sense?," World Bank Policy Research Working Paper 3801.

Gagnon, Joseph, Matthew Raskin, Julie Remache and Brian Sack (2010), "Large-Scale Asset Purchases by the Federal Reserve: Did They Work?," http://www.ny.frb.org/research/staff_reports/sr441.pdf.

Greenspan, Alan (2002), "Economic volatility," http://www.federalreserve.gov/boarddocs/speeches/2002/20020830/default.htm.

Greenspan, Alan (2005), Central Bank panel discussion - To the International Monetary Conference, Beijing, People's Republic of China (via satellite), http://www.federalreserve.gov/boarddocs/speeches/2005/20050606/default.htm.

Greenspan, Alan and James Kennedy (2007), "Sources and Uses of Equity Extracted from Homes," http://www.federalreserve.gov/pubs/feds/2007/200720/200720pap.pdf.

Greenspan, Alan (2010), "The Crisis," http://www.brookings.edu/~/media/Files/Programs/ES/BPEA/2010_spring_bpea_papers/spring2010_greenspan.pdf.

Krishnamurthy, Arvind and Annette Vissing-Jorgensen (2011), "The Effects of Quantitative Easing on Interest Rates," http://www.kellogg.northwestern.edu/faculty/vissing/htm/qe_paper.pdf.

Krugman, Paul (2007), "Will there be a dollar crisis?," *Economic Policy*, July 2007 pp. 435–467.

Lewis, Arthur W. (1954), "Economic Development with Unlimited Supplies of Labour," http://www.globelicsacademy.net/2008/2008_lectures/lewis%20unlimited%20labor%20supply%201954.pdf.

Koo, Richard C. (2009), *The Holy Grail of Macroeconomics: Lessons from Japan's Great Recession*, John Wiley & Sons, 2009.

Kuijs, Louis (2006), "How Will China's Saving-Investment Balance Evolve?," World Bank Policy Research Working Paper 3958, July 2006.

Lindsey, David E., Athanasios Orphanides and Volker Wieland (1997), "Monetary Policy Under Federal Reserve Chairmen Volcker and Greenspan: An Exercise in Description," http://www.volkerwieland.com/docs/docs/lindsey_orphanides_wieland.pdf.

Mishkin, Frederic S. (2007), "Headline versus Core Inflation in the Conduct of Monetary Policy," http://www.federalreserve.gov/newsevents/speech/mishkin20071020a.htm.

Obstfeld, Maurice and Kenneth S. Rogoff (2009), "Global Imbalances and the Financial Crisis: Products of Common Causes,"
http://www.economics.harvard.edu/faculty/rogoff/files/Global_Imbalances_and_Financial_Crisis.pdf.

Orphanides, Athanasios and Volcker Wieland (2008). "Economic Projections and Rules of Thumb for Monetary Policy," Federal Reserve Bank of St. Louis, *Review*,
vol. 90 (July/August), pp. 307-24.

Palumbo, Michael G. and Jonathan A. Parker (2009), "The Integrated Financial and Real System of National Accounts for the United States: Does It Presage the Financial Crisis?" NBER Working Paper 14663, http://www.nber.org/papers/w14663.

Roubini, Nouriel and Brad W. Setser (2004), "The U.S. as a Net Debtor: The Sustainability of the U.S. External Imbalances," http://pages.stern.nyu.edu/~nroubini/papers/Roubini-Setser-U.S.-External-Imbalances.pdf.

Reinhart, Carmen M. and Vincent R. Reinhart (2010), "After the Fall,"
http://terpconnect.umd.edu/~creinhar/Papers/AftertheFall_August_27_NBER.pdf.

Reinhart, Carmen M. and Kenneth S. Rogoff (2009), *This Time Is Different: Eight Centuries of Financial Folly*, Princeton University Press.

Romer, C.D. and Romer, D.H. (2010). 'The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks', *American Economic Review*, vol. 100(3), pp. 763-801.

Rudebusch, Glenn D. (2006), "Monetary Policy Inertia: Fact or Fiction?," *International Journal of Central Banking*, December 2006 issue, http://www.ijcb.org/journal/ijcb06q4a4.pdf.

Rudebusch, Glenn D., Eric T. Swanson and Tao Wu (2006), "The Bond Yield "Conundrum" from a Macro-Finance Perspective, *Monetary an Economic Studies* (Special edition), December 2006, p. 83-129.

Rudebusch, Glenn D. (2009), "The Fed's Monetary Policy Response to the Current Crisis," http://www.frbsf.org/publications/economics/letter/2009/el2009-17.html.

Setser, Brad W. (2008), "Sovereign Wealth and Sovereign Power – The Strategic Consequences of American Indebtedness," CSR No. 37, http://www.cfr.org/content/publications/attachments/Debt_and_PowerCSR37.pdf.

Setser, Brad W. and Arpana Pandey (May 2009 Update), "China's $1.5 Trillion Bet – Understanding China's External Portfolio," Council on Foreign Relations Working Paper, http://www.cfr.org/publication/18149/chinas_15_trillion_bet.html.

Skidelsky, Robert (2008), "Gloomy About Globalization," *The New York Review of Books*, April 17, 2008.

Smith, Josephine M. and John B. Taylor (2009), "The Term Structure of Policy Rules," http://www.stanford.edu/~jsmith83/smithtaylor2009.pdf.

Stock, James H. and Mark W. Watson (2010), "Modeling Inflation After the Crisis," http://www.kansascityfed.org/publicat/sympos/2010/2010-08-06-stock-watson.pdf.

Summers, Lawrence H. (2004), "The United States and the Global Adjustment Process," http://www.iie.com/publications/papers/paper.cfm?researchid=200.

Taylor, John B. (2007). "Housing and Monetary Policy," NBER Working Paper Series 13682. Cambridge, Mass.: National Bureau of Economic Research, December, www.nber.org/papers/w13682.pdf.

Taylor, John B. (2008), "The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong," http://www.stanford.edu/~johntayl/FCPR.pdf.

Taylor, John B. (2010), "The Fed and the Crisis: A Reply to Ben Bernanke," *Wall Street Journal*, p. A19, January 11, 2010.

Warnock, Francis E. and Veronica Cacdac Warnock (2009), "International capital flows and U.S. interest rates," *Journal of International Money and Finance*, Vol. 28 (2009) 903–919.

Wolf, Martin (2008), *Fixing Global Finance*, The John Hopkins University Press.

Wu, Yangry and Hua Zhang (1997), "Do Interest Rates Follow Unit-Root Processes? Evidence from Cross-Maturity Treasury Bill Yields," *Review of Quantitative Finance and Accounting*, 8 (1997): 69–81.

Wijnholds de Beaufort, Onno J. and Lars Søndergaard (2007), "Reserve Accumulation – Objective or By-Product?," ECB Occasional Paper Series No. 73/September 2007.

Acknowledgements:
I would like to thank both Margriet Rijff and Bert de Bruijn of the Erasmus School of Economics and Raman Ahmed of the London School of Economics for their excellent research assistance. I owe Massimo Giuliodori immeasurable gratitude for running the structural VAR models and Louis Kuijs for his help with the data on China. I am grateful to Bart van Ark, Willem Buiter, Philip Hans Franses, Rick van der Ploeg and Casper de Vries for their valuable comments.

Appendix 1

Variance decomposition of real output with [*G, Y, IRS, HEW*]′

Period	S.E.	G	Y	IRS	HEW
1	0.014520	5.153989	94.84601	0.000000	0.000000
2	0.015841	2.483602	91.50355	3.556735	2.456109
3	0.018141	3.763412	88.27725	3.176908	4.782433
4	0.021184	8.462435	77.22069	3.676140	10.64073
5	0.025040	10.94949	67.52762	3.896637	17.62625
6	0.027897	15.24855	56.48155	3.175166	25.09473
7	0.031026	18.31709	47.91450	2.560670	31.20774
8	0.033855	20.93822	40.46614	2.164710	36.43093
9	0.036234	22.93296	34.21702	1.917208	40.93281
10	0.038421	24.22304	29.37604	1.715268	44.68565
11	0.040076	25.21751	25.44367	1.503181	47.83564
12	0.041402	25.88380	22.29792	1.318338	50.49993
13	0.042416	26.28505	19.72075	1.246578	52.74762
14	0.043142	26.42238	17.59685	1.376016	54.60475
15	0.043660	26.34661	15.83254	1.757300	56.06355
16	0.044018	26.09467	14.36303	2.396874	57.14542
17	0.044276	25.71803	13.12114	3.258462	57.90237
18	0.044485	25.26658	12.05022	4.284552	58.39865
19	0.044680	24.79291	11.10143	5.398621	58.70703
20	0.044885	24.34593	10.23645	6.523096	58.89453

Variance decomposition of real output with [*TAXEXO, G, Y, IRS*]′

Period	S.E.	TAXEXO	G	Y	IRS
1	0.001948	5.770825	6.706398	87.52278	0.000000
2	0.002122	5.325170	3.771361	87.87675	3.026717
3	0.002163	3.785275	3.050263	90.83269	2.331771
4	0.002210	2.835788	4.847628	87.65619	4.660395
5	0.002239	2.878509	6.006308	85.34664	5.768539
6	0.002246	2.751842	8.950796	81.66117	6.636191
7	0.002265	2.500004	10.73448	79.71449	7.051022
8	0.002273	2.307388	12.08957	78.38203	7.221012
9	0.002277	2.194652	13.09806	77.52822	7.179066
10	0.002279	2.117793	14.07442	76.79128	7.016510
11	0.002285	2.076645	15.02156	76.04109	6.860704
12	0.002292	2.057177	15.99698	75.23367	6.712174
13	0.002297	2.048331	16.92671	74.41264	6.612319
14	0.002303	2.037269	17.79576	73.58407	6.582906
15	0.002307	2.028153	18.61533	72.73908	6.617441
16	0.002310	2.026892	19.37253	71.89850	6.702074
17	0.002313	2.038326	20.10195	71.05123	6.808496
18	0.002314	2.062608	20.80509	70.21374	6.918564
19	0.002315	2.092355	21.47280	69.41577	7.019068
20	0.002316	2.122661	22.09041	68.68133	7.105593

Variance decomposition of Y_CHINA_SA with [*G, Y, IRS, HEW, Y_China_SA*]′

Period	S.E.	G	Y	IRS	HEW	Y_CHINA_SA
1	0.006654	0.008638	0.712297	3.484342	1.262644	94.53208
2	0.008413	0.011736	0.470859	2.427020	2.552346	94.53804
3	0.009121	0.021838	0.808372	2.266371	8.038359	88.86506
4	0.009484	1.043775	0.929040	3.277444	9.543185	85.20656
5	0.010271	0.923558	0.816766	5.260963	11.34250	81.65621
6	0.011349	1.073501	0.897779	5.390684	14.52523	78.11280
7	0.012260	1.054292	1.661512	5.833134	17.19789	74.25318
8	0.012929	0.949918	2.474581	6.658545	19.96278	69.95417
9	0.013566	1.007504	3.754863	6.794999	22.01566	66.42698
10	0.014233	1.097785	5.552297	6.629153	23.47399	63.24677
11	0.014922	1.255872	8.224481	6.281973	24.15827	60.07941
12	0.015526	1.487616	11.71011	5.924549	23.94348	56.93425
13	0.016132	1.834842	16.04750	5.536992	22.98541	53.59525
14	0.016769	2.461822	20.70721	5.126673	21.46982	50.23447
15	0.017485	3.443359	25.39456	4.732336	19.74732	46.68242
16	0.018294	4.723082	29.65006	4.399504	18.27515	42.95220
17	0.019215	6.286316	32.97530	4.148618	17.49542	39.09435
18	0.020272	8.116553	35.03255	3.980847	17.66509	35.20496
19	0.021479	10.12722	35.71970	3.881936	18.86100	31.41014
20	0.022833	12.20857	35.15657	3.816104	20.99427	27.82449

Variance decomposition of Y_CHINA_SA with [TAXEXO, *G, Y, IRS, Y_China_SA*]´

Period	S.E.	TAXEXO	G	Y	IRS	Y_CHINA_SA
1	0.006447	10.55263	3.430592	0.300124	0.054817	85.66184
2	0.009015	12.90672	8.296848	0.213925	2.294010	76.28850
3	0.010507	11.35826	14.28687	1.164479	3.827858	69.36254
4	0.012213	8.768933	23.40489	0.952067	5.188491	61.68561
5	0.013346	7.893741	24.11426	1.069224	6.879090	60.04368
6	0.014250	7.310254	24.18058	2.011017	8.082079	58.41607
7	0.015202	6.739500	24.24152	3.705983	9.103772	56.20923
8	0.015951	6.582127	23.42964	5.514354	9.608734	54.86514
9	0.016656	6.286527	22.10353	8.369012	9.540320	53.70061
10	0.017448	6.049996	20.70607	11.78780	9.441966	52.01417
11	0.018252	5.935044	19.23488	15.66012	9.121413	50.04854
12	0.019068	5.788922	17.77973	19.81848	8.747460	47.86540
13	0.019906	5.648788	16.40300	24.00105	8.444789	45.50238
14	0.020740	5.516208	15.13240	28.03267	8.194103	43.12462
15	0.021546	5.358332	14.02227	31.82006	8.019875	40.77946
16	0.022303	5.183173	13.09402	35.21519	7.925241	38.58237
17	0.022990	5.007787	12.36514	38.13576	7.872723	36.61859
18	0.023604	4.835741	11.83761	40.59110	7.837977	34.89758
19	0.024138	4.676721	11.50110	42.58646	7.803175	33.43254
20	0.024594	4.534442	11.34528	44.15052	7.749049	32.22071

Appendix 2

MODEL I 10 -YEAR TREASURY = C + α FED FUNDS RATE

Model OLS, using observations **1983:01-2008:12** (T = 312)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 5 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	2.52605	0.334244	7.5575	<0.00001	***
FED FUNDS	0.793259	0.063928	12.4086	<0.00001	***

Mean dependent var	6.751731	S.D. dependent var	2.305353
Sum squared resid	433.9901	S.E. of regression	1.183202
R-squared	0.737430	Adjusted R-squared	0.736583
F(1, 310)	153.9742	P-value(F)	5.59e-29
Log-likelihood	-494.1917	Akaike criterion	992.3834
Schwarz criterion	999.8694	Hannan-Quinn	995.3754
Rho	0.970182	Durbin-Watson	0.057220

***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Model OLS, using observations **1983:01-2001:12** (T = 228)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 4 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	2.48278	0.569647	4.3585	0.00002	***
FED FUNDS	0.822705	0.090438	9.0969	<0.00001	***

Mean dependent var	7.645658	S.D. dependent var	2.052041
Sum squared resid	310.7148	S.E. of regression	1.172538
R-squared	0.674940	Adjusted R-squared	0.673501
F(1, 226)	82.75355	P-value(F)	4.94e-17
Log-likelihood	-358.8044	Akaike criterion	721.6088
Schwarz criterion	728.4675	Hannan-Quinn	724.3760
Rho	0.970397	Durbin-Watson	0.060687

Model OLS, using observations **2002:01-2008:12** (T = 84)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	3.89988	0.165638	23.5446	<0.00001	***
FED FUNDS	0.154579	0.0406764	3.8002	0.00028	***

Mean dependent var	4.325357	S.D. dependent var	0.494062
Sum squared resid	14.95703	S.E. of regression	0.427086
R-squared	0.261749	Adjusted R-squared	0.252746
F(1, 82)	14.44165	P-value(F)	0.000277
Log-likelihood	-46.71414	Akaike criterion	97.42828
Schwarz criterion	102.2899	Hannan-Quinn	99.38261
Rho	0.868993	Durbin-Watson	0.322795

We repeat MODEL I using data starting in 1989M12 instead of 1983M1

Model OLS, using observations **1989:01-2008:12** (T = 240)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 4 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	3.44541	0.212559	16.2092	<0.00001	***
FED FUNDS	0.528075	0.0406989	12.9752	<0.00001	***

Mean dependent var	5.823292	S.D. dependent var	1.483374
Sum squared resid	222.0179	S.E. of regression	0.965841
R-squared	0.577829	Adjusted R-squared	0.576055
F(1, 238)	168.3548	P-value(F)	1.80e-29
Log-likelihood	-331.1995	Akaike criterion	666.3990
Schwarz criterion	673.3603	Hannan-Quinn	669.2039
Rho	0.969969	Durbin-Watson	0.062186

Model OLS, using observations **1989:01-2001:12** (T = 156)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 4 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	4.29507	0.418484	10.2634	<0.00001	***
FED FUNDS	0.428761	0.0676206	6.3407	<0.00001	***

Mean dependent var	6.629872	S.D. dependent var	1.179574
Sum squared resid	128.9310	S.E. of regression	0.914994
R-squared	0.402174	Adjusted R-squared	0.398292
F(1, 154)	40.20433	P-value(F)	2.41e-09
Log-likelihood	-206.4893	Akaike criterion	416.9785
Schwarz criterion	423.0782	Hannan-Quinn	419.4559
Rho	0.965523	Durbin-Watson	0.062887

Model OLS, using observations **2002:01-2008:12** (T = 84)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	3.89988	0.165638	23.5446	<0.00001	***
FED FUNDS	0.154579	0.0406764	3.8002	0.00028	***

Mean dependent var	4.325357	S.D. dependent var	0.494062
Sum squared resid	14.95703	S.E. of regression	0.427086
R-squared	0.261749	Adjusted R-squared	0.252746
F(1, 82)	14.44165	P-value(F)	0.000277
Log-likelihood	-46.71414	Akaike criterion	97.42828
Schwarz criterion	102.2899	Hannan-Quinn	99.38261
Rho	0.868993	Durbin-Watson	0.322795

MODEL II 10-YEAR TREASURY = C + α FED FUNDS RATE + β GLOBAL SAVINGS RATE

Model OLS, using observations **1983:01-2008:12** (T = 312)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 5 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	16.9395	3.14998	5.3777	<0.00001	***
FED FUNDS	0.852508	0.0556119	15.3296	<0.00001	***
GL. SAVING	-0.656384	0.142163	-4.6171	<0.00001	***

Mean dependent var	6.751731	S.D. dependent var	2.305353
Sum squared resid	336.7728	S.E. of regression	1.043973
R-squared	0.796248	Adjusted R-squared	0.794929
F(2, 309)	118.1087	P-value(F)	7.92e-39
Log-likelihood	-454.6281	Akaike criterion	915.2562
Schwarz criterion	926.4852	Hannan-Quinn	919.7440
Rho	0.961546	Durbin-Watson	0.076773

Model OLS, using observations **1983:01-2001:12** (T = 228)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 4 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	11.6348	6.74318	1.7254	0.08583	*
FED FUNDS	0.888272	0.0938385	9.4660	<0.00001	***
GL. SAVING	-0.429058	0.312696	-1.3721	0.17139	

Mean dependent var	7.645658	S.D. dependent var	2.052041
Sum squared resid	298.9520	S.E. of regression	1.152682
R-squared	0.687246	Adjusted R-squared	0.684466
F(2, 225)	53.02830	P-value(F)	1.35e-19
Log-likelihood	-354.4049	Akaike criterion	714.8097
Schwarz criterion	725.0978	Hannan-Quinn	718.9606
Rho	0.967093	Durbin-Watson	0.066998

Model OLS, using observations **2002:01-2008:12** (T = 84)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	10.6546	2.78338	3.8279	0.00025	***
FED FUNDS	0.371964	0.0948145	3.9231	0.00018	***
GL. SAVING	-0.321832	0.131635	-2.4449	0.01666	**

Mean dependent var	4.325357	S.D. dependent var	0.494062
Sum squared resid	11.34390	S.E. of regression	0.374230
R-squared	0.440086	Adjusted R-squared	0.426261
F(2, 81)	11.57655	P-value(F)	0.000038
Log-likelihood	-35.10109	Akaike criterion	76.20219
Schwarz criterion	83.49464	Hannan-Quinn	79.13369
Rho	0.812999	Durbin-Watson	0.444143

We repeat MODEL II using data starting in 1989M12 instead of 1983M1.

Model OLS, using observations **1989:01-2008:12** (T = 240)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 4 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	15.3907	2.58255	5.9595	<0.00001	***
FED FUNDS	0.610357	0.0466735	13.0772	<0.00001	***
GL. SAVING	-0.54988	0.116773	-4.7090	<0.00001	***

Mean dependent var	5.823292	S.D. dependent var	1.483374
Sum squared resid	165.5087	S.E. of regression	0.835673
R-squared	0.685282	Adjusted R-squared	0.682626
F(2, 237)	89.85966	P-value(F)	9.04e-30
Log-likelihood	-295.9514	Akaike criterion	597.9028
Schwarz criterion	608.3447	Hannan-Quinn	602.1102
Rho	0.955164	Durbin-Watson	0.087883

Model 14: OLS, using observations **1989:01-2001:12** (T = 156)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 4 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	-4.95548	8.20145	-0.6042	0.54659	
FED FUNDS	0.320451	0.119501	2.6816	0.00813	***
GL. SAVING	0.444166	0.391431	1.1347	0.25827	

Mean dependent var	6.629872	S.D. dependent var	1.179574
Sum squared resid	124.8143	S.E. of regression	0.903205
R-squared	0.421261	Adjusted R-squared	0.413696
F(2, 153)	21.93337	P-value(F)	4.21e-09
Log-likelihood	-203.9582	Akaike criterion	413.9164
Schwarz criterion	423.0659	Hannan-Quinn	417.6325
Rho	0.967735	Durbin-Watson	0.061666

Model OLS, using observations **2002:01-2008:12** (T = 84)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	10.6546	2.78338	3.8279	0.00025	***
FED FUNDS	0.371964	0.0948145	3.9231	0.00018	***
GL. SAVING	-0.321832	0.131635	-2.4449	0.01666	**

Mean dependent var	4.325357	S.D. dependent var	0.494062
Sum squared resid	11.34390	S.E. of regression	0.374230
R-squared	0.440086	Adjusted R-squared	0.426261
F(2, 81)	11.57655	P-value(F)	0.000038
Log-likelihood	-35.10109	Akaike criterion	76.20219
Schwarz criterion	83.49464	Hannan-Quinn	79.13369
Rho	0.812999	Durbin-Watson	0.444143

MODEL III 10-YEAR TREASURY = C + α FED FUNDS RATE + δ DEBT SECURITIES

Model OLS, using observations **1989:01-2008:12** (T = 240)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 4 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	5.96589	0.266918	22.3510	<0.00001	***
FED FUNDS	0.332068	0.03344	9.9303	<0.00001	***
DEBT	-4.00726e-05	3.66609e-06	-10.9306	<0.00001	***

Mean dependent var	5.823292	S.D. dependent var	1.483374
Sum squared resid	95.53012	S.E. of regression	0.634886
R-squared	0.818348	Adjusted R-squared	0.816815
F(2, 237)	160.9854	P-value(F)	6.95e-45
Log-likelihood	-230.0016	Akaike criterion	466.0031
Schwarz criterion	476.4451	Hannan-Quinn	470.2105
Rho	0.929597	Durbin-Watson	0.135479

Model OLS, using observations **1989:01-2001:12** (T = 156)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 4 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	8.48023	0.484317	17.5097	<0.00001	***
FED FUNDS	0.246128	0.0466989	5.2705	<0.00001	***
DEBT	-0.000116166	1.12229e-05	-10.3509	<0.00001	***

Mean dependent var	6.629872	S.D. dependent var	1.179574
Sum squared resid	42.98418	S.E. of regression	0.530040
R-squared	0.800691	Adjusted R-squared	0.798086
F(2, 153)	106.7606	P-value(F)	9.45e-30
Log-likelihood	-120.8105	Akaike criterion	247.6211
Schwarz criterion	256.7707	Hannan-Quinn	251.3372
Rho	0.917717	Durbin-Watson	0.184989

Model OLS, using observations **2002:01-2008:12** (T = 84)
Dependent variable: 10-YEAR TREASURY
HAC standard errors, bandwidth 3 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
C	4.99587	0.349215	14.3060	<0.00001	***
FED FUNDS	0.252155	0.0326175	7.7307	<0.00001	***
DEBT	-2.07474e-05	5.2742e-06	-3.9338	0.00018	***

Mean dependent var	4.325357	S.D. dependent var	0.494062
Sum squared resid	9.668601	S.E. of regression	0.345493
R-squared	0.522776	Adjusted R-squared	0.510993
F(2, 81)	30.16136	P-value(F)	1.62e-10
Log-likelihood	-28.38964	Akaike criterion	62.77929
Schwarz criterion	70.07174	Hannan-Quinn	65.71079
Rho	0.748936	Durbin-Watson	0.504434

III Why Do Chinese Households Save So Much?[*]

1. Introduction

China's savings rate is a popular topic of research. Not only is the national savings rate at 54 percent of GDP high by almost any standard (Kuijs, 2006), and persistently so, China's high savings rate and concurrent current account surplus also have been blamed for the global financial crisis and ensuing economic recession (Bernanke, 2010). Although household savings declined as a share of China's total savings as the growth of corporate profits outpaced the growth of household income, the household savings rate nonetheless climbed robustly, from a mere 12 percent in 1978 to 27 percent in 2009. This compares with (gross) household savings rates in OECD countries ranging from 6 to 16 percent of GDP (OECD, 2009).

Compared to previous research we use data that are more recent and cover a longer time span (1960 – 2009), including the periods with the most important economic reforms, to determine the determinants of the household savings rate in China. We find that the main determinants of variations over time in the household savings rate in China are disposable income (which we measure by its reciprocal), the average 5-year income growth rate and the old-age dependency rate. Our findings support the conventional Keynesian savings hypothesis, instead of Modigliani's life cycle theory, although habit formation and precautionary saving motives are also important.

The coefficient of the old-age dependency rate is positive rather than negative, as the life cycle hypothesis would predict. Individuals approaching the age of 65 presumably save a higher percentage of disposable income than they did before, while the group of 65+, which are supposed to be *dissavers*, is still relatively small in China.[45] In 2010 only 8.2 percent of China's population was age 65+, compared to 13.1 percent of the population in the United States and 18.3 percent in Western Europe (see Figure 1 in Appendix 1). Due to one-child-policy and low mortality rates, China's population will age rapidly in the years to come.

Using exclusively our data, we find that for all Chinese households (1978 – 2009) the reciprocal of real disposable income per capita, the average income growth, the young age dependency ratio as well as the old age are the main determinants of the variations in the savings rate over time. The young age dependency ratio has the expected negative sign. The old age dependency ratio again has a positive sign, just as it had in the combined dataset.

The main determinants of the urban household savings rate (1978 – 2009) are the real disposable income per capita (measured by its reciprocal), the old age dependency ratio and the young age dependency ratio. Both the young age dependency ratio as well as the old age dependency ratio have a positive sign, which is contrary to the life cycle hypothesis. The findings lend support to the Keynesian saving theory and precautionary saving motives, and not to the life cycle hypothesis.

The main determinants of the rural household savings rate (1978 – 2009) are real disposable income per capita (measured by its reciprocal) and the young age dependency ratio. Considering the life cycle hypothesis, the young age dependency ratio unexpectedly has a positive sign. The fact that immigrants work

---

[*] Together with Raman Ahmed.

[45] The age group 65+ is a very close proxy for the age group approaching 65.

in urban areas but are still included in rural statistics may account for that. The findings lend support to the Keynesian saving theory and not to the life cycle hypothesis. The R^2 with regard to rural savings rate is only half of the R^2 for the urban savings rate and the total savings rate, which means that a large part of the rural savings rate remains unexplained.

In each sample the reciprocal of real disposable income per capita turns out to be an important determinant of the household savings rate, suggesting that the conventional Keynesian model goes a long way to explain the Chinese experience of the last fifty years. The coefficient has a negative sign as expected, as it implies a long-run tendency for the savings rate to rise with income (Ando and Modigliani, 1963). Since it is clear from developed economies like the United States that the household savings rate will not keep rising with household income indefinitely, this result can best be viewed within the context of China as an emerging economy in the past three/five decades.

There is no evidence that the household savings rate in China is high because of low deposit rates, as Michael Pettis (2012) has asserted time and again, which would indicate that the income effect of lower deposit rates trumps the substitution effect. The coefficient of the deposit rate has alternating signs, but is insignificant in every single estimate.

The concept of 'forced savings' in relation to household savings is generally understood to be (1) expansionary monetary policy to stimulate investment at the expense of higher inflation that curbs households real purchasing power, or (2) an undervalued currency that depresses households real purchasing power, or (3) the government imposing taxes on households to subsidize national industry. Since we measure household savings as a share of *real disposable* income (i.e. after tax), forced savings can't account for our findings.

Although the savings rate varies significantly per income group, with the lowest income group's savings rate in urban areas in the single digits and the highest income group's savings rate at almost 40 percent of disposable income, our findings do not support the so-called competitive saving motive, which holds that income inequality as such is a motive for households to save a larger portion of their income. The sex ratio (i.e. the number of men per woman in the pre-marital cohort) also does not significantly impact the savings rate.

Since disposable income per capita is higher in urban areas than in rural areas (urban income per capita was more than threefold rural income per capita in 2009) and because of the rapid urbanization of China (in 2009 47 percent of the population was counted as urban compared to 18 percent in 1978), the urban household savings rate and its determinants have become increasingly indicative for the total household savings rate (see Figure 2).

2. Existing Literature

Modigliani and Cao (2004) find that China's high and rising savings rate is in concordance with the life cycle theory, which predicts that the income growth rate instead of the income level determines the savings rate (Modigliani, 1970). The life cycle hypothesis (LCH) also predicts that the savings rate rises with the share of working age population in the total population, for which Modigliani and Cao find modest support.

Carroll and Weil (1994) show that, in the fast-growing high-saving East Asian countries, growth precedes the rise in savings rates. Carroll, Overland and Weil (2000) argue that habit formation, instead of the

LCH, accounts for the fact that saving and growth are positively correlated, as consumption growth does not catch up with income growth immediately.

Horioka and Wan (2007), carrying out a dynamic panel analysis of the savings rate in different provinces over a limited time span (1995 – 2004), find that the lagged savings rate and the income growth rate are important determinants of the savings rate while age structure is not, lending mixed support for the LCH. Horioka and Terada (2011), who compare national savings rates in 12 economies in emerging Asia during the 1966 – 2007 period, on the other hand, find that age structure is an important determinant of the national savings rate.

Chamon and Prasad (2010) dismiss the findings of Modigliani and Cao based on the fact that in 2005 the saving curve by age group was u-shaped: younger and older generations (measured by the age of the head of household) saved a higher percentage of their income than the generations in between, while the LCH would predict a hump-shaped saving curve.

An alternative explanation for China's high savings rate is the precautionary savings motive and the rising income uncertainty, which is favored by Blanchard and Giavazzi (2005) and also Chamon and Prasad (2010). Underdeveloped financial markets may reinforce this argument, if there is no market for annuities to insure for old age.

Wei and Zhang (2009) have pointed out that the problem with both theories may be that while the public pension and health care systems as well as the financial system in China have been improving since 2003, household savings as a share of disposable income have continued to rise sharply during the same period. This contradicts both the precautionary motive theory as well as the underdeveloped financial markets theory. It does support the habit formation theory, though.

