Was the Global Meltdown of 2007-2009 Caused by Capital Flow Bonanzas following the Asian Financial Crises?

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December 18, 2017

Paper for presentation at the 2018 ASSA meetings in Philadelphia

Abstract

We identify the primary determinants of the global financial crisis of 2007-2009 with a vector error correction model with data on ten macroeconomic and financial variables for the US economy from 1953-2006. Using forecast error and sensitivity analyses we find that the significance of specific exogenous shocks that contributed to the run-up to the crisis varies depending on the time period examined: 1980-1988; 1989-1997; and 1998-2006. Deregulation in the 1980s and capital inflows in the early and mid1990s triggered by the collapse of the European exchange rate mechanism contributed to changes in house prices significantly. However, capital inflows after the Asian financial crises in 1997 were driven in large part by rising asset prices. We conclude that, financial deregulation starting in the 1980s, surges in capital inflows in the early 1990s, and asset market bubbles in the late 1990s and early 2000s, all contributed to the crisis of 2007-2009.

Keywords: Financial crisis; VEC model

JEL codes: E32, E37, C22

1. Introduction

To a large extent the asset market meltdown and the catastrophic financial crises in the US and other countries in 2007-2009 remain inexplicable despite extensive research. One strand of research has emphasized the extraordinary "global savings glut" and the resulting large capital inflows into North America and Europe in the 1990s, especially after the Asian financial crises, as a primary determinant of the 2007-2009 crises.[1] The large capital inflows lowered the long term rate of interest and led to mispricing of risk, thus making mortgage and other loans available at attractive rates. The resulting credit boom caused dramatic increases in asset prices. When asset markets collapsed, institutions and individuals became insolvent and the crisis ensued.[2] An alternative strand of research argues that the financial crisis was caused primarily by expectations of unending asset price increases and increasing regulatory imprudence following the era of "great moderation." The rising asset prices and lax regulation caused excessive and predatory lending, high leverage, and excessive risk taking by financial institutions.[3] Large capital inflows and an extraordinary credit boom ensued, which further contributed to the inflation of real estate and stock prices.[4]

Both hypotheses include the role of a credit boom and high financial sector leverage preceding the 2007-2009 crises. The primary difference is in the direction of causality between increases in capital inflows and the inflation of stock and house prices. In the context of this debate, we ask if surges in net capital inflows were the primary cause of asset bubbles by expanding the supply of easy credit, or if rising asset prices attracted capital inflows. A related question that we address is the role of Federal Reserve monetary policy in the two decades prior to the subprime crisis. Taylor (2011), Roubini and Mihm (2010), Rajan (2010) and Bordo (2008) argue that the low interest rate policy of the Federal Reserve and other European central banks in the 1990s and the early 2000s contributed to the inflation of housing and stock prices during this period. Was this likely?

[1] Bernanke (2005) was the first to discuss the effects of the "global savings glut" on US current account balance.
[2] See Bernanke (2010, 2013), Caballero, Farhi and Gourinchas (2008), Greenspan (2014), Kauko (2012), King (2011) and Krugman (2015).
[3] See Laibson and Mollerstrom (2010, p. 373) for references on "great moderation" in developed countries as they were perceived to be becoming less risky for investments.
[4] See Shiller (2008); Akerlof and Shiller (2009); Stiglitz (2010); Roubini and Mihm (2010); Gorton (2010); Rajan (2005, 2010); Bhidè (2011); and Acharya and Richardson (2011). There are differences even among these authors. In Shiller (2008) and Akerlof and Shiller (2009) the emphasis is on people's expectation of ever-rising asset prices, while financial liberalisation and risky financial innovations are a central point in others' analyses. Also, they do not deny the role of capital inflows but maintain that such external imbalances were a secondary factor. On the other hand, Bernanke (2010), Greenspan (2014), and others recognize that asset bubbles and regulatory imprudence contributed to the global financial crisis, but their emphasis is on the low long term rate of interest caused by external imbalances.

We answer these questions by employing a new methodology with a vector error correction model to test whether exogenous shocks to net capital inflows, asset prices and other key macroeconomic and financial variables lead to large short run changes in an otherwise stable long run equilibrium relationship. We take a much longer historical view than what is generally considered in the literature and identify, specifically, what types of exogenous shocks contributed to the run-up to the crisis in three distinct historical periods. This approach identifies important short run dynamics, in particular exogenous shocks leading to large short run changes to re-attain equilibrium, but instead all of which culminated in the spectacular events of 2007-2009.

Laibson and Mollerstrom (2010) and Veld, Raciborski, Ratto and Roeger (2011) are notable prior contributions in this area. Laibson and Mollerstrom (2010) construct two alternative dynamic competitive equilibrium models, one in which capital inflows are exogenous to the system and the other in which capital inflows are determined endogenously, and show that increases in capital inflows into the US starting from the mid-1990s were the result of a domestic consumption boom driven by asset bubbles. Since there wasn't an investment boom in the US during the period when capital inflows increased, the asset market booms were not likely caused by the increase in capital inflows.[5] Veld, et al. (2011) show, with an estimated DSGE model, that the global savings glut hypothesis cannot fully explain the economic boom in the US, and that stock and housing bubbles played a larger role in this respect.

Both Laibson and Mollerstrom (2010) and Veld, et al (2011) obtain their results by estimating the models with data starting from the mid-1990s. However, utilization of data for a longer period will enable us to gain a better understanding of how the long run dynamics and the short run changes and adjustments of the variables under consideration are related, if the relationships were stable over distinct historical sub-periods, and if large short run shocks to the variables had a bearing on the crisis events that unfolded in 2007-2009. An equally pertinent question is whether or not there were important differences in the nature of shocks across different historical periods. For example, were the short run dynamics starting in the mid-1990s different from those in the earlier, relatively calmer periods? Could there be roots of the crisis in the earlier apparently calmer periods? Also, key indicators for assessing financial sector fragility (e.g. liquidity ratio and leverage ratio) may be critical in explaining financial crises and should be included.[6] These variables make explicit the links between the financial sector and the evolution of macroeconomic aggregates in the run-up to the crises.

[5] They draw the same conclusion for other OECD countries.

[6] See, for example, Roubini and Mihm (2010), Gorton (2010), Rajan (2005, 2010), Stiglitz (2010), Calvo (2011), Gallegeti, Greenwald, Richiardi and Stiglitz (2008), Barrell, Davis, Karim and Liadze (2010), Caprio, D'Apice, Ferri and Puopolo (2014), Fielding and Rewilak (2015), and Ahrend and Goujard (2015).

Our model is built upon prior contributions, particularly in our choice of variables to be included.[7] However, we start with no prior assumptions on the behaviour of market participants or the structural forms of the relationships among the variables. As is customary with long time series models, we first check the stationarity of the variables and if there are long run equilibrium relationships in the form of cointegrating equations. We specify four alternative cointegrating equations and the corresponding vector error correction equations with four different sets of variables for the US economy for the period from 1953-2006. The vector error correction equations depict both the long run equilibrium and the short run adjustments to deviations from that equilibrium. The strength of the error-correction process depends on the size and statistical significance of the short run adjustment coefficients.

The analysis then proceeds in three steps. First, for each model specification, we calculate impulse response functions to examine if the directions of the responses to an exogenous innovation in any one variable on the other variables for the entire period are meaningful in light of economic theory. Then, to analyse the short run changes and the adjustments from 1998-2006, the years after the Asian financial crises when the asset markets boomed and financial sector leverage increased, we examine how well the data generating process of any one variable can be dynamically forecasted with the actual observations of the other variables. We compare the results with that from the same exercises for two other periods, 1980-1988 and 1989-1997. Finally—and most relevant to the aim of this paper—we identify the nature and extent of exogenous shocks in these three different periods as primary causes of the global financial crisis of 2007-2009 by performing sensitivity analyses. I.e., we examine how the forecast errors change for each of the three periods when we drop variables one by one and run alternative VEC specifications. If the increases in forecast errors are large for any of the three periods after dropping a particular variable from the model then the conclusion must be that the variable had a high explanatory power in that particular period, and this leads us to search for the source of a possible large exogenous shock to the system.

Our methodology allows us to ask, for example, if there was a large exogenous shock to capital inflows in the early 1990s after speculative attacks on the European exchange rate mechanism. To the best of our knowledge, this is a question that has never been asked in the literature on the global financial crisis. And what role did the initiation of the process of financial deregulation play in the 1980s? Were the asset market bubbles of the late 1990s and early 2000s a metamorphosis caused by subtle events in the two earlier periods?

From our analysis with a much longer view of the data than that generally considered in the literature, we are in fact able to identify distinct forces at work in three different periods of history. Our

[7] We borrow from the emerging literature on similarities of banking crises. See Demirguc-Kunt and Detragiache (1998), Davis and Karim (2008), Jorda, Schularick and Taylor (2011), Schularick and Taylor (2012), Barrell, Davis, Karim and Liadze (2010), Drehmann and Juselius (2014), and Laeven and Valencia (2013).

results indicate: 1) The roots of the crisis lie in the initiation of deregulation in the 1980s, leading to increases in the share of private sector debt in GDP, a housing boom, and surges in capital inflows in the decade of 1980s; 2) the collapse of central planning in Eastern Europe and the Soviet Union and the subsequent crisis in the European exchange rate mechanism caused large capital inflows into the US from the European continent, which to a great extent contributed to changes in asset prices;[8] 3) the rapid increases of stock and house prices in the late 1990s and the early 2000s after the Asian financial crisis in 1997 were mostly bubble phenomena, and these then attracted large capital inflows and caused a credit boom; there was a reversal of the direction of causality from that of the early 1990s; plausibly, this reversal was due to an upward revision of people's expectation of future increases of asset prices, acerbating the mispricing of risk, due to the sharp increases in capital inflows and changes in asset prices from the early 1990s on; 4) declining long term interest rates contributed to the inflation of asset bubbles and surges in net capital inflows from the late 1980s through 2006 to a certain extent; however, the effects were not as strong as the prior three factors.

Next, in Section 2, we describe the empirical modelling strategy, evaluation criteria, and the data. Section 3 presents the results from estimation, forecasting and sensitivity analyses. In Section 4 we summarise and interpret the results. Section 5 concludes.

2. Methodology and Data

2.1. Choice of variables and data

The choice of variables for the model is based on the findings in the existing literature on financial crisis. The variables that are part of our model are: i) real house prices *(RHP);* ii) real share prices *(RSP);* iii) net capital inflows as a percentage of GDP *(FLOW);* iv) long term rate of interest *(LINT);* v) the real bilateral exchange rate of the Thai baht *(RERT);* vi) private sector debt as a percentage of GDP *(DEBT);* vii) banking sector liquidity ratio *(LIQ);* viii) financial sector leverage ratio *(FLEV);* ix) non-bank financial sector leverage ratio *(SLEV)*[9]*;* and x) real GDP per capita *(RGDP).* Each variable is defined and the data source is described in the appendix. Since our modelling strategy is meant to capture both short run and long run effects, we go as far back in history as possible depending on the availability of data. As monthly or quarterly data are either absent or inadequate for many of the variables considered, we use annual data from 1953-2006.

[8] Stock prices increased in the early 1990s but house prices declined (see Figure 1-1 and Figure 1-2). However, the declines started to get smaller precisely from 1992, the year when speculative attacks on the European exchange rate mechanism took place. As Figure 3 shows, the first difference of house prices started increasing from 1992. We discuss Figure 3 in detail in Section 3.

[9] Alternatively, this could be thought of as the leverage ratio of the shadow banking sector.

The inclusion of the first three variables is obvious from the existing literature and these follow directly from the discussion above. The long term interest rate, *LINT,* captures two possible factors responsible for the US subprime crisis. Capital inflows are expected to lower long term interest rates and therefore lower the equity premium, as hypothesized by Greenspan (2014, pp. 59-61), Bernanke (2010), and others, as mentioned in the introduction. In addition, lower long term rates are a reflection of expansionary monetary policies in the 1990s and 2000s (Taylor, 2009; Rajan, 2010; Roubini and Mihm, 2010; Bordo, 2008).[10] *LINT* then reflects the effects of changes in capital flows, or external imbalances, as well as the Federal Reserve's monetary policy.

A shock to the real exchange rate is likely to impact other macroeconomic variables. This is because both foreign direct investment and foreign portfolio investment are subject to substantial foreign exchange risk. Large changes in the real exchange rate could cause large changes in capital flows, which in turn could impact asset prices and other macroeconomic aggregates. Also, as mentioned, huge capital inflows in the aftermath of the Asian financial crisis following the devaluation of the Thai baht have been cited frequently as one of the primary causes of the global financial crisis. To capture these effects in our model the appropriate variable would be the real effective exchange rate. However, data is available only from 1980, insufficient for our analysis. We therefore adopt an alternative measure: the real US dollar bilateral exchange rate of the Thai baht, *RERT*. As will be seen in Section 3, this variable is significant in our model specifications and dropping it causes large increases in forecast errors.

Consistent with the aim of this paper, we include private sector debt as a percentage of GDP, *DEBT,* which according to Pill and Pradhan (1995) is the best measure to capture the degree of financial liberalization in normal times. Furthermore, based on the findings of a number of authors, it captures the effects of a credit boom often common prior to systemic banking crises.[11] Economists and policy makers across the spectrum seem to have reached a consensus that it is even more relevant in the context of the global financial crisis of 2007-2009. With increasing deregulation in the US and other advanced countries, financial institutions were able to sell new financial instruments, such as mortgage backed securities (MBS), collateralized debt obligations (CDOs) and credit default swaps, which in turn allowed a rapid expansion of mortgage loans, even to households unable to meet the repayment obligations. All increased the level of systemic risk.

[10] Bordo (2008) also discusses how such a policy might have been responsible for other historical financial crises.
[11] See Kindleberger and Aliber (2005), Demirguc-Kunt and Detragiache (1998),) Jorda, Schularick and Taylor (2011), Drehmann and Juselius (2014), Caprio, D'Apice, Ferri and Puopolo (2014), Fielding and Rewilak (2015), and Kauko (2012).

There is extensive evidence that financial sector fragility or poor financial regulation may contribute to financial crises.[12] Financial institutions with low liquidity and high leverage are fragile in the sense that they are expected to be less resilient to external shocks. Liquidity for the financial sector is defined as the ratio of liquid assets to total assets. However, in the absence of sufficient data on all types of assets for the whole financial sector, following Demirguc-Kunt and Detragiache (1998) and Davis and Karim (2008), we consider only the banking sector and define liquidity, *LIQ*, as the ratio of bank cash and reserves to bank assets. We also consider two measures of financial sector leverage. First, the banking sector leverage ratio, *FLEV*, is defined as the ratio of assets to net worth (value of assets *less* value of liabilities).[13] In addition, to capture differences in the regulatory environment, in particular differences between that of the banking and non-banking financial sectors (shadow banking), we also include a measure of leverage for the non-banking financial sector, *SLEV*, again defined as the ratio of assets to net worth (value of assets *less* value of liabilities), but only for the non-bank financial sector.

Finally, Reinhart and Rogoff (2009), *inter alia*, identify a declining growth rate of real GDP per capita as one of the common precursors to banking crisis. Therefore, we include this, *RGDP,* in the model as it is potentially related to credit and asset market booms and in turn how the booms may impact economic growth.

Other variables that may be related to financial crises include M_2/reserves and public debt. However, the empirical literature on banking crises does not find these to be critical in explaining banking crisis events. We also included them in initial specifications, but the results were statistically insignificant or implausible and therefore we do not report them herein.

Time series plots of the variables under consideration are presented in Figure 1.1 through Figure 1.10.[14] In Figure 1.1 we see that real house prices, *RHP,* increased dramatically starting from 1998, which Shiller (2005) notes as historically unprecedented. Real share prices, *RSP,* in Figure 1.2 also increased starting from 1984, and the changes were much larger from 1995 through 1999, reflecting the much known technology bubble. *FLOW*, the share of net capital inflows in GDP, depicted in Figure 1.3, increased from 1992, reaching an historical high, 5.8%, in 2006. Private sector debt as a percentage of GDP, *DEBT,* depicted in Figure 1.6, generally increased from the early 1950s through the early 1980s, and then the trend increased significantly from 1983 onward. The long term interest rate, *LINT,* in Figure 1.4, shows a rising trend through 1982, after which it generally declined. The important point to note here

[12] See Roubini and Mihm (2010), Gorton (2010), Rajan (2005, 2010), Barrell et al (2010), Caprio et al (2014), Fielding and Rewilak (2015), Ahrend and Goujard (2015), Bhidè (2011), and Acharya and Richardson (2011).
[13] This measure is different from the leverage ratio that would result from the computation method of the Basel I Capital Accord of 1988, where total "risk-adjusted assets" rather than simply total assets are considered by attaching higher weights to the riskier assets. We are unable to adopt this method due to a lack of data at the aggregate level for the entire period of our study.
[14] The figures also show one period ahead static forecasts starting in 1980, which we discuss in Section 3.4.

is that the long term rate of interest entered a declining trend around the same time that real share prices and the share of private sector debt in GDP started to increase. Yet the clearly upward trend of net capital inflows as a percentage of GDP started only in 1992 and real house prices started to increase even later, in 1998. The beginning of the Asian financial crisis is reflected in the dramatic collapse of the real bilateral exchange rate of the Thai baht, *RERT*, from 1997-1998, depicted in Figure 1.5. The banking sector liquidity ratio, *LIQ,* in Figure 1.7, generally fell over the entire period under consideration. The financial sector leverage ratio, *FLEV*, in Figure 1.8, and the non-bank financial sector leverage ratio, *SLEV*, in Figure 1.9, behaved quite differently. The financial sector leverage ratio generally fell over the sample period, flattening from about 1994 onward, while the non-bank financial sector leverage ratio increased from 1952-1988 and 2000-2006.

