Appendix

We repeat the above analysis for a trivariate TVP-VAR model that includes real output growth, inflation and the nominal interest rate compiled by the Bank of England. Due to data availability for the interest rate we examine the period 1700-2016. Since we work in first differences, we lose an observation and the final period under examination is 1701-2016. The order of the variables in the VAR is kept the same (output growth, inflation, interest rate) in order to follow the rational in our BQ-type identification scheme in order to decompose the responses into permanent and transitory shocks. The identification of the structural shocks is based on well-documented macroeconomic hypotheses. First, according to the long-run neutrality of money approach, an increase or decrease in money supply cannot affect the (real) output. Moreover, according to the natural rate hypothesis, the single source of non-stationarity in real output stems from disturbances to aggregate supply and thus from technological advancements. Thus, we restrict exogenous changes of an inflationary shock to have no long-run effect on output, placing inflation second in the VAR. We also assume that output and inflation react with a lag to monetary policy shocks whereas the monetary policy-maker responds immediately to output and inflation shocks. Thus, the interest rate variable comes third in the ordering of the TVP-VAR system.

In Figure A-1, A-2 and A-3 we depict the evolution of the coefficients for the three equations of the TVP-VAR over time along with their 16%-84% credible posterior intervals.

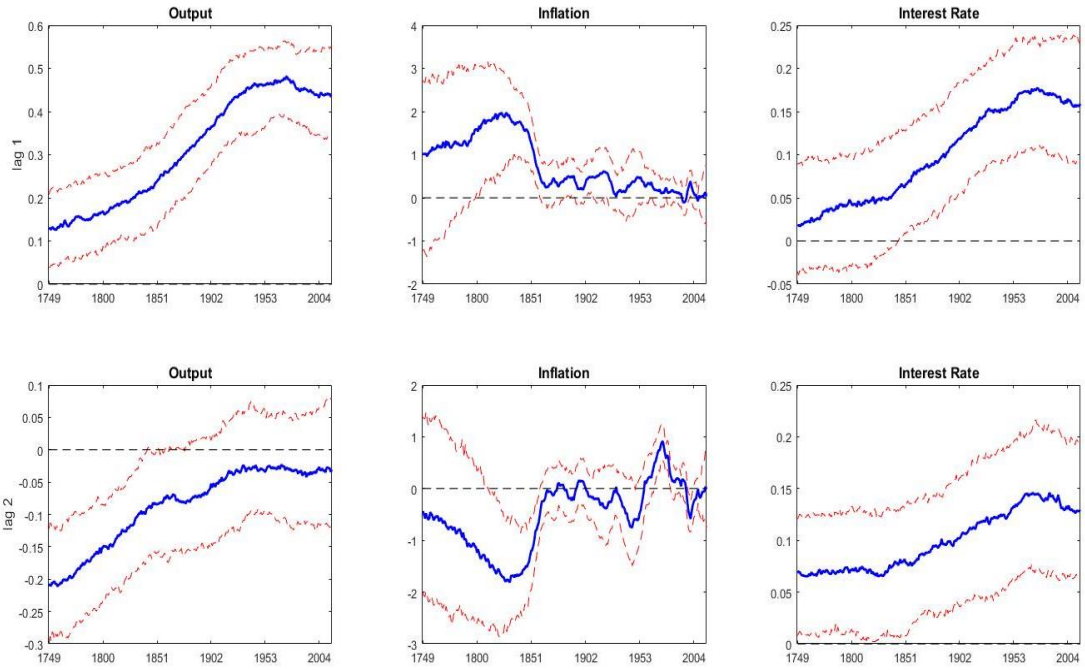

Figure A-1: Output (first) equation time-varying coefficients.

As we observe, the output coefficient is statistically significant in the first lag, while the second lag is important only before the 1850. The inflation coefficients are both insignificant in either lag, while the interest rate coefficients exhibit the same trending up behaviour as with the output coefficient.

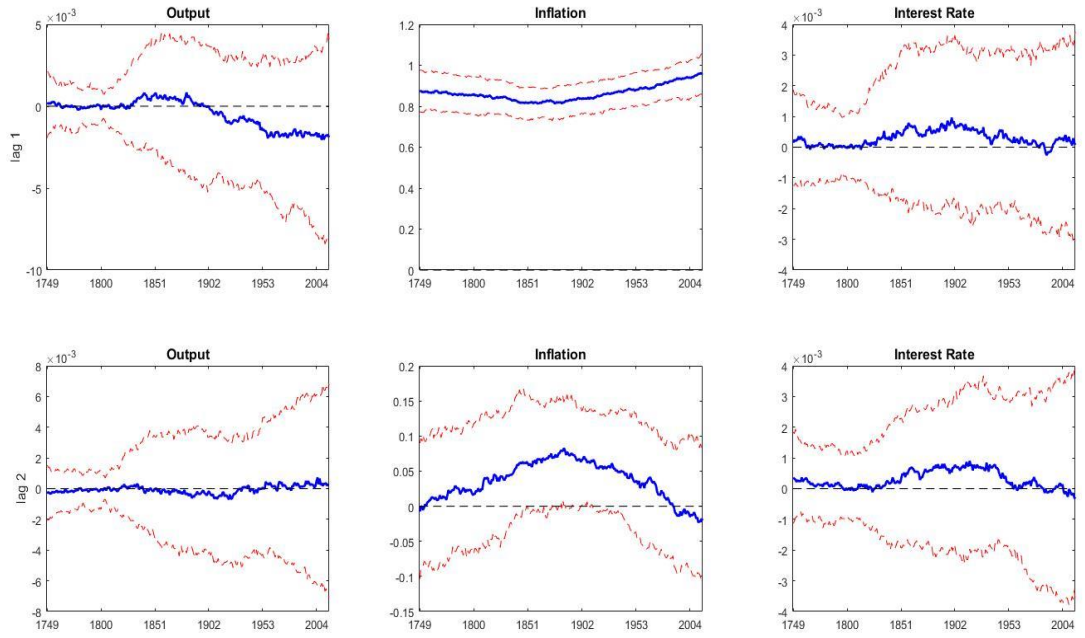

Figure A-2: Inflation (second) equation time-varying coefficients.

The only statistically important coefficient is the first lag of the inflation coefficient that has a value around unity. This suggests that most of the evolution of inflation should be attributed to short-term changes in the inflation rate per se.

