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The Swedish Money Market Risk Premium – Experiences from the Crisis

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This paper analyses the extent to which the Swedish money market risk premium has been affected by the current financial turmoil. We also examine the impact of shocks transmitted from the US and European markets in more detail. Our results indicate that the Swedish market has been significantly affected by shocks from the US market, but not from the European market. The findings also reveal that the main driver of the money market risk premium in the first part of the crisis was liquidity risk. However, during the latter part of the crisis, there has been a shift from liquidity risk to credit risk. This has specific policy implications for central banks.

1. Introduction

The international financial markets have become more open and more closely linked together over time. However, the internationalisation of the financial markets has had both positive and negative effects. On one hand, international financial markets facilitate improved risk sharing and diversification. On the other hand, when a financial crisis occurs, the contagion effects can be more severe. Although the current financial crisis started in the United States, it has become a global crisis. Thus, the situation for policymakers in Sweden today is very different from the situation in the 1990s, when Swedish banks were hit by a domestic financial crisis. In the current global environment, it is essential to understand how and to what extent Swedish financial markets are affected by the crisis, so that

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relevant and proper policy measures can be undertaken to mitigate the effects on the domestic banking system and the real economy.

To this end, this paper aims to investigate the degree to which the Swedish money market risk premium has been affected by developments in the European and US markets before and during the crisis. That is, we study the development of the Swedish short-term money market risk premium and one of its components, credit risk, with emphasis on the issues of systematic risk[2] (i.e. market risk or undiversifiable risk) and financial contagion. More specifically, we aim to answer the following questions: Has the level of systematic risk changed in the crisis period compared to the pre-crisis period? What factors drive the short-term money market risk premium and are there spillovers from the US and European markets?

In general, the risk premium is the extra return investors demand for bearing risk. The risk premium may vary over time as the investors' perception of the underlying risk and their attitude towards risk change. For example, in money markets, short term rates may reflect both liquidity and credit risk premiums. In this paper, the Swedish money market risk premium is decomposed into a credit risk part and a liquidity-driven part so as to facilitate investigation of the changes over time in the components. It is important to understand the composition of the money market premium together with the manner in which it was affected during the crisis, as the spread has an impact on the real economy through, for example, the variable-rate loans tied to it (mortgages etc).[3] The better our understanding of the risk premium, the easier it will be to implement the relevant policy measures in order to reduce the spread. For example, depending on whether the risk premium during the crisis consists mainly of credit or liquidity risk, policymakers can choose to focus on the level of capital in financial institutions, or to increase liquidity in the financial system. As the International Monetary Fund (IMF) (2009) discusses, being able to reduce the money market spread may have positive effects on other spreads, for example corporate spreads.

The rest of the paper is organised as follows. The following section describes the data. Section 3 studies the development of the short-term Swedish money market risk premium, before and during the crisis, relative to European and US risk premiums. It also investigates the transmission of shocks from the US and Euro markets to the Swedish market. Section 4 analyses data on credit risk, proxied by CDS (credit default swaps) spreads, during the pre-crisis and crisis periods. In Section 5, an indicative decomposition of the short-term money market risk premium into a credit risk part

[2] The systematic risk is the risk inherent to the entire market and, in this paper, is quantified by correlation.
[3] See Karlsson et al. (2009) for a discussion on the connection between interest rates and the real economy.

and liquidity risk part is performed. Finally, the last section presents our conclusions.

2. Data

Data on the short-term money market risk premiums is collected from Reuters EcoWin for the Swedish, US and Euro area markets. The spread between the three-month interbank rate and the expected future overnight rate is used to represent the risk premium in short-term money market rates. For Sweden, the Stibor rate is the interbank rate and the STINA interest rate swap[4] is utilised as a proxy for future overnight rates.[5] The corresponding variables for the Euro area are the 3-month BBA Libor rate and the EONIA swap, and for the US the 3-month BBA Libor rate and the overnight interest rate swap.

The data utilised in this paper covers the period from 2 January 2006 to 30 June 2009, yielding a total sample of 912 daily observations. Note that there are missing observations in the data – these have been replaced by linear interpolations. The total sample is divided into two separate periods, the pre-crisis period covering 2 January 2006 to 31 July 2007, and the crisis period from 1 August 2007 to 30 June 2009. In most graphs, however, the period January 2007 to June 2009 is displayed, as we find that the period from the beginning of 2007 provides sufficient information on the pre-crisis period.

For the credit risk measure, proxied by 5-year CDS spreads, data has been collected from Reuters EcoWin for the Euro area and from Bloomberg for the United States. The 5-year spreads are used, as these are the most liquid instruments. The variables collected for the Euro area and the United States are the iTraxx Financial Index and CDX index, respectively. The data on CDS spreads for the four largest Swedish banks (Svenska Handelsbanken, Nordea, SEB and Swedbank) has been collected from Handelsbanken Capital Markets. Data for the different Swedish banks is only available from 30 January 2006. An equally-weighted index of the spreads for the Swedish banks has been constructed as a measure of the credit risk in the Swedish market. In total, 858 daily observations have been used in the analysis of the credit risk data.

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[4] An overnight interest rate swap is a swap in which the floating leg is linked to a published index of daily overnight rates. The two parties agree to exchange at maturity, on an agreed notional amount, the difference between interest accrued on the agreed fixed rate and interest accrued through the geometric average of the floating index rate.

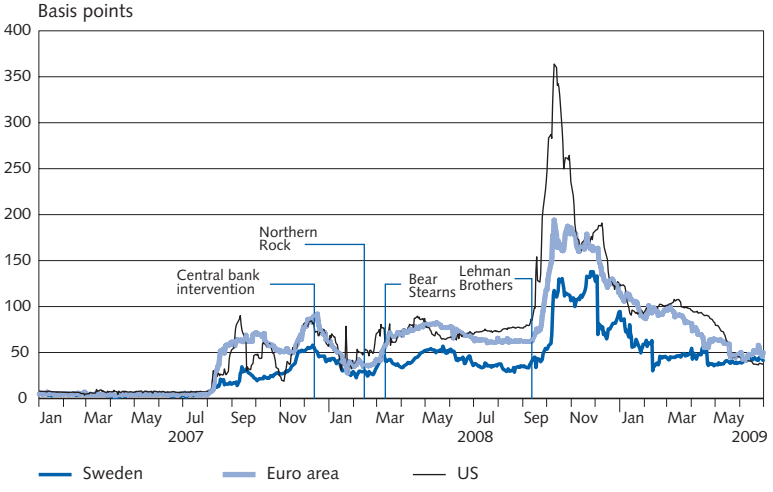
[5] STINA is used for the reason that there is no overnight interest rate available for the Swedish market. Because STINA is a so-called tomorrow/next interest rate, it will be slightly higher than a true overnight interest rate. We perform a robustness test, in which STINA is corrected by subtracting a moving average of the difference between the tomorrow/next interest rate and the repo rate. The choice of the interest rate does not affect the results.

3. The short-term money market risk premium

3.1 RECENT EVENTS

In this section, developments in the Swedish short-term money market are analysed and the risk premium is compared to the risk premiums in the Euro area and United States. Before the start of the financial turmoil in August 2007, the risk premiums were at stable and relatively low levels in all three markets (see Graph 1). For example, the short-term money market risk premium was around five basis points on average in Sweden and the Euro area and seven basis points in the United States in the period before the financial crisis, as shown in Panel A of Table 1. The volatility in the pre-crisis period was also low in all three markets. According to Heider et al. (2008), the low interest rate spread on the interbank market in Europe and the United States during the period before August 2007 indicates full participation of borrowers and lenders in the interbank market.

Figure 1. Short-Term Risk Premium
The graph shows the development of the spread between the 3-month interbank rate and O/N rate from January 2007 to June 2009 for Sweden, the euro area and the United States.
Basis points



In August 2007, the risk premiums in short-term money market rates increased significantly. This increase was brought about by concerns over losses associated with US subprime mortgage-related structured products. Although the subprime problems were US specific, the loans had been sold on outside the United States, resulting in the problems quickly spreading to other markets. Uncertainty about where losses would arise made banks and other financial institutions more cautious in lending to each other. This increased the liquidity risk and banks started to hoard

liquidity, which affected the functioning of interbank markets (Sveriges Riksbank (2008a)). At first, the risk premium peaked in December 2007 with over 100 basis points for the US and European markets. The risk premiums then declined somewhat after the liquidity injections by the Federal Reserve and other central banks. The risk premiums increased again in February 2008 after the takeover of Northern Rock and the subsequent collapse of Bear Sterns. Heider et al. (2008) conclude that the elevated spread was a sign of an adverse selection problem in the interbank market, whereby safe borrowers dropped out of the market and the interest rate rose to reflect the fact that only riskier borrowers remained.

However, the bankruptcy of Lehman Brothers in mid-September 2008 had the greatest impact on the risk premium in all three markets. According to Heider et al. (2008), after Lehman Brothers' collapse, the interbank markets in Europe and the United States broke down because of increased counterparty risk and, consequently, extensive liquidity hoarding by lenders. As shown in Panel A in Table 1, the US money market risk premium reached a maximum of 364 basis points during the crisis period. The corresponding figures for the Swedish and euro markets were 138 and 194 basis points, respectively. The Swedish spread underwent a similar development to premiums in the United States and Europe during the crisis period, but has stayed at a lower level. According to Sveriges Riksbank (2008a), the Swedish interbank market functioned relatively well during the first part of the crisis period, compared to interbank markets abroad, although it was tangibly affected after September 2008.

Since the collapse of Lehman Brothers, risk premiums have receded and are back at the same levels as prevailed prior to September 2008. However, compared to the pre-crisis period, they have remained elevated. According to the IMF (2009), liquidity hoarding and concerns about counterparty credit risk continued during spring 2009, and certain banks continued to deposit surplus liquidity with central banks.

3.2 SYSTEMATIC RISK

In general, systematic risk is defined as the portion of risk that cannot be eliminated by diversification across the markets.[6] Using correlation as an indicator for systematic risk, we can study whether Swedish markets are exposed to global market risk during a financial crisis.[7] For example, increased correlations between the money market risk premiums indicate higher systematic risk.

[6] Systematic risk is different from systemic risk which is the risk that the entire financial system will collapse.

[7] Significant increases in correlations between interest rates have been found in literature studying previous financial crises, see, for example, Baig and Goldfajn (1998).

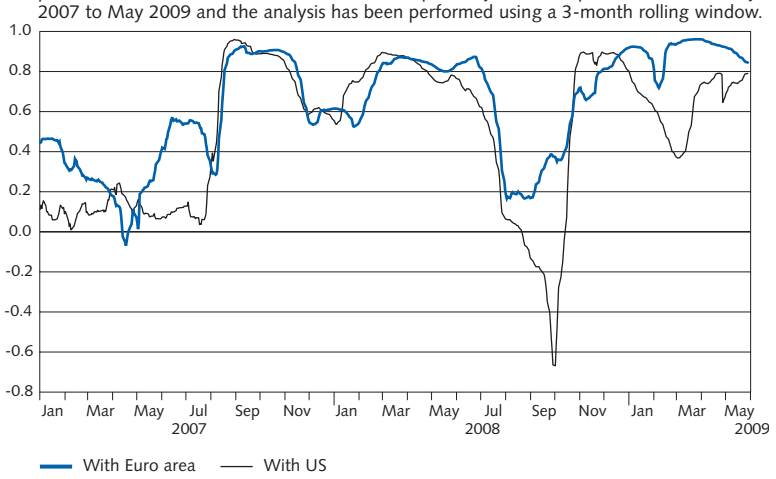
Table 1. Short-term risk premiums

Panel A displays the summary statistics for the short-term risk premiums in Sweden, the euro area and the United States in two periods. The first period is the pre-crisis period between January 2006 and the end of July 2007, while the second period lasts from August 2007 to the end of June 2009. Summary statistics are given in basis points. Statistically significant higher means and medians at the 1 % level in the crisis period (compared to the pre-crisis period) are marked with *. Panel B shows the simple correlations (Pearson) between the time series in the two periods. Statistically significant higher correlations at the 1 % level in the crisis period (compared to the pre-crisis period) are marked with *. Panel C contains the results from the principal component analysis of the short-term risk premiums of Sweden, the Euro area and the United States. The sample is divided into two periods, the pre-crisis and crisis periods, and the principal components are computed using ordinary correlations.

	Sweden	Euro area	US
Panel A: Summary statistics			
Pre-crisis period (Jan 06–Jul 07)			
Mean	4.8	5.1	6.9
Median	4.8	5.0	7.0
Std	1.4	1.1	1.4
Min	-0.5	2.5	0.5
Max	8.8	12.7	13.9
Crisis period (Aug 07–Jun 09)			
Mean	47.5*	77.9*	88.7*
Median	41.5*	68.1*	73.7*
Std	25.8	36.0	59.1
Min	4.9	5.5	6.9
Max	138.0	194.3	363.9
Panel B: Correlations			
Pre-crisis period (Jan 06–Jul 07)			
Sweden	1		
Euro area	0.160	1	
US	0.020	-0.019	1
Crisis period (Aug 07–Jun 09)			
Sweden	1		
Euro area	0.906*	1	
US	0.795*	0.878*	1
Panel C: Principal component analysis			
Pre-crisis period (Jan 06–Jul 07)			
Principal component	Proportion		
PC 1	0.3876		
PC 2	0.3348		
Loadings:	Sweden	Euro area	US
PC 1	0.7095	0.7051	0.0289
PC 2	0.0934	-0.1344	0.9865
Crisis period (Aug 07–Jun 09)			
Principal component	Proportion		
PC 1	0.9069		
PC 2	0.0689		
Loadings:	Sweden	Euro area	US
PC 1	0.5735	0.5914	0.5669
PC 2	-0.6496	-0.0935	0.7545

Using a 3-month rolling window, we have computed time-varying correlation as presented in Graph 2. In the pre-crisis period, the correlations between the markets were relatively low. This is also evident from paired correlation coefficients for the risk premiums displayed in Panel B in Table 1. During the crisis period, international risk premiums seemed to fluctuate in conjunction. For example, at that time, the average correlations between the Swedish money market risk premium and the risk premiums in the Euro area and the United States were 0.91 and 0.80, respectively. Interestingly, the correlations between markets declined rapidly in September 2008 when Lehman Brothers went bankrupt. The negative correlation with the US market could be a result of the Swedish risk premium slightly lagging the US risk premium during this period of extreme volatility in the money markets.[8]

Figure 2. Correlations 3-Month Rolling Window: Risk premiums
The graph displays the correlation between the Swedish risk premium and the risk premium in the euro area and United States respectively. The time period is from January 2007 to May 2009 and the analysis has been performed using a 3-month rolling window.



Although the correlation analysis indicates that markets tend to fluctuate in conjunction during crises, it says little about what drives these movements. Next, we want to understand whether movements in risk premiums across countries take place on the basis of the effect of common factors or region-specific factors. To identify these factors, we have adopted a statistical approach, namely principal components analysis (PCA), which is described more in detail in Box 1.

Applying PCA, we find that, in the pre-crisis period, there seem to be two independent components that explain the variation in the risk premiums

[8] Because of the time difference, some US events are incorporated in the Swedish risk premium on the following day.

Box 1: Principal Component Analysis (PCA)

In general, principal component analysis (PCA) is a way of identifying patterns in data, and of expressing this data in such a manner as to highlight similarities and differences. Principal component analysis involves a mathematical procedure that transforms a number of correlated variables into a number of uncorrelated variables called principal components. These independent components capture co-movements or variations in the series under study. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible. If the series follows a common pattern, for example a general market trend, the first principal component should be able to explain most of the joint variation in the data. Several major assumptions are made in principal component analysis, such as linearity, independence and that large variances have important structures.

For more details on PCA see Campbell et al. 1997.

as shown in Panel C in Table 1. It is reasonable to assume that these two components represent regional factors, where the first component can be interpreted as a European factor and the second one as a US-specific factor.

Turning to the crisis period, there is only one common factor that captures about 91 per cent of the total variance variability of the data[9]. This component can be interpreted as systematic risk (or market risk) which captures changes in investors' risk appetite (and cost of capital). The fact that risk premiums were driven by a common factor during the crisis, indicating an increase in systematic risk, highlights the importance for policymakers of taking the anticipated effects of systematic risk into account.

3.3. SPILLOVERS BETWEEN MARKETS: VECTOR AUTOREGRESSIVE MODEL

Next, we want to study whether the increase in systematic risk is due to the transmission of US and Euro market tensions to the Swedish markets. In order to answer this question, we use a vector autoregressive (VAR) model for the short-term risk premiums. The VAR model allows us to capture the evolution of and interdependencies between time series, and to test the causal relationship between series[10], that is, whether a market has

[9] The factor loadings on the first principal component are positive and similar in term of magnitudes for all countries.

[10] The methodology is similar to the one used in Kahlid and Kawai (2003), who only find weak support of spillover effects between the Asian economies during the Asian crisis.

a direct effect on other markets. Results of causality tests are displayed in Table 2.[11] The test results indicate that, in the pre-crisis period, the three money market risk premiums were independent of each other. In the crisis period, only the US risk premium had a significant impact on the Swedish risk premium. That is, while we find that US market tensions affected the Swedish risk premium, we do not find that there were any spillovers from the European market. One possible explanation is that the US market affected the European and Swedish markets simultaneously. Thus, in this crisis, the focus of policy measures should have been on mitigating the contagion from the US market. Similar results were found by the European Central Bank (ECB) (2008), which determined that US market tensions affected the Euro area market, but not vice versa. However, the Bank of Japan (2008) found that both the US and European markets had an impact on the Japanese market during the recent financial turmoil.

Table 2. Granger Causality Tests

First, in order to perform a Granger causality test, an estimated VAR model is presented in this table. The model has 3 lags in the pre-crisis period and 2 lags in the crisis period. The lag length was determined using the Akaike information criterion. In the second step, the null hypothesis of no causality is tested. That is, the null hypothesis is that the independent variables, i.e. the Euro area and US short-term risk premiums, do not affect (or cause) the Swedish short term risk premium. The null is rejected if the p-value < 0.05.

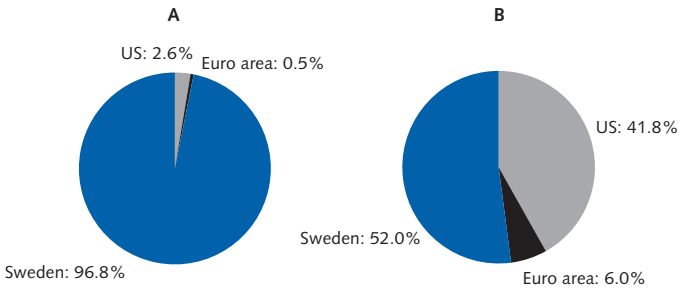
Hypothesis	Chi-sq	Prob.	Result
Pre-crisis period (Jan 06–Jul 07)			
US does *not* cause SWE	1.97	0.578	Not rejected
EURO does *not* cause SWE	2.13	0.547	Not rejected
Crisis period (Aug 2007–*Jun 2009*).			
US does *not* cause SWE	14.67	0.000	Rejected
EURO does *not* cause SWE	3.28	0.194	Not rejected

These results are supported by the variance decomposition analysis, which provides information on the relative importance of shocks on the Swedish spread over 20 trading days.[12] In the pre-crisis period, 97 per cent of the variance of the Swedish money market risk premium was attributable to Swedish shocks (see Graph 3). In the crisis period, this proportion dropped to 52 per cent. Instead, the impact from US market shocks increased from 3 per cent to 42 per cent. The impact from the Euro market remained small during the crisis.

[11] In the empirical analysis, the lag length in the model was determined using the different information criteria in the lag exclusion test, so that there is no significant serial correlation left in the residuals. The VAR(3), i.e. a model with 3 lags, was used for the pre-crisis period and VAR(2) was used for the crisis period.

[12] The variance decomposition is identified using the Cholesky decomposition, with the order being us, euro area and Sweden. The time period is the same as in ECB (2008).

Figure 3. Variance Decomposition Analysis
The two pie charts below present the variance decomposition of the Swedish risk premiums in the pre-crisis (A) and crisis (B) periods. The lengths of the periods are 20 days and the Cholesky ordering is US, euro area and Sweden.



3.4 US DOLLAR LIQUIDITY SHORTAGES IN INTERBANK MARKETS

The analysis so far has concluded that there have been spillover effects from the US market to the Swedish market. In this section, the examination is taken one step further and the US dollar liquidity shortages in interbank markets as a specific transmission channel are investigated. An understanding of which mechanisms cause financial contagion will help policymakers to be more precise in their policy measures.

During the crisis, many European banks experienced an increased need for US dollar liquidity. However, as providers of US dollar liquidity became more reluctant to lend to non-US financial institutions, these banks had to use currency swaps to access US dollars (ECB (2008)). To handle the shortage of US dollars, several central banks negotiated swap agreements with the US Federal Reserve to provide access to dollars in their domestic markets. According to the ECB (2008), during the second half of 2007, the risk premium in the Euro money market spreads increased due to increased tensions in the US dollar money market. Also, Baba et al. (2008) found a significant lead-lag relationship between the US dollar FX swap and the short-term risk premium for the Euro market. Their findings indicate that the increase in the cost of accessing US dollars for European banks raised the European money market risk premium.

The Swedish central bank announced a swap agreement with the US Federal Reserve in September 2008. The purpose of this was to address increased strains in US dollar short-term funding markets (Sveriges Riksbank (2008c)). The Swedish central bank then provided loans in dollars in the domestic market through auctions.[13] Most auctions executed until

[13] The first auction took place on 1 October 2008 and, by the end of June 2009, 13 auctions had been held, offering a total of USD 119 billion.

mid-May 2009 were fully subscribed, indicating a high interest for accessing US dollars through the central bank.

We aim to study whether the Swedish money market risk premium was correlated with the extra premium that non-US banks (relative to US banks) had to pay to access the US dollar market rate during the crisis.[14] We will interpret a positive and significant relationship as an indication that the increase in the cost of accessing US dollars for Swedish banks raised the Swedish money market risk premium. The spread between the FX US dollar implied swap rate and the US Certificate of Deposits (CD) is used to represent the extra premium that non-US banks had to pay to access the US dollar market rate. The US CD rate then represents the domestic interbank rate in the US.[15]

The paired observations are plotted in scatter-charts and a linear regression model is fitted to the data. Graphs 4a, b and c display the results. The crisis period is divided into three sub-periods to capture changes in the slope in different periods. The first period lasts until Lehman Brothers' collapse. Before 15 September 2008, there was no relationship between the Swedish money market spread and the FX US dollar spread (Graph 4a), as indicated by the linear regression model fitted to the data (R-square = 0.01).

However, in the period directly following Lehman Brothers' collapse until the end of 2008, there was a significant positive relationship between the FX US dollar swap spread and the Swedish short-term money market risk premium (Graph 4b). The slope coefficient is positive and statistically significant at the one per cent level (R-square = 0.31). Hence, the results indicate that, during the latter part of 2008, one possible transmission channel of money market tensions from the US market to the Swedish market was formed by the strains in the US dollar short-term funding markets.[16]

In the most recent period, the first half of 2009, the relationship with the US dollar funding markets again weakens (Graph 4c), indicating easier access to US dollars in the Swedish market. This is supported by the fact that the dollar auctions held by the Swedish central bank from mid-May 2009 were not fully subscribed.

[14] The analysis only considers the correlation between the two variables and, thus, not any causal effects.

[15] The US CD rate is chosen over the US Libor rate as the Libor rate is quoted by a majority of non-US financial institutions.

[16] The results are not affected if, instead of Stibor, the Swedish deposit rate is used to calculate the short-term risk premium.

Figure 4a, 4b and 4c. Correlation between the FX US dollar market and the Swedish money market during the crisis
Scatter-plots of the paired observations of the Stibor-OIS spread and the implied FX US dollar swap spread with a fitted linear regression model for the period 1 August 2007 to 15 September 2008 (Graph 4a), 16 September 2008 to 30 November 2008 (Graph 4b), and 1 December 2008 to 30 June 2009 (Graph 4c), respectively.

Figure 4a. Before Lehman Brothers

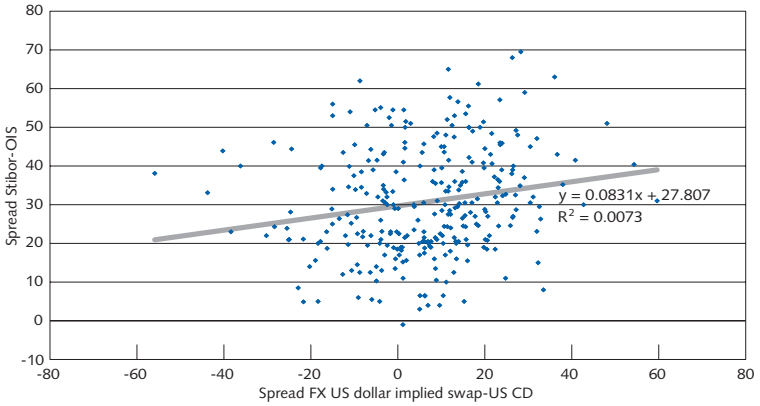


Figure 4b. Fall 2008 – After Lehman Brothers

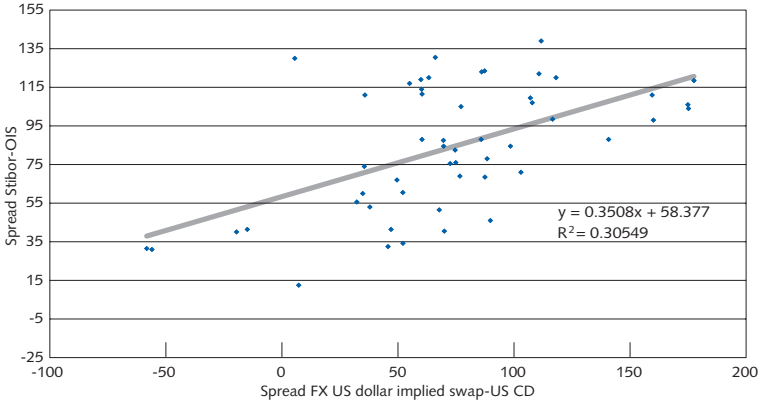
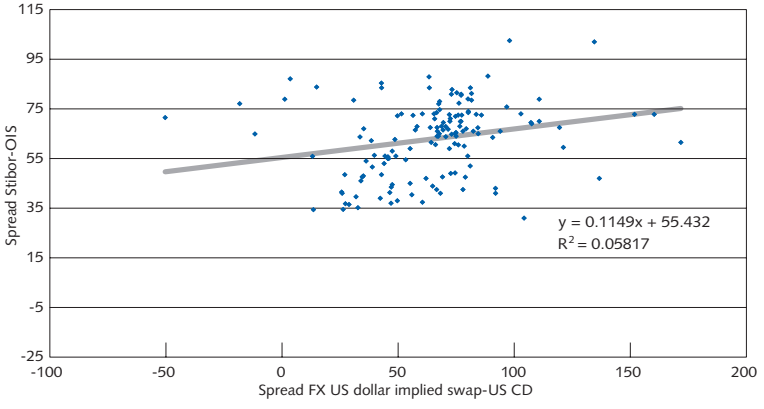


Figure 4c. Dec 2008-June 2009

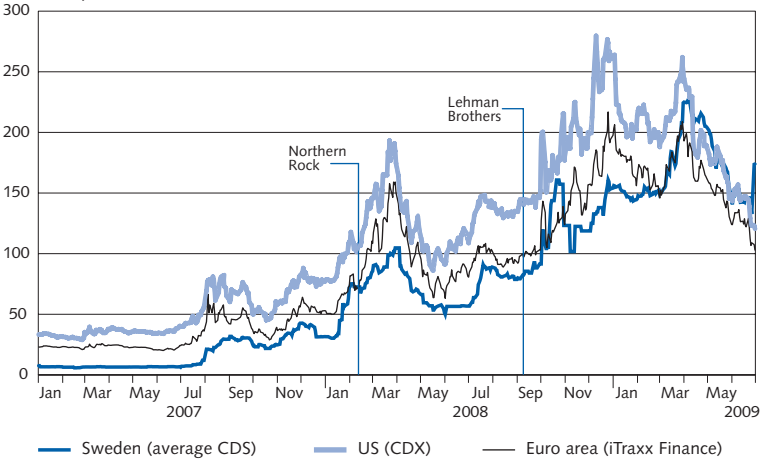


4. Credit risk

4.1 DEFINITIONS AND RECENT DEVELOPMENTS

A part of the short-term money market risk premium corresponds to credit risk, which in this paper is proxied by credit default swaps (CDS). CDS is a traded credit derivative product used as insurance against credit risk.[17] Graph 5 displays the development of the credit risk measure for the Swedish, US and European markets from January 2007 to June 2009.