A new strand of literature, notably from Chinese academics, emphasizes the competitive savings motive. Jin, Li and Wu (2010) suggest that income inequality can directly stimulate household savings due to the desire to improve social-status. It is the Chinese version of 'keeping up with the Joneses,' albeit that 'keeping up with the Wangs' does not induce conspicuous consumption but rather conspicuous saving.

In a similar vein are Wei and Zhang (2009), who argue that Chinese parents with a son raise their savings in a competitive manner in order to improve their son's relative attractiveness for marriage. Wei and Zhang claim that about half of the increase in the savings rate of the last 25 years can be attributed to the rise in the sex ratio imbalance. It is noteworthy that these competitive saving theories do not predict a u-shaped household saving curve either.

3. Data on Savings Rates and Related Variables

We set out to update the analysis carried out by Modigliani and Cao (2004) whose dataset spans 1953 – 2000. Modigliani and Cao have a rather circuitous approach to establish household income and the household savings rate. They add savings (calculated as the change in currency + deposit + bonds + individual investment in fixed assets) to consumption expenditures in order to establish (gross) income.

We use data from the household survey as reported in the Statistical Yearbook from the National Bureau of Statistics of China, which includes data on household income, disposable household income and household expenditures, both for urban and rural from 1978 on. The household survey does not distinguish between current and capital expenditures of households (counting both as consumption). We use the household survey-based measure of saving, nevertheless, as it gives the most accurate picture of household savings rates.[46]

As far as our dataset and the dataset of Modigliani and Cao overlap, we find substantially different savings rates (see Figure 3). As Kraay (2000) points out, since 1986 the change in household saving deposits exceeded household savings by a large and rising margin. China's rapid financial sector development since the initiation of economic reforms in 1978 improved households' access to banking institutions, especially in rural areas.[47]

Also, in the late 1980s and early 1990s inflation-indexed saving deposits offering very attractive real returns were made available to households, and there is some evidence that significant volumes of corporate saving have illicitly found their way into these instruments. These two reasons probably account for the overestimation of savings from 1986 onward in asset-based measures of the savings rate like Modigliani and Cao's.

We start our analysis using a data set that includes both Modigliani and Cao's data from 1953 – 1977 and our data from 1978 – 2009. We used a dummy to account for a level shift in the data for the regressions. As we apply an error correction model, the first differences for this dummy only takes the value one in 1978. The coefficient for the first differences in the dummy was not significant, which is why it can be excluded from the analysis. However, we do include the dummy variable itself in the cointegration relation as within the cointegration relation it can make a difference. We also run the analysis on the dataset that stretches from 1978-2009, which allows us to distinguish between urban and rural effects. For our analysis we use exogenous variables similar to Modigliani and Cao (2004) and Horioka (2007), i.e. (disposable) income growth, the reciprocal of disposable income per capita, the age structure of the population and inflation and the 5-year income growth rate. We also include the deposit rate and the sex ratio for the dataset 1978 - 2009.

Since data on distribution of disposable income and consumption expenditures are only available from 1985, and for urban households only, we run separate tests with this subsample. What catches the eye, though, is that income inequality is much higher in rural areas than in urban areas, even though average income in urban areas is higher. The fact that immigrants working in urban areas are tabulated as rural may account for that, or simply the fact that the income of the lowest income groups in rural areas in China is still very low.

Modigliani and Cao measure the long-term income growth trend by using the average annual rate of growth over the previous fourteen years (year one through year fifteen). Also, the savings rate of Modigliani and Cao is savings expressed as a share of gross income, while we employ the more commonly used savings as a share of disposable income. The national savings rate is construed on the basis of urban and rural disposable income and consumption expenditure per capita weighted by urban and rural population.

We define the savings rate simply by (income net of taxes - living expenditure)/living expenditure, and not by log(income net of taxes/living expenditure) as Chamon and Prasad (2011) and Wei and Zhang (2011) do. However, this does not lead to changes in the analysis as mathematically they are approximations of each other and the variations over time are similar.

[46] For an elaborate discussion see Kraay (2000).
[47] This also implies that the deposits-based measure of household saving understates actual household savings in the years before 1986.

Nominal disposable income is transformed into real disposable income using the CPI-index in the Statistical Yearbook (1978 = 100) and real disposable income growth is measured as the year-on-year percentage change. Average income growth is the geometric average of growth rates of the latest 5 years. For this we use the data before 1960 as well to get an average of the growth rates of the 5 years before 1960.

With regard to the age structure, the World Bank database includes national data expressed as a percentage of population age 14 or younger, age 15 – 64 and age 65 and higher starting 1960. For a breakdown into urban and rural we rely on census data that are interpolated using the national data on age structure and the population growth (decline) in urban/rural areas. The deposit rate from 1980 on is taken from the IMF-database, and the deposit rate for 1978 and 1979 we obtained from the People's Bank of China. Data on sex ratios at the national level are taken from Wei and Zhang (2009).

4. Estimation Results

For the analysis we make use of an error correction model (ECM). Within this specific regression framework we include other exogenous variables next to the variables in the cointegration equation to find the effects on a savings rate. Therefore, the standard ADF-test for the residuals cannot be performed as the test-statistic follows a different unknown distribution. Hence, to investigate the presence of cointegration between the variables, we follow the method set out in Boswijk (1994) and use his critical values for the significance of the cointegrating factors.

4.1 National data 1960 – 2009

In the table below, we have set out the results for the regression using the full sample of the data. We find that the cointegration relation is significant when we consider the averaged growth rate, following Modigliani and Cao (2004) (see Appendix 2A for the elaborate results where we show the cointegration relation is significant). The cointegration relation is therefore included in the regression through the ECM. From this we can derive that the savings rate is mean-reverting towards the long-run equilibrium defined by:

$$Savings\ Rate_t = C_2 Old_t + C_{dummy} Dummy_t + C_{11} Real\ Income\ Averaged\ Growth_t + \varepsilon_t.$$

Then the deviation can be described by:

$$\varepsilon_t = Savings\ Rate_t - C_2 Old_t - C_{dummy} Dummy_t - C_{11} Real\ Income\ Averaged\ Growth_t.$$

The C_1-coefficient in front of the deviation in the previous period represents the adjustments in the next period for this deviation. It signifies that if the current value of the savings rate deviates from the equilibrium, the savings rate will have a tendency to correct for this in the following periods. The coefficient for Real Income Averaged Growth is positive in this case. Increases in growth will correspond with proportional increases in savings. We can additionally see that the old-age ratio plays a large role in both the long-term equilibrium as well as short-term effects.

The reciprocal is also significant in explaining the short-term movements. As explained in Modigliani and Cao, only including a constant and the reciprocal of income per capita would correspond with the standard Keynesian model where the national saving ratio rises as per-capita income rises within a country in the form:

$S = s_0 + s \cdot YS = s_0 + s \cdot Y$, implying $\frac{S}{Y} = s + \frac{s_0}{Y}$.

Intuitively, the negative coefficient here implies that an increase in Real Income PC leads to a smaller value of the reciprocal, thus to an increase in the savings rate. However, as we consider the reciprocal, for large incomes this effect becomes increasingly smaller on the marginal. The reasoning is that people with low incomes may not be capable to save sufficiently for their old age as a large part of their income goes to their current living expenses, in comparison with higher incomes. When they start earning more, they will be able to save more.

Regression results of the non-linear model to estimate the error correction terms

$$D(Savings\ Rate_t) = C_0 + C_1\left(Savings\ Rate_{t-1} - C_3 Old_{t-1} - C_{dummy} Dummy_{t-1}\right) + C_7 D(Old_t) + C_8 D\left((Real\ Income\ PC_t)^{-1}\right)$$

where D(·) signifies the first differences function.

Variables, or coefficients (Dependent variable: ΔSavings Rate)	Averaged Growth
Constant	-16.89 (-4.62)
C_1	-0.61 (-4.78)
C_3 (Old)	3.87 (10.28)
C_{dummy}	5.66 (4.59)
C_{11}	0.32 (3.08)
D(Old)	13.98 (4.14)
D((Real Income PC)$^{-1}$)	-3478.67 (-7.79)
R^2	0.71
Wald test statistic for the joint significance of the removed variables	1.94
Corresponding P-value	0.93

We have tested for the significance of the initial cointegration relation through a Wald test. As the Wald test does not have the regular χ^2-distribution, we have used the appropriate critical values from Boswijk (1994). For the elaborate regression results, see Appendix 2A.

4.2 National data 1978 – 2009

We have set out the results for the smaller sample of the national data in the table below. We again find that the cointegration relation is significant when we consider the averaged growth rate (see Appendix 2B for the elaborate results where we show the significance of the cointegration relation). The cointegration relation is therefore again included in the regression through an ECM and the coefficient for this relationship similarly has a negative sign. In contrast to the previous regression, the young-age ratio is relevant for this specific time-period for the cointegrating relationship and it also has short-term effects. Again the old-age ratio is relevant and has a positive sign. The reciprocal of Real Income PC has a similar negative effect on the savings rate for this period as for the whole sample. Additionally, we find a negative, rather than positive effect of the averaged growth rate in the cointegrating relationship.

Regression results of the non-linear model to estimate the error correction terms

$$D(Savings\ Rate_t) = C_0 + C_1(Savings\ Rate_{t-1} - C_2 Young_{t-1} - C_{11} Real\ Income\ Averaged\ Growth_t) + C_6 D(Young_t) + C_7 D(Old_t) + C_9 D((Real\ Income\ PC_t)^{-1})$$

Variables, or coefficients (Dependent variable: ΔSavings Rate)	Averaged Growth
Constant	0.27 (5.43)
C_1	-0.64 (-4.96)
C_2 (Young)	-0.83 (-8.21)
C_{11}	-0.58 (-2.42)
D(Young)	-2.05 (-2.32)
D(Old)	28.58 (3.86)
D((Real Income PC)$^{-1}$)	-184.03 (-5.07)
R^2	0.70
Wald test statistic for the joint significance of the removed variables	5.80
Corresponding P-value	0.33

We have tested for the significance of the initial cointegration relation through a Wald test. As the Wald test does not have the regular χ^2-distribution, we have used the appropiate critical values from Boswijk (1994). For the elaborate regression results, see Appendix 2B.

4.3 Urban data 1978 - 2009

When we consider a subsample where only the urban population is included we find the results set out in the table below. The cointegrating relation here does not include averaged income growth (See Appendix 2C for the complete results). Similar to the results for the complete sample, we can find that the old-age ratio plays a role in the cointegration relationship and has a positive effect on the long run. The young-age ratio has a negative effect, which is different from the effect we have seen for the smaller sample in the previous section. However, the effect from the reciprocal of Real Income PC again is the same as we have previously seen for the different samples.

Regression results of the non-linear model to estimate the error correction terms

$$D(Savings\ Rate_t) = C_0 + C_1(Urban\ Savings\ Rate_{t-1} - C_2 Urban\ Old_{t-1}) + C_5 D(Urban\ Young_t) + C_8 D((Urban\ Real\ Income\ PC_t)^{-1})$$

Variables, or coefficients (Dependent variable: ΔUrban Savings Rate)	Averaged Growth
Constant	-0.25 (-3.59)
C_1	-0.89 (-4.90)
C_2 (Urban Old)	6.06 (10.40)
D(Urban Young)	3.12 (3.65)
D((Urban Real Income PC)$^{-1}$)	-128.27 (-2.81)
R^2	0.57
Wald test statistic for the joint significance of the removed variables	8.45
Corresponding P-value	0.21

We have tested for the significance of the initial cointegration relation through a Wald test. As the Wald test does not have the regular χ^2-distribution, we have used the appropiate critical values from Boswijk (1994). For the elaborate regression results, see Appendix 2C.

4.4 Rural data 1978 - 2009

When looking at the results for the rural population we do not find a cointegrating relationship between the variables (See Appendix 2D for the complete results). Therefore, the cointegrating relation has not been included in the regression. We still find that the young-age ratio and the reciprocal of the Real Income PC have a significant effect on the savings rate for the rural population.

Regression results of the linear model to estimate the error correction terms (the cointegration relation was found not to be significant, so it is excluded from this regression)

Variables (Dependent variable: ΔRural Savings Rate)	Regular Growth	Averaged Growth
Constant	0.02 (0.74)	0.02 (0.64)
D(Rural Real Income PC Growth)	0.09 (1.02)	$1.78*10^{-3}$ (0.46)
D(Rural Real Income PC)	$-1.96*10^{-4}$ (-0.91)	$-2.03*10^{-4}$ (-0.88)
D(Rural Young)	2.05 (1.40)	1.80 (1.12)
D(Rural Old)	0.49 (0.07)	0.60 (0.09)
D(Inflation)	0.02 (0.16)	-0.02 (-0.17)
D((Rural Real Income PC)$^{-1}$)	-79.90 (-2.47)	-76.39 (-2.07)
D(Deposit Rate)	$-2.62*10^{-3}$ (-0.68)	$-2.26*10^{-3}$ (-0.56)
R^2	0.41	0.39

We have tested for the significance of the initial cointegration relation through a Wald test. As the Wald test does not have the regular χ^2-distribution, we have used the appropiate critical values from Boswijk (1994). For the elaborate regression results, see Appendix 2D, where you can find that the cointegration relation is not significant.

5. Comparing Our Results to Previous Studies

Our findings, which show a long-term relationship between the savings rate and the age structure and the average income growth rate, lend only very weak support to the life cycle hypothesis (Modigliani and Cao, 2004). The analysis they have performed considers only the long-term effects, as they have not used an error-correction model (ECM) to account for the unit root in the level of the savings rate (S/Y).[48] A unit root in the level of the savings rate entails that the following period starts approximately at the level of the previous period and incorporates a change from one period to another.[49] This does make sense as household savings actually stay at their current level if households do not choose to adjust it. With an error correction model, we then try to model and explain the changes from one period to the next. The analysis of Modigliani and Cao also incorporates the stationary variables in the determination of the long-term relationship between the cointegrated variables.

In contrast, we have implemented a single step estimation of the long run and short run relationships present through the use of the ECM, after establishing the presence of the cointegration relationship. This provides a more accurate analysis of how the variables actually affect the savings rate, while the R^2 is informative about the part of the variation explained. Additionally, we find short-term effects of the age structure conflicting with the LCH and short-term effects of the reciprocal of the income level. Habit

[48] The results of the ADF-test for S/Y reported on p.156 of Modigliani and Cao (2004) are incorrect, as the columns with the outcomes for S/Y and ΔS/Y have been exchanged erroneously. S/Y does contain a unit root.
[49] The main implication of non-stationarity is that there is no long-term average, and so the variable therefore can take on any value, albeit in this case a value between 0 and 1. Our findings are in accordance with Jansen (1997) who finds for the large majority of countries that the national savings rate appears to be a non-stationary process, and Horioka (1997) who concludes that Japan's household savings rate has a unit root.

formation (Carroll, Overland and Weil, 2000) rather than the LCH probably accounts for the long run relation between the savings rate and average real disposable income growth per capita.

Chamon and Prasad (2010) also dismiss the findings of Modigliani and Cao, pointing out that in 2005 the saving curve by age group was u-shaped: younger and older generations (measured by the age of the head of household) saved a higher percentage of their income than the generations in between, while the LCH would predict a hump-shaped savings curve. This methodology is flawed. After all, one has to observe the savings rate of a certain generation over its lifetime to establish what the curvature of the saving curve is, instead of comparing the savings rate of different generations at a certain point in time as Chamon and Prasad do. If you plot the savings rate of the different generations over the course of Chamon and Prasad's 15-year long sample (1990 – 2005), it is clear that the savings rate of each generation rises considerably during that period of time, and that the u-shape of Chamon and Prasad disappears like snow in summer (see Figure 4).

What is interesting though is the last panel of Figure 3 that is included in Chamon and Prasad (2010). It shows that in 2005 average disposable income plotted over generations is also u-shaped, with the trough of the curve being the generation born in 1960 (head of household aged 45 in 2005). This "u-shaped" income curve provides a straightforward explanation for the "u-shaped" savings curve that Chamon and Prasad find. It suggests that the generation born around 1960 – during the Great Leap Forward and at the onset of the Cultural Revolution – has markedly less earning capacity than preceding and following generations. The Great Leap Forward resulted in the deadliest famine in the history of China and in the history of the world: estimates range from 16.5 million to 30 million deaths (Li and Yang, 2005). Because of the Cultural Revolution many schools remained closed throughout the late 1960s and universities were shut till 1973 (Hewitt, 2008).

Wei and Zhang (2011), who perform a cross-province panel analysis, find a positive relationship between the sex ratio and household savings rate and a negative relationship between household income growth and the savings rate. We have no explanation for the discrepancy between their findings and our findings. The key statistics presented by Wei and Zhang on disposable income per capita for China in table 12 do not match our data. Wei and Zhang seem to have used nominal data on rural disposable household income per capita for their cross-province panel analysis, as they do not account for inflation at all. The variables may therefore contain a unit root and the process may be non-stationary. In that case the use of OLS can produce invalid estimates.

More notably, Wei and Zhang find that the sex ratio has a larger effect on savings by urban households with a daughter than on savings by urban households with a son. Only after slicing and dicing the full sample, the sex ratio has a larger effect on savings by urban households with a son than on savings by urban households with a daughter, although the difference is still not statistically significant. Wei and Zhang successively remove households whose reported annual income or expenditure is less than ¥3000, the top and bottom 5 percent of households in terms of their savings rate, and families with no explicit information on the marital status of their children from their sample. In doing so, they reduce the overall sample size by half (from N = 769/766 to N = 384/399).

Overall, urban households with a daughter have a fractionally higher propensity to save than urban households with a son. This undercuts the entire premise of Wei and Zhang's exercise, which holds that households with a son increase savings in order to improve their son's marital status. That the sex ratio has a larger effect on savings by rural households with a son than on rural households with a daughter is of little solace. As we have argued before, the rural household savings rate and its determinants are hardly indicative for the overall household savings rate in China.

Horioka and Wan (2007) do not find evidence that variables relating to the age structure of the population have a significant impact on the household savings rate, while we find in most samples that both the young-age as well as the old-age dependency rate have an impact on the (urban) household savings rate. A possible explanation for this difference may be found in the fact that the time span of Horioka and Wan's panel analysis is quite limited (1995 – 2004) and the age structure probably does not exhibit sufficient variation in such a short time interval to find relevant effects on the savings rate. This may also explain why the lagged savings rate has large explanatory power in Horioka and Wan (2007). Horioka and Terada (2011), using data on national savings rates in twelve Asian economies during the 1966 – 2007 period, conclude that the age structure of the population actually is an important determinant of the (national) savings rate.

6. Conclusion

We started this paper by noting that China's national savings rate was remarkably high by most standards. The high national savings rate reflects high savings in all three sectors – corporate, household and government (Ma and Yi, 2010). China is however not unique, as Carroll and Weil (2004) and Modigliani and Cao (2004) have pointed out before. China's trajectory over the past 30 years is actually quite similar to the experiences of – for example – Singapore and Malaysia, which also have average national savings rates of about 45 percent of GDP (Horioka and Terada, 2011). Emerging economies in Latin America, such as Argentine and Chile, have national savings rates close to 30 percent of GDP.

There are fewer data on household savings rates compared to national savings rates. Italy (1960–70) and Japan (1971–80) had average household savings rates of 24.5 percent of disposable income, while the average household savings rate in China (2000 – 2009) was 24.6 percent of disposable income. The household savings rate in India was – at 32 percent of disposable income in 2008 – even 5 percentage points higher than in China. China's national savings rate (expressed as a percentage of GDP) is nonetheless 20 percentage points higher than India's, due to much higher corporate savings (retained earnings) and higher government savings.[50] Weak corporate governance structures, with many enterprises being (formerly) state-owned enterprises, and underdeveloped financial markets are often cited as reasons that in China few dividends get distributed (Song, 2010).[51] Another reason for high corporate savings may lie in the capital controls that are still in place, because of which foreign money has to be held at the People's Bank of China. The capital controls result in forced savings, although we suggest that the forced savings are rather a by-product than the aim of capital controls.

Studies that treat China as a unique case of a deviation from the textbook model therefore seem off the mark. In case a unique feature of China is used to explain China's high household savings rate, the studies are (a) unscientific, in the sense that essentially one data point is being used, and (b) not very interesting even if true because they have no obvious applicability to any broader understanding of how the world works.

[50] The IMF's World Economic Outlook projects India's national savings rate to climb to 43 percent of GDP in 2016, while China's national savings rate will remain above 50 percent of GDP.
[51] For a more elaborate discussion of corporate savings in China see Ma and Yi (2010).

China is only different than other emerging economies because its economy is vastly larger, and has gotten much more scrutiny because of its role in the years leading up to the 2008 financial crisis and ensuing economic recession (Mees, 2011).

The fact that the conventional Keneysian savings model, which implies a long-run tendency for the savings rate to rise with income, may largely explain the Chinese household savings rate in the past 3 to 5 decades, is best understood against the background of China as an emerging economy. There is evidence from developed countries that when income growth slows, savings rates decline. Italy and Japan's household savings rates have dropped below 10 percent of disposable income. It suggests that China's future household savings rate may largely depend on China's GDP growth and household income growth. The latter will depend on labor productivity, as well as on the (empirical) question whether the Lewis turning point has been reached. Cai and Wang (2010) conclude that a trend of labor shortage is emerging, suggesting a coming Lewis turning point. Kuijs (2009), on the other hand, argues that it is unlikely that China has already exhausted its labor surplus since 40 percent of China's employees are still employed in agriculture. If that were the case, household income growth could remain muted in the face of robust GDP growth.

Since the high household savings rate is in part prompted by precautionary savings motives, especially for old age, the successful implementation of credible retirement plans – as announced in The Twelfth Five-Year Plan (2011-2015) – may reduce the household savings rate. As many Chinese fear that their country will grow old before it grows rich, precautionary motives may continue to fuel household savings as a share of disposable income in the years to come.

References

Ando, Albert and Franco Modigliani (1963), “The "Life Cycle" Hypothesis of Saving: Aggregate Implications and Tests,” *The American Economic Review*, Vol. 53, No. 1, Part 1 (Mar., 1963), pp. 55-84

Bernanke, Ben S (2011), “Global Imbalances: Links to Economic and Financial Stability”, http://www.federalreserve.gov/newsevents/speech/bernanke20110218a.htm.

Blanchard, Olivier J. and Francesco Giavazzi (2005), “Rebalancing Growth in China: A Three-Handed Approach.” MIT Department of Economics Working Paper No. 05-32.

Boswijk, H. Peter (1994), “Testing for an unstable root in conditional and structural error correction models.” *Journal of Econometrics* 63, pp 37-60.

Cai, Fang, and Meiyan Wang (2010), “Growth and Structural Changes in Employment in Transitional China”, *Journal of Comparative Economics* 38 (2010) 71–81.

Carroll, Christopher D. and Lawrence H. Summers (1991), "Consumption Growth Parallels Income Growth: Some New Evidence," in B. Douglas Bernheim and John B. Shoven, eds., *National saving and economic performance*. Chicago: Chicago University Press, 1991, pp. 305-43.

Carroll, Christopher D. and David N. Weil, (1994), "Saving and Growth: A Reinterpretation." Carnegie-Rochester Conference Series on Public Policy, June 1994, 40, pp. 133-92.
Carroll, Christopher D., Jody Overland and David N. Weil (2000), “Saving and Growth with Habit Formation,” *The American Economic Review*, June 2000.

Chamon Marcos D. and Eswar S. Prasad (2010), “Why Are Savings rates of Urban Households in China Rising?” *American Economic Journal*: Macroeconomics, 2(1): 93–130.

Hewitt, Duncan (2008), *China: Getting Rich First: A Modern Social History*, Pegasus Books.

Horioka, Charles Y. (1997), “A Cointegration Analysis of the Impact of the Age Structure of the Population on the Household Saving Rate in Japan,” *The Review of Economics and Statistics*, August 1997, Vol. 79, No. 3, Pages 511-516.

Horioka, Charles Y. and Junmin Wan (2007), "The Determinants of Household Saving in China: A Dynamic Panel Analysis of Provincial Data," *Journal of Money, Credit and Banking*, vol. 39(8), pages 2077-2096, December.

Horioka, Charles Y. and Akiko Terada-Hagiwara (2011), “The Determinants and Long-term Projections of Savings rates in Developing Asia,” NBER Working Paper No. 17581, November 2011.

Jansen, W. Jos (1997), "Estimating saving-investment correlations: evidence for OECD countries based on an error correction model," *Journal of lnternational Money and Finance*, Vol. 15, No. 5, pp. 749-781, 1996.

Jin, Ye, Hongbin Li, Binzhen Wu (2010), "Income Inequality, Status Seeking, Consumption and Saving Behavior," Working Paper.

Kraay, Aart (2000), "Household Saving in China," World Bank Economic Review, Vol. 14, No. 3 (September), pp. 545-70.

Kuijs, Louis (2006), "How Will China's Saving-Investment Balance Evolve?" World Bank Policy Research Working Paper #3958,
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=923265.

Kuijs, Louis (2009), "China Through 2020 – A Macroeconomic Scenario," World Bank China Office, Research Paper, No. 9, June 2009.

Li, Wei and Dennis Tao Yang (2005), "The Great Leap Forward: Anatomy of a Central Planning Disaster," *Journal of Political Economy*, 2005, vol. 113, no. 4.

Ma, Guonan and Wang Yi (2010), "China's high savings rate: myth and reality," BIS Working Papers No 312.

Mees, Heleen (2011), U.S. Monetary Policy, the Interest Conundrum and the Housing Bubble, Working Paper, http://www.heleenmees.com/PDF/papers/US_Monetary_Policy.pdf.

Modigliani, Franco (1970), "The Life Cycle Hypothesis of Saving and Intercountry Differences in the Saving Ratio," *Introduction, Growth and Trade, Essays in Honor of Sir Roy Harrod*, W.A. Elits, M.F. Scott, and J.N. Wolfe, eds. Oxford University Press.

Modigliani, Franco, and Shi Larry Cao (2004), "The Chinese Saving Puzzle and the Life Cycle Hypothesis," *Journal of Economic Literature*, Vol. 42, pp. 145-70.

Pettis, Michael (2012), "China needs a new growth model, not a stimulus," *The Financial Times*, March 13, 2012.

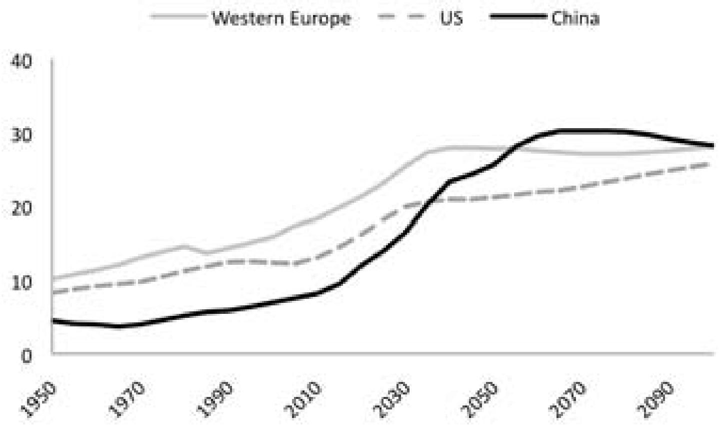
Wei, Shang-Jin and Xiaobo Zhang (2011), "The Competitive Saving Motive: Evidence from Rising Sex Ratios and Savings Rates in China," *Journal of Political Economy*, Vol. 119, No. 3 (June 2011), pp. 511-564.

Acknowledgements

We like to thank Andy Xiaoyang in Beijing for helping collect data, and Mark Treurniet for preparatory work on the estimations. We also would like to thank Christopher Carroll for sharing his thoughts on this topic with us, Philip Hans Franses for his advice on econometrics used, Louis Kuijs for the enlightening discussions and Willem Buiter for his thoughtful comments and continued encouragement.

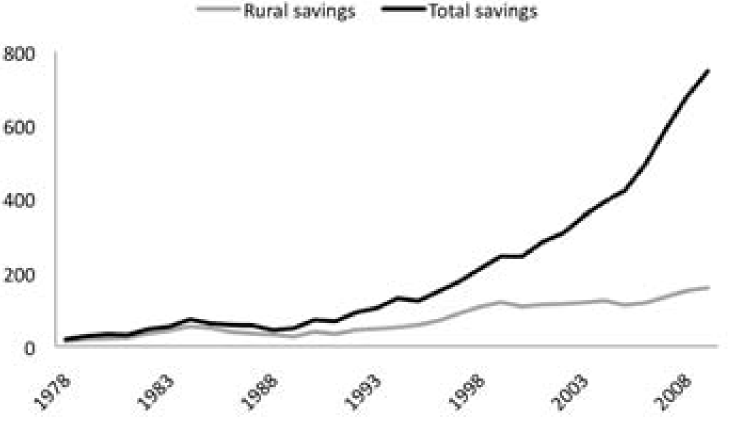
Appendix 1

Figure 1 Share of population 65+ (%)



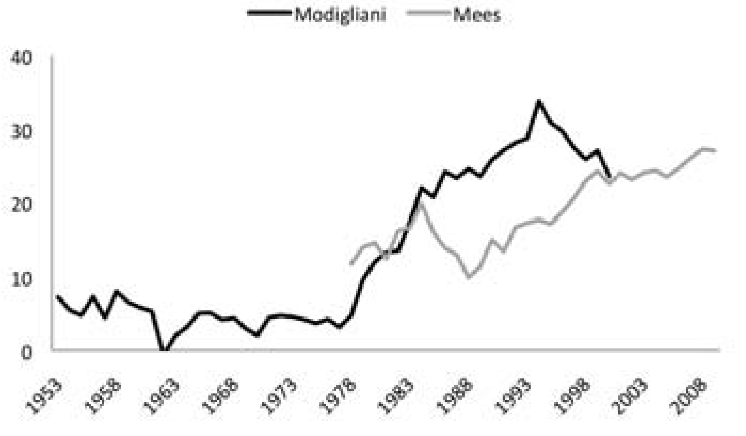
Source: UNDP

Figure 2 China's household savings (in billion 1978 RMB)



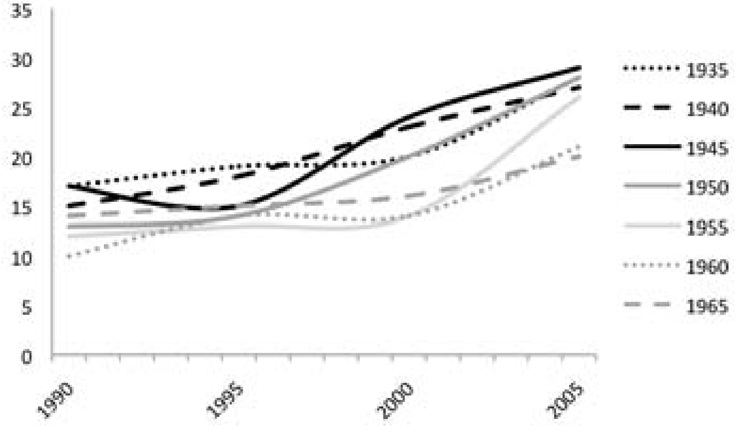
Source: China Statistical Yearbook

Figure 3 Modigliani-Cao savings rate and Mees-Ahmed savings rate (%)



Source: Modigliani and Cao (2004), China Compendium of Statistics 1949-2008, Statistical Yearbook 2010

Figure 4 Savings rate of different generations (by year of birth) over time



Source: National Bureau of Statistics of China, Chamon and Prasad (2010) [52]

[52] Data for 2005 are from the China National Bureau of Statistics, and data for 1990, 1995 and 2000 are estimates based on Chamon and Prasad (2010) as the authors were not willing to share their data in spite of repeated requests.