[Insert Figure 1.1 through Figure 1.10 about here]

2.2. Empirical model and evaluation criteria

2.2.1. The empirical model

Stock and Watson (2017) note that the basic idea of cointegration, that many macroeconomic variables move together at low frequencies and share common long-term trends, is profound and fundamental to contemporary macroeconomic theory. Hamilton (1997, p. 575) discusses why adopting a finite order vector autoregression (VAR) model in first differences is incorrect if the variables under consideration are *I(1)* and if there exists a cointegrating relationship among the variables. The modeling process requires determining the level of integration of each variable and then, if the variables are found to be *I(1),* conducting tests for the existence of cointegrating equations as long run equilibrium relationships. If the test results for the existence of cointegrating equations are positive then we specify the corresponding error correction equations that delineate both the long run equilibrium and the adjustment process of each variable necessary to return to its long run equilibrium when shocked by changes in other variables. I.e., we construct a vector error correction model to examine the nature of the long run relationship among the variables and the short run changes and adjustments to equilibrate each variable, in order to find the primary causes of the US subprime crisis. The systems of equations are estimated using the full information maximum likelihood method (Johansen, 1988, 1991).

Let $\boldsymbol{Y} = [\, y_1,\ y_2\,,\ y_3, \ldots\ldots\ldots, y_k]$ be the vector of *k* variables that are *I(1).* The variables in $\boldsymbol{Y}$ are said to be cointegrated if there exists a vector of parameters, $\boldsymbol{\beta} = [\, \beta_1\,, \beta_2\,, \beta_3 \ldots\ldots \beta_k\,]'$, such that the linear combination, $\boldsymbol{Y\beta}$, is a stationary series. The parameter vector, $\boldsymbol{\beta}$,, is the cointegrating vector. $\boldsymbol{Y\beta}$ may be interpreted as a long run equilibrium relationship, but there may be deviations in the short run from this equilibrium. Thus the regression equation is written as:

$$\boldsymbol{Y_t\beta} = \varepsilon_t \,, \qquad (1)$$

where t is the time subscript and the equilibrium error term, ε_t, is also then a stationary series. The vector error correction representation consistent with the above cointegrating equation is:

$$\Delta \boldsymbol{Y_t'} = \boldsymbol{C} + \boldsymbol{\alpha}(\boldsymbol{Y_{t-1}'\beta}) + \boldsymbol{\lambda_1}(\Delta \boldsymbol{Y'_{t-1}}) + \boldsymbol{\lambda_2}\,(\Delta \boldsymbol{Y'_{t-2}}) + \ldots + \boldsymbol{\lambda_s}\,(\Delta \boldsymbol{Y'_{t-s}}) + \boldsymbol{e_t}, \qquad (2)$$

where, $\boldsymbol{C}$ and $\boldsymbol{\alpha}$ are column vectors of constants; $\boldsymbol{\lambda_i}$ s are k x k matrices of coefficients (k=7) on the autoregressive terms; and $\boldsymbol{e_t}$ is a column vector of white noise series.

The elements of $\boldsymbol{\alpha}$ in the system of k equations in (2) are the short run speed of adjustment coefficients to deviations from the long run equilibrium (defined in equation (1)) that may arise from exogenous shocks to $\boldsymbol{Y}$. Shocks to any of the individual variables drives the whole system out of equilibrium, but the system returns to equilibrium by the working of the error correction terms, $\boldsymbol{\alpha}(\boldsymbol{Y_{t-1}'\beta})$. The strength or speed of the movement toward equilibrium depends on the magnitudes of the coefficients, $\boldsymbol{\alpha}$.

Since our measures of financial sector fragility, *DEBT, LIQ, FLEV,* and *SLEV,* move in parallel with one another, and since each of the variables has a private sector debt component (see the appendix), we do not include all four variables in the model at the same time. Instead, to gauge the relevance of each independently of the others, we consider four specifications of cointegrating and VEC equations. Accordingly, each VEC model includes the six core variables, *RHP, RSP, FLOW, LINT, RERT,* and *RGDP.* We then add a measure of financial sector fragility. Specification 1 adds *DEBT*; specification 2 adds *LIQ*; specification 3 adds *FLEV;* and specification 4 adds *SLEV.* This also allows a robustness check of the results across four sets of equations. The four different specification vectors, $\boldsymbol{Y}$, are:

Specification 1: $\boldsymbol{Y}$ = [*RHP, RSP, FLOW, LINT, RERT, RGDP, DEBT*]

Specification 2: $\boldsymbol{Y}$ = [*RHP, RSP, FLOW, LINT, RERT, RGDP, LIQ*]

Specification 3: $\boldsymbol{Y}$ = [*RHP, RSP, FLOW, LINT, RERT, RGDP, FLEV*]

Specification 4: $\boldsymbol{Y}$ = [*RHP, RSP, FLOW, LINT, RERT, RGDP, SLEV*]

Note for each specification, there are seven equations and the number of lags, s, in the autoregressive term and the inclusion of the intercept terms, $\boldsymbol{C}$, are determined with Wald lag exclusion tests, Adjusted R-squared, Akaike information criterion (*AIC),* and Schwarz information criterion (*SIC).* We also test the stability of each specification for the entire period under consideration.

Finally, we examine if the four systems of equations are meaningful in terms of standard economic theory. For this purpose, for each *VEC* specification we examine the impulse responses, each of which is the impact of an exogenous innovation in one variable on another variable, which works via both the error correction terms, $\boldsymbol{\alpha}(\boldsymbol{Y_{t-1}'\beta})$, and the AR terms in the system of seven equations. Specifically, we generate impulse responses to generalised one standard deviation innovations. Here we follow Pesaran and Shin

(1998) and generate impulse responses to a set of orthogonal innovations that are invariant across different orderings of the variables in the error correction equations. If the directions of all such responses are in agreement with standard economic theory then the four specifications are robust. This then allows us to pursue the main part of our analysis, which we describe in the next three subsections, to answer the key questions asked in Section 1.

2.2.2. Choice of sub-periods

The above procedures are the first step. However, the analyses and the results for the entire period (1953 – 2006) under consideration will not necessarily bring to light any extraordinary forces in operation in the years immediately prior to the subprime crisis and the way these forces differ from other periods. For this purpose, as mentioned earlier, based on distinctive historical events, we choose three sub-periods of equal length: i) 1980-1988; ii) 1989-1997; and iii) 1998-2006. The sub-period 1980-1988 is interesting for a number of reasons. Real house prices started to decline in 1981 from their peak in 1979, and from 1985 they started to increase again – eventually in 1988 crossing its previous peak. Real share prices, after declining from 1966-1982, started to increase from 1983, continuing through 1999. Private sector debt as a percentage of GDP, after remaining generally flat from 1971-1982, started increasing from 1983 and this mostly continued through 2006. The long term rate of interest also started declining from 1983. Net capital inflows as a percentage of GDP increased from 1980-1987. Notably, in the decade of 1980s banking sector deregulation was initiated in the United States.[15]

1989-1997 was marked by a change in capital flows and increasing deregulation of the financial sector in the US. The Berlin Wall fell in 1989, marking the collapse of central planning in Eastern Europe. With the German unification came an appreciation of the real exchange rate of the Deutschmark, and this, *inter alia*, led to a coordination failure and a series of speculative attacks on the European Monetary System in 1992-93.[16] As a result, there was a marked change in global capital flows. Notably, US net capital inflows as a percentage of GDP, after declining from 1987-1991, started to increase from 1992 which mostly continued through 2006 (see Figure 1-3). Finally, 1998 is the year that Shiller (2008) identifies as the beginning of the housing boom, and this was also the year immediately after the Asian financial crises of 1997.

2.2.3. Forecast error analysis

Three different but related exercises are conducted for all three sub-periods. First, we examine with static one-period ahead within sample forecasts how well and how consistently the estimated relationships

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[15] See Bhidè (2011, pp. 91-97) for specific measures taken for deregulating the banking industry in the 1980s.
[16] See Buiter, Corsetti and Pesenti (1998) and references therein.

explain the actual data for the variables under consideration for the three individual sub-periods. Then, we check how well and how consistently the estimated relationships and actual values of all other variables dynamically forecast within sample each variable for the three individual sub-periods. These are "pseudo-dynamic forecasts," since in each case we are using the actual past values of all variables, except the predicted past values of the particular variable under consideration. This allows us to examine the extent to which the variables were moved by forces not captured by its own history, but by innovations/shocks from other variables within the system of equations. We interpret and compare the results across the three sub-periods to identify possible behavioral differences of any of the ten variables from one sub-period to the others.

We utilise the estimated vector error correction equations (2) in Section 2.2.1 for all forecasts. Note that for each of Specifications 1- Specification 4, each of the k=7 rows in the system of equations is an expression of the current differenced value of one variable as a linear function of lagged values of all seven variables in levels (in the cointegrating equation) and first differences (in the AR component). We generate the static and pseudo-dynamic forecasts for each variable, y_i, from the *ith* row in the system. For the static forecasts we use actual lagged values of all seven variables. For the pseudo-dynamic forecasts of y_j we use lagged predicted values of y_i and lagged actual values of all other variables, $y_{j \neq i}$.[17] We then compare the mean absolute percentage errors for each model and sub-periods.

2.2.4. *Sensitivity analysis*

Finally, and most importantly, to examine more closely the influence of each individual variable in the data generating process and to identify possible exogenous shocks to the system, we conduct sensitivity analyses by dropping the variables one by one (in the order in which they appear in each of the four specifications in Section 2.2.1) and specify alternative *VEC* systems of equations with only six variables, based on the same test procedures described for *VEC* specifications 1- 4, and label these *VEC* specifications 1A-1G, 2A-2G, 3A-3G, and 4A-4G. We run pseudo-dynamic forecasts for each variable in each alternative *VEC* specification over the three distinct sub-periods. Comparing the pseudo-dynamic forecasts from these alternative *VEC* specifications with those from the full *VEC* specifications 1-4 we are able to observe the extent to which the accuracy of forecasts for each variable deteriorates with the exclusion of each other variable in the system of equations. This way we are able to identify variables for which exogenous shocks generated responses in other variables, and if and how the direction of causality varied across the three periods under examination. In particular, we can answer the central question of the

[17] However, the first point forecast for each sub-period will naturally be using lagged actual values of all variables for both types of forecasts.

paper: Did capital inflows cause low interest rates, credit booms and asset bubbles or did the asset bubbles lead to large increases in capital inflows?

3. Results

3.1. Tests for stationarity and cointegrating relationships

We conduct ADF, Phillips-Perron, Kwiatkowski-Phillips-Schmidt-Shin, and Elliott-Rothenberg-Stock Point-Optimal unit root tests for the ten variables under consideration.The test results indicate that the variables are *I(1).* Next, we test for the existence of cointegrating relationships. For all of the four combinations of variables discussed in the last section, the Trace test and the Maximum Eigenvalue test results suggest the existence of multiple cointegrating vectors at 5% significance level. These lead us to four sets of cointegrating and VEC equations, VEC Specification 1 – VEC Specification 4, which we report and discuss below.

3.2. Estimation results

The estimation results and the related diagnostics for VEC Specification 1 through VEC Specification 4 are presented in Table 1-1 through Table 1-4. Statistically significant coefficients at the 5% and 10% levels are indicated with asterisks as noted. The top panel in each table presents the estimated coefficients, $\hat{\boldsymbol{\beta}}$**,** of the long run equilibrium equation (conintegrating equation), where in each case the coefficients are normalized to make that of *RHP* equal to *one.* The bottom panel in each table presents the estimated coefficients for the corresponding error correction equations. The *LM* statistics and the related *p*-values presented in each table indicate the absence of serial correlation in the equations.

[Insert Table 1-1 through Table 1-4 about here]

For each specification we included two lags in the error correction equations based on the Adjusted *R*-squared, Akaike Information Criterion (*AIC),* Schwarz Information Criterion (*SIC),* and results from Wald tests for lag exclusion*.* The Wald test results are shown in Table 2-1 through Table 2-4.

[Insert Table 2-1 through Table 2-4 about here]

With regard to dynamic stability we find that for all four systems of equations, six out of twenty-one inverse roots of the characteristic polynomial have modulus equal to 1 and all other fifteen inverse roots have modulus less than 1. Therefore, all four estimated systems of equations are dynamically stable over the entire period under consideration. We also conduct the CUMSUM test for each individual error correction equation in each of the four specifications.[18] Time series plots of the test statistic for all twenty-eight error correction equations are found to be within the respective 95% confidence bounds, indicating that all of the equations are stable over the entire sample range.

In the bottom panel of Table 1-1, Table 1-2 and Table 1-4 the t-statistics for the estimates, $\hat{\boldsymbol{\alpha}}$, of the coefficients, $\boldsymbol{\alpha}$, in the error correction terms, $\alpha(Y_{t-1}'\beta)$, suggests that a majority of the coefficients are significant at either 5% or 10% level. This means that when an exogenous shock drives the system out of equilibrium the working of the whole error correction mechanism that brings the system back to the long run equilibrium is significant. In Table 1-3, three out of seven elements of $\hat{\boldsymbol{\alpha}}$ are significant, but at the 5% level rather than at the 10% level.

3.3. Impulse responses

Before we start the main part of our analysis, which we pursue in the next two subsections, we need to first check if the four systems of equations are meaningful and robust in terms of economic theory. As mentioned in Section 2.2.1, we accomplish this task by examining the directions of impulse responses to exogenous innovations in the variables, which work through all seven error correction equations in each specification.

The ten-year averages of impulse responses to one standard deviation innovations for the four VEC specifications (1 to 4) are presented in Table 3-1 through Table 3-4. The directions of responses are as standard economic theory would suggest, and most are robust across the four systems of equations. The first column of each table lists the responses to one standard deviation shocks to home prices (*RHP).* When home prices rise, households experience an increase in their net wealth, as a result of which their current consumption expenditures increase. This would increase real GDP per capita. If such increases in consumption are financed with more borrowing, which is likely for lower income households, then private sector debt level would also rise. At the same time, increases in home prices might spur speculation of future increases in home prices (see Shiller, 2005, 2008), and this could depress stock prices in the short run as people shift their investment funds from stocks to real estate. This is indicated by the negative sign of the response of *FLOW* in the first column of Tables 3-1, 3-2 and 3-4. Such speculations are also expected to raise capital inflows as foreign investors perceive lower risk and increasing opportunities in the real estate sector, and this in turn would expand the supply of credit, lower the long term interest rate, and increase the volume of mortgage and other loans, private sector debt, planned expenditures on current consumption and investment, and real GDP per capita. These explain the

[18] This test is valid under the classical OLS assumptions. Hence, we re-estimated each equation using OLS to conduct the test. The coefficient estimates and the related t-statistics are nearly the same as those obtained with the full information maximum likelihood method.

positive sign of the responses of *FLOW* and *RGDP* and the negative sign of the response of *LINT* to a shock in *RHP* in the first column of Tables 3-1 to 3-4.

The second column of Tables 3-1 to 3-4 lists the responses to one standard deviation shocks to real share prices (*RSP*). When real share prices soar the real value of aggregate wealth of the economy also increases, which raises both consumption and investment expenditures. As a result, demand for new home and office building constructions would increase and property prices would rise. Hence, private sector debt is expected to increase as there will be a greater number of mortgage loans. Furthermore, with the rise in the value of their net wealth, as households and firms increase their planned expenditures on current consumption and investment, real GDP per capita will also increase. Such increases in planned expenditures, when matched by increases in borrowing, would also raise the level of private sector debt and its share in GDP could rise. Increases in share prices would also bring forth new capital inflows as foreigners perceive increased opportunities in the domestic economy. This again would expand credit supply, lower the long term interest rate, and increase the volume of mortgage and other loans, private sector debt, planned expenditures on current consumption and investment, and real GDP per capita. These explain the positive sign of the responses of *RHP, DEBT*, *RGDP* and *FLOW* and the negative sign of the response of *LINT* in each specification, as depicted in the second column of Tables 3-1 to 3-4. In addition, surges in real stock prices are expected to depress the real exchange rate as foreigners demand more of the domestic currency for their investments in the domestic country. This is reflected in the negative sign of the response of *RERT* in the second column of all four tables.

The third column of Table 3-1 through Table 3-4 lists the responses to one standard deviation shocks to net capital inflows as a percentage of GDP (*FLOW*). Increasing net capital inflows as a percentage of GDP is expected to fuel booms in stock and housing markets. First, part of the new foreign funds may be invested directly in domestic stocks, thus raising stock prices. Increases in capital inflows would also expand the supply of credit and lower the long term rate of interest, and as a result the volume of mortgage and other loans would increase, leading to increases in the level of private sector debt and home prices. Further, with the lower long term rate of interest, the equity premium decreases. Hence, the risky assets—stocks and securities tied to mortgages—are now relatively more attractive than the regular fixed income assets, and so home and stock prices increase because of higher demands in these markets. Real GDP per capita would also increase as the declining long term interest rate would boost planned expenditures on current consumption and investment. These explain the positive sign of the response of *DEBT, RHP*, *RSP* and *RGDP* and the negative sign of the response of *LINT* in the third column of Table 3-1 through Table 3-4. Finally, the real exchange rate would fall as with increases in net capital inflows demand for the domestic currency increases, which is reflected in the negative sign of the response of *RERT* in Table 3-1, Table 3-2 and Table 3-4.