Figure 5. International CDS spreads
The graph shows the development of the CDS spreads from January 2007 to June 2009 for Sweden, the euro area and the United States. For Sweden, an average of the CDSs of the four largest banks is used, for the Euro area, the iTraxx Finance index and, for the United States, the CDX index.
Basis points



The CDS spreads display the same pattern as the money market premiums. The levels were stable at around ten basis points in the Swedish market and around 30 basis points in the European and US markets before the financial turbulence started in July 2007 (see Panel A in Table 3). The CDS spread then doubled in Sweden and more than doubled in Europe and the United States. The Swedish CDS spread has remained at a lower level than the spreads in the other markets during most of the crisis period. It was only during the spring of 2009 that the Swedish CDS spread became higher than the euro area spread. This largely contradicts the findings of the IMF (2009), which suggest that, during the crisis, CDS spreads have widened

[17] This involves a bilateral contract whereby the buyer of protection pays a fixed premium to the seller of protection for a period of time and, if a certain pre-specified credit event occurs, the protection seller pays compensation to the protection buyer. One drawback of using this measure is that the CDS premium refers to a combination of the risk of default and the compensation demanded by investors for bearing this risk, rather than only the risk of default.

Table 3. CDS spreads

Panel A presents a summary of statistics for the CDS spreads in Sweden, the euro area and the United States in two periods. Panel B displays a summary of statistics for the CDS spreads for the four largest Swedish banks: Swedbank, SEB, Nordea and Svenska Handelsbanken (SHB). The first period is the pre-crisis period from January 2006 to the end of July 2007, while the second period is from August 2007 to the end of June 2009. Summary statistics are given in basis points. Statistically significant higher means and medians at the 1 % level in the crisis period (compared to the pre-crisis period) are marked with *.

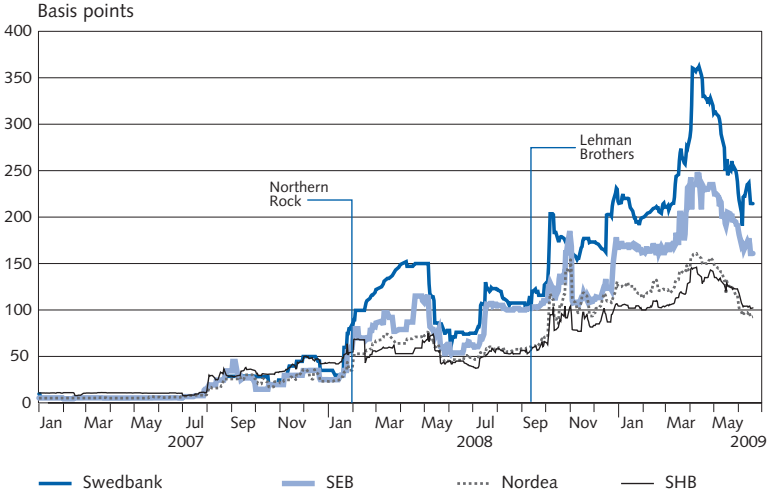
	Sweden	Euro area	US
Panel A: International CDS spreads			
Pre-crisis period (Jan 06–Jul 07)			
Mean	8.9	28.0	38.7
Median	9.5	27.4	37.9
Std	2.1	5.5	5.8
Min	5.8	20.2	28.9
Max	21.3	66.3	78.2
Crisis period (Aug 07–Jun 09)			
Mean	148.8*	146.7*	186.1*
Median	149.6*	152.1*	188.6*
Std	37.9	31.4	38.9
Min	78.8	92.0	120.5
Max	226.7	216.9	279.7

	Swedbank	SEB	Nordea	SHB
Panel B: Swedish CDS spreads				
Pre-crisis period (Jan 06–Jul 07)				
Medelvärde	8.6	8.0	7.2	11.4
Median	9.8	8.6	7.8	11.3
Standardavvikelse	2.8	2.6	1.8	2.1
Minimum	4.8	4.4	5.0	7.7
Maximum	19.5	19.5	17.1	29.9
Crisis period (Aug 07–Jun 09)				
Mean	214.7*	160.0*	112.7*	100.5*
Median	210.0*	165.0*	116.9*	103.4*
Std	65.4	41.2	26.7	23.4
Min	100.0	100.0	57.0	52.5
Max	362.0	248.3	161.1	146.0

more in smaller economies than in larger economies. The US market has had the highest average spread in the crisis period, 186 basis points. The credit measure for the euro area increased significantly in late February 2008. One contributing factor was formed by the events surrounding Northern Rock and its acquisition by the British government on 18 February 2008. The largest increase in the US CDS spread occurred on 15 September 2008, the same day that Lehman Brothers went bankrupt. The spread increased by 43 basis points compared to the previous trading day.

The CDS spreads for the four largest Swedish banks, presented in Graph 6, did not show much dispersion during the pre-crisis period.

Figure 6. CDS Spreads Swedish Banks
The graph displays the development of the CDS spreads from January 2007 to June 2009 for the four largest Swedish banks: Swedbank, SEB, Nordea and Svenska Handelsbanken (SHB).
Basis points



However, during the crisis period, the CDS spreads for Swedbank and SEB increased more than did those of the other two banks. This can be explained by the two banks' larger foreign exposures, especially in the Baltic region (see Sveriges Riksbank (2008b)).

4.2 SYSTEMATIC RISK

To illustrate the manner in which the correlations developed over time, they have been calculated using a 3-month rolling window.

Graph 7 shows the average correlation between the CDS spreads in the Swedish market. In August 2007, at the start of the crisis, the correlations between banks increased rapidly to 0.9, remaining elevated throughout the rest of the period. Thus, even though SHB and Swedbank may have very different risk exposures, their CDS spreads have tended to converge closely during the financial crisis.

The time-varying correlation between the Swedish credit risk and other markets exhibits a somewhat different pattern (see Graph 8). This correlation increased significantly in August 2007. However, the correlation with the US market decreased at the beginning of 2008, while it remained elevated with respect to the euro area. Unlike the correlation between the Swedish banks' CDS spreads, the correlation with foreign markets declined rapidly at the end of 2008, even becoming negative for a short period. It then increased again during spring 2009.

Figure 7. Correlations 3-Month Rolling Window: Swedish CDS spreads
The graph displays the average correlation over time between the four largest Swedish banks (Swedbank, SEB, Nordea and Svenska Handelsbanken). The time period is from January 2007 to June 2009 and the analysis has been performed using a 3-month rolling window.

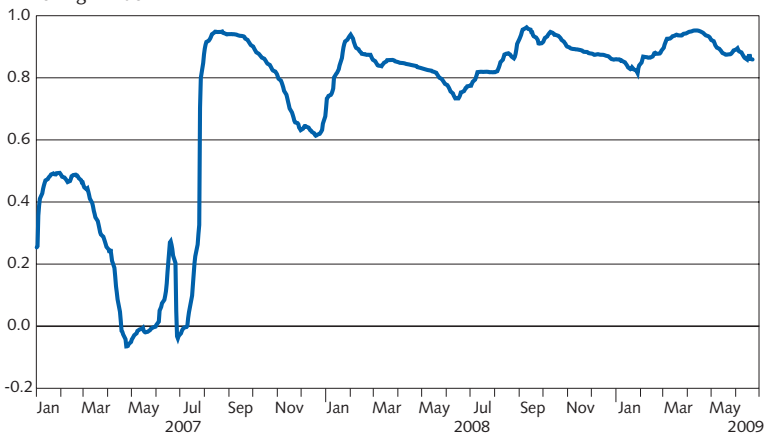
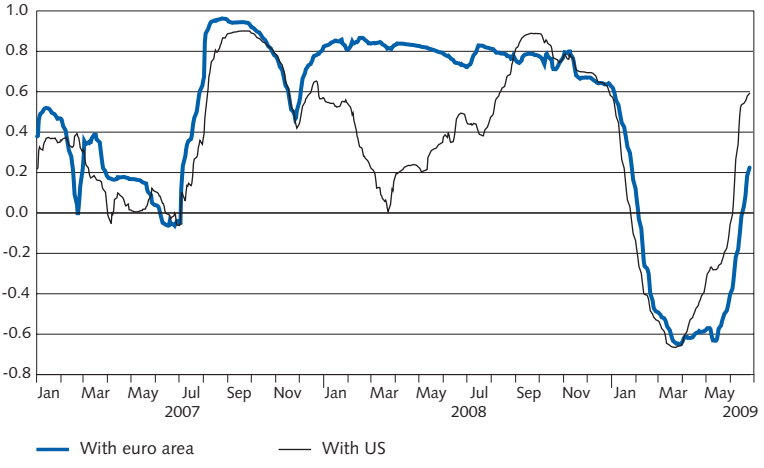


Figure 8. Correlations 3-Month Rolling Window: International CDS spreads
The graph displays the average correlations between the Swedish CDS spread and the CDS spread in the Euro area and United States, respectively. The time period is January 2007 to June 2009. For the Euro area, the iTraxx Finance index is used, for the United States, the CDX index and, for Sweden, the average CDS spread for the four largest Swedish banks.



5. To what extent does the short-term money market risk premium consist of credit risk?

This paper has so far analysed the developments of the short-term money market risk premium and one of its components, credit risk. In this section, we take this analysis a step further. Given the evidence from previous financial crises, which indicates a connection between financial instability and credit risk (see for example Herring (1999)), we wish to explore whether the part of the short-term risk premium attributed to credit risk

has increased. Hence, the money market risk premium will be separated into two parts: one part due to credit risk and one due to liquidity (both market liquidity and bank specific liquidity).

Understanding the composition of the money market premium and the manner in which it was affected during the crisis is important, given the effect the spread has on the economy through, for example, the variable-rate loans tied to it (one example being mortgages). The better the understanding of the premium and the factors affecting it during a financial crisis, the easier it will be to implement the correct and relevant policy measures to reduce the premium. This simple decomposition of the spread follows the methodology used by the Bank of England (2007) and is illustrated in Box 2.

Box 2: Decomposing the risk premium

The implied (risk-neutral) probability of default for the underlying security can be derived using a no-arbitrage relationship. The method is illustrated using a simple example:

Consider a 1-year CDS contract on a specific bank and assume the total CDS premium (p) is paid up front. Let the default probability be pd and the recovery rate be *rr*. The protection buyer pays the premium p and his expected payoff is $(1\text{-}rr)*pd$. When two parties enter a CDS transaction, the CDS premium is set so that the expected value of the swap transaction is zero, that is,

$$p = (1\text{-}rr)*pd$$

Hence, given a certain recovery rate, it is possible to get an expression for the probability of default.

This probability of default can be used to infer a credit spread (above the risk free rate) that must prevail such that a risk-neutral investor is indifferent as regards investing in a risk-free bond or a higher risk bank deposit.

5.1 METHODOLOGY

Under certain assumptions, the method maps a standard CDS price into a fair spread for obtaining funding in the interbank market. The residual of the Stibor-OIS spread net of the credit premium is the liquidity premium.

Money market risk premium – credit premium = liquidity premium

There are a number of assumptions and limitations with this methodology. Firstly, credit and liquidity premiums are unlikely to be entirely independent. Low liquidity and the consequently impaired ability of banks to obtain funding in the interbank market may affect the perceived likelihood of a bank

default. Secondly, it is assumed that investors are risk neutral. A risk neutral investor does not require any extra return for taking on risk. Hence, the investor only takes the expected return into account (and not the risk) when deciding on an investment.

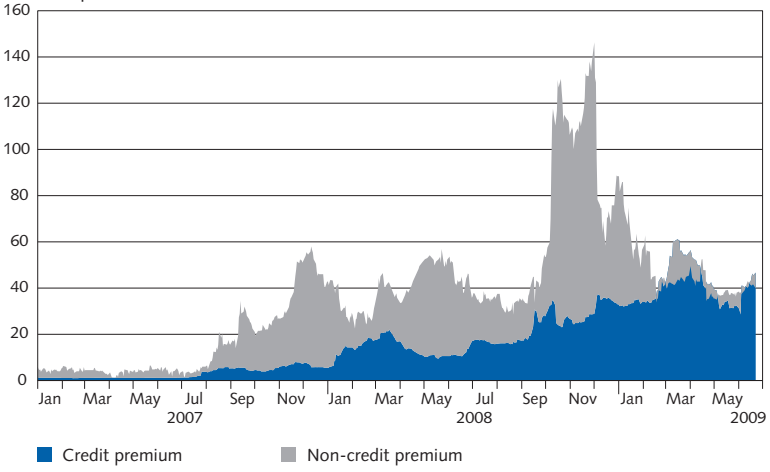
To represent the credit premium in the money market risk premium, we utilise the CDS prices presented in the previous section. In principle, CDS prices reflect the default probability of the bank in question, the loss given default and some compensation for uncertainty regarding these factors. To determine the credit premium, an assumption regarding the recovery rate of deposits in the event of default must be made. Liquidity effects in CDS markets are not taken into consideration. The Bank of England (2007) uses a recovery rate of 40 per cent, with the justification that this is the rate assumed by protection sellers in their CDS price calculations. The same recovery rate will thus be used here.

5.2 RESULTS OF DECOMPOSITION

Graph 9 displays the result of decomposing the risk premium in the Swedish market into a credit premium and a liquidity premium.

Graph 9 indicates that both the liquidity and the credit premiums were at relatively low and stable levels until August 2007. The credit premium then rose somewhat in August 2007, but the largest increase in the total risk premium came from the liquidity premium. The credit premium increased during the period from January to April 2008, while the liquidity premium increased heavily during the months of December 2007 and

Figure 9. Indicative Decomposition of the Risk Premium
The graph illustrates the indicative decomposition of the Swedish short-term risk premium into credit premium (blue area) and non-credit premium (grey area) during the period January 2007 to June 2009.
Basis points



June 2008. The liquidity premium dominated the large increase in total risk premium during the period directly before and directly following Lehman Brothers' bankruptcy in mid-September 2008. After Lehman Brothers' bankruptcy, the total risk premium immediately increased from about 20 basis points to 130 basis points, an increase of over 500 per cent. These results are in accordance with the analysis of Michaud and Upper (2008). Their results suggest that, during August and September 2007, credit factors only accounted for a lesser proportion of the spread.

However, at the beginning of 2009, the relationship between the two parts of the premium changed. During 2009, the credit risk premium rose at the same time as the liquidity premium rapidly decreased. As a result, the total premium consisted mainly of credit risk during the first half of 2009. This indicates that the crisis quickly developed from being a liquidity crisis to affecting the real economy and hence, increasing the credit risk.

The results highlight the importance of understanding the drivers of the crisis in order to be able to implement the correct policy measures. When the main driver of the risk premium is liquidity risk, policy measures should focus on increasing liquidity in the financial system. When the main driver is credit risk, policy measures should focus on increasing the capital buffer in banks and facilitating access to credit in the economy. The results also highlight the fact that the main driver of the risk premium can change during a crisis, thus emphasising the importance of the continuous analysis of crises by policymakers. Although the model and the analysis may be somewhat simplified, they clearly illustrate the general trends in risk factors and can, therefore, be used as support for policy decisions.

6. Concluding Remarks

This article considers the Swedish short-term money market risk premium during the period from January 2006 to the end of June 2009. Although the current financial crisis started in the United States, it has become a global crisis. Thus, as the conclusions of this paper demonstrate, systematic risk is a core element of the current financial crisis.

The conclusions indicate that the risk premiums have had a turbulent development from a starting point in July 2007. The most conspicuous event of the crisis so far took place in September 2008, when Lehman Brothers collapsed, causing a loss of confidence among investors. Even though Swedish banks have not had large exposures to the US sub-prime market, the Swedish premium has, to a large extent, been affected by developments in international financial markets. During the most turbulent periods, the correlation of the Swedish money market risk premium

with the US market and the euro area increased to over 0.9. It is of primary interest for Swedish policymakers to understand the extent to which Sweden is affected by systematic risk in a financial crisis, so that they can implement policies to limit the incidence and the impact of market risk. The fact that premiums which, under normal market conditions, were driven by different factors quickly became driven by a common factor when the crisis started also points to the importance, for policymakers, of taking the anticipated effects of systematic risk into account.

The analysis also investigates the spillover effects from the European and US markets. We conclude that the US risk premium has had a significant effect on the Swedish money market risk premium. One specific channel for the transmission of US money market tensions to the Swedish market was formed by the US dollar liquidity shortages in the interbank markets. One of the policy implications of this conclusion is the importance of facilitating access to funding in foreign currencies to domestic banks during a financial crisis.

The final analysis decomposes the risk premium into a credit risk premium and a liquidity risk premium. The results indicate that the risk premium during the first part of the crisis, involving the collapse of Lehman Brothers, was driven by liquidity risk. However, in 2009, the main driver instead became credit risk. The interpretation presented is that the crisis, which started as a purely financial crisis, spread to the real economy, involving an increase in credit risk. This has important policy implications. If the main driver of the risk premium is liquidity risk, policy measures should focus on increasing liquidity in the financial system. If the main driver is credit risk, policy measures should focus on increasing the capital buffer in banks and facilitating access to credit in the economy. The results also highlight the fact that the main driver of the risk premium can change during a crisis, thus emphasising the importance of the continuous analysis of crises by policymakers.

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Forecasters' ability – what do we usually assess and what would we like to assess?

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In this article, we propose a method for the comparison of various forecasters' ability. One problem in comparing forecasts is that forecasts are prepared at different points in time. This means that forecasts are based on differing amounts of information. The closer one comes to the outcome date for the variable being forecast, the more information the forecaster has regarding the development of the variable. Consequently, a comparison of the accuracy of forecasts should allow adjustments to be made for such differences. We achieve this by simultaneous estimation of the forecasters' ability and the effects of the amount of information. The proposed method of comparison is applied to a body of data covering ten Swedish forecasters. This data covers the period 1999–2008. We examine the importance of the amount of information and the ability of the various forecasters for the entire period and for a specific year, namely 2008, which is the most recent year for which we have an outcome.

What do we usually assess and what would we like to assess?

In the world of sports, winning is all-important and winners are considered to be the best. But is it true that the winner is always the best athlete (or that the best man always wins)? Sometimes this assertion holds true: the 100-metre sprinter who crosses the finishing line first wins and, assuming that the underlying conditions have been fair, it would also be reasonable to describe this sprinter as 'the best'.[1] However, there are also sports in which the equipment used is important to the result achieved – possibly

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1 However, considering the increasing frequency of injuries and doping in sports, it can be questioned whether the winner is always the best man.

even more important that the sportsman himself. One such sport is motor racing's Formula One. It is usually claimed that Michael Schumacher is the best driver of all time, but it could equally likely be the case that it was the car Schumacher drove (a Ferrari) that was the best of all time.

A similar statement could be made regarding forecasters. Can we be certain that the forecaster ranked highest in a traditional statistical evaluation is also the best forecaster? Or could it possibly be the case that this forecaster publishes its reports at a later date than all of the others and thus has an information advantage? It is thus not a foregone conclusion that the forecaster with the best forecasting accuracy under a (standard) evaluation also has the best ability in making forecasts.

Forecast elvaluations are important

Forecasts are perishable goods. They are interesting on their date of publication, but are replaced by newer forecasts relatively quickly. However, occasional studies of previously published forecasts are important, not least as important economic and political decisions are often based on them. A forecaster's accuracy is normally assessed with the aid of average forecast errors – that is, on the basis of calculations of the average amount by which forecasts have deviated from outcome. As the economy is constantly affected by different events that are difficult to foresee, the accuracy of forecasts varies. For instance, a large forecast error may be due to a shock that could not have been predicted. An assessment of an individual year thus provides only limited information on the forecaster's accuracy. It is therefore also informative to compare the precision of different forecasters, preferably over a longer period of time.

The Riksbank, the Ministry of Finance and the National Institute of Economic Research regularly evaluate their forecasts and compare them with those of other institutions.[2] Furthermore, Blix et al. (2001), Bergvall (2005) and Andersson et al. (2007) have published more detailed comparisons of Swedish forecasters. International studies of panels of forecasters include Bauer et al. (2003), who assess the participants of the Blue Chip panel of US forecasters. Goh and Lawrence (2006) compare the precision and ranking of a number of New Zealand forecasters.

[2] The Riksbank publishes an annual forecast levaluation in "Material for Assessing Monetary Policy in Sweden". "The Ministry of Finance and the National Institute of Economic Research present similar assessments in the "Spring Fiscal Bill" and in the first issue of the report, "The Swedish Economy" each year, respectively.

The comparison of forecasts can be misleading

Forecast comparisons are based on analyses of observed forecast errors.[3] Usually, the average forecast error and the mean squared forecast error (or the mean absolute forecast error) is employed to study the degree of accuracy of forecasts. The average forecast error indicates whether there exists a systematic level error (bias) in the forecasts, while the mean square error summarises the bias and dispersion of forecast errors. These measurements can be used to compare various forecasters' accuracy, with the desired values of the calculated measurements being as low as possible. Forecasts that are always accurate have no bias and their mean square error equals zero.

Forecast comparisons based on such statistical measurements are sufficient if the compared forecasts were made at the same point in time and are thereby based on the same quantities of information. However, as different forecasters publish their forecasts at different points in time, in practice implying that the forecasters have varying quantities of information (in the form, for example, of outcome, indicators and forecasts by other agencies) when they prepare their forecasts, a straight comparison of forecast errors is not entirely fair. A forecaster that systematically publishes its forecasts after everybody else can be expected, on average, to have a better accuracy than the other forecasters.

What do we wish to assess?

One legitimate question arising in comparisons of different forecasters is whether the accuracy of the forecasters is the most interesting factor to study. Could it actually be their ability in making forecasts that forms the area of real interest? Accuracy is usually compared, even though it is ability that is being discussed.

If it is, then, ability that is of interest, how can this ability be separated from other factors affecting accuracy? This is not entirely obvious. One could, for example, dwell upon the parallel with the sporting world, in which competition and comparisons are commonplace. Michael Schumacher is considered by many to be a giant within Formula One, where he is history's most successful driver. But is Schumacher's success due to his being the most skilful driver – or could it be due to his having driven a better car?[4] In Formula One, it is (probably) not enough to be the most

[3] The term forecast error refers to the difference between outcome and forecast. The error for a forecast made at a point in time t and which refers to an outcome of a variable at time T is defined as $pf(T|t) = outcome(T) \quad forecast(T|t)$.

[4] Presumably winning (a combination of the driver's skill and the car's performance) is the most interesting element of Formula One.

skilful driver – in order to be a potential champion, a very good car is also needed. During the 2000s, Kimi Räikkönen was one of Schumacher's foremost challengers. During the years 2002–2006, Schumacher finished 1, 1, 1, 3 and 2, while Räikkönen finished 6, 2, 7, 2 and 5. Räikkönen thus only succeeded in getting a better placing than Schumacher in the total series in one of these years, namely 2005. Would it, then, be fair to say that Schumacher was a better driver than Räikkönen during this entire period?[5] During these years, we know that Schumacher drove for Ferrari, while Räikkönen drove for McLaren-Mercedes. So, has it been established, without doubt, that Schumacher was the better driver – or could it be that Ferrari cars were better than Mercedes?

In the example above, it cannot be identified how much of the performance depends upon the driver and how much depends upon the car. In order to make it possible to identify the most skilful driver, both drivers would have needed to have "exchanged" cars with one another (preferably with the aid of random selection). Another method of identifying a driver's skill would be to allow a third driver to alternately drive Ferrari and Mercedes. This would allow an objective comparison to be made between the cars, after which the drivers' skill could be identified, given the cars' performance.

When comparing forecasters, it is normal to state when the forecasts under comparison were made. The National Institute of Economic Research relates the publishing date of each forecaster's report to the publication date of its own report. However, this is only equivalent to saying that Schumacher won *and* that he drove a Ferrari.

In this article, we take matters one step further and propose a method that takes into account the different amounts of information held by forecasters when they make their forecasts. We use the difference between publication date and outcome date (in months) as an approximation of the value of the available amount of information. The method is based on a model in which the importance of the quantity of information and the ability of the forecaster are estimated simultaneously. Unlike the Formula One example, we have sufficient variation in the data material to separate the effects of the available information from the forecaster's ability.

One way of considering the importance of the quantity of information

Assume that $\hat{x}(h)_{it}$ is a forecast made by forecaster i for variable x, at point in time t and which is published h months before the outcome of variable x is known. This implies that forecaster i has access to information up

[5] We cannot, based on a so-called sign test, reject that both drivers were equally skilful.

to and including time t to make its forecast. The absolute forecast error, which is comprised of the difference between the outcome for point in time $T\,(x_T)$ and the forecast at point in time t in absolute figures, can be expressed as follows

$$(1) \qquad \varepsilon_{it} = |x_T - \hat{x}(h)_{it}|$$

We model the absolute forecast error as a function of the distance to outcome and each forecaster's ability in making forecasts according to the following general specification

$$(2) \qquad \varepsilon_{it} = \alpha_1 h_{it} + \alpha_2 h_{it}^2 + \alpha_3 h_{it}^3 + \mu_i + \lambda_t + e_{it}$$

where h_{it} is a horizon variable approximating the information available during the period of time until and including the publication date t. The coefficients preceding the horizon variable (α_1, α_2 och α_3) measure the marginal effect on the absolute forecast error of increasing the horizon by one month. The variables h_{it}^2 and h_{it}^3 are included in the model to provide it with the functional form best resembling the empirical relation between the absolute forecast error and the available information.[6,7] The parameter μ_i describes forecaster *i:s* average ability (described in the literature as individual effect), while λ_t reflects the differing levels of difficulty in forecasting for different years. This quantity is usually called a time-specific effect and is shared by all forecasters, but varies across time. The model's residual, e_{it}, is an error term that is assumed to be randomly distributed, with mean zero and constant variance.

Forecasts from ten different institutions

The analysis presented in this study is based on data gathered by the National Institute of Economic Research.[8] The forecast comparison covers ten forecasting institutions and their full-year forecasts for GDP growth, CPI and unemployment (rate) figures for the period 1999–2008. GDP and CPI are measured as the average annual percentage change, while unemployment is measured as the annual average of the number of unemployed (in relation to the size of the labour force).

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6 A description of the manner in which the average forecast error can be approximated by use of the forecast horizon is presented in the Appendix.

7 Assessment of the model proceeds from equation (2), allowing the data to determine which trend components will finally be included in the specification, that is, we perform individual tests of whether $\alpha 1$, $\alpha 2$ and $\alpha 3$ can statistically be separated from zero.

8 The data supplied by the National Institute of Economic Research covers the period 1994–2007. We have complemented the data with information for 2008.