Appendix 2

A: National Data 1960-2009

Table A.1: The results of the augmented Dickey-Fuller (ADF) test for unit roots within the variables.

Variable	ADF test-statistic	P-value
S/Y	-0.342	0.911
ΔS/Y	-8.347***	0.000
Real income pc growth	-5.487***	0.000
Real income pc growth 5yrs	-0.603	0.859
ΔReal income pc growth 5yrs	-6.576***	0.000
Young	-0.495	0.883
ΔYoung	-5.664***	0.000
Old	3.607	1.000
ΔOld	-6.417***	0.000
Inflation	-4.049***	0.002

***, ** and * signify rejection of the null hypothesis of a unit root at the 1%, 5% and 10% significance levels respectively. The lag lengths to be included are automatically selected based on the SIC.

We can see here that the savings rate, the averaged income growth, young-age ratio and the old-age ratio contain a unit root. Therefore, we have to check in the ECM whether there is a cointegrating relationship present between these variables.

Table A.2: Regression result to test for the significance of the error correction terms

Variables (Dependent Variable: ΔSavings Rate)	Regular Growth	Averaged Growth
Constant	-17.63	-17.73
	(-1.73)	(-1.81)
Savings Rate$_{t-1}$	-0.48	-0.61
	(-3.68)	(-4.27)
Young$_{t-1}$	0.08	0.04
	(0.92)	(0.50)
Old$_{t-1}$	1.77	2.08
	(2.21)	(2.61)
Dummy$_{t-1}$	5.15	4.78
	(2.39)	(2.13)
Real Income Growth$_{t-1}$		0.18
		(1.36)
D(Dummy)	0.92	2.30
	(0.37)	(1.02)
D(Real Income PC Growth)	0.05	-0.07
	(0.95)	(-0.40)
D(Real Income PC)	0.01	0.01
	(1.10)	(0.89)
D(Young)	-0.08	0.30
	(-0.20)	(0.73)
D(Old)	12.31	14.31
	(3.09)	(3.52)
D(Inflation)	0.03	0.02
	(0.62)	(0.45)
D((Real Income PC)$^{-1}$)	-2378.38	-3092.04
	(-2.99)	(-3.84)
R^2	0.70	0.72
Wald test on significance of the error correction variables[53]	14.35	19.70*

* signifies rejection of the null hypothesis of no presence of a cointegration relation at the 10% significance level.

For the regression in which we include one year growth we have looked at the following regression:

$$\begin{aligned} &D(Savings\ Rate_t) \\ &= C_0 + C_{dummy} D(Dummy_t) + C_4 D(Real\ Income\ PC\ Growth_t) + C_5 D(Real\ Income\ PC_t) \\ &+ C_6 D(Young_t) + C_7 D(Old_t) + C_8 D(Inflation_t) + C_9 D((Real\ Income\ PC_t)^{-1}), \end{aligned}$$

where D(·) signifies the first differences function.

In contrast, for the regression in which we include the five-year averaged growth we have looked at the following regression where we include a cointegration relation, which was significant as is visible in table A.2:

[53] As the Wald test does not have the regular χ^2-distribution, we have used the appropriate critical values from Boswijk, H. Peter (1994), "Testing for an unstable root in conditional and structural error correction models." *Journal of Econometrics*, 63, pp 37-60.

$$
\begin{aligned}
&D(Savings\ Rate_t) \\
&= C_0 \\
&+ C_1\big(Savings\ Rate_{t-1} - C_2 Young_{t-1} - C_3 Old_{t-1} - C_{11} Real\ Income\ Averaged\ Growth_{t-1} \\
&- C_{dummy} Dummy_{t-1}\big) + C_{dummy2} D(Dummy_t) + C_4 D(Real\ Income\ PC\ Growth_t) \\
&+ C_5 D(Real\ Income\ PC_t) + C_6 D(Young_t) + C_7 D(Old_t) + C_8 D(Inflation_t) \\
&+ C_9 D((Real\ Income\ PC_t)^{-1})
\end{aligned}
$$

We have looked at the significance of the cointegrating relation through the use of a Wald-test, where the critical values are taken from Boswijk (1994). The null hypothesis of no cointegrating relation has been rejected at the 10% significance level when using the averaged growth rate. We therefore include this cointegrating relation in a non-linear model and estimate the corresponding coefficients.

Table A.3: Regression results of the non-linear model to estimate the error correction terms

Variables, or coefficients (Dependent Variable: ΔSavings Rate)	Regular Growth	Averaged Growth
Constant	-0.45 (-1.29)	-17.73 (-1.81)
C_1		-0.61 (-4.27)
C_2 (Young)		0.07 (0.49)
C_3 (Old)		3.40 (3.36)
C_{dummy}		7.81 (2.20)
C_{11}		0.29 (1.53)
C_{dummy2} (D(Dummy))	-0.05 (-0.02)	2.30 (1.02)
C_4 (D(Real Income PC Growth))	0.06 (1.23)	-0.07 (-0.40)
C_5 (D(Real Income PC))	$1.69*10^{-3}$ (0.32)	0.01 (0.89)
C_6 (D(Young))	0.21 (0.74)	0.30 (0.73)
C_7 (D(Old))	5.41 (1.86)	14.31 (3.52)
C_8 (D(Inflation))	$-9.53*10^{-3}$ (-0.20)	0.02 (0.45)
C_9 (D((Real Income PC)$^{-1}$))	-3280.47 (-4.30)	-3092.04 (-3.84)
R^2	0.58	0.72

After removing the variables with the lowest t-statistics, one by one we get the following regression, with the test of the joint significance of the removed variables. We see that the tests return that the removed variables do not have coefficients that significantly deviate from zero.

Table A.4: Regression results of the linear model to estimate the error correction terms

Variables (Dependent variable: ΔSavings Rate)	Regular Growth
Constant	-0.49 (-1.69)
D(Real Income PC)	0.07 (2.09)
D(Old)	5.24 (2.30)
D((Real Income PC)$^{-1}$)	-3006.81 (-4.87)
R^2	0.57
Wald test statistic for the joint significance of the removed variables	0.69
Corresponding P-value	0.95

Table A.5: Regression results of the non-linear model to estimate the error correction terms

Variables, or coefficients (Dependent variable: ΔSavings Rate)	Averaged Growth
Constant	-16.89 (-4.62)
C_1	-0.61 (-4.78)
C_3 (Old)	3.87 (10.28)
C_{dummy}	5.66 (4.59)
C_{11}	0.32 (3.08)
D(Old)	13.98 (4.14)
D((Real Income PC)$^{-1}$)	-3478.67 (-7.79)
R^2	0.71
Wald test statistic for the joint significance of the removed variables	1.94
Corresponding P-value	0.93

B: National Data 1978-2009

Table B.1: The results of the augmented Dickey-Fuller (ADF) test for unit roots within the variables.

Variable	**ADF test-statistic**	**P-value**
S/Y	-2.178	0.485
ΔS/Y	-6.079***	0.000
Real income pc growth	-2.318	0.173
ΔReal income pc growth	-10.435***	0.000
Real income pc growth 5yrs	-2.472	0.133
ΔReal income pc growth 5yrs	-2.669*	0.093
Young	-3.314*	0.085
ΔYoung	-4.869***	0.001
Old	-0.889	0.944
ΔOld	-5.985***	0.000

***, ** and * signify rejection of the null hypothesis of a unit root at the 1%, 5% and 10% significance levels respectively. The lag lengths to be included are automatically selected based on the SIC.

The savings rate, real income growth, the averaged income growth, young-age ratio and the old-age ratio contain a unit root. Therefore, we have to check in the ECM whether there is a cointegrating relationship present between these variables.

Table B.2: Regression result to test for the significance of the error correction terms

Variables (Dependent Variable: ΔSavings Rate)	Regular	Averaged
Constant	0.36	0.87
	(-1.43)	(3.75)
Savings Rate$_{t-1}$	-0.67	-0.63
	(-3.06)	(-3.94)
Young$_{t-1}$	-0.54	-1.18
	(-1.98)	(-4.22)
Old$_{t-1}$	-1.13	-4.61
	(-0.56)	(-2.58)
Real Income Growth$_{t-1}$		0.02
		(0.11)
D(Real Income PC Growth)	-0.05	-1.13
	(-0.52)	(-3.10)
D(Real Income PC)	$1.12*10^{-4}$	$1.26*10^{-4}$
	(-0.45)	(0.59)
D(Young)	-3.28	-5.06
	(-1.69)	(-3.35)
D(Old)	34.62	58.42
	(1.88)	(3.84)
D(Inflation)	-0.03	0.01
	(-0.37)	(0.09)
D((Real Income PC)$^{-1}$)	-124.56	$1.83*10^{-3}$
	(-1.88)	(0.78)
D(Deposit Rate)	$5.79*10^{-4}$	-265.73
	(-0.20)	(-4.09)
R^2	0.63	0.78
Wald test on significance of the error correction variables[54]	12.22*	36.56***

*** and * signify rejection of the null hypothesis of no presence of a cointegration relation at the 1% and 10% significance levels respectively.

For the regression in which we include one-year growth we have looked at the following regression, where we include the significant cointegrating relation:

$$\begin{aligned} &D(\mathit{Savings\ Rate}_t) \\ &= C_0 + C_1(\mathit{Savings\ Rate}_{t-1} - C_2\mathit{Young}_{t-1} - C_3\mathit{Old}_{t-1}) + C_4D(\mathit{Real\ Income\ PC\ Growth}_t) \\ &+ C_5D(\mathit{Real\ Income\ PC}_t) + C_6D(\mathit{Young}_t) + C_7D(\mathit{Old}_t) + C_8D(\mathit{Inflation}_t) \\ &+ C_9D((\mathit{Real\ Income\ PC}_t)^{-1}) + C_{10}D(\mathit{Deposit\ Rate}_t) \end{aligned}$$

In contrast, for the regression in which we include the five-year averaged growth we have looked at the following regression where we include a cointegration relation, which was significant as is visible in table B.2:

[54] As the Wald test does not have the regular χ^2-distribution, we have used the appropriate critical values from Boswijk, H. Peter (1994), "Testing for an unstable root in conditional and structural error correction models." *Journal of Econometrics*, 63, pp 37-60.

$$
\begin{aligned}
&D(Savings\ Rate_t)\\
&= C_0\\
&+ C_1(Savings\ Rate_{t-1} - C_2 Young_{t-1} - C_3 Old_{t-1} - C_{11} Real\ Income\ Averaged\ Growth_t)\\
&+ C_4 D(Real\ Income\ PC\ Growth_t) + C_5 D(Real\ Income\ PC_t) + C_6 D(Young_t) + C_7 D(Old_t)\\
&+ C_8 D(Inflation_t) + C_9 D((Real\ Income\ PC_t)^{-1}) + C_{10} D(Deposit\ Rate_t)
\end{aligned}
$$

We have looked at the significance of the cointegrating relation through the use of a Wald-test, where the critical values are taken from Boswijk (1994). The null hypothesis of no cointegrating relation has been rejected at the 1% (10% respectively) significance level when using the averaged growth rate (real income growth rate). We therefore include this cointegrating relation in a non-linear model and estimate the corresponding coefficients.

Table B.3: Regression results of the non-linear model to estimate the error correction terms

Variables, or coefficients (Dependent Variable: ΔSavings Rate)	Regular Growth	Averaged Growth
Constant	0.36 (1.43)	0.87 (3.75)
C_1	-0.67 (-3.06)	-0.63 (-3.94)
C_2 (Young)	-0.81 (-2.01)	-1.86 (-3.20)
C_3 (Old)	-1.7 (-0.58)	-7.27 (-2.24)
C_{11}		0.03 (0.11)
D(Real Income PC Growth)	-0.05 (-0.52)	-1.13 (-3.10)
D(Real Income PC)	$1.12*10^{-4}$ (0.45)	$1.26*10^{-4}$ (0.59)
D(Young)	-3.28 (-1.69)	-5.06 (-3.35)
D(Old)	34.62 (1.88)	58.42 (3.84)
D(Inflation)	-0.03 (-0.37)	$5.24*10^{-3}$ (0.09)
D((Real Income PC)$^{-1}$)	-124.56 (-1.88)	-265.73 (-4.09)
D(Deposit Rate)	$5.59*10^{-4}$ (0.20)	$1.83*10^{-3}$ (0.78)
R^2	0.63	0.78

After removing the variables with the lowest t-statistics, one by one we get the following regression, with the test of the joint significance of the removed variables. We can again see that the removed variables do not have coefficients that significantly deviate from zero.

Table B.4: Regression results of the non-linear model to estimate the error correction terms

Variables, or coefficients (Dependent variable: ΔSavings Rate)	Regular Growth
Constant	0.23 (4.29)
C_1	-0.62 (-4.28)
C_2 (Young)	-0.68 (-8.12)
D(Young)	-2.69 (-2.79)
D(Old)	27.19 (3.31)
D((Real Income PC)$^{-1}$)	-92.77 (-4.20)
R^2	0.59
Wald test statistic for the joint significance of the removed variables	0.59
Corresponding P-value	0.99

Table B.5: Regression results of the non-linear model to estimate the error correction terms

Variables, or coefficients (Dependent variable: ΔSavings Rate)	Averaged Growth
Constant	0.27 (5.43)
C_1	-0.64 (-4.96)
C_2 (Young)	-0.83 (-8.21)
C_{11}	-0.58 (-2.42)
D(Young)	-2.05 (-2.32)
D(Old)	28.58 (3.86)
D((Real Income PC)$^{-1}$)	-184.03 (-5.07)
R^2	0.70
Wald test statistic for the joint significance of the removed variables	5.80
Corresponding P-value	0.33

C: Urban Data 1978-2009

Table C.1: The results of the augmented Dickey-Fuller (ADF) test for unit roots within the variables for the urban population

Variable	ADF test-statistic	P-value
Urban S/Y	-2.290	0.425
Urban ΔS/Y	-3.365**	0.021
Urban Real Income pc growth	-4.398***	0.002
Urban Real Income pc 5 yr growth	-1.324	0.601
ΔUrban Real Income pc 5 yr growth	-3.660**	0.012
Urban Young	-3.260*	0.093
Urban Old[55]	-0.206	-
ΔUrban Old[47]	-1.624*	-

***, ** and * signify rejection of the null hypothesis of a unit root at the 1%, 5% and 10% significance levels respectively. The lag lengths to be included are automatically selected based on the SIC information criterion.

Also for the urban population we can see that the savings rate, the averaged income growth and the old-age ratio contain a unit root. Therefore, we have to check in the ECM whether there is a cointegrating relationship present between these variables.

[55] To increase the power for this test, we have used the Dickey-Fuller Generalised Least Squares test proposed by Elliott, Graham, Thomas J. Rothenberg and James H. Stock (1996), "Efficient Tests For An Autoregressive Unit Root" *Econometrica*, v64 (4,Jul), pp. 813-836. Using this test only leads to different results for the Urban Old variable. Note that the way we have performed this test does not give us a P-value.

Table C.2: Regression result to test for the significance of the error correction terms

Variables (Dependent variable: ΔUrban Savings Rate)	Regular	Averaged
Constant	-0.29 (-3.60)	-0.27 (-3.10)
Urban Savings Rate$_{t-1}$	-1.31 (-5.84)	-1.21 (-5.97)
Urban Old$_{t-1}$	6.33 (4.97)	5.99 (4.39)
Urban Real Income Growth$_{t-1}$		-0.03 (-0.16)
D(Urban Real Income PC Growth)	-0.08 (-0.91)	-0.19 (-0.57)
D(Urban Real Income PC)	$1.78*10^{-4}$ (1.75)	$1.54*10^{-4}$ (1.54)
D(Urban Young)	2.35 (2.58)	2.27 (2.19)
D(Urban Old)	14.37 (2.39)	13.52 (2.19)
D(Inflation)	-0.08 (-1.12)	-0.06 (-0.78)
D((Urban Real Income PC)$^{-1}$)	-170.29 (-2.38)	-160.92 (-2.18)
D(Deposit Rate)	$-7.85*10^{-4}$ (-0.27)	$-2.09*10^{-4}$ (-0.07)
R²	0.78	0.78
Wald test on significance of the error correction variables[56]	36.31***	37.31***

*** signifies rejection of the null hypothesis of no presence of a cointegration relation at the 1% significance level.

For the regression in which we include one-year growth we have looked at the following regression:

$$\begin{aligned} &D(Savings\ Rate_t) \\ &= C_0 + C_1(Urban\ Savings\ Rate_{t-1} - C_2 Urban\ Old_{t-1}) \\ &+ C_3 D(Urban\ Real\ Income\ PC\ Growth_t) + C_4 D(Urban\ Real\ Income\ PC_t) \\ &+ C_5 D(Urban\ Young_t) + C_6 D(Urban\ Old_t) + C_7 D(Inflation_t) \\ &+ C_8 D((Urban\ Real\ Income\ PC_t)^{-1}) + C_9 D(Deposit\ Rate_t) \end{aligned}$$

Similarly, for the regression in which we include the five-year averaged growth we have looked at the following regression:

[56] As the Wald test does not have the regular χ^2-distribution, we have used the appropriate critical values from Boswijk, H. Peter (1994), "Testing for an unstable root in conditional and structural error correction models." *Journal of Econometrics*, 63, pp 37-60.

$$
\begin{aligned}
&D(\mathit{Savings\ Rate}_t)\\
&= C_0\\
&+ C_1(\mathit{Urban\ Savings\ Rate}_{t-1} - C_2\mathit{Urban\ Old}_{t-1}\\
&- C_{11}\mathit{Urban\ Real\ Income\ Averaged\ Growth}_t) + C_3D(\mathit{Urban\ Real\ Income\ PC\ Growth}_t)\\
&+ C_4D(\mathit{Urban\ Real\ Income\ PC}_t) + C_5D(\mathit{Urban\ Young}_t) + C_6D(\mathit{Urban\ Old}_t)\\
&+ C_7D(\mathit{Inflation}_t) + C_8D((\mathit{Urban\ Real\ Income\ PC}_t)^{-1}) + C_9D(\mathit{Deposit\ Rate}_t)
\end{aligned}
$$

The null hypothesis of no cointegrating relation has been rejected at the 1% significance level in both cases. The cointegrating relation therefore turns out to be significant and should be included in the ECM.

Table C.3: Regression results of the non-linear model to estimate the error correction terms

Variables, or coefficients (Dependent variable: ΔUrban Savings Rate)	Regular Growth	Averaged Growth
Constant	-0.29 (-3.60)	-0.30 (-3.29)
C_1	-1.31 (-5.84)	-1.33 (-5.63)
C_2 (Urban Old)	4.83 (6.42)	4.98 (5.92)
C_{11}		-0.05 (-0.41)
D(Urban Real Income PC Growth)	-0.08 (-0.91)	-0.11 (-0.95)
D(Urban Real Income PC)	$1.78*10^{-4}$ (1.75)	$1.78*10^{-4}$ (1.71)
D(Urban Young)	2.35 (2.58)	2.18 (2.15)
D(Urban Old)	14.37 (2.39)	14.71 (2.37)
D(Inflation)	-0.08 (-1.12)	-0.09 (-1.17)
D((Urban Real Income PC)$^{-1}$)	-170.29 (-2.38)	-180.52 (-2.33)
D(Deposit Rate)	$-7.85*10^{-4}$ (-0.27)	$-7.01*10^{-4}$ (-0.23)
R^2	0.78	0.78

After removing the variables with the lowest t-statistics, one by one we get the following regression, with the test of the joint significance of the removed variables. Again the removed variables when using the averaged growth rate in the regression do not have coefficients significantly different from zero and therefore can be excluded in the regression.

Table C.4: Regression results of the non-linear model to estimate the error correction terms

Variables, or coefficients (Dependent variable: ΔUrban Savings Rate)	Regular Growth
Constant	-0.23 (-2.74)
C_1	-1.28 (-6.79)
C_2 (Urban Old)	4.28 (6.44)
D(Urban Real Income PC)	$2.20*10^{-4}$ (2.94)
D(Urban Young)	1.75 (2.13)
D(Urban Old)	16.57 (2.79)
R^2	0.67
Wald test statistic for the joint significance of the removed variables	8.74
Corresponding P-value	0.07

Table C.5: Regression results of the non-linear model to estimate the error correction terms

Variables, or coefficients (Dependent variable: ΔUrban Savings Rate)	Averaged Growth
Constant	-0.25 (-3.59)
C_1	-0.89 (-4.90)
C_2 (Urban Old)	6.06 (10.40)
C_{11}	
D(Urban Young)	3.12 (3.65)
D((Urban Real Income PC)$^{-1}$)	-128.27 (-2.81)
R^2	0.57
Wald test statistic for the joint significance of the removed variables	8.45
Corresponding P-value	0.21

D: Rural Data 1978-2009

Table D.1: The results of the augmented Dickey-Fuller (ADF) test for unit roots within the Rural variables.

Variable	ADF test-statistic	P-value
Rural S/Y	-1.571	0.485
Rural ΔS/Y	-4.629***	0.001
Rural Real Income pc growth	-3.315**	0.023
Rural Real Income pc growth 5yr	-2.472	0.133
ΔRural Real Income pc growth 5yr	-3.469***	0.001
Rural Young	-3.252*	0.094
Rural Old	-2.430	0.358
ΔRural Old	-2.782*	0.073

***, ** and * signify rejection of the null hypothesis of a unit root at the 1%, 5% and 10% significance levels respectively. The lag lengths to be included are automatically selected based on the SIC.

Similarly, for the rural population we can see that the savings rate, the averaged income growth and the old-age ratio contain a unit root. Therefore, we have to check in the ECM whether there is a cointegrating relationship present between these variables.

Table D.2: Regression result to test for the significance of the error correction terms

Variables (Dependent variable: ΔRural Savings Rate)	Regular	Averaged
Constant	-0.01	-0.05
	(-0.14)	(-0.57)
Rural Savings Rate$_{t-1}$	-0.16	-0.27
	(-1.09)	(-1.31)
Rural Old$_{t-1}$	0.47	0.00
	(0.51)	(0.55)
Rural Real Income Growth$_{t-1}$		1.07
		(0.86)
D(Rural Real Income PC Growth)	0.05	$2.57*10^{-3}$
	(0.56)	(0.41)
D(Rural Real Income PC)	$-1.87*10^{-4}$	0.00
	(-0.41)	(-0.69)
D(Rural Young)	1.17	1.12
	(0.66)	(0.60)
D(Rural Old)	3.85	3.92
	(0.46)	(0.46)
D(Inflation)	0.03	$-8.86*10^{-5}$
	(0.30)	(0.00)
D((Rural Real Income PC)$^{-1}$)	-70.57	-64.24
	(-1.50)	(-1.18)
D(Deposit Rate)	$-3.83*10^{-3}$	$-3.63*10^{-3}$
	(-0.94)	(-0.83)
R^2	0.45	0.45
Wald test on significance of the error correction variables[57]	1.27	1.97

The wald test, using the appropiate critical values does not allow us to reject the null hypothesis of no presence of a cointegration relation at the 10% significance levels.

For the regression in which we include one year growth we have looked at the following regression:

$$
\begin{aligned}
&D(Savings\ Rate_t)\\
&= C_0 + C_1(Rural\ Savings\ Rate_{t-1} - C_2 Rural\ Old_{t-1})\\
&+ C_3 D(Rural\ Real\ Income\ PC\ Growth_t) + C_4 D(Rural\ Real\ Income\ PC_t)\\
&+ C_5 D(Rural\ Young_t) + C_6 D(Rural\ Old_t) + C_7 D(Inflation_t)\\
&+ C_8 D((Rural\ Real\ Income\ PC_t)^{-1}) + C_9 D(Deposit\ Rate_t)
\end{aligned}
$$

Similarly, for the regression in which we include the five-year averaged growth we have looked at the following regression:

[57] As the Wald test does not have the regular χ^2-distribution, we have used the appropriate critical values from Boswijk, H.Peter. (1994). "Testing for an unstable root in conditional and structural error correction models." *Journal of Econometrics*, 63 , pp 37-60.

$$
\begin{aligned}
&D(Savings\ Rate_t)\\
&= C_0\\
&+ C_1(Rural\ Savings\ Rate_{t-1} - C_2 Rural\ Old_{t-1}\\
&- C_{11} Rural\ Real\ Income\ Averaged\ Growth\ Rate_{t-1})\\
&+ C_3 D(Rural\ Real\ Income\ PC\ Growth_t) + C_4 D(Rural\ Real\ Income\ PC_t)\\
&+ C_5 D(Rural\ Young_t) + C_6 D(Rural\ Old_t) + C_7 D(Inflation_t)\\
&+ C_8 D((Rural\ Real\ Income\ PC_t)^{-1}) + C_9 D(Deposit\ Rate_t)
\end{aligned}
$$

The null hypothesis of no cointegrating relation has not been rejected at the 10% significance level in both cases. The cointegrating relation does not turn out to be significant and should not be included in the ECM. We, therefore, only need to estimate a linear model in both cases.

Table D.3: Regression results of the linear model to estimate the error correction terms, the cointegration relation was found not to be significant, so it is excluded from this regression

Variables (Dependent variable: ΔRural Savings Rate)	Regular Growth	Averaged Growth
Constant	0.02	0.02
	(0.74)	(0.64)
D(Rural Real Income PC Growth)	0.09	$1.78*10^{-3}$
	(1.02)	(0.46)
D(Rural Real Income PC)	$-1.96*10^{-4}$	$-2.03*10^{-4}$
	(-0.91)	(-0.88)
D(Rural Young)	2.05	1.80
	(1.40)	(1.12)
D(Rural Old)	0.49	0.60
	(0.07)	(0.09)
D(Inflation)	0.02	-0.02
	(0.16)	(-0.17)
D((Rural Real Income PC)$^{-1}$)	-79.90	-76.39
	(-2.47)	(-2.07)
D(Deposit Rate)	$-2.62*10^{-3}$	$-2.26*10^{-3}$
	(-0.68)	(-0.56)
R^2	0.41	0.39

After removing the variables with the lowest t-statistics, one by one we get the following regression, with the test of the joint significance of the removed variables. The test for the joint significance of deviation of the coefficients of the removed variables from zero does not turn out to be larger than the critical values. Therefore, these do not significantly deviate from zero and can be excluded from the regression.

Table D.4: Regression results of the non-linear model to estimate the error correction terms

Variables (Dependent variable: ΔRural Savings Rate)	**Regular Growth**
Constant	0.02
	(1.92)
D(Rural Young)	2.08
	(2.84)
D((Rural Real Income PC)$^{-1}$)	-73.23
	(3.93)
R²	0.36
Wald test statistic for the joint significance of the removed variables	2.78
Corresponding P-value	0.73

Table D.5: Regression results of the non-linear model to estimate the error correction terms

Variables (Dependent variable: ΔRural Savings Rate)	**Averaged Growth**
Constant	0.02
	(1.92)
D(Rural Young)	2.08
	(2.84)
D((Rural Real Income PC)$^{-1}$)	-73.23
	(3.93)
R²	0.36
Wald test statistic for the joint significance of the removed variables	1.88
Corresponding P-value	0.87

IV Are Individuals in China Prone to Money Illusion?*

"It isn't the sum you get, it's how much you can buy with it, that's the important thing; and it's that that tells whether your wages are high in fact or only high in name."

Mark Twain *A Connecticut Yankee in King Arthur's Court* (1889)

1. Introduction

The term "money illusion" refers to a tendency to think in terms of nominal monetary values rather than real monetary values. The relevant literature presents various experiments to establish whether people are subject to money illusion, and various potential psychological causes that underlie this phenomenon. In this paper we examine how respondents in Beijing, China, respond to changes in inflation and prices, using the questionnaire designed and implemented by Shafir, Diamond and Tversky (1997).

We set out to examine whether there is money illusion in China. In addition, we examine whether respondents in China tend to think in different terms about economic transactions than respondents in the United States, where the original questionnaire was held. Shafir, Diamond and Tversky (1997) conclude on the basis of the responses to the survey that money illusion is a widespread phenomenon in the United States. As (an unexpected bout of) inflation hurts creditors and aids debtors, we expect respondents in China, which is a creditor nation, to be less susceptible to money illusion than respondents in the United States, which is a debtor nation (Okimoto, 2009).

Our survey-based findings suggest that money illusion is prevalent in China just like in the United States. However, respondents in our sample are in general less prone to money illusion than respondents in the sample of Shafir et al. If asked explicitly to evaluate an economic transaction in terms of happiness or satisfaction, respondents in our sample are as likely as respondents in Shafir et al.'s sample to prefer the transaction with the highest nominal monetary value instead of the economic transaction with the highest real monetary value.

As recent research shows that money illusion may play a much greater and more disruptive role in the economy than economists have allowed for in the past, both with regard to the functioning of the labor market (Mees, 2011) as well as the housing market (Brunnermeier and Julliard (2008), Bernanke (2010)), it is important to shed further light on the phenomenon in all its forms, and its implications for economic theory.

The outline of our paper is as follows. We first give a review of the relevant economic literature on money illusion. Next, in Section 3, we discuss potential occurrences of money illusion in China. Section 4 deals with the main contribution of our study, which is the survey and the responses, for which we interviewed many Chinese individuals. This unique dataset allows us to answer the question in the title. In Section 5 we conclude with a discussion of the main results, the implications for economic theory and we suggest avenues for further research.

---

* Together with Philip Hans Franses

2. Existing Literature

In the early '20s John Maynard Keynes coined the term 'money illusion' to describe the tendency of people to be fooled by thinking in nominal rather than real terms, ignoring the effect of inflation on the purchasing power of money. A few years later Irving Fisher devoted an entire book to the subject (Fisher, 1928). But even though money illusion was recognized early on in the economic literature (see also Leontief (1936) and Patinkin (1965)), mainstream economists have generally considered money illusion an anathema, as the phenomenon is irreconcilable with the rational expectations postulate (Fehr and Tyran, 2001, page 1239).

That did, however, not prevent Shafir, Diamond and Tversky (1997) from drafting a fascinating questionnaire and collecting evidence that people often tend to think about economic transactions in both nominal and real terms, resulting in a bias toward a nominal evaluation. Shafir, Diamond and Tversky (1997) conclude on the basis of the responses to their survey that money illusion is a widespread phenomenon in the United States.