We also note that in each of the above cases when capital inflows increase and foreigners (or the domestic borrowing from foreigners) make new deposits in domestic banks, the reserves in the domestic banking sector would increase, and thus the banking sector liquidity ratio would rise. This explains the positive responses of *LIQ* to innovations in *RHP, RSP* and *FLOW* in the first three columns of Table 3-2. At the same time, when *RHP* increases, the financial sector might make more mortgage loans relative to its net worth[19] with the expectation of future increases in the prices of homes that they keep as collateral[20]— thus leading to a rise in its leverage ratio. Hence, the responses of *FLEV* and *SLEV* have positive signs in the first column of Table 3-3 and Table 3-4. The impact of innovations to *RSP* on the leverage ratio is ambiguous, however. With soaring stock prices the net worth of the whole financial sector increases. This lowers the leverage ratio. But with the expectation of higher stock prices for the whole private sector, bankers may become more optimistic about the future economic outlook, underestimate risks arising from moral hazard, and buy more assets relative to the net worth. Thus, the impact of increasing *RSP* on the leverage ratio could be negative or positive. We find that the impact is negative for the whole financial sector, which includes the heavily regulated commercial banks (the second column of Table 3-3), but it is near-zero for the shadow banking sector (the second column of Table 3-4).

The responses to one standard deviation shocks to the long term rate of interest (*LINT*) are listed in the fourth column of Tables 3-1 to 3-4. Increases in the long term rate of interest would make fixed income securities more attractive relative to stocks and real estate assets that are generally more risky, and thus stock and home prices would fall as people transfer part of their investments to less risky fixed income assets. These are reflected in the negative sign of the responses of *RHP* and *RSP* in the fourth column of Tables 3-1 to 3-4. On the other hand, increases in the domestic long term interest rate widens the difference between domestic and foreign interest rates, *ceteris paribus*, and therefore increases net capital inflows, as domestic fixed income assets are now relatively more attractive than their foreign counterparts. Hence, the response of *FLOW* is positive in the fourth column of Tables 3-1 – 3-3. Such increases in net capital inflows in turn would depress the real exchange rate as demand for the domestic currency increases. This explains the negative sign of the response of *RERT* in the fourth column of Table 3-1 to the extent that our exchange rate measure captures this, and the zero response appearing in the other tables. At the same time, with increases in the long term rate of interest the cost of borrowing increases, thus causing declines in private sector debt, planned expenditures on current consumption and

[19] In the years prior to the global financial crisis the mortgage loans were financed with debt that financial institutions incurred by selling newly invented financial instruments, such as mortgage backed securities and collateralized debt obligations. This practice of course increased their leverage as with more debt financing the value of their assets increased relative to their net worth.
[20] See Shiller (2008, p. 50).

investments, and real GDP per capita. These are reflected in the negative sign of *DEBT* in the fourth column of Table 3-1 and the negative sign of *RGDP* in the fourth column of all four tables.

The fifth column of each of Tables 3-1 to 3-4 shows the responses to one standard deviation shocks to the real exchange rate of the Thai baht (*RERT*). The results also suggest that this exchange rate does appear to capture the potential effects of a broader measure of the effective real exchange rate, which is not available for the sample period we consider. An increase in the real exchange rate means a depreciation of the domestic currency, which increases capital outflows as domestic and foreign investors find foreign assets relatively more attractive. This will negatively impact net capital inflows, and as a result bank liquidity will decrease and the long term interest rate will rise. Decreases in net capital inflows will also depress house and stock prices. These explain the negative sign of the response of *FLOW* in the fifth column of Table 3-1 and Table 3-2, the negative sign of the response of *LIQ* in the fifth column of Table 3-2, and the negative signs of the responses of *RHP* and *RSP* and the positive sign of the response of *LINT* in the fifth column of Tables 3-1 to 3-4. As stock prices decline the financial sector suffers a loss of net worth and an increase in leverage. The rise in the real exchange rate would also mean that dollar values of foreign assets and liabilities of domestic financial institutions would increase, and if the increases on the liability side are far greater than the increases in their asset values then there will be further increases in their leverage. At the same time, the rise in the long term rate of interest would lead to declines in the private sector debt level, current consumption and investment, and real GDP per capita. These are reflected in the respective signs of the impacts on *DEBT*, *FLEV* and *SLEV* in the fifth column of Tables 3-1, 3-3 and 3-4. However, with the depreciation of the domestic currency domestic goods become relatively cheaper, and this will cause net exports and real GDP per capita to increase. Thus, following a depreciation of the domestic currency, real GDP per capita may increase or decrease depending on if their initial declines are more than offset or not in the longer run. In Tables 3-1 and 3-2 the net effects are negative, while in Tables 3-3 and 3-4 the net effects are positive.

The sixth column of Tables 3-1 to 3-4 lists the impacts of one standard deviation shocks to our measures of financial fragility, private sector debt as a percentage of GDP (*DEBT*), banking sector liquidity ratio (*LIQ*), financial sector leverage ratio (*FLEV*), and non-bank financial sector leverage ratio (*SLEV*), respectively. The responses vary somewhat. When the share of private sector debt in GDP increases, which could be due to increasing deregulation and the resulting financial innovation, then there could be booms in asset markets,[21] which could also increase capital inflows. Rising asset prices and capital inflows in turn would lower the long term rate of interest and the real exchange rate. As a result, planned expenditures on current consumption, investment and exports would increase, thus increasing real GDP per capita. Hence, the positive signs of *RHP, RSP, FLOW* and *RGDP* and the negative signs of

[21] See the discussion in Section 1 and the references therein.

LINT and *RERT* in the sixth column of Table 3-1. Increases in banking sector liquidity could boost the level of confidence and positively impact the future economic outlook with the perception of lower systemic risk, and this could increase asset prices and capital inflows, lower the long term rate of interest and the real exchange rate, and raise per capita real GDP. These explain the positive signs of *RHP, RSP, FLOW* and *RGDP* and the negative signs of *LINT* and *RERT* in the sixth column of Table 3-2. Increases in financial sector leverage could lead to rising home prices, particularly if caused by expansions of mortgage credits. On the other hand, such increases in leverage could lead to higher levels of systemic risk perceived by investors and could negatively impact stock prices and capital inflows, causing the long term rate of interest and the real exchange rate to rise and real GDP per capita to decline. These make sense of the respective signs of *RHP, RSP, FLOW, LINT, RERT* and *RGDP* in the sixth column of Tables 3-3 and 3-4.

Finally, the responses to one standard deviation shocks to per capita real GDP appear in the last column of Tables 3-1 to 3-4. With the growth of per capita real GDP there would be higher demand for assets based on higher savings, and this would cause both real house and stock prices to rise. With higher asset prices and import demand, net capital inflows would increase and the real exchange rate would fall. With the growth of output, firms may optimistically engage in higher investments with more borrowings, and this would cause private sector debt and the long term rate of interest to increase. Thus, in the end the long term rate of interest could rise or fall. From this line of thought the positive signs of the responses of *RHP, RSP* and *FLOW* in the last column of Tables 3-1 to 3-4, the negative sign of the response of *RERT* in the same column of Table 3-2, the positive sign of the response of *DEBT* in the same column of Table 3-2, and the positive sign of the response of *LINT* in the last column of Table 3-1, Table 3-3 and Table 3-4 as well as the negative sign of *LINT* in the same column of Table 3-2 flow naturally. In all cases, provided the percentage of illiquid assets does not increase excessively, banking sector liquidity could increase as higher incomes lead to more deposits adding to the bank reserves. Thus, the sign of the response of *LIQ* in the last column of Table 3-2 is positive. However, with higher level of private sector debt financial sector leverage would increase, as financial institutions make more loans by increasing their own borrowings. This is reflected in the positive signs of *FLEV* and *SLEV* in the last column of Table 3-3 and Table 3-4, respectively.

The impulse responses discussed above are in line with economic intuition. We therefore conclude that the four systems of equations are meaningful with regard to standard economic theory. Nevertheless, the impulse responses for the entire sample period do not shed light on the potential differences in short run changes and adjustments towards the long run equilibrium across the specific sub-periods,1980-1988, 1989-1997 and 1998-2006, that we chose in Section 2.2.2 based on distinct historical events for understanding the forces in the run-up to the US subprime crisis. Examining the sub-periods is the task we undertake in the next two subsections.

3.4. Static forecasts

We start our sub-period analysis by examining how well and how consistently the estimated systems of equations reported in Tables 1-1 to 1-4 can explain actual data for the three sub-periods, 1980-1988, 1989-1997 and 1998-2006. For this purpose we perform one-period-ahead static within sample forecasts with all four estimated systems of equations reported in Tables 1-1 to 1-4 and calculate and compare the mean absolute percent errors of the forecasts separately for each of the three sub-periods. The results are shown in Table 4. The plots of the actual values and the forecasts for all ten variables are shown in Figure 1-1 through Figure 1-10 introduced earlier. The plots of forecasts for *RHP, RSP, FLOW, LINT, RERT, RGDP* and *DEBT* are from VEC Specification 1 and the plots of forecasts for *LIQ, FLEV,* and *SLEV* are from VEC Specifications 2, 3 and 4, respectively.

The mean absolute percentage forecast errors (MAPE) for each variable are similar across the four specifications. These are also by and large consistent across the three periods, except for *FLOW,* which is best predicted for the period 1998-2006. These mean that the VEC model is robust and is able to explain the data in our sample very well. The worst forecast performance for *FLOW* is for the period 1989-1997. Figure 2-3 shows that the model picks up the sudden turnaround of capital inflows in 1992, rather late, and continues to miss the increases from that point onwards by a wide margin. On the other hand, changes in capital inflows are well explained by each specification of the model for 1998-2006, the period after the Asian financial crises, when the housing and stock markets boomed. The results from the empirical exercises presented in the next subsection confirm these findings and present additional useful findings.
[Insert Table 4 about here]

3.5. Pseudo-dynamic forecasts and sensitivity analyses

Our next task is to examine more closely how each variable of the model is explained by the other variables in the three sub-periods, 1980-1988, 1989-1997 and 1998-2006. We first perform within sample pseudo-dynamic forecasts[22] for all ten variables using Specification 1 – Specification 4 over all three sub-periods. These exercises allow us to examine more closely than the static forecasts how well the data generating process of each variable is explained by the other six variables in each specification based on the estimated systems of equations and how these differ across the three sub-periods.

However, as noted in Section 2.2.4, even the results from the pseudo-dynamic forecasts with Specification 1 through Specification 4 do not tell us whether an exogenous shock to a particular variable

[22] See Section 2.2.1 for definition and calculation method.

caused a significant change to other variables and the related differences across the three sub-periods. We need to know the differences in the nature and impact of exogenous shocks across the three different sub-periods to understand the different forces at work in the run-up to the US sub-prime crisis. For example, to what extent are the dramatic rises in US house prices starting from 1998 explained by changes in which variables precisely and how were these different from the changes in the other two sub-periods, which, as mentioned in Section 2.2.2, were distinct in terms of historical events? Net capital inflows increased from 1992 through 2006, but were such increases through 1997 caused by the same factors as those during 1998-2006? Was there a reversal in the direction of causality between asset prices and net capital inflows after 1997?

To fill this gap, we perform sensitivity analyses. We drop the variables one by one from each system of equations and examine the impacts on the forecast errors for each of the other variables in the alternative VEC specifications. If dropping a variable causes large increases in the forecast error for other variables for any sub-period then we infer that the variable has large explanatory power in that sub-period. By examining all such large impacts of variable exclusions we are able to identify the directions of causality and possible exogenous shocks to the system for a sub-period and compare these with those for the other sub-periods.[23]

The mean absolute percent errors (MAPE) for the pseudo-dynamic forecasts with the systems of equations 1-4 and the alternative smaller systems of equations, 1A-1G, 2A-2G, 3A-3G, and 4A-4G, for which one of the variables is dropped, are presented in Table 5-1 through Table 5-4. We first note that, similar to what we found with the static forecasts, the MAPEs for the forecasted values of FLOW in every model specification for the sub-period 1989-1997 are much larger than the MAPEs for the sub-periods 1980-1988 and 1998-2006. Thus, again, the sudden turn-around and the subsequent large increases of *FLOW* in this period are not explained by changes in other variables. The implication is that the sudden increases in FLOW are exogenous shocks.[24] On the other hand, the forecast errors for *FLOW* with all model specifications are in fact lowest for 1998-2006, much the same as with the earlier static forecasts. This suggests that the variables in the model, predominately domestic macroeconomic fundamentals, were determining FLOW during 1998-2006. We also see that, unlike with the static exercises, the forecast errors for *RHP* from all four systems of equations are much larger for 1998-2006 and 1980-1988 than for 1989-1997. Thus, 1989-1997 is the sub-period when *FLOW* is least explained but *RHP* is best explained

[23] We could conduct Granger causality tests, but the power of such tests for a sub-period having only nine observations will be extremely low.

[24] At the same time, the MAPE for the forecasted values of FLOW in every model specification for the sub-period 1980-1988 is higher than that for the sub-period 1998-2006. This means that FLOW had a larger exogenous component for part or full of the sub-period 1980-1988 than for 1998-2006.

by the estimated relationships. The plots of the actual values of *RHP* and *FLOW* and the respective pseudo-dynamic forecasts are shown in Figure 2-1 and Figure 2-2.

[Insert Figure 2-1, Figure 2-2 and Table 5-1 through Table 5-4 about here]

Sub-period variations in forecast errors for real house prices (RHP)

If we focus first on the 1998-2006 sub-period and compare the MAPEs reported in the first row in each of Table 5-1 through Table 5-4 it appears that, except in Table 5-4, dropping any of the nine other variables does not increase the forecast error for *RHP,* significantly. This means that home prices in the sub-period 1998-2006 were not significantly affected by changes in macroeconomic fundamentals— and hence the dramatic surges were part of an inflating bubble. We note, at the same time, that the exclusion of *RERT, LINT* or *FLOW* from Specification 1 and Specification 2 does increase forecast error for *RHP*, albeit by small margins (see Table 5-1 and Table 5-2). This points to the possibility that to a certain extent changes in the real exchange rate of the Thai Baht, net capital inflows, and the long term rate of interest that resulted from the Asian financial crises might have contributed to the housing boom during this period. We further examine this possibility later in the current and the next sections.

By contrast, the forecast errors for *RHP* for the sub-period 1989-1997 increase dramatically when *FLOW* is dropped from Specification 1 through Specification 4. The increases in MAPEs are by 100% to 550% across the four types of specifications. Exclusion of no other variable has such a consistently large impact on the forecast error for *RHP.* This suggests that the sudden increases in net capital inflows in the aftermath of the extraordinary events in Europe—the collapse of central planning in the countries of East Europe and the crisis in the European exchange rate mechanism— did contribute to the changes in house prices in 1989-1997. Real house prices mostly declined during this period, but as Figure 3 below shows, the absolute declines decreased precisely from 1992, the year when *FLOW* also turned around and increased rapidly thereafter.

Finally, the pattern of the changes in forecast errors for *RHP* for the sub-period 1980-1988, when the core variables (i.e. variables other than *DEBT, LIQ, FLEV* and *SLEV*) are dropped serially from the four original systems of equations, resemble those for the sub-period 1998-2006. The exclusion of the core variables does not have consistently large impacts on the forecast errors across the four alternative specifications. Whereas for the same sub-period the exclusion of any of the measures of financial fragility, *DEBT, LIQ, FLEV,* and *SLEV,* does have notable impacts on the forecast errors for *RHP* (unlike for the sub-period 1998-2007). This then implies that the financial sector played a role in changing home prices. Real house prices declined from 1980 to 1984 and after that it started to increase again, but, as Figure 3 shows, even the rate of decline started to fall from 1982. On the other hand, private sector debt as a percentage of GDP, after remaining generally flat from 1971-1982, started increasing from 1983 and this mostly continued through 2006. There was a net increase in the non-bank financial sector leverage ratio (*SLEV)* from 1983 through 1988 and the liquidity of the banking sector decreased over this entire sub-period. Notably, the 1980s were also when the process of financial liberalization gained momentum in the United States.

[Insert Figure 3 about here]

Sub-period variations in forecast errors for real share prices (RSP)

RSP increased from 1982 through 1999 consistently, but at faster rates in the late 1990s. Nevertheless, comparing the MAPEs reported in the second row for each sub-period in Table 5-1 through Table 5-2 suggests that the forecast errors are not impacted in a large way from the exclusion of other variables across all four specifications, with the exception of *RERT* for all and *LINT* for two specifications. The exclusion of *RERT* from all four original specifications increases the forecast error rates for *RSP* for the sub-period 1989-1997, and the effect is large when *RERT* is dropped from Specification 1 and Specification 2 (see Table 5-1 and Table 5-2). *RERT* had a rising trend during this period, and thus with the fall in the value of the US dollar, which is indeed an asset in the international financial markets, domestic and foreign investors might have switched to purchases of US stocks, which fueled the stock market boom during this period. In this case, with extraordinary conditions in the emerging market economies of East Europe, and with relatively poor investment opportunities in Asia and other developing parts of the world[25], many investors simply chose to substitute one type of US asset for another type of US asset. The already rising real prices of stocks since the early 1980s might have spurred people's expectations of future increases of stock prices, and this probably also contributed to the decision to switch assets. Furthermore, the increases in forecast errors (103% and 65%) for *RSP* for the sub-period 1989-1997 when *LINT* is dropped from Specification 1 and Specification 2 suggest that the declining long term rate of interest also contributed to the surges in stock prices during this sub-period by lowering the equity premium.

