

Response to referee comments on “Monetary Policy and Swedish Unemployment Fluctuations”

Most of the referee’s comments are concerned with (or objections to) the use of an MCI as proxy for monetary policy. We agree that this is not an ideal measure but believe that the advantages of the strategy outweighs the disadvantages in this application as we want to study the effects of the unusually large monetary policy shocks during the defence of the Swedish fixed exchange rate in 1992. Parts of the discussion about MCIs below is now included in the paper (section 3.2), thereby providing a clearer motivation of our choice to use this measure and a more critical evaluation of it.

(i)

- (a) The referee disagrees with the statement that an MCI is self-evident. The meaning of the phrase in question was that *some* measure of monetary policy obviously has to be included in the VAR, not that the use of an MCI as this measure is self-evident. This sentence has now been altered.
- (b) While we certainly agree that an MCI is not an ideal measure of monetary policy we believe that it is superior to feasible alternatives in this case. It is very difficult to find other measures of monetary policy that can be used across exchange rate regimes. The main alternative is to estimate different models for the different regimes, using the exchange rate as monetary policy instrument during the fixed exchange rate regime up to 1992 and the short-term interest during the floating exchange rate regime after 1992. This results in much shorter samples with loss of power. Furthermore the extremely large monetary policy shocks emanating from the defence of the fixed exchange rate during 1992 would be difficult to analyze for several reasons. The 500 percent interest rate hike occurred towards the end of the fixed exchange rate sample and would not be captured at all if the exchange rate was used as measure of monetary policy during this period since the nominal exchange rate remained fixed. Due to lags and persistence, most of the effects on the output gap and unemployment of the contractionary monetary policy in 1992 occurred during 1993 and 1994. If the sample is split in November 1992 and two different models are estimated for these two sub periods, the recession in 1993-94 loses any possible link to the 1992 monetary policy since these two events are not included in the same sample. Hence if we want to analyze the effects of these major Swedish monetary policy shocks we have to include data both from fixed and floating exchange rate regimes and use a measure of monetary policy that is applicable to both regimes. Turning to an MCI allows us to do this.
- (c) The construction of an MCI requires assumptions about unobservable phenomena like the relative effect of the short-term interest rates versus the exchange rate on demand and the equilibrium levels of real exchange rates and interest rates. We have constructed several MCI-indices, three of which are shown and used in the paper. It turns out that the specific assumptions are of very little consequence. All MCI-series look similar and yield similar results. Hence objections to the specific assumptions behind an MCIs are theoretically well justified but have limited practical bearing (at least in this case and for reasonable assumptions about equilibria and relative weights). Allowing time varying weights is a practical concession to the presence of regime shifts noted

by the referee. It allows the exchange rate to be relatively more important in the measure of monetary policy in the beginning of the sample period, while the short-term interest rate becomes relatively more important during the final decade. Indeed data speaks clearly in favour of the MCI constructed using time varying weights. As with the construction of the fiscal variable, this is a feasible, practical solution. This is admittedly somewhat unorthodox but appears (at least to us) to be a sensible way of handling empirical problems encountered during this investigation. We have tried to explain more carefully how the indexes are constructed. The reader who accepts the notion of an MCI as measure of monetary policy but objects to the use of time varying weights can always choose to rely on the results for the MCI with constant weights in the robustness section.

- (ii) The referee objects to the use of real rather than nominal exchange rates and interest rates in the MCI. We agree in general but in this particular case the development of nominal rates yield a different and misleading description of the stance of monetary. The Swedish nominal exchange rate remained unchanged between 1982 and November 1992. Hence there would not have occurred any monetary policy action up to the floating of the Krona in November 1992 if the nominal exchange rate had been used as measure of monetary policy. However, the real exchange rate was severely overvalued in 1990-1992, which resulted in a 40 percent reduction of Swedish exports during these years. Keeping the heavily overvalued nominal exchange rate unchanged was clearly a contractionary monetary policy measure, as witnessed by the rapidly deteriorating competitiveness of Swedish exporting firms. The deviation of the real exchange rate from equilibrium included in the MCI captures this, while the development of the nominal exchange rate would not. Similarly, real interest rates increased much more than nominal interest rates during the crisis because inflation fell from 12 percent in 1990 to only two percent in 1992. One can argue that a central bank chooses a nominal interest rate/exchange rate to achieve a desired real interest rate/exchange rate, which is what affects the economy. We believe that during our sample period the real exchange rate and the real interest rate are better measures of monetary policy on the economy than nominal exchange rates and nominal interest rates, especially during the defence of the Krona which is the major monetary policy shock. We also want to capture the effect of both an overvalued real exchange rate and high real interest rates. An MCI allows us to do this while other measures that we have considered do not. Concerning terms of trade and inflation, an MCI is a weighted average of the deviations *from equilibrium* of the real interest rate and the real exchange rate. Terms of trade effects belong (at least theoretically) to the equilibrium real exchange rate and are hence not included in the MCI. (Movements in terms of trade are typically not considered to be an important source of economic fluctuations in Sweden as the terms of trade have remained relatively constant). Finally, because inflation is often considered to be predetermined, innovations to the MCI are mainly innovations in monetary policy. We now include some of the referee's criticism in the discussion of disadvantages of MCIs.

To conclude, an MCI has strengths as well as weaknesses as measure of the monetary policy stance (as do all measures). We believe that the advantages outweigh the

disadvantages in this application since an MCI allows us to analyze the unusually large monetary policy shocks during the 1992 crisis while other measures that we have considered fail to capture this episode. The defence of the Krona involved interest rates reaching 500 percentage points and a heavily overvalued real exchange rate during a fixed exchange rate regime. An MCI captures both these effects in a single number. In contrast, the nominal exchange rate (which is the standard measure of monetary policy in fixed exchange rate regimes) captures neither as it simply remained unchanged. We have tried to motivate our choice of an MCI as measure of monetary policy better and hope that the referee can accept the arguments.

- (iii) The referee is concerned about the endogeneity of the MCI. Monetary policy shocks are by definition the residuals from the MCI-equation in the VAR. Hence it includes only innovations to the MCI that are unrelated to changes in other endogenous variables such as fiscal policy. Endogenous responses of the MCI to other variables in the model are not included in the monetary policy shocks. We now try to explain this better.

Minor comments:

- (i) In line with the VAR tradition, monetary shocks are defined as the residuals from the MCI-equation in the VAR. This can be interpreted as innovations to the MCI minus estimated responses of monetary policy to movements in endogenous variables (such as fiscal policy). We try to clarify better exactly how monetary policy shocks are defined.
- (ii) The construction of the fiscal variable is now better explained and cross-references have been added in the data section. We encountered problems with non-linear effects of the output gap on the government budget during deep recessions that are difficult to handle within a linear VAR-model. Our solution to remove both linear and quadratic effect of the output gap from the fiscal variable in a separate step before estimating the VAR is not as theoretically appealing as one would desire but a practical solution that allows us to model fiscal policy in a reasonable manner even though there are significant non-linearities.
- (iii) The opening statement about stylized facts concerning the effects of monetary policy on output has now been supplied with references.