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COULD A LARGE-SCALE ASSET PURCHASE PROGRAMME HAVE MITIGATED THE GREAT DEPRESSION?

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Abstract

Since Friedman and Schwarz (1963), the role of the Federal Reserve during the Great Depression has been an issue of debate. In this paper, we focus on the purchases of government securities by the Federal Reserve over a four-month period in 1932. Using a Bayesian VAR model, we estimate the effect of an extension of this programme in conjunction with an interest rate cut on a range of variables capturing prices, output and macro-financial linkages. Our results indicate that this policy would have substantially shortened and reduced the impact of the Great Depression.

Keywords: Federal Reserve, Bayesian VARs, Quantitative easing, Great Depression.

JEL Number: B16, E51, E58.

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Non-Technical Summary

In the wake of the recent global financial crisis, central banks in many advanced economies cut interest rates sharply and engaged in large scale asset purchase programmes with the aim of restoring inflation and economic growth. Although asset purchases were considered 'non-standard', they are not without historical precedent. In particular, the Federal Reserve purchased US government securities during the Great Depression. Against a background of soaring unemployment and sharp deflation, the Fed purchased almost $100bn in US government securities over the course of four months between April and July 1932.

This episode has raised debate about the Fed's policy at the time. Friedman and Schwartz (1963) argue that the 1932 asset purchases were successful in slowing the decline in money supply, prices and the real economy. This implies that the failure to extend these purchases was a 'missed opportunity'. The question arises, could the Fed have prevented some of the hardships of the Great Depression had it purchased securities on a large scale?

In this paper, we seek to answer this question using a Bayesian VAR framework which incorporates 17 variables that capture prices, output, the labour market and financial markets (Banbura, Giannone and Reichlin (2010)). The literature indicates that by including a larger set of variables than would be possible in a classical framework, Bayesian VARs can improve forecasting performance. We use the model to estimate forecasts conditional on alternative policy scenarios. These techniques have been used to study the effect of recent asset purchase programmes on economic and financial variables. In principle, they can be applied to the Federal Reserve's purchases in 1932 to answer similar questions, however, to our knowledge no similar study has been undertaken.

The baseline scenario we employ entails more aggressive monetary policy action by the Fed: a reduction in interest rates to the zero lower bound, and a continuation of the average level of purchases for a further 12 months. Alternative policy scenarios show how asset purchases could have improved economic outcomes compared to interest rate cuts, and the impact of purchase programmes of different sizes.

Our findings suggest that this policy would have had a significant positive impact on the economy. Specifically, prices reverse their deflationary trend more quickly than otherwise, measures of output begin to grow again sooner, and measures of financial stress show a marked decline.

In conjunction with this, we show that asset purchases would have increased the money supply substantially. This is unsurprising, but in line with Friedman and Schwartz's prescription for the

time. However, we show that this expansion of the money supply would have had a large impact on the exchange rate, most likely forcing the US off the gold standard earlier than otherwise. In this respect, we also add to the literature which discusses the limiting role played by the Gold Standard on the Fed's actions at this time (Hsieh and Romer (2006) and Bordo, Choudhri and Schwartz (1999)).

1. Introduction

In a 2002 speech, Ben Bernanke, then a member of the Federal Reserve Board, said:

> *'Regarding the Great Depression, … we did it. We're very sorry. … We won't do it again."*[1]

That the Federal Reserve could have acted more decisively to reduce the severity of the Great Depression is now well accepted. Bernanke, who became Chairman of the Federal Reserve in 2006, acted in this belief when responding to the financial crisis following the collapse of Lehmann Brothers in 2008. Then, the Federal Reserve cut rates aggressively and engaged in large scale asset purchase programmes with the aim of restoring stability and economic growth.

While these measures were unprecedented in scale and scope, they were not without precedent. Anderson (2010, p. 1), notes that although the term 'quantitative easing' only became popular with the Federal Reserve's asset purchase programmes during the Global Financial Crisis, these programmes were not the first of their kind; the Federal Reserve purchased US government securities during the Great Depression.

Following the stock market crash of 1929, the US economy slowed, prices fell and unemployment began to rise. The first of four waves of banking panics began in the fall of the 1930; the second followed in spring 1931. Unemployment increased to 15 million in 1932, or almost a fifth of the population of the US, and prices were falling rapidly. Throughout this period, the Federal Reserve did little to mitigate the effects of the crisis. Indeed, there was no prevailing wisdom about how to respond to the downturn. As a result, although official rates were reduced at the start of the crisis, they never reached the zero lower bound and, indeed, they were raised in late 1931 and early 1932 in response to strong outflows of gold after Britain abandoned the gold standard.

The dire economic situation prompted Congress to pass the Banking Act in February 1932, the purpose of which was to address deflation by allowing the Federal Reserve to issue currency backed by Treasury bills rather than gold.[2] The Federal Reserve was reluctant to engage in such purchases, although it began to do so in April 1932. Over the course of the following four months it purchased almost $100bn in US government securities, until a general lack of appetite for such purchases among the Board of Governors ended the programme. Nonetheless, this short period of purchases has prompted much debate among economists.

[1] https://www.federalreserve.gov/boarddocs/speeches/2002/20021108/default.htm

[2] Congress also passed the Reconstruction Finance Corporation Act to provide emergency financing for financial institutions and aid financing to agriculture, industry and commerce, which was approved by the President in January 1932.

