Do Swedish forecasters properly account for Sweden's international dependence?

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Sweden is a small, open economy that is affected to a large extent by developments abroad. An important question is whether Swedish forecasters take sufficient account of Sweden's international dependence in their forecasts of domestic developments. In this study, we analyse this for forecasts made during the period 2007–2017 for GDP growth and inflation. We compare the Riksbank's forecasts with those of a number of major Swedish forecasters, including the National Institute of Economic Research (NIER). The analysis shows that several forecasters, including the Riksbank and NIER, take too little account of other countries in their long-term GDP and inflation forecasts. In the short term, however, the influence of foreign inflation is in line with the correlation in the data, while the influence of foreign GDP growth is still slightly lower than the correlation in actual outcomes even in the short term. Finally, we show that the weaker influence from other countries in the forecasts cannot be explained by monetary policy is more aggressive in the forecasts compared with how the repo rate *de facto* has been set in relation to policy rates abroad.

1 How other countries affect the Swedish economy

After a number of tough years for the global economy with weak growth and low inflation, particularly in the euro area, the International Monetary Fund (IMF) now finally projects that an improvement in the world economy lies ahead.[1] An important question for Sweden is what such an improvement means for GDP growth and inflation in Sweden, and what implications this normally has for monetary policy in Sweden if interest rates abroad rise.

Sweden is a small open economy with substantial international trade; the export (import) share of GDP were about 45 (40) per cent in 2016. The globalisation of financial markets in recent decades has also increased the financial ties between Sweden and other countries. Economic activity is therefore largely governed by developments abroad. An early study stressing the importance of other countries for Swedish economic cycles is Lindbeck (1975), who argues that economic cycles in Sweden closely follow the pattern and timing we see in other industrialised countries. Lindé (2003) finds formal support for Lindbeck's conclusions and shows that fluctuations abroad explain a significant proportion of the fluctuations in Swedish growth and inflation. The correlation between Swedish and foreign GDP growth is as high as 0.9, while the correlation between domestic and foreign CPI inflation is around 0.5. But even if the correlation for inflation is lower than for growth, it is important to note that it is still a high and clearly significant correlation.

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1 See the IMF's edition of 'World Economic Outlook' published on 24 July, http://www.imf.org/en/Publications/WEO/Issues/2017/07/07/world-economic-outlook-update-july-2017.

The finding that inflation is also strongly interconnected with other countries is supported by Ciccarelli and Mojon (2010), who show that inflation in the industrialised world seems to be largely a global phenomenon, where almost 70 per cent of the variation in 22 OECD-countries can be explained by common factors. Furthermore, Aastveit et al. (2016) analyse to what extent economic variations in Canada, Norway, New Zealand and the United Kingdom can be explained by developments abroad and through which channels these work. They find that a significant proportion of the economic variations in these countries can be explained by developments abroad and that the trade channel is most significant.

Given Sweden's strong international dependence, an important question is whether forecasts from Swedish forecasters, including the Riksbank, have had a neutral revision pattern for domestic variables relative to changes in the international forecast. What then does a neutral revision pattern for the relationship between domestic and foreign variables mean? Our way of looking at this question is that a revision of the foreign outlook should result in a revised view of domestic developments with a degree of change in line with historical correlations in actual outcomes. Of course, this need not apply to every single revision. In certain situations, an international revision can be more or less linked to the domestic view depending on the origin of the revision and whether the economic policy response is more or less aggressive than normal. But on average over a longer period, the correlation in actual data should be reflected in the corresponding correlation between the forecast revisions, given that the structure of the economy (including how monetary and fiscal policy are conducted) has not changed to any great degree.[2]

In this article, we analyse this issue for a number of Swedish forecasters. We start by studying the Riksbank's forecasts made during the period 2007–2017 for GDP growth and inflation. We then compare the Riksbank's forecasts with those of a number of other major Swedish forecasters, including the National Institute of Economic Research (NIER), the Ministry of Finance and the major Swedish banks. Our focus is, however, on the Riksbank and, to a certain extent, the NIER. We also study the role of monetary policy in the forecasts, as different assumptions regarding monetary policy design can have important consequences for the impact of revisions to the foreign outlook.

Justiniano and Preston (2010) find that standard macroeconomic models for small, open economies cannot easily capture the effects of fluctuations abroad. This could lead us to believe that there is a weaker correlation in the revisions than what we see in the data. However, the forecasts we study are not pure model forecasts but rather better viewed as 'assessment forecasts'. In these judgmental forecasts, we should expect that forecasters are aware of the actual correlation in the data and that they are also aware of the models' potential inability to sufficiently include developments abroad in the analysis, and thus make correctly assessed forecast revisions.[3]

Despite this, our findings suggest that the Riksbank and the NIER have both had a slightly less-than-neutral revision pattern, i.e. they have taken slightly too little account of foreign GDP growth in their forecasts for domestic GDP growth in relation to the correlation in the outcome data in the short term. The regression coefficient for Swedish GDP growth as a function of foreign GDP growth (KIX) is 1.42 in the data and 0.91 in the Riksbank's forecast revisions. The NIER seems to have taken slightly more account than the Riksbank and has a regression coefficient of 1.09 (regarding the euro area) in the short term. For the Riksbank, we can draw the conclusion that the regression coefficient is statistically significantly lower

2 Please note that developments in a small country like Sweden should only have a marginal, if any, effect on other countries. In a forecasting process, this normally allows us to consider international forecast as exogenous when working out the domestic forecast. In other words, the international forecast is allowed to influence the domestic forecast but the domestic forecast normally does not influence the forecast for international developments. This relationship, which is true for GDP growth, inflation and policy rates alike, means that simple and straightforward methods can be used to perform our analysis.

3 Lindé and Reslow (2017) show that models are not so important when it comes to explaining the Riksbank's published forecasts. Instead, it seems as if informal judgments have a large influence on the Riksbank's forecasts. One possible explanation why the Riksbank has deviated from the models is that it has had a different view of the impact of international developments.

than the coefficient in the data (KIX). We cannot, however, draw the conclusion that the NIER's regression coefficient is significantly lower than the regression coefficient in the data (1.20 for the euro area). For inflation, both the Riksbank and the NIER seem to have taken reasonable account in the short term of foreign inflation in their forecasts for domestic inflation. For this variable, the correlation in the forecasts is even slightly stronger and closer to historical patterns (0.46) for the Riksbank (0.45) compared with the NIER (0.42).

At longer forecast horizons – two- to three-years ahead – we find that the influence of international developments in the forecast revisions for both domestic GDP and inflation is much lower than stipulated by historical patterns. As far as the Riksbank is concerned, the regression coefficient for GDP at the three-year horizon amounts to −0.02, which is to be compared with 1.42 in the data. The findings also indicate that the major Swedish banks take account of developments abroad to approximately the same degree as the Riksbank with regard to GDP and inflation 1–2 years ahead. It is important to point out, however, that the data material does not allow for the same in-depth analysis for the banks as for the Riksbank and the NIER.

We argue that the smaller impact on domestic GDP growth and inflation at longer forecast horizon is hard to explain by more aggressive monetary policy. Indeed, when we study the role of monetary policy in the forecasts, we find that the influence of foreign policy rates is high but yet lower in the short term than the historical pattern specifies, and about the same for both the Riksbank and the NIER. At longer forecast horizons, however, we see certain differences between the Riksbank's and the NIER's interest rate forecasts. In the longer term, the Riksbank's repo rate forecast revisions are still substantially influenced by revisions of foreign interest rates, while the influence on the NIER's forecast revisions is virtually non-existent.

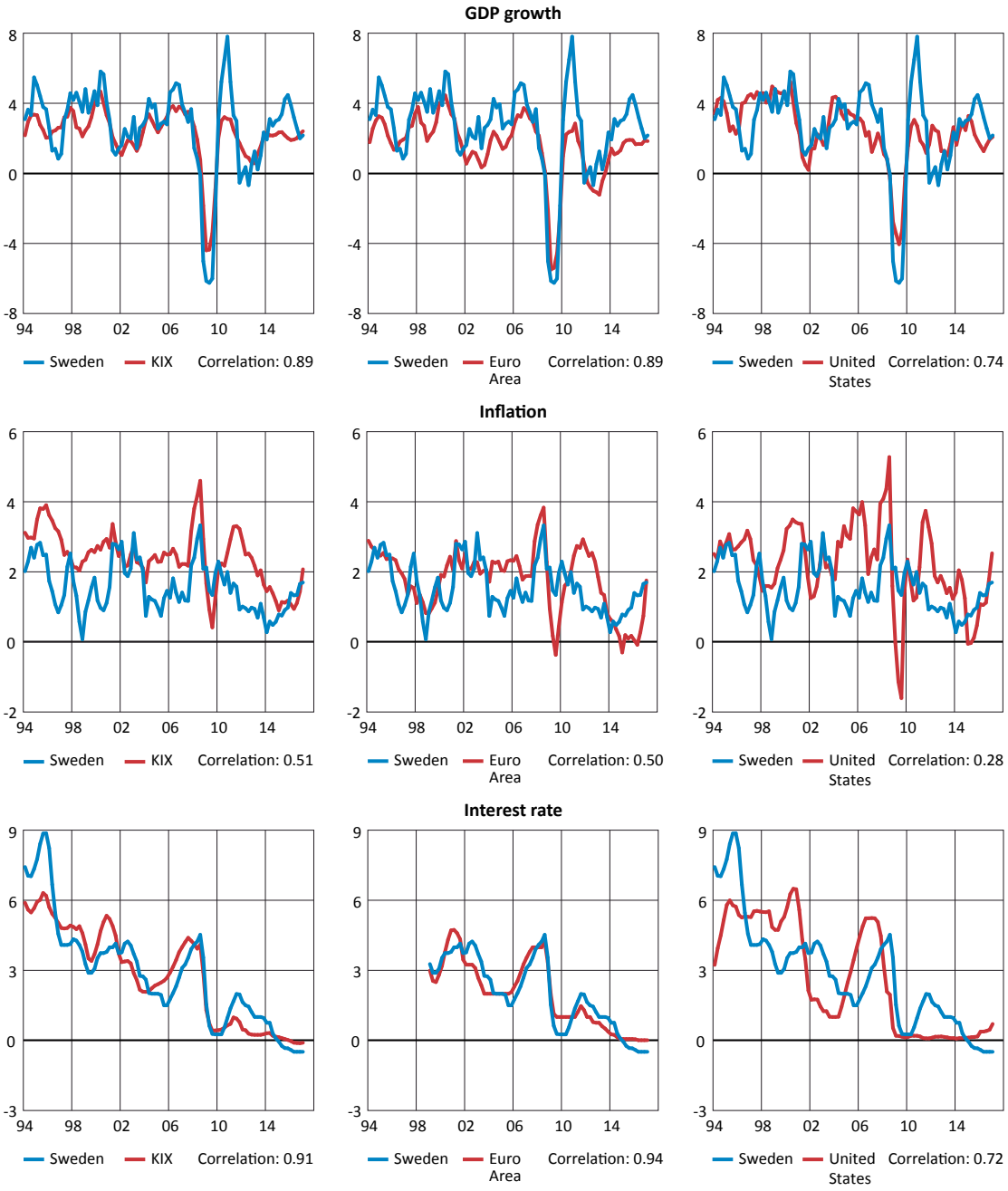
The rest of the article is arranged as follows. Below we begin by looking at the correlation between economic development in Sweden and abroad in the data. Then we analyse how the Riksbank has taken account of international developments in its forecasts. In Section 4, we study the NIER's forecasts and in Section 5 we make a comparison with other Swedish forecasters. In Section 6, we discuss the role of monetary policy in the forecasts and in Section 7, we provide a few concluding reflections.

2 Sweden's international dependence

Sweden's strong links to other countries manifests themselves in high positive correlation coefficients between, for example, Swedish and foreign GDP growth, inflation and interest rates. Figure 1 shows quarterly data on Swedish and foreign GDP growth (top row), inflation (second row) and the policy rate (third row). We show the Swedish variables together with three different international 'measures'. The first column refers to KIX-weighted countries abroad.[4] The second column shows the euro area and the third column the United States. Both GDP growth and inflation are measures as the annual rate of change in output and the price level, that is $(X_t - X_{t-4})/X_{t-4}$. Throughout the article, we use the annual change instead of quarterly growth (inflation) expressed as an annual pace (that is: $4(X_t - X_{t-1})/X_{t-1}$). This is because economic policy is focused on responding to underlying changes in the economy and these underlying changes are better measured in terms of the annual rate of change rather than in terms of the annualized quarterly rate. Another more practical reason for our choice is that many institutions (perhaps for the reason just discussed) only make and publish forecasts for the annual rate of change.

4 Foreign variables are weighed together with KIX weights, which capture the relative significance of the countries to which Sweden exports and from which it imports. For other countries, inflation is measured in terms of the CPI or HICP, while inflation in Sweden is measured in terms of the CPIF, which adjusts for the direct effects of changes in the repo rate as this measure gives a more accurate comparison.