There have also been more experimental approaches to money illusion. Using a pricing game with students in Switzerland as participants, Fehr and Tyran (2001) show that seemingly innocuous differences in payoff representation cause pronounced differences in nominal price inertia, indicating the behavioral importance of money illusion. Moreover, money illusion causes asymmetric effects of negative and positive nominal shocks. While nominal inertia is rather small after a positive shock, it is quite substantial after a negative shock. This may account for downward wage stickiness in the U.S. in the 2000s (Mees, 2011). Noussair, Richter, and Tyran (2008) find an asymmetry in the price response to inflationary and deflationary nominal shocks in a laboratory asset market situation as well.

Brunnermeier and Julliard (2008) show that a reduction in inflation can fuel run-ups in housing prices if people suffer from money illusion. They mistakenly assume that real and nominal interest rates move in lockstep. Hence, they wrongly attribute a decrease in inflation to a decline in the real interest rate and consequently underestimate the real cost of future mortgage payments. According to Brunnermeier and Julliard (2008), inflation and nominal interest rates explain a large share of the mispricing in the British housing market from 1966 to 2004.

Bernanke (2010) asserts that mortgages with exotic features, which lowered monthly mortgage installments significantly, are to blame for the U.S. housing boom in the 2000s. This suggests not so much money *illusion* on the part of economic subjects, but rather money *delusion*. Regardless of the veracity of Bernanke's claim (mortgages with exotic features accounted for less than 5 percent of total mortgage originations from 2000 – 2006 (Mees, 2011)), Brunnermeier and Julliard (2008) find for the United States a similar link between housing market mispricing and inflation as for the United Kingdom.

Liu (2010) suggests that money illusion may account to a large extent for the mechanism of sharp run-ups in stock prices during the low inflation period in China. Chinese investors failed to recognize that the nominal dividend growth rate would drop significantly, and estimated the value of the future nominal dividend growth rate simply by extrapolating the historical nominal dividend growth rate. According to Liu, long-term low inflation spurred China's stock market to rise sharply twice via the money illusion effect last decade.

In view of the findings of Brunnermeier and Julliard (2008), Bernanke (2010) and Liu (2010), money illusion may be of greater economic significance than most mainstream economists allow for, because of the interaction between the housing market, stock market and the real economy. Given its potential impact on the functioning of the economy, it is of interest to see whether money illusion also holds for China.

3. The Occurrence of Money Illusion in China

Shafir, Diamond and Tversky (1997) distinguish three phenomena in the real economy that suggest the existence of money illusion on the part of economic subjects.[58] One is that prices are sticky. A second is that indexing does not occur in contracts and laws in times of relatively low inflation, as theory would predict. The third occurrence is through conversation, rather than behavior, that is, people talk and write in ways that seem to indicate some confusion between money's nominal and real value. We would like to add a fourth phenomenon to the previous ones, which occurs at the intersection of asset markets and the real economy, and that is that parameters from the real economy (interest, dividends) are used as yardsticks for asset pricing.

Within the context of China, which still has abundant characteristics of a centrally planned economy, price stickiness may primarily be the result of price and quantity controls.[59] Kim, Nan, Wan and Wu (2011), for example, find that significant price stickiness exists for U.S. imports from China. The mean duration is 11 months compared to 7 months for China imports from the United States. The price stickiness of U.S. imports from China however declined after June 2005, when China switched from a fixed exchange rate regime to a managed floating one (Kim et al. (2011).

Compared to the United States and Europe, you find in China less indexed contracts, which should not come as a complete surprise as China is still very much an economy in transition. As noted by Shafir, Diamond and Tversky (1997), even in developed economies you do not find indexed contracts in nearly as many places as economic theory suggests they should be found. As China is the largest foreign holder of U.S. Treasuries and agency bonds, it is worthwhile to note that only few are so-called treasury inflation-protected securities (TIPS) that hold their value as inflation rises.[60]

With regard to stock markets, Liu (2010) suggests that money illusion played a major role in the sharp run-ups in Chinese stock prices. There is not similar research available for China's still young housing market, which is often deemed to be in bubble-territory. Since the traditional regime of welfare-oriented home distribution was terminated in 1998 and the housing market was liberalized, mortgage loans have become the primary home financing tool for Chinese citizens. Though Hong and Chen (2010) conclude that there is a strong correlation between mortgage credit and housing prices, the variation in inflation and mortgage rates over 10 years is insufficient to find a link between housing market mispricing and inflation.

[58] See Shafir, Diamond and Tversky (1997) for an in-depth discussion of money illusion in the US.

[59] In an attempt to dampen inflation, the Chinese government in 2010 announced price controls and said it would put state commodity reserves (grains, edible oils and sugar) on the market when necessary in order to guarantee supplies (*China Daily*, November 17, 2010). In May 2011 Unilever got fined $300,000 for simply talking about plans to raise prices (*Christian Science Monitor*, May 9, 2011).

[60] The US Treasury Department, responding to growing demand from China and other investors, announced in August 2009 that it would boost the sale of inflation-protected bonds (*Wall Street Journal*, August 6, 2009).

4. The Survey

In this section we will examine whether money illusion is prevalent in China as well. For that purpose we replicate a well-established survey, which was implemented in Shafir, Diamond and Tversky (1997). We translated the survey questions designed by Shafir, Diamond and Tversky (1997) to (simplified) Chinese, using Chinese names and adapting prices and dates to present respondents with realistic choices in the context of Beijing anno 2011. Shafir, Diamond and Tversky collected responses from people in Newark International Airport and in two New Jersey shopping malls. In addition, they surveyed undergraduate students at Princeton University. As the responses from these groups did not differ significantly, Shafir, Diamond and Tversky reported the data in a combined format.

We collected responses from undergraduate students from the economic departments at Peking University (1/2) and Tsinghua University in Beijing (1/4), as well as from workers at Alibaba, a tech company with a large office in Beijing (1/4).[61] The undergraduate students were about 19 – 21 years old and the Alibaba workers were in their mid twenties and early thirties. The students were of both sexes, while the majority of Alibaba workers were male.

The survey questions were in part handed out on paper sheets (3/4) and in part collected through an Internet survey tool (1/4). More than 400 respondents participated in the survey. For each problem below we will report the exact number of respondents. Where appropriate, respondents were presented with only one version of the problem at hand. With respect to problem 1, for example, we asked one group of respondents to make a decision based on economic terms, another group of respondents to make a decision in terms of happiness and still another group of respondents to make a decision based on job attractiveness. Problem 4 was presented in six different versions to six different groups. For each (version of a) problem we had at least as many respondents as for the original 1997 survey, but often we had many more respondents than Shafir, Diamond and Tversky (1997).

Although neither sample is representative of the respective general populations, we believe that it is nonetheless worthwhile to compare the results of Shafir, Diamond and Tversky (1997) with our results. Shafir et al. indicate that their sample is drawn from people in New Jersey shopping malls and Newark airport as well as from undergraduate students at Princeton University without specifying the number of respondents in each group.[62] Since general background information such as gender, age and profession is lacking in their study, we cannot determine the differences between their and our sample using statistical tests. The fact that respondents in China and in the United States respond in virtually the same way to two specific questions pertaining to job satisfaction (see problem 1 and 7), may serve as an indication that the samples are in fact comparable.

We test the differences between the scores for the United States and China by using the following test. Denote p_2 as the relevant fraction in the sample of size N_2 (China) and p_1 as the associated fraction in the sample of size N_1 (U.S.). Further, denote p as the relevant total fraction in the total sample N_1+N_2. The test statistic is then given by

[61] We decided not to collect responses in public places, as it was highly unlikely that we would get official clearance from Chinese authorities amid the popular uprisings in the Arab world at the time.

[62] A repeated request to the authors for information about the number of respondents in each group was left unanswered.

$$\frac{p_2 - p_1}{\sqrt{p(1-p)(\frac{1}{N_1} + \frac{1}{N_2})}} \sim N(0,1)$$

Each time we evaluate the fractions for China relative to the fractions for the U.S., assuming that it each time deals with a binary choice. We indicate significant differences at the 5% level with a * and at the 1% level with **. To test whether the scores for China amount to randomness with a probability 0.5 in case of two choice options and 0.33 in case of three, we use the familiar test. We indicate significant differences at the 5% level with a + and at the 1% level with ++.

A. Earnings

The following survey presented three different groups of subjects with a scenario involving two individuals who receive raises in salary. One group was asked to rate the two protagonists' salary raises on purely "economic terms;" a second group was asked to indicate which of the two they thought would be happier; the third group was asked to indicate which of the two was more likely to leave her present job for another position. (To the right of each option is the percentage of subjects who chose it, while the percentage in parentheses reflects the U.S.-based results given by Shafir, Diamond and Tversky).

Problem 1

Consider two individuals, Li Li and Wang Lan, who graduated from the same college a year apart. Upon graduation, both took similar jobs with publishing firms. Li Li started with a yearly salary of ¥120,000. During her first year on the job there was no inflation, and in her second year Li Li received a 2% (¥2400) rise in salary. Wang Lan also started with a yearly salary of ¥120,000. During her first year on the job there was 4% inflation, and in her second year Wang Lan received a 5% (¥6000) rise in salary.

Economic terms (N=137):

As they entered their second year on the job, who was doing better in economic terms?

Li Li: 82% (++) (71%)* Wang Lan: 18%(++) (29%)*

Happiness (N=138):

As they entered their second year on the job, who do you think was happier?

Li Li: 39%(+) (36%) Wang Lan: 61%(+) (64%)

Job attractiveness (N=134):

As they entered their second year on the job, each received a job offer from another firm. Who do you think was more likely to leave her present position for another job?

Li Li: 65%(++) (65%) Wang Lan: 35%(++) (35%)

Just as in Shafir, Diamond and Tversky (1997), the majority of respondents correctly evaluate the above scenario in real rather than in nominal terms when economic terms are emphasized. However, significantly more respondents in China than in the United States (82% versus 71%) were likely to evaluate the scenario correctly, suggesting that respondents in China better seem to understand the logic of inflation. An alternative explanation may be that more respondents in the United States than in China have interpreted 'economic terms' sufficiently broadly to incorporate happiness and/or job attractiveness.

When the emphasis is not on economic terms, but on terms like 'happiness' and 'job attractiveness' instead, the majority of Chinese respondents prefer the transaction that is most attractive in nominal terms. In this instance the outcome among Chinese respondents is precisely the same as among American respondents. Just like in the United States, wellbeing in China is driven primarily by a nominal rather than a real evaluation.

B. Transactions

If we consider people's assessment of specific transactions instead of income, we see below that respondents in China are twice as likely to assess the transactions represented to them correctly in real terms rather than in economic terms.

> Problem 2 (N=415):
>
> Suppose Zhang, Wang and Li each received an inheritance of ¥800,000 and each used it immediately to purchase a house. Suppose that each of them sold the house a year after buying it. Economic conditions, however, were different in each case:
>
> * When Zhang owned the house, there was a 25% deflation – the prices of all goods and services decreased by approximately 25%. A year after Zhang bought the house, he sold it for ¥616,000 (23% less than he paid).
>
> * When Wang owned the house, there was no inflation or deflation – prices had not changed significantly during that year. He sold the house for ¥792,000 (1% less than he paid for it).
>
> * When Li owned the house, there was 25% inflation – all prices increased by approximately 25%. A year after he bought the house, Li sold it for ¥984,000 (23% more than he paid).
>
> Please rank Zhang, Wang, and Li in terms of the success of their house-transactions. Assign '1' to the person who made the best deal and '3' to the person who made the worst deal.

	Zhang		Wang		Li	
Nominal transaction:	– 23%		– 1%		+ 23%	
Real transaction:	+ 2%		– 1%		– 2%	

Rank:

	Zhang		Wang		Li	
1st:	64% (++)	(37%)**	12% (++)	(17%)*	12% (++)	(48%)**
2nd:	13% (++)	(10%)	80% (++)	(73%) *	18% (++)	(6%)**
3rd:	23%	(53%) **	8% (++)	(10%)	70% (++)	(36%)**

Note that the question was to assess Zhang, Wang, and Li's transactions in terms of "success," which is a rather neutral phrasing that does not frame the case in economic terms, or in terms of happiness for that matter. Compared to respondents in the United States, respondents in China were twice as likely to rank Zhang, who had the best deal in real terms but the worst deal in nominal terms, number 1 and also twice as likely to rank Li, who had the best deal in nominal terms but the worst deal in real terms, number 3. Also respondents in China were more likely than respondents in the United States to rank Wang correctly as the person who had the second best deal. The differences are significant and suggest that respondents in China are either (much) better at understanding the logic of inflation than their peers in the United States, or they are more likely to conceive "success" in economic terms while respondents in the United States are more likely to conceive "success" in terms of happiness. In view of the previous results (problem 1), we propose that it is a combination of both.

Problem 3:

Changes in the economy often have an effect on people's financial decisions. Imagine that China experienced unusually high inflation that affected all sectors of the economy. Imagine that within a six-month period all benefits and salaries, as well as the prices of all goods and services, went up by approximately 25%. You now earn and spend 25% more than before.

Six months ago, you were planning to buy a leather armchair whose price during the 6-month period went up from ¥3200 to ¥4000. Would you be more or less likely to buy the armchair now? (N=209)

More:	Same:	Less:
19% (++) (7%)**	29% (55%)**	59% (++) (38%)**

Six months ago, you were also planning to sell an antique desk you own, whose price during the 6-month period went up from ¥3200 to ¥4000. Would you be more or less likely to sell your desk now? (N=202)

More:	Same:	Less:
15% (++) (43%)**	17% (++) (42%)**	68% (++) (15%)**

While inflation makes respondents in the United States more likely to sell at higher prices and less likely to buy at higher prices, a majority of respondents in China exhibit significantly greater wariness to buy as well as to sell at higher prices. This may seem at odds with the previous outcome (problem 2), where the judgment of respondents in China did not seem to be clouded by inflation, but is not. In problem 2 respondents were asked to evaluate – ex-post – transactions that had already taken place, following decisions taken by others. Respondents were not asked to reflect on whether they themselves would have been more likely to sell a house at a lower nominal price but higher real price, or vice versa.

In problem 3, on the other hand, respondents were asked whether they themselves would be more or less likely to buy or sell (durable) consumption goods in times of high inflation. The fact that respondents in China are less likely to engage in economic transactions of any kind in times of high inflation probably does not imply money illusion. After all, if that were the case you would see an asymmetry with regard to buying and selling (less likely to buy, more likely to sell). The actual outcome may well reflect (1) path-dependence of inflation expectations (respondents in China expect prices to increase even further), (2) a more general association of inflation with economic hardship that may result in economic paralysis at the level of the individual, or a combination of (1) and (2).[63]

C. Contracts

We asked subjects to consider signing a contract for a future transaction in an inflationary context, and to decide whether to agree upon a specified amount to be paid upon delivery or, instead, agree to pay whatever the price is at the future time. A risk-averse decision-maker is likely to prefer an indexed contract since, at a future time, a predetermined nominal amount may be worth more or less than its anticipated real worth. On the other hand, a nominally risk-averse decision maker may perceive indexed contracting as riskier as the indexed amount may end up being greater or smaller in nominal terms than a fixed dollar amount (Shafir, Diamond and Tversky, 1997). The following problem was presented in China in the spring of 2011.

> <u>Problem 4-1 (N=68):</u>
>
> Imagine that you are the head of a corporate division located in Singapore that produces office computer systems. You are now about to sign a contract with a local firm for the sale of new systems, to be delivered in January 2013.
>
> These computer systems are currently priced at ¥4000 a piece but, due to inflation, all prices, including production costs and computer prices, are expected to increase during the next couple of years. Experts' best estimate is that prices in Singapore two years from now will be about 20% higher, with an equal likelihood that the increase will be higher or lower than 20%. The experts agree that a 10% increase in all prices is just as likely as a 30% increase.
>
> You have to sign the contract for the computer systems now. Full payment will be made only upon delivery in January 2013. Two contracts are available to you. Indicate your preference between the contracts by checking the appropriate contract below:

[63] Nineteen percent of respondents in China (versus 7 percent in the US) indicated that they were more likely to buy at a higher price, which suggests that they expected further price increases and hoped to beat future inflation.

One group of subjects chose between contracts A and B below.

Contracts framed in real terms:

Contract A: You agree to sell the computer systems (in 2013) at ¥4800 a piece, no matter what the price of computer systems is at that time. Thus, if inflation is below 20% you will be getting more than the 2013-price, whereas if inflation exceeds 20% you will be getting less than the 2013-price. Because you have agreed on a fixed price, your profit level will depend on the rate of inflation.

59% (19%)**

Contract B: You agree to sell the computer systems at 2013's price. Thus, if inflation exceeds 20%, you will be paid more than ¥4800, and if inflation is below 20%, you will be paid less than ¥4800. Because both production costs and prices are tied to the rate of inflation, your "real" profit will remain essentially the same regardless of the rate of inflation.

41% (81%)**

<u>Problem 4-2 (N=70):</u>

Another group of subjects chose between contracts C and D:

Contracts framed in nominal terms:

Contract C: You agree to sell the computer systems (in 2013) at ¥ 4800 a piece, no matter what the price of computer systems is at that time.

53% (41%)

Contract D: You agree to sell the computer systems at 2013's price. Thus, instead of selling at ¥4800 for sure, you will be paid more if inflation exceeds 20%, and less if inflation is below 20%.

47% (59%)

<u>Problem 4-3 (N=69):</u>

A third group of subjects was presented with the following, neutral version of the problem:

Contracts under a neutral frame:

Contract E: You agree to sell the computer systems (in 2013) at ¥4800 a piece, no matter what the price of computer systems is at that time.

60% (46%)

Contract F: You agree to sell the computer systems at 2013's prices.

40% (54%)

We have run a second version of the above study; this time exploring people's contracting preferences as buyers rather than sellers. The following problem, along with the alternative framings of contract choices, is identical to those of Problem 4 except that the subject is now buying instead of selling.

<u>Problem 4-4 (N=66):</u>

Contracts framed in real terms:

Contract A': You agree to buy the computer systems (in 2013) at ¥ 4800a piece, no matter what the price of computer systems is at that time. Thus, if inflation exceeds 20%, you will be paying for the computers less than the 2013-price, whereas if inflation is below 20%, you will be paying more than the 2013-price. Because you have agreed on a fixed price, your profit level will depend on the rate of inflation.

50% (36%)

Contract B': You agree to buy the computer systems at 2013's price. Thus, if inflation exceeds 20%, you will pay more than ¥4800, and if inflation is below 20%, you will pay less than ¥4800. Because the prices of both computer systems and financial services are tied to the rate of inflation, your "real" profit will remain essentially the same regardless of the rate of inflation.

50% (64%)

<u>Problem 4-5 (N=67):</u>

Contracts framed in nominal terms:

Contract C': You agree to buy the computer systems (in 2013) at ¥4800 a piece, no matter what the price of computer systems is at that time.

60% (51%)

Contract D': You agree to buy the computer systems at 2013's price. Thus, instead of buying at ¥4800 for sure, you will pay more if inflation exceeds 20%, and less if inflation is below 20%.

40% (49%)

<u>Problem 4-6 (N=68):</u>

Contracts under a neutral frame:

Contract E': You agree to buy the computer systems (in 2013) at ¥4800 apiece, no matter what the price of computer systems is at that time.

58% (52%)

Contract F': You agree to buy the computer systems at 2013's price.

42% (48%)

In the United States the framing of the problem – either in real, nominal or neutral terms – significantly influenced respondents' choices between contracts. In China, on the other hand, the framing of the problem did not notably impact respondents' choices. A majority of respondents in China preferred the option that was risky in real terms, no matter how the decision was framed although the differences found were often not significant.

The outcome of problems 4-1 through 4-6 reinforces the notion that respondents in our sample in China are less clouded by the "veil of money" (Schumpeter, 1908) compared to respondents in Shafir et al.'s sample in the United States While respondents in the United States exhibit frame-dependent risk-aversion (a larger proportion opt for the contract that is nominally riskless when the contracts are framed in nominal terms than when they are framed in real terms), we do not find frame-dependent risk-aversion in China. Not only does the framing of the question not predict the outcome, also respondents in China exhibit risk-preference instead of risk-aversion (in real terms at least), which somewhat runs counter to common (western) perceptions about Asian culture. The demographics of our respondents (young and talented with a promising future), the demographics of China in general (the population is so vast that you cannot stand out by playing safe), or – most likely – a combination of both, may account for this result.

D. Mental accounting

Money illusion may arise from the use of historic cost, which can differ from replacement cost because of a change in the value of money or because of a change in relative prices. With nominal and real prices changing, people's assessment of the value of their possessions may present them with some conflicting intuitions, as illustrated by the following problem that Shafir and Thaler (1996) presented to experienced wine collectors and subscribers to a wine newsletter in the United States. We did not look for wine connoisseurs in China. Judging by Shafir, Diamond and Tversky (1997), however, that should not prejudice the plausibility of our outcome. They presented a variant of the problem to students at Princeton University, which yielded identical results as the problem presented to wine connoisseurs. So, we will do that also for our survey participants in China.

Problem 5 (N=415):

Suppose you bought a case of good 1982 Bordeaux in the futures market for ¥160 a bottle. The wine now sells at auction for about ¥600 a bottle. You have decided to drink a bottle of this wine with dinner.

Which of the following best captures your feeling of the cost to you of drinking this bottle?

Costs ¥600	48% (++)	(20%)**
Doesn't cost anything	25% **(++)**	**(**30%)
Feels like saving ¥440	27% (++)	**(**25%)

Shafir and Thaler (1996) included two other possibilities (feels like it costs $20 (historic cost) and feels like it costs $20 plus interest) so the results are not entirely comparable. However, the observation that respondents in China were more than twice as likely to see the replacement cost as the actual cost of drinking the bottle of wine, suggests that they are less susceptible to money illusion.

Problem 6 (N=412):

Two competing bookstores have in stock an identical leather-bound edition of Oscar Wilde's collected writings. Store A bought its copies for 80 ¥ each. Liu, who works for Store A, has just sold 100 copies of the book to a local high school for ¥176 a copy. Store B bought its copies a year after Store A. Because of a 10% yearly inflation, Store B paid ¥88 per copy. Xiao Wu, who works for Store B, has just sold 100 copies of the book to another school for ¥180 a copy.

Who do you think made a better deal selling the books, Liu or Xiao Wu?

Liu	69% (++)	(87%)**
Xiao Wu	31% (++)	(13%)**

Like in the United States, a majority of respondents in China perceived Liu, who had the highest profit margin in nominal terms, as having the better book selling deal. But just as in previous cases, we see that respondents in China are less likely to be guided by nominal monetary values than by real monetary values, indicating that they are significantly less prone to money illusion.

E. Fairness and morale

Community standards of fairness appear to have a significant influence on economic behavior. The perception of fairness is expected to impinge on worker morale and, consequently, may have implications for actual job decisions. To explore this issue, we presented respondents in China with the hypothetical scenario below, followed by one of two questions. Half the subjects received the "morale" question, the other half the "job decision" question:

Problem 7:

Ablex and Booklink are two publishing firms, each employing a dozen editors. Because the firms are small, unequal raises in salary can create morale problems. In a recent year of no inflation, Ablex gave half its editors a 6% raise in salary and the other half a 1% rise. The following year there was 9% inflation, and Booklink gave half its editors a 15% raise in salary and the other half a 10% rise.

Morale (N=204):

In which firm do you think there were likely to be more morale problems?

Ablex	51% (++)	(49%)
Booklink:	27%	(8%)**
Same in both:	21% (++)	(43%)**

Job decision (N=202):

Suppose that an editor who received the lower raise in each firm was then offered a job with a competing company. Which editor do you think was more likely to leave their present position for another job?

The editor who received the lower raise in Ablex	60% (++)	(57%)
The editor who received the lower raise in Booklink	7% (++)	(5%)
The two were equally likely	33%	(38%)

Problem 7 describes two situations where salary raises were the same in real terms, but proportionally different in nominal terms. Virtually to the same extent as respondents in the United States, respondents in China expected morale problems in Ablex, where there was a 500 percent difference in salary raises in nominal terms (between 1 percent and 6 percent).

However, there were quite a few respondents in China who expected morale problems at Booklink, where the editors received higher raises in nominal terms and where the difference between the nominal raises was smaller, that is 50 percent. It is unclear what led respondents in China to see significantly more often greater morale problems with Booklink compared to Ablex. Perhaps respondents considered the salary raises at Ablex negligible altogether, while the pay rises at Booklink were more ostensible, and hence the difference in pay rises.

Asked subsequently who was more likely to leave his job, the outcome in the United States and China was nearly identical. Just like in the United States, most participants in China thought that the editor who received a 1 percent rather than a 6 percent raise would be more likely to leave his present job than the editor who got 10 percent rather than 15 percent. As Shafir, Diamond and Tversky (1997) suggested, money illusion enters into respondents' perceptions of fairness and worker morale, and then naturally extends to their views regarding workers' propensity to quit their present position. Note the striking similarity with problem 1, where respondents in China and the United States also gave virtually identical responses to a question pertaining to the likelihood that a worker would decide to quit her job.

5. Discussion and Conclusion

Money illusion seems to be the stepchild of economic theory. Most economists do not even wish to ponder its existence as money illusion ostentatiously violates the rational expectations postulate that has been so central to economic theorizing in the past decades. Recent research, however, shows that money illusion may play a much greater and more disruptive role in the economy than mainstream economists allow for (Brunnermeier and Julliard (2008), Bernanke (2010) and Liu (2010)). Therefore our study, which sheds further light on the phenomenon now for China, seems to be well timed.

Our findings suggest that money illusion is quite prevalent in China, just as it is in the United States. Respondents in our sample in China are less prone to money illusion, that is, they are more likely to base decisions on the real monetary value of economic transactions instead of on the nominal monetary value, compared to respondents in the sample of Shafir et al in the United States. If asked explicitly to evaluate an economic transaction in terms of happiness or satisfaction instead of economic terms, respondents in our sample are as likely as respondents in the Shafir et al. sample to prefer the transaction with the highest nominal monetary value to the economic transaction with the highest real monetary value.

The results show that considerations of happiness, morale and job satisfaction are intimately related with each other, in contrast to economic considerations. The default decision-making framework for respondents in our sample in China appears to be dominated by economic considerations, while the default decision-making framework for respondents in the Shafir sample in the United States appears to be dominated by considerations of happiness, morale and/or job satisfaction. This may well reflect the difference in affluence between respondents in the United States and China, with the former having already conquered the top layers of Maslow's pyramid of needs while (many of) the latter find themselves still scrambling at the bottom (Maslow, 1943). It also suggests that affluent societies may be more prone to money illusion and, hence, more susceptible to irrational exuberance (Akerlof and Shiller, 2009).

There are two distinct reasons why our respondents in China are less prone to money illusion than Shafir et al.'s respondents in the United States. First, when asked specifically to judge a transaction on economic terms, respondents in China are more likely to correctly choose the transaction with the highest real monetary value. Second, if no guidance is given on whether to judge a transaction on economic terms or terms of well-being, respondents in China are more likely to adopt a decision-making framework that is dominated by economic considerations. Hence, they are more likely to correctly choose the transaction with the highest real monetary value instead of the transaction with the highest nominal monetary value.

Our results confirm our initial conjecture, that respondents in our sample in China are less susceptible to money illusion than respondents in Shafir et al.'s sample in the United States. We are, however, not convinced that it is for reason that China is a creditor nation and many Chinese people personally stand to lose from inflation. The difference in affluence between respondents in the United States and China, which allows the former to adopt a more hedonistic framework for decision-making than the latter, seems a more plausible explanation.

When presented with a risk-free and a risky option in real monetary value, respondents in China were almost twice as likely compared to respondents in the United States to choose the risky option over the risk-free one.

Although the differences between responses in China and the United States may seem limited at first sight, it is important to notice that this is only true when respondents are explicitly asked to judge a transaction based on economic terms, as was the case in the first version of problem 1, where 82 percent of respondents in China versus 71 percent of respondents in the United States correctly chose the transaction with the highest real value over the transaction with the highest monetary value. However, in every day life individuals both in China and the United States will often make choices without explicit instructions to decide in economic terms or in terms of happiness. In that case respondents in China seem to take a decision based on economic terms while respondents in the United States seem guided by happiness. Hence, the responses to problem 2, where 64 percent of respondents in China versus 37 percent of respondents in the United States correctly chose the transaction (out of three) with the highest real value over the transaction with the highest monetary value, may more accurately depict to what extent individuals in China and in the United States, respectively, are susceptible to money illusion.

Shafir, Diamond and Tversky (1997) conclude that people attend to nominal value because it is salient, easy to gauge, and in many cases provides a reasonable estimate of real worth. We would like to add a fourth motive, and that is that nominal values reflect wellbeing better than real values does. The tendency is likely to persist despite economists' attempts to educate the public (Fisher, 1928). Shafir et al. amend Solow's model of efficiency wages with money illusion by adding the ratio of the current nominal wage to the previous nominal wage and show that over some range higher inflation will result in a lower real wage (Solow, 1979).

Since the responses to questions pertaining to job attractiveness were similar in China as in the United States, money illusion may interfere with the Chinese labor market in a way similar as with the U.S. labor market. However, China's labor market in the past decades has broadly been characterized by unlimited supplies of labor, as described in Arthur Lewis' classic essay 'Economic Development with Unlimited Supplies of Labor' (1954). With laborers working for subsistence wages, it is unlikely that inflation will result in lower real wages, since the abstract subsistence wage level is defined as a basket of goods and services rather than in monetary terms. As far as minimum wage laws apply, inflation may indeed erode real wages in case the minimum wage law does not provide indexation, not necessarily because of money illusion but also in case workers have no bargaining power in an economy with unlimited supplies of labor. Since the spate of wage rises in recent years suggests that the Lewis turning point may have been (b)reached, the labor market in China soon may share the same characteristics as the U.S. labor market and also be modeled as in Solow's model for efficiency wages added with money illusion, where higher inflation within a certain range will result in lower real wages (Cai and Fang, 2010).

In asset pricing theory both models with nominal variables (nominal interest rate and nominal cash flows) as well as models with real variables (real interest rate and real cash flows) are employed (Chen, Roll and Ross, 1986). Changes in the rate of inflation influence nominal cash flows as well as the nominal rate of interest. To incorporate money illusion in models for asset pricing, we suggest that asset-pricing models should not strictly use either nominal variables or real variables, but a combination of both.

The results of our survey in China are interesting in their own right, but still we believe there are further issues to be examined. First, our survey amounts to a cross section and, given China's rapid development, it would be insightful to carry out similar surveys in future years. When China approaches U.S. economic standards, also in terms of equality and wealth, we expect that money illusion may become more prevalent in China too. Second, as the degree of money illusion may correspond with economic progress, it would be interesting to see if other emerging economies in, say Africa or South America, give similar survey results. Third, it may be interesting to tie individual responses to individual background characteristics, like age, income/wealth and education. Finally, as money illusion can be associated with a few economic conditions that may generate economic downturns, it would be beneficial for China to learn from U.S. experiences, and perhaps carry out educational programs to inform people about money illusion.