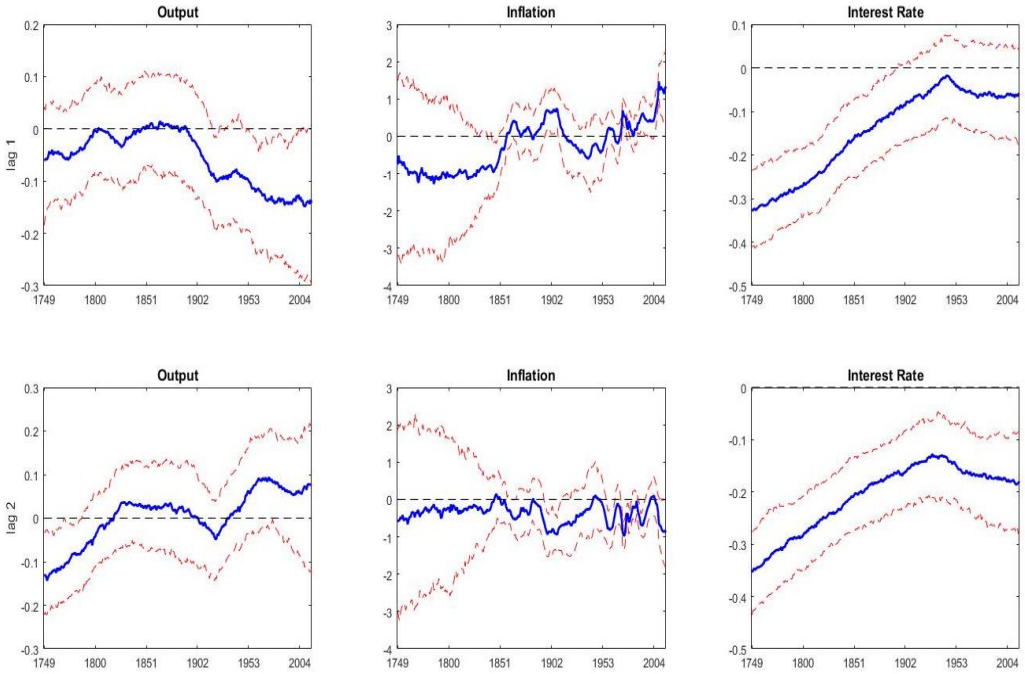

Figure A-3: Interest rate (third) equation time-varying coefficients.

As with the coefficients in the equation of inflation (second in the VAR) interest rate evolution is driven by past changes in the interest rate value. In fact, interest rates exhibit higher persistence than inflation since the interest rate coefficient is statistically important for the entire sample in the second lag.

In figure A-4 we present the unconditional volatility of output growth, inflation and interest rates.

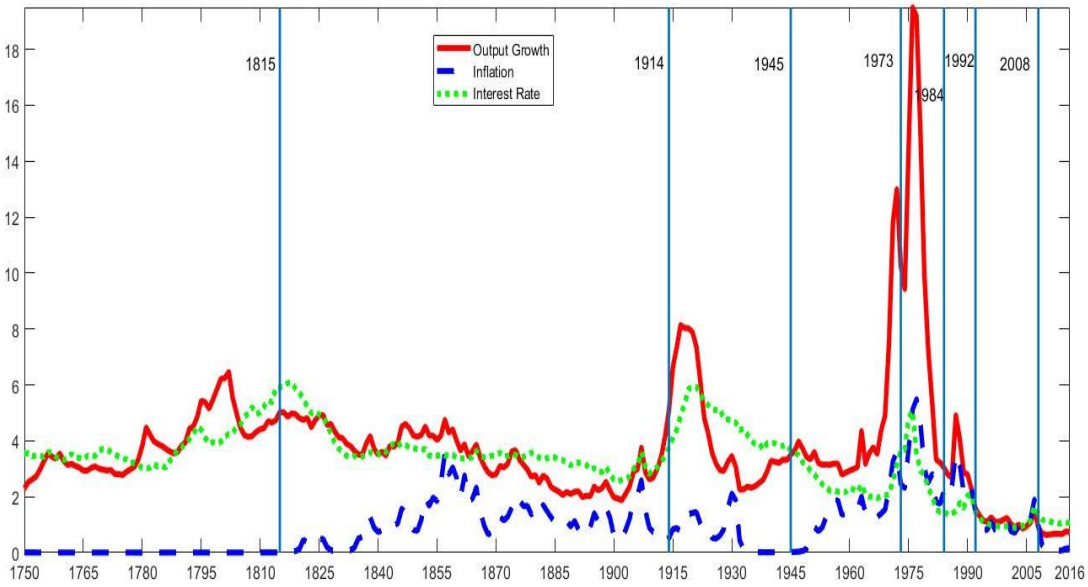

Figure A-5: Unconditional Standard Deviations

The volatility of output growth increases around 1815, the aftermath of the WWI, the oil crisis of 1970s and the dissolution of the Bretton Woods system in 1973. After a historical peak around 1975 volatility drops significantly and increases with the turbulent period of the 1990s. After that with the Great Moderation of the 1992 output growth volatility decreases in its lowest historical value. We would expect a peak around WWII, but the expectations of that period did not seem to transmit to the economy. The inflation volatility is smaller in magnitude in comparison to both other volatilities, and peaks around 1975, a period of significant inflation for the English economy. This finding is interesting posing that the Bank of England is monitoring inflation very closely not only after 1992 (the period of the Great Moderation of the English economy) but throughout history. Interest rate volatility is more persistent that in the other two variables and peaks in the 1815, (end of Napoleonic wars), the 1920s (the Great Recession – Stock crash) and after the 1973 (end of the fixed exchange rates system). Overall, output volatility exhibits higher fluctuation while it follows significant historical, political and economic events closely.

In figure A-6 we depict the conditional volatilities of output growth on a permanent technology (output) shock and the transitory price and money shocks.