Figure 1. Covariation between Sweden and other countries
Annual percentage change and percent respectively



Note. Inflation in Sweden refers to the CPIF. The CPIF is the CPI with a fixed mortgage rate. KIX-weighted interest rate refers to KIX4-weighting, which includes the Euro Area, the United States, the United Kingdom and Norway. GDP and inflation in annual percentage change and interest rates in per cent.
Sources: National sources, Statistics Sweden and the Riksbank

The interest rates in the chart refer to the policy rate for each country/region respectively (the repo rate for Sweden, the EONIA rate for the euro area, the Federal Funds Rate for the United States, and a weighted policy rate for the KIX area). The figures generally show a very high degree of covariation (correlation) between Sweden and other countries, even if the correlation with KIX-weighted countries and with the euro area seems to be slightly higher than the correlation with the United States. For inflation and the GDP growth rate, these high correlations are not driven by trends in the data, but for the interest rate series, there is a clear downward trend that reinforces the degree of covariation. When we remove these trends, the degree of covariation weakens slightly, especially between Sweden and

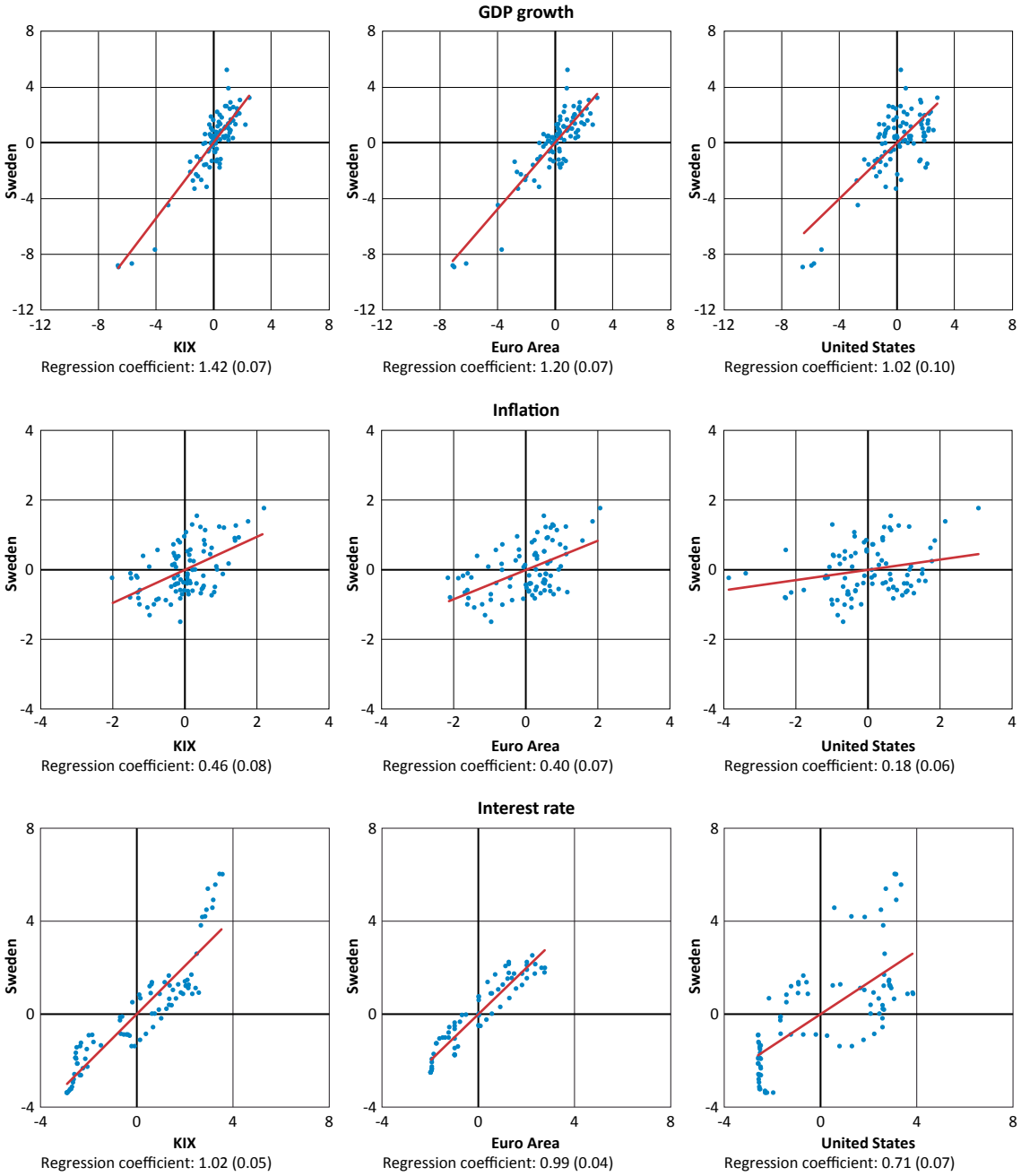
the United States. But the trend seems to be common and likely reflects a decline in the global equilibrium rate over time. This is formally supported by econometric estimates that provide very similar estimates for the downward trend in the various interest rates. This is why we choose to report the results for the interest rates at the levels shown in the chart. It can also be noted that if we were to calculate a so-called KIX2 index – i.e. a KIX-weighting including only the euro area and the United States – the correlations for GDP growth and inflation would be approximately 0.90 and 0.50 respectively and for the interest rate the corresponding coefficient is 0.90. These correlations are very close to those for the broader KIX index, which is not so surprising as the euro area and the United States together constitute around 55 per cent of KIX.

We can also illustrate the same data as we used in Figure 1 in a scatter plot. We do this in Figure 2, where we plot the Swedish series for each variable on the vertical axis and the foreign series on the horizontal axis for each time observation. As the Swedish and foreign series have different averages, the time series have been demeaned to be able to draw the charts using the same scale on the x- and y-axis. In the charts, we have also plotted a regression line through the points. The slope of the regression line captures the historical pattern and measures how much the Swedish variable changes on average when the international variable changes by one unit. The figure in brackets specifies the standard deviation for the regression coefficient – the higher the standard deviation, the greater the uncertainty regarding the regression coefficient. Using classical inference methods, a 95-percent confidence interval is formulated for the true regression coefficient by subtracting and adding two standard deviations from the point estimate.

In Figure 2, we can see that, when we measure the foreign economy using KIX, the regression coefficients for all the variables are higher compared with when we use the euro area or the United States. We obtain the lowest regression coefficients when we use the United States as the foreign measure. For GDP growth, the regression coefficient is greater than one for all measures of the foreign economy. For KIX, it is as high as 1.42. The fact that the regression coefficient for GDP growth is 1.42 implies that variations in foreign growth are very important for variations in Swedish growth. Specifically, the coefficient implies that a temporary increase in GDP growth abroad by 1 percentage point usually coincides with an increase in GDP growth in Sweden of 1.42 percentage points.[5] For inflation, the regression coefficient is 0.46 when we use the KIX index and 0.40 when we use the euro area. For the United States, the correlation is significantly weaker with a coefficient of 0.18. For the policy rates, the regression coefficients are very high – around 1 – for the KIX- and euro area, while it is significantly lower, although still relatively high, for the United States (0.71).

5 The reason why the coefficient exceeds 1 is that growth in Sweden is more volatile than the weighted average of growth among our trading partners. It is not due to the fact that Swedish GDP growth has on average been somewhat higher than growth abroad during the period.

Figure 2. The relationship between the economy in Sweden and abroad
Annual percentage change and per cent respectively



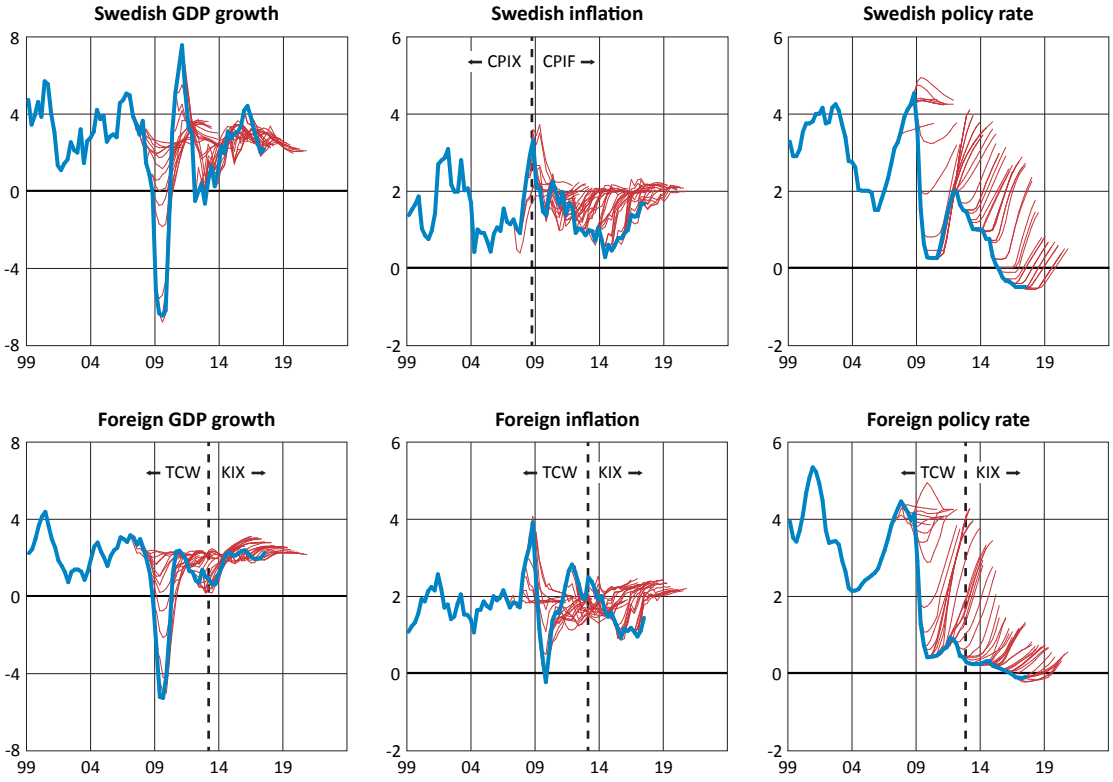
Note. Mean-value adjusted data. Standard error in brackets. GDP and inflation in annual percentage change and interest rates in per cent.
Sources: National sources, Statistics Sweden and the Riksbank

Apart from Figure 2 indicating that the regression coefficients are high, another important insight from the charts is that the uncertainty regarding these coefficients is relatively low. This means that changes abroad contain a clear signal for Swedish developments. Take, for example, the regression coefficient between Swedish and KIX-weighted GDP growth. A 95-percent uncertainty band is about 1.3–1.6, which means that there is a very strong signal that changes abroad have a major impact on the Swedish economy. For inflation, the corresponding uncertainty band is 0.3–0.6 and for the policy rate, it is approximately 0.9–1.1. The absolute impact is therefore smallest for inflation and it is shrouded in considerable uncertainty – but it should nevertheless be remembered that the confidence interval indicates a clearly positive impact.

3 The influence of foreign developments in Riksbank's forecasts

The Riksbank makes forecasts and publishes them in connection with its monetary policy decisions (normally 6 times per year). On each occasion, the Riksbank makes a forecast that looks ahead at least three years. In the forecasting process, an assessment is made of developments in the economy in Sweden and abroad. Figure 3 presents the forecasts that we are studying for the period 2007–2017.[6] In the Monetary Policy Report in July 2008, the Riksbank changed over from making forecasts for the CPIX inflation measure to making forecasts for the CPIF.[7] The Riksbank has also made forecasts for KIX-weighted countries abroad since the Monetary Policy Report in February 2013. Prior to February 2013, the Riksbank made forecasts for TCW-weighted countries abroad.[8]

Figure 3. The Riksbank's forecasts for Swedish and foreign GDP growth, inflation and the interest rate
Annual percentage change and per cent respectively



Note. Actual data (thick blue line) refers to the latest known outcomes for GDP growth and inflation, while the forecasts refer to real-time forecasts conditional on real-time outcomes that do not coincide with the latest known outcomes. The forecasts can therefore fluctuate somewhat when compared with the subsequent outcomes on which they were not based on. This is especially true at the time when the inflation-series was changed from CPIX to CPIF and the periods when the international weighting is changed from TCW to KIX. GDP and inflation in annual percentage change and interest rates in per cent.
Source: The Riksbank

6 We include forecasts up to and including the Riksbank's forecasts in connection with the April 2017 Monetary Policy Report.

7 In order to understand the difference between the CPIX and the CPIF, one needs to know that the index for interest costs for owner-occupiers in the CPI is calculated as follows: *Interest cost index = Interest rate index * Capital stock index*. The CPIX excludes the entire interest cost index and the direct effect of changes in indirect taxes and subsidies. When calculating the CPIF, only the interest rate is held constant and the change in the interest cost that is derived from the change in the capital stock is thus still there. The CPIF is therefore referred to as 'the CPI with a fixed interest rate'. An important difference is that the entire interest cost index is excluded from the CPI when calculating the CPIX and a change in the capital stock may therefore not have any effect on CPIX inflation but an effect on CPIF inflation.