In order to evaluate each forecaster's accuracy, we study the forecasts made up to two years before the publication of outcome. This provides a maximum horizon of 24 months.[9]

Figure 1 summarises the relation between the forecasters' absolute forecast errors and the horizon. We can observe that errors are minor during the short horizons (a few months) and, in general, increase as the distance to outcome increases. This is not surprising. When forecasts are made closer to the date of outcome, more details of the approaching outcome are known (refer to the Appendix for a more detailed description of outcome effects).

A further description of the dataset is presented in Table 1. Among other information, the table indicates that the number of forecasts published differs between the various forecasters. During the period studied, 1999–2008, the Swedish Trade Union Confederation published the smallest number of forecasts (37) and the National Institute of Economic Research the largest (81).

The lower portion of each panel in Table 1 indicates the average absolute forecast error for the respective variable. The standard deviation of the data has been allocated between the various forecasters and within each individual forecaster. In general, forecast error does not vary greatly between forecasters, while the variation is greater within the individual forecasters' sets of forecast errors. For example, the variation, measured as a standard deviation, between the various participants' average forecast error is 0.08 per cent in GDP forecasts, while the respective participants' forecast error in the same forecasts indicates a variation of 0.85.[10] This indicates that forecasters regularly adjust their forecasts and, at the same time, that the forecasts do not markedly differ between the various participants. According to our interpretation, this implies that 'herd behaviour' is taking place among the studied forecasters.[11]

Table 2 presents the number of forecasts that each respective forecaster has published at various horizons. There are some regularities regarding when various forecasters publish their forecasts, and dates of publication vary between the forecasters. The final row in the table indicates the mean horizon of the various forecasters. A comparison of these mean horizons provides an indication of the manner in which a correction of the forecast error can affect the result. As most forecasters' average horizons lie relatively close to one another, adjustments of forecast errors are expected to be minor.

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9 Forecasts prepared the year following the assessment year are excluded from the investigation as the data does not cover them.

10 Note that the variation between different forecasters and the variation for each forecaster do not add up to the total variation, as the two standard deviations are not calculated around the same mean value.

11 The occurrence of herd behaviour among forecasters is not particularly remarkable. Forecasters study approximately the same information and have access to each other's forecasts and analyses.

The mean horizon for the entire dataset is 12.1 months. The Riksbank's mean horizon of 11.3 implies that the Riksbank, on average, publishes its forecasts 0.8 months (24–25 days) later than the average forecaster. This implies, in turn, that the Riksbank, on average, has access to more information than other forecasters. An adjustment of the forecast error as regards the information set should thus increase the Riksbank's forecast error relative to the other forecasters. The reverse probably applies to those forecasters with a longer mean horizon than average (for all forecasters).

As different forecasters publish their forecasts at different points in time within and across the years, information regarding each forecaster's mean horizon is not sufficient to adjust the forecast error. In order to perform a fair adjustment, information regarding the distance to outcome for *all* forecasts must be utilised.

Forecasters' estimated ability

In this section, we present the estimated models, discuss the importance of the quantity of information and analyse the various forecasters' average forecasting ability. We estimate and compare this ability for the entire period 1999–2008, as well as for 2008 alone. Forecast evaluations usually focus on individual years. Such analyses have a certain value, but tend to have the character of a description. Consequently, in order to be able to draw conclusions regarding general forecasting ability, a broader range of years is required, particularly as accuracy can vary widely from year to year.

THE MODEL CAN BE USED TO ESTIMATE FORECAST ABILITY

Table 3 presents the estimation result for the forecasts for GDP, CPI and unemployment, respectively. For each specification, the model includes a set of constant time effects and individual effects (see equation 2). The estimated linear portion of the horizon variable (h) is positive and differs significantly from zero for each of the three variables. This means that, just as expected, the average forecast error increases the further away from the outcome date the forecast is published. The squared horizon variable (h^2), which enables the forecast error to increase or decrease at a faster rate than the linear portion, is only significantly separated from zero for the GDP specification.[12] The cubed horizon term (h^3) is not significant

[12] The linear-quadratic horizon effect does not differ significantly between the various forecasters, according to a variation test.

for any of the specifications.[13] At the same time, these estimates indicate that the linear portion of the horizon specification is most important for the approximation of the effects of the available information. The marginal effect on forecast error of publishing forecasts one month earlier is 0.11–0.004*h* for GDP, 0.036 for CPI and 0.028 for unemployment.[14] The marginal effect for (for example) CPI indicates that the absolute forecast error could be expected to decrease by 0.036 in the event that a forecast were to be published one month later. That the marginal horizon effect for GDP is a function of the horizon *h* is due to the fact that the squared horizon term h^2 is included in the model for GDP.[15]

The time effects are strongly significant for each of the three variables – implying that in certain years, it is easier or more difficult to forecast the outcome of the variables than it is in other years.[16] A similar test is used to investigate differences in the ability of the various forecasters. As regards both CPI and unemployment, a joint F-test indicates that there exist significant differences between the forecasters concerning the accuracy of forecasts for these variables. On the other hand, we find no significant differences in their ability in making forecasts for GDP. However, pair wise t-tests indicate differences between certain forecasters. These two tests differ from each other in that the F-test determines whether any particular forecaster's precision deviates from the average value for all forecasters, while the t-test investigates whether two individual forecasters have differing abilities. Table 4 presents significance tests for the Riksbank's forecasting ability in comparison with other forecasters. We will discuss the result of these tests later in this article.

It is important that the horizon variable and forecasting ability are not strongly correlated with each other, as this would raise doubts as to the possibility of separating ability from the horizon effect. We find no serious indications of such multicollinearity (dependency between the explanatory variables) in the respective specification.[17] Furthermore, the model diagnostics indicate that the specifications function well, which, in turn, suggests that the models can be used to analyse and compare the ability of the various forecasters.

Below, we present the estimated forecast ability (adjusted for quantity of information at publication date) for each forecaster as regards forecasts for GDP, CPI and unemployment. Panels (b) and (c) in Figures

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[13] The cubed trend term is included to allow a flexible representation of the importance of the horizon. We provide further information regarding this in the Appendix of this article.

[14] The marginal effects are estimated as the derivative of the estimated relation $\alpha_1 h_{it} + \alpha_2 h_{it}^2 + \alpha_3 h_{it}^3$

[15] Compare the horizon effect for GDP (panel (a) in Figure 2) with the equivalent effects for CPI and unemployment (panel (a) in Figures 3 and 4, respectively).

[16] We use an F-test with the null-hypothesis that λ_t is equal for all years against the alternative that all λ_t are not equal – that is to say that outcome for all years is not as difficult to forecast.

[17] For this, we have used variance inflation factors (VIF).

2, 3 and 4 indicate forecast ability for the entire period 1999–2008 and for 2008 alone.[18] In each figure, we present the estimated ability and the more traditional measure mean absolute error (MAE). Both of these measurements are stated as deviations from all forecasters' average accuracy. A positive column (value >0) implies a greater adjusted forecast error than the average forecaster and thus a lower forecast ability, while a negative column (value <0) implies the reverse. As a complement to these figures, Table 5 presents the ranking of forecasters, 1999–2008 and 2008, for the three investigation variables.

In our example from the world of Formula One, Ferrari probably had a better car, as the company invested more resources in Formula One than elsewhere. This also holds true for forecasters – the public institutions (the Ministry of Finance, National Institute of Economic Research and Riksbank) have larger forecasting organisations than, for example, the commercial banks. Even though our method does not examine this resource aspect, our results still provide a certain degree of information about it.[19]

SIZE DOES NOT MATTER – WHEN PREDICTING GDP

The ability of both the Ministry of Finance and the Riksbank in the forecasting of GDP appears to be relatively good for the entire period under examination (see panel (b) in Figure 2 and Table 5 for a ranking of forecasters). However, even smaller participants such as Nordea and Skandinaviska Enskilda Banken are included among those with the best forecasting ability. Consequently, it cannot be taken for granted that organisations with major resources produce better GDP forecasts than those with lesser resources.

The Swedish Retail Institute, Svenska Handelsbanken, the Confederation of Swedish Enterprise and Swedbank are the forecasters with a greater than average adjusted forecast error and, thus, lower ability in their GDP forecasts over time (1999–2008).

Panel (c) in Figure 2 shows that the forecast ability for an individual year, in this case 2008, can deviate greatly from that estimated on a longer sample. For example, the Confederation of Swedish Enterprise reports the most accurate forecasts for 2008. However, considered across the entire period (1999–2008), the Confederation of Swedish Enterprise is

[18] The estimate of μ_i in Equation (2) reports forecast ability during the years 1999–2008. In order to compare forecast precision for individual years, Equation (2) must include an interaction term that is only active for the year in question.

[19] We can only comment on the differences between larger and smaller forecasters. The effect of the amount of resources invested by a forecaster could be identified in a similar manner to the horizon effect with the aid of the inclusion, among other factors, of the number of employees, their educational level and wage costs. However, this lies outside the scope of this study.

placed among those forecasters with lower than average ability (see panel (b) in the same figure).

THE MAJOR ACTORS HAVE MADE THE BEST CPI FORECASTS

The test results indicate that, over time, there exist systematic differences between the levels of ability of different forecasters in the prediction of CPI. The major authorities made the most accurate CPI forecasts during the period 1999–2008 (see the ranking in Table 5 and estimated ability in panel (b) in Figure 3). These authorities also provided reliable forecasts for 2008.

THE AUTHORITIES' ABILITY IN MAKING UNEMPLOYMENT FORECASTS LIES CLOSE TO AVERAGE

Generally seen, the major forecasters made forecasts lying, in terms of accuracy, close to the average for all participants, with the exception of the National Institute of Economic Research, which had the best ability in forecasting unemployment during the period 1999–2008. The least accurate unemployment forecasts were made by the labour market organisations – the Swedish Trade Union Confederation and the Confederation of Swedish Enterprise.

Regarding the Riksbank's forecasts

In this article, our primary aim has been to describe our method of evaluating forecasts and comparing the forecasts of ten Swedish forecasters. Consequently, we have tried not to focus specifically on the Riksbank's forecasting ability. However, in this section we take matters one step further and analyse the Riksbank's own forecasts, comparing them with those of the other forecasters.

In comparison with those prepared by other forecast institutions, the Riksbank's forecasts for GDP appear to be relatively accurate (see Table 5 for a ranking of forecasters). According to our ranking, the Riksbank has made the second most accurate GDP forecasts for the entire period, but the quantitative difference between the forecasters with the best forecast precision is small. This is shown by the point estimations presented in panel (b) in Figure 2. Paired significance tests of the Riksbank and other forecasters indicate that the Riksbank, over time, has been significantly better at predicting GDP than have the Swedish Retail Institute, Svenska Handelsbanken, the Confederation of Swedish Enterprise and Swedbank (see Table 4). The accuracy of the Riksbank's forecasts for GDP growth was also relatively high in 2008.

The Riksbank also belongs to the group of forecasters making the most accurate CPI forecasts over time. Paired significance tests indicate that the Riksbank's CPI forecasts have been significantly better than similar forecasts by the Swedish Retail Institute, Nordea, Svenska Handelsbanken and the Confederation of Swedish Enterprise (see Table 4). The Riksbank is also included among the best forecasters of CPI in the individual year of 2008. However, the differences within the group of forecasters demonstrating better than average accuracy are minor. The Riksbank's ability for 2008 was significantly better than that of the Swedish Trade Union Confederation and Nordea.

Over time, the Riksbank's unemployment forecast was only marginally better than average. In contrast, the Riksbank's forecasts for 2008 have been among the most accurate and significantly better than those of the Ministry of Finance, the National Institute of Economic Research, the Swedish Trade Union Confederation and the Confederation of Swedish Enterprise. These forecasters belong to the group of forecasters with a greater than average adjusted forecast error for this individual year. Over the longer period of time the forecasts prepared by the Riksbank have been significantly more accurate than those prepared by Nordea and Svenska Handelsbank (see Table 4).

THE RIKSBANK'S FORECASTS HOLD UP WELL

Our assessment of mean ranking indicates that the Riksbank's forecast accuracy, in terms of each of the three variables, has been the second best of the investigated forecasters (see Table 5). The mean ranking is calculated as the mean value of each forecaster's ranking for the individual variables (GDP, CPI and unemployment). The Riksbank is ranked as second best for GDP, third best for CPI and fourth best for unemployment. Consequently, the Riksbank's mean rank is 3.0 (= (2+3+4)/3).[20] One interesting observation is that the three forecasters with the most resources are included among the four best forecasters, according to the mean ranking. The best mean ranking over the entire period was attained by the National Institute of Economic Research (2.7), while the worst mean ranking was attained by Svenska Handelsbanken (9.0).

[20] The mean ranking provides a better way of aggregating the variables than calculating the sum (or mean value) of the mean absolute error for the variables. The mean absolute error cannot be compared across variables as different levels of difficulty apply to the forecast of different variables. Mean ranking is not affected by this problem. However, mean ranking does not consider the extent of the differences between the levels of forecasting ability of the various participants.

The equivalent mean ranking calculation for 2008 indicates that, all in all, the Riksbank's and Svenska Handelsbanken's forecast precision was best among all investigated forecasters. Their mean ranking for 2008 is 3.0. The third most precise forecasts were made by the Swedish Retail Institute and SEB, which both attained mean rankings of 5.0. The least accurate forecaster for this year was the National Institute of Economic Research, with a mean ranking of 8.3.

A comparison of our measurement of precision and a traditional measurement

What are we actually interested in? Do we want to know who won or who was most skilful? In Formula One, it is, of course, most important to win, and winning often entails that the driver in question is considered to be the best (even if he has also probably driven the best car). However, when we evaluate forecasters, it is the second option we are looking for – we want to know who is most skilful. So far, we have used our method to compare the ability of the investigated forecasters. In this section, we compare the precision measurements we propose in this study (that is, the measurements answering the question: who is most skilful?) with a standard MAE evaluation (which seeks to answer the question: who won?). The results are presented in panels (b) and (c), respectively, in Figures 2, 3 and 4. In addition, Table 5 illustrates a comparison of the rankings of forecasters.

Unlike a study of mean absolute errors, our precision measurement indicates, for example, that the Riksbank, on the whole, has a worse place in the ranking. This is due to the fact that the Riksbank often publishes its forecasts at a later date than the other investigated forecasters. The opposite effect can be seen for Swedbank, which, on average, publishes earlier than other forecasters. Swedbank improves its ranking considerably using this method, as compared with an assessment of mean absolute error.

This empirical result also indicates the importance of the manner in which an investigation is conducted, as well as the importance of considering the importance of the quantity of information, in order to obtain a fairer comparison of different forecasters.

As a concluding observation, we would like to mention that Kimi Räikkönen changed to Ferrari (Schumacher's old team) for the 2007 season. That year, Räikkönen won the entire Formula One series.

Summary

In this article, we introduce a method for the comparison of different forecasters which considers that they publish their forecasts at different points in time. This method is applied to a body of data including forecasts made by ten Swedish forecasters. The result of the method, in the form of the ranking of forecasters, can deviate from the result provided by more traditional statistical assessment measurements. It is thus meaningful to adjust for differences in publication date when comparing forecasters.

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Tables and figures

In the tables and figures below, the ten investigated forecasters are designated as follows:
FD – Ministry of Finance
HUI – Swedish Retail Institute
KI – National Institute of Economic Research
LO – Swedish Trade Union Confederation
NORDEA
RB – Riksbank
SEB – Skandinaviska Enskilda Banken
SHB – Svenska Handelsbanken
SN – Confederationof Swedish Enterprise
SWED – Swedbank.

Table 1: Descriptive statistics for absolute forecast error

		Number of forecasts	Mean value	Standard deviation	Min	Max
		Panel (a) GDP				
FD		41	0.97	0.82	0	3.50
HUI		79	0.96	0.87	0	3.70
KI		81	0.94	0.90	0	4.00
LO		37	0.98	0.85	0	3.20
NORDEA		73	0.93	0.75	0	3.00
RB		80	0.91	0.83	0	3.20
SEB		80	0.93	0.84	0	3.60
SHB		70	1.14	0.95	0	3.80
SN		73	1.02	0.84	0	3.20
SWED		42	1.12	0.95	0	3.30
Total variation	N	656	0.98	0.86	0	4.00
Between	n	10		0.08	0.91	1.14
Within	N/n	65.6		0.85	-0.16	4.05
		Panel (b) CPI				
FD		41	0.38	0.38	0	1.30
HUI		79	0.43	0.36	0	1.50
KI		81	0.33	0.38	0	1.20
LO		37	0.43	0.41	0	1.40
NORDEA		73	0.50	0.52	0	2.10
RB		80	0.35	0.39	0	1.80
SEB		80	0.42	0.40	0	1.70
SHB		70	0.48	0.53	0	2.30
SN		73	0.51	0.46	0	1.80
SWED		42	0.45	0.45	0	1.70
Total variation	N	656	0.43	0.43	0	2.30
Between	n	10		0.06	0.33	0.51
Within	N/n	65.6		0.43	-0.08	2.25
		Panel (c) Unemployment				
FD		41	0.38	0.35	0	1.20
HUI		79	0.35	0.31	0	1.80
KI		81	0.32	0.31	0	1.20
LO		37	0.45	0.42	0	1.50
NORDEA		73	0.45	0.37	0	1.40
RB		78	0.35	0.34	0	1.60
SEB		80	0.33	0.29	0	1.20
SHB		70	0.47	0.44	0	1.90
SN		73	0.42	0.43	0	2.00
SWED		42	0.36	0.34	0	1.60
Total variation	N	654	0.38	0.36	0	2.00
Mellan	n	10		0.06	0.32	0.47
Within	N/n	65.4		0.36	-0.09	1.96

Note. The first row in the table describes the absolute error in the GDP forecasts published by the Ministry of Finance between 1999 and 2008. The Ministry of Finance made 41 forecasts and the absolute error averaged 0.97, with a standard deviation of 0.82. The smallest absolute error registered for the Ministry of Finance is 0 and the greatest is 3.50.

In total, for the entire body of data, 656 forecasts by the ten forecasters have been analysed. The average of all of these GDP forecast errors is 0.98 and the standard deviation is 0.86.

"Between" indicates the spread between the various forecasters' mean absolute error, while "Within" refers to the degree to which each forecaster's absolute error deviates from its mean absolute error. As regards the forecasts for GDP, we find the smallest average forecast error with the Riksbank (0.91) and the greatest with Svenska Handelsbanken (1.14); these are the figures presented in the columns "Min" and "Max" on the row "Between" in panel (a).

Table 2: Number of forecasts by horizon (time in months to outcome date) and forecaster

Horizon	FD	HUI	KI	LO	NORDEA	RB	SEB	SHB	SN	SWED	Total
1	1	10	6			8	2	4	8	1	40
2			3	1	7	1	8	3		1	24
3	2	7	2	5	1	10				1	28
4	8	2		1	6	1	5	5	5		33
5			10	2	3		5	4	5	6	35
6						1					1
7		10	9			9		2	7	3	40
8					7		10	6			23
9	8	5	1	3	3	1		3	2	1	27
10	2	5	9	6		7	2		7	1	39
11				1	4	3	8	3	3	1	23
12			1		6			5		7	19
13		10	5			8	2	3	7	1	36
14			4	1	7	1	8	4		1	26
15	3	7	2	4	1	10				1	28
16	7	3		1	5		6	6	5		33
17			10	2	3		4	3	5	5	32
18											0
19		10	9	1		10		1	6	3	40
20					7		10	7			24
21	8	5		2	3			2	3	1	24
22	2	5	10	6		8	4		6	1	42
23				1	5	2	6	4	4	1	23
24					5			5		6	16
Total	41	79	81	37	73	80	80	70	73	42	656
Mean horizon	12.2	11.3	11.8	12.7	12.8	11.3	12.2	12.7	12.1	13.5	12.1

Note. Horizon 1 signifies that the forecast was published one month before publication of outcome, while Horizon 24 signifies that the forecast was published two years before outcome became known. The information in the other columns indicates the number of forecasts each institution made at each horizon. For example, in the years under analysis, the Ministry of Finance made one forecast in December of the year referred to by the forecast, and 41 forecasts in total. All forecasters published a total of 40 forecasts for the forecast year in December of that same year. Furthermore, it can be noted that the Ministry of Finance, on average, published its forecasts 12.2 months before the end of the forecast year. The equivalent figure for the entire body of data is 12.1 months. The column "Total" indicates that the 656 forecasts are spread relatively evenly across the year, with the exception of June.

Table 3: Estimation result

	GDP	CPI	Unemployment
Horizon	0.111 (10.3)**	0.036 (19.3)**	0.028 (16.8)**
Horizon^2	–0.002 (–5.7)**	– – –	– – –
Horizon^3	– – –	– – –	– – –
Time effects	Yes**	Yes**	Yes**
Forecaster effects	Yes	Yes*	Yes*
R^2	0.88	0.73	0.74
Number of observations	656	656	654

Note. The upper part of the table presents the estimated coefficients for the horizon components of equation (2). The *t*-value (based on White's robust estimations of standard error) for the estimated coefficients are presented in parentheses. ** indicates that the parameter, or effect, is significantly different from zero at the one-percent level and * that it is statistically significant at the five-percent level.

Table 4: Paired significance tests of the ability of the Riksbank and other forecasters

	GDP	CPI	Unemployment
	Panel 1: 1999–2008		
RB vs FD	0.47	0.53	0.42
RB vs HUI	**0.05**	**0.02**	0.48
RB vs KI	0.27	0.79	0.90
RB vs LO	0.38	0.29	0.14
RB vs NORDEA	0.59	**0.03**	**0.06**
RB vs SEB	0.47	0.20	0.88
RB vs SHB	**0.02**	**0.08**	**0.02**
RB vs SN	**0.06**	**0.00**	0.14
RB vs SWED	**0.09**	0.29	0.70
	Panel 2: 2008		
RB vs FD	0.37	0.41	**0.01**
RB vs HUI	0.15	0.35	0.70
RB vs KI	**0.04**	0.19	**0.03**
RB vs LO	0.53	**0.03**	**0.05**
RB vs NORDEA	0.87	**0.04**	0.35
RB vs SEB	0.24	0.53	0.13
RB vs SHB	0.44	0.57	0.41
RB vs SN	0.90	0.12	**0.02**
RB vs SWED	0.18	0.37	0.31

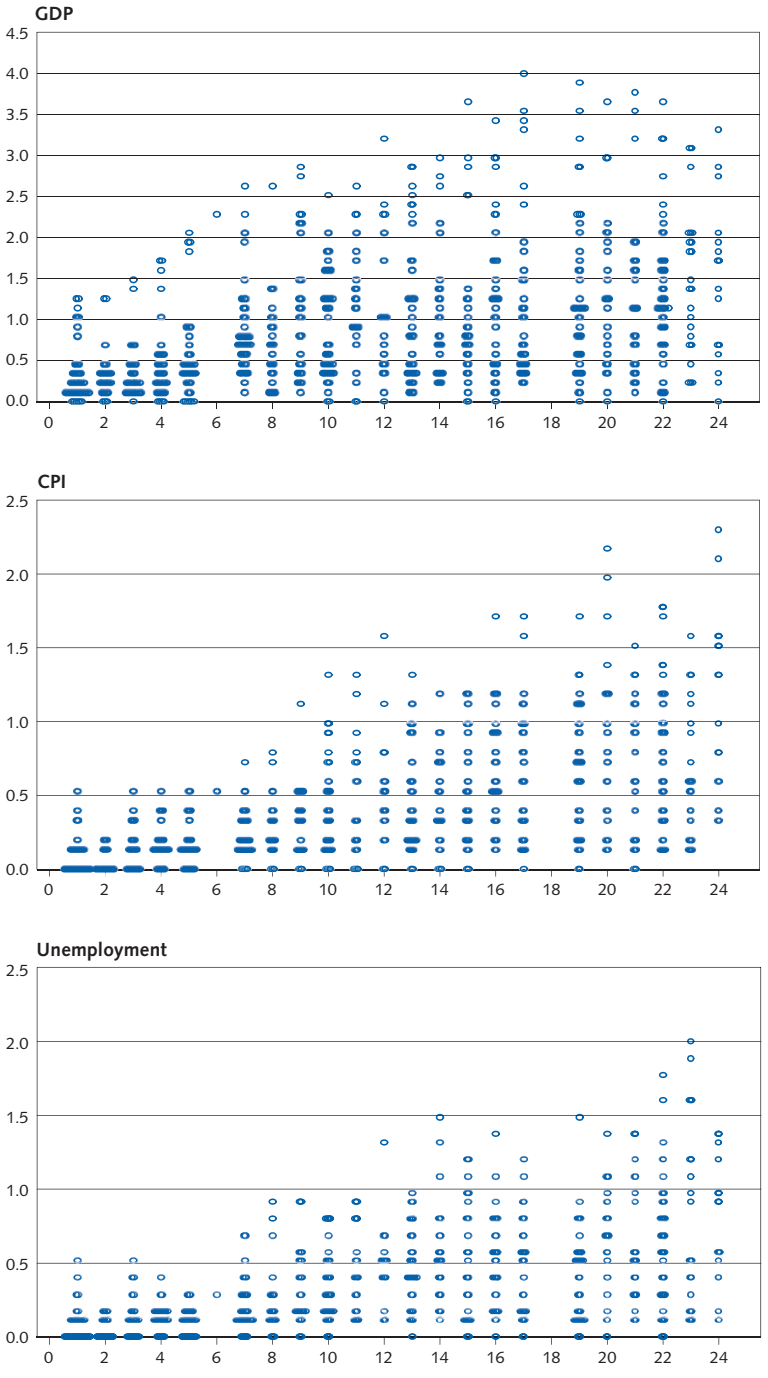
Note. The table presents the *p*-values from a test of the null-hypothesis that the Riksbank's ability is equivalent to the ability of the other forecaster, against the alternative that the Riksbank's ability is superior. A *p*-value lower than 0.1 (at the selected significance level of 10 per cent) indicates that the Riksbank has made statistically proven more precise forecasts (see the figures in bold).

Table 5: Ranking based on forecasting ability and MAE, 1999–2008 and 2008.

	GDP		CPI		Unemployment		Mean ranking	
	Ability	MAE	Ability	MAE	Ability	MAE	Ability	MAE
Panel 1: 1999–2008								
FD	4	6	2	3	6	6	4.0	5.0
HUI	7	5	8	5	5	3	6.7	4.3
KI	6	4	1	1	1	1	2.7	2.0
LO	5	7	5	6	9	8	6.3	7.0
NORDEA	1	2	9	9	8	9	6.0	6.7
RB	2	1	3	2	4	4	3.0	2.3
SEB	3	3	6	4	2	2	3.7	3.0
SHB	10	10	7	8	10	10	9.0	9.3
SN	8	8	10	10	7	7	8.3	8.3
SWED	9	9	4	7	3	5	5.3	7.0
Panel 2: 2008								
FD	6	4	4	2	9	5	6.3	3.7
HUI	9	8	5	5	1	2	5.0	5.0
KI	10	10	7	6	8	6	8.3	7.3
LO	3	5	9	9	7	7	6.3	7.0
NORDEA	2	2	10	10	4	4	5.3	5.3
RB	4	3	3	1	2	1	3.0	1.7
SEB	7	7	2	4	6	8	5.0	6.3
SHB	5	6	1	3	3	3	3.0	4.0
SN	1	1	8	7	10	10	6.3	6.0
SWED	8	9	6	8	5	9	6.3	8.7

Note. Ability is an estimated individual effect according to Equation (2) and MAE is a mean absolute error. The mean ranking is calculated as the mean value of each forecaster's ranking for the three variables of GDP, CPI and unemployment. The rankings (based upon ability according to our assessment and MAE) are separated in order to allow comparisons between both approaches. Comparisons are presented for 1999–2008 (panel 1) and for 2008 (panel 2).