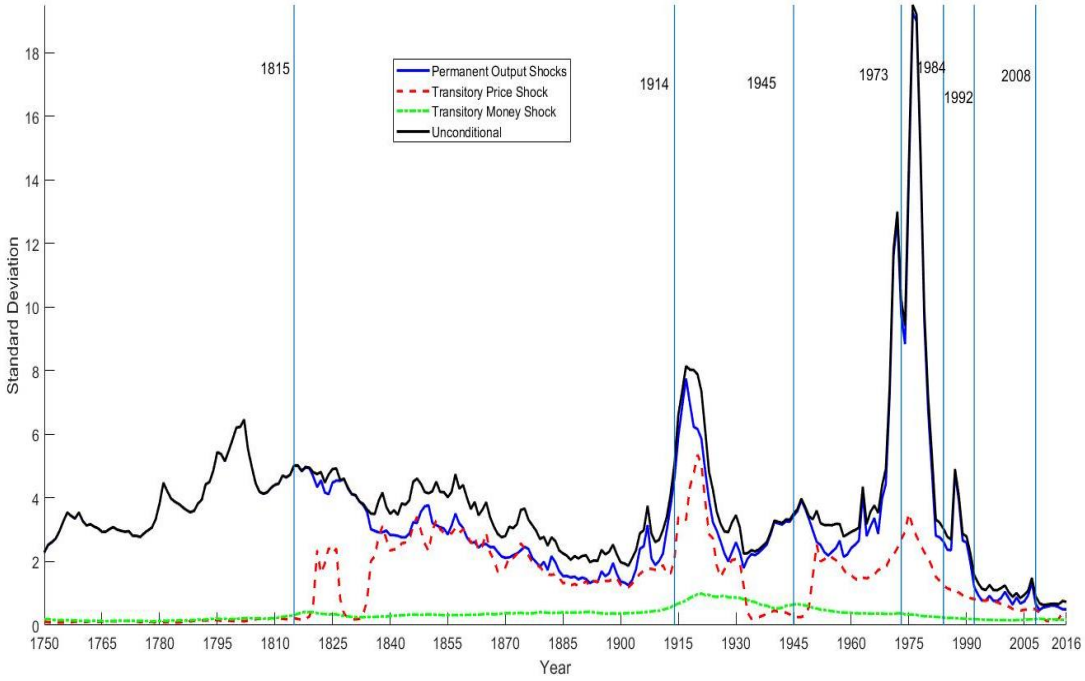

Figure A-6: Conditional Standard Deviations of Output on the structural shocks.

As we observe, the patterns of output growth volatility are the same as before, with most of the volatility being attributed to the permanent shocks. Price shocks have a lower volatility and rise only after WWI and 1975, following the path of unconditional inflation volatility. The effect of monetary policy (money shock) is almost unimportant, as assumed.

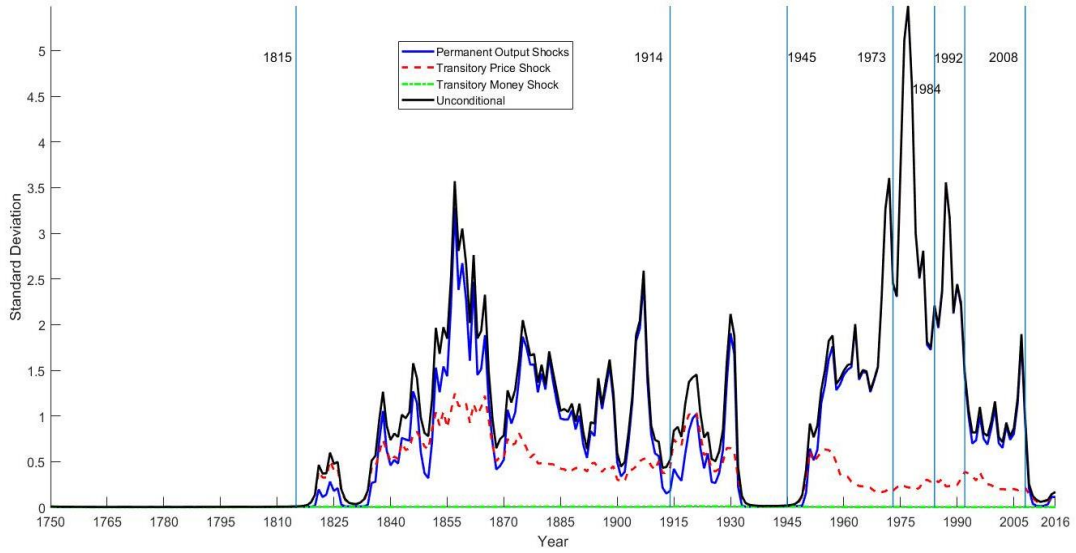

Figure A-7: Conditional Standard Deviations of Inflation on the structural shocks.

As expected inflation volatility is mostly driven by transitory price shocks that are more intense in the 18th century and for 1960 to 1992, following significant economic and political events of that period. Transitory money shocks have no effect on the inflation level.

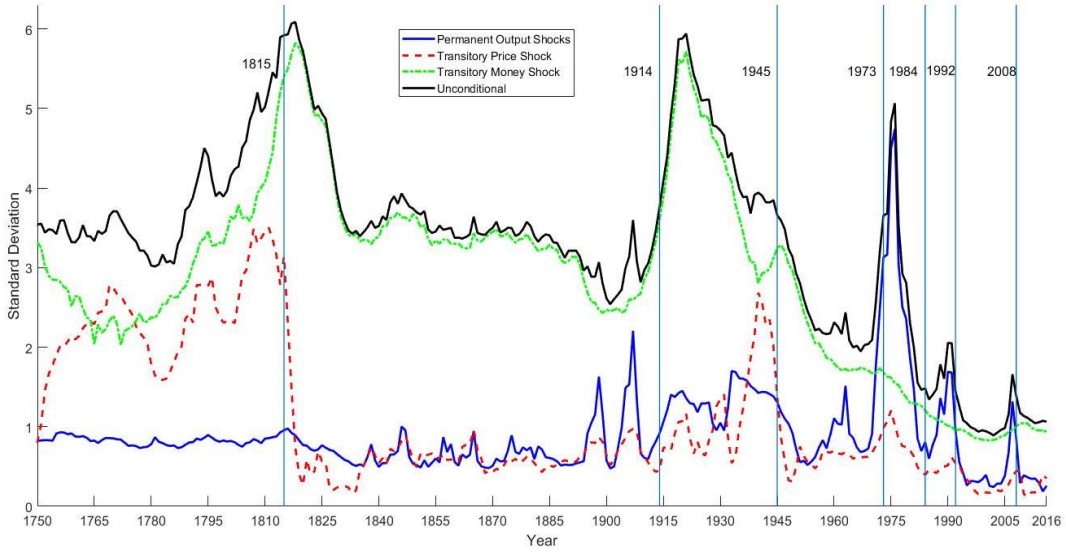

Figure A-8: Conditional Standard Deviations of Interest rates on structural shocks.

The interest rate unconditional volatility exhibits three major peaks; around 1815, 1920 and 1975. All these are periods where the England excited a war or was a period of political and economic turmoil. Thus the use of the monetary policy to boost the economy. Apart from the 2008 financial crisis, the interest rate volatility is lower after the 1992 from the entire economic history of the sample. Most of the variation prior to 1970 could be attributed to transitory money shocks, while in the 1970 and the 2008 peak the permanent output shocks drive its fluctuations. Thus, we observed a significant structural change in the economy of the U.K. after the 1970s. In figure A-9 we depict the 3d responses of all variables to the imposed shocks.