8 The most significant difference between TCW and KIX is that the TCW weights were not changed each year but were based on trade flows in 1989–1991. As a result, TCW-weighted variables do not capture the increased importance of emerging market economies for the Swedish economy. The KIX weights are, on the other hand, updated annually based on available trade data and therefore take into account changes in Sweden's trading patterns. Another difference is that KIX includes more countries than TCW.

From the charts in Figure 3, it is not possible to see with the naked eye how much the Riksbank takes international developments into account in its forecasts. To investigate this, we must study the covariation between the Swedish and the foreign variables analogically as in Figure 2. We do this by studying the covariation between the Riksbank's forecast revisions for Swedish and foreign variables during a given time period. The forecast revisions are obtained by calculating the difference between the forecasts made between each Monetary Policy Report for international GDP growth and inflation and the corresponding revisions for the Swedish variables. We use the following formula to calculate revisions:

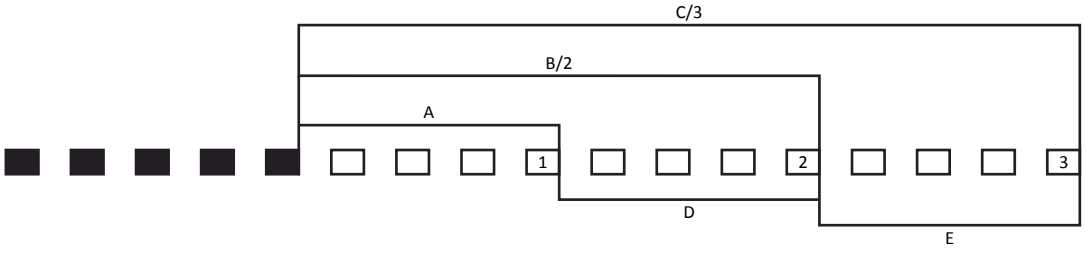
$$(1) \qquad Revision_{t,h}^{New} = Forecast_{t,h}^{New} - Forecast_{t,h}^{Previous}$$

The formula above means that the forecast revision on a given forecasting occasion is obtained by calculating the difference between the new forecast and the preceeding forecast round. A concrete example is when the Riksbank makes a forecast at the monetary policy meeting in April 2017 for inflation three years ahead. A forecast for inflation was also made in connection with the monetary policy meeting in February 2017. The revision is then the difference between the two forecasts:

$$(2) \qquad Revision_{2017,h}^{April} = Forecast_{2017,h}^{April} - Forecast_{2017,h}^{February}$$

It is worth noting that we can calculate this revision on different horizons, *h*. This means that on each forecasting occasion, we can take different parts of the forecast into consideration. The forecasts we investigate are illustrated in Figure 4. The black boxes refer to available outcomes. At the end of outcomes, a three-year forecast is made at a quarterly frequency. Each quarter is illustrated by a white box. The figures 1, 2 and 3 represent the one-, two- and three-year horizon in the forecast. The lines and letters A–E denote different ways of calculating comparable 'one-year' forecasts. A denotes the first year in the forecast, B denotes a two-year forecast which is divided by 2 to obtain an average of the two years. Correspondingly, C denotes a three-year forecast which is divided by 3 to obtain a three-year average. One can also calculate a forecast, D, which denotes the second year in the forecast, and a forecast, E, which denotes the third year in the forecast. Please note therefore that the third year in the forecast refers to the end of year two to the end of year three across the forecast horizon. It is important to clarify that new and previous forecasts are calculated so that they correspond calendar-wise. The previous forecast may hence need to be shifted a quarter or two horizon-wise.

Figure 4. Calculation methods for different forecast horizons for a given forecast



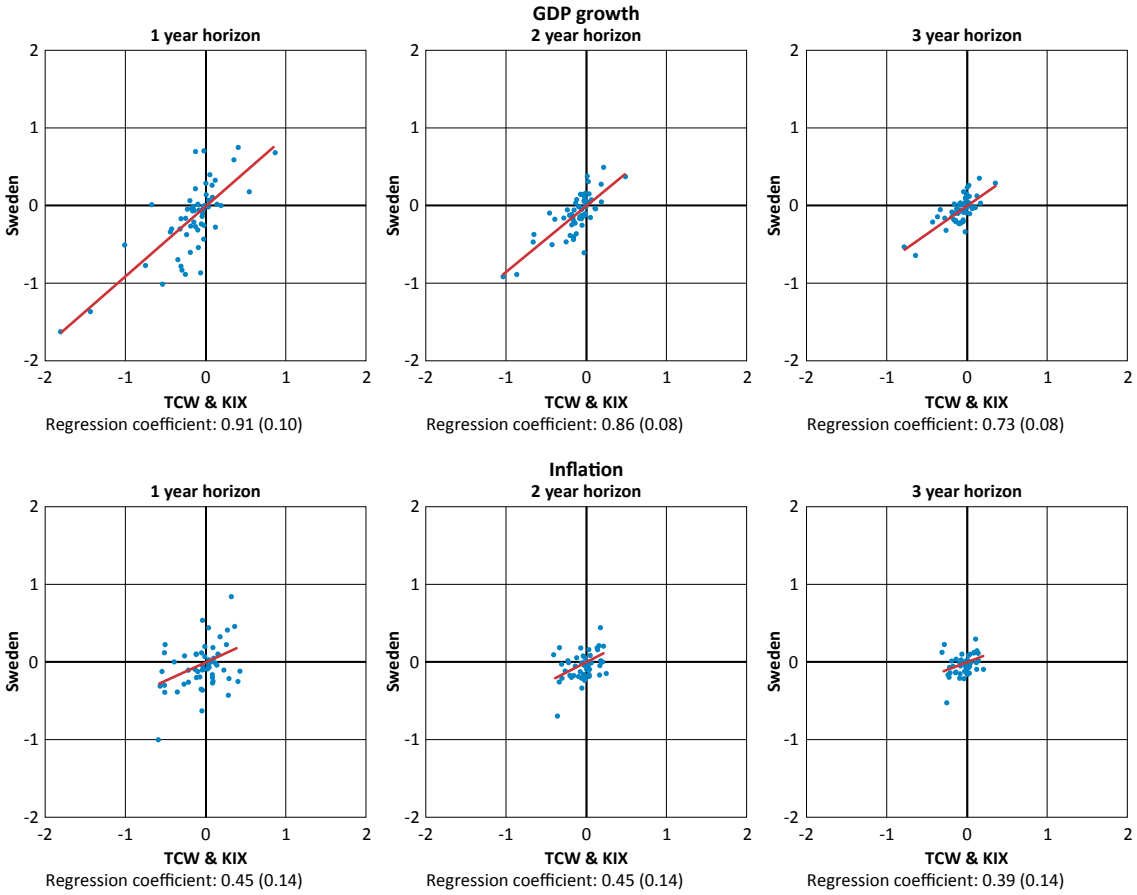
Note. Black box denotes quarterly outcome. White box denotes forecast quarter. The figures 1, 2 and 3 mark out the one-, two- and three-year horizon in a forecast. The lines and letters A–E denote different ways of calculating forecasts.
Source: Own illustration

We calculate forecast revisions based on the forecasts in Figure 3. We disregard the periods when the Riksbank changed over from TCW to KIX trade-weighted international variables and the periods when the Riksbank switched from CPIX to CPIF. With the forecast revisions

that we have calculated, we can therefore illustrate this data in scatter plots for different horizons in the same way as in Figure 2.

In the figures in Figure 5, you can see the revisions of the foreign variable on the horizontal axis and the revisions of the corresponding Swedish variable for GDP growth and inflation on the vertical axis. We will discuss the policy rate in Section 6. In the figure, you can see revisions of forecasts corresponding to the principles A, B and C in Figure 4. For each variable respectively, the regression coefficients in the figures in Figure 5 should therefore be in line with the regression coefficients seen in the data in Figure 2. When we plot the regression line, we do not allow for a constant. This is because, intuitively speaking, there cannot be a constant in revisions. If we allowed for a constant, the revisions would drift away uncontrollably in the long term, which is unreasonable.[9]

Figure 5. Revisions of forecasts for Swedish and foreign (KIX) GDP growth and inflation
Revisions, annual percentage change



Note. Standard error in brackets. The 1-, 2- and 3-year horizons refer to the calculation methods A, B and C from Figure 4.
Source: The Riksbank

From Figure 5, we see that a relatively strong short-term correlation for GDP growth, 0.91. However, this regression coefficient is significantly lower than the one we observed in the data (1.3–1.6).[10] In the longer term, the influence of other countries diminishes further, so that on average across the whole forecast horizon (i.e. the three-year horizon, method C in Figure 4), we only have a coefficient of just over 0.7. For inflation, we see in the short

9 An alternative to studying the forecast revisions is to simply plot the forecasts on a level in the same way as Figure 2. The results using this alternative approach are presented in Appendix B and do not differ from the forecast revisions we analyse in the main text. We prefer to study the forecast revisions as they show marginal effects on domestic variables when the international picture is revised for different horizons during the forecast period.

10 Appendix A presents methods for calculating significance. Generic tables with all significance tests are also presented there.

term that the regression coefficient (0.45) is in line with historical patterns (the regression coefficient is between 0.3 and 0.6 in the data according to Figure 2). In the longer term, the curve coefficient decreases, but on average across the forecast horizon, the influence is still in line with historical patterns according to the results in Figure 5. This may indicate that the influence of other countries is lower than historical patterns in the longer term. We will analyse this in more detail in the following section.

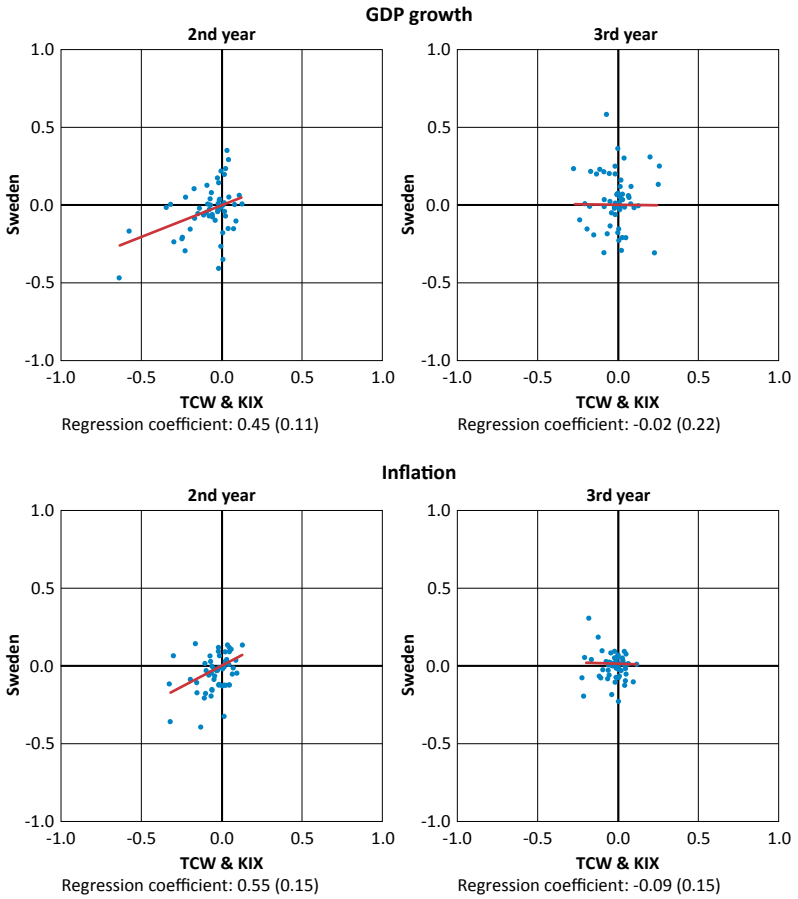
3.1 Longer-term forecast revisions

In Figure 5, we saw that the regression coefficient for both GDP revisions and inflation revisions decreased the further forward we looked during the forecast horizon. One year ahead, we had a coefficient for GDP of around 0.91 while the coefficient was only 0.86 two years ahead and finally 0.73 at the three year horizon. This demonstrates that the Riksbank projections takes foreign developments more into account in the short term than in the long term. However, it does not show the extent to which the Riksbank does this, as the variance in the forecasts can differ at different horizons. In order to perform a more exhaustive analysis, we have to study revisions of forecasts according to the principles D and E from the illustration in Figure 4, in addition to studying forecasts according to principles A, B and C. In other words, we must study forecasts for the second and third year separately across the forecast horizon. Figure 6 presents estimates of principles D and E. The first column shows that the regression coefficient for revisions between the end of year one in the forecast and the end of year two in the forecast is around 0.45 for GDP growth and 0.55 for inflation. The second column, which shows revisions between the end of year two and the end of year three, has a coefficient close to zero for both GDP growth and inflation. This is consistent with the results from Figure 5, i.e. the Riksbank has taken foreign influences more into account in the short term in both the GDP and the inflation forecasts. The higher regression coefficients three years ahead in Figure 5 relative to the revisions during the third year in Figure 6 are due to the fact that in Figure 5 we look at an average over the three years in the forecast and that the variations in the forecast for the longer forecast horizons are small in relation to the variation in the forecasts during the first year.[11]

An important question that we have not analysed so far is whether the impact of other countries varies over time. A natural division of our data material to investigate this is to separate the period with TCW-weights and KIX-weights and recalculate the results that only cover the KIX-weighted foreign block. This corresponds to forecasts made from 2013 onwards, i.e. primarily including forecasting rounds when monetary policy was rerouted in a more expansionary direction. For this period, we obtain a greater impact from foreign revisions in the short term. The regression coefficient for GDP growth for the one-year horizon then amounts to 1.3 with a standard deviation of 0.35 (which is higher as the material is now only based on 25 observations instead of twice as many for the entire period). For inflation, the corresponding figure is 0.52. On longer horizons, the correlation is as before much weaker. For GDP growth and inflation, the regression coefficients are −0.41 and −0.12 respectively during the third year, which can be compared with −0.02 and −0.09 in Figure 6 below. Both qualitatively and quantitatively, the results are very similar to the results in Figures 5 and 6. The difference being that, for this period, we cannot reject the conclusion that the Riksbank has taken adequate account of foreign GDP growth in the short term. We can only reject the hypothesis that the GDP forecast implies a neutral revision pattern relative to changes in the international forecast on the longer forecast horizons. The greater uncertainty surrounding the influence of foreign developments in the forecast revisions during this period is natural as fewer observations are used.