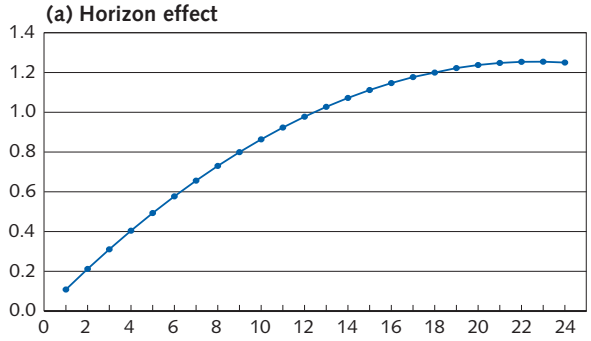
Figure 1. Forecast error (in absolute figures) for various forecast horizons, percentage points



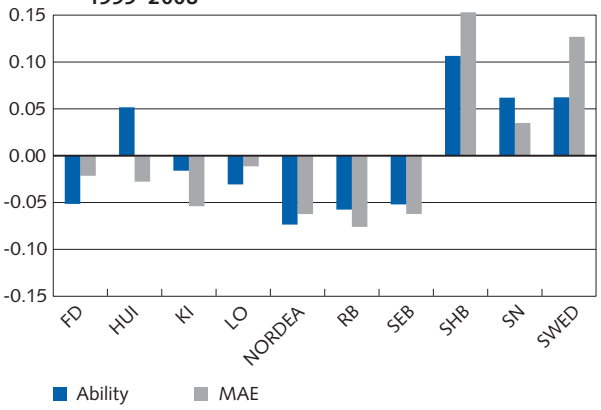
Note. The figure presents all forecasters' absolute forecast errors for GDP, CPI and unemployment in relation to the horizon. Darker and wider points indicate those cases in which there is more than one observation.

Figure 2. Result of model estimates, GDP

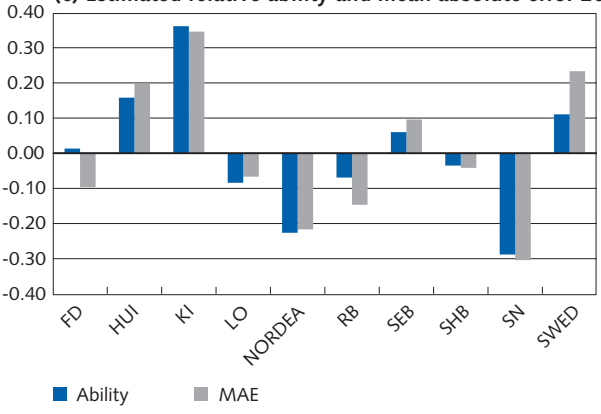
(a) Horizon effect



(b) Estimated relative ability and mean absolute error 1999–2008



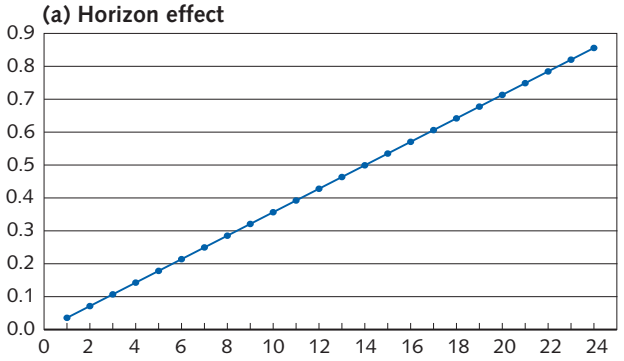
(c) Estimated relative ability and mean absolute error 2008



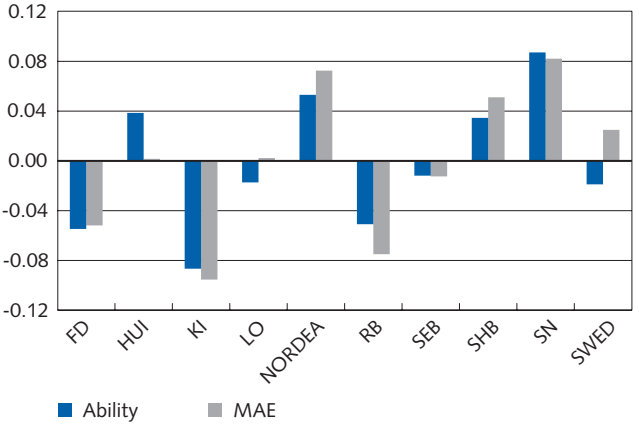
Note. Panel (a) in the figure indicates the marginal effect of the horizon, while panel (b) shows the estimated ability of each forecaster for the entire sample and panel (c) shows the corresponding quantity for 2008. The estimated ability in the figures is adjusted for the average ability of all forecasters. The zero line can thus be interpreted as the average ability.

Figure 3. Result of model estimates, CPI

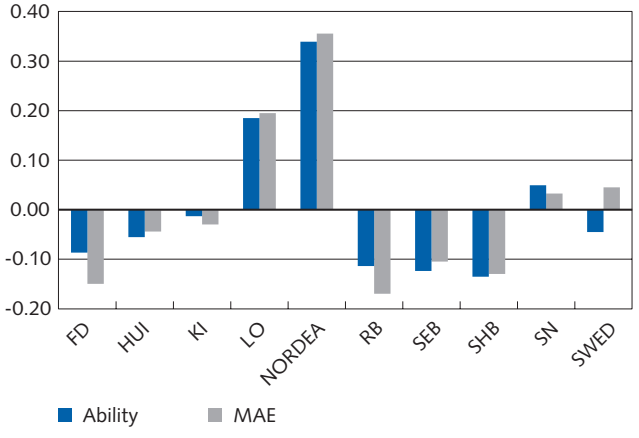
(a) Horizon effect



(b) Estimated relative ability and mean absolute error 1999–2008



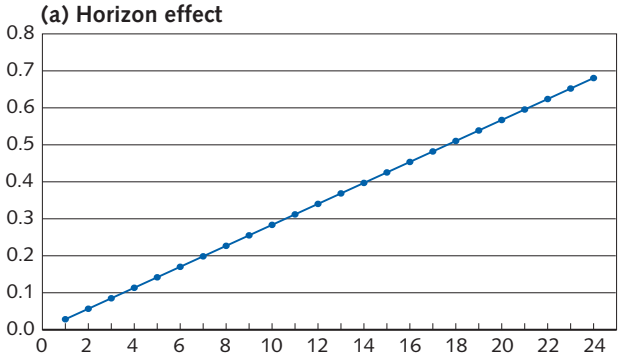
(c) Estimated relative ability and mean absolute error 2008



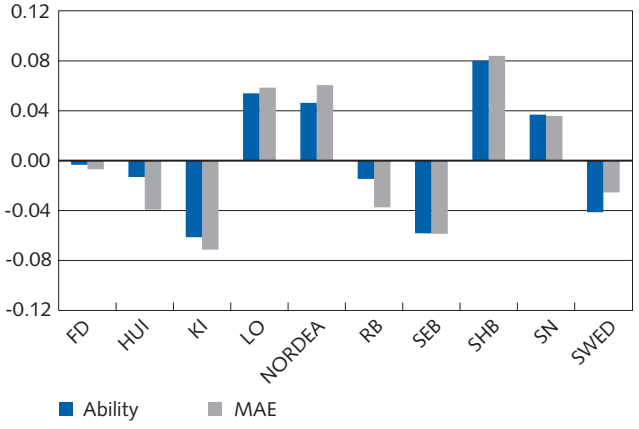
Note. See note to Figure 2.

Figur 4. Result of model estimates, unemployment

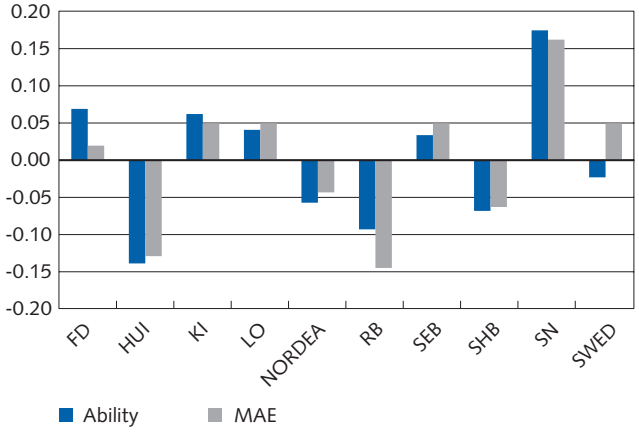
(a) Horizon effect



(b) Estimated relative ability and mean absolute error 1999–2008



(c) Estimated relative ability and mean absolute error 2008



Note. See note to Figure 2.

Appendix: The importance to the forecast error of the quantity of information

It is easily understandable that forecasts made at a point in time close to the outcome date will, on average, be more accurate than those made earlier.[21] The most important reason for this is that more 'components' of the year's outcome become known as time passes. In this appendix, we present an example showing the manner in which the annual growth rate depends on quarterly growth rates. In addition, we demonstrate the fashion in which a forecast's dependence on information on the outcome of the forecast variable (and the time aspect of this), as well as other information, can be utilised to improve (average) forecast precision. We call these three effects outcome effect, own effect and information effect, respectively. Together, these effects provide an understanding of how the distance to outcome impacts the expected forecast errors.[22]

In order to be able to understand how the information included in quarterly outcomes impacts the precision of annual forecasts, we start by studying the manner in which annual changes and quarterly changes are related. The annual percentage change in a variable is defined as the change in the variable in relation to that variable's value in the same period of the previous year. For a variable measured per quarter[23] , this means that the annual percentage change during the year's first quarter can be divided up into the four most recent quarters' percentage change as follows

$$\text{(A1)} \qquad \begin{aligned} \frac{y_{T,1}-y_{T-1,1}}{y_{T-1,1}} &= \frac{y_{T,1}}{y_{T-1,1}}-1 \\ &= \frac{y_{T,1}}{y_{T-1,4}}\times\frac{y_{T-1,4}}{y_{T-1,3}}\times\frac{y_{T-1,3}}{y_{T-1,2}}\times\frac{y_{T-1,2}}{y_{T-1,1}}-1, \end{aligned}$$

in which $y_{T,q}$ is the level of the variable y in quarter q of the year T. Let $g^4_{T,q}$ and $g^1_{T,q}$ be the annual and quarterly percentage change, respectively, for quarter q of year T. Equation (A1) can thereby be expressed as

$$\text{(A2)} \qquad 1+g^4_{T,1} = (1+g^1_{T,1}) \times (1+g^1_{T-1,4}) \times (1+g^1_{T-1,3}) \times (1+g^1_{T-1,2}).$$

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21 For example, one might imagine that it would be easy to forecast average unemployment rate (the level of unemployment as a percentage of the labour force) for one year if monthly outcome until the end of November is already known. In this case, only a forecast for December would need to be made, and this forecast would have a weight of 1/12. However, calculations become more complicated when a variable is measured by growth rates.

22 Here, we will only discuss expected, or average, forecast errors. In reality, the actual forecast errors deviate from the expected errors, for reasons including the exposure of the economy to (unexpected) disruptions.

23 Equivalent calculations can easily be generalised for arbitrary data frequencies.

The annual percentage change during quarters 2, 3 and 4 are calculated in the same fashion as equation (A2). In this case, yearly growth for the year T, $\Delta_4 y_T$, can be stated as the average of the annual percentage change in the year's various quarters, as follows

$$\Delta_4 y_T = \left(\frac{1}{4} \sum_{q=1}^{4} 1 + g_{T,q}^4 \right) - 1 \tag{A3}$$

Equation (A3) holds exactly for CPI as measured by Statistics Sweden, and the equation holds approximately for GDP.[24] If we use Equation (A2) in Equation (A3), we obtain the following relation between quarterly growth and annual growth.

$$\begin{aligned} \Delta_4 y_T = \frac{1}{4}\Big[& \left(1+g_{T,1}^1\right)\times\left(1+g_{T-1,4}^1\right)\times\left(1+g_{T-1,3}^1\right)\times\left(1+g_{T-1,2}^1\right)+ \\ & \left(1+g_{T,2}^1\right)\times\left(1+g_{T,1}^1\right)\times\left(1+g_{T-1,4}^1\right)\times\left(1+g_{T-1,3}^1\right)+ \\ & \left(1+g_{T,3}^1\right)\times\left(1+g_{T,2}^1\right)\times\left(1+g_{T,1}^1\right)\times\left(1+g_{T-1,4}^1\right)+ \\ & \left(1+g_{T,4}^1\right)\times\left(1+g_{T,3}^1\right)\times\left(1+g_{T,2}^1\right)\times\left(1+g_{T,1}^1\right)\Big] - 1. \end{aligned} \tag{A4}$$

Equation (A4) indicates that annual growth is a function of all quarterly growth from quarter 2 of the previous year until the final quarter of the year to which the calculation applies. The equation also indicates that the opening quarter of the forecast year weighs differently in terms of yearly growth. The different weights are presented in Table A1.

Table A1: The relative importance of each quarter in annual average calculations.

Year		T-1			T		
Quarter	2	3	4	1	2	3	4
Weight	1/16	2/16	3/16	4/16	3/16	2/16	1/16
Accum	1/16	3/16	6/16	10/16	13/16	15/16	16/16

Note. The table indicates the weight of each quarter in the yearly calculation, together with the proportion of the full year value (accumulated) known at each point in time. See also equation (A4).

Table A1 reveals that those forecasts based on information from the period lasting until the end of quarter 1 of the year prior to that referred to by the forecast do not include any information pertaining to outcome. One quarter later, which is to say in quarter 2 of the previous year, 1/16 of the outcome is known. By the point in time at which growth up to and

[24] Yearly growth in GDP is defined as the total of quarterly levels of the year *T* divided by the total of the quarterly levels of *T-1*.

including quarter 1 of the forecast year is known, 10/16 of the yearly outcome is known to the forecaster. Note that these calculations are stylised and do not consider current revisions of quarterly outcome.[25] We have, of course, observed that the closer to the date of full year outcome that the forecast is made, the more of the approaching outcome is known. The phenomenon in which an increasingly minor portion of outcome needs to be forecast as the horizon decreases is here designated the *outcome effect.*

In addition to outcome effect, there exists further reason as to why forecast error ought to decrease the closer to outcome date the forecast is made. Assume that variable y of the quarterly change develops as follows

$$\Delta y_t = \mu_y + \alpha \Delta y_{t-1} + z_t + \varepsilon_t. \tag{A5}$$

Equation (A5) indicates that the outcome of quarterly growth depends on quarterly growth in the previous period and other information. This other information is symbolised by the variable z_t and is assumed to be unknown in period t. The variable ε_t is randomly distributed and represents disturbances to variable y. Furthermore, we assume that the other information will develop according to

$$z_t = \mu_z + \beta z_{t-1} + \eta_t. \tag{A6}$$

If we replace z_t in Equation (A5) with Equation (A6), we obtain the following relationship

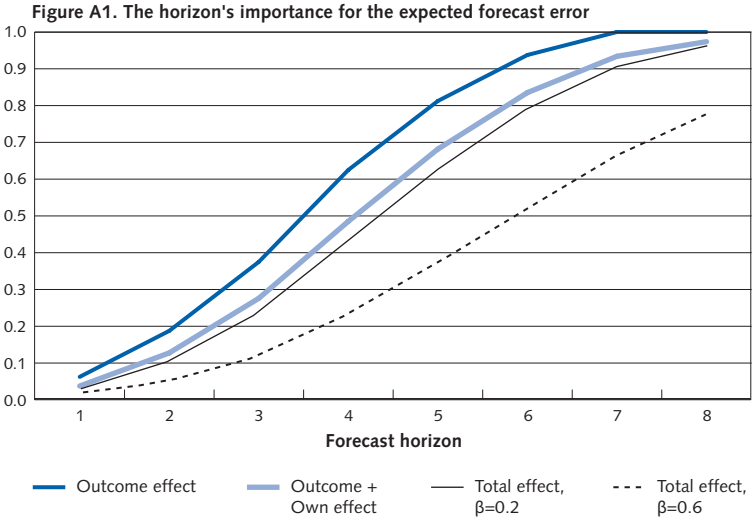
$$\begin{aligned} \Delta y_t &= \mu_y + \mu_z + \alpha \Delta y_{t-1} + \beta z_{t-1} + \varepsilon_t + \eta_t \\ &= \mu + \alpha \Delta y_{t-1} + \beta z_{t-1} + \xi_t \end{aligned} \tag{A7}$$

Equation (A7) provides a simplified description of the information held by the forecaster on each forecasting occasion and the manner in which this information is utilised. As a new outcome for Δy becomes available, this information is utilised to make forecasts. Parameter α (persistence of Δy) determines how far into the future the new outcome will remain important. This effect is known here as the *own effect*. Similar reasoning can be applied to the other information, z: when new outcome for z is registered, this can be utilised for forecasting purposes, with the period of time for which z will remain usable depending upon the parameter β. This effect is known here as the *information effect*.

[25] CPI is not normally revised, while GDP observations are revised back in time when a new outcome is published. Any seasonal adjustments made also lead to revision of historical GDP observations.

Given these three effects, it can be calculated how the anticipated forecast errors will develop as the time remaining until outcome is known decreases. We here demonstrate a calculation in which α is 0.4 and β is 0.2 and 0.6, respectively.[26] The forecast error arising before any information on outcome is known, i.e. quarter 1 of the year before the outcome year, has been normed as 1. The expected forecast error (disregarding ε_t and η_t) is presented in Figure A1 as a function of the horizon. The observed forecast error will deviate from the expected forecast error due to the disturbances ε_t and η_t, but, on average, the forecast error complies with that presented in Figure A1.

Figure A1. The horizon's importance for the expected forecast error



Note. The black line indicates the extent to which the expected forecast error depends on the outcome effect, the blue line indicates the extent to which the forecast error depends on the outcome and own effects and the two black lines (dashed and dotted) indicate the extent to which the forecast error depends on all effects, where β is 0.2 and 0.6, respectively.

Figure A1 demonstrates that the function form of the expected forecast error depends on the outcome effect and the parameters in equation (A7), which are unknown. In addition, possible revisions of data also contribute to the circumstance that the functional form, in practice, is unknown. In this study, we have decided to proceed from a flexible cubic function as an approximation of the manner in which the expected absolute forecast error declines as the horizon decreases. However, in the estimation, we test the significance of the horizon, removing from the specification those parts of the trend not significantly impacting the forecast error.

[26] The value of α is assessed with the aid of GDP data from 1980 with a dummy variable for the years 1991–93. In contrast, the values of β have been arbitrarily selected. The selected coefficients mean that the expected forecast error coincides with the expected *absolute* forecast error.

Wage formation in Sweden

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The development of wages in an economy can have an impact on inflation and as it is the objective of the Riksbank to keep inflation at a low and stable level we have to regularly analyse and produce forecasts for wage development. Historically, wages and prices in Sweden have covaried fairly well. However, instability in price and wage formation, for example in the form of upward or downward price-wage spirals, can occur in an economy for various reasons.

The aim of this article is to provide a greater understanding of how instability in price and wage formation can arise, but also of how the Swedish wage-formation model works. The article analyses wage formation in Sweden from the historical, institutional and international perspectives. It also presents an econometric model for wage formation that makes it possible to analyse how a number of factors affect wage formation in the Swedish economy. This model shows that the situation on the labour market and the collective agreements between the central employee and employer organisations are of great significance for wage formation in the short term.

Why do central banks produce forecasts of wage development?

Safeguarding price stability is an overall objective for most central banks today. The main tool that the central banks use to keep inflation low and stable is the policy rate. As the interest rate decisions affect inflation with a certain time lag, the central banks must base their decisions on forecasts of future inflation and the factors that may affect it. One such factor may be wage development in the economy. Many central banks thus attempt to forecast the development of wages. Wage development can, however, be measured in different ways and the measure or measures used vary

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from country to country.[1] It may also be the case that the development of labour costs, that is wages including employer's social contributions [2], or unit labour costs, which are also dependent on productivity, are more relevant when attempting to explain fluctuations in inflation.

Another reason for forecasting the development of wages is the attempt to predict price-wage spirals or wage-wage spirals. A central bank that has stable inflation as one of its objectives aims to prevent the occurrence of such spirals in the economy. For example, rising inflation can lead to higher inflation expectations among the social partners. Higher expectations of the future level of inflation may then influence the level of wage increases. A higher rate of wage increases may lead the rate of inflation to increase further, which in turn may lead to even higher inflation expectations – in other words, a price-wage spiral has begun. So-called wage-wage spirals can also arise in the economy. One example is when the social partners in one area of the labour market negotiate a wage agreement that entails wage increases of a certain level. The partners in other areas are influenced by the level in this agreement and conclude agreements that provide the same or somewhat higher wage increases than in the first agreement – in other words a wage-wage spiral has arisen.[3]

What can prevent or hinder the occurrence of price-wage spirals?

The probability of a price-wage spiral arising in the economy is affected by both cyclical and institutional factors. One important cyclical factor is the situation on the labour market. On a weak labour market, for example, an individual employee will be in a weaker bargaining position in relation to the employer. A falling rate of inflation in such a situation may increase the risk of a downward price-wage spiral. Similarly, a rising rate of infla-

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1 Most OECD countries use the level of the wage sums in relation to the number of people in employment according to their national accounts as a measure of national wage development. In Sweden, we often use the level of the wage sums in relation to the number of hours worked according to the national accounts, which provides a measure of the average hourly wage in the economy. Statistics Sweden also publishes short-term wage statistics and structural wage statistics, which means that more measures of wage development are available in Sweden than in many of the other OECD countries.

2 Employers' social contributions charges includes statutory employers' contributions and premiums for collective insurance schemes. The statutory employers' contributions consist of charges for old-age pensions, survivor's pensions, health insurance, occupational injury insurance and parental insurance, as well as a labour market contribution and a general wage charge. The general wage charge is essentially a tax on labour. The companies that are affiliated to the Confederation of Swedish Enterprise pay premiums to a range of collective health, occupational injury, life and supplementary pension schemes. Premiums for similar collective schemes for employees in the State sector are paid by the Swedish Agency for Government Employers and for employees in the local government sector by municipalities and county councils affiliated to the Swedish Association of Local Authorities and Regions.

3 During the 1970s and 1980s, a number of articles on economic theories relating to price-wage spirals and wage-wage spirals were published. A review of early economic theories regarding these phenomena is provided by Wood (1978). In more recent economic theory, terms such as price inflation persistence and wage inflation persistence are used to a greater extent to describe phenomena of this type.

tion when the labour market is strong increases the risk of an upward price-wage spiral.

The probability of a price-wage spiral arising in an economy is also affected by a number of institutional factors in wage formation. One such factor is how the social partners conclude wage agreements. In Sweden, wages are primarily negotiated between organisations on the labour market. The results of this collective bargaining process are shown in the collective agreements that these organisations enter into. Apart from collaboration at the sector level, there is also collaboration at a more central level. Since 1998, the central organisations on the employees' side have, to varying degrees, coordinated their demands ahead of the various rounds of collective bargaining. The employers have also coordinated their efforts to a varying extent. Local wage formation at the workplaces also occurs to a greater or lesser degree within the various sectors. The degree of centralisation in the collective bargaining process may be of importance with regard to preventing or hindering the occurrence of price-wage spirals. It is, for example, conceivable that a high degree of centralisation in wage negotiations will make it more difficult for such spirals to arise. According to a hypothesis presented in Calmfors and Driffill (1988), the most favourable macroeconomic outcome, that is an outcome that entails relatively lower levels of unemployment and inflation, is achieved in central and local wage negotiations. The least favourable macroeconomic outcome, according to this hypothesis, arises from wage negotiations that are not co-ordinated and conducted sector by sector.

Long agreement periods provide more stability

The Swedish wage formation model with collective agreements also makes the duration of the agreements an important factor that can affect the probability of price-wage spirals arising in the economy. Long agreement periods reduce the risk of price-wage spirals as the pay increases are partly or wholly stipulated in agreements during the period concerned. Since 1995, three-year agreements have been signed in several sectors of the Swedish labour market. According to the National Mediation Office (2008), approximately 99 per cent of the employees whose wage agreements were signed in 2007 have an agreement period of 31-42 months. In 2007, again according to the National Mediation Office, 572 wage agreements were signed between confederations/central organisations on the Swedish labour market and a total of approximately 3.4 million employees were covered by these agreements. A large number of companies also signed so-called application agreements that covered over 260 000 employees. The wage agreements that were signed in 2007 therefore cover

more than ¾ of the total labour force. This means that the probability of a price-wage spiral arising in the current situation should be fairly small.

Price and wage clauses in the agreements previously represented a strong breeding ground for price-wage spirals

However, the risk of price-wage spirals arising also depends on the structure of the individual wage agreements In the 1980s, wage agreements with price and wage clauses were common. Price clauses (price indexation clauses) in a collective agreement mean that the agreed wages are adjusted upwards if a given inflation index, usually the CPI, exceeds a certain predetermined level. Wage clauses (wage adjustment clauses) in a collective agreement mean that the agreed wages are adjusted upwards to the same level as other, as yet unknown, agreed wage increases within one or several other sectors. The use of price and wage clauses in collective agreements, which previously represented a strong breeding ground for price-wage spirals and wage-wage spirals, was dropped in connection with the so-called Rehnberg Agreement of 1991–1992. Agreements with such clauses have been very unusual on the Swedish labour market since then.

How large a part of the wage scope is determined by the central organisations on the labour market can also affect the probability of price-wage spirals arising in the economy. Agreements in which the entire wage scope is determined by the outcome of negotiations between the central organisations within the sector concerned should hinder the occurrence of price-wage spirals as the level of the wage increase is firmly stipulated in an agreement. Agreements in which wage increases are determined entirely or partly in a local wage formation process may, on the other hand, increase the risk of a price-wage spiral arising. According to the National Mediation Office (2008), approximately 24 per cent of the employees on the Swedish labour market covered by agreements signed in 2007 have agreements in which wage increases are wholly or partly determined locally.

Agreements with or without termination clauses may also affect the probability of price-wage spirals. Termination clauses in wage agreements may, for example, help to increase the probability of a price-wage spiral arising. According to the National Mediation Office (2008), the premature termination of wage agreements is possible in the case of more than 30 per cent of the employees in the private sector covered by the agreements signed in 2007. In the manufacturing industry, all of the agreements include clauses on premature termination. There are also termination clauses in some agreements in the local government sector, but there are no such clauses in the wage agreements in the State sector.

Temporary framework agreements increase wage flexibility but can contribute to instability

It is also possible for the central organisations on the labour market to temporarily circumvent wage agreements that have already been entered into. One example of this is the temporary framework agreement, the so-called "Framework agreement on temporary lay-offs and training", entered into between the trade union IF Metall and three employer organisations in the engineering, manufacturing, chemical and metal-working industries in early March 2009. A three-year wage agreement was signed in these sectors in March 2007 with the proviso that the final year could be terminated (the agreement could be terminated on 30 September 2008 at the latest). Under the framework agreement, wages may be reduced to a limit of 80 per cent, while there is no lower limit for the reduction of working hours.[4] The framework agreement applies until 31 March 2010 at the latest.

At the same time as agreements of this type increase wage flexibility, that is the adaptation of wages to the prevailing situation on the labour market, they may also entail a certain risk that a downward price-wage spiral will arise. According to a survey conducted by Teknikföretagen, an employers' organisation in the engineering industry, almost 400 of the organisation's affiliated companies have signed local agreements within the framework of the central framework agreement. These local agreements cover approximately 50 000 employees in this sector. Similar agreements have been entered into in other industrial sectors. It is estimated that a total of 100 000 employees in industry are covered by local agreements on reductions in wages and working hours.