Sub-period variations in forecast errors for net capital inflows as a percentage of GDP (FLOW)

Based on the MAPEs reported in the third row in each of Table 5-1 through Table 5-4, the forecast errors for *FLOW* almost uniformly increase in every period when *RHP* or *RSP* is dropped*,* and this is quite consistent and prominent across the four specifications and across the three sub-periods. However, the percentage increases in errors are generally much larger for the sub-periods 1980-1988 and 1998-2006 than for the sub-period 1989-1997. It is also seen that the percentage increases in MAPEs for *FLOW* that are caused by the exclusion of *RHP* for the sub-period 1989-1997 are much smaller than the percentage

[25] This was partly due to the absence of well-functioning capital and money markets during that time.

increases in MAPEs for *RHP* that are caused by the exclusion of *FLOW* for the same sub-period. Quite the opposite is true for the other two sub-periods, and, moreover, dropping *FLOW* does not necessarily increase the forecast error for *RHP.* This suggests that there were reversals in the main directions of causality between *RHP* and *FLOW* from 1980-1988 to 1989-1997 and from 1989-1997 to 1998-2007. A reasonable interpretation is that increases in asset prices generally cause increases in net capital inflows and little the other way round. But the period 1989-1997 was an exception in this regard due to the collapse of the system of central planning in Eastern Europe and the subsequent crisis in the European exchange rate mechanism that generated large capital outflows from Europe. During this period increases in asset prices in the US contributed to the surges in capital inflows, but the influx of capital from other economies contributed to the soaring asset prices to a greater degree.

That the political turmoil in Eastern Europe and the speculative attacks on the European Monetary System were largely responsible for the sudden influx of capital into the US starting from 1992 is quite evident from the current account data[26] for major European countries. We do not have consistent data for the countries of Eastern Europe, however, but we find that the average of shares of current account balance relative to GDP of eleven major West European countries, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Spain, Sweden and the UK, rose from -0.82% in 1991 to 1.8% in 1997 – an increase of more than 318%. The plot of the time series is shown in Figure 4. Over the same period, the US share of net capital inflows in GDP rose from -0.13% to 1.5%.

[Insert Figure 4 about here]

We also find that the exclusion of *LINT* substantially increases the forecast errors for *FLOW* for the sub-periods 1989-1997 and 1998-2006. The long term rate of interest generally fell starting from 1983. However, we find that starting in the early 1980s the long term interest rates closely aligned with the federal funds rate, generally the key monetary policy rate of the Fed from the 1970s.[27] The plots of the two rates are shown in Figure 5 below. Hence, the declines in the long term rate of interest might have been more due to the declines in the Fed`s policy rate.[28] And the declines in the long term rate of interest contributed to the surges in asset prices[29], as investors found stocks and real estate assets relatively more attractive, and also because mortgage loans could be secured at lower rates. The surges in asset prices in turn contributed to the increases in net capital inflows.

[Insert Figure 5 about here]

The exclusion of *RERT* from the four original systems of equations generally causes large increases in the forecast errors for *FLOW* for the sub-periods 1980-1988 and 1998-2006. We note that *RERT*

[26] The source is noted in the appendix.
[27] Except in the short period from 1979-1982 when the Fed targeted non-borrowed reserves.
[28] We confirm this later in this section.
[29] Which we know from the previous discussions on variations of forecast errors for *RHP* and *RSP.*

declined sharply from 1980-1985 and from 1997-1998 (the devaluation of the Thai baht in 1997). When the value of the US dollar shot up there were large increases in capital inflows as foreign investors found safe haven in US assets.

We find further that the forecast errors for *FLOW* generally increase notably for the periods 1980-1988 and 1989-1997 when *RGDP* is dropped from the four original systems of equations. The growth rate of real GDP per capita peaked in 1984 at 6.4%, after which it declined through 1991. The share of net capital inflows in GDP increased from 1980-1987, and it declined thereafter through 1991. Both the growth rate of real GDP per capita and the share of net capital inflows in GDP began increasing again in 1992. From that point onward the increases in the growth rate of real GDP per capita were short lived while that of the share of net capital inflows in GDP had a clear upward trend through the end of the sample period. Nevertheless, the pattern of short run movements from 1980 through 1992-1993 and the changes in forecast errors when *RGDP* is dropped from the systems of equations suggest that the short run changes in the growth of real GDP per capita, among other things, helped sway the mood of investors from abroad.

Finally, we find that exclusions of *DEBT, LIQ, FLEV,* and *SLEV* from the four original systems of equations result in large increases in the forecast errors for *FLOW* for the sub-period 1980-1988. *DEBT* rose from 1981-1988, *LIQ* had a generally declining trend from 1980-1988, and *SLEV* increased from 1983-1988. However, *FLEV* had a declining trend over this sub-period. It seems, while the banking sector leverage declined[30] and might have boosted confidence in the domestic financial sector, the increases of private sector debt and the leverage of the shadow banking sector as well as shrinking liquidity of the banking sector—all representing the process of financial liberalization gaining importance in the 1980s—contributed to the surges in net capital inflows as a percentage of GDP from 1980-1987. This was particularly because financial institutions were increasingly willing to make more loans which they would finance by increasing the sale of securities.

Sub-period variations in forecast errors for the long term rate of interest (LINT)

According to the MAPEs for *LINT* reported in the fourth row of Tables 5-1 to 5-4, the exclusion of *RERT* results in increases in forecast errors for *LINT* for every model specification in every sub-period, except for Specifications 1 and 4 in 1980-1988. For the sub-period 1998-2006 the increases are very large. Once again, the effect of the Asian financial crisis is quite prominent. The sudden increase in the value of dollar from 1997-1998 resulting from the devaluation of the Thai baht in 1997 caused increases in capital inflows, which depressed the long term rate of interest. That this might have happened is also

[30] During this period the financial sector leverage decreased, but the non-bank financial sector leverage increased from 1983. So, the decreases in the financial sector leverage must have been due to decreases in the banking sector leverage.

suggested by the increases in error rates for *LINT* for this sub-period when *FLOW* is dropped from the systems of equations 2-4, as mentioned above.[31]

None-the-less, while the percentage drop (15.8%) in *LINT* was larger than the percentage drop (2%) in the federal funds rate from 1997 to 1998, the percentage decrease (37.7%) in *LINT* from 2000 to 2004 was much smaller than that (78.4%) in the federal funds rate, despite the fact that *FLOW* continued to increase during this entire period. This of course casts a doubt on the idea that the reductions in the long term rate of interest during this period were entirely, or mostly, due to increases in net capital inflows. The forecast errors for *LINT* increased also for the other two sub-periods when *FLOW* was dropped. However, for the two sub-periods, 1989-1997 and 1998-2006, where the forecast errors for *FLOW* increases when *LINT* is dropped, which we discussed earlier, the effect is generally much larger than the effects on forecast errors for *LINT* when *FLOW* is dropped. We also do not find the exclusion of any variable, other than FLOW and RERT, having any significant impact on the error rates for *LINT* for any sub-period that is consistent across the four original systems of equations. These are confirmations of our earlier observation that the long term rate of interest was influenced more by changes in the Fed's monetary policy than changes in capital inflows or any other factor.

This is further corroborated by the results from the pairwise Granger causality tests. The results for the long term rate of interest and the federal funds rate over the period from 1970-2006, during which the latter was the Fed's key policy rate, strongly indicate that any possible causality is from the federal funds rate to the long term rate of interest (see also Figure 5). At the same time, the test results for the long term rate of interest and net capital inflows as a percentage of GDP over the period from 1990-2006, during which the latter had an upward trend clearly and consistently, suggest that any possible causality is from the long term rate of interest to net capital inflows as a percentage of GDP and not in the opposite direction. This is also consistent with the MAPE results for FLOW discussed above.

Sub-period variations in forecast errors for the real exchange rate of the Thai baht (RERT)

When we compare the MAPEs reported in the fifth row in each of Tables 5-1 to 5-4 we find that the forecast errors for *RERT* are subject to large increases for every specification for the sub-period 1998-2006 when *RSP* or *LINT* is dropped.[32] The internet bubble had burst after 1999 and stock prices were on a decline until 2003. The long term rate of interest also declined from 2000 through 2003 primarily because of the Fed's expansionary monetary policy. These two factors of course increased the demand for the US

[31] However, as discussed earlier, these changes might not have impacted the real house prices during this period significantly, and if at all then certainly much less than the impact of rising real house and stock prices on net capital inflows.

[32] The forecast error for *RERT* also increases for every specification for the other two sub-periods when *LINT* is dropped, but these increases are much less than the increases for the sub-period 1998-2006.

dollar during this short period simply because many people preferred holding cash to buying stocks or long maturity bonds. As a result, the value of the dollar increased and the real exchange rate declined. However, in 2004 real stock prices and the long term interest rate started to increase again, and so did the real exchange rate.

Sub-period variations in forecast errors for financial fragility: private sector debt as a percentage of GDP (DEBT), banking sector liquidity ratio (LIQ), financial sector leverage ratio (FLEV), and *non-bank financial sector leverage ratio (SLEV)*

The MAPEs reported in the seventh row in Table 5-1 suggest that *FLOW* is the only variable the exclusion of which from VEC Specification 1 increases the forecast error for *DEBT* substantially, and this is true for all three sub-periods.[33] Thus, increasing net capital inflows as a percentage of GDP contributed to the expansion of credit and private sector debt as a percentage of GDP in all three sub-periods. The MAPEs reported in the last row of Table 5-2 suggests that excluding *RSP* or *LINT* from VEC Specification 2 increases the forecast error for *LIQ* by a large percentage for the sub-period 1998-2006. Banking sector liquidity (*LIQ*) declined from 1999 through 2006, stock prices fell from 1999 through 2003, and the long term rate of interest also fell from 2000 through 2003. Thus, declining stock prices and the long term rate of interest contributed to shrinking bank liquidity, as banks ventured for more risky and illiquid assets to increase their earnings. Table 5-2 also suggests that the forecast error for *LIQ* increases for the sub-period 1989-1997 when *RHP, LINT, FLOW* or *RERT* is dropped. During this sub-period both *RHP* and *LINT* declined and so they contributed to declining *LIQ* from 1994 through 1997 and slowed the increases in the beginning of this sub-period. In the beginning of this sub-period from 1991 through 1994 *LIQ* increased, and this seems to be mainly due to surges in net capital inflows which led to larger deposits and reserves in domestic banks. Also, during the sub-period 1989-2007 *RERT* generally increased, and with the fall in the value of the US dollar domestic banks experienced a gain in the dollar value of their foreign assets, which reduced the banking sector liquidity ratio. Finally, for the sub-period 1980-1988 deleting any variable improves the forecast errors for *LIQ*, suggesting it is stable and perhaps somewhat exogenous from the core variables.

According to the MAPEs reported in the seventh row of Table 5-3 the forecast errors for *FLEV* are relatively stable as variables are dropped from Specification 3 in the 1980-1988 and 1989-1997 sub-periods. But for the sub-period 1998-2006 when any one of *RHP, RSP, FLOW* or *LINT* is dropped the forecast errors increase. In the seventh row in Table 5-4 the forecast errors for *SLEV* increase notably for

[33]Also recall from above that removing *DEBT* from Specification 1 dramatically increased the forecast error for *FLOW* for 1980-1988. However, removing *DEBT* from the same specification decreases forecast error for *FLOW* for 1989-1997 and increases only marginally for 1998-2006. These suggest that changes in *DEBT* tend to be contributing to changes in *FLOW* during 1980-1988, but not the later periods.

the same sub-period when either *RHP* or *RSP* is dropped. The bursting of the internet bubble, after which real share prices declined until 2003, lowered the net worth of financial institutions, causing increases in their leverage. Increases in real house prices and net capital inflows and the declines in the long term interest rate increased the financial sector leverage as many financial institutions made mortgage loans that they financed with debt incurred by selling new esoteric financial instruments[34], which increased the value of their assets without increasing their net worth. Other financial institutions simply bought more securities related to mortgages by financing with the sale of other regular securities, and this also increased the financial sector leverage ratio.

We also find that the forecast error for *SLEV* for the sub-period 1989-1997 increases when *RHP, RSP, FLOW, LINT* or *RER* is dropped (see the seventh row in Table 5-4). The exclusion of *RSP* or *FLOW* also increases the forecast error for *FLEV,* but the effects are not as large (see the seventh row in Table 5-3). Figure 1-8 and Figure 1-9 suggest that both the financial sector leverage ratio (*FLEV*) and the non-bank financial sector leverage ratio (*SLEV*) declined for the sub-period 1989-1997. As noted earlier, the fall in the value of the US dollar and the reductions in the long term rate of interest contributed to increases in stock prices during this period. These raised the net worth of the financial sector and lowered the two leverage ratios. Also, as discussed earlier, to the extent the increases in capital inflows, apart from the Fed's monetary policy, lowered the long term rate of interest, such increases in capital inflows also contributed to rising stock prices and declining financial sector leverage. Increases in net capital inflows and reductions in the long term rate of interest could also raise the leverage ratios, as financial institutions were encouraged to borrow more and expand the volumes of their loans to the private sector and other financial institutions. However, in this case, the declining leverage ratios during this period suggest a stronger effect of soaring stock prices.

In this section we have presented and discussed the estimation results, impulse responses, static and pseudo-dynamic forecasts, and the results from sensitivity analysis to identify the distinct forces in three different sub-periods leading to the US sub-prime crisis. In the next section we summarise and interpret the results and provide a detailed explanation for the crisis.

4. Interpretation of Results

The results presented in the last section allow us to identify the compelling forces in the run-up to the crisis by taking a longer, evolutionary view of the data. We presented and discussed the estimation results for four model specifications with four alternative measures of financial sector fragility, the related

[34] Such as mortgage backed securities and collateralized debt obligations that combined securities of different grades. For more details see Gorton (2010), Bhidè (2011), and Acharya and Richardson (2011).

impulse responses for the whole sample period (1953 – 2006), and the static and pseudo-dynamic forecasts and the results from sensitivity analysis for three sub-periods, 1980-1988, 1989-1997 and 1998-2006. The directions of impulse responses to one standard deviation innovations confirmed that the model specifications are robust in light of standard economic theory. The static forecast errors suggest that the VEC model is able to explain the data fairly well and consistently for the three sub-periods, except for the data on *FLOW* for the sub-period 1989-1997. The pseudo dynamic forecasts and the sensitivity analyses, excluding individual variables one-by-one, reveal important information on the short run changes and adjustments in the three sub-periods and allow us to identify the distinct forces at work in the run-up to the crisis, which is the goal of this paper. Here we summarise and interpret the results from the sensitivity analyses.

4.1. Exogenous shocks and directions of causality during 1980-1988

We start with the sub-period 1980-1988. This is the period when the process of financial liberalization started in earnest in the United States. [35] Commercial banks were permitted to operate across state lines, and new products and instruments were being introduced. The shadow banking sector, which was not subject to standard financial regulation as the traditional commercial banks, also grew during this period. Mortgage backed securities, which were introduced in the 1970s by the Government National Mortgage Association, became more popular in the 1980s.[36] The changes are reflected in the data. The share of private sector debt in GDP started to increase during this period, banking sector liquidity declined, and non-bank financial sector leverage increased. The results from the sensitivity analysis of the previous section on variations of forecast errors for real house prices suggest that all of these contributed strongly to the falling rates of declines in house prices starting in 1982 and the increases of such prices after 1986. Deregulation and rising stock and house prices also initiated increases in net capital inflows as a percentage of GDP that lasted for most of this period. Increases in net capital inflows further contributed to the expansion of private sector debt by increasing the supply of credit.

4.2. Exogenous shocks and directions of causality during 1989-1997

Net capital inflows as a percentage of GDP, after a period of decline, started to increase again in 1992 and the surges continued through 2006. As we have noted earlier, the beginning of the surges in net capital inflows in 1992 was concurrent with the beginning of a series of speculative attacks on the European Monetary System and immediately after the deep political crisis and the demise of central planning in the countries of East Europe (see Figure 1-3 and Figure 4, which we earlier discussed in

[35] See Bhidè (2011, pp. 91-97) and Roubini and Mihm (2010, ch. 3).
[36] However, they became even more popular in the 1990s (see Roubini and Mihm, 2010, p. 64).

Section 3.5). The results from the sensitivity analyses suggest that this large influx dampened the declines in house prices that started in 1990 and the impact was significant (see Figure 3). The surges in capital inflows also contributed to the expansion of private sector debt by increasing the supply of credit. We further find that the declines in the long term rate of interest that started in 1983 continued in 1989-1997, and the continuing declines fueled the soaring stock prices that started in the mid-1980s. Furthermore, the declines in the long term rate of interest and the value of the US dollar lowered the leverage ratio of financial institutions. There is also evidence that changes in stock and house prices during 1989-1997 contributed to the surges in net capital inflows, but the effects were much smaller than the effects of increases in net capital inflows on changes in real house prices during the same period.