11 A fundamental insight in linear regression analysis is that the regression coefficient is mostly governed by observations with the highest variation around the mean value. For this reason, the regression coefficients for the average revisions at the two-year and three-year horizons shown in Figure 5 are governed by the revisions one year ahead as their variation is significantly higher. Normally, the forecasts further ahead are not revised to the same extent.

Figure 6. Revisions of forecasts in the longer term
Revisions, annual percentage change



Note. Standard error in brackets. The figures refer to the calculation methods D and E from Figure 4.
Source: The Riksbank

Is the lower correlation in the longer term a cause for concern? Not necessarily. A common view is that monetary policy affects inflation with a certain time lag, and active monetary policy offers one reason for the low correlation between the forecast revisions for Swedish and foreign inflation during the third year, compared with the first year of the forecast. A well-balanced monetary policy implies that changes in the repo rate counteract the variations in foreign inflation in the longer term. CPIF inflation therefore comes close to target at the end of the forecast horizon. In the shorter term, it is more difficult to counteract foreign inflationary impulses – such as major changes in the oil price – as effectively. The impact on the one-year horizon in the forecasts is therefore greater than during, for example, the third forecast year. In other words, a strong covariation in the shorter term and a weak covariation in the longer term is exactly what one would expect if monetary policy is well-balanced. We discuss the role of monetary policy in more detail in Section 6, in which we also analyse the Riksbank's interest rate revisions.

4 Comparison with the National Institute of Economic Research

So far, we have only studied the Riksbank's forecasts. What about other forecasters? Few other institutions publish and make the same amount of forecast data available as the Riksbank. This makes it difficult to carry out the same detailed evaluation as we can do for the Riksbank. One institution that provides a relatively large amount of forecast information

is, however, the National Institute of Economic Research (NIER). We therefore perform a similar analysis of the NIER's forecasts to make a comparison with the Riksbank. In the next section, we further expand the comparison by studying the forecasts of a number of other institutions, including the major Swedish banks.

One problem when we compare the Riksbank's forecasts with those of the NIER is that the latter does not publish forecast paths for international variables at a quarterly frequency. They are only available as full-year forecasts for the period 2009–2017.[12] As regards to international forecasts, we use the NIER's forecasts for the euro area, as it does not publish forecasts for KIX-weighted international variables. The analysis is not therefore completely comparable with our previous analysis.

Just as for the Riksbank, we calculate revisions in the NIER's forecasts by taking the difference between two consecutive forecasts. As the NIER publishes forecasts for the current year and the following one to two calendar years, the results obtained here should be compared with the results on the two-year horizon for the Riksbank (i.e. method B in Figure 4). To gain an understanding of the impact in the short and longer term, we also present results from two different horizons. One horizon refers to the last calendar year in the forecast, which is about two years ahead on average (i.e. Alternative D in Figure 4). The other horizon refers to the penultimate full-year in the forecast, which should be compared with the results for the Riksbank's one-year horizon. Just as for the Riksbank, we plot the forecast revisions for Sweden and other countries (the euro area) for the different horizons in a scatter plot.

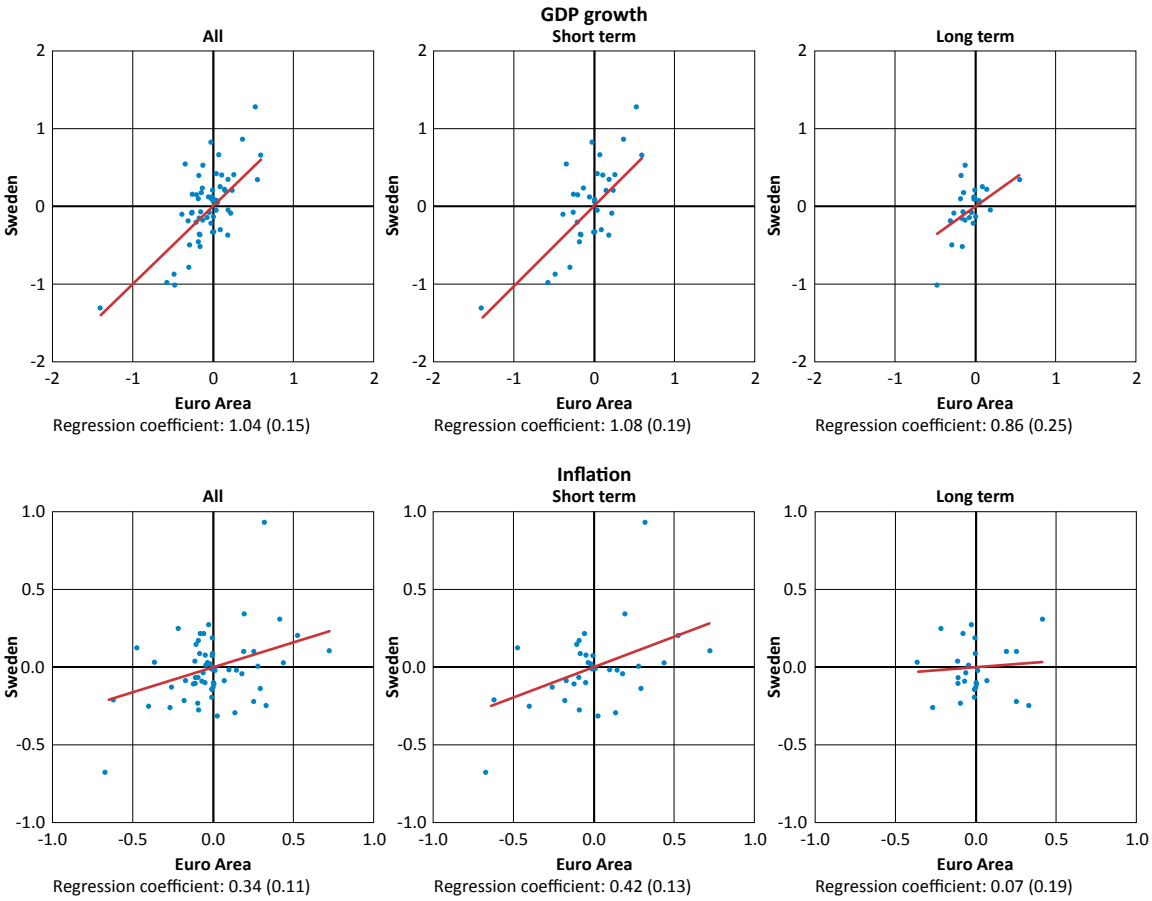
Figure 7 shows the revisions of the foreign variable on the horizontal axis and revisions of the corresponding Swedish variable on the vertical axis. The regression coefficient for the regression line through the scatter points tells us the extent to which the NIER has on average revised its view of domestic developments when it has revised its view of developments in the euro area. We see similar tendencies as we did for the Riksbank: The correlation between Sweden and abroad is weaker in the longer term in the forecasts. Especially for inflation, we see that the correlation is very weak for the longer forecast horizon, while it is in line with the data in the short term. For GDP growth, the correlation is lower than in the data for all horizons, but the difference is not statistically significant.[13] For inflation, the correlation in the short term is well in line with the data but in the long term, the correlation is close to zero. However, the correlation in the long term has a considerable degree of uncertainty in the estimate, which means that we can only say that it is significantly lower than the data on a 10-percent significance level.[14]

12 Last available forecast refers to the forecast published in June 2017.

13 For GDP growth in the short term (and hence also for all horizons), there is an unusual observation (which refers to the financial crisis in autumn 2008) with a major downward revision of foreign GDP growth (around –1.5 percentage points) and a relatively minor revision (about –1.2 percentage points) of Swedish GDP growth. If we exclude this observation, the regression coefficient increases from 1.04 to 1.11 for all horizons. This is slightly higher, but not significantly different. Neither is it obvious why this observation shall be excluded.

14 In the same way as for the Riksbank, we also present the NIER's forecasts in levels in Appendix B.

Figure 7. Revisions of forecasts for Swedish and foreign GDP growth and inflation
Revisions, annual percentage change



Note. Standard error in brackets.
Source: National Institute of Economic Research

5 Comparison with other forecasters

Comparing the Riksbank with other forecasters can provide both valuable information to help understand the forecasting institution's actions and an indication of what has been possible and not possible to predict. If, for example, all institutions have taken foreign developments too little or too much into consideration, it may be genuinely surprising events that are the basis for their actions. On the other hand, if an individual institution differs from the others, it seems reasonable to assume that another specific assessment or assumption about the economy lies behind the deviations. In this part of the analysis, we look at how the Riksbank and some other large forecasting institutions in Sweden have taken foreign developments into account in their domestic forecasts. As data for all forecaster is only available for a shorter horizon (the current and following year), the focus of the analysis is on a comparison between the institutions and not primarily with the actual data.

5.1 Data for comparison with other institutions

The forecasting institutions studied are, in addition to the Riksbank: the Ministry of Finance, the National Institute of Economic Research (NIER), SEB, Svenska Handelsbanken, Nordea, Swedbank, the Swedish Trade Union Confederation (LO) and the Confederation of Swedish Enterprise. Several of these institutions make significantly fewer forecasts in a year than the Riksbank. We have elected to deal with this by dividing the institutions into three groups. The Ministry of Finance and the NIER make up a group we call *Government*. SEB, Svenska

Handelsbanken, Nordea and Swedbank constitute a group we call *Banks* and finally, LO and the Confederation of Swedish Enterprise make up the group *Labour market institutions.*[15] The groups are explained in more detail in the discussion of the actual analysis.

Due to limitations in the data for a few of the institutions, a smaller amount of information is used here compared with the previous analysis of the Riksbank's forecasts. More specifically, we use the same data material here as is used every year in the forecast comparison conducted by the Riksbank to compare forecasting performance.[16] This data material consists of forecasts made for average outcomes for the current and following full-year for the period 2008–2017.[17] For example, the Riksbank made six forecasts in 2015, each of which contained forecasts for GDP growth for 2015 (current year) and for GDP growth in 2016 (following year). This means that several forecasts in the data material were made on different occasions (and different horizons) but refer to the same outcomes. The Riksbank has therefore made six forecasts for the 2016 outcome during 2016 and six forecasts during 2015. This gives forecasts with horizons of potentially between one and twenty-four months. A complication is that the various forecasting institutions make a different number of forecasts during the year and they make them at different times of the year. This means that the data is not entirely comparable between the different institutions. For our purpose, it should still provide valuable insights into how Swedish forecasters act as we are not interested in forecasting precision but in their revision patterns. We calculate forecast revisions for each institution respectively for the variables Swedish GDP growth and inflation (CPIF), euro area GDP growth and inflation (HICP) and U.S. GDP growth and inflation (CPI). After calculating the revisions for the United States and the euro area, we weight these together in a KIX2 index. The broader KIX index we used to analyse the Riksbank's forecasts can no longer be used as few institutions apart from the Riksbank make forecasts for KIX-weighted countries abroad. Together, however, the euro area and the United States constitute about 55 per cent of the broader KIX index, which should be a good approximation of the broader KIX index.[18]

An important aspect to point out is that the forecasts in this data material consist of actual outcomes to a significantly higher degree than in previous sections. A full-year forecast made with a horizon of one month has access to a large share of the outcome and only a small part actually needs to be forecast. In the data material that we use, we have an average forecast horizon of about twelve months, which provides an average forecast in which almost half the outcome is known.[19]

5.2 Account taken of other countries by Swedish forecasters

In Figure 8 and 9, we plot revisions for other countries on the horizontal axis and the domestic revisions on the vertical axis in scatter plots for each group respectively. Through the scatter points, we also plot a regression line in the same way as before. We have also drawn a yellow line showing the correlation in KIX2-calculated data. For GDP growth (Figure 8), we see that the Riksbank and the banks have coefficients close to one. For the labour market and government institutions, we have the highest coefficients. For the government institutions, including the Ministry of Finance and the NIER, it is worth noting that the picture does not significantly change if we treat them as separate institutions. But even if the results indicate that the Ministry of Finance and the NIER have taken

15 The *Labour market institutions* group is excluded in the analysis of inflation due to a lack of data. For the same reason, Swedbank is excluded from the *Banks* group in the inflation analysis. It is also worth noting that, for inflation, the *Government* group is mainly made up of the NIER, as we only have a few observations for the Ministry of Finance.