Varying degrees of centralisation in wage negotiations during the 1980s

The Swedish wage formation model has changed somewhat over the years. Throughout the 1980s and early 1990s, the degree of centralisation in collective bargaining varied in the different rounds (see Table 1). Up to and including 1983, wage negotiations were conducted at three levels: at the central level between central bargaining organisations such as SAF, LO

[4] This framework agreement makes it possible to circumvent the regulations on lay-offs/redundancies in the Act on Security of Employment. This Act contains a discretionary regulation that employees should be paid in full in the event of lay-offs. Under the framework agreement, the employers can reduce their labour costs more quickly than in the case of the normal procedure for lay-offs.

Table 1. Wage agreements and agreement outcomes in Sweden 1980–2009

Agreement period	Bargaining level etc.	Collectively-agreed wage increase	Nominal wage increase	Real wage increase
1980	1-year central agreement	7.5	9.1	–4.8
1981–1982	2-year central agreement	5.6	7.3	–3.0
1983	1-year central agreement The Swedish Metalworkers' Union and the Swedish Metal Trades Employers' Association sign a separate agreement.	5.1	6.5	–2.4
1984	1-year agreement at sector level. The Swedish Metalworkers' Union and the Employers' Association of the Swedish Mining Industry are the first to sign an agreement.	5.7	8.1	0.0
1985	1-year central agreement	4.5	6.6	–0.8
1986–1987	2-year central agreement	5.2	7.2	3.0
1988	1-year agreement at sector level. The Swedish Factory Workers' Union and the General Industrial Group of the Swedish Employers' Confederation are the first to sign an agreement.	3.5	7.0	1.2
1989–1990	2-year central agreement The trade unions in the engineering industry sign a separate agreement.	6.5	10.3	1.9
1991–1992	Rehnberg Agreement (2-year central agreement). The Rehnberg group, i.e. Bertil Rehnberg and the chief negotiators of SAF, LO, TCO and SACO propose a stability agreement. Almost all of the trade unions accept the proposal with no or only slight deviations from the proposal.	2.5	4.9	–1.0
1993–1994	2-year agreement at sector level. The Commercial Employees Union and the Commercial Employers' Association are the first to sign an agreement.	1.4	2.5	–0.9
1995–1997	3-year agreement at sector level. The Swedish Paper Workers' Union and the Swedish Forest Industries' Association are the first to sign an agreement.	3.5	4.6	3.4
1998–2000	3-year agreement at sector level. Collective bargaining is coordinated at the central level, including LO's coordination. Wage negotiations in the manufacturing industry are conducted within the framework of the Cooperation Agreement. The Swedish Metal Workers' Union and the Swedish Metal Trades Employers' Association are the first to sign an agreement.	2.7	3.6	3.3
2001–2003	3-year agreement at sector level. Collective bargaining is coordinated at the central level. Other agreements on bargaining procedures are in place, in addition to the Cooperation Agreement. New legislation on mediation is adopted and the National Mediation Office is established in 2000. The Industrial Workers' Union and the Swedish Industrial and Chemical Employers' Association are the first to sign an agreement	2.5	4.0	1.8
2004–2006	3-year agreement at sector level. Collective bargaining is coordinated at the central level. The Swedish Association of Health Professionals, SKTF (employees in the local government sector), the Swedish Medical Association, the Swedish Association of Graduate Engineers and the Employers' Alliance are the first to sign an agreement.	2.0	3.2	2.4
2007–2009	3-year agreement at sector level. Collective bargaining is coordinated at the central level. IF Metall and the Swedish Industrial Association are the first to sign an agreement.	2.9	3.7*	1.9*

Note. The average of annual percentage changes for the total economy during the agreement period (calculated per calendar year) is shown in the table.

* = forecast for 2009.

Sources: Friberg (2004), the National Institute of Economic Research, the National Mediation Office, the Confederation of Swedish Enterprise, Statistics Sweden and the Riksbank.

and PTK[5], at the sector level between trade unions and employer confederations and at the local level between employees and companies. A typical central wage agreement contained three components: a nominal wage increase, usually specified as a cash amount, a wage drift guarantee and a special kitty for the low paid. The typical wage agreement also included price and wage clauses.

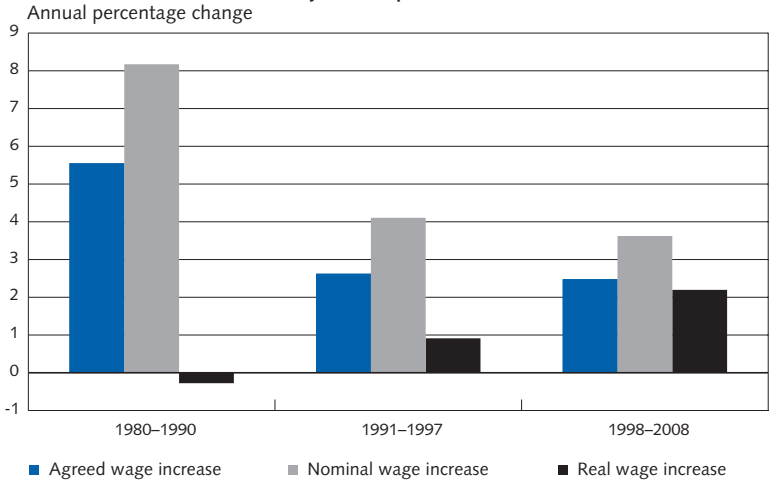
In 1983, the Swedish Metalworkers' Union did not participate in the central negotiations but signed a separate agreement with the Swedish Metal Trades Employers' Association. This affected the other parties on the labour market such that the negotiations for the 1984 wage agreement were conducted at only two levels: the sector level and the local level. For several years following 1984, the number of levels in the rounds of collective bargaining varied between two and three, that is central agreements were entered into in some years but not in others. During this period, the average duration of the agreement periods was also relatively short, i.e. 1 to 2 years. The nominal wage outcomes were high, averaging increases of 8.2 per cent per year, while the real wage outcome was negative, averaging -0.3 per cent, in the period 1980–1990 (see Figure 1). In the early 1980s, the real wage outcome was extremely negative, averaging -3.3 per cent during the period 1980-1983.

Stabilisation agreements and new preconditions for stabilisation policy during the 1990s

In the period 1990-1991, the situation on the Swedish labour market deteriorated dramatically. In an attempt to counteract this deterioration, a proposal for a stabilisation agreement for 1991-1992 was presented by the so-called Rehnberg group, which consisted of a mediator appointed by the government, Bertil Rehnberg, and the chief negotiators of SAF, LO, TCO and SACO. Practically all of the organisations on the labour market signed wage agreements that were largely in line with the proposed stabilisation agreement. The proposal entailed low agreed wage levels and the removal of the price and wage clauses. The wage agreements entered into in the period 1991-1992 are often referred to under the collective name "The Rehnberg Agreement". In 1991–1992, the collectively-agreed wage increases in the Swedish economy averaged 2.7 per cent per year, as compared to the average level of wage increases in the period 1980–1990 of 5.6 per cent per year.

[5] SAF (Swedish Employers' Confederation), LO (Swedish Trade Union Confederation) and PTK (Federation of Salaried Employees in Industry and Services) were central organisations for various areas in the Swedish private sector. PTK was a central bargaining organisation for white-collar workers in the private sector affiliated to TCO (Swedish Confederation for Professional Employees), SACO (Swedish Confederation of Professional Associations) and SALF (Swedish Association of Supervisors and Managers).

Figure 1. Average agreed wage increases, nominal wage increases and real wage increases in the Swedish economy in three periods.
Annual percentage change



Sources: The National Institute of Economic Research, the National Mediation Office, Statistics Sweden and the Riksbank.

Since 1993, wage negotiations have been conducted under the new preconditions for stabilisation policy. One such important precondition for stabilisation is the price stability target that the Riksbank introduced in 1993, which is that inflation measured in terms of changes in the CPI should be 2 per cent with a tolerance interval of +/- 1 percentage point. Ahead of the round of collective bargaining in 1995, inflation expectations were, however, still relatively high and it appeared that the new monetary policy regime had not yet achieved full credibility among the social partners. Attempts to coordinate the bargaining demands of the trade unions affiliated to LO also failed. The Swedish Paper Workers Union and the Swedish Forest Industries Association were the first organisations to conclude an agreement with relatively high wage increases. This wage agreement then acted as a guide for the level of agreed wage increases in other sectors for a large part of the labour market. The collectively-agreed wage increases averaged 3.5 per cent per year in the period 1995–1997. The agreements entered into in 1995 also entailed a lengthening of the average duration of the agreement periods to approximately 3 years.

Local wage formation has also increased in extent since the early 1990s. An agreement model in which the central organisations do not specify the scope for wage increases for those in management positions has been applied in large parts of the labour market since 1992/1993. The structure of these agreements inspired several other sectors ahead of the round of collective bargaining in 1995. Agreements that did not specify particular figures were signed in a number of sectors, primarily

for white-collar workers in the private sector but also for some groups of academics in the public sector. Under this type of agreement, new salaries are set in connection with pay reviews either by the local parties or in discussions between managers and employees, so-called salary-setting discussions. The number of employees covered by agreements that do not specify any centrally-determined scope for wage increases increased steadily up to the mid-2000s.

Increased coordination among the parties since 1997

In 1997, the trade unions in the manufacturing industry entered into an agreement on collective bargaining demands and rules on bargaining procedures, the so-called Industrial Cooperation Agreement or Industrial Agreement. In the collective bargaining round of 1998, all of the trade unions affiliated to LO also agreed on a recommendation regarding joint demands. LO has also been successful in coordinating demands ahead of the various rounds of collective bargaining since 1998. Other central employee organisations have also to a greater or lesser extent coordinated their demands since then, as have organisations on the employers' side.

Coordination and cooperation among the central organisations on the labour market have probably contributed to the fact that wage increases in agreements have averaged approximately 2.5 per cent per year in the period 1998–2009, which on average is around 3.3 per cent lower than in the agreements entered into in the period 1980–1991 and approximately 1 per cent lower than during the agreement period 1995–1997. However, in the period 1998–2008 real wages increased by an average of approximately 2.1 per cent per year. It is also expected that employees in Sweden will receive real wage increases in 2009. An interesting observation is that average real wage increases were so much higher in the period 1998-2008 than in the period 1991-1997 despite the fact that the collectively-agreed wage increases were on average marginally lower during the later period (see Figure 1). This indicates that less costly collective agreements for the companies can still provide higher real wage outcomes for the employees.

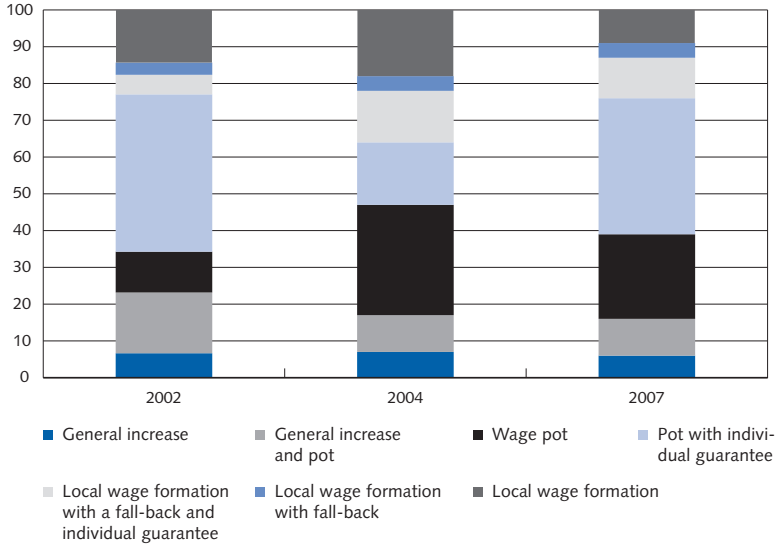
An increase in the coordination of collective bargaining that leads to lower outcomes is thus in line with the Calmfors-Driffill hypothesis. However, the weaker situation on the labour since the crisis of the 1990s and the delayed recovery due to the costly wage agreements for the companies in the period 1995–1997 have probably also contributed to the lower wage negotiation outcomes since 1998. It is also probable that the increasing credibility of the Riksbank's inflation target in the eyes of the social partners has helped to keep down the level of collectively-agreed

wage increases since then. The establishment of the National Mediation Office in 2000 as a mediation service for the social partners may also have had an impact on the level of the agreed wage increases. It is uncertain, however, whether this is the case, although the National Mediation Office has probably helped to reduce both the number and duration of industrial conflicts.

Less local wage formation in the agreements of 2007

In recent years, a typical wage agreement comprises a wage pot specified as a percentage with some form of individual guarantee (see Figure 2). Around 37 per cent of the employees were covered by this type of wage agreement in 2007. Agreements with a wage pot but without individual guarantees are also common (23 per cent of the employees in 2007). In these two types of agreement, the size of the pot and the individual guarantee is mainly determined in trade union negotiations at the sector level. Between 2004 and 2007, the percentage of employees in the entire economy covered wholly or partly by local wage formation fell from 36 per cent to 24 per cent. A certain degree of centralisation in wage forma-

Figure 2. Distribution of different forms of agreement throughout the economy.
Percentage of employees.



The National Mediation Office only has statistics reaching back to 2002 for the entire economy.

Brief wordlist: General increase = Wage increases in trade union agreements that are paid to all. Individual guarantee = Guaranteed minimum wage increase for the individual employee. Wage pot = Wage increase that is determined in trade union negotiations and then distributed by the employers and local trade union organisations. Fall-back clause = A compulsory default regulation in trade union agreements that comes into force if the local parties can not agree.

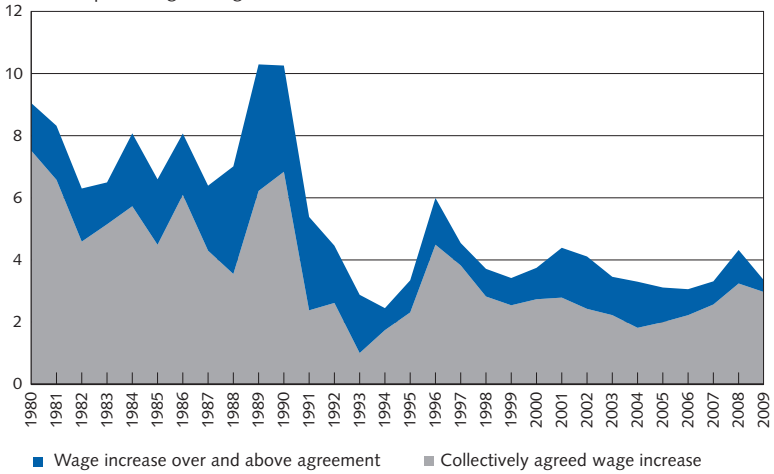
Source: The National Mediation Office.

tion thus took place in the agreements signed in 2007 compared with the agreements signed in 2004.

The Swedish wage formation model enables a division of total wage increases into two components: collectively-agreed wage increases and wage increases over and above the collective agreement (often referred to as residual wages or wage drift). Figure 3 presents such a division. The series for the collectively-agreed wage increases contains centrally and/or sectorally-determined wage increases. The series for wage increases over and above those determined in collective agreements contains locally-agreed wage increases, wage drif in the more traditional sense – that is wage increases over and above the agreement – and structural effects in the wage statistics.[6]

The percentage of wage increases over and above those in collective agreements in relation to total wage increases has varied over time. Up to and including the early 1990s, there was an increasing trend to around 45 per cent but this level then declined. In the period 1998-2008, the percentage was approximately 31 per cent, while for 2009 it is estimated that the percentage of wage increases over and above those in collective agreements will be very low due to the situation on the labour market.

Figure 3. Collectively-agreed wage increases and wage increases over and above those in central agreements (wage drift) in the total economy 1980–2009.
Annual percentage change



Note. For the period 1980–1991, a number of sectors are missing in the weighted series for agreed wage increases. Forecast for wage drift in 2009.

Sources: The National Institute of Economic Research, the National Mediation Office, Statistics Sweden and the Riksbank.

[6] One such structural effect may be that changes in the composition of the labour force lead to changes in the average wage level. If cyclical wage statistics are used to calculate wage increases over and above central agreements, changes in, for example, the sample or in the division into industrial sectors may lead to structural effects in the wage statistics.

Wage formation in Sweden has similarities with that in other industrialised countries

Swedish wage formation has a lot of similarities with wage formation in other industrialised countries. There are, however, some differences. In Du Caju et al. (2008) institutional factors in wage formation in 23 European countries, the USA and Japan are compared. Their results are based on the responses to a written questionnaire that was sent to economists at the central banks of the various countries in 2007.

In most of the countries, wage formation takes place at several different levels: the national/central level, the regional level, the inter-sector level, the sector level, the occupational level and the company/local level. The most common wage formation level in the countries studied is the sector level. This level predominates in, for example, Germany, Spain, France, Italy, the Netherlands, Portugal, Japan and Sweden. In some countries, the national/central level predominates, for example in Ireland, while the company level predominates in the USA, the UK and several of the countries in eastern Europe.

According to the Calmfors-Driffill hypothesis, the non-coordinated sector level is the level that provides the least favourable macroeconomic outcomes. However, Du Caju et al. (2008) show that in several of the countries wage formation also takes place at the central and local levels, that is bargaining levels that according to the hypothesis provide more favourable macroeconomic outcomes. In Sweden, for example, we have both coordinated wage formation between different central organisations on the labour market, wage formation at the sector level and local wage formation.

Relatively limited political intervention in wage formation in Sweden

Direct political intervention in wage formation in Sweden is, according to the compilation by Du Caju et al., relatively limited. In Sweden, for example, there is no legislation on wage indexation[7] like that in Belgium, Luxembourg and Cyprus. Sweden also has no national legislation on the level of the minimum wage of the type that exists in most other countries. In Sweden, minimum wage levels are instead specified in the collective agreements, as in Austria and Finland. On the other hand, Sweden and several of the other industrialised countries have relatively strict legislation on security of employment which may affect wage formation indirectly.

[7] Wage indexation is a formal and automatic indexation of nominal wages in line with an official price index.

Strict legislation on security of employment can give the trade unions a better negotiating position in relation to the employers and thus affect the outcome of negotiations. Sweden is also one of the countries where the State offers specific mediation services to companies and other organisations (through the National Mediation Office). Other countries, for example the USA, the UK, France and Finland, have similar bodies that offer similar services.

Sectoral wage leadership is common in Sweden

In Sweden, sectoral wage leadership has also been common according to the compilation and the manufacturing industry has been the wage leader.[8] Similar forms of wage leadership are also common in Germany and Austria. In recent years, Sweden, Denmark and Ireland have had the longest agreement periods, approximately 3 years, among the countries in the compilation. In Sweden, as in most of the other countries, collective bargaining is not conducted during a specific month of the year but usually begins 1 to 2 months before the current agreement expires and the expiry date can vary from sector to sector. During the last three rounds of collective bargaining, however, most of the agreements expired on 31 March.

In the study, the economists were also asked to specify the factors that they thought were of the greatest importance for the outcomes of wage negotiations in the respective countries. The development of inflation or inflation expectations was regarded as being the most important factor. The development of labour productivity was the factor mentioned most often after this. Factors such as the average wage increases in other countries (particularly neighbouring countries), announced or assumed changes in taxes and employers' contributions and the profits and competitive situation of the companies were also regarded by the economists as being important for the outcomes of wage negotiations in the countries studied.[9]

[8] The research results vary regarding the wage leadership of the manufacturing industry on the Swedish labour market in an historical perspective. Tägtström's (2000) findings support the claim that the manufacturing industry has played a wage leadership role in relation to the central and local-government sectors and the rest of the private sector, while Friberg (2007) does not find the same clear support. It is likely that, periodically at least, the manufacturing industry has been the wage leading sector on the Swedish labour market. The findings of Holmlund and Ohlsson (1992), and Jacobson and Ohlsson (1994) support the belief that the private sector has played a wage leadership role in relation to the central and local-government sectors.

[9] It should be mentioned that the results should be interpreted with caution as the design of the questionnaire in this type of study may have affected the responses received.

Central banks try to forecast the future development of wages …

The fact that different measures of the development of wages have, historically speaking, covaried relatively well with inflation and that monetary policy works with a certain time lag means that many central banks attempt to predict the future development of wages. The Riksbank, for example, uses a number of econometric models to forecast the development of wages and other factors. These include VAR-models, Bayesian VAR (BVAR) models, DSGE models and partial OLS models.[10]

Forecasts from econometric models are an important complement to mere assessments of the development of different economic variables. This is because econometric models make it possible, on the basis of published statistics for economic variables, to identify historical relations between these variables. These relations change of course over time, but they can nevertheless provide valuable information on the possible level of future outcomes given the historical links. The ongoing use of econometric methods also provides information on gradual changes in the relations between different economic variables. It is then up to the forecaster to evaluate the information and see whether any structural changes have taken place, for example in wage formation, such that the historical relations have changed.

In the econometric models, it is also possible to use published information that applies to the future to forecast economic variables. One example of such information is the statistics published by the National Mediation Office on collectively-agreed wage levels which, in the case of three-year agreement periods for instance, can affect wages three years ahead.

…but depicting wage formation in an econometric model can be difficult

It is important in this context, however, to be aware of the difficulties involved in depicting economic relations such as the determinants of wage formation in an econometric model. In the first place, wage formation in Sweden has varied between different contractual and industrial sectors. The structure and duration of the agreements, the degree of influence of the central organisations and the bargaining strengths of the respective parties differ, for example, from sector to sector. There may, however, be strong wage spread effects between different sectors. Friberg (2004), for example, demonstrates a strong correspondence/influence in wage for-

[10] For a more general description of VAR models and Bayesian VAR models see, for example, Andersson and Löf (2007). For more information on the Bayesian VAR model used by the Riksbank, see Andersson et al. (2008). For more information on the DSGE model used by the Riksbank, see Andersson et al. (2007).

mation between different sectors. This correspondence indicates, however, that it is equally effective to analyse wage formation at an aggregated level as at the sector level.

In the second place, there have been a number of shifts or shocks in the Swedish wage formation process that may be difficult to capture in an econometric model. Friberg and Uddén Sonnegård (2001) identify two such regime shifts in the Swedish wage formation model since 1980. The first occurred in 1982–1983 when the Swedish Metalworkers' Union chose not to participate in the central negotiations. The traditional central wage formation model was abandoned and was followed by a period of more decentralised wage formation.

The second regime shift is the Rehnberg Agreement of 1991–1992 and the change in monetary policy around 1992/1993. Since the Rehnberg Agreement, the wage agreements no longer contain any price and wage clauses, which has probably led to greater stability in the formation of prices and wages. The Rehnberg Agreement also entailed a downward shift in the level of collectively-agreed wages. The change in monetary policy meant that the social partners needed to take more account of the fact that wage formation should not drive inflation. In reality, however, it took several years before the new monetary policy regime achieved full credibility among the social partners. High inflation expectations among the social partners ahead of the round of collective bargaining in 1995 contributed to the collectively-agreed wage increases reaching an average of 4.2 per cent during the period 1996–1997. All in all, however, there has been a downward shift in both the collectively-agreed wage increases and the nominal wage increases since the beginning of the 1990s, which can be seen as a regime shift in wage formation.

It may also be possible to add a third regime shift in the Swedish wage formation model. This is the coordination of the bargaining demands that has taken place for a large part of the labour market from and including the round of collective bargaining in 1998. On the employers' side too, coordination has taken place ahead of the rounds of collective bargaining to a varying degree since 1998. These regime shifts thus make it difficult to depict wage formation in an econometric model.

An econometric model of wage formation

In the economic literature, prices, inflation expectations, productivity and various measures of the situation on the labour market are often used as variables in wage formation models. Politically-determined factors such as the tax wedge, the benefit ratio in the unemployment insurance scheme and the number of people involved in active labour-market policy meas-

ures are also commonly used to explain wage formation. A variable such as collectively-agreed wages can be used to depict the Swedish collective agreement model with collective bargaining between the central organisations on the labour market. The percentage of trade union members and the profits of the companies can, for example, be used as measures of the bargaining strength of the social partners.

There is thus a range of possible explanatory factors to choose from when one wants to create an econometric model for wage formation in Sweden. With this in mind, a Bayesian VAR model of wage formation in Sweden has been estimated. Seasonally-adjusted quarterly data for the period 1980:1-2008:4 are used in the model. Data on wages throughout the economy according to short-term wage statistics, productivity (measured as GDP at fixed prices divided by the number of hours worked), the CPI, the percentage of unemployed according to the ILO-definition and collective agreement levels are used in the model.[11] The model contains a shift dummy for the period 1991:1-2009:1 that is assumed to capture the permanent structural shift in wage and price formation that arose in connection with the Rehnberg Agreement 1991-1992 and the regime shift in monetary policy in 1993. The model also contains a shift dummy for the period 1993:1–1994:4 which is assumed to capture the significant shift in unemployment that occurred in this period.[12]

The situation on the labour market and the collective agreements are of great importance to wage formation in the short term

By estimating the model and conducting an impulse-response analysis[13] it is possible to see the short-term effects on wage formation in Sweden of the variables used in the model.[14] Figure 4 shows the results of such an analysis. An increase in the collective agreement levels of one percentage point leads to an increase in wages of 1.6 percentage points after four quarters. An increase in unemployment of one percentage point leads to a fall in wages of over 0.8 percentage points after six quarters. The situation on the labour market and the collective agreements are thus of

[11] Short-term statistics on pay and statistics on central-agreement levels have been compiled by the National Mediation Office since the beginning of the 1990s. These series have been extended back in time using processed data from the structural wage statistics produced in connection with SOU 1988:35 and SOU 1990:63.

[12] See Appendix A for more information on the estimated Bayesian VAR model.

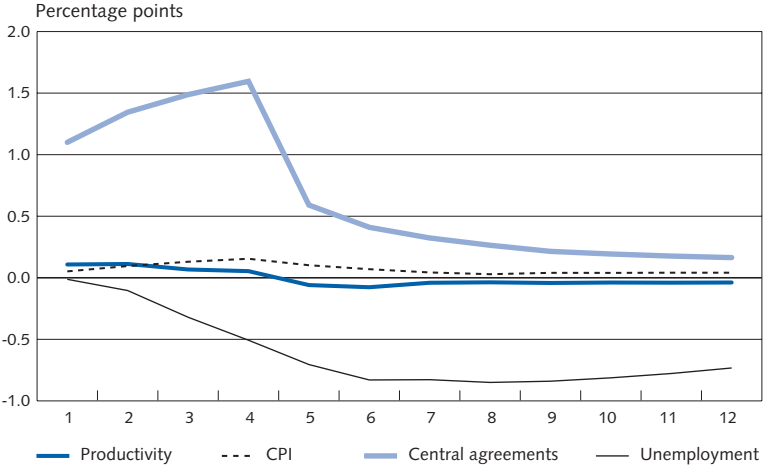
[13] In a so-called impulse-response analysis, one equation at a time is shocked with an impulse of a magnitude equal to 1. The reactions of all the variables in the model to the impulse are then measured, that is the responses of the model's variables are measured.

[14] In the long term it may be reasonable to believe, on the basis of economic theory, that there is a significant link between the wage level, the price level and the level of productivity, i.e. a constant wage share. In a Bayesian VAR model, however, no long-term links are estimated. Instead a prior distribution is used, that is an assessment made prior to the estimate, for instance how high the long-term sustainable rate of wage increases will be.

relatively high significance for wage formation in the Swedish economy in the short term according to this model specification. Wages react quickly to the agreement level, while unemployment has a gradual impact over a longer period of time.

Changes in the CPI and productivity, on the other hand, have only marginal direct effects on wage formation. A one percent increase in productivity leads to an increase in wages of 0.11 percentage points after two quarters, while a one per cent increase in the rate of inflation leads to an increase in wages of 0.15 percentage points after four quarters. Changes in unemployment, productivity and the CPI may, however, affect wages indirectly via the collective agreements. The impulse-response analysis does not, however, show any significant direct effects via the collective agreements. It should be pointed out that the results presented above are specific to this model.