References

Akerlof, George A. and Robert J. Shiller (2009), *Animal Spirits: How Human Psychology Drives the Economy, and Why It Matters for Global Capitalism*, Princeton University Press.

Bernanke, Ben S. (2010), "Monetary Policy and the Housing Bubble," http://www.federalreserve.gov/newsevents/speech/bernanke20100103a.htm.

Brunnermeier, Markus K. and Julliard, Christian (2008), "Money Illusion and Housing Frenzies," *Review of Financial Studies*, 21 (1). pp. 135-180.

Cai, Fang, and Meiyan Wang (2010), "Growth and Structural Changes in Employment in Transitional China", *Journal of Comparative Economics* 38 (2010) 71–81.

Chen, Nai-Fu, Richard Roll and Stephen A. Ross (1986), "Economic Forces and the Stock Market," *The Journal of Business*, Vol. 59, No. 3 (Jul., 1986), pp. 383-403

Fehr, Ernst, Tyran, Jean-Robert (2001), "Does Money Illusion Matter?" *American Economic Review*, 91 (5): 1239–1262.

Fisher, Irving (1928), *The Money Illusion*, New York: Adelphi Company.

Hong, Fang and Jie Chen (2010), "The Relationship Between Home Mortgage Loan and Real Estate Market in China: Evidences and Insights from a Regional Perspective," Working Paper.

Leontief, Wassily (1936), "The Fundamental Assumptions of Mr. Keynes' Monetary Theory of Unemployment," *Quarterly Journal of Economics*, 5(4):192–7.

Lewis,W. Arthur (1954), "Economic Development with Unlimited Supplies of Labour," http://www.globelicsacademy.net/2008/2008_lectures/lewis%20unlimited%20labor%20supply%201954.pdf.

Liu, Renhe (2010), "The Effects of Inflation on China`s Stock Prices: An Explanation Based on Money Illusion Hypothesis," Working Paper.

Maslow, Abraham H. (1943), "A Theory of Human Motivation," *Psychological Review* 50(4) (1943):370-96.

Mees, Heleen (2011), "U.S. Monetary Policy and the Interest Conundrum," Working Paper, http://www.heleenmees.com/PDF/papers/US_Monetary_Policy.pdf.

Mees, Heleen (2011), "Beware of Runaway Headline Inflation," VoxEU, http://voxeu.org/index.php?q=node/6448.

Noussair, Charles N., Gregers Richter, and Jean-Robert Tyran (2008), “Money Illusion and Nominal Inertia in Experimental Asset Markets,” http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1307717.

Okimoto, Daniel I. (2009), “The Financial Crisis and America’s Capital Dependence on Japan and China,” *Asia-Pacific Review*, Vol. 16, No. 1, 2009.
Patinkin, Don (1965), *Money, Interest, and Prices*, Harper and Row, New York.

Pei, Minxin (2011), “Why China's Leaders Fear Inflation,” Carnegie Endowment for International Peace.

Schumpeter, Joseph A. (1908), *Das Wesen und der Hauptinhalt der theoretischen Nationalökonomie*, Leipzig:Duncker & Humblot.

Shafir, Eldar and Richard H. Thaler (1996), “Invest Now, Drink Later, Spend Never: On the Mental Accounting of Delayed Consumption,” *Journal of Economic Psychology*, 27 (2006) 694–712.

Shafir, Eldar, Peter A. Diamond and Amos Tversky (1997), "On Money Illusion," *Quarterly Journal of Economics*, 112 (2): 341–374.

Solow, Robert M., “Another Possible Source of Wage Stickiness,” *Journal of Macroeconomics*, I (1979), 9–82.

Acknowledgements

We would like to thank Eldar Shafir, Peter Diamond and Amos Tversky for letting us use the 1997 survey for our research in China and making suggestions. We also thank our Chinese assistants, Chao Fang and Andy Xiaoyang. Without their help we would not have been able to do the survey. And we would like to offer our gratitude to Min Chum of Ali Baba and Wei Chi of Tsinghua University for providing us access to Ali Baba workers and students at Tsinghua University and Peking University.

V Does News on Real Chinese GDP Growth Impact Stock Markets?*

1. Introduction

The quarterly real GDP growth data for China have interesting properties. One of these is that they are released quite rapidly after the relevant quarter, although China tends to have quite significant revisions of annual economic growth at a one year lag. Second, real GDP growth follows random walk properties, which means that the growth rates cannot be predicted through mere extrapolation. Third, it is often suggested that statistics in China are manipulated and therefore unreliable. The Wall Street Journal pointed out the discrepancy between Chinese GDP growth data and data on oil and electricity demand (May 29, 2009). In the first quarter of 2009, for example, 6.1 percent GDP growth coincided with a mere 3.0 percent growth in energy consumption. The Financial Times reported that the tally of GDP estimates provided by the 31 provincial and municipal governments for the first half of 2009 was significantly higher, about 10 percent, than the GDP figure released by the National Bureau of Statistics (August 5, 2009).

We study the consequences of these properties on stock market fluctuations. For this, we analyze an EGARCH model which includes 16 dummies concerning the announcement dates in the level equation and in the conditional volatility equation. The model is fitted to daily stock market returns data for 8 Asian stock markets and 4 U.S. stock markets. According to the efficient market hypothesis (EHM), financial markets should respond only tepidly to news on GDP that is deemed unreliable.

The outline of our paper is as follows. In Section 2 we describe a few features of real GDP growth rates of China. In Section 3 we discuss our methodology and we present the results. Section 4 provides the general conclusion. Our main finding is that Chinese news has only a limited and also non-systematic impact on stock market fluctuations.

2. Real GDP Growth in China

Figure 1 gives the nominal levels of GDP in China as they are published each quarter. The data are cumulated, which means that the first quarter reports the data on the first quarter, whereas the second quarter concerns the sum of output in the first two quarters, and so on.

Figure 2 gives the real GDP growth rates. In Franses and Mees (2010) it is documented that this series follows a random walk. This is quite an unusual finding as most growth rates of real GDP data for industrialized countries can be described by simple time series models like ARMA, which implies that these figures can be predicted to some extent through extrapolation. When the data are a random walk, the best forecast is the most recent observation, hence a no-change forecast. In Table 1 we present the actual data and the no-change forecasts, as well as the forecast errors. Later on we will classify these forecast errors as negative or positive news to see if such news has an impact on stock market returns or stock market volatility.

In Table 2 we give the announcement dates for the growth rates of real GDP for the United States and for China. The actual dates will be used to create associated zero-one dummy variables in the models below. We observe that the release dates for the Chinese data lead the dates of U.S. announcements.

* Together with Philip Hans Franses.

As said, the best forecast for real growth rates for Chinese GDP using extrapolation is the no-change forecast. This implies that traders all can rely on the same information concerning expected growth rates. Surprises in announcements would then be equally important for all traders, and nobody can make better forecasts. The distribution of past forecast errors can be instrumental to assign whether new GDP quotes are large or small surprises. In the analysis below we will take absolute forecast errors exceeding 1.0 as large. So, traders may assign different interpretation to forecast errors, but they will not be able to create better forecasts than the no-change forecasts.

Professional traders generally will not rely exclusively on historic GDP data to make forecasts for real GDP growth. Data regarding payrolls, manufacturing, exports and other leading economic indicators will help traders to make their predictions. If the official GDP data are considered to be untrustworthy, however, financial markets should only respond tepidly to surprises in announcements of official data.

Taking altogether this suggests that news on real GDP growth rates of China would not have a large impact on stock market returns nor on stock market volatility. We will put this suggestion to a test in the next section.

3. Modeling Stock Markets

In the section we analyze whether the announcements concerning real GDP growth in China has an impact on stock market returns or stock market volatility.

3.1 The data and the model

We consider four years of daily stock market returns. These are India BSE, Nikkei 225, Hang Seng, Straits (Singapore), Korea, LQ45 (Indonesia), Shanghai, and Shenzhen as the leading Asian stock markets, and the S&P500, Nasdaq, Dow Jones and Russell2000 as the U.S. stock markets. For the levels equation for the returns y_t we consider

(1) $$y_t = \mu + \sum_{i=1}^{16} \delta_i^{USA} D_{i,t}^{USA} + \sum_{i=1}^{16} \delta_i^{China} D_{i,t}^{China} + u_t$$

where the zero-one dummy variables $D_{i,t}^{USA}$ correspond with the dates in the second column of Table 2 and the zero-one dummy variables $D_{i,t}^{China}$ with the dates in the third column. Below we will be interested in the hypotheses that $\delta_1^{USA} = \ldots = \delta_{16}^{USA} = 0$ and that $\delta_1^{China} = \ldots = \delta_{16}^{China} = 0$, and for that we will use a joint Wald test. Note that we import the dates such that they match the proper time zones. Chinese news will reach Asia during the very same day, while it reaches the American time zone the next day. The reverse holds for U.S. news.

The next model we consider as in EGARCH(1,1) equation, which comprises the following two equations, that is

(2) $$y_t = \mu + z_t \sqrt{h_t}$$

with

(3) $$\log h_t = \omega + \theta z_t + \lambda(|z_t| - E(|z_t|)) + \alpha \log h_{t-1} + \sum_{i=1}^{16} \lambda_i^{USA} D_{i,t}^{USA} + \sum_{i=1}^{16} \lambda_i^{China} D_{i,t}^{China}$$

Below we are interested in the hypotheses $\lambda_1^{USA} = ... = \lambda_{16}^{USA} = 0$ and $\lambda_1^{China} = ... = \lambda_{16}^{China} = 0$, and again we will use a Wald test. Estimation will be carried out using the Eviews program. Note that we cannot replace (2) by (1) as then the parameters for the dummy variables are not identified.

3.2 *The results, general*

The Wald test values for the hypotheses concerning the conditional volatility equations are given in Table 3. We see that stock market returns in 4 of the 8 Asian indexes react to U.S. news, while this occurs for only 2 of the 8 concerning Chinese news. At the same time, U.S. stock market returns do not significantly react to U.S. news or to Chinese news.

It is well known that at the very same day of presentation of national accounts figures the response at the level of returns can be small, but perhaps more response is there to be expected at the level of volatility. Table 4 presents the relevant Wald test results, and indeed, news announcements do seem to have more effect on volatility than on returns. For 5 of the 12 stock markets Chinese news (and U.S. news alike) have an impact on volatility. The S&P500 and Nasdaq respond about similar to both U.S. and Chinese news. This also holds for the LQ45 of Indonesia, where news seems to imply the largest effects for volatility.

3.3 *The results, more refined*

Finally, we examine which of the announcement dates for Chinese news have most impact, and whether this news could have been considered as positive or negative. In Table 5 we classify the forecast errors of real GDP growth accordingly. In Table 6 we give the dates for which the news has an individual significant impact on stock market volatility.

Table 6 shows that if news has an impact on conditional volatility it usually makes this volatility to decrease, and hence to calm down stock market fluctuations. A second observation of Table 6 is that it does not seem to matter much whether this news is positive or negative. In the panel for an increase in volatility, we see that it is only positive or no news that makes volatility increase (in, as must be said, a very small amount of cases). Table 6 also shows that out of the 16 (news dates) times 12 (stock markets) possibly significant outcomes, only 24 are significant, which amounts to a fraction of 12.5%. Table 7 shows that this percentage for U.S. news is 19.8% while for Germany it is 10.4%. At the same time, we observe from Table 6 that the nature of the news that makes volatility to decrease can be positive or negative, and there is no systematic pattern.

4. Conclusion

There is a limited effect of Chinese news on world stock markets (12.5% of the news dates there is a significant impact) compared to U.S. news (19.8% of the news dates there is a significant impact). Stock market returns in 4 of the 8 Asian stock indexes react to U.S. news, while they react in only 2 of the 8 Asian stock indexes to Chinese news. U.S. stock market returns do not significantly react to either U.S. news or to Chinese news. U.S. and Chinese news have a similar impact on stock market volatility.

We started this paper discussing the fact that Chinese real GDP follow a random walk, and the fact that Chinese data are often deemed as not trustworthy. We suggested that these properties imply that stock markets respond only tepidly to Chinese news as traders might be expected to take the official announcements with a pinch of salt. Indeed we found that stock markets respond less to Chinese news than to U.S. news.

An alternative explanation for the fact that stock markets respond more tepidly to Chinese news than to U.S. news may be the size of the Chinese economy. We included in the last batch (table 7) German data that could serve as a benchmark this hypothesis. The German authorities are known for their punctuality. Hence few traders will doubt the trustworthiness of the German GDP data.

The stock market's timid response to the German data shows that the relative size of the economy is a quite plausible explanation. Stock indexes respond less to German news than to U.S. news while German and U.S. data are deemed equally reliable. German GDP is about a quarter of U.S. GDP.

Measured in current U.S. dollars the German economy is almost equal the size of the Chinese economy (see Table 8A). German and Chinese news significantly impacted world stock markets on 10.4% respectively 12.5% of the news dates (compared to 19.8% for U.S. news). The relative size of the Chinese economy measured in current U.S. dollars may be a plausible explanation for the fact that stock markets respond less often to Chinese news (12.5%) than to U.S. news (19.8%).

If GDP is measured on a purchasing-power-parity (PPP) base, the Chinese economy is three times the size of the German economy. (see Table 8B). In that case the size of the Chinese economy cannot fully account for the fact that stock markets respond less often to Chinese news (12.5%) than to U.S. news (19.8%). The unpredictability/unreliability of Chinese GDP data may then serve as an additional explanation.

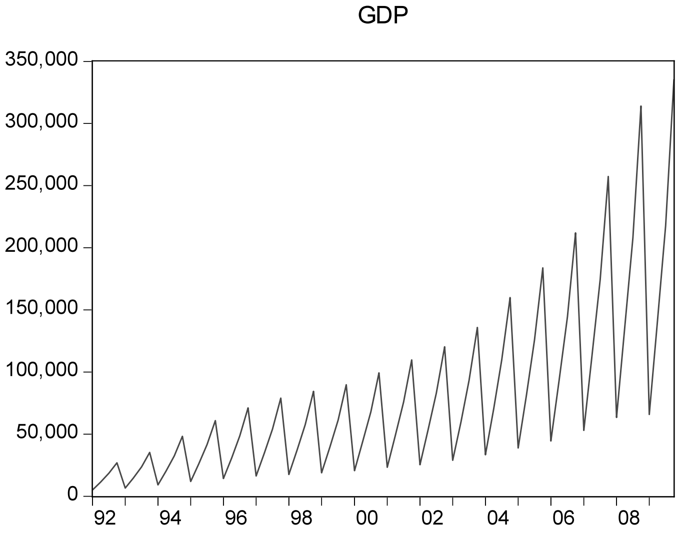


Figure 1: Nominal GDP (levels) in China, 1992Q1-2009Q4

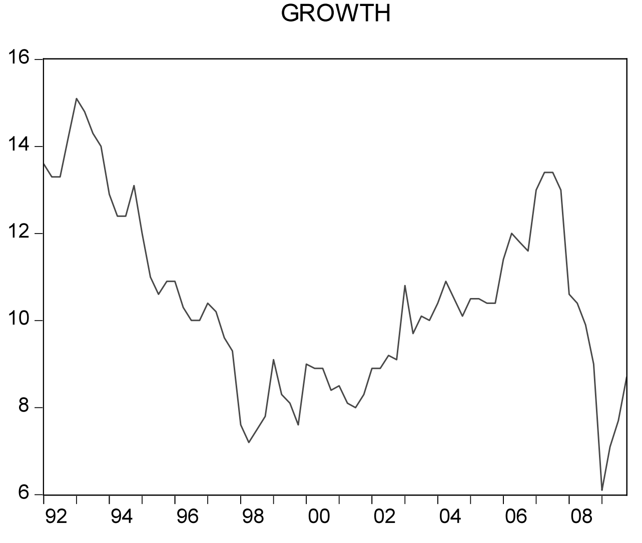


Figure 2: Quarterly real growth rates of GDP in China, 1992Q1-2009Q4

Table 1: The real GDP figures, as they are available from the National Bureau of Statistics of China, and the forecasts that follow from a random walk

Quarter	REAL GROWTH	NO –CHANGE FORECAST	FORECAST ERROR
2005Q4	10.4	10.4	0.0
2006Q1	11.4	10.4	1.0
2006Q2	12.0	11.4	0.6
2006Q3	11.8	12.0	-0.2
2006Q4	11.6	11.8	-0.2
2007Q1	13.0	11.6	1.4
2007Q2	13.4	13.0	0.4
2007Q3	13.4	13.4	0.0
2007Q4	13.0	13.4	-0.4
2008Q1	10.6	13.0	-2.4
2008Q2	10.4	10.6	-0.2
2008Q3	9.90	10.4	-0.5
2008Q4	9.00	9.90	-0.9
2009Q1	6.10	9.00	-2.9
2009Q2	7.10	6.10	1.0
2009Q3	7.70	7.10	0.6
2009Q4	8.70	7.70	1.0

Source: http://www.stats.gov.cn/english (Consulted: January 22 2010)

The data in this table are calculated at constant prices, and are relative to the same period of the preceding year = 100

Table 2:

Dates with first announcements concerning the flash values of GDP growth in the previous quarter

Year	USA	China	Difference
2006	January 27	January 25	2
	April 28	April 20	8
	July 28	July 20	8
	October 27	October 24	3
2007	January 31	January 25	6
	April 27	April 18	9
	July 27	July 18	9
	October 31	October 23	8
2008	January 30	January 24	6
	April 30	April 17	13
	July 31	July 17	14
	October 30	October 21	9
2009	January 30	January 22	8
	April 29	April 16	13
	July 31	July 16	15
	October 29	October 22	7

Table 3:

Wald test values (and p values) for joint significance of sixteen dummy variables measuring days with GDP announcements ***for the levels equation*** of regression model (with an intercept) model for stock returns, 01/03/2006-11/24/2009 (correcting for time zones)

Stock market	U.S. news		Chinese news	
India BSE	12.41	(0.715)	13.96	(0.602)
Nikkei 225	***41.89***	***(0.000)***	10.60	(0.833)
Hang Seng	***44.10***	***(0.000)***	***38.16***	***(0.001)***
Straits (Singapore)	***40.26***	***(0.001)***	21.60	(0.157)
Korea	***125.9***	***(0.000)***	13.12	(0.664)
LQ45 (Indonesia)	20.45	(0.201)	***34.45***	***(0.005)***
Shanghai	18.85	(0.276)	10.98	(0.811)
Shenzhen	18.03	(0.322)	11.47	(0.780)
S&P500	10.28	(0.852)	7.811	(0.954)
Nasdaq	8.743	(0.924)	16.51	(0.418)
Dow Jones	8.818	(0.921)	8.376	(0.937)
Russell2000	12.63	(0.700)	10.31	(0.850)

Table 4:

Wald test values (and p values) for joint significance of sixteen dummy variables measuring days with GDP announcements ***for the conditional volatility equation*** of an EGARCH(1,1) model for stock returns, 01/03/2006-11/24/2009, with t-distributed innovations (correcting for time zones)

Stock market	U.S. news		Chinese news	
India BSE	***29.81***	***(0.019)***	24.65	(0.076)
Nikkei 225	***362.4***	***(0.000)***	21.12	(0.174)
Hang Seng	24.80	(0.073)	***373.1***	***(0.000)***
Straits (Singapore)	6.919	(0.975)	7.084	(0.972)
Korea	17.01	(0.385)	7.318	(0.967)
LQ45 (Indonesia)	***745.6***	***(0.000)***	***597.5***	***(0.000)***
Shanghai	2.425	(1.000)	0.243	(1.000)
Shenzhen	2.131	(1.000)	***32.20***	***(0.009)***
S&P500	***36.50***	***(0.003)***	***30.61***	***(0.015)***
Nasdaq	***173.2***	***(0.000)***	***49.09***	***(0.000)***
Dow Jones	24.93	(0.071)	21.13	(0.174)
Russell2000	9.084	(0.910)	15.64	(0.478)

Table 5:

Dates with first announcements concerning the flash values of GDP growth in the previous quarter and indication if realization was higher (++ for larger than 1.0 forecast errors, or + for forecast errors in between 0.0 and 1.0) or lower (-- for larger than -1.0 forecast errors or – forecast errors in between 0 and -1.0) than expected (based on random walk forecast for real GDP growth, see Table 1)

Year		Nature of the news
2006	January 25	0
	April 20	+
	July 20	+
	October 24	-
2007	January 25	-
	April 18	++
	July 18	+
	October 23	0
2008	January 24	-
	April 17	--
	July 17	-
	October 21	-
2009	January 22	-
	April 16	--
	July 16	+
	October 22	+

Table 6:

Detailed results concerning increase of decrease in conditional volatility due to Chinese news on specific days (increase in volatility is due to worse than expected news, and a decrease in volatility due to better than expected news)

Stock market	Increase	Decrease
Asia		
India BSE		January 25 2007 (-)
		April 17 2008 (--)
Nikkei 225		July 20 2006 (+)
		October 23 2007 (-)
Hang Seng	July 16 2009 (++)	July 20 2006 (+)
		April 18 2007 (++)
LQ45 (Indonesia)		January 25 2006 (0)
		October 24 2006 (-)
		January 25 2007 (-)
		April 18 2007 (++)
		October 21 2008 (-)
		April 16 2009 (--)
		October 22 2009 (+)
Shenzhen	January 25 2006 (0)	July 18 2007 (+)
USA		
S&P500		April 17 2008 (--)
		October 21 2008 (-)
Nasdaq	April 20 2006 (+)	January 25 2006 (0)
		July 18 2007 (+)
		October 22 2009 (+)
Dow Jones		October 24 2006 (-)
Russell2000	July 18 2007 (+)	

Table 7:

Number of days (out of the 16) where U.S. and German news has a significant impact on conditional volatility

	U.S. news	German news
India BSE	2	2
Nikkei 225	10	2
Hang Seng	1	2
Straits (Singapore)	1	1
Korea	2	1
LQ45 (Indonesia)	11	1
Shanghai	0	2
Shenzhen	0	3
S&P500	3	2
Nasdaq	5	2
Dow Jones	2	1
Russell2000	1	1

Table 8A:

Gross domestic product in current U.S. dollars (billions)

	China	Germany	United States
2006	2657.84	2919.51	13398.93
2007	3382.45	3328.18	14007.65
2008	4327.45	3673.11	14441.43
2009	4757.74	3235.46	14266.20
2006-2009	15125.48	13156.26	56184.21

Table 8B:

Gross domestic product based on purchasing power parity (PPP) as share of world GDP (%)

	China	Germany	United States
2006	10.06	4.39	21.66
2007	10.72	4.29	21.07
2008	11.35	4.21	20.61
2009	12.05	4.09	20.02
2006-2009	11.05	4.24	20.84

(Source: IMF)

References

Engle, Robert F. (1982), Autoregressive Conditional Heteroskedasticity with Estimates of the Variance if United Kingdom Inflation, Econometrics, 50, 987-1008.

Franses, Philip Hans and Heleen Mees (2010), Approximating the DGP of China's Quarterly GDP, Econometric Institute Report 2010-04, Erasmus School of Economics.

Nelson, Daniel B (1991), Conditional Heteroskedasticity in Asset Returns: A New Approach, Econometric 59, 347-370.

VI Approximating the DGP of China's Quarterly GDP[*]

1. Introduction

Since 1992 China presents its quarterly GDP figures in a format that is accessible to the general public. In 2007 the National Bureau of Statistics of China (NBSC) published the China Quarterly GDP Time Series for 1992Q1-2005Q4. Since 2006 this information also appears on the NBSC website (www.stats.gov.cn).

In this paper we analyze the time series properties of the GDP series as they are given as aggregates in current prices (100 million Yuan). We will analyze the total GDP series as well as the three sector-specific GDP series, concerning the Primary, Secondary and Tertiary Sectors. We construct time series models for the data covering 1992Q1-2005Q4, and we use these models to forecast the data for 2006Q1 to 2009Q4. The data are presented in Appendix A and B. We also analyze the GDP growth rates at constant prices, and these data appear in Appendix C and D.

The Chinese GDP series in current prices are reported in a format that contrasts with the usual practice in western countries. First, the data are given in cumulated format, that is, Quarter 1 first, and then in Quarter 2 the NBSC presents the sum of Quarters 1 and 2, and so on. Second, when cumulating the data, NBSC also includes revised figures of earlier quarters. Third, after one year, it is only the cumulated value in Quarter 4 (which is of course equal to the sum for that particular year) that is revised.[64][65] To write it in a more formal way, denote actual, that is, de-cumulated GDP in a single year as $Y_{Q,T}$, where Q is either Quarter 1, 2, 3 or 4, and T is year. Next, denote $Y^{r}_{Q,T}$ as the first revised value of the quarter, $Y^{rr}_{Q,T}$ as the second revised value, and so on. The data that the NBSC subsequently reports in the Quarters 1 to 4 are thus equal to

$$
\begin{aligned}
X_{1,T} &= Y_{1,T} \\
X_{2,T} &= Y^{r}_{1,rT} + Y_{2,T} \\
X_{3,T} &= Y^{rr}_{1,T} + Y^{r}_{2,T} + Y_{3,T} \\
X_{4,T} &= Y^{rrr}_{1,T} + Y^{rr}_{2,T} + Y^{r}_{3,T} + Y_{4,T}
\end{aligned} \tag{1}
$$

And, with (approximately) a one year lag, NBSC presents $X^{r}_{4,T}$, the revised year-total. A consequence of this way of reporting is that the data have graphical patterns like those reported in Figures 1 and 2. Another consequence is for de-cumulated GDP for China, which would amount to data like $X_{2,T} - X_{1,T}$, and so on, and that is that these data are difficult to interpret and to analyze as they amount to a mixture of actual figures and revisions. In fact, the actual and revised figures can simply not be identified. A graph of the de-cumulated data that we will not analyze in this paper appears in the Appendix.

---

[*] Together with Philip Hans Franses.

[64] The practice of presenting cumulated data is a heritage of the planned economy, where macroeconomic data are expected to meet certain targets. By using cumulated data, one can see at a glance to what extent the targets have been met.

[65] Since 2003 the NBSC is reporting de-cumulated growth figures in its press releases, but not in the time series on the NSBC website.

In this paper we therefore focus on the actual data as presented by the NBSC, that is, those as constructed in (1), the cumulated GDP data at current prices. Additionally, we analyze the time series properties of real growth rates (concerning cumulated GDP at constant prices).

Our rather basic analysis shows that the GDP data (cumulated levels at current prices) can be fitted and predicted with (relatively) great precision. The rule that seems to govern the data is that growth in a quarter, relative to the same quarter in the previous year, is a random walk. Second, this random walk experiences shocks only in the first quarter, and in the other three quarters, the error term has variance (approximately) equal to zero. In words this means that once the observation in Quarter 1 is known, the data for the rest of the year can be predicted quite accurately. We show that the median percentage error of one-step-ahead forecasts for the actual nominal GDP (in 100 million Yuan) for these quarters has a mean often lower than 1.0%. .

GDP growth in constant prices can also be described as a random walk, albeit that the error term variance is much larger. As a result, real GDP growth, as opposed to nominal GDP growth, cannot accurately be predicted through extrapolation.

2. An Analysis of Cumulative GDP in Current Prices

We start with an analysis of cumulative total GDP, as it is given in Figure 1, for the sample 1992Q1 to 2005Q4. The data seem to have a trend (upwards) and strong seasonality, which is in part of course due to the accumulation process. It is common in such instances to take logarithms of the data and to use so-called differencing filters to remove non-stationary components, see Franses (1998), among others. Denoting the quarterly series as composed like (1) as x_t, where t runs from 1992Q1 to 2005Q4, then we shall analyze the properties of

(2) $$(1-L)(1-L^4)\log x_t$$

The L denotes the familiar lag operator and "log" denotes the natural logarithm. In words, the variable in (2) is the change (1-*L*) in the annual growth rate $(1-L^4)\log x_t$, observed per quarter. A graph of the series in (2) is given in Figure 3.

2.1 Approximating the DGP

The time series properties of this variable turn out to have interesting properties, and certainly when compared with GDP data for other countries. The first property is that the mean of the variable in Figure 3 is equal to zero. A regression of $(1-L)(1-L^4)\log x_t$ on a constant gives a t-ratio of -0.990. The residuals of this regression do not appear to be auto-correlated. The LM test for first to fourth auto-correlation has a p-value of 0.164. This is quite interesting as many quarterly and trending economic time series can be described by the so-called airline model[66], which implies auto-correlations for $(1-L)(1-L^4)\log x_t$ at lags 1, 3, 4 and 5.

The series $(1-L)(1-L^4)\log x_t$ has a second interesting property and that is that in the regression of the squares of $(1-L)(1-L^4)\log x_t$ on four seasonal dummies only the parameter for the first seasonal dummy obtains a significant parameter (t-statistic is 6.977). Basically this means that total GDP in current prices can be described by

$$(1-L)(1-L^4)\log x_t \sim (0, D_{1,t}\sigma^2) \tag{3}$$

where $D_{1,t}$ is a one-zero seasonal dummy for the first quarter and σ^2 is the variance of the error term. The variance is estimated as 0.001098 with standard error 0.000151.

2.2 *Forecasts*

The expression in (3) says that in all quarters but the first one, the data on GDP in current prices obey the rule: growth in this quarter is equal to growth in the previous quarter. And in the first quarter, the rule is this quarter's growth is growth in the previous quarter plus a non-zero error term. In other words, the actual data $(1-L)(1-L^4)\log x_t$ are all approximately zero except in Quarter 1, which is visualized in Figure 4.

With the model in (3), we can easily create forecasts for GDP, using the following extrapolation scheme:

$$GDP_{t+h} = \exp\left\lfloor \log(GDP_{t+h-1}) + \log(GDP_{t+h-4}) - \log(GDP_{t+h-5}) + \tfrac{1}{2} D_{1,t+h}\sigma^2 \right\rfloor \tag{4}$$

where GDP_{t+h} denotes the h-step-ahead forecast. In case of recurrent one-step-ahead (static) forecasts, the forecast origin each time moves with one quarter. In case of multiple-step-ahead (dynamic) forecasts, the forecast origin is the same (2005Q4), and in (4) earlier forecasts then replace the future observations.

In Figure 5 we give the multiple-step-ahead forecasts generated from 2005Q4 as the forecast horizon, and the realizations as they are displayed in Appendix B. It is clear from this graph that these multiple-step-ahead forecasts seem to give an adequate impression of the upward trend in China's GDP. The actual forecasts are presented in Table 1. This table also gives the percentage forecast error. Even though the forecasts are created for years ahead, still the percentage forecast error remains below around 10%.