4.3. Exogenous shocks and directions of causality during 1998-2006

In the period from 1998-2006, increases in real home and stock prices had huge effects on net capital inflows as a percentage of GDP. This is the same as in 1980-1988. On the other hand, we do not find changes in any of the other eight variables impacting real stock and house prices significantly. However, to an extent reductions in the long term rate of interest fueled the housing bubble. There is little evidence of increasing net capital inflows causing declines of the long term rate of interest, except briefly immediately after the Asian financial crisis when the increases in net capital inflows were largely driven by the drastic fall of the real exchange rate. Nevertheless, increases in net capital inflows from 1998-2006, much as in the other two sub-periods, contributed to the expansion of private sector debt as a percentage of GDP by increasing the supply of credit. The declines of stock prices after the bursting of the internet bubble in 2000 and the declining long term rate of interest negatively impacted banking sector liquidity. Also, rising real house prices, increases in net capital inflows as a percentage of GDP, and declining long term rate of interest and real stock prices, in the sub-period 1998-2006, increased leverage in the shadow banking sector and the whole financial sector.

4.4. The run-up to the US sub-prime crisis

The discussion so far suggests that the sub-period 1998-2006 was distinct from the other two sub-periods in that asset prices mostly had their own life. The short run dynamics were largely driven by peoples' expectations of future increases in asset prices; whereas in 1980-1988 the primary force was increasing deregulation, and in 1989-1997 the key driving factor was increases in net capital inflows as a percentage of GDP. Thus, there was a reversal in the direction of causality from that in 1989-1997 vis-a-vis 1998-2006. As discussed earlier in Section 3.5 in the context of variations in forecast errors for real house prices and net capital inflows as a percentage of GDP, the sudden increases in net capital inflows into the US after the crisis in the European exchange rate mechanism and the resulting changes in asset prices in the early 1990s led to an upward revision of expectations of future increases in asset prices, giving birth to stories of a new era of "great moderation." The result was mispricing of risk and the spectacular stock and housing bubbles during 1998-2006.

At the same time, starting in the early 1980s, increases in net capital inflows had always contributed to the expansion of the share of private sector debt in GDP, and in the late 1990s and the early 2000s such increases along with other factors increased financial sector leverage and the percentage of illiquid assets in banks' balance sheets to a level that heightened the familiar moral hazard problem. The US subprime crisis was sparked by the bursting of the housing bubble that led to sharp declines of real house and stock prices and sudden huge losses of net worth of households and firms, which resulted in widespread debt defaults, further aggravating moral hazard. The declines in the long term rate of interest accelerated the changes in asset prices since the late 1980s as investors switched to more risky assets with a lower equity premium. However, the sensitivity analyses performed in the last section suggest that the effects were not as large as those of increasing deregulation, changes of capital inflows, and expectations of future increases in asset prices.

Our analyses in the previous section also suggests that regardless of the effects of changes in the long term rate of interest, such changes were caused more by the Fed's monetary policy than any other factor. Except for a brief period immediately after the Asian financial crises, increases in net capital inflows in the 1990s and the early 2000s were not the main driving force for the changes in the long term rate of interest. According to the results on variations in forecast errors for net capital inflows as a percentage of GDP, the causality is much stronger in the opposite direction. Declining long term rate of interest led to part increases in net capital inflows by accelerating the increases in real asset prices. When asset prices increased, both domestic and foreign investors misperceived risk, having expectations of similar increases in the future, and the stories and proclamations of an era of "great moderation" further promoted such thoughts and beliefs.

It is also worth noting in this context—an observation we also made in Section 2.1—that the long term rate of interest started declining from the early 1980s, around the same time real share prices and the share of private sector debt in GDP started increasing, and well before the share of net capital inflows in GDP embarked on a continuous ascent from 1992-2006. Perhaps more importantly, as Figure 5 shows, the long term rate of interest started declining shortly after the federal funds rate starting declining in the early 1980s, and they have been on similar paths ever since

A final comment on the effect of increases in capital inflows is in order. Contrary to what has been argued frequently, neither a global savings glut nor extraordinary increases in capital inflows triggered by the Asian financial crises caused the crises of 2007-2009. As illustrated by Taylor (2011, pp. 154-155), there were clear downward trends in the shares of global saving and investment in global GDP from the early 1970s through the early 2000s, and the two shares have been mostly equal. Hence, a "global savings glut" of the late 1990s and the early 2000s in the strict sense of the phrase didn't exist in the first place. However, during this period the United States was investing more than it was saving and the rest of the world was saving more than it was investing. At the same time, starting from the early 1980s the United States experienced a persistent current account deficit, which meant that the gap between domestic investment and domestic saving was being filled with capital inflows from other countries. The results of the present study suggest that increases in the share of net capital inflows in GDP in the aftermath of the collapse of central planning in East Europe and the crisis in the European exchange rate mechanism were mostly exogenous as opposed to the increases in the share after the Asian financial crises. This means that increases in capital inflows of the early 1990s, and not of the late 1990s and the early 2000s which were largely triggered by the dramatic surges in home prices, should be considered as one of the primary causes of the crises of 2007-2009.[37] In fact, we find that the annual average increase in the share of net capital inflows in GDP was 123% from 1991-1997 and only 17.3% from 1997-2006. The increase in the share was 642% from 1991-1992 and only 50% from 1997-1998. Furthermore, in the three-year period from 1991-1994 the share increased by 1321%, whereas the increase in the three-year period from 1997-2000 was only 161%.

5. Conclusions

We have identified the primary drivers of the global financial crisis of 2007-2009 with a much longer view of the historical data than that generally considered in the extant empirical literature. The rationale for our strategy was to find possible roots of the crisis in more distant history and to take a careful look at how the interactions of several forces evolved, and possibly transformed, over a longer period leading up to the catastrophic events of 2007-2009.

Our analysis furthers the understanding of the dynamics leading to a spectacular global financial meltdown by finding causes other than asset bubbles, credit boom, surges in capital inflows or deregulation of the late 1990s and the early 2000s, the factors that are commonly emphasised in the current literature. Our results suggest that there were distinct forces in the lead in three different periods of history, but all led up to the surprising events of 2007-2009. Financial liberalization of the 1980s and large capital inflows of the early 1990s triggered by the collapse of the European exchange rate

[37] This conclusion is further bolstered by the fact that Canada also experienced a similar housing boom starting from 1998, but, according to World Bank data, the share of the current account balance in GDP increased from -1.4% in 1998 to 2.3% in 2004, and the share was positive in all years except 1998. In fact, Canada's housing boom was as spectacular as the US housing boom. According to the Bank of International Settlements calculations based on national data, US real house prices rose by 87% from 1997-2006, whereas real house prices in Canada rose by 88% over the same period.

mechanism—and much less in the aftermath of the Asian financial crises in 1997— caused changes in asset prices, revisions of expectations upward and the mispricing of risk, following the proponents of the "great moderation. " This in turn later caused asset bubbles and increasing financial sector leverage that were not supported by the economy's fundamentals. There was therefore an interesting change in the direction of causality from the early 1990s to the late 1990s and early 2000s. In the early 1990s surges in capital inflows mainly caused changes in asset prices while in the late 1990s and early 2000s capital inflows were mostly the result of dramatic increases in asset prices and the expectation that such increases would continue. However, surges in capital inflows contributed to the expansion of private sector debt in both periods and an increase in the financial sector leverage in the later period. The declining long term rate of interest, mostly driven by the Federal Reserve's monetary policy, also contributed to the run-up to the crisis, but the effects in this regard were much smaller than the other contributory factors.

Our results are consonant with the proposition that the implosion of speculative bubbles in asset markets triggered the crisis of 2007-2009. According to Shiller (2005, 2008) and Roubini and Mihm (2010), such a bubble can be metaphorically seen as a white swan. People wishfully expect asset prices to rise indefinitely based on stories of a new era, and this keeps the swan flying even higher.[38] But this also begs the question: What induced the swan to start flying in the first place? The findings above deliver a definite answer to this question. While the initiation of the process of financial deregulation of the 1980s has been part of the discussion on the crisis of 2007-2009, it has never been part of a formal empirical model attempting to explain the crisis. We find no mention in the related literature of speculative attacks on the European exchange rate mechanism leading to sudden and rapid increases of capital inflows in the United States in the early 1990s, which, in fact, heavily contributed to the upward momentum of stock and real estate prices. On the other hand, an exogenous shock to capital inflows caused by the Asian financial crisis in 1997 was not a primary factor in the run-up to the crisis, contrary to what many tend to think.

Our findings from tracking the swan over a much longer period back in history reveals important information for developing better insights into the right tools for future macro-prudential policies. In particular, while regulatory measures to control the financial sector leverage and accumulation of bad loans will be necessary, international flows of capital to the extent it contributes to the build-up of speculative bubbles in asset markets should also be monitored. Further, according to Shiller (2005, 2008) and Akerlof and Shiller (2009), there are psychological, social and cultural factors that help inflate a speculative bubble. These studies call for social policies and structural changes to enable firms and households to better assess and manage risk.

[38] I.e. the bubble keeps inflating.

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TABLES AND FIGURES TO BE INSERTED IN THE TEXT

Table 1-1. Coefficient Estimates [t-statistics]: VEC Specification 1 including *DEBT* (1953 – 2006)

Variable	*Estimated coefficients ($\hat{\boldsymbol{\beta}}$) of the long run equilibrium relationship*
RHP(-1)	1.00
RSP(-1)	2.72** [7.80]
FLOW(-1)	1.51 [0.35]
LINT(-1)	11.90** [7.07]
RERT(-1)	1734.34** [2.00]
DEBT(-1)	-1.85** [3.94]
RGDP(-1)	0.001 [0.39]
C	-117.27** [-3.74]

Estimated coefficients ($\hat{\boldsymbol{\alpha}}$ and $\hat{\boldsymbol{\lambda}}$) of the error correction equations

	D(RHP)	*D(RSP)*	*D(FLOW)*	*D(LINT)*	*D(RERT)*	*D(DEBT)*	*D(RGDP)*
$\hat{\boldsymbol{\alpha}}$	0.006844 [0.33322]	-0.1108130** [-2.65910]	0.0113820** [2.03508]	0.0010500 [0.09060]	-0.00012** [4.13716]	-0.0204600 [-0.47640]	13.103790** [2.76661]
D(RHP(-1))	0.6048770** [3.14242]	-0.5802560* [-1.48570]	0.0060680 [0.11576]	-0.0377370 [-0.34730]	-0.0001950 [-0.72317]	-0.0784610 [-0.19493]	-0.5191900 [-0.01170]
D(RHP(-2))	0.1126720 [0.55078]	-0.0981530 [-0.23647]	0.0012270 [0.02203]	0.0673090 [0.58288]	-0.0000878 [-0.30686]	-0.1730880 [-0.40464]	-11.2218200 [-0.23787]
D(RSP(-1))	-0.0747720 [-0.66750]	-0.1540120 [-0.67761]	0.0006520 [0.02138]	-0.0017790 [-0.02813]	-0.00044** [-2.82637]	-0.3787810* [-1.61711]	-11.1342300 [-0.43102]
D(RSP(-2))	-0.0645000 [-0.83725]	-0.0068250 [-0.04366]	-0.0127730 [-0.60888]	0.0195540 [0.44965]	0.0000196 [0.18201]	-0.1069150 [-0.66370]	-30.1797000** [-1.69876]

Table 1-1. Continued

	D(RHP)	D(RSP)	D(FLOW)	D(LINT)	D(RERT)	D(DEBT)	D(RGDP)
D(FLOW(-1))	1.0029770*	1.6605390	0.1075380	-0.1646480	-0.00160**	1.2475150	70.2512300
	[1.48533]	[1.21198]	[0.58482]	[-0.43195]	[-1.69519]	[0.88352]	[0.45114]
D(FLOW(-2))	0.3525140	-1.2201480	-0.0688080	0.4055820	0.0003280	-1.1914760	-122.7492000
	[0.54483]	[-0.92942]	[-0.39053]	[1.11046]	[0.36269]	[-0.88066]	[-0.82267]
D(LINT(-1))	-0.0233030	1.2690880*	-0.0744590	-0.2182540	0.0007270*	0.3648800	-293.043000**
	[-0.05951]	[1.59719]	[-0.69823]	[-0.98731]	[1.32773]	[0.44559]	[-3.24490]
D(LINT(-2))	-0.4619880	0.2976430	-0.0581360	0.2798210*	0.001479**	-0.6729190	-240.118400**
	[-1.25017]	[0.39696]	[-0.57771]	[1.34141]	[2.86106]	[-0.87084]	[-2.81765]
D(RERT(-1))	-76.9816400	-404.21120**	-30.0502900	183.95560**	-0.184991*	-624.69310**	-35457.3700000*
	[-0.78192]	[-2.02348]	[-1.12087]	[3.31002]	[-1.34298]	[-3.03444]	[-1.56172]
D(RERT(-2))	-38.1147400	401.29970**	-23.2785400	50.0122500	-0.31381**	393.13550**	25638.6500000
	[-0.37395]	[1.94045]	[-0.83870]	[0.86923]	[-2.20053]	[1.84458]	[1.09078]
D(DEBT(-1))	0.1809990*	0.876372**	0.0402090*	-0.0229720	0.0001750	0.3520120*	77.1329500**
	[1.65549]	[3.95052]	[1.35053]	[-0.37221]	[1.14526]	[1.53973]	[3.05923]
D(DEBT(-2))	0.0672780	0.500084**	-0.0156380	-0.0125250	0.000426**	0.63070**	0.3873040
	[0.55212]	[2.02265]	[-0.47127]	[-0.18209]	[2.50012]	[2.47526]	[0.01378]
D(RGDP(-1))	-0.0002350	-0.0003330	-0.0000935	0.000851**	0.000002**	0.0014730	0.1725400
	[-0.32794]	[-0.22916]	[-0.47890]	[2.10188]	[1.95629]	[0.98242]	[1.04327]
D(RGDP(-2))	-0.0003950	0.0005050	-0.0001880	-0.000649*	-0.0000003	0.0000590	0.1157440
	[-0.55102]	[0.34722]	[-0.96111]	[-1.60304]	[-0.30642]	[0.03937]	[0.69999]
R-squared	0.70	0.58	0.33	0.37	0.52	0.42	0.45
Adj. R-squared	0.59	0.41	0.07	0.12	0.34	0.19	0.24
AIC	4.50	5.91	1.89	3.35	-8.65	5.97	15.38
SIC	5.06	6.48	2.46	3.92	-8.08	6.54	15.94

LM statistics for serial correlation (p-values)

Lag 1	42.27 (0.74)
Lag 2	49.91 (0.44)
Lag 3	57.57 (0.19)

* Significant at the 10% level. ** Significant at the 5% level.

Table 1-2. Coefficient Estimates [t-statistics]: VEC Specification 2 including *LIQ* (1953 – 2006)

Variable	*Estimated coefficients ($\widehat{\boldsymbol{\beta}}$) of the long run equilibrium relationship*
RHP(-1)	1.00
RSP(-1)	-38.09** [-5.30]
FLOW(-1)	-138.70 [-0.87]
LINT(-1)	-117.68** [-1.75]
RERT(-1)	-138.00** [-4.42]
LIQ(-1)	-7041.50 [-0.59]
RGDP(-1)	0.05** [1.34]
C	6417.08

Estimated coefficients ($\widehat{\boldsymbol{\alpha}}$ and $\widehat{\boldsymbol{\lambda}}$) of the error correction equations

	D(RHP)	*D(RSP)*	*D(FLOW)*	*D(LINT)*	*D(RERT)*	*D(LIQ)*	*D(RGDP)*
$\widehat{\boldsymbol{\alpha}}$	0.0001500 [0.17544]	0.0024780 [1.19234]	-0.000294* [-1.30661]	-0.00083** [-1.94541]	0.0000037** [2.94791]	0.0000014** [1.75640]	-0.2829380* [-1.57624]
D(RHP(-1))	0.64249** [3.32723]	-0.1726580 [-0.36872]	0.0075400 [0.14876]	0.0092290 [0.09575]	0.0000120 [0.04269]	-0.000045 [-0.25882]	29.171420 [0.72128]
D(RHP(-2))	0.1499030 [0.70344]	-0.0800110 [-0.15483]	0.0114470 [0.20464]	0.0631520 [0.59369]	-0.000157 [-0.50710]	-0.000168 [-0.86612]	-3.5181880 [-0.07882]
D(RSP(-1))	0.0572060 [0.79158]	0.57490** [3.28054]	0.0147680 [0.77847]	-0.0332190 [-0.92088]	-0.000144* [-1.37281]	-0.000059 [-0.89968]	31.14852** [2.05789]
D(RSP(-2))	-0.0604660 [-0.78526]	-0.0639140 [-0.34229]	-0.0047190 [-0.23346]	-0.0089190 [-0.23205]	-0.000009 [-0.08533]	-0.000048 [-0.68834]	-25.39147* [-1.57441]

Table 1-2. Continued

	D(RHP)	*D(RSP)*	*D(FLOW)*	*D(LINT)*	*D(RERT)*	*D(LIQ)*	*D(RGDP)*
D(FLOW(-1))	1.154066*	1.045798	0.094840	-0.474011	-0.00164*	0.000688	48.232170
	[1.56726]	[0.58568]	[0.49065]	[-1.28959]	[1.53114]	[1.02915]	[0.31274]
D(FLOW(-2))	0.601109	-0.396647	0.047227	0.170473	0.000182	-0.00074	77.722360
	[0.85535]	[-0.23275]	[0.25601]	[0.48596]	[0.17850]	[1.15927]	[0.52804]
D(LINT(-1))	0.034412	0.387552	0.010775	-0.43712**	0.000071	0.000142	-209.35540**
	[0.08751]	[0.40644]	[0.10438]	[-2.22700]	[0.12419]	[0.39799]	[-2.54202]
D(LINT(-2))	-0.389751	-0.088179	-0.002512	0.073077	0.001138**	0.000237	-208.72210**
	[-1.00197]	[-0.09348]	[-0.02460]	[0.37636]	[2.01376]	[0.66962]	[-2.56192]
D(RERT(-1))	-69.665650	-216.98340	-55.2980*	95.71006*	0.142152	-0.11611	-64640.540**
	[-0.54096]	[-0.69482]	[-1.63579]	[1.48888]	[0.75956]	[0.99286]	[-2.39652]
D(RERT(-2))	-66.047630	400.33290*	-42.7304*	6.732972	-0.21183*	0.055456	-19468.26000
	[-0.60698]	[1.51718]	[-1.49597]	[0.12396]	[1.33956]	[0.56124]	[-0.85423]
D(LIQ(-1))	75.777600	233.102200	70.64701*	-129.4244*	-0.4561**	0.028680	-3381.270000
	[0.46207]	[0.58615]	[1.64107]	[-1.58100]	[-1.9136]	[0.19259]	[-0.09844]
D(LIQ1(-2))	-44.020670	46.683080	29.289510	16.895230	-0.09217	0.126220	24319.140000
	[-0.32550]	[0.14235]	[0.82504]	[0.25027]	[-0.4690]	[1.0278]	[0.85856]
D(RGDP(-1))	-0.000671	-0.002085	-0.000260	0.00099**	0.000002**	0.000002**	-0.18835
	[-0.80250]	[-1.02797]	[-1.18579]	[2.36986]	[1.8502]	[1.9689]	[-1.07531]
D(RGDP(-2))	-0.000209	0.001436	-0.00033*	-0.000372	0.000001	0.000002**	0.01478
	[-0.24736]	[0.70200]	[-1.51047]	[-0.88451]	[0.5680]	[2.4163]	[0.0837]
C	0.697132	1.606530	0.557231**	-0.428483	-0.00239**	-0.00291**	667.4163**
	[0.89493]	[0.85048]	[2.72509]	[-1.10195]	[-2.1129]	[-4.1167]	[4.0907]
R-squared	0.69	0.37	0.35	0.48	0.46	0.48	0.53
Adj. R-sqrd.	0.56	0.10	0.07	0.26	0.23	0.26	0.33
AIC	4.57	6.35	1.90	3.18	-8.49	-9.43	15.26
SIC	5.18	6.95	2.50	3.79	-7.89	-8.83	15.87

LM statistics for serial correlation (p-values)

Lag 1	50.24 (0.42)
Lag 2	35.66 (0.92)
Lag 3	48.55 (0.49)

*Significant at the 10% level. ** Significant at the 5% level.