Figure 4. Results of an impulse-response analysis for the BVAR model. The effects on wage increases (annual percentage change) throughout the economy of positive shocks to productivity, the CPI, unemployment and central agreements.
Percentage points

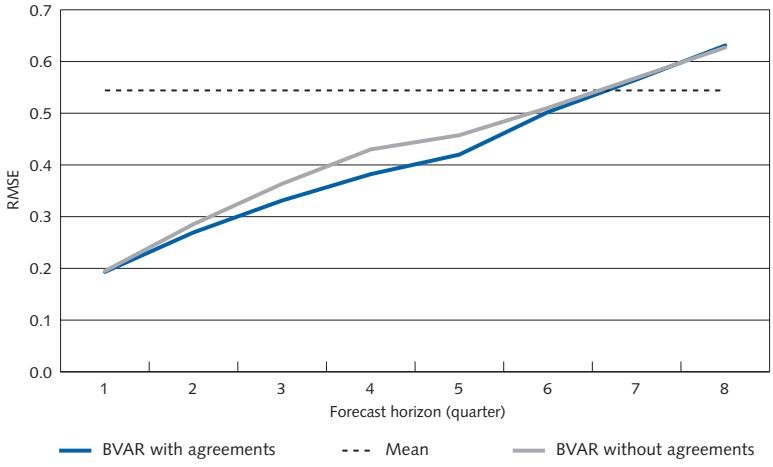


Source: the Riksbank.

Should the collective agreements be included in the model?

The impulse-response analysis indicates that the collective agreements have relatively significant impacts on wage formation in the short term. But should collective agreements really be included in a wage formation model? One way of testing this is to estimate two models: one that contains a series for central agreements and one that does not. We can then perform recursive forecast evaluations for both models. If the forecasting ability of the model that contains the series for collective agreements is

Figure 5. Results of forecast evaluations for two Bayesian VAR models (with and without central agreements).
RMSE for wage development (annual percentage change) throughout the economy for the period 2001:1–2008:4



Source: the Riksbank.

better than the forecasting ability of the model that does not, then the former model should be used to forecast the development of wages in the economy.

The forecasting ability of the models with regard to the development of wages is evaluated in terms of the root mean square error (RMSE). A model with a low RMSE has a better forecasting ability than a model with a high RMSE. The model forecasts are then evaluated in relation to the mean value for the rate of wage increases in the entire economy during the period 2001:1-2008:4.

Figure 5 shows the results of the forecast evaluation. After six quarters, the mean forecast's RMSE is lower than the model forecasts' RMSE, that is after six quarters the mean value is a better forecast than the models' forecasts. This means that the models are primarily useful as forecasting tools up to a horizon of six quarters. Within a forecasting horizon of six quarters, the model that includes central agreements provides better forecasts of wage development than the model that excludes central agreements.

Model forecasts provide a complement to the assessment of wage development

The historical and institutional review in this study shows that a lot has happened in the field of wage formation in Sweden since the 1980s. This makes it difficult to adequately estimate wage formation in an econometric model. Despite these difficulties, we make an attempt to do so in this study.

The results of the estimate show that the collective agreements and the situation on the labour market have a direct impact on wage formation in Sweden in the short term. Changes in the CPI and productivity, on the other hand, have only marginal short-term effects on wage formation. A forecast evaluation shows that forecasting ability improves if the collective agreements are included in the models.

It is, however, important to remember that the forecasts produced in econometric models only provide support or act as a complement to the assessment of wage development in the future. The Riksbank's assessment is also influenced by other information. One example of this is the government's announcement regarding changes in the statutory employers' contributions. Such changes are relevant to the assessment of the development of wage costs in the future and they are usually announced six months or a year before the change is implemented. Agreements entered into between the social partners on new levels for premiums for various collective insurance schemes may also influence the Riksbank's assessment. One example of this is the new agreement concluded between LO and the Confederation of Swedish Enterprise on one of the supplementary pension schemes which, among other things, stipulates the level of the premiums for the period 2008–2012. The Riksbank also constantly monitors the wage formation process on the Swedish labour market. For example, the Riksbank regularly analyses the agreements that are entered into. The "Framework agreement on lay-offs and training" that was signed at the begining of March is one example of an agreement that will have an impact on wage formation in the manufacturing industry.

Appendix A

The estimated Bayesian VAR-model is presented below.

$$(1) \qquad \begin{bmatrix} \Delta \ln q_t - \varphi_1' D_t \\ u_t - \varphi_2' D_t \\ \Delta \ln p_t - \varphi_3' D_t \\ \Delta \ln A_t - \varphi_4' D_t \\ \Delta \ln w_t - \varphi_5' D_t \end{bmatrix} = \sum_{\gamma=1}^{k=4} B_\gamma \begin{bmatrix} \Delta \ln q_{t-\gamma} - \varphi_1' D_{t-\gamma} \\ u_{t-\gamma} - \varphi_2' D_{t-\gamma} \\ \Delta \ln p_{t-\gamma} - \varphi_3' D_{t-\gamma} \\ \Delta \ln A_{t-\gamma} - \varphi_4' D_{t-\gamma} \\ \Delta \ln w_{t-\gamma} - \varphi_5' D_{t-\gamma} \end{bmatrix} + \begin{bmatrix} v_{1t} \\ v_{2t} \\ v_{3t} \\ v_{4t} \\ v_{5t} \end{bmatrix},$$

where Δ denotes first differences, *ln* natural logarithms, q_t productivity, u_t the percentage of unemployed according to the ILO-definition, p_t the CPI, A_t collective agreements, w_t wages, B_γ parameter matrices of the dimension (5x5) and k the number of lags. $D_t = [1 \;\; d_{1t} \;\; d_{2t}]$ is a vector that contains an intercept and two shift dummies where d_{1t} $\{0$ if $t < 1991{:}1;$ 1 if $t \geq 1991{:}1\}$ and d_{2t} $\{0$ if $1993{:}1 < t > 1999{:}4;$ 1 if $1993{:}1 \leq t \leq 1999{:}4\}$; 0 if $t > 1994{:}4$. $V_t = [v_{1t} \;\; v_{2t} \;\; v_{3t} \;\; v_{4t} \;\; v_{5t}]$ is a vector with residuals where $V_t \sim N(0,\Omega)$, that is the residuals are normally distributed with the mean value zero and Ω is a covariance matrix. The model's impulse-responses are based on the model's structural form, which in turn stems from a Cholesky factorisation.

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Anchoring fiscal expectations

av Eric M. Leeper

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ABSTRACT. In this lecture, I argue that there are remarkable parallels between how monetary and fiscal policies operate on the macro economy and that these parallels are sufficient to lead us to think about transforming fiscal policy and fiscal institutions as many countries have transformed monetary policy and monetary institutions. Making fiscal transparency comparable to monetary transparency requires fiscal authorities to discuss future possible fiscal policies explicitly. Enhanced fiscal transparency can help anchor expectations of fiscal policy and make fiscal actions more predictable and effective. As advanced economies move into a prolonged period of heightened fiscal activity, anchoring fiscal expectations will become an increasingly important aspect of macroeconomic policy.

1. Introduction

A stunning transformation in monetary policy has occurred in the past 15 years. Central banks have moved from "monetary mystique" to a "culture of clarity," a movement in which the Reserve Bank of New Zealand and the Sveriges Riksbank have led the way. It is now widely accepted that for monetary policy to effectively stabilize the real economy and inflation, it should be guided by several principles: monetary policy should be independent of fiscal policy, insulated from political pressures, and avoid

Date: September 18, 2009. Department of Economics, Indiana University; eleeper@indiana.edu. A previous version of this article appeared in *Reserve Bank of New Zealand Bulletin* 72(3), September 2009, 7–32. This paper draws on the author's public lecture on November 12, 2008 in Wellington, New Zealand, which was part of the author's tenure as a Professorial Fellow in Monetary and Financial Economics at Victoria University of Wellington and the Reserve Bank of New Zealand. I thank the Victoria University of Wellington Foundation, the Victoria University of Wellington School of Economics and Finance, and the RBNZ for their fabulous hospitality to me and my family and for providing me with this unusual intellectual opportunity. Many people provided useful input to this lecture, particularly, Mark Blackmore, Stephen Burnell, Peter Bushnell, Arthur Grimes, Viv Hall, John Janssen, John McDermott, Adrian Orr, and Bryce Wilkinson. I also thank Huixin Bi, Troy Davig, Jim Poterba, Shu-Chun Susan Yang, and Jürgen von Hagen for comments on this draft.

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fooling people in order to offset the dynamic effects of distortions in the economy; in addition, central bankers should communicate transparently about their objectives and their strategies for achieving those objectives and they should be held accountable for their decisions.

There is less widespread agreement about the position taken by some central banks to take transparency to the next level by announcing the governors' own views about the likely future path of the policy interest rate.[1]

Still more remarkable is that this transformation occurred in the absence of any real evidence that transparency of monetary policy and improved communication by central banks actually matter for the performance of the economy.[2] Two conditions drove the move toward greater transparency. First, a professional consensus emerged that inflation is a monetary phenomenon and that inflation control is the appropriate purview of the central bank. Second, and perhaps more important, a political consensus developed that low and stable inflation is desirable because inflation fluctuations redistribute wealth in capricious ways [Faust and Henderson (2004)]. It took several decades of poor macroeconomic performance for these consensuses to develop.

Why have we seen no corresponding enlightenment in governments' tax and spending policies? Despite a range of changes in fiscal frameworks across advanced countries since the 1990s, in general, fiscal policy remains as opaque as ever. Is it desirable to transform fiscal policy in a manner that is analogous to what has occurred with monetary policy? Is it feasible? Can professional and political consensuses on the effects and role of fiscal policies be reached?

Monetary authorities and fiscal authorities appear to mean different things by "transparency." For central banks it is a means to an end: the better the public understands and anticipates monetary policy choices, the more firmly expectations will be anchored on actual monetary policy goals, and the more effective monetary policy will be in achieving its objectives. This is the sense in which I shall use the term. But this is not how fiscal authorities apply the term. In fiscal realms, "transparency" means the adoption of generally accepted accounting principles, the conduct of policy in an open and public way, and so forth. Fiscal transparency is more about establishing the integrity of the fiscal process than it is about helping the public to form expectations of future tax and spending policies. Although fiscal authorities compute and publish fiscal projections, the projections typically condition on current policies; they are silent on

[1] Faust and Leeper (2005) discuss these issues in more detail in the context of monetary policy.

[2] There is now evidence supporting the earlier presumption [see Blinder, Ehrmann, Fratzscher, De Haan, and Jansen (2008)].

possible *future* policies and, therefore, contribute little to transparency and the anchoring of fiscal expectations.

This lecture will argue that there are strong parallels between how monetary and fiscal policies affect private-sector behavior and what the two kinds of policies can achieve in the macro economy. Along many important dimensions monetary and fiscal policies have more similarities than dissimilarities. As a consequence, the arguments that have led countries to make dramatic reforms to their monetary policy institutions apply with equal – or possibly greater – force to fiscal policy. Because fiscal policy actions typically generate changes in government debt, taxes, and spending that extend over several decades, in practice, dynamics may be more important for fiscal policy than for monetary policy [Chung and Leeper (2007), Leeper, Plante, and Traum (2009)].

This fact has not been fully embraced by institutional reformers.[3] Instead, fiscal reforms are often superficial and frequently ineffectual when compared to the thorough-going reformations of monetary policy in many countries. I will argue that this asymmetric treatment of monetary and fiscal policies runs the risk of undermining the progress made in monetary policy. I will also argue that, because fiscal policy in many countries is likely to raise substantial economic and political challenges over the next several decades, fiscal transparency and the anchoring of fiscal expectations will become increasingly important aspects of macroeconomic policy. Effective reforms may require statutory or constitutional enforcement that give the reforms bite.

Inconsistencies between monetary and fiscal policy frameworks are most likely to become apparent in times of economic stress. The current financial turmoil and worldwide recession may provide a challenging test to the monetary-only reforms.

2. Fiscal Failure Breeds Monetary Success

2.1. FISCAL ROOTS OF EXTREME CRISES

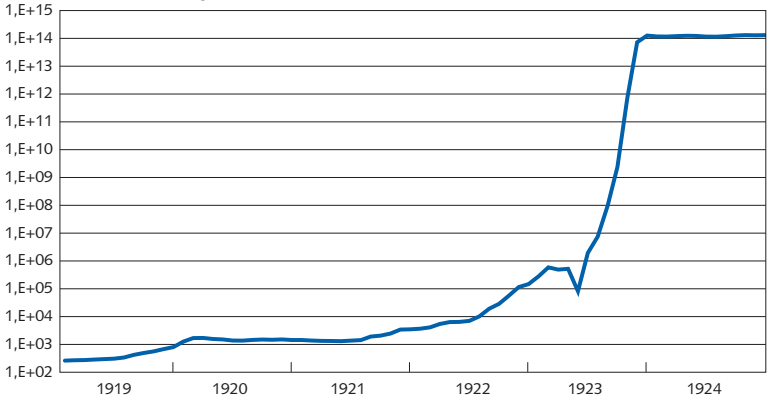
History abounds with examples where badly managed fiscal policies undermined the ability of monetary policy to achieve its macroeconomic objectives. Even observers who subscribe to the adage that "inflation is always and everywhere a monetary phenomenon," acknowledge that it is "almost always" and "nearly everywhere." Hyperinflation is the clas-

[3] Although many treasuries or other fiscal agencies are required to construct long-term projections, for reasons discussed below, these projections do not adequately reflect the dynamics of fiscal policies; neither do they contribute toward making fiscal policy meaningfully more transparent.

sic exception – presumably the one that makes the rule – of an inflation whose fundamental cause is fiscal policy run amok.

The best-known hyperinflation occurred between the world wars in Europe. After World War I, Germany was under tremendous fiscal strain: the Versailles Treaty entailed substantial reparation payments from Germany to France and England; the German government needed to provide for large numbers of war victim; the destroyed economy created an extraordinarily weak tax base, making it impossible to collect sufficient revenues to cover expenditures. Government budget deficits were large, with revenues never covering more than about 35 percent of expenditures. Running the printing presses was the only fiscal option available to the government, with the predictable results. Between July and November of 1923, the inflation rate was 560 *billion* percent. Figure 1 records the overall price level in Germany from 1919 to 1924, using a logarithmic scale. During this period, the price level increased several *trillion* fold.[4]

Figure 1. The price level in Germany during the interwar era.
Vertical scale is logarithmic.



Source: Sargent (1986).

Germany's hyperinflation led after World War II to the Bundesbank law in 1948 that granted the bank independence and made price stability its primary objective. Germany's Bundesbank was widely regarded as the world's foremost inflation fighter, even during the 1970s when many countries experienced a steady upward march in inflation rates.[5] Even now hyperinflation's legacy looms large over European monetary policy: European Monetary Union, with Germany as a central player, is designed

[4] Of course, along with the massive inflation came large distortions to the real economy and the associated output losses. Sargent (1986) describes several other historical episodes of hyperinflation at the same time – Austria, Hungary, and Poland – tracing each to large-scale fiscal failures.

[5] As von Hagen (1999) documents, the reality of the Bundesbank's success in combating inflation deviated from those perceptions, especially in the early 1970s.

to carry the legacy of the horrors of hyperinflation into policy decisions of the European Central Bank.

Latin American countries are well known for having high inflation or periodic bouts of hyperinflations in which fiscal policies have played a central role [Singh, Belaisch, Collyns, De Masi, Krieger, Meredith, and Rennhack (2005)]. Some examples of peak inflation rates are: Bolivia, May to August 1985, 60,000 percent [Sachs (1987)]; Argentina, May 1989 to March 1990, 20,266 percent [Reinhart and Savastano (2003)]; Peru, July to August 1990, 12,378 percent [Reinhart and Savastano (2003)]. Chile became the world's second inflation targeting country when it transformed its monetary policy in September 1990. Four other Latin American countries – Brazil, Columbia, Mexico, and Peru – now officially target inflation [Vega and Winkelried (2005)]. Several of these countries, and Chile in particular, backed up their monetary reforms with dramatic fiscal reforms.

2.2. FISCAL ROLE IN MODERATE CRISES

Sweden and New Zealand are instructive examples of countries that experienced moderate – judged by the standards of hyperinflations – economic crises to which the macroeconomic policy response was reform of both monetary and fiscal institutions. Both countries also underwent extensive deregulation of financial markets immediately preceding the macroeconomic reforms. Although both countries did adopt fiscal reforms, those reforms were not nearly as through-going as the monetary changes, which were wholesale reforms of the objectives and the execution of monetary policy.

2.2.1. Sweden

In the early 1990s Sweden experienced a boom-bust cycle that severely tested the prevailing monetary-fiscal policy regime.[6] After deregulation of the financial system, the economy boomed in the late 1980s, with rapid growth in GDP, employment, consumption, and imports. Despite a worsening current account balance, monetary policy was prevented from reacting to the boom because the krona was pegged to a basket of currencies.

By 1989–1990 the boom had ended and the bust began. Rising international real interest rates exerted further pressure on the pegged krona while simultaneously the Riksbank raised nominal interest rates to defend the krona against speculative attacks. Major tax reform in 1990–

[6] This section draws liberally from Swedish Ministry of Finance (2001), Jonung (2009), and Wetterberg (2009).

1991 sharply lowered marginal tax rates and reduced mortgage deductibility, raising real after-tax interest rates still more. The strong increases in real rates deflated asset values, which reduced wealth and triggered a banking crisis.

The resulting recession was comparable to Sweden's experience in the Great Depression. GDP fell for three consecutive years. Unemployment rose from 1.5 percent in 1989 to over 8 percent in 1993. The cumulative employment loss exceeded that of the Great Depression, according to Jonung (2009). Attacks on the krona continued, culminating in the famous instance on September 16, 1992 when the Riksbank raised the overnight rate to 500 percent.[7] In the event, by November 19 the Riksbank allowed the krona to float.

Large automatic stabilizers built into Swedish fiscal rules swung the general government balance from a 5 percent surplus in 1989 to nearly a 12 percent deficit in 1993.[8] Central government debt rose from 30 percent to 80 percent of GDP over the same period.

The Swedish government responded with a thorough reform of both monetary and fiscal policy. Beginning in January 1993, the Riksbank announced a 2 percent target for CPI inflation, applying from 1995 on. This target was formalized by the Sveriges Riksbank Act, passed in 1997, an act that greatly reinforced the Riksbank's independence [Sveriges Riksbank (2008)]. Fiscal policy in 1993 consolidated in fits and starts, but projections showed government debt continuing to grow rapidly and fears of sustainability arose. Progress on fiscal reform was motivated by at least three concerns. First, bond markets downgraded Swedish sovereign debt in 1993. Second, by the end of 1993 one-third of government expenditures were devoted to debt service. Third, it was recognized that fiscal instability could undermine the Riksbank's newly adopted inflation targeting regime. A series of bills beginning in late 1994, called the "Consolidation Programme," sought to stabilize debt by adopting both a nominal expenditures ceiling and a surplus target. By 1998 the budget had swung back to surplus and debt was on a downward trajectory.

Jonung (2009) lists macroeconomic policy reforms as critical factors in resolving crises in both the financial sector and the real economy. Swedish policies continue to be guided by the reforms that grew out of the crises.

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7 The Riksbank had plans to go as high as 4000 percent [Swedish Ministry of Finance (2001)].

8 Sweden is known for having unusually strong automatic stabilizers [Floden (2009), Calmfors (2009)].

2.2.2. New Zealand

After a decade of poor economic performance, in July 1984 New Zealand launched comprehensive economic reforms that transformed the country's economic landscape. Over the previous decade, government debt had increased sixfold, inflation rates were chronically in the double digits, and the unemployment rate had risen from 0.2 percent to 4.9 percent.

Reforms were broad and deep. They included privatization and deregulation of industries, financial and trade liberalization, reform of public finance, and deregulation of labor markets [Evans, Grimes, Wilkinson, and Teece (1996)]. In terms of macroeconomic policies, the critical changes were the decision to allow the Kiwi dollar to float on March 4, 1985, the passage of the Reserve Bank of New Zealand Act in December 1989, and the Fiscal Responsibility Act in 1994.

New Zealand led the way in reform of its monetary policy.[9] Although at the time other central banks were operating with considerable autonomy – for example, the German Bundesbank, the Swiss National Bank, and the U.S. Federal Reserve – the Reserve Bank Act established that the central bank's primary function was "achieving and maintaining stability in the general level of prices." The Act also required the Governor of the RBNZ and the Minister of Finance to negotiate a Policy Targets Agreement (PTA), which laid out specific targets – in practice, an inflation target – that the Bank would aim to hit. Transparency was served by publicly announcing the PTA. Accountability was addressed by making the Governor's contract conditional on achieving the agreed upon targets; in principle the Governor could be dismissed or not renewed for failing to attain the targets. The Reserve Bank Act and its implementation were bold initiatives that began the worldwide movement toward inflation targeting, the monetary policy regime now adopted by more than 20 central banks.

As in Sweden, fiscal reforms in New Zealand progressed more gradually. In the decade from the early 1980s, New Zealand sovereign debt was downgraded three times, from AAA to AA–. Estimates of default and liquidity premia on its debt ranged from about 125 basis points in 1990 to 75 basis points in 1994 [Hawkesby, Smith, and Tether (2000)] when the debt-GDP ratio had climbed to over 50 percent. Just as monetary policy became focused on a single objective – inflation targeting – fiscal reforms were designed "to provide stable policies rather than stabilization policies," as (Evans, Grimes, Wilkinson, and Teece, 1996, p. 1863) put it.

Fiscal reforms culminated in the Fiscal Responsibility Act of 1994, which shifted focus from short-run economic and political issues to strate-

[9] Lloyd (1992) provides a nice overview.

gic and long-run objectives [Scott (1995)]. Out of the Act grew enhanced transparency in the form of detailed accounts and long-run projections, which are made public. It also mandates that sovereign debt levels should be at "prudent levels," a mandate that is now interpreted as an informal debt target of 20 percent of GDP, a level that presumably will ensure that New Zealand sovereign debt is not assessed a substantial default premium.

2.3. SUMMARY

Many countries, in addition to Sweden and New Zealand, transformed their monetary policies, adopting either explicit or *de facto* inflation targeting. Advocates of the monetary policy transformation point to data like those depicted in figures 2 and 3 as evidence that the monetary transformation has been highly successful. Both the average level and the volatility of inflation across countries have declined markedly over the past 20 years [figure 2]. And the success with inflation begat less variation in output growth in those same countries, a phenomenon that has been labeled, perhaps immoderately, "the great moderation" [figure 3]. Those advocates attribute these two striking successes entirely to monetary policy reforms that have delivered better policies. But for many countries whose data appear in those figures, the years from the mid-1980s to 2007 were particularly benign, with only mild recessions and no large and persistent adverse economic shocks.[10]

Benign, that is, until now. The current global recession and financial crisis are testing the view that monetary policy alone can deliver good economic performance.

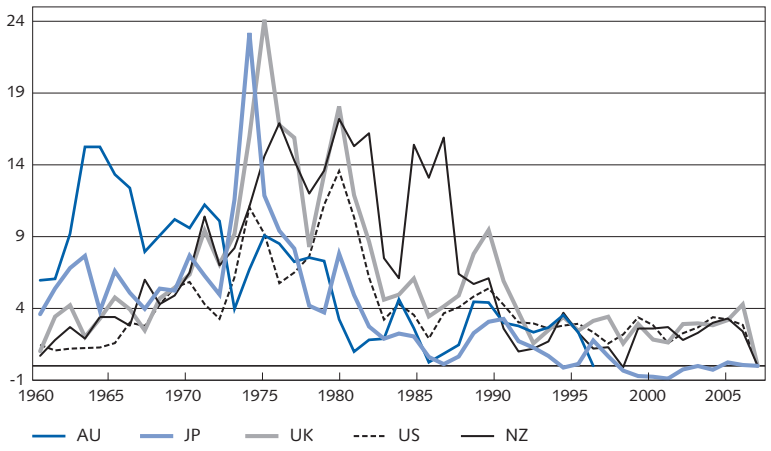
3. Parallels Between Monetary and Fiscal Policies

Despite the willingness of economists to concede that fiscal policy may drive inflation in extreme circumstances, such as hyperinflations, those same economists hold fast to the view that "normally" monetary policy alone can control inflation, if only central bankers have sufficient resolve. I now develop the argument that in the realm of inflation control, as well as other matters, it is generically true that it is the *joint* behavior of monetary and fiscal policy that matters, even in normal times.

Classic writings about macroeconomic policies recognized the inherent symmetry between monetary and fiscal policies. For example, Friedman's sweeping policy prescriptions treated the two branches of macroeconomic

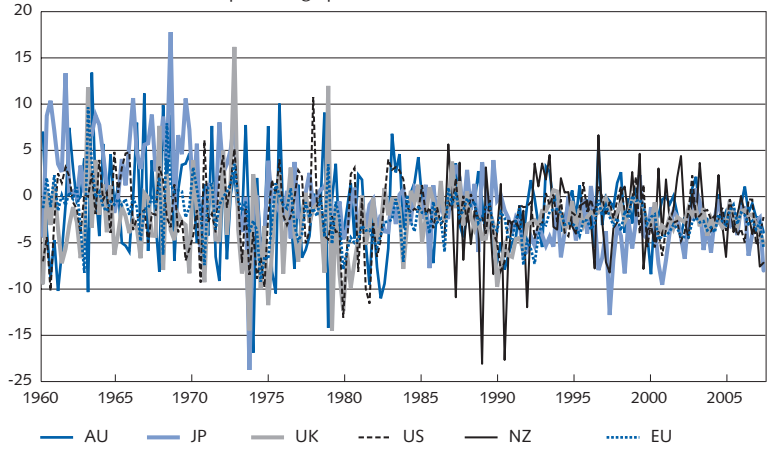
[10] In this same set of countries, New Zealand stands out as the exception, with the recession in the early 1990s producing large negative growth rates in GDP.

Figure 2. Inflation rates in selected countries.
Vertical scale is annual percentage points.



Sources: OECD *Economic Outlook*, various issues, and Reserve Bank of New Zealand.

Figure 3. Output growth rates in selected countries.
Vertical scale is annual percentage points.



Sources: OECD *Economic Outlook*, various issues, and Reserve Bank of New Zealand.

policy equally [Friedman (1948, 1960)]. In later years, when Friedman began to discuss monetary policy exclusively, his critics shot back that fiscal policy and government liabilities, such as debt, needed to be brought in as equal partners with monetary policy and money [Brunner and Meltzer (1974, 1972), Tobin (1974, 1980), Tobin and Buiter (1976)].

The profound influence of Friedman's later work is apparent even today. Leading graduate textbooks in monetary economics by Walsh (2003), Woodford (2003), and Gali (2008) discuss monetary policy in tremendous detail with only scant, if any, reference to fiscal policy, and then only to acknowledge that the book's maintained assumptions serve

to trivialize fiscal policy. Walsh (2003) does contain some discussion of fiscal theories of the price level, but treats them as a distinct perspectives on macro policy, rather than as an integral part of a comprehensive view of price level determination. The bulk of the book, however, examines monetary policy in isolation from fiscal policy. Discussions by leading monetary economists about monetary frameworks and inflation targeting rarely, if ever, mention fiscal policy [Bernanke and Mishkin (1997), Bernanke, Laubach, Mishkin, and Posen (1999), Rotemberg and Woodford (1999), Svensson (1999), Taylor (1999), Goodfriend (2005)]. Econometric models estimated at central banks typically treat fiscal policy in only the most perfunctory manner, if they include it at all [Brayton and Tinsley (1996), Smets and Wouters (2003, 2007), Harrison, Nikolov, Quinn, Ramsey, Scott, and Thomas (2005), Adolfson, Laseen, Linde, and Villani (2007)].[11]

I will take the position that, despite the established tradition of treating monetary policy separately from fiscal policy, there are remarkable parallels between how monetary and fiscal policies operate on the macro economy and that these parallels are sufficient to lead us to think about transforming fiscal policy and fiscal institutions as many countries have transformed monetary policy and monetary institutions. Indeed, it makes little sense to reform monetary policy independently of fiscal policy.