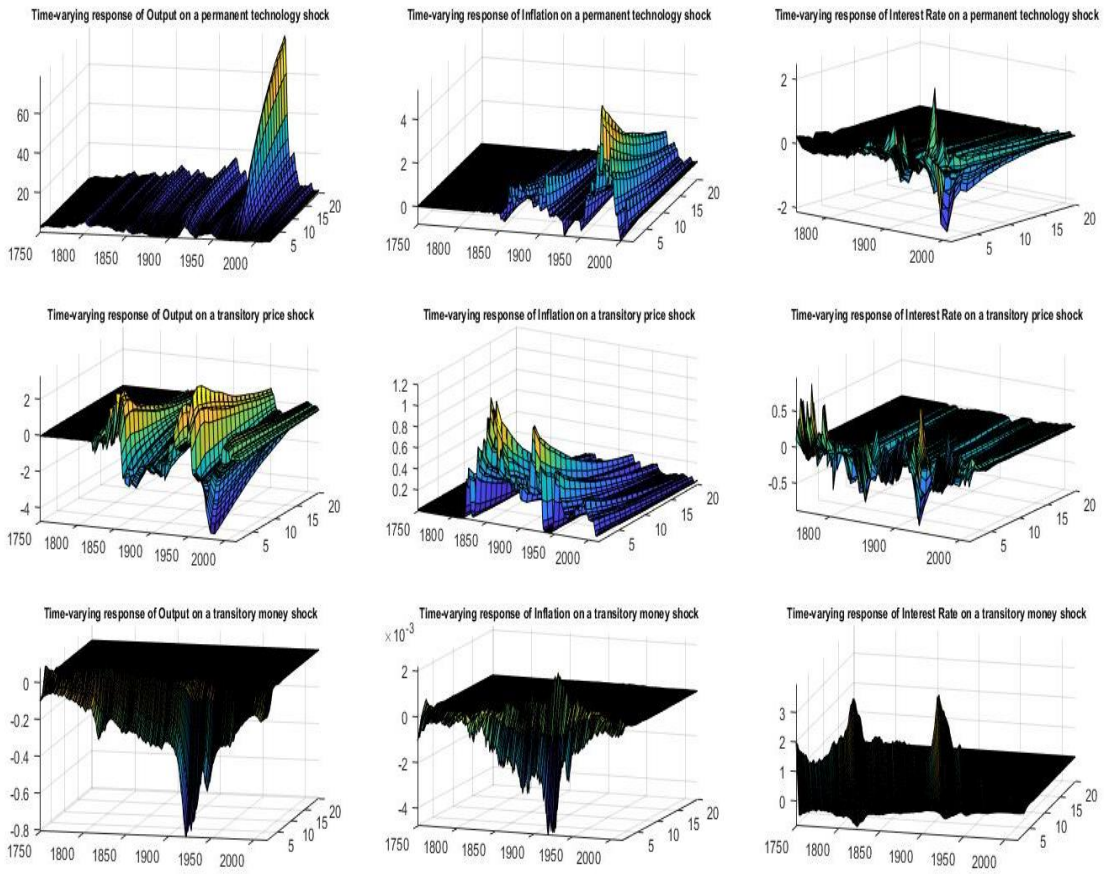

Figure A-9: Responses of TVP-VAR variables to structural shocks.

As we observe, the responses of output are larger and more permanent than the other variables, with the interest rates exhibiting the lowest shocks. Nevertheless, the 3d figures are not ideal in drawing inferences on time-varying responses, so we splice each response based on the horizon of the shock and add the 16%-84% posterior credible intervals. Figures A-10, A-11 and A-12 show the response of output growth to a permanent, a price transitory and a money transitory shock, respectively.

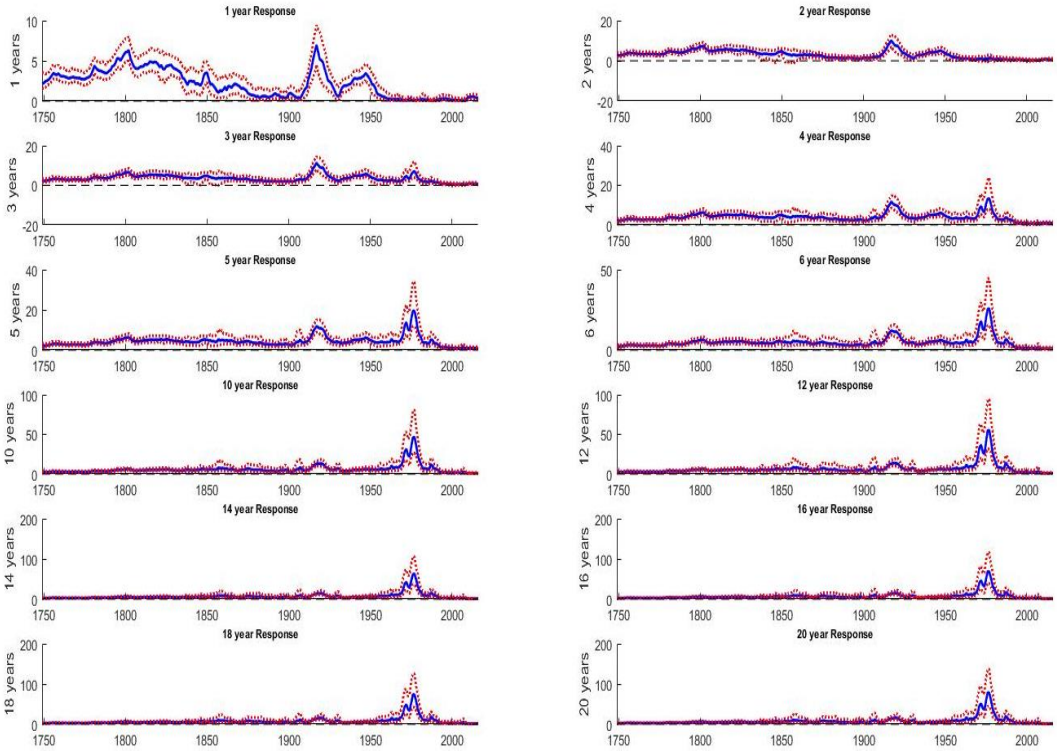

Figure A-10: Output growth responses to a permanent output shock.