Table 1-3. Coefficient Estimates [t-statistics]: VEC Specification 3 including *FLEV* (1953 – 2006)

Variable	*Estimated coefficients ($\hat{\boldsymbol{\beta}}$) of the long run equilibrium relationship*
RHP(-1)	1.00
RSP(-1)	1.82** [3.96]
FLOW(-1)	-8.74 [-1.15]
LINT(-1)	14.23** [4.54]
RERT(-1)	6524.37** [4.07]
FLEV(-1)	-82.60** [-3.22]
RGDP(-1)	-0.005** [-3.38]
C	-125.25* [-1.50]

Estimated coefficients ($\hat{\boldsymbol{\alpha}}$ and $\hat{\boldsymbol{\lambda}}$) of the error correction equations

	D(RHP)	*D(RSP)*	*D(FLOW)*	*D(LINT)*	*D(RERT)*	*D(FLEV)*	*D(RGDP)*
$\hat{\boldsymbol{\alpha}}$	-0.005221 [-0.42044]	0.003771 [0.12215]	0.007954** [2.45623]	0.004287 [0.63406]	-0.00006** [-3.16618]	-0.000280 [-0.69365]	12.18462** [4.65991]
D(RHP(-1))	0.564670** [2.64270]	0.012239 [0.02304]	0.043332 [0.77771]	-0.027273 [-0.23447]	-0.000210 [-0.66939]	-0.008378 [-1.20502]	73.90150* [1.64266]
D(RHP(-2))	0.144769 [0.69061]	-0.058324 [-0.11192]	0.024405 [0.44648]	0.080930 [0.70920]	-0.00021 [-0.68185]	0.010021* [1.46918]	28.41487 [0.64379]
D(RSP(-1))	0.102882 [1.19830]	0.439393** [2.05864]	-0.007600 [-0.33948]	-0.005591 [-0.11961]	-0.000122 [-0.96796]	0.002783 [0.99631]	0.262547 [0.01452]
D(RSP(-2))	-0.110542* [-1.28734]	-0.098279 [-0.46039]	-0.002922 [-0.13051]	0.012277 [0.26263]	0.000005 [0.04158]	0.004974** [1.78011]	-21.05561 [-1.16460]

Table 1-3. Continued

	D(RHP)	D(RSP)	D(FLOW)	D(LINT)	D(RERT)	D(FLEV)	D(RGDP)
D(FLOW(-1))	1.014918*	0.419846	0.181542	-0.216033	-0.00224**	0.010921	121.9897
	[1.46174]	[0.24324]	[1.00271]	[-0.57156]	[-2.19405]	[0.48341]	[0.83445]
D(FLOW(-2))	0.346757	-1.267775	-0.012391	0.409317	-0.00026	0.041029**	-52.89032
	[0.52642]	[-0.77420]	[-0.07214]	[1.14149]	[-0.27502]	[1.91431]	[-0.38135]
D(LINT(-1))	0.081325	-0.404312	-0.086918	-0.28558*	0.000282	0.002547	-370.0128**
	[0.21802]	[-0.43600]	[-0.89359]	[-1.40639]	[0.5147]	[0.20989]	[-4.71116]
D(LINT(-2))	-0.255728	-0.780496	-0.079628	0.211061	0.00132**	0.0319**	--312.6697**
	[-0.67398]	[-0.82745]	[-0.80482]	[1.02183]	[2.3715]	[2.5868]	[-3.91377]
D(RERT(-1))	-95.09923	-457.9539*	-55.52956*	163.2234**	0.027076	6.325580*	-77255.55**
	[-0.86191]	[-1.66959]	[-1.93006]	[2.71750]	[0.16691]	[1.76195]	[-3.32549]
D(RERT(-2))	-75.30398	288.8134*	-54.40327**	51.29201	-0.17301*	-1.189316	-19819.95
	[-0.74441]	[1.14845]	[-2.06243]	[0.9314]	[-1.16329]	[-0.36132]	[-0.93054]
D(FLEV(-1))	5.049119	-10.06701	-1.754744	2.226069	-0.00043	0.200852	-1833.210*
	[0.9215]	[-0.73909]	[-1.22820]	[0.7463]	[-0.0540]	[1.12662]	[-1.58909]
D(FLEV(-2))	1.073327	1.123296	1.196798	0.290701	-0.003063	0.279523**	1483.754
	[0.24005]	[0.04205]	[0.89355]	[-0.35430]	[-0.1485]	[1.9699]	[0.95154]
D(RGDP(-1))	0.000106	-0.001549	-0.000170	0.000754**	0.000003**	0.000023	0.03349
	[0.1424]	[-0.83512]	[-0.87277]	[1.85709]	[2.28459]	[0.96573]	[0.21319]
D(RGDP(-2))	0.000375	0.00259*	-0.000169	-0.00077**	0.0000006	-0.00004**	0.179359
	[0.5518]	[1.51263]	[-0.95330]	[-2.07657]	[0.60555]	[-1.93879]	[1.25190]
R-squared	0.69	0.33	0.35	0.38	0.45	0.36	0.52
Adj. R-squared	0.57	0.08	0.10	0.14	0.23	0.12	0.33
AIC	4.54	6.36	1.85	3.33	-8.50	-2.31	15.24
SIC	5.11	6.93	2.42	3.89	-7.93	-1.74	15.81

LM statistics for serial correlation (p-values)

Lag 1	31.32 (0.98)
Lag 2	45.90 (0.60)
Lag 3	53.86 (0.29)

* Significant at the 10% level. ** Significant at the 5% level.

Table 1-4. Coefficient Estimates [t-statistics]: VEC Specification 4 including *SLEV* (1953 – 2006)

Variable	*Estimated coefficients ($\hat{\boldsymbol{\beta}}$) of the long run equilibrium relationship*
RHP(-1)	1.00
RSP(-1)	0.62** [3.50]
FLOW(-1)	-0.55 [-0..15]
LINT(-1)	4.31** [3.62]
RERT(-1)	3451.21** [4.73]
SLEV(-1)	-263.25** [-3.87]
RGDP(-1)	0.001* [1.38]
C	44.54 [0.67]

Estimated coefficients ($\hat{\boldsymbol{\alpha}}$ and $\hat{\boldsymbol{\lambda}}$) of the error correction equations

	D(RHP)	*D(RSP)*	*D(FLOW)*	*D(LINT)*	*D(RERT)*	*D(SLEV)*	*D(RGDP)*
$\hat{\boldsymbol{\alpha}}$	-0.019631 [-0.63951]	-0.029586 [-0.43070]	0.015854** [1.97104]	0.019104** [1.17851]	-0.000139** [-3.17081]	0.000138 [0.52267]	25.00160** [3.95814]
D(RHP(-1))	0.570617** [2.82493]	-0.155973 [-0.34505]	0.019123 [0.36129]	-0.014639 [-0.13724]	-0.00006 [-0.21995]	-0.000354 [-0.20424]	35.00824 [0.84225]
D(RHP(-2))	0.136931 [0.65685]	0.041078 [0.08805]	0.012597 [0.23062]	0.058371 [0.53022]	-0.00006 [-0.23285]	0.002873* [1.60782]	8.731949 [0.20356]
D(RSP(-1))	0.098819 [1.09235]	0.318482* [1.57319]	-0.009274 [-0.39123]	0.001071 [0.02243]	-0.000163 [-1.25639]	0.000112 [0.14385]	-2.476166 [-0.13302]
D(RSP(-2))	-0.080209 [-0.96437]	0.094766 [0.50915]	-0.007570 [-0.34733]	0.007492 [0.17057]	0.000030 [0.25956]	0.000765 [1.07294]	-21.12969* [-1.23458]

Table 1-4. Continued

	D(RHP)	*D(RSP)*	*D(FLOW)*	*D(LINT)*	*D(RERT)*	*D(SLEV)*	*D(RGDP)*
D(FLOW(-1))	1.205952**	0.762286	0.126526	-0.228378	-0.00211**	0.000177	71.45574
	[1.71740]	[0.48510]	[0.68765]	[-0.61587]	[-2.09899]	[0.02943]	[0.49452]
D(FLOW(-2))	0.464023	-1.395544	-0.021009	0.461456*	-0.000340	0.013720**	-56.37776
	[0.70573]	[-0.94846]	[-0.12194]	[1.32899]	[-0.36181]	[2.43405]	[-0.41669]
D(LINT(-1))	0.164937	-0.464648	-0.080455	-0.310437*	0.000217	-0.00036	-359.7257**
	[0.44403]	[-0.55897]	[-0.82660]	[-1.58255]	[0.40766]	[-0.11583]	[-4.70623]
D(LINT(-2))	-0.194762	-0.014116	-0.021567	0.122474	0.001278**	0.003040	-229.8031**
	[-0.48134]	[-0.01559]	[-0.20342]	[0.57318]	[2.20731]	[0.87635]	[-2.76006]
D(RERT(-1))	-52.34637	-334.6177	-63.6421**	142.6580**	0.112549	0.359522	-87362.69**
	[-0.43597]	[-1.24535]	[-2.02284]	[2.24986]	[0.65492]	[0.34929]	[-3.53592]
D(RERT(-2))	-54.72013	301.6017	-59.82467**	45.42763	-0.134796	0.259943	-27397.70
	[-0.51543]	[1.26950]	[-2.15058]	[0.81028]	[-0.88712]	[0.28562]	[-1.25415]
D(SLEV(-1))	8.621909	-123.9017**	-6.990662	14.37398*	-0.026395	0.178572	-8306.881**
	[0.41863]	[-2.68831]	[-1.29537]	[1.32159]	[-0.89541]	[1.01142]	[-1.96008]
D(SLEV(-2))	9.542246	72.96708*	4.826314	2.420005	-0.030034	-0.187953	9370.291**
	[0.44647]	[1.52560]	[0.86179]	[0.21441]	[-0.98183]	[-1.02584]	[2.13060]
D(RGDP(-1))	0.000105	0.000295	0.00007	0.000520	0.0000027**	0.00000008	0.157264
	[0.13313]	[0.16749]	[-0.38190]	[1.24808]	[2.41899]	[0.00664]	[0.96950]
D(RGDP(-2))	0.000248	0.002192*	-0.000163	-0.000905**	0.00000098	-0.000003	0.142184
	[0.34650]	[1.36606]	[-0.86563]	[-2.38931]	[0.95357]	[-0.42845]	[0.96373]
R-squared	0.68	0.46	0.34	0.41	0.47	0.37	0.54
Adj. R-squared	0.56	0.24	0.08	0.18	0.26	0.13	0.36
AIC	4.55	6.16	1.87	3.28	-8.55	-4.97	15.20
SIC	5.12	6.73	2.44	3.84	-7.98	-4.40	15.77

LM statistics for serial correlation (p-values)

Lag 1	40.13 (0.81)
Lag 2	45.15 (0.63)
Lag 3	55.07 (0.26)

* Significant at the 10% level. ** Significant at the 5% level.

Table 2-1: VEC Specification 1: Lag Exclusion Wald Tests - Chi-Squared Test Statistics (p-values) for Lag Exclusion

	D(RHP)	*D(RSP)*	*D(FLOW)*	*D(LINT)*	*D(RERT)*	*D(DEBT)*	*D(RGDP)*	Joint
D(Lag 1)	31.60 (0.00)	38.75 (0.00)	8.85 (0.26)	17.32 (0.02)	17.01 (0.02)	18.50 (0.01)	55.77 (0.00)	225.17 (0.00)
D(Lag 2)	4.63 (0.70)	12.05 (0.10)	4.49 (0.72)	5.31 (0.62)	16.46 (0.02)	12.94 (0.07)	9.91 (0.19)	94.61 (0.00)

Table 2-2: VEC Specification 2: Lag Exclusion Wald Tests - Chi-Squared Test Statistics (p-values) for Lag Exclusion

	D(RHP)	*D(RSP)*	*D(FLOW)*	*D(LINT)*	*D(RERT)*	*D(LIQ)*	*D(RGDP)*	Joint
D(Lag 1)	25.35 (0.00)	13.25 (0.07)	7.72 (0.36)	21.78 (0.00)	9.58 (0.21)	10.56 (0.16)	19.78 (0.01)	119.18 (0.00)
D(Lag 2)	4.50 (0.72)	3.43 (0.84)	5.70 (0.57)	1.74 (0.97)	8.60 (0.28)	12.64 (0.08)	12.15 (0.10)	92.03 (0.00)

Table 2-3: VEC Specification 3: Lag Exclusion Wald Tests - Chi-Squared Test Statistics (p-values) for Lag Exclusion

	D(RHP)	*D(RSP)*	*D(FLOW)*	*D(LINT)*	*D(RERT)*	*D(FLEV)*	*D(RGDP)*	Joint
D(Lag 1)	28.64 (0.00)	16.21 (0.02)	10.57 (0.16)	18.46 (0.01)	10.43 (0.17)	6.73 (0.46)	69.82 (0.00)	200.37 (0.00)
D(Lag 2)	4.88 (0.67)	4.30 (0.74)	7.02 (0.43)	6.50 (0.48)	8.78 (0.27)	14.86 (0.04)	21.65 (0.00)	97.34 (0.00)

Table 2-4: VEC Specification 4: Lag Exclusion Wald Tests - Chi-Squared Test Statistics (p-values) for Lag Exclusion

	D(RHP)	*D(RSP)*	*D(FLOW)*	*D(LINT)*	*D(RERT)*	*D(SLEV)*	*D(RGDP)*	Joint
D(Lag 1)	29.78 (0.00)	28.06 (0.00)	10.11 (0.18)	18.61 (0.01)	10.37 (0.17)	1.71 (0.97)	71.12 (0.00)	194.96 (0.00)
D(Lag 2)	4.18 (0.76)	7.94 (0.34)	7.40 (0.39)	7.73 (0.36)	10.04 (0.19)	12.63 (0.08)	22.73 (0.00)	112.67 (0.00)

Table 3-1: VEC Specification 1: Impulse Responses to Generalized One S.D. Innovations: Ten year averages

	Response to						
Response of	RHP	RSP	FLOW	LINT	RERT	RGDP	DEBT
RHP	6.559	1.168	4.529	-1.398	-2.034	1.284	2.769
RSP	-1.522	7.591	0.675	-3.531	-3.586	2.107	7.908
FLOW	0.181	0.291	0.592	0.123	-0.113	0.202	0.287
LINT	-0.193	-0.437	-0.228	0.989	0.497	0.054	-0.396
RERT	0.000	-0.002	-0.001	-0.001	0.002	0.000	-0.001
DEBT	1.178	6.026	1.930	-2.178	-2.245	2.800	7.986
RGDP	146.497	886.737	382.857	-294.576	-104.804	962.748	896.990

Table 3-2: VEC Specification 2: Impulse Responses to Generalized One S.D. Innovations: Ten year averages