Four important parallels stand out: macroeconomics impacts, the centrality of expectations for policy effects, ensuring government solvency, and the importance of transparency and credibility for policy effectiveness. In what follows, I focus on fiscal policy because much has already been written about these issues with regard to monetary policy.

3.1. MACROECONOMIC IMPACTS.

Both monetary and fiscal policies can influence real economic activity and control inflation, and both do so with, in Friedman's (1961) famous phrase, "long and variable lags." That changes in tax distortions and government purchases can have important effects on the real economy is widely accepted. Empirical evidence suggests that for a variety of reasons, even changes in non-distorting taxes and transfers have real effects.

Fiscal policies play an important countercyclical role in many countries. Automatic stabilizers are built into tax codes and expenditure programs that ensure that during economic downturns tax burdens decline while government transfers increase, with the aim of cushioning individuals

[11] The International Monetary Fund's "Global Integrated Monetary Fiscal Model" is an important exception [Kumhof and Laxton (2008a)].

against declines in their incomes. In Sweden, for example, automatic stabilizers are large and have been relied on as nearly the sole source of countercyclical policies during the 2007–2009 recession [Floden (2009), Borg (2009)]. "Discretionary" policies, which require legislative action, are a form of countercyclical response that has played a major role in the current recession [examples of recent fiscal initiatives appear in Romer and Bernstein (2009), HM Treasury (2009a), Australian Treasury (2009), and New Zealand Treasury (2009)].

Less well appreciated, and less studied, are the impacts of fiscal policy on inflation. Recent research under the rubric of the "fiscal theory of the price level" argues that under certain assumptions about monetary and fiscal policy behavior, it is *fiscal policy*, rather than monetary policy, that determines the price level and the rate of inflation.[12]

At its most basic level, the fiscal theory brings to the foreground the role of an intertemporal equilibrium condition that in most monetary-only analyses of inflation is swept into deep background. This equilibrium condition, which equates the value of outstanding government liabilities – money plus bonds – to the expected present value of net-of-interest fiscal surpluses inclusive of seigniorage revenues, is ubiquitous in formal economic models and intrinsic to thinking about policy in dynamic economies. Schematically, the intertemporal equilibrium condition (IEC) is expressed as

$$\text{Market Value of Liabilities} = \text{Expected Present Value of Future Net Real Surpluses} \qquad \text{(IEC)}$$

where

$$\text{Net Real Surpluses} = \text{Total Revenues} + \text{Central Bank Seigniorage} - \text{Government Consumption \& Investment} - \text{Government Transfer Payments}$$

Importantly, the expected present value of surpluses reflects the beliefs that holders of government liabilities have about the entire future paths of the policy variables that constitute net surpluses.

It is natural to interpret expression (IEC) as a valuation formula for liabilities [Cochrane (1999)]. Government liabilities derive their value from their anticipated backing. That backing comes from the government's ability to raise revenues through direct taxes or through inflation taxes, as well as the ability to reduce spending obligations.

[12] These papers include Leeper (1991), Sims (1994), Woodford (1995, 2001a), Cochrane (1999), Gordon and Leeper (2006), and Leeper and Yun (2006), among many others.

Following an economic disturbance that perturbs the equality in the (IEC), equilibrium can be reestablished through some combination of adjustments in the value of the liabilities – prices of bonds or the general price level – or in expected surpluses.[13] Stark forms of monetary or fiscal theories of price level determination are distinguished by assumptions about how equality of the (IEC) is achieved.

Monetary theories assume adjustment occurs primarily through surpluses, typically in some non-distorting way, such as via lump-sum taxes. In this manner, monetary policy is free to determine the price level – as it does in characterizations of inflation targeting central banks – and thereby the value of government liabilities. Fiscal policy is relegated to a supporting role, as it is required to adjust future surpluses sufficiently to ensure the (IEC) holds. This monetary-fiscal policy regime is variously referred to as "monetary dominance" [Sargent (1982)], "monetarist/Ricardian" [Aiyagari and Gertler (1985)], or "active monetary/passive fiscal policy" [Leeper (1991)]. Of course, fiscal policy's supporting role is *essential* for monetary policy to be able to control inflation. If fiscal policy is unwilling or unable to provide appropriate support, monetary policy will lose control of inflation, a point that has been forcefully made by Sims (2005) in the context of inflation targeting and by Cochrane (2009) in reference to current macro policies.

Fiscal theories posit that surpluses do not systematically adjust to establish the (IEC), so adjustment must occur through the market value of liabilities. Because liabilities are denominated in nominal, or dollar, terms, changes in the price level alter their real value: a higher price level reduces their value and requires less backing from future surpluses. Alternatively, when government bonds have long maturities, their prices can adjust, which change long-term interest rates and, therefore, expected inflation [Cochrane (2001)]. Now monetary policy plays the supporting role by allowing to occur the fluctuations in the inflation rate that are needed to stabilize debt. The policy regime underlying the fiscal perspective is called "fiscal dominance," "non-Ricardian," or "passive monetary/active fiscal policy."[14] Symmetrically, if monetary policy fails to provide support, then fiscal policy cannot control the price level.

Two striking conclusions emerge from the fiscal theory: newly issued nominal government debt is inflationary and increases in nominal interest

[13] Of course, the discount rate can also play a role in the adjustment process, as empirical work seems to suggest [Chung and Leeper (2007), Leeper, Plante, and Traum (2009)].

[14] There is evidence that macroeconomic policies in some countries have been consistent with the fiscal theory equilibrium [Cochrane (1999), Sims (2001, 2008), and Woodford (2001a)]. Davig and Leeper (2006, 2009) pursue the plausible idea that monetary and fiscal regimes fluctuate over time, bouncing among mixes of the two policies, according to estimates of policy behavior. In that environment, the fiscal mechanisms are always at work.

rates induced by monetary policy behavior *raise* rather than lower inflation. Sims (2008) nicely summarizes the mechanisms at work:

> "Increases in nominal debt in the hands of the public that are not accompanied by any increase in expected future tax liabilities or by any increase in the price level leave the public with apparently increased wealth, which they will try to spend, until price increases erode their wealth or expectations about future taxes or economic growth make them scale back spending. In these circumstances, an increased nominal interest rate flows directly through to increased nominal government spending. In a flexible price model, the monetary authority loses any ability to affect the price level, as interest rate increases increase the rate of expansion of nominal government debt without any restrictive effect on spending plans [p. 2]."

Two key roles of macroeconomic policies – output stabilization and price level control – can be achieved by either monetary or fiscal policy. Successful regimes that assign these tasks to either monetary or fiscal policy alone, however, require that the other policy cooperate by playing the appropriate supporting role.

3.2. ROLE OF EXPECTATIONS

A central tenet of modern economic analysis is that households and firms base their decisions, in part, on how they expect economic conditions to evolve in the future. Because future policies influence future economic conditions, economic agents must also form expectations over how policy choices will evolve. For monetary policy this forward-looking behavior implies that both the current policy interest rate and the *expected path* of interest rates indicate the stance of monetary policy that determines the impacts of policy. As Woodford (2001b) puts it: "…successful monetary policy is not so much a matter of effective control of overnight interest rates...as of affecting...the evolution of market *expectations*…[p. 307]."

Transparency and clear communications are most important when people make forward-looking decisions. Most central banks now try to include in their communications with the public some information about the "tilt" or the "risks" to policy, revealing to some extent where the central bank thinks policy is headed. A handful of innovative central banks have taken communication about future policy to the next level. These banks, which include Canada, New Zealand, Norway, and Sweden,

announce what they believe is the most likely path for the policy interest rate over the forecast horizon.

What's true about the role of expectations in transmitting the effects of monetary policy is true in spades about fiscal policy. There is substantial evidence that households and firms respond to tax changes at the time the changes are announced, which typically is before the changes are implemented [Poterba (1988, 1989), Steigerwald and Stuart (1997), Auerbach and Slemrod (1997), Ramey and Shapiro (1998), Ramey (2007)]. Moreover, economic theory is unambiguous in its predictions: anticipated changes in taxes or government spending can have large effects on economic behavior [Yang (2005), Mertens and Ravn (2008), Leeper, Walker, and Yang (2008, 2009a)].

Some kinds of taxes, such as those on savings, operate entirely through expectations. Consumption-savings decisions are influenced, not by the current tax rate on savings, but by the expected tax rate because it is the tax rate in the future that affects the expected return to saving. Firms' production and employment decisions depend on anticipated taxes on profits and payrolls. Government infrastructure spending, which takes time to reach fruition, gets transmitted to the macro economy through its impacts on expected productivity and anticipated returns to labor and capital [Leeper, Walker, and Yang (2009b)]. These are examples of how the *direct* effects of fiscal decisions can operate through expectations.

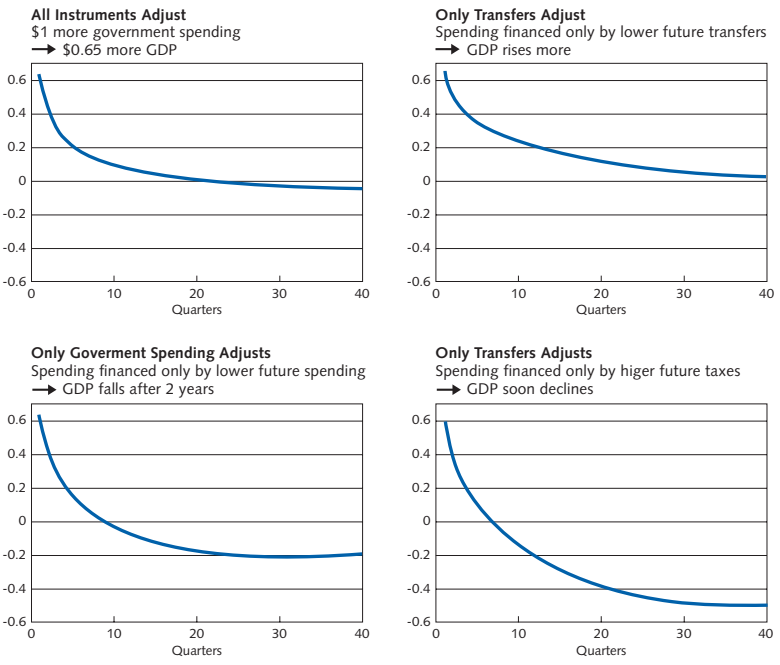
Expectations also play a key role in determining the *indirect* effects of fiscal actions. A quantitative sense of the potential importance of expectations in fiscal policy can be gleaned from estimates of fiscal effects in the United States taken from Leeper, Plante, and Traum (2009). These estimates come from a neo-classical growth model estimated on post-war U.S. data. The model includes rich fiscal detail, including policy rules for government spending, lump-sum transfers, and distortionary taxation on labor and capital income and on consumption expenditures. It also allows for debt dynamics, so spending increases or tax cuts are financed initially by selling government debt. Both the timing and the sources of fiscal adjustments that eventually retire debt back to its initial level are determined by historical experience.

Figure 4 reports conventional impact multipliers that report the dynamic effects of an initial $1 increase in government spending on GDP. The top left panel is the best fitting model in Leeper, Plante, and Traum (2009) in which all fiscal instruments adjust to finance increases in government debt. In the short run output rises by about $0.65, and then smoothly declines, with essentially no effect after about 5 years. The remaining panels of the figure report the effects under counterfactual assumptions about which future instruments will adjust to stabilize debt. When only

lump-sum transfers are cut in the future (top right panel), the output multipliers are uniformly larger. If future government spending is cut (bottom left panel), the multiplier turns negative after about 2 years and reaches a trough at –$0.20. But when future capital and labor taxes are expected to rise (bottom right panel), the multiplier becomes negative in a little more than a year and then falls to –$0.50. This figure emphasizes that because dynamics play such a central role in transmitting fiscal policy, fiscal effects in the short run can differ dramatically from long run effects.

Differences among fiscal financing schemes emerge because forward-looking economic decision makers understand the nature of the fiscal rules in place and adjust their behavior accordingly. Although future fiscal financing considerations are indirect, they can be of first-order importance in projecting the impacts of, say, a fiscal stimulus engineered by increasing government spending. As the bottom two panels of the figure make clear, the stimulus may be short lived and even counterproductive if people believe that future government spending will be cut or future taxes will be raised.

Figure 4. Government spending impact multipliers for output under alternative assumptions about fiscal financing.
Top left panel is the best fitting model in Leeper, Plante, and Traum (2009) in which all fiscal instruments adjust to finance increase in government debt; top right panel only lump-sum transfers adjust; bottom left panel only government spending adjusts; bottom right panel only capital and labor taxes adjust. Vertical scale is dollars of output following an initial increase in government spending of $1.

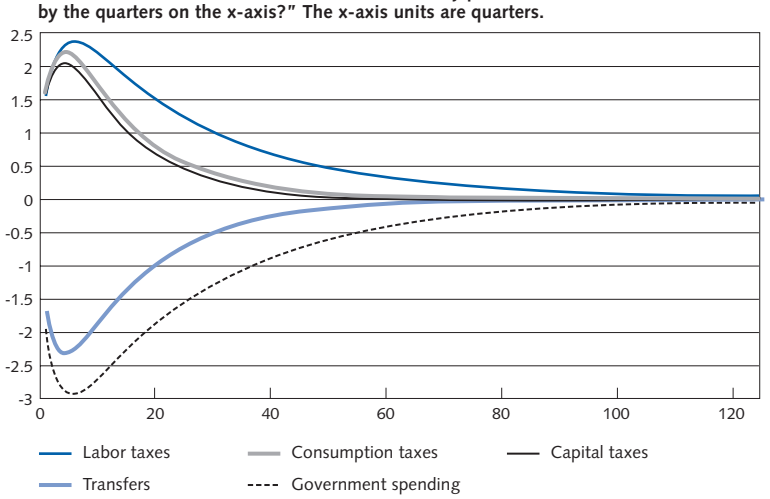


Source: Leeper, Plante, and Traum (2009).

With an estimated model of fiscal policy in hand, we can ask: "How long does it take for present-value balance to occur – that is, for the intertemporal equilibrium condition in (IEC) to be established – following fiscal disturbances that change the level of government debt outstanding?" The answer from U.S. data is: a very long time indeed; on the order of 25 to 35 years. Figure 5 answers the closely related question: "What fraction of a 1-unit change in government debt in quarter t, due to each of the five fiscal shocks, is financed by period $t + K$, where K is determined by the quarters on the x-axis?" This is really about the discrepancy between the two sides of (IEC) when the left side changes by 1 unit and the right side is truncated K periods into the future. Regardless of the fiscal shock, the discrepancy widens in the short run before the gap begins to close. The gap closes faster for some shocks than for others and in all cases, the gap is still substantial even 10 years after the initial change in fiscal policy.[15]

Figures 4 and 5 underscore three points about fiscal policy dynamics. First, fiscal effects depend strongly on *expected* future financing; even the signs of government spending multipliers can change under alternative financing schemes. Second, fiscal dynamics are long lived, extending many decades into the future. Third, fiscal impacts can change dramati-

Figure 5. Government debt funding horizons for each of five fiscal shocks—labor taxes, consumption taxes, capital taxes, transfer payments, government spending—using the mean estimates of posterior draws from the model best fitting model in Leeper, Plante, and Traum (2009) where all fiscal instruments adjust to debt. The figure can answer the question, "What fraction on a 1-unit innovation in government debt in quarter t, due to each of the five fiscal shocks, is financed by period t + K, where K is determined by the quarters on the x-axis?" The x-axis units are quarters.



Source: Leeper, Plante, and Traum (2009).

[15] Leeper, Plante, and Traum (2009) show through alternative counterfactual exercises that accelerating or decelerating fiscal adjustments – so the gap closes faster or slower – can have important consequences for the impacts of fiscal policy.

cally over time, so the total effect of a fiscal stimulus may be quite different from the initial effect. Each of these points connects explicitly to the role that expectations play in transmitting fiscal policy.

3.3. ENSURING GOVERNMENT SOLVENCY.

Either monetary or fiscal policy can ensure that the government is solvent, as touched on in section 3.1. Conventional wisdom has increases in government debt backed by some combination of higher future taxes and lower future government expenditures; these are the adjustments that occur in figures 4 and 5. "Passive" fiscal policy, which delivers this backing, is the most prevalent maintained assumption about fiscal behavior.[16]

But as the equilibrium condition (IEC) makes clear, other adjustments can occur to establish equilibrium. Here I mention three potential adjustments. First, Sargent and Wallace (1981) study an environment in which government debt is indexed to inflation, there is a threshold level of government debt that the public is willing to hold, and taxes and expenditures are unresponsive to the state of government debt. Government rolls over debt until it reaches the threshold beyond which people are unwilling to absorb new debt issuances. At this point the only option available to ensure solvency is to print money to generate seigniorage revenues, as countries did during the hyperinflations discussed in section 2.1. This raises the seigniorage component of net surpluses on the right side of (IEC). Sargent and Wallace's point is that in such an environment the central bank loses control of inflation because the required inflation tax is driven by fiscal considerations.

A second set of adjustments that ensure solvency can arise when government issues nominal debt, rather than indexed, or real, debt. With outstanding nominal debt, the stage is set for the fiscal theory to operate, as section 3.1 describes. Debt can be revalued by changes in the price level that guarantee equality holds in expression (IEC). Once again, as the quotation from Sims (2008) in section 3.1 emphasizes, monetary policy loses control of the price level. Fiscal theory adjustments have no necessary connection to the seigniorage mechanism that Sargent and Wallace (1981) emphasize, although some authors have linked the two mechanisms [King (1995)]. Whereas seigniorage financing typically implies persistently higher money growth and inflation, the fiscal theory mechanism is more subtle and difficult to detect in data.

[16] Passive fiscal policy does not preclude periodic episodes in which fiscal instruments to not adjust to debt, so that debt grows rapidly for some time. But bond holders must believe that eventually the adjustments will occur. Davig (2005) applies this reasoning in his tests of the sustainability of U.S. fiscal policy.

In all the potential adjustments just discussed – fiscal instruments, money creation, and price-level changes – the maintained assumption is that the government cannot default outright on its debt obligations.[17] This assumption is at odds with how financial markets operate in practice, a fact into which treasuries and ministries of finance around the world are well tuned.

Fears of sovereign debt default in several countries have arisen during the recent global recession. In July 2009 Irish government debt was downgraded to AA and its risk premium over German bonds was nearly 3 percentage points. In May even the venerable United Kingdom had its sovereign bond rating placed on "negative watch" in response to forecasts that government debt as a share of GDP will reach 100 percent and remain there for the medium run.

More generally, countries are frequently penalized with risk premia when their macroeconomic fundamentals or their fiscal policies raise concerns about the riskiness of their government debt [Bi (2009)]. New Zealand government debt was downgraded from AAA to AA-over the period from 1983 to 1991 when net government debt grew to a peak of a bit over 50 percent of GDP. Because risk premia are costly, making debt service consume a larger fraction of government expenditures, New Zealand adopted the fiscal reforms discussed above in section 2.2.2.

Even in the face of default risk and concerns about a country's fiscal soundness, the intertemporal equilibrium condition, (IEC), continues to hold. Risk premia serve to reduce the value of outstanding debt, reducing the left side of (IEC) to line up with expected future surpluses.

Taken literally, government "insolvency" means that a government's debt obligations exceed its ability to back the obligation: the left side of (IEC) exceeds the right side. But such an outcome is difficult to rationalize in an economy with well-informed and forward-looking investors because the (IEC) is a condition of economic equilibrium. So long as there is *some* positive price that investors are willing to pay for a government's debt, (IEC) must hold and the government is not insolvent.

Equilibrium condition (IEC) shifts the focus from "solvency" to the notion of "riskfree" policy. As Bi (2009) shows formally, risk-free policies ensure that in the face of shocks to economic fundamentals, the probabi-

[17] But a type of default, surprise revaluations of debt, does occur under the fiscal theory.

lity is negligible that an economy will reach its fiscal limit and investors will demand a risk premium to hold the government's bonds.[18]

Monetary and fiscal policy both play a role in delivering risk-free policies that keep government debt at a level where (IEC) can be satisfied without investors building in a risk penalty.

3.4. MOST EFFECTIVE WHEN TRANSPARENT

Transparency of policy has been interpreted by fiscal authorities as referring to tracking how tax revenues get spent, achieving "value for money" from government programs, following accepted accounting standards, and conducting policy in an open and public way. These laudable goals have been codified by the International Monetary Fund [International Monetary Fund (2007a,b). But these goals are really the minimal standards that a democratic society should expect from its government.

Central banks have pushed transparency to a higher plane. They take for granted that their decisions – both policy and non-policy – will be scrutinized by legislators, economists, and the public. This intense scrutiny has led the most transparent central banks to reveal to the public in written documents, public speeches, and news conferences three key aspects of their decision making processes: the objectives of monetary policy and the means by which the central bank tries to achieve the objectives; the central bank's views of the current state of the economy, including its understanding of the sources of shocks to the economy in the recent past; the central bank's forecasts of important economic variables, including at least some discussion of where future policy is likely to head. In sum, a transparent central bank communicates to the public whatever information it possesses that will help the public form its views about current and future states of the economy, which includes policy choices.

Using central banks as the model sets the transparency bar quite high for fiscal authorities. It also fundamentally redefines "transparency." To central banks, transparency is a means to the end of enhancing the effectiveness of monetary policy. By informing the public about the "hows" and the "whys" of monetary policy choices, efforts at transparency are designed to anchor the public's expectations of policy and of the targets of policy. In principle, transparency also reduces macroeconomic uncertainty by taking some of the guesswork out of policy intentions. Transparency,

[18] Bi (2009) distinguishes between the "natural fiscal limit" and the "maximum level of debt." A natural limit corresponds to the maximum tax revenues an economy can raise – the peak of the Laffer curves – when the (IEC) reflects the present value over the infinite future. Maximum level of debt is designed to reflect the populace's tolerance for government debt accumulation. It is derived by setting tax rates at the leak of the Laffer curve, but truncating the present value at some finite period to reflect a concern about policy only over the "foreseeable" future, rather than the infinite future. Bi interprets this lower debt threshold as the maximum level of debt an economy is able to service over some foreseeable horizon.

then, is a monetary policy tool that makes the central bank's other tools work better.

Fiscal transparency, as it is typically perceived, is less about the "hows" and "whys" of tax and spending decisions and more about establishing the integrity of and instilling trust in the fiscal policy process. With only a few minor exceptions, efforts at fiscal transparency do little to anchor expectations of future policy choices and, therefore, may not directly improve fiscal policy's efficacy.

Figure 4 illustrates that whether a government spending stimulus will successfully stimulate depends on how the public believes policy will adjust in the future to finance the higher spending. If the fiscal authority anticipates the new debt will be financed as debt has been historically (upper left panel), but the public believes future taxes will rise (lower right panel), the fiscal initiative could fail to stimulate the economy and co uld even cause output to contract sharply within a short time. When the public's expectations of fiscal financing are not aligned with the policy authority's, the impacts of fiscal actions become less predictable and, as the figure illustrates, can be counterproductive. This example highlights why it may be desirable for fiscal authorities to think about transparency as central banks do: anchoring expectations by providing information about what policies might occur in the future.

4. Fiscal Transparency and Predictability

For many reasons it is not an easy task to enhance fiscal transparency by providing information that helps to anchor expectations of future fiscal choices. The two most prominent reasons offered for the difficulties are:

(1) Fiscal policy is complex;

(2) Current governments cannot commit future governments.

These reasons are true. But they also underscore why enhanced fiscal transparency is potentially so valuable.

4.1. COMPLEXITY

Whereas in normal times the central bank conducts routine monetary policy by setting one or two instruments – an overnight interest rate and possibly a rate at which commercial banks can borrow from the central bank – the fiscal authority routinely sets a seemingly endless array of

instruments.[19] There is a long list of tax rates on various sources of income and types of consumption and investment expenditures. Tax codes can be enormously complicated and imply highly non-linear tax functions. Government spending falls on a large variety of goods and services with different characteristics and potentially different impacts on the macro economy. Taxes and transfer payments affect income distribution and can have profound effects on economic incentives.

Fiscal decisions are taken by many actors with many motives. Political factions arise in response to some issues and dissolve in response to others. Lobbyists and groups representing small constituencies can have disproportionate influence on fiscal outcomes. Fiscal decisions, which are taken in the political realm, can be difficult for the public to understand, much less forecast.

Further complicating the fiscal decision process is a stunning fact: a clearly defined and attainable set of objectives for fiscal policy is rarely specified. Many fiscal authorities lay out their objectives on their web pages. Sustainable fiscal policy is the most common goal. But achieving sustainable policy is equivalent to aiming to avoid government insolvency. If a company's CEO were to announce to shareholders that the company's overarching goal is to avoid bankruptcy, the CEO would soon be replaced. Surely people can ask for more than minimal competence from their public officials.

Treasuries and ministries of finance, of course, do list objectives in addition to achieving sustainable policies. In fact, they tend to list *many* objectives to which they do not attach weights and whose internal compatibility is not discussed. Here is a sampling of objectives gleaned from the web pages of fiscal authorities in Australia, New Zealand, Sweden, the United Kingdom, and the United States:[20] achieve high and sustainable economic growth; improve living standards; promote a sound macroeconomic environment; reduce labor market exclusions; strengthen national security; encourage global economic growth; predict and prevent economic and financial crises; raise productivity; deliver conditions for business success; maximize employment opportunity; combat climate change; reduce poverty at home and abroad; equalize income distribution; support low inflation; build infrastructure; reduce smoking; minimize deadweight losses. The list could go on. In contrast, central banks in those same countries list their objectives as: maintain price stability; maintain

[19] In response to the current recession, central banks have pursued a number of non-standard policies, which have greatly expanded the effective number of instruments. But this has been a reaction to highly unusual circumstances, so presumably when times return to normal, central banks will go back to manipulating their usual instruments.

[20] Sources include Australian Treasury (2008), New Zealand Treasury (2003), Government Offices of Sweden (2009), HM Treasury (2009b), U.S. Department of the Treasury (2007).

full employment; ensure the safety and soundness of the financial system; promote moderate long-term interest rates; supply legal tender. This contrast highlights one reason that it is difficult for fiscal authorities to communicate about their future intentions: when fiscal objectives are diffuse and not prioritized, the public's expectations of fiscal actions will be equally diffuse and ill formed.

There is no disputing the complexity of fiscal policy. But complexity argues for *more* transparency, not less. The more ways that fiscal initiatives insinuate themselves into the public's decisions and the macro economy, the greater is the need for government to communicate with the public about the precise range of initiatives and their likely impacts. Fiscal complexity as an argument against enhanced transparency is a red herring.

4.2. INABILITY TO PRECOMMIT

The second major stumbling block to improved fiscal transparency stems from the well known problem of the time inconsistency of government plans and has been invoked as a rationale for policymakers to follow rules, rather than apply discretion to their policymaking [Kydland and Prescott (1977)]. Mankiw (2006) clearly explains the problem:

> "In some situations policymakers may want to announce in advance the policy they will follow to influence the expectations of private decisionmakers. But later, after the private decisionmakers have acted on the basis of their expectations, these policymakers may be tempted to renege on their announcement. Understanding that policymakers may be inconsistent over time, private decisionmakers are led to distrust policy announcements. In this situation, to make their announcements credible, policymakers may want to make a commitment to a fixed policy rule."