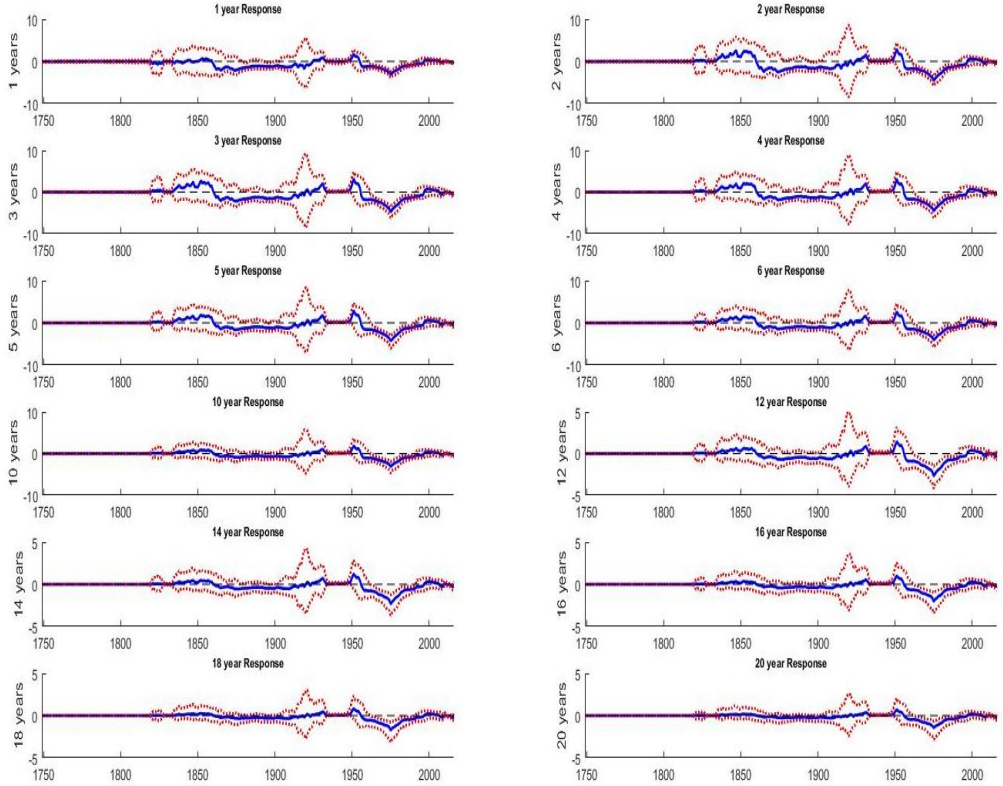

Figure A-11: Output growth responses to a transitory price shock.

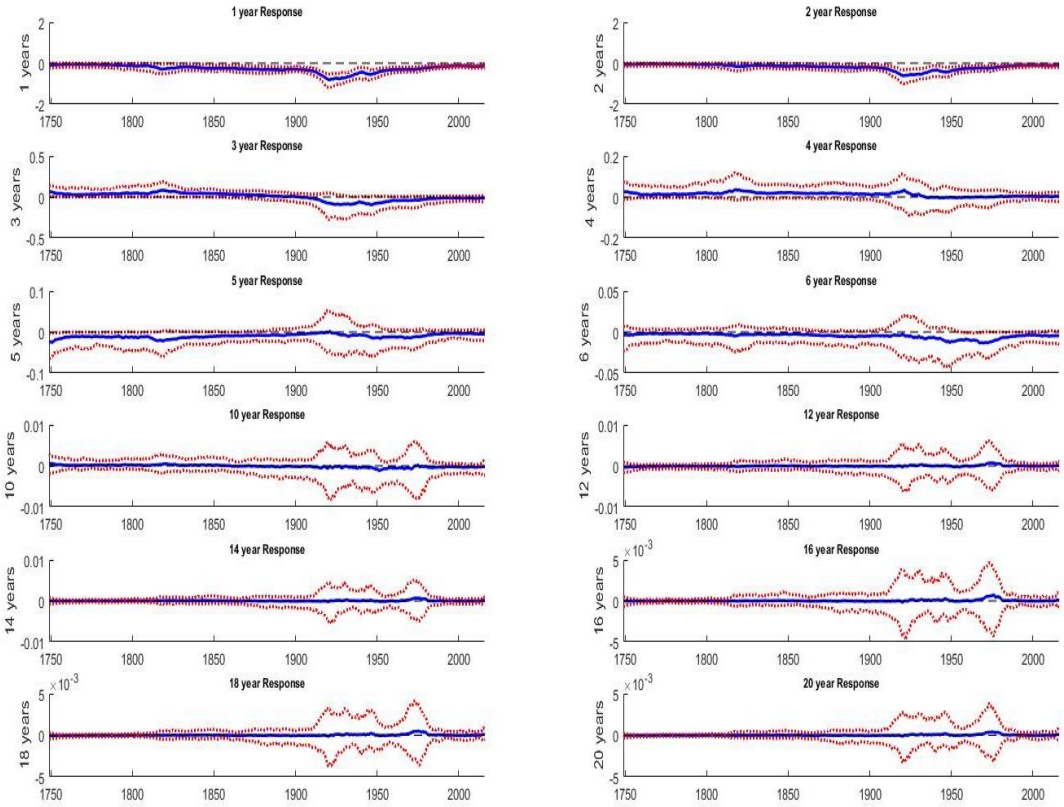

Figure A-12: Output growth responses to a transitory money shock.

For figure A-10 we observe that the response of output growth is more intense at the first year but slowly becomes smoother and reaches its long-run response after approximately 4-5 years. The two statistically significant peaks that remain are the 1920s and the 1970s peak, both periods of economic turbulence and significant (even tough different) changes in the structure of the English economy. The response on a transitory price shock (figure A-11) reaches rapidly its long run range in only 2 years after the imposition of the shock. The response is negative and around the same period of the 1970s peak of the response in the permanent shock. Thus, we corroborate to our finding from the bivariate model, that output shocks are more of the aggregate supply side, while transitory price shocks could be classified as aggregate demand shocks. The response on a money shocks (figure A-12) as very small in magnitude and smooth out completely after two years, as we assumed in our identification scheme.