	Response to						
Response of	RHP	RSP	FLOW	LINT	RERT	RGDP	LIQ
RHP	7.078	0.403	5.159	-1.573	-2.409	1.748	2.960
RSP	-1.191	7.113	0.652	-1.118	-4.082	2.594	1.028
FLOW	0.241	0.193	0.601	0.052	-0.030	0.247	0.224
LINT	-0.044	-0.021	-0.195	0.814	0.857	-0.067	-0.381
RERT	0.000	-0.002	-0.001	0.000	0.001	-0.001	-0.001
LIQ	0.001	0.000	0.001	-0.001	-0.002	0.002	0.003
RGDP	230.033	422.871	390.050	-312.379	-195.081	581.403	288.066

Table 3-3: VEC Specification 3: Impulse Responses to Generalized One S.D. Innovations: Ten year averages

	Response to						
Response of	RHP	RSP	FLOW	LINT	RERT	RGDP	FLEV
RHP	7.699	1.704	6.092	-2.510	-2.081	3.588	0.725
RSP	0.262	8.585	0.313	-3.007	-1.375	3.131	-6.175
FLOW	0.376	0.188	0.526	0.037	0.053	0.199	-0.085
LINT	-0.115	-0.196	-0.196	0.973	0.617	0.130	0.245
RERT	0.000	-0.001	0.000	0.000	0.001	0.000	0.001
FLEV	0.030	-0.002	0.052	0.008	0.016	0.019	0.078
RGDP	705.955	684.781	268.666	-509.148	270.270	1062.303	-398.160

Table 3-4: VEC Specification 4: Impulse Responses to Generalized One S.D. Innovations: Ten year averages

	Response to						
Response of	RHP	RSP	FLOW	LINT	RERT	RGDP	SLEV
RHP	7.734	1.536	6.213	-2.742	-2.412	3.504	0.787
RSP	-0.225	8.573	-0.474	-2.950	-1.699	2.175	-5.484
FLOW	0.423	0.170	0.573	-0.030	0.021	0.208	-0.119
LINT	-0.044	-0.197	-0.179	0.967	0.701	0.113	0.054
RERT	-0.001	-0.001	-0.001	0.000	0.001	0.000	0.001
SLEV	0.019	0.000	0.017	-0.006	0.002	0.015	0.014
RGDP	766.672	646.598	367.910	-667.756	178.248	1079.609	-227.223

Table 4: VEC Specifications 1-4 (1953-2006): Mean absolute percent errors for static forecasts[1]

	1980-1988				1989-1997				1998-2006			
Variable	1	2	3	4	1	2	3	4	1	2	3	4
RHP	2.3	2.1	2.1	2.2	2.2	2.6	2.6	2.7	1.9	1.9	1.7	1.7
RSP	10.1	7.1	7.9	9.5	7.0	10.2	9.5	9.4	4.2	5.6	5.3	3.8
FLOW	35.8	50.0	49.7	41.8	119.4	142.3	127.7	137.0	8.2	7.3	7.8	9.0
LINT	13.5	10.8	12.8	12.1	11.3	9.5	10.3	10.5	16.7	12.4	16.2	18.0
RERT	6.5	6.6	6.9	7.2	4.0	4.5	4.5	4.4	8.6	10.8	10.4	10.4
RGDP	1.4	1.4	1.2	1.3	1.2	1.1	1.1	1.2	0.7	0.5	0.5	0.5
DEBT	1.7				2.5				2.6			
LIQ		8.2				7.4				12.4		
FLEV			1.7				2.7				1.8	
SLEV				0.7				1.4				0.9

[1] Generated with vector error correction equations in Section 2.2.1 using actual values for all variables.

Table 5-1: VEC Specifications 1-1G (1953 – 2006): Mean absolute percent errors for pseudo-dynamic forecasts[1]

Variable	1980-1988								1989-1997								1998-2006							
	1	1A (RHP)[2]	1B (RSP)	1C (FLOW)	1D (LINT)	1E (RERT)	1F (RGDP)	1G (DEBT)	1	1A (RHP)	1B (RSP)	1C (FLOW)	1D (LINT)	1E (RERT)	1F (RGDP)	1G (DEBT)	1	1A (RHP)	1B (RSP)	1C (FLOW)	1D (LINT)	1E (RERT)	1F (RGDP)	1G (DEBT)
RHP	22.6		24.2	24.4	24.6	15.9	25.1	29.8	2.6		3.4	11.2	1.5	2.0	3.3	3.8	9.8		5.9	11.0	11.7	11.6	7.8	8.1
RSP	23.6	16.7		15.7	10.0	11.5	13.8	12.6	11.6	8.0		5.2	23.5	17.6	6.5	13.0	3.4	3.6		3.5	5.7	4.5	3.4	8.5
FLOW	40.0	54.5	122.1		58.0	92.0	70.9	163.2	148.4	207.0	172.4		202.8	122.0	205.1	137.5	28.4	40.8	39.0		42.5	30.6	29.7	31.7
LINT	20.4	23.8	13.5	22.6		17.5	18.6	16.3	28.5	24.8	13.0	31.5		35.8	26.1	12.1	16.5	19.0	12.7	13.8		27.1	14.9	17.4
RERT	7.6	6.0	7.8	6.3	11.1		4.5	6.8	5.1	5.0	7.3	6.9	7.9		5.9	5.6	10.3	8.7	12.0	14.7	34.9		9.2	10.5
RGDP	1.7	1.0	1.1	1.0	1.3	1.8		1.8	4.0	0.8	1.2	1.2	1.9	3.4		1.2	2.1	0.8	1.5	0.7	0.7	1.1		1.4
DEBT	2.7	2.1	1.5	3.9	3.1	3.7	1.7		4.6	5.4	4.3	12.7	4.9	5.8	6.7		7.3	6.2	2.2	11.1	5.0	8.1	7.2	

[1] Generated with vector error correction equations 2 in Section 2.2.1 using lagged forecasted values of the variable being forecasted but lagged actual values of all other variables. In each sub-period column 1 has the bench mark, full model MAPEs to be used for comparison with Models A-G in which one of the other variables is dropped from the equation estimated and forecasted.

[2] This and other variables in parentheses in this row are excluded from the respective equations.

Table 5-2: VEC Specifications 2-2G (1953 – 2006): Mean absolute percent errors for pseudo-dynamic forecasts

Variable	1980-1988								1989-1997								1998-2006							
	2	2A (RHP)[2]	2B (RSP)	2C (FLOW)	2D (LINT)	2E (RERT)	2F (RGDP)	2G (LIQ)	2	2A (RHP)	2B (RSP)	2C (FLOW)	2D (LINT)	2E (RERT)	2F (RGDP)	2G (LIQ)	2	2A (RHP)	2B (RSP)	2C (FLOW)	2D (LINT)	2E (RERT)	2F (RGDP)	2G (LIQ)
RHP	25.0		23.1	25.3	26.6	20.7	27.9	29.8	9.7		5.6	20.6	3.2	4.0	3.7	3.8	12.1		10.9	13.3	13.8	15.2	7.3	8.1
RSP	18.9	11.6		10.3	22.5	23.1	13.1	12.6	15.0	16.0		17.5	24.7	33.7	13.4	13.0	9.9	10.4		9.3	8.3	7.9	7.2	8.5
FLOW	99.2	140.4	147.7		63.5	143.6	156.0	163.2	175.4	188.5	202.2		211.2	147.3	149.8	137.5	34.4	32.6	50.9		44.9	55.5	14.7	31.7
LINT	14.1	19.9	14.6	19.4		17.3	21.9	16.3	18.1	13.5	21.3	13.5		34.7	8.9	12.1	9.0	11.0	18.3	11.4		27.7	19.9	17.4
RERT	8.2	7.4	10.1	8.6	11.8		4.6	6.8	5.7	6.1	8.9	5.4	7.9		6.1	5.6	12.0	11.4	29.1	12.7	38.2		11.1	10.5
RGDP	2.0	1.9	1.4	1.8	2.0	1.2		1.8	1.7	1.0	2.0	1.2	2.4	2.2		1.2	1.0	0.9	0.7	1.0	0.8	0.8		1.4
LIQ	20.6	18.0	5.5	17.9	6.0	7.0	16.8		14.7	23.0	15.4	19.6	16.9	24.3	19.1		21.4	12.4	48.6	26.5	50.5	9.0	29.9	

[1] Generated with vector error correction equations 2 in Section 2.2.1 using lagged forecasted values of the variable being forecasted but lagged actual values of all other variables. In each sub-period column 1 has the bench mark, full model MAPEs to be used for comparison with Models A-G in which one of the other variables is dropped from the equation estimated and forecasted.

[2]This and other variables in parentheses in this row are excluded from the respective equations.

Table 5-3: VEC Specifications 3-3G (1953 – 2006): Mean absolute percent errors for pseudo-dynamic forecasts

1980-1988

Variable	3	3A (RHP)[2]	3B (RSP)	3C (FLOW)	3D (LINT)	3E (RERT)	3F (RGDP)	3G (FLEV)
RHP	15.4		3.3	15.0	11.3	2.7	11.3	29.8
RSP	14.2	12.9		10.3	28.5	24.8	10.6	12.6
FLOW	83.5	200.3	99.0		75.2	109.3	88.2	163.2
LINT	19.5	22.0	25.9	23.5		20.9	17.6	16.3
RERT	7.1	6.5	6.5	8.0	11.3		8.7	6.8
RGDP	3.8	1.4	2.3	1.9	2.7	1.4		1.8
FLEV	8.5	8.0	10.3	8.0	5.1	8.0	9.35	

1989-1997

Variable	3	3A (RHP)	3B (RSP)	3C (FLOW)	3D (LINT)	3E (RERT)	3F (RGDP)	3G (FLEV)
RHP	2.0		2.8	12.9	4.7	2.2	3.0	3.8
RSP	13.9	12.7		13.6	8.1	16.0	9.3	13.0
FLOW	159.4	195.8	228.2		221.9	159.5	283.7	137.5
LINT	13.2	12.7	17.7	16.6		23.8	14.2	12.1
RERT	8.4	4.6	8.0	4.8	7.2		5.5	5.6
RGDP	3.1	1.0	1.1	1.1	1.5	1.0		1.2
FLEV	17.3	11.9	17.6	19.5	16.7	14.5	14.3	

1998-2006

Variable	3	3A (RHP)	3B (RSP)	3C (FLOW)	3D (LINT)	3E (RERT)	3F (RGDP)	3G (FLEV)
RHP	9.4		4.2	9.5	2.6	4.2	1.5	8.1
RSP	6.7	9.2		8.1	8.4	8.3	7.4	8.5
FLOW	29.8	30.7	43.8		41.1	41.1	40.5	31.7
LINT	15.5	13.7	14.3	16.0		35.4	26.0	17.4
RERT	12.1	11.2	31.9	11.5	20.2		12.1	10.5
RGDP	1.3	1.8	0.6	1.2	0.8	0.6		1.4
FLEV	3.0	5.1	12.6	6.8	6.4	3.3	1.5	

[1] Generated with vector error correction equations 2 in Section 2.2.1 using lagged forecasted values of the variable being forecasted but lagged actual values of all other variables. In each sub-period column 1 has the bench mark, full model MAPEs to be used for comparison with Models A-G in which one of the other variables is dropped from the equation estimated and forecasted. .

[2]This and other variables in parentheses in this row are excluded from the respective equations.

Table 5-4: VEC Specifications 4-4G (1953 – 2006): Mean absolute percent errors for pseudo-dynamic forecasts

1980-1988

Variable	4	4A (RHP)[2]	4B (RSP)	4C (FLOW)	4D (LINT)	4E (RERT)	4F (RGDP)	4G (SLEV)
RHP	15.0		3.2	12.9	6.6	1.9	29.6	29.8
RSP	9.1	5.4		7.7	24.4	7.1	8.9	12.6
FLOW	115.8	163.6	59.6		278.7	104.4	135.0	163.2
LINT	13.1	17.6	11.5	17.0		10.7	19.8	16.3
RERT	8.2	8.0	6.9	9.0	11.6		4.6	6.8
RGDP	5.7	2.8	2.4	2.9	1.6	1.5		1.8
SLEV	3.1	3.1	3.2	2.6	1.1	2.5	2.8	

1989-1997

Variable	4	4A (RHP)	4B (RSP)	4C (FLOW)	4D (LINT)	4E (RERT)	4F (RGDP)	4G (SLEV)
RHP	4.9		4.8	18.8	1.7	3.4	8.1	3.8
RSP	11.2	11.4		10.8	13.2	12.7	13.1	13.0
FLOW	188.0	221.6	256.6		258.8	289.0	301.5	137.5
LINT	14.5	9.7	16.3	15.5		27.0	17.6	12.1
RERT	7.0	5.3	6.7	3.5	8.1		4.6	5.6
RGDP	2.3	1.0	1.5	1.5	3.2	1.0		1.2
SLEV	1.2	1.6	1.9	2.9	1.7	1.8	1.6	

1998-2006

Variable	4	4A (RHP)	4B (RSP)	4C (FLOW)	4D (LINT)	4E (RERT)	4F (RGDP)	4G (SLEV)
RHP	9.1		6.2	13.3	2.3	2.4	9.0	8.1
RSP	6.4	6.4		5.6	5.8	6.0	6.5	8.5
FLOW	39.5	47.8	54.0		32.0	88.8	39.2	31.7
LINT	21.8	27.7	10.3	29.7		31.1	23.6	17.4
RERT	10.5	11.6	18.8	11.6	14.3		10.7	10.5
RGDP	1.3	0.7	0.4	0.3	3.3	0.9		1.4
SLEV	2.4	3.8	3.5	2.4	1.1	2.3	2.0	

[1] Generated with vector error correction equations 2 in Section 2.2.1 using lagged forecasted values of the variable being forecasted but lagged actual values of all other variables. In each sub-period column 1 has the bench mark, full model MAPEs to be used for comparison with Models A-G in which one of the other variables is dropped from the equation estimated and forecasted.

[2]This and other variables in parentheses in this row are excluded from the respective equations.

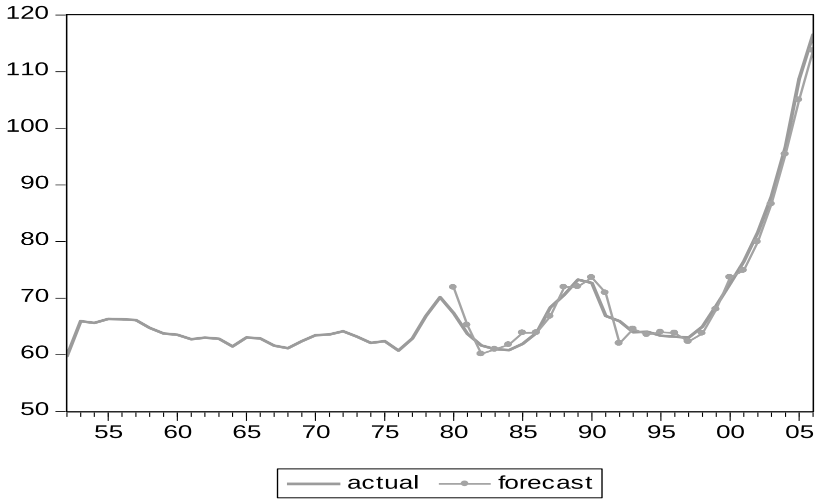

Figure 1-1: US Real house prices and static forecasts (Specification 1)

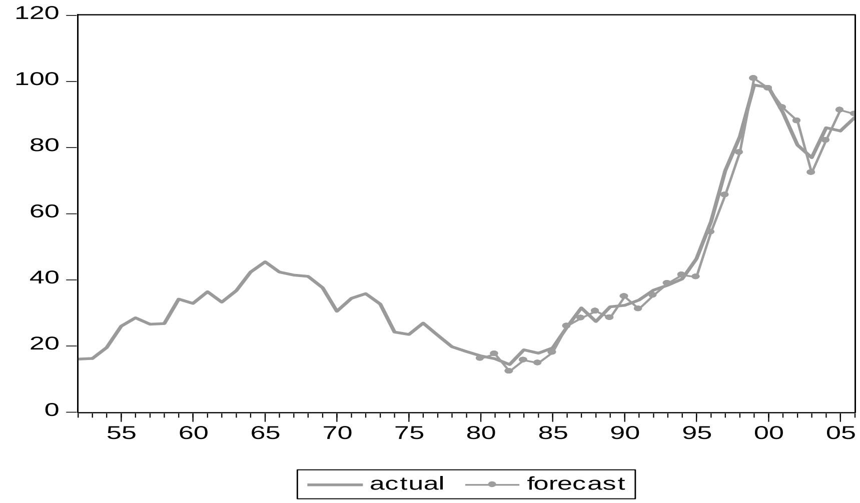

Figure 1-2: US Real share prices and static forecasts (Specification 1)

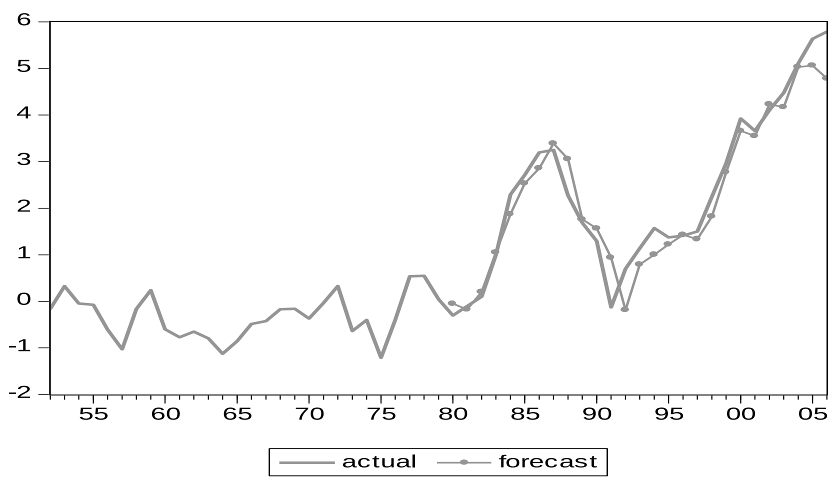

Figure 1-3: US net capital inflows as a percentage of GDP and static forecasts (Specification 1)