16 See, for instance, Sveriges Riksbank (2017).

17 The data material covers forecasts made before 22 June 2017.

18 In the calculation of the so-called KIX2 index, we have used the relative KIX weights 0.85 for the euro area and 0.15 for the United States.

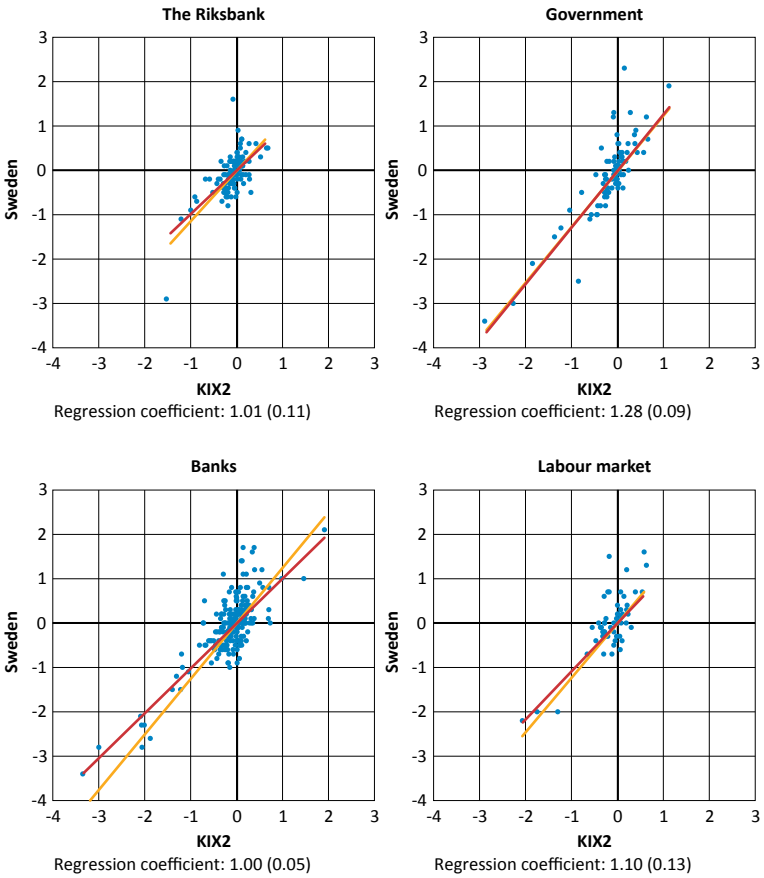
19 See Andersson et al. (2017) for a more detailed discussion on the significance of the horizon and calculation of outcome weights in outcomes and forecasting errors.

developments in the euro area and the United States more into account in their revisions in the short term compared with the Riksbank, the private banks and the labour market institutions, we cannot draw the conclusion that the difference is statistically significant. The difference in point estimates are not large enough and the standard deviations for the point estimates (figures in brackets) are relatively high. Finally, we can note that the results in Figure 8 indicate that the Riksbank has taken this foreign measure more into account than KIX-weighted countries abroad. In Figure 5, we saw that the regression coefficient for GDP growth was 0.91 for the one-year horizon while for KIX2 we have 1.01 in Figure 8. As fluctuations abroad measured using the KIX2 index have less impact on the Swedish economy than the KIX index, this relationship may seem surprising.[20] A possible explanation is that the euro area and the United States receive a little extra attention during a forecasting process, as they are the world's largest economies. One should also remember that the horizon is not completely comparable with our earlier analysis. In the material for this section, the horizon varies potentially from one to twenty-four months as previously noted. On shorter horizons, a lot of outcome information is available and it then seems natural that the correlation in the data is correctly reflected in the forecast.

Figure 9 presents the results for inflation. For the Riksbank and the banks, we once again see similar results. For the government institutions, we observe a coefficient that is slightly lower. The results are in line with what we saw in the comparison between the Riksbank and the NIER. One difference between the Riksbank and the other forecasters (government and banks) in Figures 8 and 9 is that the Riksbank has made notably smaller revisions of foreign growth. This is because the Riksbank publishes more forecasts each year, and it is therefore natural that the revisions in each given forecasting round is smaller in magnitude. We have hence verified that the results for the Riksbank are robust when we remove two forecasting rounds each year (the April and September forecasts). In this case, the regression coefficient increases to 1.1 for GDP growth and to 0.37 for inflation which compares well to the coefficients for the other institutions.

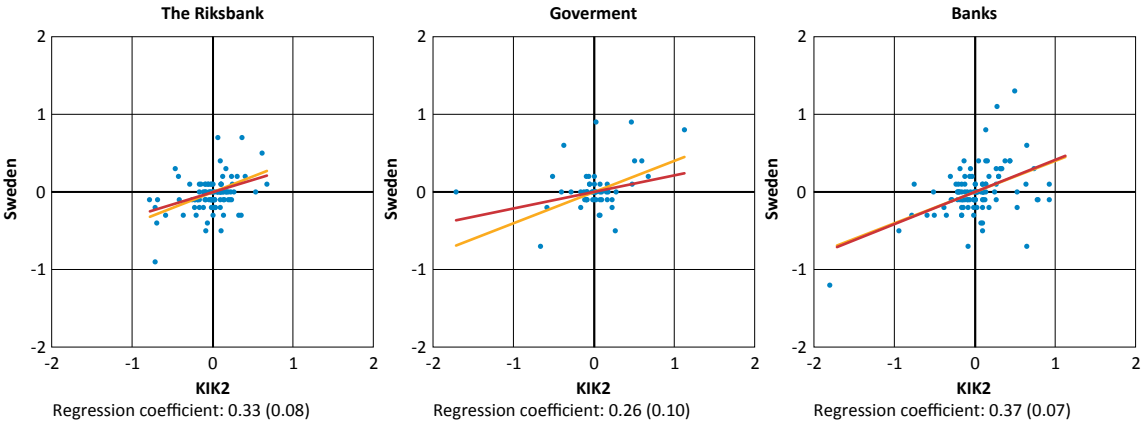
20 The regression coefficient in the data is 1.26 for the KIX2 index according to Figure 8 while the coefficient is 1.42 for the KIX index according to Figure 2.

Figure 8. Revisions for KIX2-weighted GDP growth
Revisions, annual percentage change



Note. Red line shows regression line through the points. Yellow line shows correlation in data for KIX2: 1.26 (0.07). Standard error in brackets.
Sources: Each institution respectively and the Riksbank

Figure 9. Revisions for KIX2-weighted inflation
Revisions, annual percentage change



Note. Red line shows regression line through the points. Yellow line shows correlation in data for KIX2: 0.37 (0.07).
Sources: Each institution respectively and the Riksbank

6 The role of monetary policy in the forecasts

The design of monetary policy is of central importance in the forecasts. A common conceptual framework about the functioning of the economy is that central banks can use monetary policy to influence the development of domestic GDP growth and inflation.[21] When the Executive Board of the Riksbank adopts a particular monetary policy, they also make an assessment of what monetary policy will be conducted in the future. They normally do this by communicating an interest rate path. This interest rate path is part of the monetary policy decision and has a direct effect on the forecasts of, for example, GDP and inflation published by the Riksbank. In other words, an interest rate path is associated with an assumption about how inflation is going to develop. A different interest rate path would, all else equal, give a different inflation forecast.

Why then is monetary policy of interest in the discussion about taking international developments into account? In very simple terms, one can say that an foreign revision can be dealt with in two ways in the forecast. The first option is to allow the changed view of international developments to 'impact' the domestic forecast in full. The second option is to 'counteract' the foreign impulse with an active, well-balanced monetary policy. To understand this a little better, we will perform a conjectural experiment. Let's say that the Executive Board decides on a certain interest rate level and an interest rate path that brings inflation back to target at a desirable pace. At the next policy meeting, their assessment is that foreign inflation needs to be revised down. In other words, they now think foreign inflation will be lower than they previously thought. According to historical patterns, lower foreign inflation is often an indication of lower inflation in Sweden as well. The domestic inflation forecast should therefore be revised down. But recalling that the Executive Board was satisfied with the inflation projection they envisaged at the previous meeting, it is reasonable to assume that the Executive Board at its next meeting will take a decision on a different rate level and a different rate path in order to counteract the change from abroad.

One should remember, however, that a common perception of monetary policy is that it works with a time lag. This means that it is only partly possible to counteract a foreign impulse in the short term. In the longer term, it should, however, be easier to influence inflation through monetary policy. This means that we can expect foreign revisions to have a greater impact in the short term as monetary policy cannot counteract the revision. On the other hand, monetary policy has a greater chance of counteracting the impact of foreign revisions on domestic variables in the longer term. So an important question is whether the Riksbank has conducted a sufficiently active monetary policy to justify a reduction in the longer-term impact from abroad in the forecasts. To examine this, we next study outcomes contra forecasts for the repo rate.

6.1 Monetary policy in the data and the Riksbank's forecasts

We start by looking at how the policy rate in Sweden and abroad has developed historically. In Figure 1, we showed how the repo rate in Sweden has covaried with a number of different measures of the policy rate abroad. We saw that the correlation between the repo rate in Sweden and the policy rate in the euro area has been very high between 1999 and 2017. Even the correlation with the KIX-weighted policy rate (we use a KIX4-weighting which included the euro area, the United States, the United Kingdom and Norway) is very high.[22] As before, we also plot this data in a scatter plot. Figure 2 illustrates what the correlation looks like in the data. The regression coefficients show that the policy rate in Sweden has

21 According to conventional theory, monetary policy can only influence real variables like GDP growth in the short term. In the long term, monetary policy is normally considered neutral and only influences nominal variables such as inflation. Long term in this context is normally deemed to be beyond the three-year forecast horizon.

22 KIX4 is what the Riksbank bases its forecast on. Together, the euro area, the United States, the United Kingdom and Norway make up 65 per cent of KIX.

on average changed 'one-to-one' with the policy rate abroad (KIX or the euro area). As the euro area weighs very heavily in this weighting, it is not so surprising that the euro area and KIX have a similar impact. The correlation with the United States is weaker and considerably more uncertain. From the chart, we see a notably higher dispersion around the regression line for the United States. It also appears from Figure 1 that there tends to be a phase shift between the repo rate and the US federal funds rate, with the latter changing earlier. The correlation between them is therefore slightly stronger if we compare the current policy rate with changes that occurred in the federal funds rate six months previously.