In Figure 6 we give the one-step-ahead forecasts, where the first forecast origin is 2005Q4, then in becomes 2006Q1 and so on, until 2009Q3. Table 2 presents these forecasts and the percentage forecast errors. As could be expected given (3), the forecast errors in the first quarters are largest, with the exceptionally large

[66] The airline model is given by $(1-L)(1-L^4)\log x_t = (1+\theta_1 L)(1+\theta_4 L^4)\varepsilon_t$, see Franses (1998, Chapter 5), where ε_t is an error term with zero auto-correlation. This model is also at the heart of various seasonal adjustment programs.

value in 2009Q1. So, indeed, it is not easy to forecast first-quarter GDP in current prices in China. In contrast, the forecast errors for the other three quarters are small, as one can safely state that percentage forecast errors below 1% are quite small (for levels of GDP type data). The median error is 0.436 and the median absolute error is 0.599.

The model in (3) suggests that once the first-quarter observation is known, it shall not be too difficult to forecast Quarters 2, 3 and 4. If we thus generate three-step-ahead forecasts for the final quarter (= year) GDP data, we get forecasts of 210236.0 for 2006Q4, 253135.1 for 2007Q4, 307823.5 for 2008Q4 and 311422.6 for 2009Q4. These forecasts have percentage errors equal to 0.802, 1.648, 2.021 and 7.684, respectively, which is rather small (as compared forecasts for the levels of GDP for other countries).

3. The Three Components of Cumulated GDP in Current Prices

Given that total cumulated GDP can be approximated by a simple model as given in (3), it is now of interest whether this also holds for its three components. Following the same approach as in the previous section, it so turns out the nominal GDP for the Primary Sector, for the Secondary Sector and for the Tertiary Sector each can be described by a model like (3), where the σ^2 is estimated (with standard errors in parentheses) as 0.004161 (0.000989), 0.001470 (0.000255) and 0.001341 (0.000333), respectively. Clearly, the error term has largest variance for the Primary Sector. Graphs similar to that in Figure 4 are given in Figures 7, 8 and 9. One can see a very close fit between the data and the model. Hence, the data generating process (DGP) of Chinese GDP in current prices can be approximated rather well.

In Tables 3 to 8 we present the multiple-step-ahead forecasts and one-step-ahead forecasts for the three sectors, and we contrast these with the realizations displayed in Appendix B. One can see that these forecasts are again quite accurate, although forecasts for the Secondary Sector seem to be best, except for 2009Q4.

4. Analysis of Growth Rates at Constant Prices

The second important variable that is reported by the National Bureau of Statistics of China is the Growth Rate of Gross Domestic Product at Constant Prices. Dong (2006) discusses the creation of these inflation-corrected growth rates. In contrast to what is common practice in western countries, NBSC does not report a single GDP deflator. In fact, each component of the national accounts has its own deflator. We might therefore expect that modeling and forecasting of this variable would be less easy than in the earlier case of cumulated GDP at current prices.

The relevant growth rates for total GDP appear in Figure 10 and for the three sectors in Figure 11. In Figure 12 we contrast the growth rates with those of the USA, where one should bear in mind that the Chinese data refer to real growth rates of cumulated data within each calendar year. Until 2007Q4, the USA growth figures show stability with an average of 3.2%. The Chinese data show much more fluctuations. The data as used in this paper are displayed in Appendix C and D. Again, we analyze the data for 1992Q1 to 2005Q4 and we create forecasts for 2006Q1 to 2009Q4.

Given the fact that constant prices GDP cannot be derived as a function of current prices GDP and a GDP deflator, we shall not expect that (3) has predictive value for the models for constant prices GDP. The autocorrelations of the growth rates (total and for the three sectors) show a pattern that is typical for a unit root process (relevant more formal tests confirm this), so we will analyze the growth rates after first differencing, that is, this quarter's growth minus growth in the previous quarter.

For constant prices growth in total GDP we obtain

$$Growth_t - Growth_{t-1} = 0.254D_{1,t} - 0.371D_{2,t} + \varepsilon_t \tag{5}$$

where $D_{1,t}$ and $D_{2,t}$ are the one-zero dummies for Quarters 1 and 2. If we regress the squares of the estimated residuals on the four seasonal dummies, one can learn that the variance in Quarter 1 is about 0.97 and significant, while the variances in the other three quarters are estimated as being insignificantly different from zero. Note that this variance is substantially larger than that for nominal GDP. Anyway, similar to GDP at current prices, it shall thus be most difficult to forecast data in Quarter 1. This is reflected by the one-step-ahead forecasts in Table 9, where indeed the forecast errors are largest in the first quarter, and notably in 2008Q1 and 2009Q1.

A similar model as in (5) is obtained for the growth rates at constant prices for GDP in the Primary Sector. The estimation results are

$$Growth1_t - Growth1_{t-1} = 0.669D_{1,t} - 1.021D_{2,t} + \varepsilon_t \tag{6}$$

And also here we obtain that error variance in Quarter 1 is the only significant variance, with value 0.867.

For the Secondary Sector GDP growth rates we get

$$Growth2_t - Growth2_{t-1} = -0.869D_{1,t} + \varepsilon_t \tag{7}$$

Here the error variance in Quarter 1 is 3.339, so one may expect large forecast errors in Quarter 1.

Finally, for the Tertiary Sector we obtain that the growth simply is a zero-mean random walk. The variance of this variable is 1.852 in Quarter 1 and 0.824 in Quarter 4, and otherwise this variance is zero.

In contrast with the GDP data at current prices, the GDP data at constant prices will be much less easy to forecast. This is also reflected by the forecast errors in Tables 10, 11 and 12. In particular, the forecast for 2009Q4 for the Secondary sector is quite off track.

5. Discussion and Conclusion

In this paper we have demonstrated that quarterly Chinese GDP time series data, at current prices, can be predicted quite well using very simple extrapolation schemes. This does not only hold for one-step-ahead forecasts, where percentage errors of less than 1% are often found, but also for multiple-step-ahead forecasts where percentage errors are much larger, but still much smaller than what is typically found for other country-specific GDP data. When econometric models are to be developed to predict GDP for China, they should have the challenge of improving this reported forecast accuracy.

In contrast to what is common practice, China does not use a single GDP deflator, but uses various different prices data to correct the current prices GDP to constant prices GDP. This should make the growth rates in constant prices GDP much less easy to model and forecast, which we verified in the second part of the paper. Basically, these growth rates are random walks, with some mild seasonality and with large variance.

Current prices GDP in China is reported in cumulated form. This makes the Quarter 4 observation automatically equal to the year total. The cumulated data contain actual quarterly data and the revisions to earlier quarters. This makes the de-cumulated GDP data less useful as it cannot be identified which part of the de-cumulated observation can be associated with genuine new information and with revisions. This should reduce the usefulness of de-cumulated GDP in econometric models for other macro-economic variables. At the same time, as there is almost no variation in the cumulated GDP data, at least not in Quarters 2, 3 and 4, this particular series is also less useful for subsequent econometric modeling. The only variable that could be considered for modeling and forecasting is the growth rate of GDP at constant prices.

When it comes to forecasting GDP at current prices, the only observation that seems of interest to forecast is the first-quarter observation. Given knowledge of that quarter, the next three quarters within the same year can be predicted with great accuracy.

Finally, GDP growth in constant prices can also be described as a random walk, albeit that the error term variance is much larger. Therefore real GDP growth cannot accurately be predicted through extrapolation.

Appendix A: The data for 1992Q1-2005Q4

Aggregates in current prices, in 100 million Yuan

Quarter	GDP	Primary Industry	Secondary Industry	Tertiary Industry
1992Q1	4974.300	589.9000	2365.200	2019.200
1992Q2	11332.10	1690.900	5350.300	4290.900
1992Q3	18451.50	3670.800	8319.500	6461.200
1992Q4	26923.50	5866.600	11699.50	9357.400
1993Q1	6500.500	673.1000	3363.800	2463.600
1993Q2	14543.50	1897.400	7532.200	5113.900
1993Q3	23591.50	4020.500	11574.60	7996.400
1993Q4	35333.90	6963.800	16454.40	11915.70
1994Q1	9064.700	922.7000	4710.100	3431.900
1994Q2	20149.70	2539.500	10546.10	7064.100
1994Q3	32596.60	5380.300	16248.60	10967.70
1994Q4	48197.90	9572.700	22445.40	16179.80
1995Q1	11858.50	1232.600	6227.100	4398.800
1995Q2	25967.60	3420.800	13693.40	8853.400
1995Q3	41502.60	7139.200	20775.60	13587.80
1995Q4	60793.70	12135.80	28679.50	19978.40
1996Q1	14261.20	1487.200	7576.500	5197.500
1996Q2	30861.80	4251.900	16197.90	10412.00
1996Q3	48533.10	8194.100	24413.80	15925.20
1996Q4	71176.60	14015.40	33835.00	23326.20
1997Q1	16256.70	1675.500	8433.500	6147.700
1997Q2	34954.30	4730.500	18109.30	12114.50
1997Q3	54102.40	8547.500	27084.20	18470.70
1997Q4	78973.00	14441.90	37543.00	26988.10
1998Q1	17501.30	1775.200	8757.100	6969.000
1998Q2	37222.70	4860.400	18693.10	13669.20
1998Q3	57595.20	8740.200	28013.00	20842.00
1998Q4	84402.30	14817.60	39004.20	30580.50
1999Q1	18789.70	1878.600	9204.800	7706.300
1999Q2	39554.90	5039.900	19479.00	15036.00
1999Q3	61414.20	9048.700	29436.90	22928.60
1999Q4	89677.10	14770.00	41033.60	33873.50
2000Q1	20647.00	1924.900	9981.400	8740.700
2000Q2	43748.20	5094.500	21429.90	17223.80
2000Q3	68087.50	9169.300	32629.50	26288.70
2000Q4	99214.60	14944.70	45555.90	38714.00
2001Q1	23299.50	2035.200	11127.40	10136.90
2001Q2	48950.90	5297.100	23813.30	19840.50
2001Q3	75818.20	9715.200	35856.10	30246.90
2001Q4	109655.2	15781.30	49512.30	44361.60
2002Q1	25375.70	2181.300	11811.30	11383.10
2002Q2	53341.00	5635.200	25562.60	22143.20
2002Q3	83056.70	10325.60	38807.30	33923.80
2002Q4	120332.7	16537.00	53896.80	49898.90
2003Q1	28861.80	2258.100	13776.40	12827.30
2003Q2	59868.90	5779.400	29478.00	24611.50
2003Q3	93329.30	10866.40	44853.10	37609.80

2003Q4	135822.8	17381.70	62436.30	56004.80
2004Q1	33420.60	2663.500	16077.30	14679.80
2004Q2	70405.90	7027.500	34674.50	28703.90
2004Q3	109967.6	13385.00	52869.60	43713.00
2004Q4	159878.3	21412.70	73904.30	64561.30
2005Q1	38848.60	3013.600	18968.40	16866.60
2005Q2	81422.50	7652.000	40902.60	32867.90
2005Q3	125984.9	14451.20	61542.40	49991.30
2005Q4	183867.9	23070.40	87364.60	73432.90

Source: National Bureau of Statistics of China (2007), *China Quarterly GDP Time Series*, 1992-2005, Department of National Accounts, China Statistics Press, ISBN 978-7-5037-5356-5.

Appendix B: The data for 2006Q1-2009Q4

Quarter	GDP	Primary Industry	Secondary Industry	Tertiary Industry
2006Q1	44419.80	3093.000	22076.10	19250.70
2006Q2	93611.60	7973.600	47909.40	37728.60
2006Q3	144569.6	15058.20	72008.20	57503.20
2006Q4	211923.0	24040.00	103162.0	84721.00
2007Q1	53058.00	3654.000	26465.00	22939.00
2007Q2	112458.0	9283.000	57614.00	45561.00
2007Q3	174428.0	17937.00	86405.00	70086.00
2007Q4	257306.0	28627.00	124799.0	103880.0
2008Q1	63475.00	4720.000	31658.00	27097.00
2008Q2	134726.0	11800.00	69330.00	53596.00
2008Q3	208025.0	22062.00	103974.0	81989.00
2008Q4	314045.0	33702.00	149003.0	131340.0
2009Q1	65745.00	4700.000	31968.00	29077.00
2009Q2	139862.0	12025.00	70070.00	57767.00
2009Q3	217817.0	22500.00	106477.0	88840.00
2009Q4	335353.0	35477.00	156958.0	142918.0

Source: http://www.stats.gov.cn/english (Consulted: January 22 2010)

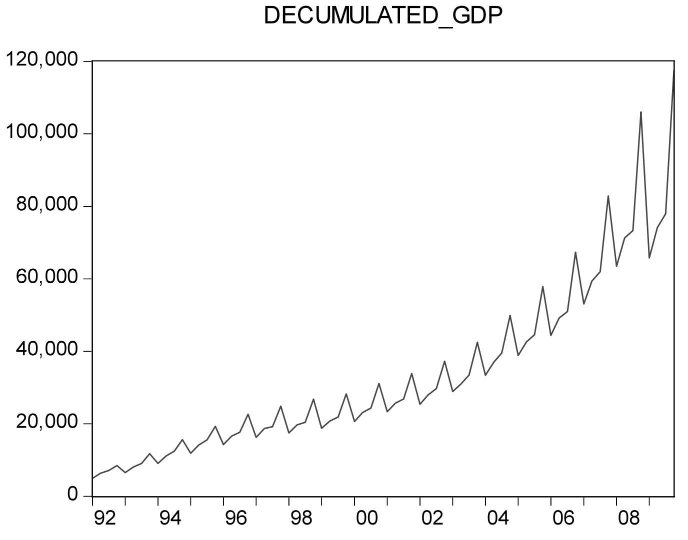


Figure A1: Quarterly GDP (de-cumulated) as the aggregate in current prices, 1992Q1-2009Q4

Appendix C: The data for 1992Q1-2005Q4

The data in this table are calculated at constant prices, and are relative to the same period of the preceding year = 100

Quarter	GROWTH	GROWTH 1	GROWTH2	GROWTH3
1992Q1	13.6	10.0	17.4	9.80
1992Q2	13.3	7.70	18.0	9.50
1992Q3	13.3	5.50	18.8	10.8
1992Q4	14.2	4.70	21.2	12.4
1993Q1	15.1	6.10	19.4	12.2
1993Q2	14.8	4.20	19.7	13.1
1993Q3	14.3	4.20	19.4	13.0
1993Q4	14.0	4.70	19.9	12.2
1994Q1	12.9	6.00	16.5	9.80
1994Q2	12.4	4.50	16.6	9.60
1994Q3	12.4	4.50	16.9	9.90
1994Q4	13.1	4.00	18.4	11.1
1995Q1	12.0	6.00	14.7	9.70
1995Q2	11.0	6.20	13.6	8.80
1995Q3	10.6	5.50	13.1	9.20
1995Q4	10.9	5.00	13.9	9.80
1996Q1	10.9	5.50	12.3	10.2
1996Q2	10.3	5.00	12.0	9.60
1996Q3	10.0	4.80	11.9	9.60

1996Q4	10.0	5.10	12.1	9.40
1997Q1	10.4	5.00	10.3	12.2
1997Q2	10.2	5.00	10.7	11.6
1997Q3	9.60	3.90	10.3	11.5
1997Q4	9.30	3.50	10.5	10.7
1998Q1	7.60	4.00	7.60	8.60
1998Q2	7.20	2.20	7.70	8.50
1998Q3	7.50	2.50	8.10	9.00
1998Q4	7.80	3.50	8.90	8.40
1999Q1	9.10	4.00	9.60	9.50
1999Q2	8.30	3.00	9.00	9.20
1999Q3	8.10	3.30	8.70	9.30
1999Q4	7.60	2.80	8.10	9.30
2000Q1	9.00	3.00	9.10	10.4
2000Q2	8.90	1.50	9.50	10.7
2000Q3	8.90	2.20	9.60	10.7
2000Q4	8.40	2.40	9.40	9.70
2001Q1	8.50	3.10	9.20	8.80
2001Q2	8.10	1.80	9.50	8.40
2001Q3	8.00	2.90	9.10	8.40
2001Q4	8.30	2.80	8.40	10.3
2002Q1	8.90	3.40	9.10	9.90
2002Q2	8.90	2.00	9.50	10.1
2002Q3	9.20	3.40	9.80	10.2
2002Q4	9.10	2.90	9.80	10.4
2003Q1	10.8	3.60	12.5	10.3
2003Q2	9.70	2.10	11.8	9.10
2003Q3	10.1	3.10	12.5	9.30
2003Q4	10.0	2.50	12.7	9.50
2004Q1	10.4	4.60	11.6	10.0
2004Q2	10.9	4.40	11.5	11.6
2004Q3	10.5	6.00	11.1	10.9
2004Q4	10.1	6.30	11.1	10.1
2005Q1	10.5	4.60	11.2	10.6
2005Q2	10.5	5.00	11.3	10.8
2005Q3	10.4	5.00	11.2	10.9
2005Q4	10.4	5.20	11.7	10.5

Appendix D: The data for 2006Q1-2009Q4

The data in this table are calculated at constant prices, and are relative to the same period of the preceding year = 100

Quarter	GROWTH	GROWTH 1	GROWTH2	GROWTH3
2006Q1	11.4	4.50	12.6	11.3
2006Q2	12.0	5.10	13.6	11.7
2006Q3	11.8	4.90	13.3	11.8
2006Q4	11.6	5.00	13.0	12.1
2007Q1	13.0	4.40	14.6	12.7
2007Q2	13.4	4.00	15.0	13.5
2007Q3	13.4	4.30	14.8	14.0
2007Q4	13.0	3.70	14.7	13.8
2008Q1	10.6	2.80	11.5	10.9
2008Q2	10.4	3.50	11.3	10.7
2008Q3	9.90	4.50	10.6	10.5
2008Q4	9.00	5.50	9.30	9.50
2009Q1	6.10	3.50	5.30	7.40
2009Q2	7.10	3.80	6.60	8.30
2009Q3	7.70	4.00	7.50	8.80
2009Q4	8.70	4.20	9.50	8.90

Source: http://www.stats.gov.cn/english (Consulted: January 22 2010)

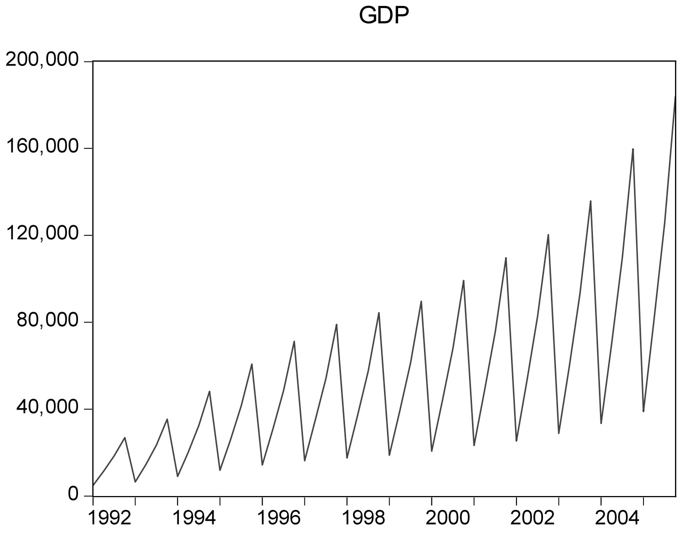


Figure 1: Quarterly GDP (cumulated) as the aggregate in current prices, 1992Q1-2005Q4 (the data are given in Appendix A)

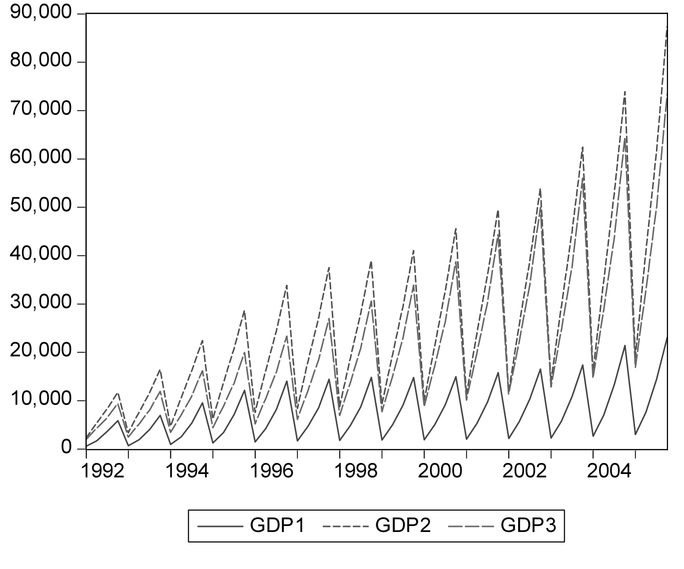


Figure 2: Quarterly GDP (cumulated) as the aggregate in current prices, 1992Q1-2005Q4, per industry (primary, secondary and tertiary) (the data are given in Appendix A)

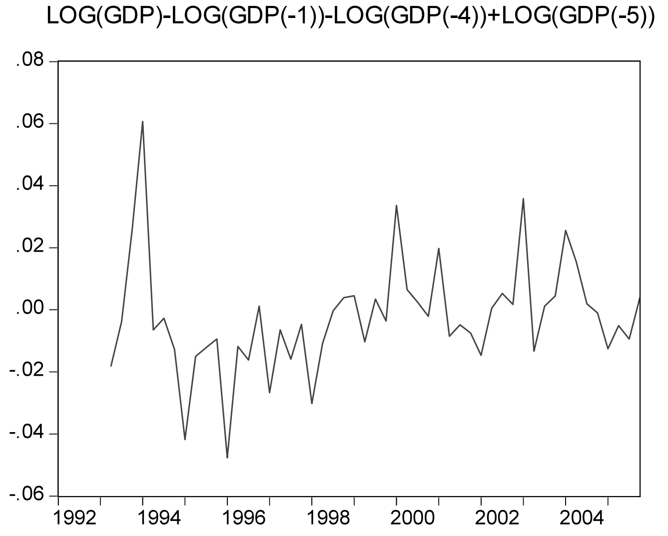


Figure 3: Quarterly change in the annual growth rate of GDP (cumulated) as the aggregate in current prices, 1992Q1-2005Q4

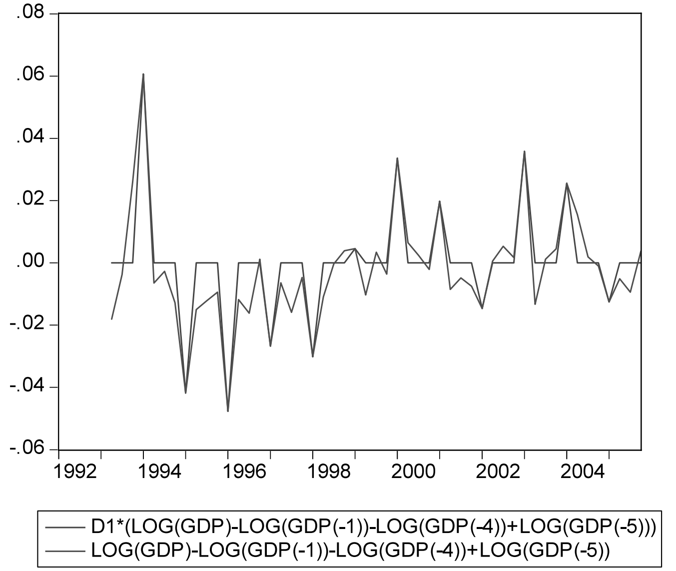


Figure 4: Quarterly change in the annual growth rate of GDP (cumulated) as the aggregate in current prices, 1992Q1-2005Q4 versus the same variable when assumed to be non-zero only in Quarter 1

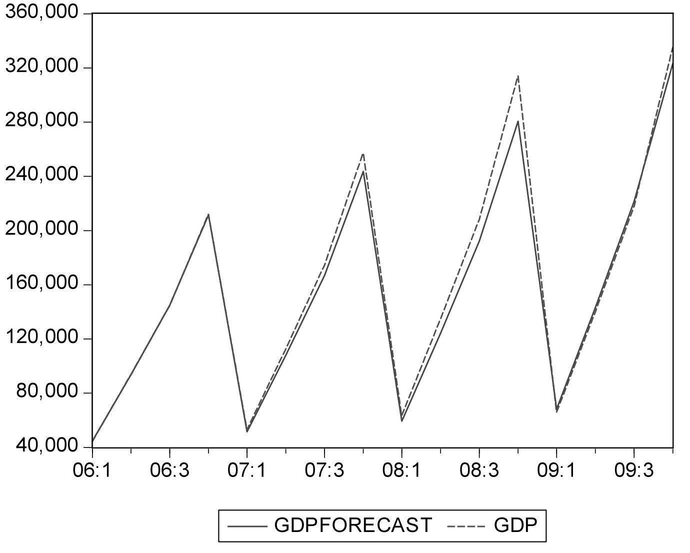


Figure 5: Multi-step-ahead forecasts (Dynamic Forecasts) for 2006Q1 to 2009Q4 from forecast origin 2005Q4 generated using (4)

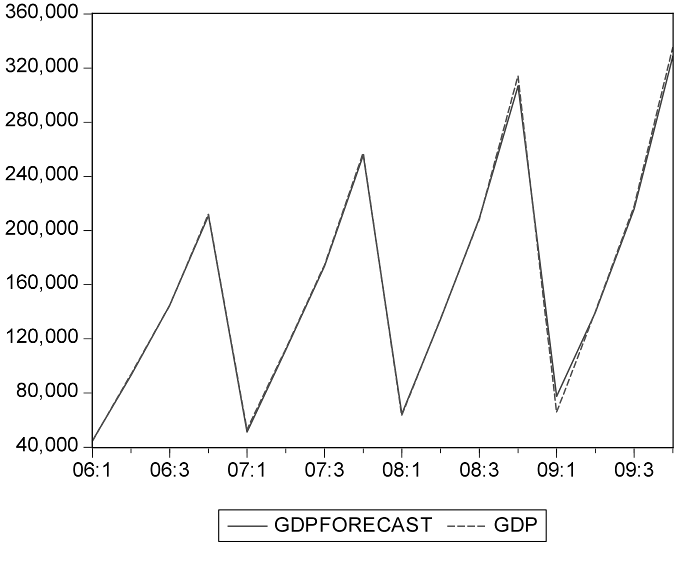


Figure 6: One-step-ahead forecasts (Static Forecasts) for 2006Q1 to 2009Q4 from forecast origin 2005Q4, 2006Q1, and so on, generated using (4)

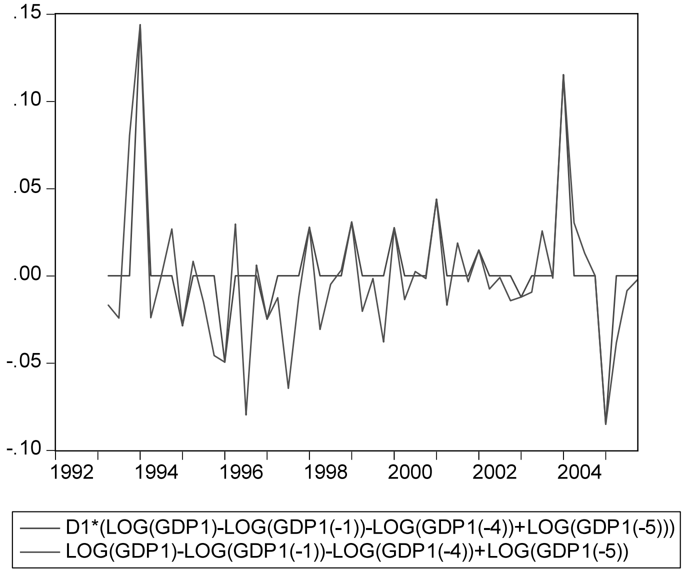


Figure 7: Quarterly change in the annual growth rate of GDP ***Primary Sector*** (cumulated) as the aggregate in current prices, 1992.1-2005.4 versus the same variable when assumed to be non-zero only in Quarter 1

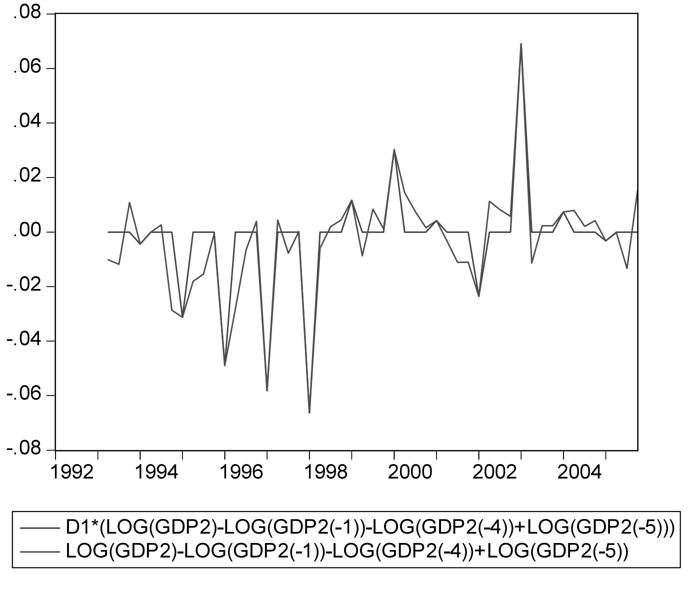


Figure 8: Quarterly change in the annual growth rate of GDP ***Secondary Sector*** (cumulated) as the aggregate in current prices, 1992.1-2005.4 versus the same variable when assumed to be non-zero only in Quarter 1

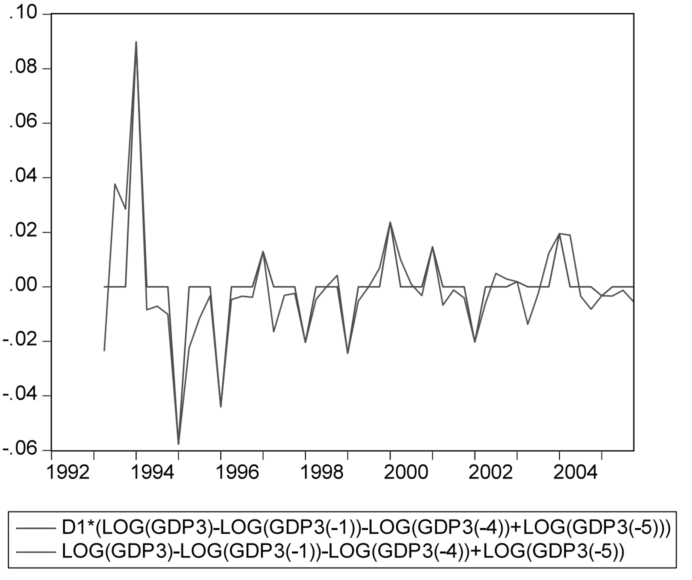


Figure 9: Quarterly change in the annual growth rate of GDP ***Tertiary Sector*** (cumulated) as the aggregate in current prices, 1992.1-2005.4 versus the same variable when assumed to be non-zero only in Quarter 1