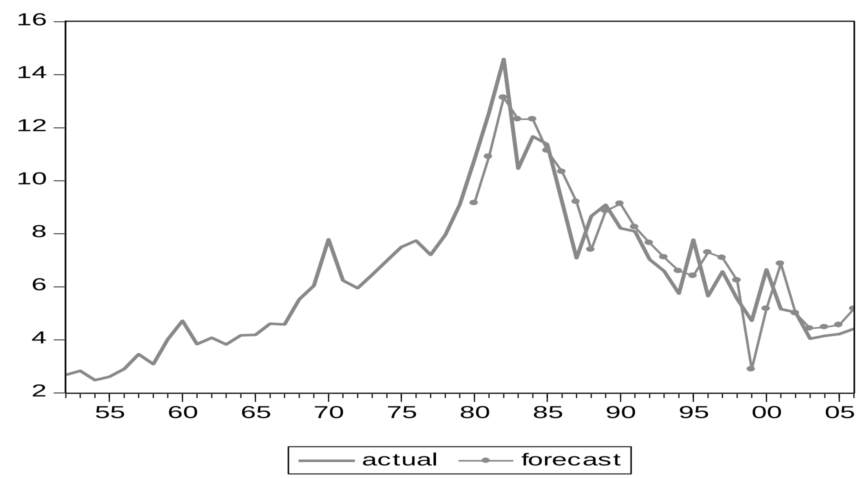

Figure 1-4: US long term rate of interest and static forecasts (Specification 1)

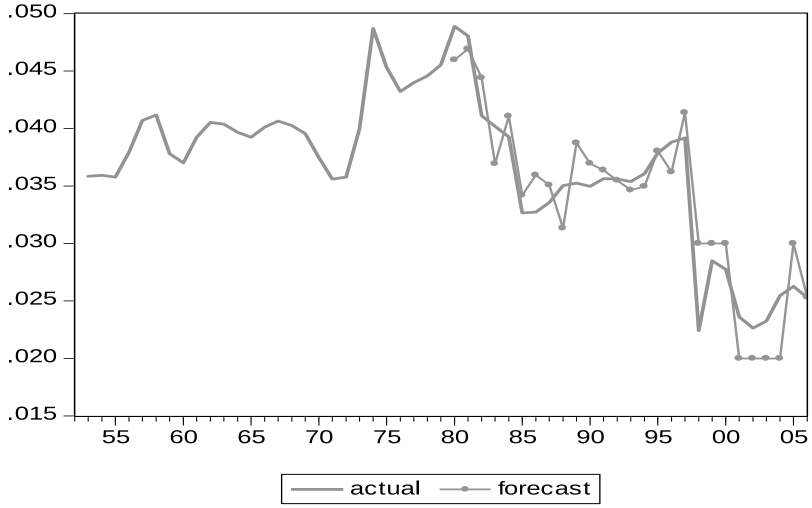

Figure 1-5: US real exchange rate against Thai baht and static forecasts (Specification 1)

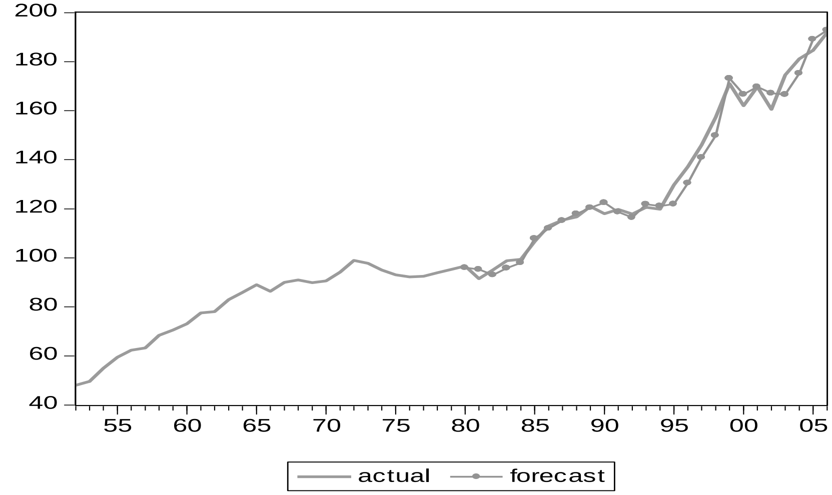

Figure 1-6: US share of private sector debt in GDP and static forecasts (Specification 1)

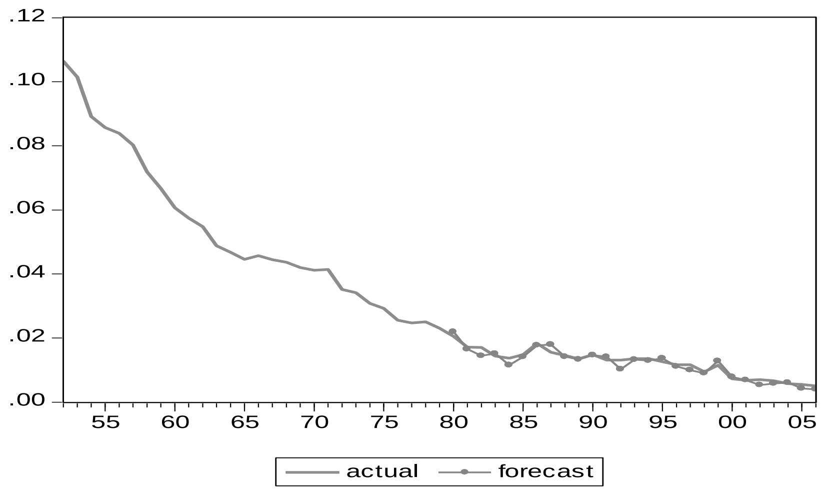

Figure 1-7: US banking sector liquidity ratio and static forecasts (Specification 2)

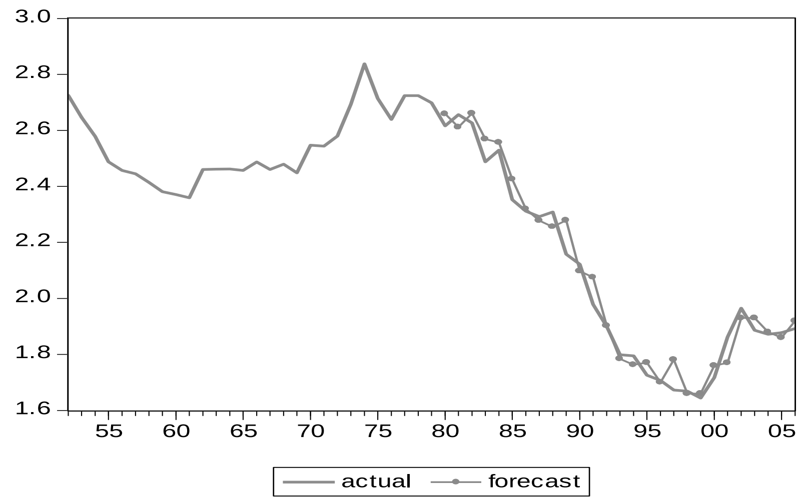

Figure 1-8: US financial sector leverage ratio and static forecasts (Specification 3)

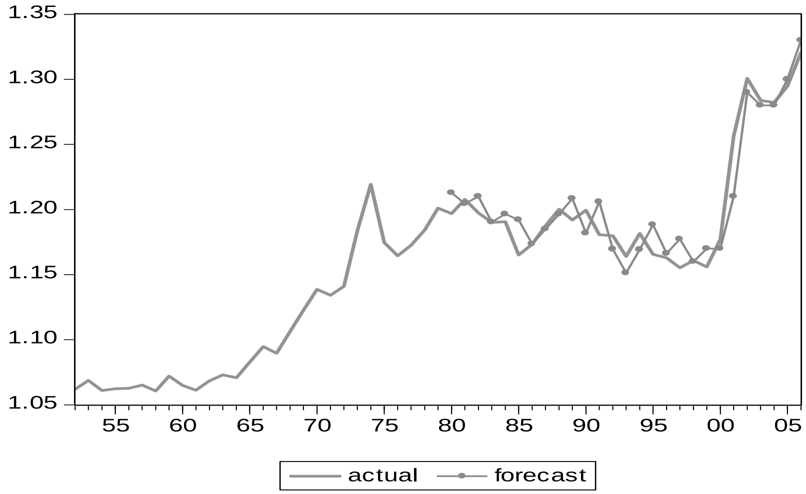

Figure 1-9: US non-bank financial sector leverage ratio and static forecasts (Specification 4)

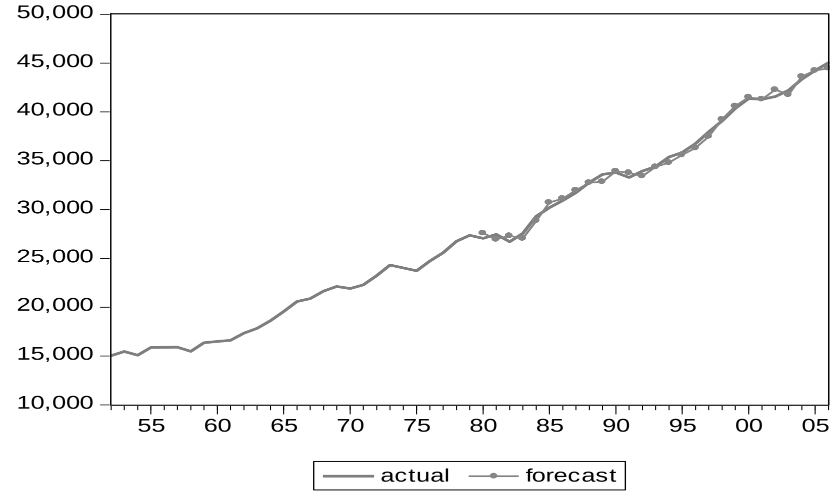

Figure 1-10: US real GDP per capita and static forecasts (Specification 1)

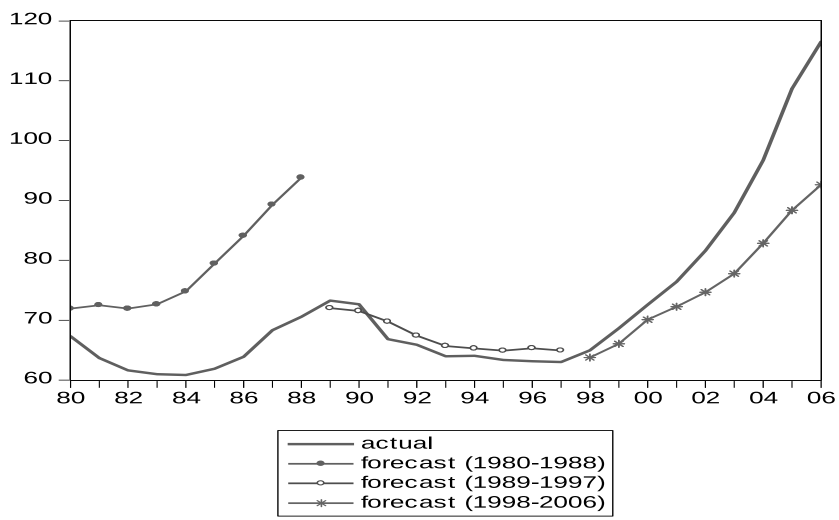

Figure 2-1: US real house prices and pseudo-dynamic forecasts

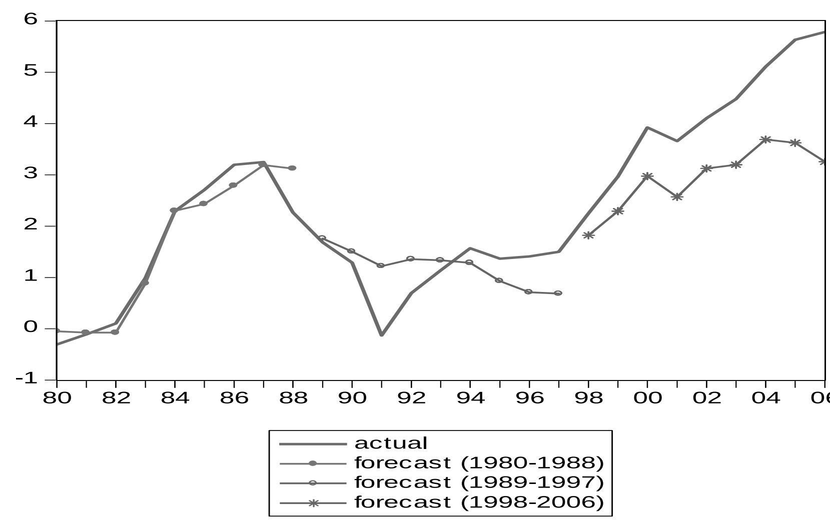

Figure 2-2: US share of net capital inflows in GDP and pseudo-dynamic forecasts

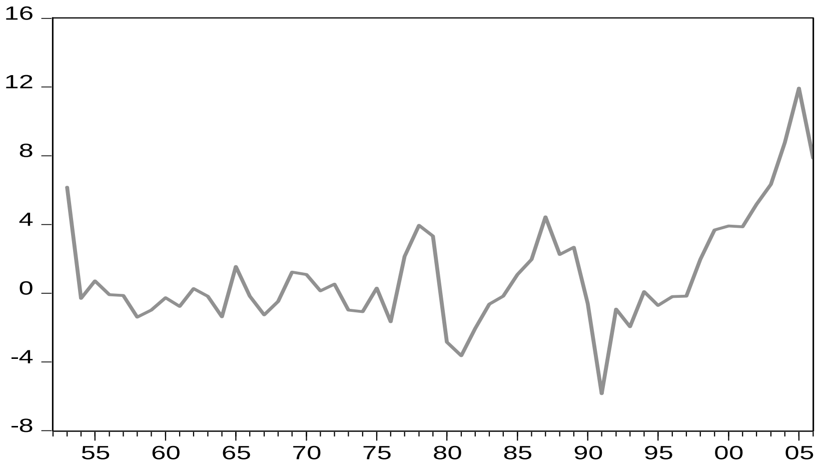

Figure 3: US real house prices in first difference

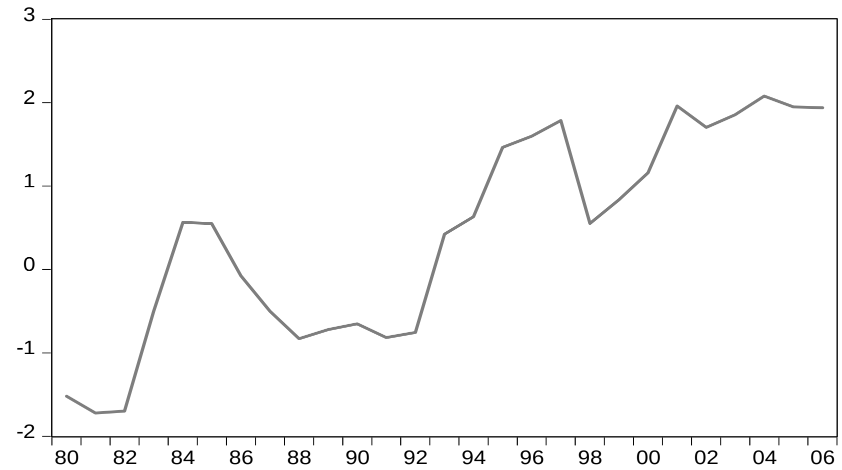

Figure 4: Current Account as a percentage of GDP (1980 – 2006): Average across eleven countries: Denmark, Finland, France, Germany, Italy, Norway, Netherlands, Portugal, Spain, Sweden and the UK

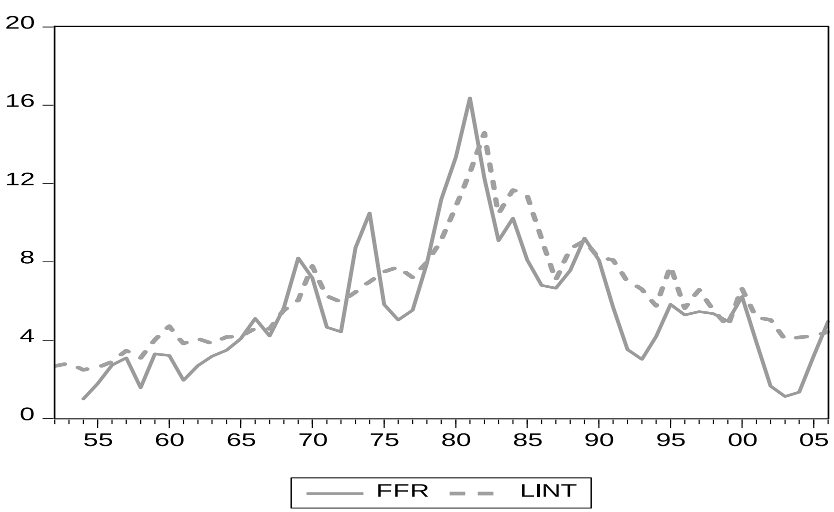

Figure 5: US Federal funds rate (*FFR*) and the long term rate of interest (*LINT*)