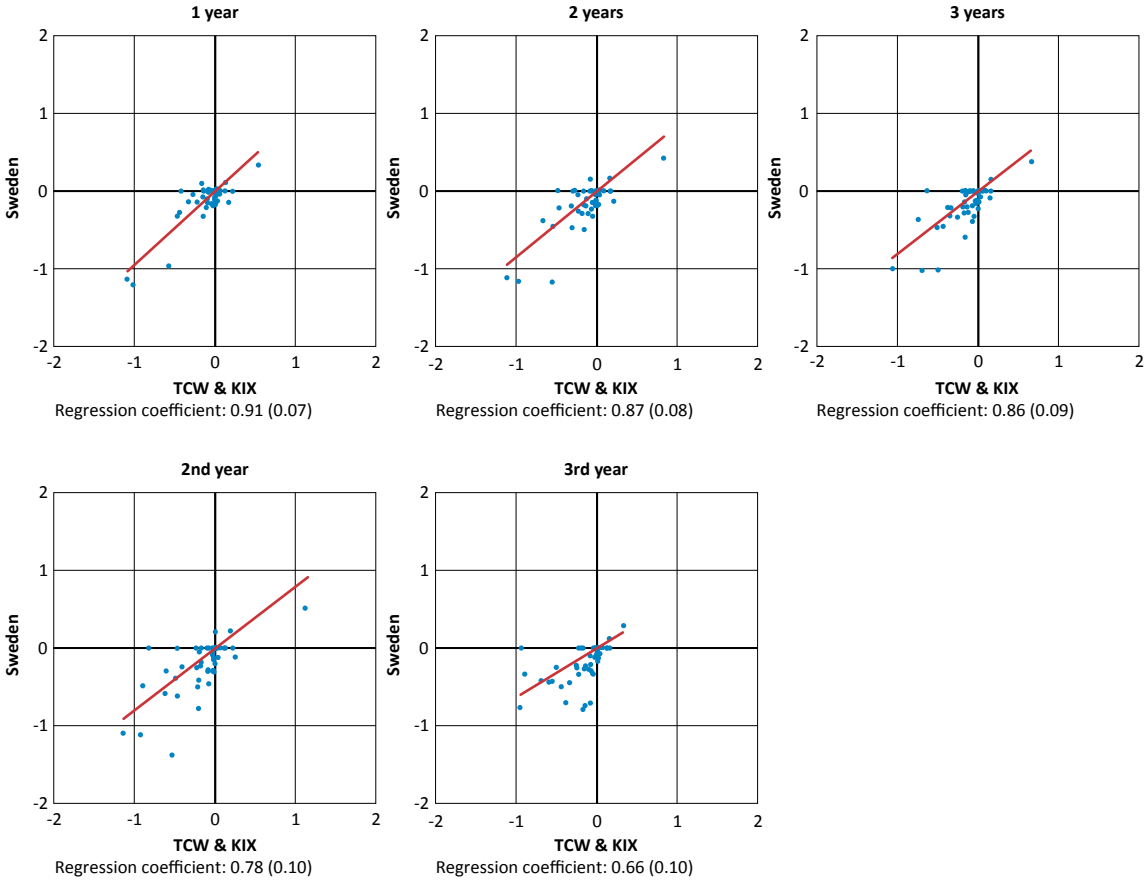
Figure 3 shows the Riksbank's forecasts for the repo rate in Sweden and the Riksbank's forecasts for the KIX-weighted policy rate. The similarity between the profiles of the domestic forecasts and the international forecasts is clear from the figure. It is also clear that the interest rate has been surprisingly low both in Sweden and abroad. As before, by calculating revisions between two consecutive forecasts, we can plot the revisions in scatter plots. But how strong is the correlation between the domestic and foreign rates in the revisions? To study this, we follow the analysis in Figures 5 and 6 and plot the revisions in the foreign rate (x-axis) for all forecasting rounds against the revisions in the Swedish repo rate (y-axis) for all forecasting rounds. By plotting a regression line through the points, we then obtain a measure of what the correlation has looked like in the Riksbank's interest rate forecasts. There is, however, a slight difference from what we did with the GDP growth rate and inflation in Figures 5 and 6: When we calculate the interest rate forecasts according to the principles in Figure 4, we calculate the revisions for alternatives A, B and C between two consecutive forecasting rounds as the difference between the average for the 4, 8 and 12 first quarters respectively in the later forecasting round. The choice of starting quarter is hence guided by the later forecasting round. The principles D and E are calculated as follows: the average of quarters 5–8 and the average of quarters 9–12 respectively.[23]

Figure 10 shows the results of this exercise. The figures in the first row show the correlation one, two and three years ahead in the forecasts. As can be seen, the correlation is relatively high on all horizons but slightly low in relation to the correlation in the data (1.02). It is not significantly lower than the data, however. The second row in Figure 10 shows the correlations between the revisions during the second and third year in the forecast respectively.[24] The coefficient is 0.78 when we look at the second year in the forecast, and 0.66 when we look at the third year. These two coefficients are significantly lower than the coefficient in the data. Quantitatively, these results are not in line with the same analysis we made for GDP and inflation. In that analysis, we saw that the correlation was close to zero during the third year in the forecasts. Qualitatively, the results for the repo rate at longer horizons are similar to those obtained for GDP growth and inflation in the sense that the comovement in the revisions is lower.

23 When we calculate the revisions three years ahead, we lose six observations because we cannot calculate the difference from the previous forecasting round on the twelve-quarter horizon. This is because the previous forecasting round sometimes does not extend far enough. We chose to exclude these six revisions for the shorter horizons as well in order to keep the number of revisions constant over the different horizons.

24 According to principles D and E illustrated in Figure 4.

Figure 10. Revisions of the forecast for Swedish and foreign policy rate
Revisions, per cent



Note. Standard error in brackets. The figures refer to the calculation methods: A, B, C, D and E.
Source: The Riksbank

How do these figures compare with historical patterns? We saw in Figure 2 that the correlation in actual data suggested a regression coefficient of around one for both the euro area and KIX-weighted countries abroad with an uncertainty band of 0.9–1.1. So even if the Riksbank has taken significant account of interest rates abroad in its forecasts, it has done so to a slightly less extent than is implied by a neutral revision pattern.

The results from Figure 5 and Figure 6 demonstrate that the Riksbank has, in the short term, allowed foreign revisions to have a relatively substantial impact on GDP and inflation according to the correlations in the outcome data, albeit slightly weak for GDP growth. In the long term, however, the Riksbank has not allowed foreign revisions to have much of an impact. This may be because the Riksbank, in its forecasts, has felt that it is conducting a monetary policy that has counteracted the foreign impulse and hence has been able to 'steer' domestic developments in the longer term. However, the results in Figure 10 do not suggest that the Riksbank has been more activist in its rate-setting in the forecast than historical patterns might imply. The Riksbank has revised the domestic forecast for the interest rate on all horizons to almost the same extent as the foreign revision, albeit slightly weaker than the correlation in the outcome data.

In other words, the Riksbank has changed its monetary policy stance between the Swedish repo rate and foreign policy rate in line with the historical patterns, but, despite this, it has had a significantly smaller impact of international developments on domestic GDP growth and inflation on longer forecast horizons. If the regression coefficients for the interest rate in Figure 10 had been greater than one, it would have been a sign that the monetary policy in the forecasts had been more aggressive than the historical patterns and a smaller

impact in the longer term could therefore have been justified. As the regression coefficients now seem to be slightly below one, it is more difficult to argue that the Riksbank has been more active. From a monetary policy perspective, therefore, it appears difficult to justify a smaller impact of revisions to foreign inflation on domestic inflation for the longer forecast horizons.[25] However, there may be a few other reasons why the Riksbank has expected a smaller impact of international developments on domestic forecasts in the longer term.

First of all, it can be an expression of the Riksbank having different views on the transmission mechanism in Sweden and abroad. It might be that the Riksbank expects the impact from the interest rate in Sweden to be more rapid and possibly also stronger than in other countries. This might be reasonable provided that Sweden is a very open economy. It is also possible that the transmission mechanism is faster now than it used to be as Sweden's integration with the rest of the world has increased both in terms of trade and via financial markets. One way of trying to quantify a different view of the transmission mechanism is the exchange rate. The exchange rate is a forward-looking price determined by the impact of various shocks affecting the economy. It may be that the Riksbank has made different assessments of how the exchange rate covaries with GDP growth, inflation and the nominal policy rate to what historical patterns indicate and this may have led the bank to deviate from historical patterns with regard to the covariation between foreign and domestic variables in the longer run across the forecast horizon (also in the short run for GDP growth). We have therefore examined the relationship between the real KIX exchange rate and the three domestic variables in the data, and what these relationships look like in the Riksbank's forecast revisions. We report these results in Appendix C. In the appendix, however, we show that the Riksbank's forecast revisions for the covariation between the real exchange rate and annual GDP growth, inflation and the nominal repo rate do follow historical patterns in the data. In the data, there is a significantly positive correlation between the real exchange rate and GDP growth and the repo rate: A stronger appreciated exchange rate is associated with higher GDP growth and the repo rate. Even so, there is no significant direct correlation between inflation and the real exchange rate, and the causality between these variables is not obvious. The real exchange rate, domestic interest rate, inflation and GDP growth are all endogenous variables so, without making additional assumptions, we cannot say which variable has caused which. Still, this is not what is important here. The important thing here is that the correlation between these variables in the Riksbank's forecast revisions looks approximately the same as in the data. We can therefore rule out deviating exchange rate assessments as an important factor behind the lower influence of international developments in the long-term. Hence, it seems that the influence of foreign variables is lower than in historical patterns would suggest.

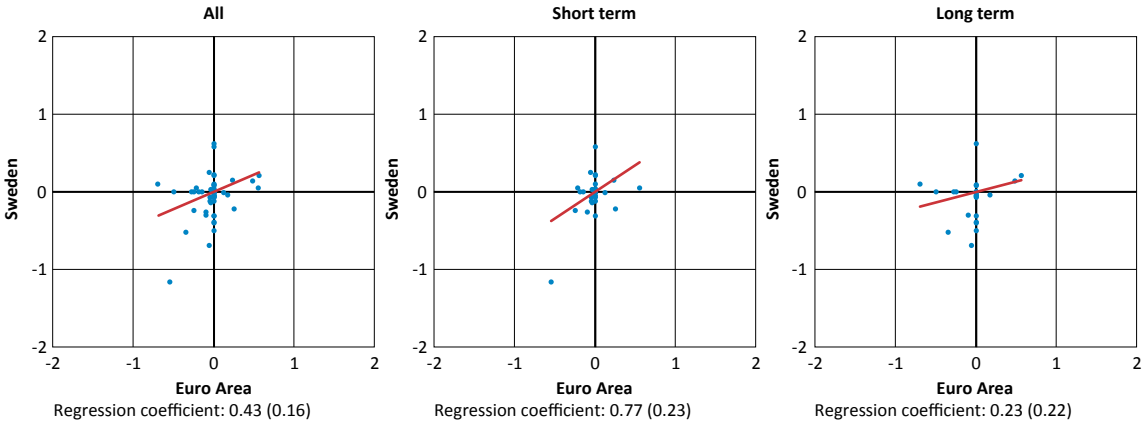
Another explanation for why the correlations deviate might be that Sweden, to a greater extent than other countries, is deemed to have more effective so-called 'automatic stabilisers', in which the public sector fiscal balance varies according to the economic situation without active decisions being necessary. A greater degree of and more efficient automatic stabilisers would then lead to the economy returning to long-term equilibrium more quickly.

25 This reasoning is valid in a traditional, backward-looking model, in which only actual interest rate changes affect economic activity and inflation. In a model with forward-looking expectations, such as Ramses, a similar change in the *actual* interest rate may stabilise the economy *better* if the central bank communicates a *greater willingness* to respond to deviations of inflation around the target and the GDP growth rate across the forecast horizon. Doing so causes the variation in these variables to decrease, which results in it not being necessary to actually change the interest rate more than normal in equilibrium. To investigate this possible explanation for the results, we have estimated a simple Taylor rule for the Riksbank's revisions of the repo-rate path on revisions of the inflation forecast and the GDP growth rate one year ahead and between year two and year three across the forecast horizon (alternative A and E respectively in Figure 4). When we do that, we find no support for a more aggressive policy stance across the longer forecast horizon. Our simple reasoning that monetary policy has not been sufficiently aggressive therefore seems also to be valid in a framework with forward-looking expectations.

6.2 The National Institute of Economic Research's interest rate forecasts

Due to a lack of data, we cannot perform the same analysis for all the other institutions. The National Institute of Economic Research (NIER) has, however, published interest rate forecasts that we can use. Figure 11 shows the NIER's interest rate revisions. In Figure 11, we do not really see the same pattern as we do for the Riksbank. For the NIER, we see a weak correlation that is statistically proven to be lower than in the data for the longest forecast horizon while we saw tendencies towards a continued strong correlation in the Riksbank's revisions. In the NIER's interest rate forecasts, we see that large number of revisions for the euro area and Sweden are zero or close to zero, as the NIER does not seem to have changed the outlook for monetary policy very often.

Figure 11. The National Institute of Economic Research's revisions of the forecast for Swedish and foreign policy rate
Revisions, per cent



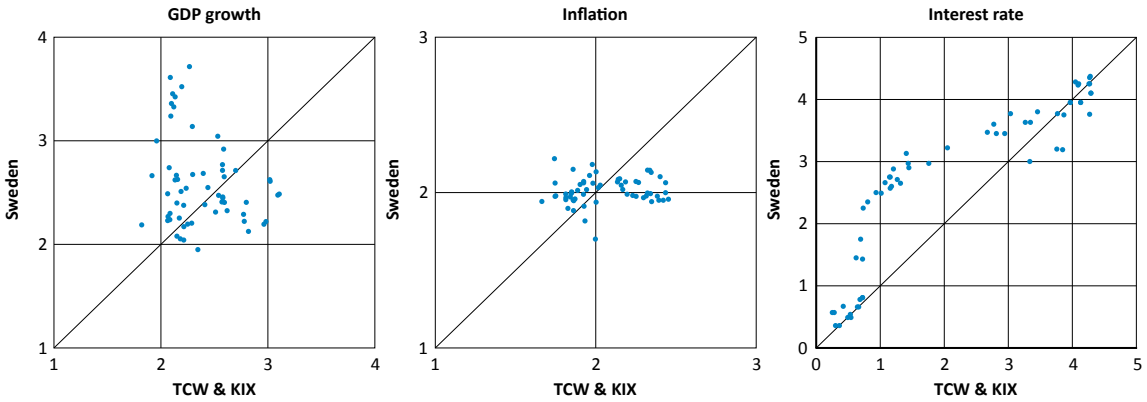
Regression coefficient: 0.43 (0.16) | Regression coefficient: 0.77 (0.23) | Regression coefficient: 0.23 (0.22)

Source: National Institute of Economic Research

6.3 End-point analysis

The weak correlation between the revisions for other countries and Sweden for GDP and inflation further out during the projection horizon can possibly be explained by the fact that the Riksbank, in the long term, forecasts a return to long-term equilibrium. By studying the end points in the forecasts, we can gain further insights into this. We start by selecting and plotting the last observation from each forecast from Figure 3 in a scatter plot, where the observation for the foreign variable is on the x-axis and the domestic variable is on the y-axis. In addition, we include a 45-degree line to facilitate interpretation. If the end-point observations are above the line, it means that the Riksbank has, on average, had a higher end point in the domestic forecast compared with the international forecast, and a lower end point if the points are below the line. In Figure 12, we see that the Riksbank has possibly had a slightly higher end point in the domestic GDP forecasts. We also see that the Riksbank has often had a higher domestic interest rate at the end of the forecast than it has had for its projection of the foreign policy rate. For inflation, it is not possible to see any clear pattern regarding whether the Riksbank has had a lower or higher inflation in the end points. On the other hand, one can quite clearly see that the dispersion is significantly greater for foreign inflation in relation to domestic inflation in the longer run.