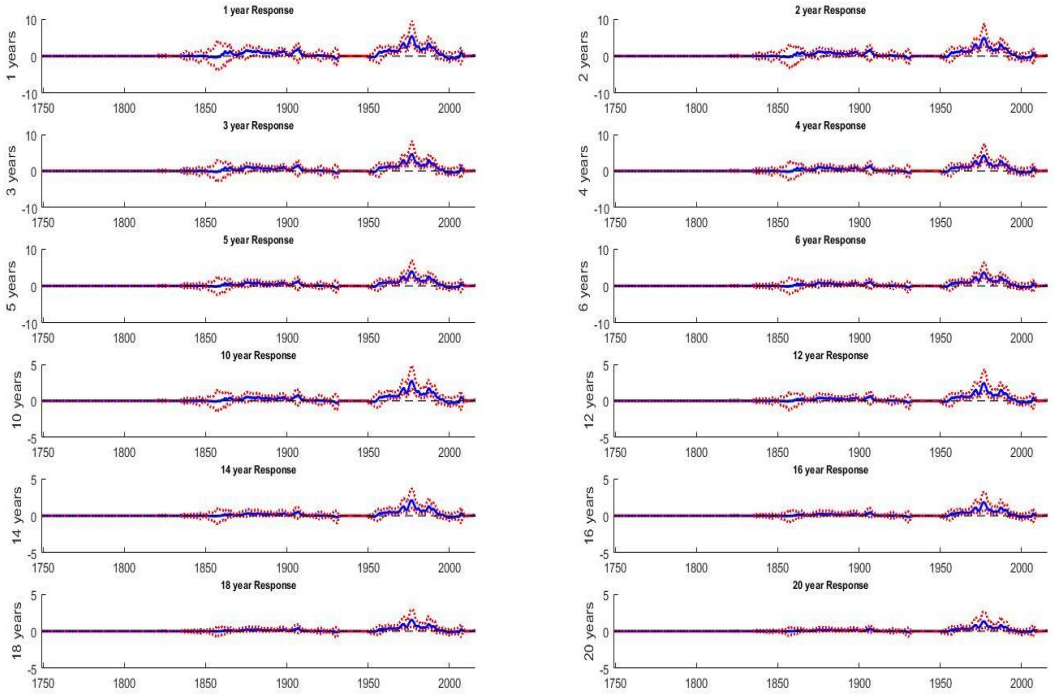

Figure A-13: Inflation responses to a permanent output shock.

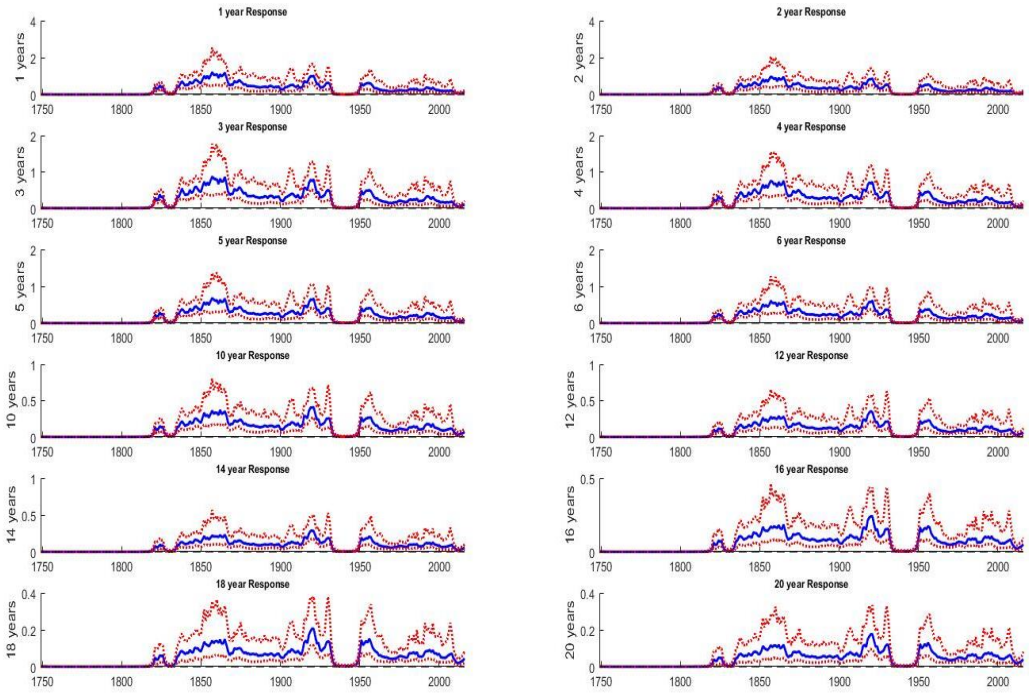

Figure A-14: Inflation responses to a transitory price shock.

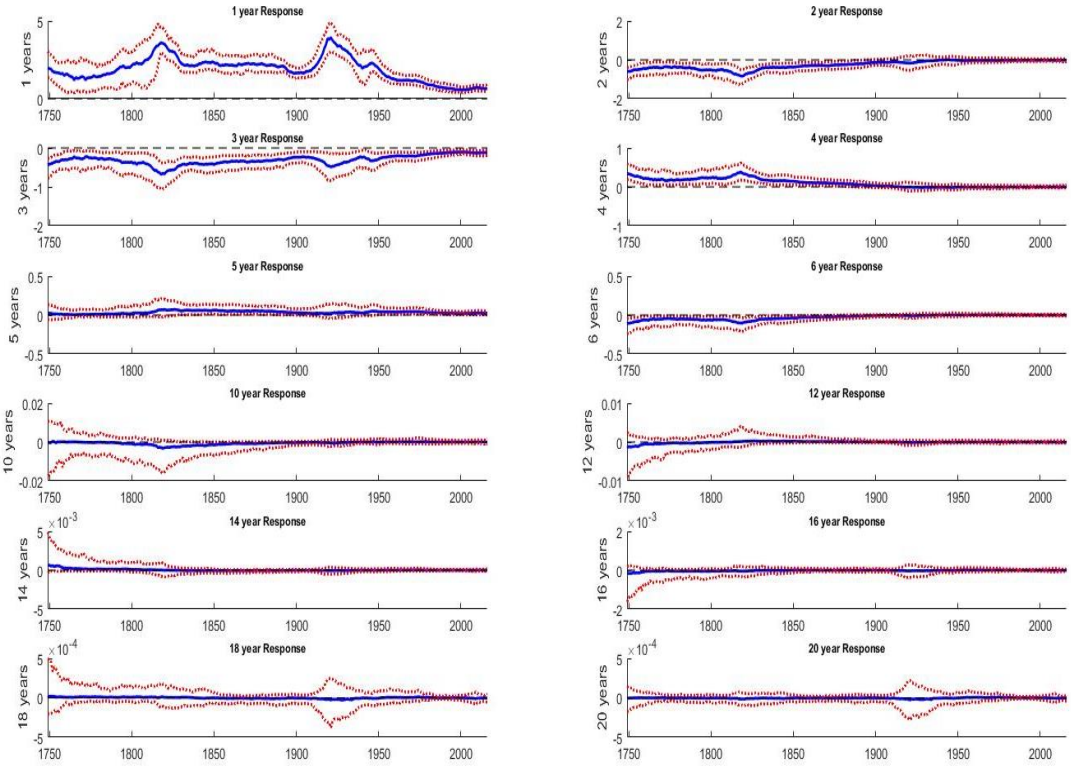

Figure A-15: Inflation responses to a transitory money shock.

Inflation seems to be driven by idiosyncratic price shocks. As we observe form figure A-13 output shocks have a small short-tempered effect on prices that is statistically insignificant, apart from the 1975 shock. That response of prices to an output shock fades away after almost 15 years. Nevertheless, transitory price shocks (figure A-14) have persistent effects on inflation, since a rise in prices quickly affects on its long-run response and keeps that effect after the entire examined period of 20 years. Monetary policy shocks on inflation have only short-run positive effects for 1 year, after 3 years that the economy absorbs the interest rate change the response turns negative, and smoothes out.