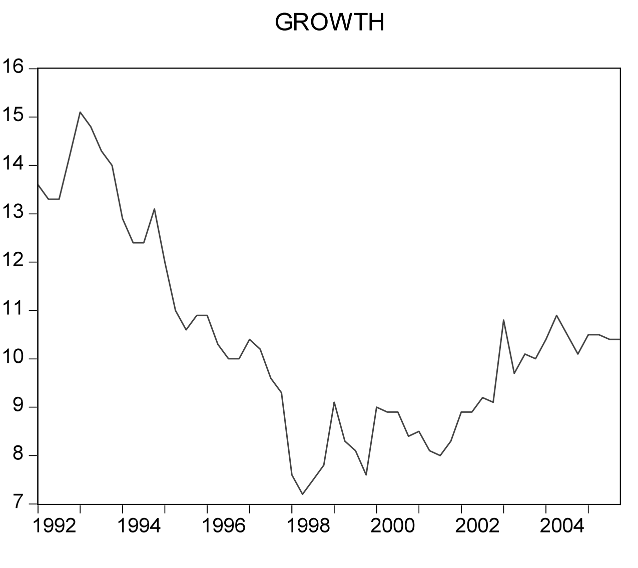


Figure 10: Growth Rate of total GDP, at constant prices, 1992Q1-2005Q4

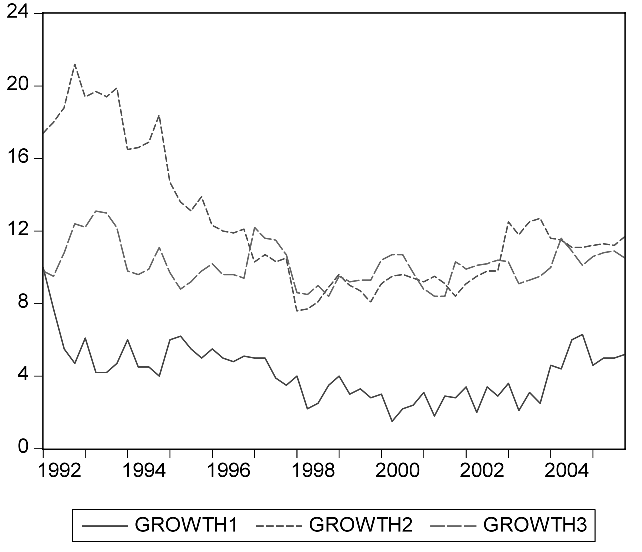


Figure 11: Growth Rate of GDP in the three sectors, at constant prices, 1992Q1-2005Q4

Figure 12: Real growth rates, USA and China, 1992Q1-2009Q4

Table 1: Multiple-step-ahead forecasts and realizations of the levels of current prices GDP, 2006Q1-2009Q4, percentage forecast error computed as $100 * \frac{GDP - Forecast}{GDP}$

Quarter	Forecast	GDP	Percentage Forecast Error
2006Q1	44702.33	44419.80	-0.636
2006Q2	93691.30	93611.60	-0.085
2006Q3	144968.4	144569.6	-0.276
2006Q4	211573.2	211923.0	0.165
2007Q1	51466.36	53058.00	3.000
2007Q2	107868.0	112458.0	4.082
2007Q3	166903.9	174428.0	4.314
2007Q4	243586.9	257306.0	5.332
2008Q1	59286.41	63475.00	6.599
2008Q2	124257.9	134726.0	7.770
2008Q3	192264.1	208025.0	7.576
2008Q4	280598.7	314045.0	10.650
2009Q1	68332.17	65745.00	-3.935
2009Q2	143216.9	139862.0	-2.399
2009Q3	221599.3	217817.0	-1.736
2009Q4	323411.7	335353.0	3.962

Table 2: One-step-ahead forecasts and realizations of the levels of current prices GDP, 2006Q1-2009Q4, percentage forecast error computed as $100 * \frac{GDP - Forecast}{GDP}$

Quarter	Forecast	GDP	Percentage Forecast Error
2006Q1	44702.33	44419.80	-0.636
2006Q2	93099.14	93611.60	0.547
2006Q3	144845.1	144569.6	-0.191
2006Q4	210991.2	211923.0	0.440
2007Q1	51225.62	53058.00	3.454
2007Q2	111816.0	112458.0	0.571
2007Q3	173675.1	174428.0	0.432
2007Q4	255692.1	257306.0	0.627
2008Q1	64455.67	63475.00	-1.545
2008Q2	134537.1	134726.0	0.140
2008Q3	208966.8	208025.0	-0.453
2008Q4	306866.3	314045.0	2.286
2009Q1	77514.53	65745.00	-17.902
2009Q2	139544.1	139862.0	0.227
2009Q3	215955.3	217817.0	0.855
2009Q4	328827.5	335353.0	1.984
Median error			0.436
Median absolute error			0.599

Table 3: Multiple-step-ahead forecasts and realizations of the levels of current prices GDP, ***Primary Sector***, 2006Q1-2009Q4, percentage forecast error computed as $100 * \frac{GDP - Forecast}{GDP}$

Quarter	Forecast	GDP1	Percentage Forecast Error
2006:1	3253.665	3093.000	-5.195
2006:2	8261.563	7973.600	-3.612
2006:3	15602.39	15058.20	-3.614
2006:4	24908.20	24040.00	-3.612
2007:1	3520.170	3654.000	3.663
2007:2	8938.260	9283.000	3.714
2007:3	16880.37	17937.00	5.891
2007:4	26948.41	28627.00	5.864
2008:1	3816.436	4720.000	19.143
2008:2	9690.526	11800.00	17.877
2008:3	18301.06	22062.00	17.047
2008:4	29216.45	33702.00	13.309
2009:1	4146.254	4700.000	11.782
2009:2	10527.98	12025.00	12.449
2009:3	19882.65	22500.00	11.633
2009:4	31741.35	35477.00	11.769

Table 4: One-step-ahead forecasts and realizations of the levels of current prices GDP, ***Primary Sector***, 2006Q1-2009Q4, percentage forecast error computed as $100 * \frac{GDP - Forecast}{GDP}$

obs	Forecast	GDP1	Percentage Forecast Error
2006Q1	3253.665	3093.000	-5.194
2006Q2	7853.609	7973.600	1.505
2006Q3	15058.56	15058.20	-0.002
2006Q4	24039.44	24040.00	0.002
2007Q1	3229.705	3654.000	11.612
2007Q2	9419.830	9283.000	-1.474
2007Q3	17531.01	17937.00	2.263
2007Q4	28635.92	28627.00	-0.032
2008Q1	4360.271	4720.000	7.621
2008Q2	11991.18	11800.00	-1.620
2008Q3	22800.45	22062.00	-3.347
2008Q4	35210.40	33702.00	-4.476
2009Q1	5568.335	4700.000	-18.475
2009Q2	11750.00	12025.00	2.287
2009Q3	22482.67	22500.00	0.077
2009Q4	34371.09	35477.00	3.218
Median error			0.000
Median absolute error			2.275

Table 5: Multiple-step-ahead forecasts and realizations of the levels of current prices GDP, ***Secondary Sector***, 2006Q1-2009Q4, percentage forecast error computed as $100 * \frac{GDP - Forecast}{GDP}$

Quarter	Forecast	GDP2	Percentage Forecast Error
2006Q1	22439.63	22076.10	-1.647
2006Q2	48387.80	47909.40	-0.999
2006Q3	72804.70	72008.20	-1.106
2006Q4	103352.4	103162.0	-0.185
2007Q1	26565.62	26465.00	-0.380
2007Q2	57284.89	57614.00	0.571
2007Q3	86191.34	86405.00	0.247
2007Q4	122355.8	124799.0	1.958
2008Q1	31473.37	31658.00	0.583
2008Q2	67867.76	69330.00	2.109
2008Q3	102114.4	103974.0	1.789
2008Q4	144960.0	149003.0	2.713
2009Q1	37315.21	31968.00	-16.727
2009Q2	80464.83	70070.00	-14.835
2009Q3	121068.1	106477.0	-13.704
2009Q4	171866.3	156958.0	-8.674

Table 6: One-step-ahead forecasts and realizations of the levels of current prices GDP, ***Secondary Sector***, 2006Q1-2009Q4, percentage forecast error computed as $100 * \frac{GDP - Forecast}{GDP}$

Quarter	Forecast	GDP2	Percentage Forecast Error
2006Q1	22439.63	22076.10	-1.647
2006Q2	47603.90	47909.40	0.638
2006Q3	72084.89	72008.20	-0.107
2006Q4	102221.7	103162.0	0.911
2007Q1	26087.10	26465.00	1.428
2007Q2	57434.16	57614.00	0.312
2007Q3	86594.29	86405.00	-0.219
2007Q4	123787.5	124799.0	0.811
2008Q1	32039.26	31658.00	-1.204
2008Q2	68919.10	69330.00	0.593
2008Q3	103975.7	103974.0	-0.002
2008Q4	150174.8	149003.0	-0.786
2009Q1	37825.67	31968.00	-18.324
2009Q2	70008.89	70070.00	0.087
2009Q3	105083.8	106477.0	1.308
2009Q4	152590.0	156958.0	2.863
Median error			0.200
Median absolute error			0.799

Table 7: Multiple-step-ahead forecasts and realizations of the levels of current prices GDP, ***Tertiary Sector***, 2006Q1-2009Q4, percentage forecast error computed as $100 * \dfrac{GDP - Forecast}{GDP}$

Quarter	Forecast	GDP3	Percentage Forecast Error
2006Q1	19197.17	19250.70	0.278
2006Q2	37409.47	37728.60	0.846
2006Q3	56898.92	57503.20	1.051
2006Q4	83579.60	84721.00	1.347
2007Q1	21864.42	22939.00	4.685
2007Q2	42607.14	45561.00	6.483
2007Q3	64804.45	70086.00	7.536
2007Q4	95192.14	103880.0	8.364
2008Q1	24918.96	27097.00	8.038
2008Q2	48559.52	53596.00	9.397
2008Q3	73857.88	81989.00	9.917
2008Q4	108490.8	131340.0	17.397
2009Q1	28419.28	29077.00	2.262
2009Q2	55380.59	57767.00	4.131
2009Q3	84232.57	88840.00	5.186
2009Q4	123730.4	142918.0	15.508

Table 8: One-step-ahead forecasts and realizations of the levels of current prices GDP, ***Tertiary Sector***, 2006Q1-2009Q4, percentage forecast error computed as $100 * \dfrac{GDP - Forecast}{GDP}$

Quarter	Forecast	GDP3	Percentage Forecast Error
2006Q1	19197.17	19250.70	0.278
2006Q2	37513.79	37728.60	0.569
2006Q3	57384.31	57503.20	0.207
2006Q4	84467.23	84721.00	0.300
2007Q1	22224.81	22939.00	3.113
2007Q2	44957.14	45561.00	1.325
2007Q3	69440.78	70086.00	0.921
2007Q4	103259.6	103880.0	0.597
2008Q1	28145.34	27097.00	-3.869
2008Q2	53819.54	53596.00	-0.417
2008Q3	82446.15	81989.00	-0.558
2008Q4	121522.4	131340.0	7.475
2009Q1	34282.89	29077.00	-17.904
2009Q2	57512.30	57767.00	0.441
2009Q3	88369.63	88840.00	0.529
2009Q4	142314.8	142918.0	0.424
Median error			0.433
Median absolute error			0.564

Table 9: One-step-ahead forecast for constant prices growth in GDP (total, based on cumulated data), realizations and differences calculated as Forecast-Realization

Quarter	Forecast	GROWTH	Forecast-Growth
2006Q1	10.7	11.4	-0.7
2006Q2	11.0	12.0	-1.0
2006Q3	12.0	11.8	0.2
2006Q4	11.8	11.6	0.2
2007Q1	11.9	13.0	-1.1
2007Q2	12.6	13.4	-0.8
2007Q3	13.4	13.4	0.0
2007Q4	13.4	13.0	0.4
2008Q1	13.3	10.6	2.7
2008Q2	10.2	10.4	-0.2
2008Q3	10.4	9.90	0.5
2008Q4	9.90	9.00	0.9
2009Q1	9.30	6.10	3.2
2009Q2	5.73	7.10	-1.4
2009Q3	7.10	7.70	-0.6
2009Q4	7.70	8.70	-1.0
Median error			-0.10
Median absolute error			0.75

Table 10: One-step-ahead forecast for constant prices growth in GDP (***Primary Sector***, based on cumulated data), realizations and differences calculated as Forecast-Realization

Quarter	Forecast	GROWTH 1	Forecast-GROWTH1
2006Q1	5.9	4.5	1.4
2006Q2	3.5	5.1	-1.6
2006Q3	5.1	4.9	0.2
2006Q4	4.9	5.0	-0.1
2007Q1	5.7	4.4	1.3
2007Q2	3.4	4.0	-0.6
2007Q3	4.0	4.3	-0.3
2007Q4	4.3	3.7	0.6
2008Q1	4.4	2.8	1.6
2008Q2	1.8	3.5	-1.7
2008Q3	3.5	4.5	-1.0
2008Q4	4.5	5.5	-1.0
2009Q1	6.2	3.5	2.7
2009Q2	2.5	3.8	-1.3
2009Q3	3.8	4.0	-0.2
2009Q4	4.0	4.2	-0.2
Median error			-0.20
Median absolute error			1.00

Table 11: One-step-ahead forecast for constant prices growth in GDP (***Secondary Sector,*** based on cumulated data), realizations and differences calculated as Forecast-Realization

Quarter	Forecast	GROWTH2	Forecast-GROWTH2
2006Q1	10.8	12.6	-1.8
2006Q2	12.6	13.6	-1.0
2006Q3	13.6	13.3	0.3
2006Q4	13.3	13.0	0.3
2007Q1	12.1	14.6	-2.5
2007Q2	14.6	15.0	-0.4
2007Q3	15.0	14.8	0.2
2007Q4	14.8	14.7	0.1
2008Q1	13.8	11.5	2.3
2008Q2	11.5	11.3	0.2
2008Q3	11.3	10.6	0.7
2008Q4	10.6	9.3	1.3
2009Q1	8.4	5.3	3.1
2009Q2	5.3	6.6	-1.3
2009Q3	6.6	7.5	-0.9
2009Q4	7.5	9.5	-2.0
Median error			0.15
Median absolute error			0.95

Table 12: One-step-ahead forecast for constant prices growth in GDP (***Tertiary Sector,*** based on cumulated data), realizations and differences calculated as Forecast-Realization

Quarter	Forecast	GROWTH3	Forecast-GROWTH3
2006Q1	10.5	11.3	-0.8
2006Q2	11.3	11.7	-0.4
2006Q3	11.7	11.8	-0.1
2006Q4	11.8	12.1	-0.3
2007Q1	12.1	12.7	-0.6
2007Q2	12.7	13.5	-0.8
2007Q3	13.5	14.0	-0.5
2007Q4	14.0	13.8	0.2
2008Q1	13.8	10.9	2.9
2008Q2	10.9	10.7	0.2
2008Q3	10.7	10.5	0.2
2008Q4	10.5	9.50	1.0
2009Q1	9.50	7.40	2.1
2009Q2	7.40	8.30	-0.9
2009Q3	8.30	8.80	-0.5
2009Q4	8.80	8.90	-0.1
Median error			-0.20
Median absolute error			0.50

References

Dong, Lihua (2006), Quarterly GDP Estimation in China, in Series 9 of “Research of Methodological Issues in National Accounts – China”, OECD
http://www.oecd.org/document/57/0,3343,en_2649_34253_31640185_1_1_1_1,00.html

Franses, Philip Hans (1998), Time Series Models for Business and Economic Forecasting, Cambridge: Cambridge University Press.

National Bureau of Statistics of China (2007), *China Quarterly GDP Time Series*, 1992-2005, Department of National Accounts, China Statistics Press, ISBN 978-7-5037-5356-5.

VII Summary in English

This collection of papers reflects my first foray in academia. All papers relate – one way or the other – to China. Chapter 2 proves the central thesis of this thesis, namely that China's boom caused the 2008 financial crisis and ensuing recession. It builds on the work by Taylor (2008), Obstfeld and Rogoff (2010), Bernanke (2005), Greenspan (2011) and Warnock and Warnock (2009). Its main contribution is that it shows that the built-up of total debt securities, rather than foreign purchases of U.S. Treasuries, depressed 10-year Treasury yields from 2004 on. In addition, I show that the Fed, with its excessively loose monetary policy in the early 2000s, contributed to a large extent to the housing bubble and current debt overload of U.S. households.

The paper on China's household savings rate (Chapter 3) builds on the work of Ando and Modigliani (1963), Modigliani and Cao (2004), Blanchard and Giavazzi (2005), Horioka and Wan (2007), Chamon and Prasad (2010) and Wei and Zhang (2011). We use data that are more recent and cover a longer time span (1960 – 2009) than previous studies. The paper's first contribution is that it disproves many assertions about China's household savings rate, including (1) the claim that China's one-child-policy explains the high household savings rate, (2) the claim that the household savings curve is u-shaped, (3) the claim that the savings rate is high because interest rate are low, and (4) the claim that the so-called competitive savings motive, also dubbed 'keeping up with the Wangs,' is a decisive factor in Chinese households' preference for saving over consumption. Its second contribution is that it supports the conventional Keynesian savings hypothesis over Modigliani's life cycle hypothesis, although habit formation and precautionary saving motives are also important. Disposable income (which is measured by its reciprocal), the average 5-year income growth rate and the old-age dependency rate are the main determinants of the household savings rate.

In chapter 4 we show that individuals in China are susceptible to money illusion, albeit to a lesser extent than their American counterparts. The paper builds on the seminal paper by Shafir, Diamond and Tversky (1997). Although it is tentative to draw conclusions from comparing two not entirely representative samples, our findings suggest that money illusion may be more prevalent in affluent societies, which may therefore be more vulnerable for irrational exuberance (Akerlof and Shiller, 2009). In chapter 5 we look at financial markets' response to U.S., Chinese and German quarterly GDP growth data. Based on a comparison of financial markets reactions, we have found no evidence that China's National Bureau of Statistics 'cooks the books.' As far as financial markets respond less to Chinese growth data compared to U.S. growth data, the difference can fully be attributed to the size of the Chinese economy. Last and also least, in chapter 6 we show that China's Q2, Q3 and Q4 GDP numbers are rather predictable because China's National Bureau of Statistics reports quarterly GDP cumulatively. A keen understanding of the cumulated Chinese data, however, won't bring any privileged knowledge about China's quarterly GDP growth to which financial markets respond.

VIII Summary in Dutch

Deze verzameling papers weerspiegelt mijn eerste uitstapje in de academische wereld. De papers hebben – op een of andere manier – allemaal betrekking op China. Hoofdstuk 2 geeft het bewijs van de centrale stelling van dit proefschrift, namelijk dat de opkomst van China de financiële crisis van 2008 heeft veroorzaakt. Mijn onderzoek bouwt voort op het werk van Taylor (2008), Obstfeld en Rogoff (2010), Bernanke (2005), Greenspan (2011) en Warnock en Warnock (2009). Mijn belangrijkste bijdrage is dat ik laat zien dat het totaal aan schuldvorderingen, in plaats van de buitenlandse aankopen van Amerikaanse staatsobligaties, verantwoordelijk is voor de daling van de rente op Amerikaanse staatsobligaties sinds 2004. Daarnaast laat ik zien hoe het Amerikaanse stelsel van centrale banken, de Federal Reserve, door een excessief los monetair beleid te voeren na de eeuwwisseling, heeft bijgedragen aan de bubbel op de Amerikaanse huizenmarkt en de hoge schuldenlast van Amerikaanse huishoudens.

De paper over de spaarquote van Chinese huishoudens (hoofdstuk 3) bouwt voort op het werk van Ando en Modigliani (1963), Modigliani en Cao (2004), Blanchard en Giavazzi (2005), Horioka en Wan (2007), Chamon en Prasad (2010) en Wei en Zhang (2011). We maken gebruik van gegevens die recenter zijn en een langere periode (1960 – 2009) beslaan dan eerdere onderzoeken. De eerste bijdrage is dat onze bevindingen veel beweringen over het huishouden van China spaarquote ontkrachten, waaronder (1) de bewering dat het één-kindbeleid in China de hoge spaarquote van Chinese huishoudens verklaart, (2) de bewering dat de spaarcurve U-vormig is en (3) de bewering dat het zogenoemde competitieve spaarmotief, dat wil zeggen dat Chinezen veel sparen omdat de buren het ook doen,' het spaargedrag bepaalt. De tweede bijdrage is dat onze bevindingen de traditionele Keynesiaanse spaarhypothese steunen, in plaats van Modigliani's levenscyclushypothese, hoewel gewoontevorming en sparen voor de oude dag ook belangrijke motieven zijn. Behalve het besteedbaar inkomen, zijn de gemiddelde inkomensgroei en de ratio 65-plussers/beroepsbevolking de belangrijkste determinanten van de spaarquote van Chinese huishoudens.

In hoofdstuk 4 laten we zien dat mensen in China gevoelig zijn voor geldillusie, zij het in mindere mate dan Amerikanen. De paper is gebaseerd op het baanbrekende artikel van Shafir, Diamond en Tversky (1997). Hoewel alleen tentatieve conclusies kunnen worden getrokken uit de vergelijking van twee niet geheel representatieve steekproeven, impliceren onze bevindingen dat geldillusie vaker voorkomt in welvarende samenlevingen, en dat die bijgevolg kwetsbaarder zijn voor irrationele exuberantie (Akerlof en Shiller, 2009). In hoofdstuk 5 kijken we hoe financiële markten reageren op de Amerikaanse, Chinese en Duitse groeicijfers. Op basis van een vergelijking van de reactie van financiële markten op deze kwartaalcijfers hebben we geen bewijs kunnen vinden voor de bewering dat het Chinese Bureau voor de Statistiek met de boeken knoeit. Voor zover financiële markten minder sterk reageren op Chinese groeicijfers dan op Amerikaanse groeicijfers, kan het verschil volledig worden toegeschreven aan de omvang van de Chinese economie. *Last and also least*, in hoofdstuk 6 laten we zien dat in kwartaal 2, 3 en 4 de Chinese BBP data relatief voorspelbaar zijn, omdat het Chinese Bureau voor de Statistiek het BBP cumulatief rapporteert per kwartaal. Een goed begrip van de gecumuleerde Chinese data leidt echter niet tot bijzondere kennis over de kwartaalgroei van het BBP van China waar financiële markten op reageren.

About the Author

Heleen Mees is Adjunct Associate Professor at New York University Wagner Graduate School of Public Service. Before joining NYU, Mees was Assistant Professor in Economics at Tilburg University and researcher at the Erasmus School of Economics. Her research interests include monetary policy, financial crises and China. Mees is contributing editor to *Foreign Policy* and a columnist for the *Financieele Dagblad*. Her opinion articles have been published in international newspapers including *The New York Times*, *The Financial Times* and *Le Monde*. From 2006 – 2010 she was a columnist for *NRC Handelsblad*. Heleen Mees is the author of three books; her latest *Between Greed and Desire – The World between Wall Street and Main Street* was published in the Netherlands in 2009. Before, she worked at Ernst & Young's headquarters in New York, the European Commission in Brussels and the Dutch Treasury in The Hague. Mees graduated both in economics and law. Mees is fluent in English and Dutch. In addition, she speaks Chinese (Mandarin), French and Italian. Mees lives and works in New York City.

ERASMUS RESEARCH INSTITUTE OF MANAGEMENT (ERIM)

ERIM PH.D. SERIES RESEARCH IN MANAGEMENT

The ERIM PhD Series contains PhD dissertations in the field of Research in Management defended at Erasmus University Rotterdam and supervised by senior researchers affiliated to the Erasmus Research Institute of Management (ERIM). All dissertations in the ERIM PhD Series are available in full text through the ERIM Electronic Series Portal: http://hdl.handle.net/1765/1

ERIM is the joint research institute of the Rotterdam School of Management (RSM) and the Erasmus School of Economics at the Erasmus University Rotterdam (EUR).

DISSERTATIONS LAST FIVE YEARS

Acciaro, M., *Bundling Strategies in Global Supply Chains.* Promoter(s): Prof.dr. H.E. Haralambides, EPS-2010-197-LIS, http://hdl.handle.net/1765/19742

Agatz, N.A.H., *Demand Management in E-Fulfillment*. Promoter(s): Prof.dr.ir. J.A.E.E. van Nunen, EPS-2009-163-LIS, http://hdl.handle.net/1765/15425

Alexiev, A., *Exploratory Innovation: The Role of Organizational and Top Management Team Social Capital.* Promoter(s): Prof.dr. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2010-208-STR, http://hdl.handle.net/1765/20632

Asperen, E. van, *Essays on Port, Container, and Bulk Chemical Logistics Optimization***. Pr**omoter(s): Prof.dr.ir. R. Dekker, EPS-2009-181-LIS, http://hdl.handle.net/1765/17626

Assem, M.J. van den, *Deal or No Deal? Decision Making under Risk in a Large-Stake TV Game Show and Related Experiments,* Promoter(s): Prof.dr. J. Spronk, EPS-2008-138-F&A, http://hdl.handle.net/1765/13566

Benning, T.M., *A Consumer Perspective on Flexibility in Health Care: Priority Access Pricing and Customized Care*, Promoter(s): Prof.dr.ir. B.G.C. Dellaert, EPS-2011-241-MKT, http://hdl.handle.net/1765/23670

Betancourt, N.E., *Typical Atypicality: Formal and Informal Institutional Conformity, Deviance, and Dynamics*, Promoter(s): Prof.dr. B. Krug, EPS-2012-262-ORG, http://hdl.handle.net/1765/32345

Bezemer, P.J., *Diffusion of Corporate Governance Beliefs: Board Independence and the Emergence of a Shareholder Value Orientation in the Netherlands.* Promoter(s): Prof.dr.ing. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2009-192-STR, http://hdl.handle.net/1765/18458

Binken, J.L.G., *System Markets: Indirect Network Effects in Action, or Inaction,* Promoter(s): Prof.dr. S. Stremersch, EPS-2010-213-MKT, http://hdl.handle.net/1765/21186

Blitz, D.C., *Benchmarking Benchmarks,* Promoter(s): Prof.dr. A.G.Z. Kemna & Prof.dr. W.F.C. Verschoor, EPS-2011-225-F&A, http://hdl.handle.net/1765/22624

Boer-Sorbán, K., *Agent-Based Simulation of Financial Markets: A modular, Continuous-Time Approach,* Promoter(s): Prof.dr. A. de Bruin, EPS-2008-119-LIS, http://hdl.handle.net/1765/10870

Boon, C.T., *HRM and Fit: Survival of the Fittest!?,* Promoter(s): Prof.dr. J. Paauwe & Prof.dr. D.N. den Hartog, EPS-2008-129-ORG, http://hdl.handle.net/1765/12606

Borst, W.A.M., *Understanding Crowdsourcing: Effects of Motivation and Rewards on Participation and Performance in Voluntary Online Activities,* Promoter(s): Prof.dr.ir. J.C.M. van den Ende & Prof.dr.ir. H.W.G.M. van Heck, EPS-2010-221-LIS, http://hdl.handle.net/1765/ 21914

Braun, E., *City Marketing: Towards an Integrated Approach,* Promoter(s): Prof.dr. L. van den Berg, EPS-2008-142-MKT, http://hdl.handle.net/1765/13694

Brumme, W.-H., *Manufacturing Capability Switching in the High-Tech Electronics Technology Life Cycle,* Promoter(s): Prof.dr.ir. J.A.E.E. van Nunen & Prof.dr.ir. L.N. Van Wassenhove, EPS-2008-126-LIS, http://hdl.handle.net/1765/12103

Budiono, D.P., *The Analysis of Mutual Fund Performance: Evidence from U.S. Equity Mutual Funds,* Promoter(s): Prof.dr. M.J.C.M. Verbeek, EPS-2010-185-F&A, http://hdl.handle.net/1765/18126

Burger, M.J., *Structure and Cooptition in Urban Networks*, Promoter(s): Prof.dr. G.A. van der Knaap & Prof.dr. H.R. Commandeur, EPS-2011-243-ORG, http://hdl.handle.net/1765/26178

Burgers, J.H., *Managing Corporate Venturing: Multilevel Studies on Project Autonomy, Integration, Knowledge Relatedness, and Phases in the New Business Development Process,* Promoter(s): Prof.dr.ir. F.A.J. Van den Bosch & Prof.dr. H.W. Volberda, EPS-2008-136-STR, http://hdl.handle.net/1765/13484

Camacho, N.M., *Health and Marketing; Essays on Physician and Patient Decision-making*, Promoter(s): Prof.dr. S. Stremersch, EPS-2011-237-MKT, http://hdl.handle.net/1765/23604

Carvalho de Mesquita Ferreira, L., *Attention Mosaics: Studies of Organizational Attention*, Promoter(s): Prof.dr. P.M.A.R. Heugens & Prof.dr. J. van Oosterhout, EPS-2010-205-ORG, http://hdl.handle.net/1765/19882

Chen, C.-M., *Evaluation and Design of Supply Chain Operations Using DEA*, Promoter(s): Prof.dr. J.A.E.E. van Nunen, EPS-2009-172-LIS, http://hdl.handle.net/1765/16181

Chen, H., *Individual Mobile Communication Services and Tariffs*, Promoter(s): Prof.dr. L.F.J.M. Pau, EPS-2008-123-LIS, http://hdl.handle.net/1765/11141

Defilippi Angeldonis, E.F., *Access Regulation for Naturally Monopolistic Port Terminals: Lessons from Regulated Network Industries,* Promoter(s): Prof.dr. H.E. Haralambides, EPS-2010-204-LIS, http://hdl.handle.net/1765/19881

Deichmann, D., *Idea Management: Perspectives from Leadership, Learning, and Network Theory*, Promoter(s): Prof.dr.ir. J.C.M. van den Ende, EPS-2012-255-ORG, http://hdl.handle.net/1765/ 31174

Derwall, J.M.M., *The Economic Virtues of SRI and CSR*, Promoter(s): Prof.dr. C.G. Koedijk, EPS-2007-101-F&A, http://hdl.handle.net/1765/8986

Desmet, P.T.M., *In Money we Trust? Trust Repair and the Psychology of Financial Compensations*, Promoter(s): Prof.dr. D. De Cremer & Prof.dr. E. van Dijk, EPS-2011-232-ORG, http://hdl.handle.net/1765/23268

Diepen, M. van, *Dynamics and Competition in Charitable Giving*, Promoter(s): Prof.dr. Ph.H.B.F. Franses, EPS-2009-159-MKT, http://hdl.handle.net/1765/14526

Dietvorst, R.C., *Neural Mechanisms Underlying Social Intelligence and Their Relationship with the Performance of Sales Managers,* Promoter(s): Prof.dr. W.J.M.I. Verbeke, EPS-2010-215-MKT, http://hdl.handle.net/1765/21188

Dietz, H.M.S., *Managing (Sales)People towards Perfomance: HR Strategy, Leadership & Teamwork*, Promoter(s): Prof.dr. G.W.J. Hendrikse, EPS-2009-168-ORG, http://hdl.handle.net/1765/16081