Figure 12. End points in the Riksbank's forecasts
Annual percentage change and per cent

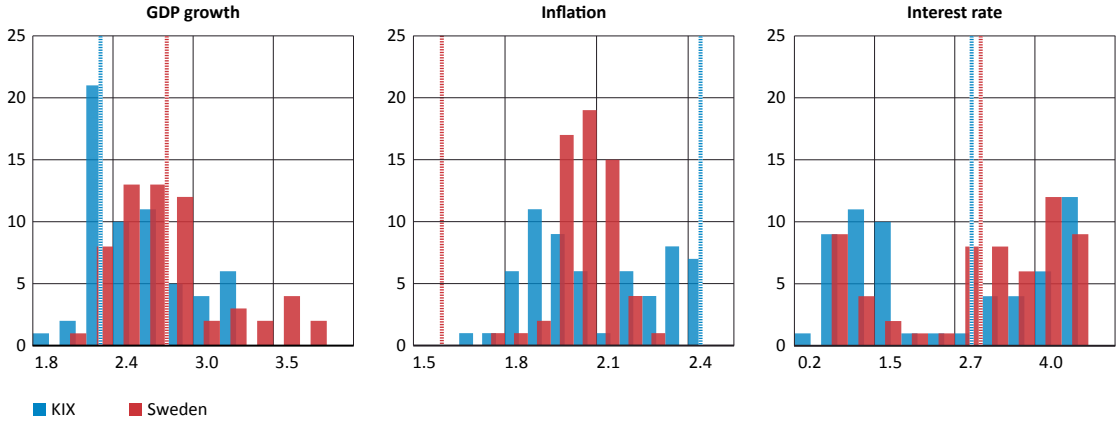


The data points in Figure 12 can also be illustrated by showing what the distributions look like. Figure 13 shows distributions for the forecasts' end points for the domestic and foreign variables separately. The subplots in Figure 13 confirm what Figure 12 initially suggested for GDP growth – they are very similar but the forecasts for Swedish GDP growth are slightly higher. For the interest rate, we see two clusters: One with a higher interest rate, 3–4 per cent and one with a lower rate, 0–2 per cent. Once again, we see that the forecasts for monetary policy are characterised by slightly higher end points in the Swedish interest rate forecasts. For inflation, it is now even clearer that the longer-run forecasts for Swedish CPIF inflation are clearly characterised by a return to a long-term equilibrium around the inflation target of 2 per cent. This can be seen by the very tight clustering of the distribution around 2 per cent, i.e. the inflation target. For foreign inflation, the distribution is not so concentrated in the end points. The foreign inflation forecasts refer to KIX-weighted countries abroad, and if we calculate a KIX-weighted inflation target, it turns out to be approximately 2.4 per cent.[26] In other words, the longer-term foreign inflation forecasts are often characterised by them not being expected to return to the long-term equilibrium, despite the fact that many of the countries included in the KIX index have an inflation target and conducts monetary policy in a similar way to how it is done in Sweden.[27] For the policy rates and GDP growth, we see a similar dispersion in the end-point forecasts.

26 It is important to point out that it is not possible to calculate an exact measure of KIX-weighted inflation target as a number of countries do not have a point target for inflation. For example, the European Central Bank's target states that inflation shall be below but close to 2 per cent. The Swiss central bank has specified a target for inflation of below 2 per cent. The central bank in Australia has a target that specifies a target interval of 2–3 per cent. Some countries have even changed their inflation target during our study period. In other words, there is uncertainty about the level of the KIX-weighted inflation target.

27 For the economic region with the greatest weight in the KIX index, the euro area, we unfortunately only have access to the Riksbank's end-point forecasts for the period 2013–2017. For this period, these vary between 1.4 and 1.9 percentage points, which is systematically lower than the ECB's inflation target of 'close to, but just below 2 per cent'. However, as the dispersion in the end-point forecasts for the euro area is not higher than in the Riksbank's end-point forecasts for CPIF, as shown in Figure 13, and as the number of observations is small (25), the possibility of drawing any wide-ranging conclusions about any differences between the forecasts for Sweden and the euro area is limited.

Figure 13. End-point distribution
Frequency



Note. Broken vertical lines refer to average values in actual data from 1994.
Source: The Riksbank

7 Concluding remarks

In this study, we have analysed how the Riksbank and other Swedish forecasters have taken international developments into account in their forecasts for Swedish GDP growth, CPIF inflation and the repo rate. Our focus has been on whether a revision of the view on international developments has led to a revised view on domestic developments in line with historical patterns.

Sweden is a small, open economy that is strongly influenced by developments abroad. The fact that the assessment of international developments is also important for the assessment of domestic developments is reflected in the Riksbank's forecasting process. When the Riksbank prepares an economic forecast, it starts work by making an assessment of economic activity and inflation abroad, with a particular focus on countries with strong trade links with Sweden. The euro area and the United States are particularly important in this regard.[28]

Our findings, however, indicate that the Riksbank has taken too little account of foreign GDP growth in its forecasts for Swedish GDP growth in relation to historical correlation patterns, especially in the longer run. The National Institute of Economic Research (NIER) has also taken less account of international developments than is implied in the outcomes, although the difference for the NIER is not statistically significant. The findings also show that the major Swedish banks and key labour market insitutions have similar results to those of the Riksbank. For inflation, the results suggest that both the Riksbank and the NIER have taken reasonable account in the short term of foreign inflation in their forecasts for domestic inflation. In the longer term, however, both seem to have taken very little account of international developments in their inflation forecasts. Once again, the results for the major Swedish banks are in line with the results for the Riksbank.

For policy rates we found that both the Riksbank and the NIER take considerable account of foreign policy rates in the short term, albeit slightly less than historical patterns prescribe. At longer forecast horizons, we see certain differences between the Riksbank and the NIER. The Riksbank continues to incorporate substantial influence of international developments in the longer term while the NIER takes little account of foreign rate-setting in its long-term forecasts. These findings mean that a more active monetary policy stance cannot easily explain the lower impact on domestic GDP growth and inflation on the longer forecast horizons. Only if the domestic interest rate-setting had been more aggressive than

28 See Hallsten and Tägström (2009) for a description of the forecasting process.

prescribed by historical patterns would it have been possible to motivate a smaller impact from a monetary policy perspective. Other assessments must be behind the more limited impact in the Riksbank's and NIER's medium- and long-term forecasts.

Finally, it is important to point out that we have not in this study looked at forecasting performance, with regard to either domestic or international developments. An institution that does not revise its domestic forecast in line with its foreign revisions could possibly motivate this by stating that it considers its international assessment to be particularly uncertain. Such a reasoning may, however, be problematic if it is extended to apply over a longer period of time. It is difficult to see any reason why it would be fundamentally much more difficult to forecast international developments (e.g. KIX, the euro area or the United States) than domestic developments.[29]

29 See Sveriges Riksbank (2017) for an evaluation of the forecasting performance of various forecasting institutions. See also Aranki and Reslow (2015) for an evaluation of the Riksbank's international forecasts.

References

Aastveit, Knut Are, Hilde C Bjørnland and Leif Anders Thorsrud (2016), 'The world is not enough! Small open economies and regional dependence', *Scandinavian Journal of Economics*, Vol. 118, No. 1, pp. 168–195.

Andersson, Mikael K., Ted Aranki and André Reslow (2017), 'Adjusting for information content when comparing forecast performance', *Journal of Forecasting*, Vol. 36, No. 7, pp. 784–794.

Aranki, T. and Reslow, A. (2015), 'An assessment of the Riksbank's international forecasts', Economic Commentary No. 14, Sveriges Riksbank.

Ciccarelli, Matteo and Benoit Mojon (2010), 'Global inflation', *The Review of Economics and Statistics*, Vol. 92, No. 3, pp. 524–535.

Hallsten, Kerstin and Sara Tägtström (2009), 'The decision-making process: how the Executive Board of the Riksbank decides on the repo rate', *Sveriges Riksbank Economic Review*, No. 1, pp. 69–84.

Justiniano, Alejandro and Bruce Preston, 'Can structural small open-economy models account for the influence of foreign disturbances?', *Journal of International Economics*, Vol. 81, No. 1, pp. 61–74.

Lindbeck, Assar (1975), *Swedish economic policy*, Macmillan: London.

Lindé, Jesper (2003), 'Monetary policy shocks and business cycle fluctuations in a small open economy: Sweden 1986–2002', Working Paper No. 153, Sveriges Riksbank.

Lindé, Jesper and André Reslow (2017), 'A myth that the Riksbank's forecasts are governed by models', *Sveriges Riksbank Economic Review,* No. 1, pp. 27–48.

Sveriges Riksbank (2017), 'A review of the Riksbank's forecasts', Riksbank Studies, Sveriges Riksbank.

Appendix A

When we examine whether a regression coefficient in forecast revisions is statistically significantly different from the corresponding regression coefficient in the data, we calculate the following Z-statistic:

(3) $$Z=(\hat{\beta}_{data}-\hat{\beta}_i)/\sqrt{\sigma^2_{data}+\sigma^2_i}$$

where $\hat{\beta}_{data}$ denotes the estimated regression coefficient in the data and $\hat{\beta}_i$ denotes the estimated regression coefficient in the forecast revisions. σ denotes standard error in the estimates of the coefficients in the data and revisions respectively. Given our Z-statistic, we can then calculate a significance test with two-sided *p*-values. The null hypothesis in the test is that the two coefficients β_{data} and β_i are the same. A low *p*-value (normally below 0.05) allows us to reject the null hypothesis that they are equal. Tables A1 and A2 present *p*-values for the various regression coefficients calculated for the Riksbank and the National Institute of Economic Research respectively.

Table A1. Testing statistical significance in the Riksbank's revisions

	GDP	Inflation	Interest rate
1 year	0.00	0.93	0.23
2 years	0.00	0.95	0.12
3 years	0.00	0.66	0.11
2nd year	0.00	0.57	0.03
3rd year	0.00	0.00	0.00

Note. The figures refer to p-values. A low p-value allows us to reject the null hypothesis that the regression coefficients in the revisions are the same as the regression coefficients in the data.