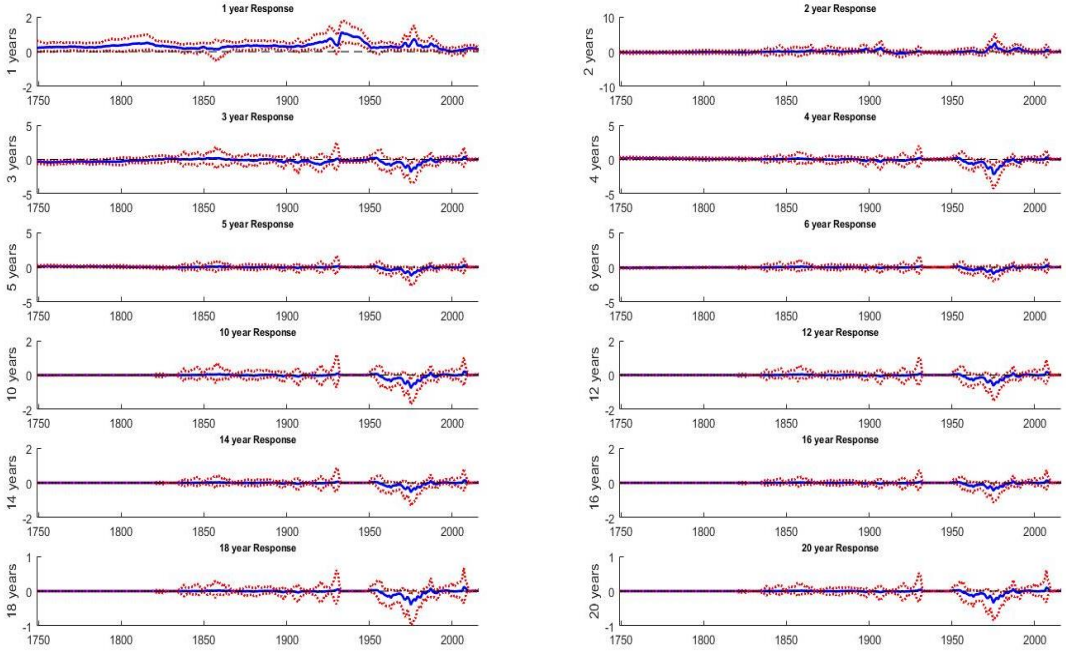

Figure A-16: Interest rate responses to a permanent output shock.

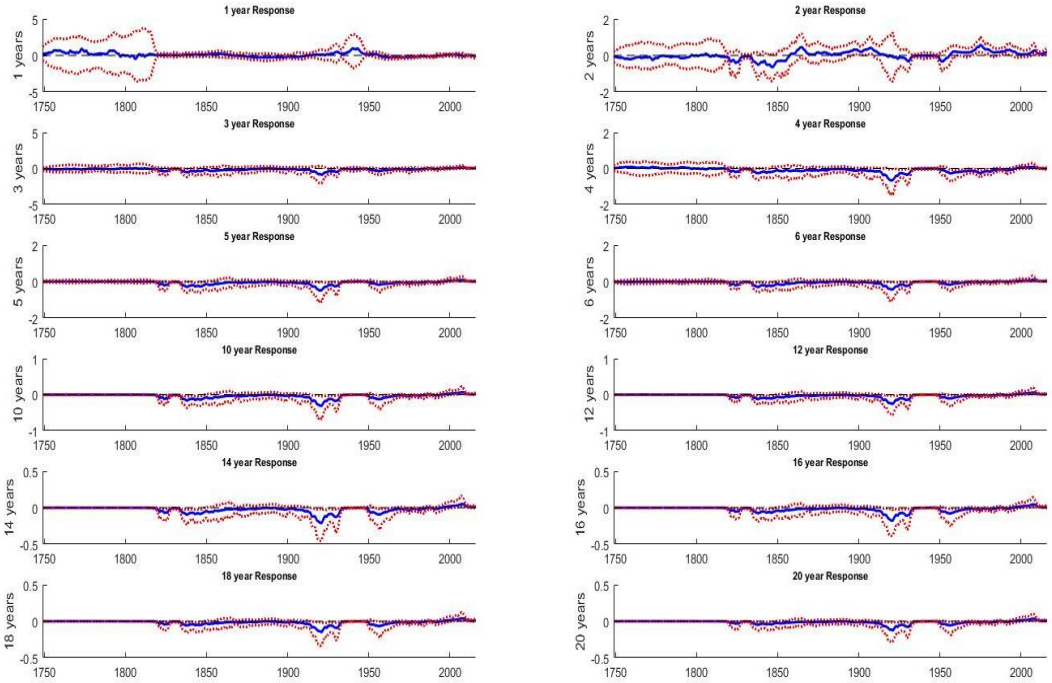

Figure A-17: Interest rate responses to a transitory price shock.

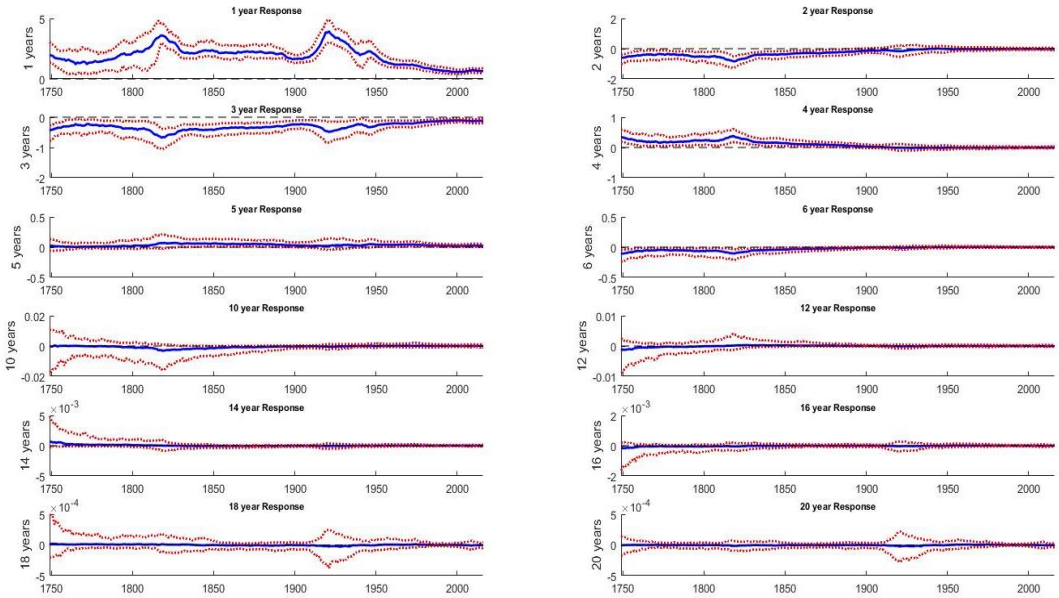

Figure A-18: Interest rate responses to a transitory price shock.