Doorn, S. van, *Managing Entrepreneurial Orientation*, Promoter(s): Prof.dr. J.J.P. Jansen, Prof.dr.ing. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2012-258-STR, http://hdl.handle.net/1765/32166

Douwens-Zonneveld, M.G., *Animal Spirits and Extreme Confidence: No Guts, No Glory*, Promoter(s): Prof.dr. W.F.C. Verschoor, EPS-2012-257-F&A, http://hdl.handle.net/1765/31914

Duca, E., *The Impact of Investor Demand on Security Offerings*, Promoter(s): Prof.dr. A. de Jong, EPS-2011-240-F&A, http://hdl.handle.net/1765/26041

Eck, N.J. van, *Methodological Advances in Bibliometric Mapping of Science*, Promoter(s): Prof.dr.ir. R. Dekker, EPS-2011-247-LIS, http://hdl.handle.net/1765/26509

Eijk, A.R. van der, *Behind Networks: Knowledge Transfer, Favor Exchange and Performance*, Promoter(s): Prof.dr. S.L. van de Velde & Prof.dr.drs. W.A. Dolfsma, EPS-2009-161-LIS, http://hdl.handle.net/1765/14613

Elstak, M.N., *Flipping the Identity Coin: The Comparative Effect of Perceived, Projected and Desired Organizational Identity on Organizational Identification and Desired Behavior*, Promoter(s): Prof.dr. C.B.M. van Riel, EPS-2008-117-ORG, http://hdl.handle.net/1765/10723

Erken, H.P.G., *Productivity, R&D and Entrepreneurship*, Promoter(s): Prof.dr. A.R. Thurik, EPS-2008-147-ORG, http://hdl.handle.net/1765/14004

Essen, M. van, *An Institution-Based View of Ownership*, Promoter(s): Prof.dr. J. van Oosterhout & Prof.dr. G.M.H. Mertens, EPS-2011-226-ORG, http://hdl.handle.net/1765/22643

Feng, L., *Motivation, Coordination and Cognition in Cooperatives,* Promoter(s): Prof.dr. G.W.J. Hendrikse, EPS-2010-220-ORG, http://hdl.handle.net/1765/21680

Gertsen, H.F.M., *Riding a Tiger without Being Eaten: How Companies and Analysts Tame Financial Restatements and Influence Corporate Reputation*, Promoter(s): Prof.dr. C.B.M. van Riel, EPS-2009-171-ORG, http://hdl.handle.net/1765/16098

Gijsbers, G.W., *Agricultural Innovation in Asia: Drivers, Paradigms and Performance,* Promoter(s): Prof.dr. R.J.M. van Tulder, EPS-2009-156-ORG, http://hdl.handle.net/1765/14524

Ginkel-Bieshaar, M.N.G. van, *The Impact of Abstract versus Concrete Product Communications on Consumer Decision-making Processes*, Promoter(s): Prof.dr.ir. B.G.C. Dellaert, EPS-2012-256-MKT, http://hdl.handle.net/1765/31913

Gong, Y., *Stochastic Modelling and Analysis of Warehouse Operations*, Promoter(s): Prof.dr. M.B.M. de Koster & Prof.dr. S.L. van de Velde, EPS-2009-180-LIS, http://hdl.handle.net/1765/16724

Greeven, M.J., *Innovation in an Uncertain Institutional Environment: Private Software Entrepreneurs in Hangzhou, China*, Promoter(s): Prof.dr. B. Krug, EPS-2009-164-ORG, http://hdl.handle.net/1765/15426

Guenster, N.K., *Investment Strategies Based on Social Responsibility and Bubbles*, Promoter(s): Prof.dr. C.G. Koedijk, EPS-2008-175-F&A, http://hdl.handle.net/1765/16209

Hakimi, N.A, *Leader Empowering Behaviour: The Leader's Perspective: Understanding the Motivation behind Leader Empowering Behaviour*, Promoter(s): Prof.dr. D.L. van Knippenberg, EPS-2010-184-ORG, http://hdl.handle.net/1765/17701

Halderen, M.D. van, *Organizational Identity Expressiveness and Perception Management: Principles for Expressing the Organizational Identity in Order to Manage the Perceptions and Behavioral Reactions of External Stakeholders*, Promoter(s): Prof.dr. S.B.M. van Riel, EPS-2008-122-ORG, http://hdl.handle.net/1765/10872

Hensmans, M., *A Republican Settlement Theory of the Firm: Applied to Retail Banks in England and the Netherlands (1830-2007)*, Promoter(s): Prof.dr. A. Jolink & Prof.dr. S.J. Magala, EPS-2010-193-ORG, http://hdl.handle.net/1765/19494

Hernandez Mireles, C., *Marketing Modeling for New Products,* Promoter(s): Prof.dr. P.H. Franses, EPS-2010-202-MKT, http://hdl.handle.net/1765/19878

Hessels, S.J.A., *International Entrepreneurship: Value Creation Across National Borders*, Promoter(s): Prof.dr. A.R. Thurik, EPS-2008-144-ORG, http://hdl.handle.net/1765/13942

Heyden, M.L.M., *Essays on Upper Echelons & Strategic Renewal: A Multilevel Contingency Approach*, Promoter(s): Prof.dr. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2012-259-STR, http://hdl.handle.net/1765/32167

Hoedemaekers, C.M.W., *Performance, Pinned down: A Lacanian Analysis of Subjectivity at Work*, Promoter(s): Prof.dr. S. Magala & Prof.dr. D.H. den Hartog, EPS-2008-121-ORG, http://hdl.handle.net/1765/10871

Hoogendoorn, B., *Social Entrepreneurship in the Modern Economy: Warm Glow, Cold Feet*, Promoter(s): Prof.dr. H.P.G. Pennings & Prof.dr. A.R. Thurik, EPS-2011-246-STR, http://hdl.handle.net/1765/26447

Hoogervorst, N., *On The Psychology of Displaying Ethical Leadership: A Behavioral Ethics Approach*, Promoter(s): Prof.dr. D. De Cremer & Dr. M. van Dijke, EPS-2011-244-ORG, http://hdl.handle.net/1765/26228

Huang, X., *An Analysis of Occupational Pension Provision: From Evaluation to Redesigh,* Promoter(s): Prof.dr. M.J.C.M. Verbeek & Prof.dr. R.J. Mahieu, EPS-2010-196-F&A, http://hdl.handle.net/1765/19674

Hytönen, K.A. *Context Effects in Valuation, Judgment and Choice*, Promoter(s): Prof.dr.ir. A. Smidts, EPS-2011-252-MKT, http://hdl.handle.net/1765/30668

Jalil, M.N., *Customer Information Driven After Sales Service Management: Lessons from Spare Parts Logistics,* Promoter(s): Prof.dr. L.G. Kroon, EPS-2011-222-LIS, http://hdl.handle.net/1765/22156

Jaspers, F.P.H., *Organizing Systemic Innovation*, Promoter(s): Prof.dr.ir. J.C.M. van den Ende, EPS-2009-160-ORG, http://hdl.handle.net/1765/14974

Jennen, M.G.J., *Empirical Essays on Office Market Dynamics*, Promoter(s): Prof.dr. C.G. Koedijk & Prof.dr. D. Brounen, EPS-2008-140-F&A, http://hdl.handle.net/1765/13692

Jiang, T., *Capital Structure Determinants and Governance Structure Variety in Franchising*, Promoter(s): Prof.dr. G. Hendrikse & Prof.dr. A. de Jong, EPS-2009-158-F&A, http://hdl.handle.net/1765/14975

Jiao, T., *Essays in Financial Accounting*, Promoter(s): Prof.dr. G.M.H. Mertens, EPS-2009-176-F&A, http://hdl.handle.net/1765/16097

Kaa, G. van, *Standard Battles for Complex Systems: Empirical Research on the Home Network,* Promoter(s): Prof.dr.ir. J. van den Ende & Prof.dr.ir. H.W.G.M. van Heck, EPS-2009-166-ORG, http://hdl.handle.net/1765/16011

Kagie, M., *Advances in Online Shopping Interfaces: Product Catalog Maps and Recommender Systems,* Promoter(s): Prof.dr. P.J.F. Groenen, EPS-2010-195-MKT, http://hdl.handle.net/1765/19532

Kappe, E.R., *The Effectiveness of Pharmaceutical Marketing*, Promoter(s): Prof.dr. S. Stremersch, EPS-2011-239-MKT, http://hdl.handle.net/1765/23610

Karreman, B., *Financial Services and Emerging Markets,* Promoter(s): Prof.dr. G.A. van der Knaap & Prof.dr. H.P.G. Pennings, EPS-2011-223-ORG, http://hdl.handle.net/1765/ 22280

Klein, M.H., *Poverty Alleviation through Sustainable Strategic Business Models: Essays on Poverty Alleviation as a Business Strategy,* Promoter(s): Prof.dr. H.R. Commandeur, EPS-2008-135-STR, http://hdl.handle.net/1765/13482

Krauth, E.I., *Real-Time Planning Support: A Task-Technology Fit Perspective,* Promoter(s): Prof.dr. S.L. van de Velde & Prof.dr. J. van Hillegersberg, EPS-2008-155-LIS, http://hdl.handle.net/1765/14521

Kwee, Z., *Investigating Three Key Principles of Sustained Strategic Renewal: A Longitudinal Study of Long-Lived Firms,* Promoter(s): Prof.dr.ir. F.A.J. Van den Bosch & Prof.dr. H.W. Volberda, EPS-2009-174-STR, http://hdl.handle.net/1765/16207

Lam, K.Y., *Reliability and Rankings*, Promoter(s): Prof.dr. P.H.B.F. Franses, EPS-2011-230-MKT, http://hdl.handle.net/1765/22977

Lander, M.W., *Profits or Professionalism? On Designing Professional Service Firms*, Promoter(s): Prof.dr. J. van Oosterhout & Prof.dr. P.P.M.A.R. Heugens, EPS-2012-253-ORG, http://hdl.handle.net/1765/30682

Langhe, B. de, *Contingencies: Learning Numerical and Emotional Associations in an Uncertain World*, Promoter(s): Prof.dr.ir. B. Wierenga & Prof.dr. S.M.J. van Osselaer, EPS-2011-236-MKT, http://hdl.handle.net/1765/23504

Larco Martinelli, J.A., *Incorporating Worker-Specific Factors in Operations Management Models,* Promoter(s): Prof.dr.ir. J. Dul & Prof.dr. M.B.M. de Koster, EPS-2010-217-LIS, http://hdl.handle.net/1765/21527

Li, T., *Informedness and Customer-Centric Revenue Management,* Promoter(s): Prof.dr. P.H.M. Vervest & Prof.dr.ir. H.W.G.M. van Heck, EPS-2009-146-LIS, http://hdl.handle.net/1765/14525

Liere, D.W. van, *Network Horizon and the Dynamics of Network Positions: A Multi-Method Multi-Level Longitudinal Study of Interfirm Networks,* Promoter(s): Prof.dr. P.H.M. Vervest, EPS-2007-105-LIS, http://hdl.handle.net/1765/10181

Lovric, M., *Behavioral Finance and Agent-Based Artificial Markets*, Promoter(s): Prof.dr. J. Spronk & Prof.dr.ir. U. Kaymak, EPS-2011-229-F&A, http://hdl.handle.net/1765/ 22814

Maas, A.A., van der, *Strategy Implementation in a Small Island Context: An Integrative Framework,* Promoter(s): Prof.dr. H.G. van Dissel, EPS-2008-127-LIS, http://hdl.handle.net/1765/12278

Maas, K.E.G., *Corporate Social Performance: From Output Measurement to Impact Measurement,* Promoter(s): Prof.dr. H.R. Commandeur, EPS-2009-182-STR, http://hdl.handle.net/1765/17627

Markwat, T.D., *Extreme Dependence in Asset Markets Around the Globe*, Promoter(s): Prof.dr. D.J.C. van Dijk, EPS-2011-227-F&A, http://hdl.handle.net/1765/22744

Meuer, J., *Configurations of Inter-Firm Relations in Management Innovation: A Study in China's Biopharmaceutical Industry*, Promoter(s): Prof.dr. B. Krug, EPS-2011-228-ORG, http://hdl.handle.net/1765/22745

Mihalache, O.R., *Stimulating Firm Innovativeness: Probing the Interrelations between Managerial and Organizational Determinants*, Promoter(s): Prof.dr. J.J.P. Jansen, Prof.dr.ing. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2012-260-S&E, http://hdl.handle.net/1765/32343

Moitra, D., *Globalization of R&D: Leveraging Offshoring for Innovative Capability and Organizational Flexibility,* Promoter(s): Prof.dr. K. Kumar, EPS-2008-150-LIS, http://hdl.handle.net/1765/14081

Moonen, J.M., *Multi-Agent Systems for Transportation Planning and Coordination*, Promoter(s): Prof.dr. J. van Hillegersberg & Prof.dr. S.L. van de Velde, EPS-2009-177-LIS, http://hdl.handle.net/1765/16208

Nalbantov G.I., *Essays on Some Recent Penalization Methods with Applications in Finance and Marketing*, Promoter(s): Prof. dr P.J.F. Groenen, EPS-2008-132-F&A, http://hdl.handle.net/1765/13319

Nederveen Pieterse, A., *Goal Orientation in Teams: The Role of Diversity*, Promoter(s): Prof.dr. D.L. van Knippenberg, EPS-2009-162-ORG, http://hdl.handle.net/1765/15240

Nguyen, T.T., *Capital Structure, Strategic Competition, and Governance*, Promoter(s): Prof.dr. A. de Jong, EPS-2008-148-F&A, http://hdl.handle.net/1765/14005

Nielsen, L.K., *Rolling Stock Rescheduling in Passenger Railways: Applications in Short-term Planning and in Disruption Management*, Promoter(s): Prof.dr. L.G. Kroon, EPS-2011-224-LIS, http://hdl.handle.net/1765/22444

Niesten, E.M.M.I., *Regulation, Governance and Adaptation: Governance Transformations in the Dutch and French Liberalizing Electricity Industries*, Promoter(s): Prof.dr. A. Jolink & Prof.dr. J.P.M. Groenewegen, EPS-2009-170-ORG, http://hdl.handle.net/1765/16096

Nieuwenboer, N.A. den, *Seeing the Shadow of the Self*, Promoter(s): Prof.dr. S.P. Kaptein, EPS-2008-151-ORG, http://hdl.handle.net/1765/14223

Nijdam, M.H., *Leader Firms: The Value of Companies for the Competitiveness of the Rotterdam Seaport Cluster,* Promoter(s): Prof.dr. R.J.M. van Tulder, EPS-2010-216-ORG, http://hdl.handle.net/1765/21405

Noordegraaf-Eelens, L.H.J., *Contested Communication: A Critical Analysis of Central Bank Speech,* Promoter(s): Prof.dr. Ph.H.B.F. Franses, EPS-2010-209-MKT, http://hdl.handle.net/1765/21061

Nuijten, I., *Servant Leadership: Paradox or Diamond in the Rough? A Multidimensional Measure and Empirical Evidence*, Promoter(s): Prof.dr. D.L. van Knippenberg, EPS-2009-183-ORG, http://hdl.handle.net/1765/21405

Oosterhout, M., van, *Business Agility and Information Technology in Service Organizations,* Promoter(s): Prof,dr.ir. H.W.G.M. van Heck, EPS-2010-198-LIS, http://hdl.handle.net/1765/19805

Oostrum, J.M., van, *Applying Mathematical Models to Surgical Patient Planning*, Promoter(s): Prof.dr. A.P.M. Wagelmans, EPS-2009-179-LIS, http://hdl.handle.net/1765/16728

Osadchiy, S.E., *The Dynamics of Formal Organization: Essays on Bureaucracy and Formal Rules*, Promoter(s): Prof.dr. P.P.M.A.R. Heugens, EPS-2011-231-ORG, http://hdl.handle.net/1765/23250

Otgaar, A.H.J., *Industrial Tourism: Where the Public Meets the Private,* Promoter(s): Prof.dr. L. van den Berg, EPS-2010-219-ORG, http://hdl.handle.net/1765/21585

Ozdemir, M.N., *Project-level Governance, Monetary Incentives and Performance in Strategic R&D Alliances*, Promoter(s): Prof.dr.ir. J.C.M. van den Ende, EPS-2011-235-LIS, http://hdl.handle.net/1765/23550

Peers, Y., *Econometric Advances in Diffusion Models*, Promoter(s): Prof.dr. Ph.H.B.F. Franses, EPS-2011-251-MKT, http://hdl.handle.net/1765/ 30586

Pince, C., *Advances in Inventory Management: Dynamic Models,* Promoter(s): Prof.dr.ir. R. Dekker, EPS-2010-199-LIS, http://hdl.handle.net/1765/19867

Porras Prado, M., *The Long and Short Side of Real Estate, Real Estate Stocks, and Equity*, Promoter(s): Prof.dr. M.J.C.M. Verbeek, EPS-2012-254-F&A, http://hdl.handle.net/1765/30848

Potthoff, D., *Railway Crew Rescheduling: Novel Approaches and Extensions,* Promoter(s): Prof.dr. A.P.M. Wagelmans & Prof.dr. L.G. Kroon, EPS-2010-210-LIS, http://hdl.handle.net/1765/21084

Poruthiyil, P.V., *Steering Through: How Organizations Negotiate Permanent Uncertainty and Unresolvable Choices*, Promoter(s): Prof.dr. P.P.M.A.R. Heugens & Prof.dr. S. Magala, EPS-2011-245-ORG, http://hdl.handle.net/1765/26392

Pourakbar, M. *End-of-Life Inventory Decisions of Service Parts*, Promoter(s): Prof.dr.ir. R. Dekker, EPS-2011-249-LIS, http://hdl.handle.net/1765/30584

Prins, R., *Modeling Consumer Adoption and Usage of Value-Added Mobile Services*, Promoter(s): Prof.dr. Ph.H.B.F. Franses & Prof.dr. P.C. Verhoef, EPS-2008-128-MKT, http://hdl.handle.net/1765/12461

Quak, H.J., *Sustainability of Urban Freight Transport: Retail Distribution and Local Regulation in Cities*, Promoter(s): Prof.dr. M.B.M. de Koster, EPS-2008-124-LIS, http://hdl.handle.net/1765/11990

Quariguasi Frota Neto, J., *Eco-efficient Supply Chains for Electrical and Electronic Products*, Promoter(s): Prof.dr.ir. J.A.E.E. van Nunen & Prof.dr.ir. H.W.G.M. van Heck, EPS-2008-152-LIS, http://hdl.handle.net/1765/14785

Radkevitch, U.L, *Online Reverse Auction for Procurement of Services*, Promoter(s): Prof.dr.ir. H.W.G.M. van Heck, EPS-2008-137-LIS, http://hdl.handle.net/1765/13497

Rijsenbilt, J.A., *CEO Narcissism; Measurement and Impact*, Promoter(s): Prof.dr. A.G.Z. Kemna & Prof.dr. H.R. Commandeur, EPS-2011-238-STR, http://hdl.handle.net/1765/ 23554

Roelofsen, E.M., *The Role of Analyst Conference Calls in Capital Markets*, Promoter(s): Prof.dr. G.M.H. Mertens & Prof.dr. L.G. van der Tas RA, EPS-2010-190-F&A, http://hdl.handle.net/1765/18013

Rook, L., *Imitation in Creative Task Performance*, Promoter(s): Prof.dr. D.L. van Knippenberg, EPS-2008-125-ORG, http://hdl.handle.net/1765/11555

Rosmalen, J. van, *Segmentation and Dimension Reduction: Exploratory and Model-Based Approaches*, Promoter(s): Prof.dr. P.J.F. Groenen, EPS-2009-165-MKT, http://hdl.handle.net/1765/15536

Roza, M.W., *The Relationship between Offshoring Strategies and Firm Performance: Impact of Innovation, Absorptive Capacity and Firm Size,* Promoter(s): Prof.dr. H.W. Volberda & Prof.dr.ing. F.A.J. van den Bosch, EPS-2011-214-STR, http://hdl.handle.net/1765/22155

Rus, D., *The Dark Side of Leadership: Exploring the Psychology of Leader Self-serving Behavior*, Promoter(s): Prof.dr. D.L. van Knippenberg, EPS-2009-178-ORG, http://hdl.handle.net/1765/16726

Samii, R., *Leveraging Logistics Partnerships: Lessons from Humanitarian Organizations,* Promoter(s): Prof.dr.ir. J.A.E.E. van Nunen & Prof.dr.ir. L.N. Van Wassenhove, EPS-2008-153-LIS, http://hdl.handle.net/1765/14519

Schaik, D. van, *M&A in Japan: An Analysis of Merger Waves and Hostile Takeovers,* Promoter(s): Prof.dr. J. Spronk & Prof.dr. J.P.M. Groenewegen, EPS-2008-141-F&A, http://hdl.handle.net/1765/13693

Schauten, M.B.J., *Valuation, Capital Structure Decisions and the Cost of Capital,* Promoter(s): Prof.dr. J. Spronk & Prof.dr. D. van Dijk, EPS-2008-134-F&A, http://hdl.handle.net/1765/13480

Schellekens, G.A.C., *Language Abstraction in Word of Mouth,* Promoter(s): Prof.dr.ir. A. Smidts, EPS-2010-218-MKT, ISBN: 978-90-5892-252-6, http://hdl.handle.net/1765/21580

Sotgiu, F., *Not All Promotions are Made Equal: From the Effects of a Price War to Cross-chain Cannibalization,* Promoter(s): Prof.dr. M.G. Dekimpe & Prof.dr.ir. B. Wierenga, EPS-2010-203-MKT, http://hdl.handle.net/1765/19714

Srour, F.J., *Dissecting Drayage: An Examination of Structure, Information, and Control in Drayage Operations*, Promoter(s): Prof.dr. S.L. van de Velde, EPS-2010-186-LIS, http://hdl.handle.net/1765/18231

Stam, D.A., *Managing Dreams and Ambitions: A Psychological Analysis of Vision Communication*, Promoter(s): Prof.dr. D.L. van Knippenberg, EPS-2008-149-ORG, http://hdl.handle.net/1765/14080

Stienstra, M., *Strategic Renewal in Regulatory Environments: How Inter- and Intra-organisational Institutional Forces Influence European Energy Incumbent Firms,* Promoter(s): Prof.dr.ir. F.A.J. Van den Bosch & Prof.dr. H.W. Volberda, EPS-2008-145-STR, http://hdl.handle.net/1765/13943

Sweldens, S.T.L.R., *Evaluative Conditioning 2.0: Direct versus Associative Transfer of Affect to Brands,* Promoter(s): Prof.dr. S.M.J. van Osselaer, EPS-2009-167-MKT, http://hdl.handle.net/1765/16012

Szkudlarek, B.A.*, Spinning the Web of Reentry: [Re]connecting reentry training theory and practice*, Promoter(s): Prof.dr. S.J. Magala, EPS-2008-143-ORG, http://hdl.handle.net/1765/13695

Tempelaar, M.P., *Organizing for Ambidexterity: Studies on the Pursuit of Exploration and Exploitation through Differentiation, Integration, Contextual and Individual Attributes,* Promoter(s): Prof.dr.ing. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2010-191-STR, http://hdl.handle.net/1765/18457

Tiwari, V., *Transition Process and Performance in IT Outsourcing: Evidence from a Field Study and Laboratory Experiments,* Promoter(s): Prof.dr.ir. H.W.G.M. van Heck & Prof.dr. P.H.M. Vervest, EPS-2010-201-LIS, http://hdl.handle.net/1765/19868

Tröster, C., *Nationality Heterogeneity and Interpersonal Relationships at Work*, Promoter(s): Prof.dr. D.L. van Knippenberg, EPS-2011-233-ORG, http://hdl.handle.net/1765/23298

Tuk, M.A., *Is Friendship Silent When Money Talks? How Consumers Respond to Word-of-Mouth Marketing*, Promoter(s): Prof.dr.ir. A. Smidts & Prof.dr. D.H.J. Wigboldus, EPS-2008-130-MKT, http://hdl.handle.net/1765/12702

Tzioti, S., *Let Me Give You a Piece of Advice: Empirical Papers about Advice Taking in Marketing,* Promoter(s): Prof.dr. S.M.J. van Osselaer & Prof.dr.ir. B. Wierenga, EPS-2010-211-MKT, hdl.handle.net/1765/21149

Vaccaro, I.G., *Management Innovation: Studies on the Role of Internal Change Agents,* Promoter(s): Prof.dr. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2010-212-STR, hdl.handle.net/1765/21150

Verheijen, H.J.J., *Vendor-Buyer Coordination in Supply Chains,* Promoter(s): Prof.dr.ir. J.A.E.E. van Nunen, EPS-2010-194-LIS, http://hdl.handle.net/1765/19594

Verwijmeren, P., *Empirical Essays on Debt, Equity, and Convertible Securities*, Promoter(s): Prof.dr. A. de Jong & Prof.dr. M.J.C.M. Verbeek, EPS-2009-154-F&A, http://hdl.handle.net/1765/14312

Vlam, A.J., *Customer First? The Relationship between Advisors and Consumers of Financial Products*, Promoter(s): Prof.dr. Ph.H.B.F. Franses, EPS-2011-250-MKT, http://hdl.handle.net/1765/30585

Waard, E.J. de, *Engaging Environmental Turbulence: Organizational Determinants for Repetitive Quick and Adequate Responses*, Promoter(s): Prof.dr. H.W. Volberda & Prof.dr. J. Soeters, EPS-2010-189-STR, http://hdl.handle.net/1765/18012

Wall, R.S., *Netscape: Cities and Global Corporate Networks,* Promoter(s): Prof.dr. G.A. van der Knaap, EPS-2009-169-ORG, http://hdl.handle.net/1765/16013

Waltman, L., *Computational and Game-Theoretic Approaches for Modeling Bounded Rationality*, Promoter(s): Prof.dr.ir. R. Dekker & Prof.dr.ir. U. Kaymak, EPS-2011-248-LIS, http://hdl.handle.net/1765/26564

Wang, Y., *Information Content of Mutual Fund Portfolio Disclosure*, Promoter(s): Prof.dr. M.J.C.M. Verbeek, EPS-2011-242-F&A, http://hdl.handle.net/1765/26066

Weerdt, N.P. van der, *Organizational Flexibility for Hypercompetitive Markets: Empirical Evidence of the Composition and Context Specificity of Dynamic Capabilities and Organization Design Parameters,* Promoter(s): Prof.dr. H.W. Volberda, EPS-2009-173-STR, http://hdl.handle.net/1765/16182

Wubben, M.J.J., *Social Functions of Emotions in Social Dilemmas*, Promoter(s): Prof.dr. D. De Cremer & Prof.dr. E. van Dijk, EPS-2009-187-ORG, http://hdl.handle.net/1765/18228

Xu, Y., *Empirical Essays on the Stock Returns, Risk Management, and Liquidity Creation of Banks*, Promoter(s): Prof.dr. M.J.C.M. Verbeek, EPS-2010-188-F&A, http://hdl.handle.net/1765/18125

Yang, J., *Towards the Restructuring and Co-ordination Mechanisms for the Architecture of Chinese Transport Logistics*, Promoter(s): Prof.dr. H.E. Harlambides, EPS-2009-157-LIS, http://hdl.handle.net/1765/14527

Yu, M., *Enhancing Warehouse Perfromance by Efficient Order Picking*, Promoter(s): Prof.dr. M.B.M. de Koster, EPS-2008-139-LIS, http://hdl.handle.net/1765/13691

Zhang, D., *Essays in Executive Compensation*, Promoter(s): Prof.dr. I. Dittmann, EPS-2012-261-F&A, http://hdl.handle.net/1765/32344

Zhang, X., *Scheduling with Time Lags,* Promoter(s): Prof.dr. S.L. van de Velde, EPS-2010-206-LIS, http://hdl.handle.net/1765/19928

Zhou, H., *Knowledge, Entrepreneurship and Performance: Evidence from Country-level and Firm-level Studies,* Promoter(s): Prof.dr. A.R. Thurik & Prof.dr. L.M. Uhlaner, EPS-2010-207-ORG, http://hdl.handle.net/1765/20634

Zwan, P.W. van der, *The Entrepreneurial Process: An International Analysis of Entry and Exit*, Promoter(s): Prof.dr. A.R. Thurik & Prof.dr. P.J.F. Groenen, EPS-2011-234-ORG, http://hdl.handle.net/1765/23422

Zwart, G.J. de, *Empirical Studies on Financial Markets: Private Equity, Corporate Bonds and Emerging Markets*, Promoter(s): Prof.dr. M.J.C.M. Verbeek & Prof.dr. D.J.C. van Dijk, EPS-2008-131-F&A, http://hdl.handle.net/1765/12703

Erasmus Research Institute of Management - ERIM

CHANGING FORTUNES
HOW CHINA'S BOOM CAUSED THE FINANCIAL CRISIS

Since the financial crisis in 2008 and the ensuing economic recession that rocked the world economy, plenty of blame has been going around. The chairman of the U.S. Federal Reserve, Ben Bernanke, specifically singled out subprime mortgages and the Wall Street bankers that sold those mortgages. In bureaucratic jargon it is often dubbed a regulatory oversight failure. This study, however, shows that the Federal Reserve's loose monetary policy at the start of the new millennium triggered the U.S. refinancing boom in 2003 and 2004, spurring personal consumption expenditures through home equity extraction. The U.S. spending binge boosted economic growth and savings in China and oil-exporting nations. The build-up of savings in China, which are heavily skewed towards fixed income assets, depressed interest rates worldwide from 2004 on. The decline in long-term interest rates accounts for the U.S. housing boom. Despite popular belief, the proliferation of exotic mortgage products can hardly be faulted for the U.S. housing boom and eventual bust.

ERIM

The Erasmus Research Institute of Management (ERIM) is the Research School (Onderzoekschool) in the field of management of the Erasmus University Rotterdam. The founding participants of ERIM are the Rotterdam School of Management (RSM), and the Erasmus School of Economics (ESE). ERIM was founded in 1999 and is officially accredited by the Royal Netherlands Academy of Arts and Sciences (KNAW). The research undertaken by ERIM is focused on the management of the firm in its environment, its intra- and interfirm relations, and its business processes in their interdependent connections.

The objective of ERIM is to carry out first rate research in management, and to offer an advanced doctoral programme in Research in Management. Within ERIM, over three hundred senior researchers and PhD candidates are active in the different research programmes. From a variety of academic backgrounds and expertises, the ERIM community is united in striving for excellence and working at the forefront of creating new business knowledge.

ERIM PhD Series
Research in Management

Erasmus Research Institute of Management - ERIM
Rotterdam School of Management (RSM)
Erasmus School of Economics (ESE)
Erasmus University Rotterdam (EUR)
P.O. Box 1738, 3000 DR Rotterdam,
The Netherlands

Tel. +31 10 408 11 82
Fax +31 10 408 96 40
E-mail info@erim.eur.nl
Internet www.erim.eur.nl

Design & layout: B&T Ontwerp en advies (www.b-en-t.nl) Print: Haveka (www.haveka.nl)