Table A2. Testing statistical significance in the National Institute of Economic Research's revisions

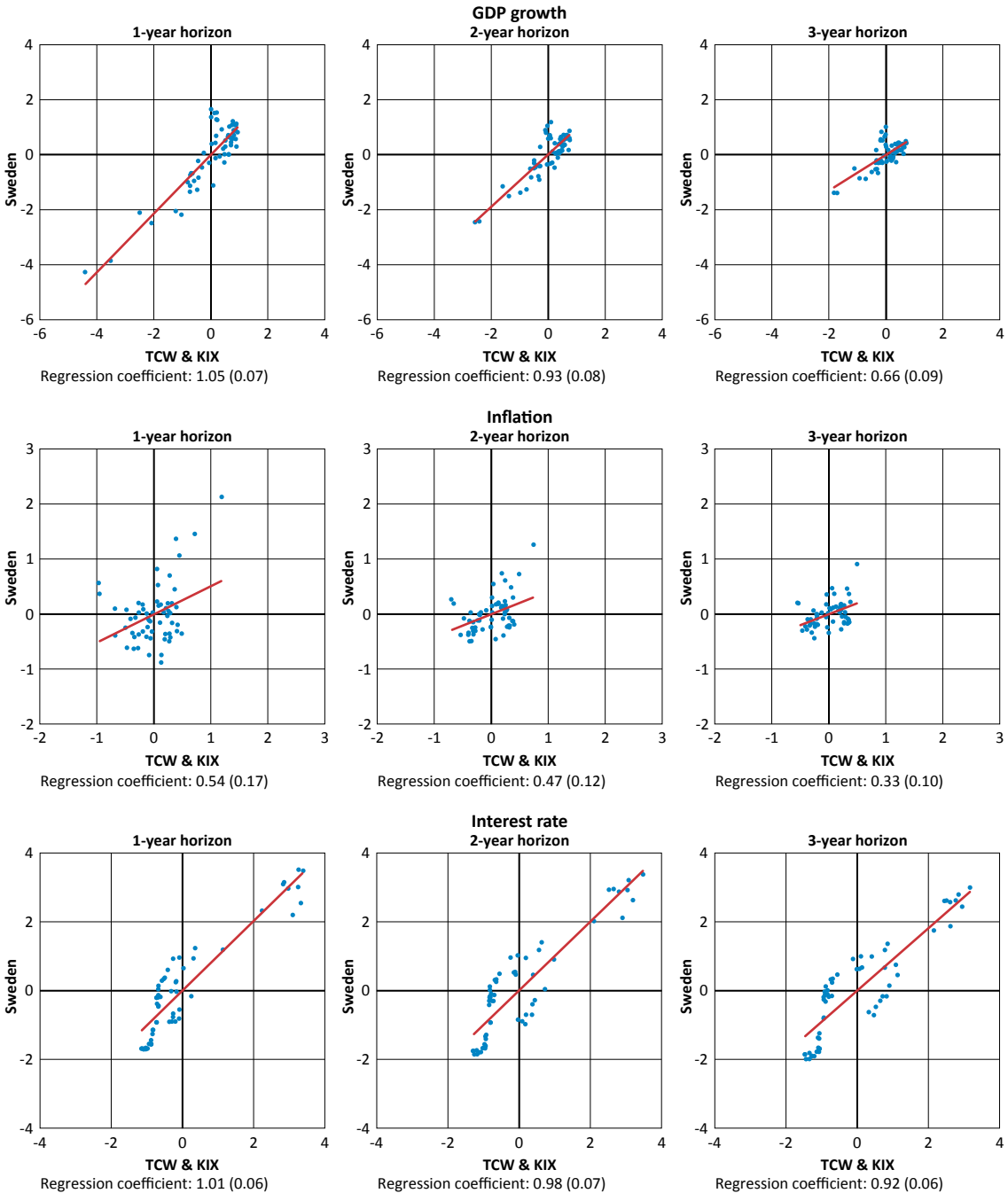
	GDP	Inflation	Interest rate
All	0.33	0.65	0.00
Short	0.55	0.89	0.36
Long	0.19	0.10	0.00

Note. The figures refer to p-values. A low p-value allows us to reject the null hypothesis that the regresion coefficients in the revisions are the same as the regression coefficients in the data.

Appendix B

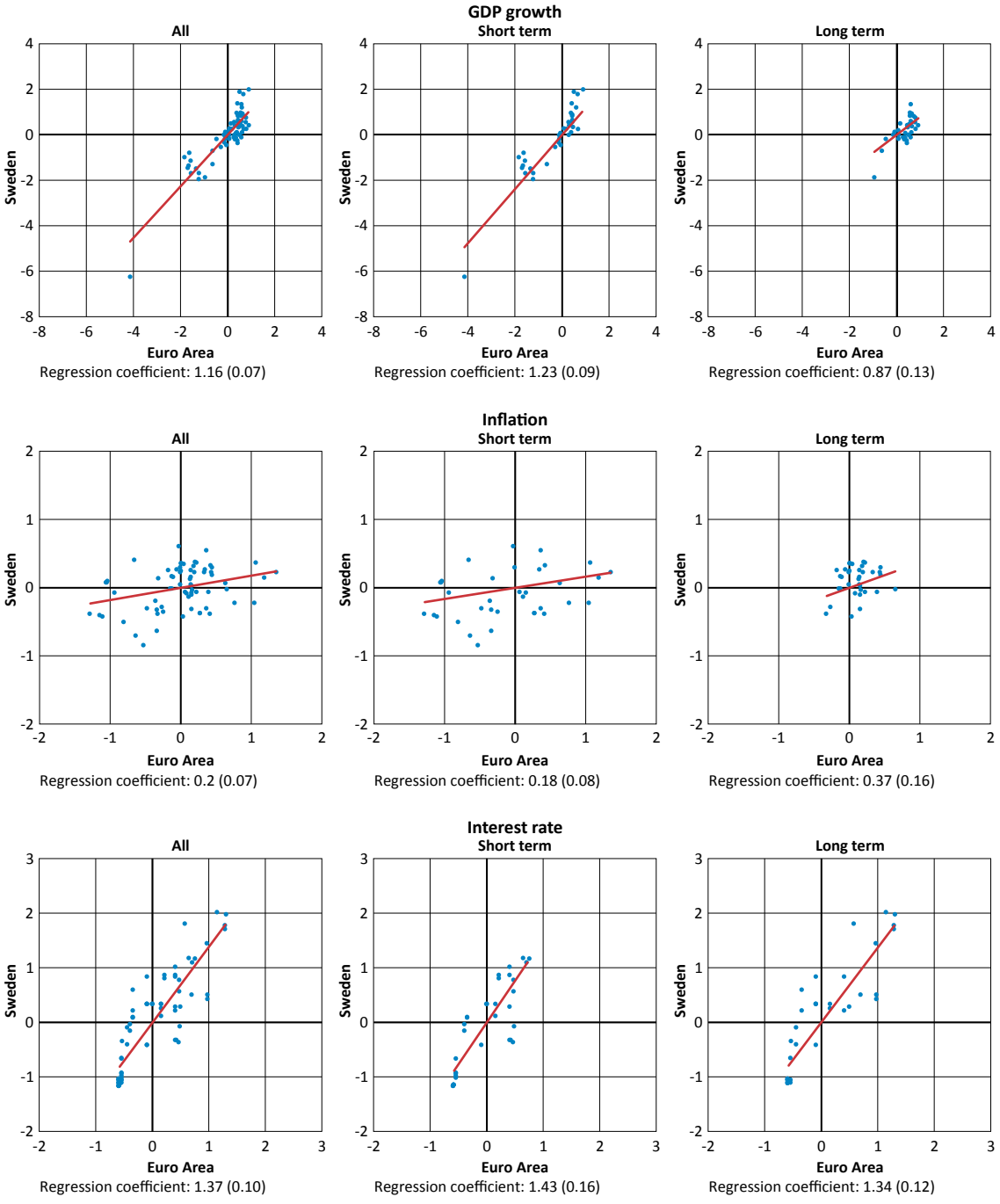
In this appendix we present the correlation in level between the foreign forecast and the domestic forecast. We present results for both the Riksbank (Figure B1) and the National Institute of Economic Research (Figure B2).

Figure B1. The Riksbank's forecasts in level
Forecasts, demeaned data



Note. Standard error in brackets. The figures refer to the calculation methods A, B and C from Figure 4.
Source: The Riksbank

Figure B2. The National Institute of Economic Research's forecasts in level
Forecasts, demeaned data

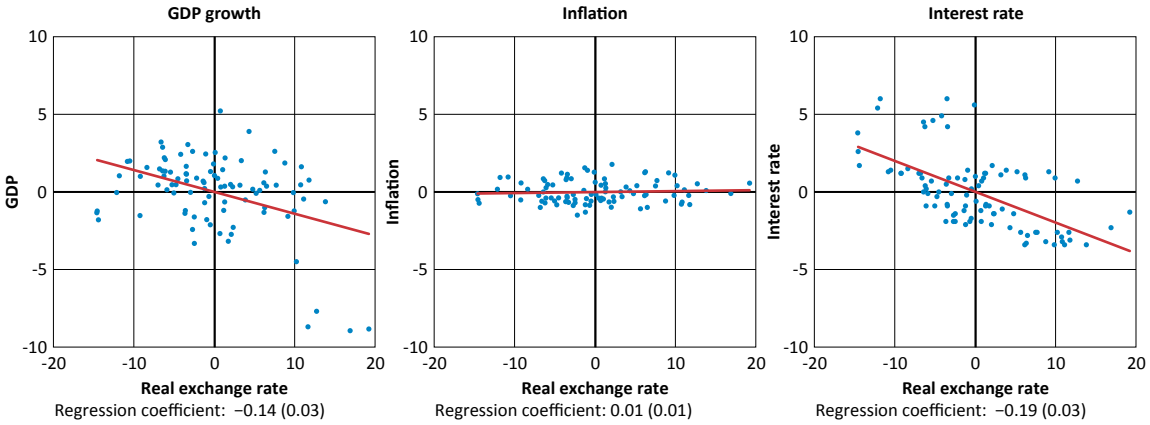


Note. Standard error in brackets.
Source: National Institute of Economic Research

Appendix C

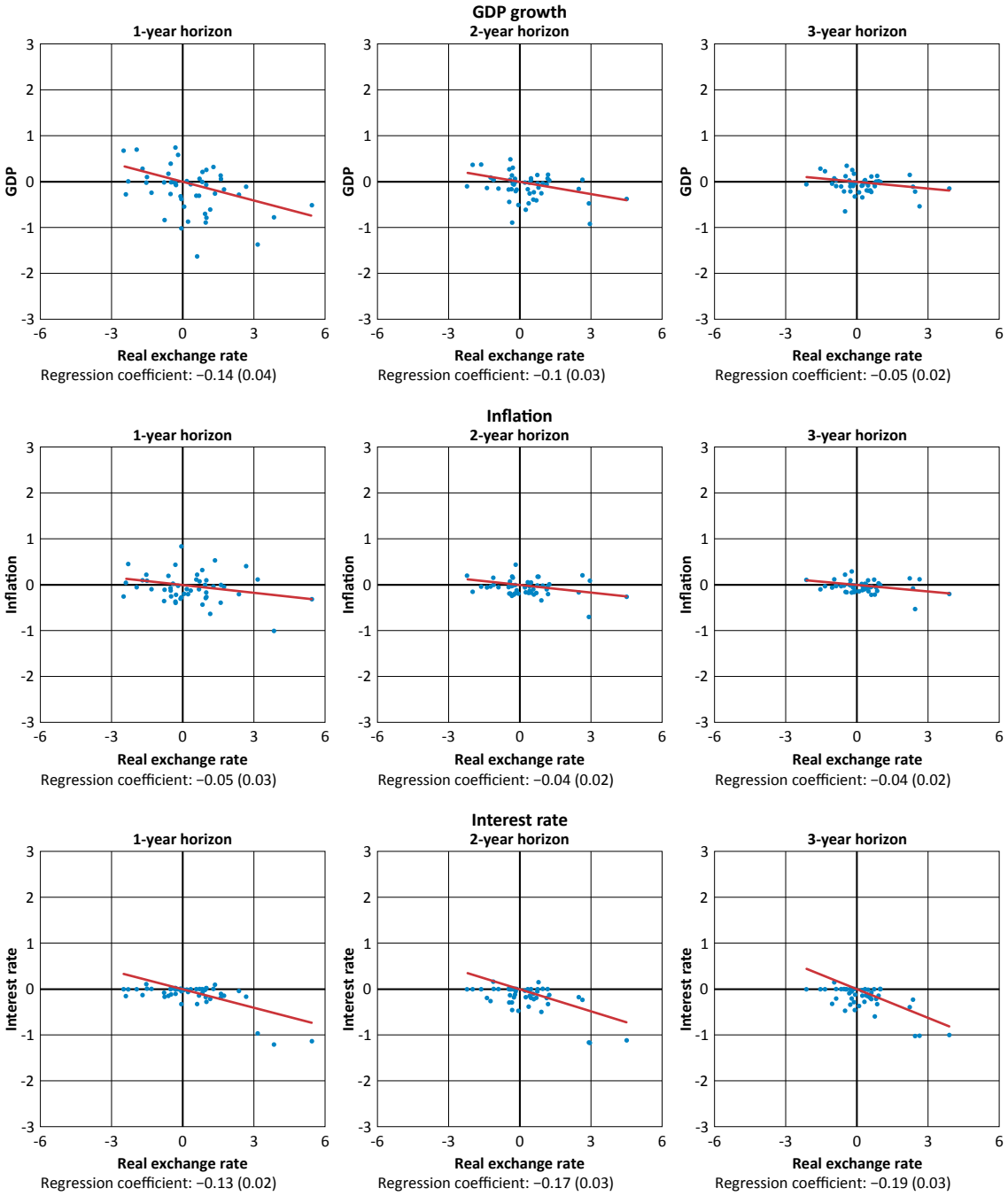
In this appendix, we present the covariation between the real exchange rate and out three domestic variables: GDP growth, inflation and the nominal repo rate. Figure C1 shows the correlations in the data and Figure C2 shows the correlations in the Riksbank's forecast revisions.

Figure C1. Correlation with the real exchange rate in the data
Annual percentage change, index and percentage points respectively



Note. All data has been demeaned. Real exchange rate refers to the KIX-weighted exchange rate.
Sources: National sources, Statistics Sweden and the Riksbank

Figure C2. Revisions of the forecast for the real exchange rate and the domestic economy
Annual percentage change, index and percentage points respectively



Note. Standard error in brackets. Real exchange rate forecasts are calculated by taking the nominal exchange rate forecasts multiplied by the ratio between the forecasts for the foreign and domestic price levels.
Sources: National sources, Statistics Sweden and the Riksbank