Interest rate responses are statistically insignificant in permanent output and transitory price shocks, while transitory money shocks have a positive, short-run effect that turn negative after three years and then fades away as the economy adjusts to the new interest rate levels. In figures A-19, A-20 and A-21 we depict the IRFs based on a trivariate SVECM with constant parameters over time. To keep things tractable, we include two lags in our model as with the bivariate case.

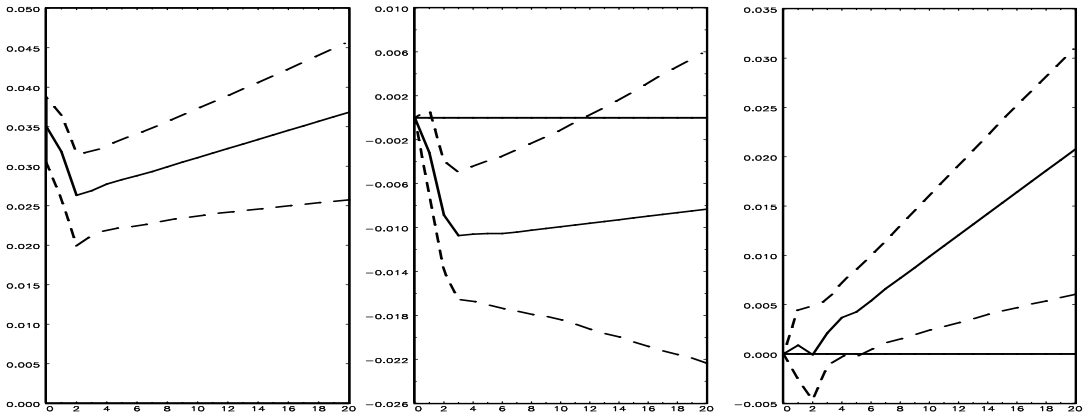

Figure A-19: Time invariant output growth responses based on a VECM with constant parameters over time. Responses on a permanent output growth shock are reported on the left figure, on a transitory price shock on the centre and on a transitory money shock on the right. The 95% confidence intervals depicted in dashed lines and are computed based on 5000 bootstrap repetitions.

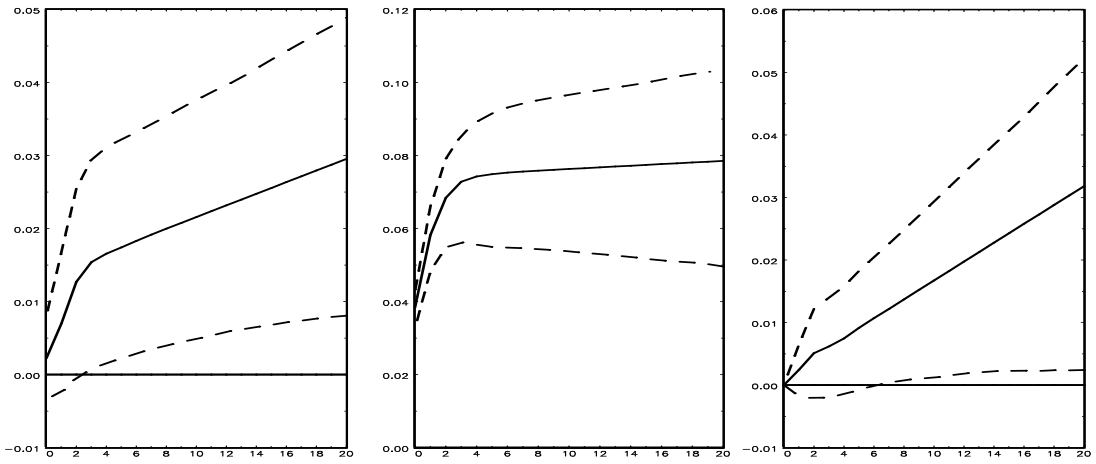

Figure A-20: Time invariant inflation responses based on a VECM with constant parameters over time. Responses on a permanent output growth shock are reported on the left figure, on a transitory price shock on the centre and on a transitory money shock on the right. The 95% confidence intervals depicted in dashed lines and are computed based on 5000 bootstrap repetitions.

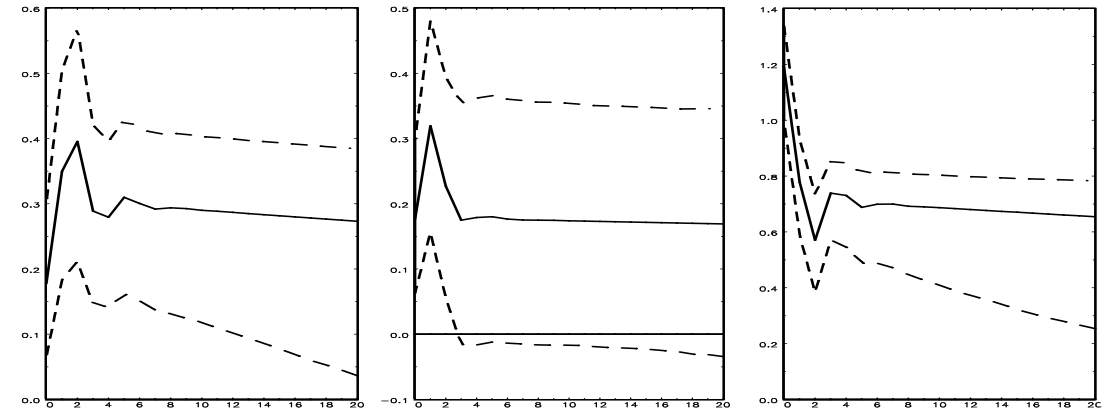

Figure A-21: Time invariant interest rate responses based on a VECM with constant parameters over time. Responses on a permanent output growth shock are reported on the left figure, on a transitory price shock on the centre and on a transitory money shock on the right. The 95% confidence intervals depicted in dashed lines and are computed based on 5000 bootstrap repetitions.

The impulse responses of the SVEC based on the three assumed shocks produce somewhat controversial results. We assume that a money shock has no effect on output growth in the long-run. Nevertheless, we observe positive and statistically significant responses (figure A-19 right subplot). In fact, the effect is rising with time, without reaching to a long-run response. The effect is observed in the inflation response on a transitory money shock (figure A-20, right subplot), where a money shock exceeds a temporary transitory effect on inflation and causes prices to rise continuously. Of course

we attribute this findings to the existence of the structural breaks of our long-run dataset during the estimation of the SVECM model, that fails to face structural breaks.