Time inconsistency applies to monetary policy, but it has been consciously attenuated by various institutional arrangements, such as a clearly stated objective like inflation targeting and other features that insulate central bankers from political pressures that might induce monetary policymakers to renege on their previously announced plans.

Fiscal policy is rife with sources of time inconsistency. Fiscal actions that operate directly through expectations formation, by their nature, change future states of the economy, which can trigger future policy shifts. Elected governments are often short lived and have no mechanism

to force future governments to follow through on earlier promises.[21] Short-lived governments can also be short sighted and pursue policies that leave fiscal messes, which future governments must clean up.

Some countries have made progress toward dealing with time inconsistency problems by adopting targets or rules for fiscal variables. Sweden imposes a nominal limit on government spending and it aims for a fiscal surplus of 1 percent of GDP. New Zealand has an informal net debt target of 20 percent of GDP. Members of the Euro Area are expected to obey the limits set by the Growth and Stability Pact – total annual deficits may not exceed 3 percent of GDP and debt may not exceed 60 percent of GDP. The United Kingdom follows a "Code for Fiscal Stability" that usefully distinguishes between current account and capital account expenditures and then applies the golden rule, which requires current account budgets to be balanced over the business cycle. Since the mid-1980s the United States has flirted with a variety of efforts to reign in fiscal deficits – ranging from Gramm-Rudman-Hollings to PAYGO. All of these measures were adopted more for reasons of sustainability than for transparency; they are ways of ensuring that fiscal policy does not get too out of whack.

To a limited degree, the rules may contribute to transparency. If government debt is currently above its target level – and the target is credible – then the public knows that in the future taxes must rise or spending must fall. This information helps expectations formation by eliminating some possible beliefs; for example, high debt will not be permitted to persist or to rise still more. Unfortunately, experience does not inspire confidence in the credibility of existing rules. When France and Germany violated the Growth and Stability Pact, the pact was watered down. Creative accounting or exemption of bills has allowed the U.S. Congress to circumvent every effort to impose fiscal discipline.

More generally, existing rules may be *sufficient* to deliver sustainability, but they are only *necessary* for achieving transparency. Rules that contribute importantly to transparency need to deal with the specifics of *how* sustainability is to be assured – which taxes and what spending will adjust and when will they adjust – and *why* the government is opting for the specified adjustments. Governments are far from providing this kind of information, which will help the public form reasonable expectations of future policies.

The argument that governments cannot precommit to future policies applies with equal force to the types of fiscal rules that countries have already adopted as it does to the kinds of details that will help to guide

[21] These issues arose in the debate that led to passage of New Zealand's Fiscal Responsibility Act in 1994 [Scott (1995)].

the public's beliefs. Inability to precommit has also been raised by opponents to central bank moves to announce forward tracks for the policy interest rate. Experience in countries that announce tracks suggests that policy observers understand that the tracks are not commitments; they are state-contingent indications of where monetary policy is headed, which do not bind future decisions [Archer (2004)]. But the act of announcing a track imposes discipline on central bankers and forces them to think dynamically about their policy choices. Evidence also suggests that announced tracks help guide financial market expectations of interest rates.

Identical reasoning applies to fiscal policy. Regardless of how much information the fiscal authority supplies to the public, people are going to form expectations of future taxes and spending. Those expectations can be informed by the policymakers who choose fiscal variables or they can be diffuse, drawn solely from historical evidence or other source of information, such as talk radio. Fiscal authorities who fail to offer information that anchors expectations run the risk that figure 4 illustrates: fiscal initiatives can have unintended consequences.

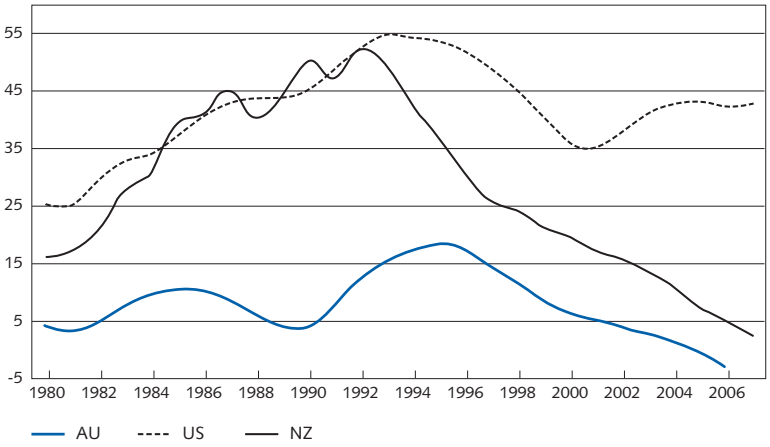
5. Transparency Going Forward

Until the current global recession hit, many countries' fiscal positions were improving. Figure 6 shows that in Australia, New Zealand, and the United States the past two decades had seen steady declines in government debt as a share of GDP. New Zealand's net debt fell from a peak of over 50 percent in the early 1990s – when the debt was also downgraded by bond-rating agencies and interest rates on debt embedded a risk premium – to under 5 percent before the recession affected the country's public finances.

Declining indebtedness boded well for how these countries would enter a prolonged period in which their aging populations would impose growing demands on the government in the form of old-age pensions and health care. Some countries, like Australia and New Zealand but unlike the United States, have planned for these inevitable demands by creating superannuation funds [Janssen (2001), Gruen and Sayegh (2005)].[22] The current economic downturn may disturb those plans by placing countries in a worse fiscal state going forward. In the United States, for example, fiscal stimulus bills, financial rescues, and the Obama Administration's 2009-2010 budget are expected to double the debt-GDP ratio over the

[22] Norway's sovereign wealth fund is another well known example. Sweden's surplus target of 1 percent of GDP is designed, in part, to finance its aging population.

Figure 6. Net government debt as a percentage of GDP in Australia, New Zealand, and the United States.



Sources: OECD *Economic Outlook*, various issues.

next decade, from 40 percent to 80 percent [Congressional Budget Office (2009a)].

Figures 7 through 9 show long-term projections of debt-GDP ratios for the United States, Australia, and New Zealand.[23] Fiscal agencies produce such projections making assumptions about non-discretionary and discretionary spending, economic growth, inflation rates, immigration patterns, and so forth. Importantly, the projections do not embed assumptions that future surpluses will adjust to stabilize debt. They also rule out other potential adjustments, including various forms of reneging on future spending commitments.[24] Evidently, fiscal issues will remain on the front burner for many years to come.

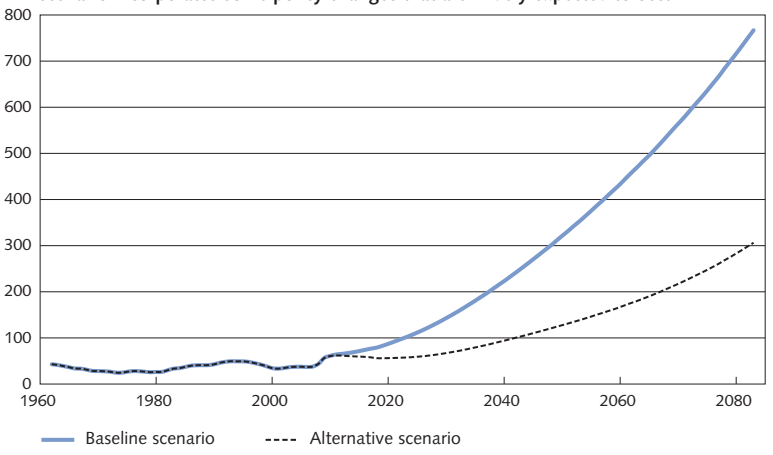
What can we learn from such projections? Two things. First, under the maintained assumptions, debt will grow exponentially in these countries. Second, the maintained assumptions – which produced the exploding debt paths – cannot possibly hold. We learn the second point from the intertemporal equilibrium condition. Figure 7 implies that within our children's lifetimes, U.S. debt will exceed the fiscal limit, violating the (IEC).[25] These projections are public information and well understood by investors who continue to buy these government bonds without demanding a risk premium. Why do they continue to buy bonds? Because their

[23] Australian projections are from Australian Treasury (2007), so the short-run outlook does not reflect recent developments. The latest projections from the 2009-2010 budget now have net debt rising to about 14 percent of GDP by 2012 and remaining positive up to the end of the projection period, 2019 [Australian Treasury (2009)]. Similarly, New Zealand projections are from New Zealand Treasury (2006) and the 2009 budget forecasts that gross debt will be over 40 percent of GDP by 2014 [New Zealand Treasury (2009)].

[24] Reneging could be outright repudiation of the commitment or it could be more subtle. For example, eligibility ages for pensions could be increased or some benefits could be taxes.

[25] The U.S. fiscal limit is unknown, but I imagine it implies something less than a 300 percent debt-GDP ratio.

Figure 7. Long-term projection of government debt as a percentage of GDP in the United States. Baseline scenario assumes current law remains in place; alternative scenario incorporates some policy changes that are widely expected to occur.



Source: Congressional Budget Office (2009b).

expectations of future policy adjustments are at odds with the projections' maintained assumptions. In sum, figures of exploding debt paths, which fiscal authorities around the world routinely publish, arise from economic behavior that is not happening and which flies in the face of basic economic logic.

Having the future inherit larger government debt is problematic for several reasons. First, higher debt entails higher debt service and more government expenditures must be devoted to paying interest on outstanding debt. Historically, countries have found that higher debt service crowds out other forms of government expenditures. Second, as the intertemporal equilibrium condition, (IEC), implies, higher debt requires higher present-value surpluses. But that present value is bounded: as a share of GDP, tax revenues have some maximum level and spending has some minimum level. At those levels, the natural fiscal limit is reached and the economy cannot support a value of debt higher than that limit. By pushing more debt into the future, current policies move debt closer to the fiscal limit, which places restrictions on fiscal flexibility in the future. But the future is when the fiscal consequences of aging populations come home to roost; it is precisely when fiscal flexibility is most needed.

Additional reasons that higher debt is problematic tie back to transparency. Higher levels of interest payments require larger future fiscal adjustments. If the public is uncertain about the hows and whys of those adjustments, the macroeconomic consequences of the move to higher debt will be difficult to predict. But there is another more fundamental issue. In countries without guidelines governing debt levels, large debt run-ups leave unanswered a question that is critical to the public's forma-

tion of expectations: will the economy settle in at the new, higher level of debt or will policy endeavor to retire debt back to its previous level or some other level? The answer to this question is central to the public's ability to form reasonable fiscal expectations.

Many industrialized countries are heading into an extended period of heightened fiscal activity. Transparency will be more important than ever in the face of the inevitable public debates about how to handle the looming fiscal challenges.

6. Steps Toward Fiscal Transparency

To be clear, by fiscal "transparency" I mean having the government bring current and *future* fiscal decisions into the public debate. In this sense, transparency is really about anchoring fiscal expectations and raising the level of discourse about fiscal policy effects and financing options. Although for the reasons discussed in sections 4.1 and 4.2 it is difficult for fiscal policy to achieve a degree of transparency comparable to that in central banks, fiscal authorities could nonetheless *strive* to achieve it. This section lays out some steps that would enhance the transparency of fiscal policymaking institutions.

6.1. MORE SOPHISTICATED PROJECTIONS

Section 5 argues that the long-term projections in figures 7 through 9 cannot describe actual outcomes. Are such projections useful? Some would argue that they are because they make the point that in the absence of substantive changes in fiscal policies, policy is not sustainable. But this observation alone is of limited utility. First, we hardly need pictures showing that the debt-GDP ratio could reach 500 percent in 50 years to tell us that current policies cannot persist. Second, because the figures depict a scenario that cannot occur, they do nothing to help the public form expectations about how policies are likely to change. Third, the process that creates such projections is not sufficiently dynamic: "current policy" is an incomplete description of fiscal behavior because it ignores the fact that "future policy" can, and certainly will, be different.

Fiscal authorities could produce more sophisticated projections, grounded in economic reasoning, that characterize outcomes that, as a matter of economic logic, *could* occur. A minimal requirement is that the projections ensure that, among other things, equilibrium condition (IEC) is satisfied. Of course, there are many ways that the equilibrium condition can be made to hold. Transparent projections would then present a menu of the more interesting and relevant adjustments and show how

other aspects of the macro economy are likely to evolve under each contemplated adjustment. For example, it would be interesting to report the consequences of the types of financing schemes underlying figure 4. This would force policy discussions to focus on the economic substance of fiscal issues. It could also serve to expose specious fiscal arguments that consist of political rhetoric and are devoid of economic support.

Figure 4, however, depicts a limited class of adjustments because the economic model behind the figure assumes that regardless of what happens to government debt in the short run, eventually it is retired back to its long-run average. Additional interesting scenarios would examine how outcomes would change if debt were to settle down at a permanently higher (or lower) level.

6.2. INDEPENDENT OVERSIGHT

Some fiscal authorities, following their monetary brethren, have opened themselves to external scrutiny by establishing fiscal policy councils. Councils's remits vary from independent fiscal authorities (Belgium) to large government-run agencies that prepare assessments of fiscal proposals (the Netherlands, the United States) to independent "academic" agencies that evaluate whether the government's fiscal objectives are being achieved (Austria, Denmark, Hungary, Sweden).[26]

Kirsanova, Leith, and Wren-Lewis (2006) make an institutional proposal grounded in economic theory. They argue that optimal fiscal policy has debt, rather than tax rates, act as a shock absorber. To smooth tax distortions, debt follows a random walk, implying that debt targets produce sub-optimal outcomes.[27] They find, though, that the optimal fiscal rules are sufficiently complex as to not be practically implementable. Instead of advocating those rules, Kirsanova, Leith, and Wren-Lewis propose that the United Kingdom establish a fiscal council that would produce annual long-term projections and assess sustainability and optimality of the government's plans. The council could also publish its preferred adjustments to policy. In Kirsanova, Leith, and Wren-Lewis's proposal, a fiscal council serves as a surrogate for a fiscal policy rule. Wyplosz (2005, 2008) takes this idea further to advocate the creation of independent fiscal policy committees with more bite. Modeled after central banks, Wyplosz's proposal gives the committees the task of achieving debt targets and the authority to set or recommend deficits.

[26] Early proposals along these lines appear in von Hagen and Harden (1994).

[27] The random walk result is sensitive to how the possibility of debt default is handled. Pouzo (2009) shows that it breaks down in the presence of incomplete markets and endogenous default. See also Bi (2009).

Even "soft" fiscal policy councils like those manned by academic economists can contribute to fiscal transparency by raising the right questions about policy. If current policies are unsustainable, which set of policies will set things right? What are the macroeconomic effects of various policies that stabilize debt? Why does the government favor one policy over another? Are the government's guidelines for sustainability appropriate or too harsh?

It is critical for the council to have a public forum. In Sweden, for example, the chair of the Swedish Fiscal Policy Council gives annual testimony before the Riksdag (the parliament) and the council's annual report is used by the Riksdag to evaluate the government's policies [Swedish Fiscal Policy Council (2008, 2009)]. If councils offer independent and intellectually credible evaluations that receive public attention, the quality of public discussion of fiscal policy will rise well above its current levels.

6.3. AGREE ON BROAD PRINCIPLES

If fiscal authorities were given relatively narrow objectives, just as many legislatures have done for their monetary authorities, those objectives would need to be achievable and verifiable. This would require arriving at a political consensus on the goals of government spending and tax programs. To a large extent, fiscal decisions would then be a technical matter, just as many monetary policy decisions are now.[28]

I recognize that this is an exceedingly Panglossian perspective. Even small, largely homogeneous populations would have difficulty reaching consensus on the goals of fiscal policy. But perhaps it is possible for elected officials to reach agreement on some broad principles of fiscal policy. Without advocating them, I can offer some examples of such principles:

- reduce the complexity of current tax and spending rules;
- raise revenues in the least inefficient manner possible;
- use spending and transfer programs, rather than taxes, to achieve social goals, such as income redistribution;
- include (or not include) automatic stabilizers in fiscal policy rules;
- engage (or not engage) in discretionary countercyclical fiscal actions;
- manage government debt to avoid risk premia;
- aim to make fiscal policy as transparent as monetary policy;
- talk explicitly about current and future fiscal policy options and report likely economic outcomes of the options;
- produce long-term fiscal projections that make economic sense;

[28] This is the aim of the "science of monetary policy," in Clarida, Gertler, and Gali's (1999) rather hopeful phrase. The practice of monetary policy remains – and probably always will be – more than a technical matter [Faust (2005)].

- adopt fiscal policy rules that are compatible with monetary policy rules;
- ensure that fiscal principles do not conflict with monetary policy objectives.

This is intended to be a suggestive, rather than an exhaustive list of fiscal principles. Each society will have its own set of principles on which consensus can be reached.

A well-understood set of principles to guide fiscal decisionmaking provides a framework within which the technical analysis of how to design policies that satisfy the principles can progress.

6.4. REACH CONSENSUS ON RULES

Once a broad set of principles has been agreed on, fiscal authorities can develop rules for determining spending and taxation decisions that are consistent with the principles. As discussed, many countries have jumped to this step without first establishing the guiding principles. Rules that enforce sustainability have been adopted without checking whether those rules conflict with other aims of fiscal policy. There is no unique set of fiscal rules to ensure policy is sustainable. But almost certainly some rules for sustainability will prevent governments from pursuing other objectives such as countercyclical policy. Fiscal policy is intrinsically a general equilibrium problem and fiscal policy design must be approached from a general equilibrium perspective.

Academic research on fiscal policy is at a shockingly nascent stage. The dynamic consequences of various fiscal financing schemes have only begun to be explored. Optimal fiscal policy prescriptions tend to be so sharply at odds with observed policies that it is difficult to know how seriously the prescriptions should be taken. Econometric models of fiscal behavior remain crude and to date there are few micro-founded models that integrate monetary policy with sufficient fiscal detail to address practical questions.[29] Recent global macroeconomic developments have made apparent the shortcomings of existing models, and work is already underway at several central banks to address those shortcomings.

Answers to fundamental questions about fiscal policy still lack professional consensus. There are examples in which countercyclical fiscal policies can be unhelpful or counterproductive [Eser, Leith, and Wren-Lewis (2009), figure 4, Gordon and Leeper (2005)], yet the modal view is that automatic stabilizers "quietly do their thing" [Cohen and Follette (2000), Domenech and Andres (2005), Schmitt-Grohe and Uribe (2007), Andres,

[29] Though the International Monetary Fund has made progress along these lines with its global model [Kumhof and Laxton (2008a,b)].

Domenech, and Fatas (2009)]. Most economists contend that government debt crowds out private capital, but this conclusion depends on the underlying source of the debt expansion, the anticipated future adjustments that finance the debt, and assumptions about monetary policy behavior [Leeper and Yang (2008), Davig and Leeper (2009)].

In contrast, hundreds of papers have been written about rules for monetary policy that deliver good economic outcomes and are robust to various forms of misspecification of the model. Analogous work in models that integrate monetary and fiscal policy can begin to discover implementable rules for fiscal policy that produce outcomes consistent with the fiscal principles. Optimal fiscal rules are extraordinarily complex and highly model dependent. Are there robust "simple" rules that can come close to replicating the outcomes of the optimal ones? Relatively simple fiscal rules can then be used as benchmarks to be compared to actual policy behavior, much as Taylor's (1993) rule is used in monetary policy analysis.

Naturally, as with monetary policy, fiscal authorities should consider rules that are explicit about the state-contingent nature of their decisions. Under what conditions can the public expect taxes to increase? When will discretionary countercyclical actions take place? What elements will be included in a countercyclical package? During periods of debt run-ups, how rapidly can people expect policies to adjust to stabilize debt?

Inevitably, fiscal rules will be more complex than monetary rules. Fiscal rules will need to apply to a large set of instruments and handle a variety of contingencies. And, of course, fiscal decisions ultimately are made in the political arena, rather than by one or a small handful of technocrats. But if society can agree on fiscal principles and fiscal authorities can derive rules consistent with those principles, huge strides toward transparency and anchoring expectations will have been taken.

6.5. ESTABLISHING CREDIBILITY

To this point I have used the term "fiscal authority" without distinguishing between the treasury or ministry of finance and the elected officials who propose and vote for spending and tax legislation. All the transparency in the world will do little to anchor fiscal expectations if the actual fiscal decisionmakers' communications about fiscal plans are not credible.

How can elected officials establish credibility? The standard answer is for them to do as they say and say as they do. True enough. But how can such behavior be institutionalized to instill it across elected officials and across time?

Here it is useful to point out an important difference between monetary and fiscal decisionmakers. Central bankers can be held accountable

and earn credibility because they own their decisions *and the economic analyses and projections underlying those decisions.* Central banks around the world employ sizeable staffs of professional economists who produce high-quality research that finds its way into board rooms, central bank communications with the public, and leading academic journals. Many central banks publish the econometric models they use in their routine policy analysis.[30] Some banks even include in their public reports explicit references to results from their models [for example, Sveriges Riksbank (2007)]. By devoting substantial resources to the analyses behind their policy choices and then exposing the analyses to the public, monetary policymakers consciously take ownership both of their decisions and their economic rationales. Recognizing that there may also be grounds for dissenting views well grounded in economic reasoning, some central banks also publish the minutes of their meetings [for example, Sveriges Riksbank (2009)].

Nothing comparable occurs with fiscal policy. Fiscal decisionmakers do own their votes and they can be held accountable for those votes at election time. But fiscal decisions are only a small subset of the votes that legislators place, so fiscal votes can easily get lost in the morass of electoral politics. More importantly, even if legislators own their fiscal decisions, they rarely own the economic analysis underlying the decisions. In fact, as an institutional matter, legislators tend consciously to distance themselves from the nitty gritty economic details. Instead, fiscal decisionmakers farm out the analysis and forecasting to autonomous or semi-autonomous agencies, which ensures that decisionmakers do not have to ascribe to any particular analysis or set of projections.

Legislators could adopt procedures similar to those as central banks. Political coalitions could employ economists whose models and forecasts would be public and subjected to independent professional scrutiny. Each legislator's vote *and underlying economic rationale* would be recorded and made public. Because coherent economic analyses would be dynamic and satisfy the intertemporal equilibrium condition, they would necessarily embed assumptions about both current and future policies. By owning a fiscal projection, decisionmakers would also be revealing their views about likely and desirable future policy adjustments. Future decisionmakers, of course, would not be bound by these views. But the act of revealing the views also brings them into sharp focus and into the public discourse about fiscal options. In this way, the discourse about fiscal decisions can also help to guide the public's expectations about future policies.

[30] Examples include Poloz, Rose, and Tetlow (1994), Brayton and Tinsley (1996), Smets and Wouters (2003), Reserve Bank of New Zealand (2004), Harrison, Nikolov, Quinn, Ramsey, Scott, and Thomas (2005), Adolfson, Laseen, Linde, and Villani (2007).

7. Concluding Remarks

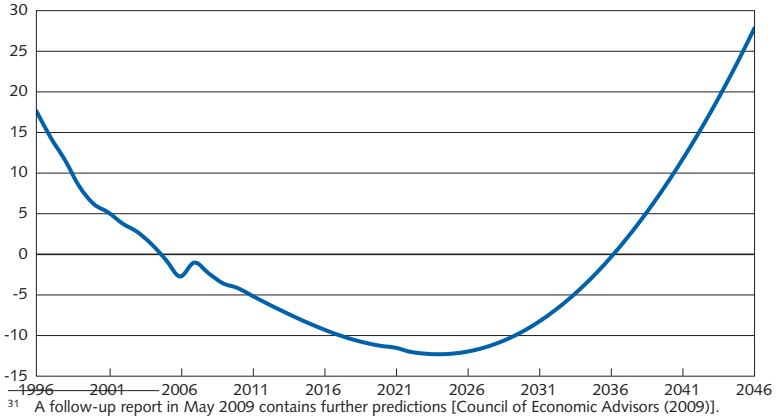
I shall end with an egregious example of non-transparent fiscal policy: the recent $787 billion American fiscal stimulus plan. Leading up to the introduction and passage of the American Recovery and Reinvestment Act, the entire economic rationale for the stimulus package consisted of the job creation prediction in a document by Romer and Bernstein (2009).[31] An appendix to the document reports multipliers for a permanent increase in government spending and decrease in taxes of 1 percent of GDP. Four years after the initial stimulus, government purchases raise GDP by 1.55 percent, while tax cuts raise GDP by 0.98 percent. Sources for these numbers are reported as the Federal Reserve's FRB/US model and "a leading private forecast firm."

To assess how this rationale for stimulus measures up in terms of transparency, I raise some questions that are not addressed in the Romer-Bernstein document, but are important for anchoring fiscal expectations:

- What are the economic models underlying the multiplier numbers and are those numbers reproducible?
- Why consider permanent changes in fiscal variables when the Act makes transitory changes?
- What are the consequences of the stimulus for government debt?
- What are the repercussions of significantly higher government debt?
- Will the debt run-up be sustained or retired?
- How will policies adjust in the future to either sustain or retire the debt?

Some might accuse me of finding a straw man to ridicule. But this is an important example because of its potential impact on the world economy. At over 5 percent of U.S. GDP, this is the world's largest stimulus in

Figure 8. Long-term projection of net government debt as a percentage of GDP in Australia.



[31] A follow-up report in May 2009 contains further predictions [Council of Economic Advisors (2009)].

Source: Australian Treasury (2007).

response to the current recession [International Monetary Fund (2009)], and that figure does not include the 2008 tax rebate or the substantial financial rescue packages.

Some might also argue that the United States is a bad example because it has among the least transparent fiscal policies. I grant that. But measured against the bulleted items above, few fiscal authorities would emerge looking very transparent.

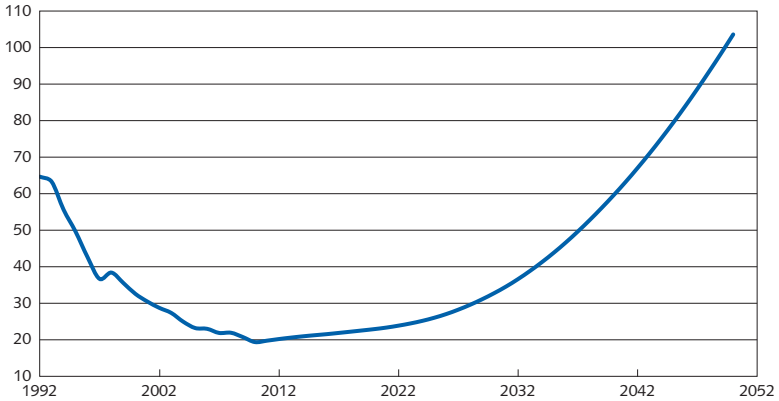
Principles, guidelines, rules, and independent oversight may help to improve the transparency and efficacy of fiscal policy by nailing down the private sector's expectations. Or they can provide a smoke screen behind which fiscal shenanigans can proceed as usual.

To be successful, fiscal principles need to reduce the complexity of fiscal policy. This can be accomplished at the implementation stage when the principles are transformed into quantifiable rules governing fiscal decisions. It may be necessary to provide statutory or even constitutional protections for the rules. Rules that are adopted in a frenzy are likely to be ill-conceived and can easily have deleterious effects.

Research has not yet quantified the social costs of the uncertainty about fiscal policy that non-transparent policies engender. Neither has research explored the possible consequences of unanchored fiscal expectations. Both of these issues need to be understood.

But some things are certain. Fiscal policy is too important to be left to the vagaries of the political process. Reform of fiscal institutions, the design of fiscal rules, and fiscal decisions can be informed and guided to a much larger extent by careful economic analysis. Failure to achieve appropriate fiscal reforms threatens to undermine the progress made on monetary policy and, in the face of the looming heightened fiscal activity, the stability of macro economies.

Figure 9. Long-term projection of gross sovereign-issued debt as a percentage of GDP in New Zealand.



Source: New Zealand Treasury (2006).

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