For instance, Bordo and Sinha (2016) consider the transmission channels through which asset purchases might have impacted on the real economy in the 1930s, and use a DSGE framework to argue that, although the structure of the economy was different from today, large scale asset purchases could have impacted the economy positively. Hsieh and Romer (2006) use regressions of the expected devaluation of the dollar and various dummies to capture the purchase programme and argue that the Fed was not restricted in its ability to purchase assets by adherence to the Gold Standard. Wheelock (1989) performs forecasts for the Fed's holdings of government securities for the period 1930 to 1933 based on policy estimates for the period 1924 to 1929. His forecasts suggest that the Fed's holdings should have been much larger than they actually were. However, this shortfall is explained by the Fed's understanding of monetary policy transmission at the time, rather than by a shift in their strategy.

More broadly, the literature has considered the monetary causes of – and, by implication, possible solutions to – the Great Depression.[3] In their seminal work, Friedman and Schwartz (1963, p.323), argue that the 1932 asset purchases were successful in significantly improving financial market conditions. Basile, et al., (2010), using impulse responses from classical VARs, find that changes in M2 money supply did impact longer term interest rates in the 1930s. Bordo et al., (1995) develop a structural model in which they simulate Friedman's money growth rules, and show that prices and output would have been higher in the 1930s, had such rules been followed. Romer (1992) argues that monetary expansion in the mid- to late-1930s, in the form of massive gold inflows, were crucial in the economic recovery from the Great Depression. A central tenet of Bernanke's academic research is that tensions in the credit market deepened and prolonged the Great Depression[4]; he refers to the purchase programmes he instituted from 2009 onwards as 'credit easing' measures.[5]

This implies that the failure to extend the 1932 purchases may have been a 'missed opportunity'. Indeed, the Federal Reserve acknowledged in its July 1932 Bulletin (p. 396), that credit conditions had become easier in the previous months, primarily as a result of the:

> *'accession of funds to the money market during the period through (1) purchase by the reserve banks of $440,000,000 in United States Government securities…'*

The question arises, could the Fed have prevented some of the hardships of the Great Depression had it purchased securities on a large scale?

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[3] There is also a literature considering the non-monetary causes of the Great Depression. See, for instance, Temin (1976), Hamilton (1987), Romer (1990) and Mishkin (1978).
[4] Bernanke (2000b).
[5] For instance, https://www.federalreserve.gov/newsevents/speech/bernanke20090218a.htm, and https://www.federalreserve.gov/newsevents/speech/bernanke20090113a.htm

In this paper, we seek to answer this question using a Bayesian VAR framework which incorporates variables that capture prices, output, the labour market and financial markets to estimate forecasts conditional on alternative policy scenarios. These techniques have been implemented in recent years to study the effect of the modern asset purchase programmes on economic and financial variables.[6] In principle, they can be applied to the Federal Reserve's purchases in 1932 to answer similar questions, however, to our knowledge, no similar study has been undertaken.

Our framework has two main attractions. First, the Bayesian framework enables us to use a larger set of variables than would be possible in a classical framework. The literature indicates that increasing the information set in a VAR can improve its forecasting performance.[7] We can thus examine both the macroeconomic (inflation, unemployment, output, wages), and the financial impact (return, spreads, risk), while taking into account important macro-financial linkages and feedback effects.

Second, the VAR framework allows us to calculate forecasts that are conditional on the path of monetary policy. In particular, we can compare the actual data with forecast scenarios in which the Fed loosened monetary policy in the form of interest rate reductions and asset purchases. This enables us to evaluate the effect that a more expansionary monetary policy would have had on the economy, and whether it might not have attenuated some of the worst effects of the Great Depression.

An interesting aspect of the Federal Reserve's purchases at this time was that they were conducted in isolation from other policies. When the Federal Reserve purchased these securities, it did not announce publicly its intentions either in relation to the length or size of the programme (although the purchases could be inferred *ex post* from its monthly balance sheet).[8] Indeed, the above-quoted Federal Reserve Bulletin of July 1932, was the first time that the purchases were noted at all.[9] This is in contrast to more recent purchase programmes which were generally well-publicized in advance. Thus, we are able to identify a pure monetary policy effect in our sample, and estimate the impact of this, untainted by communication or forward guidance.

[6] See, for instance, Baumeister and Benati (2013), Kapetanios et al. (2012).
[7] See, Christiano et al., (1999) and Giannone et al., (2014).
[8] Romer and Romer (2013) provide an in-depth study of contemporaneous public awareness of the purchases and its impact on expectations of deflation.
[9] Although, the purchases had been acknowledged in communications by individual members of the Board as early as April, although no specific purchasing policy was ever announced (see Romer and Hsieh (2006) for a discussion of the public's level of knowledge of the purchases).

Our findings suggest that extending the purchase programme would have had a significantly positive impact on the economy. In particular, the downturn in the economy would have been shallower and would have reversed more quickly than otherwise: the conditional forecasts for industrial production growth show that the downturn is reversed much more quickly, while prices start rising sooner.

However, we also show that, as per Friedman and Schwartz, an extension of the asset purchase programme would have increased the money supply substantially. Furthermore, the impact on the exchange rate would have been similar in size to the devaluation of the dollar that took place in 1933. Thus it appears that such a programme would have forced the US off the gold standard sooner than otherwise. This is an important finding since there is debate in the literature about whether it was even possible for the Federal Reserve to engage in more expansionary monetary policy at the time at that time (see for instance Hsieh and Romer (2006), Temin (1976), Eichengreen (1992) and Bordo et al., 1999)).

Overall, therefore, we find that although more aggressive policy could have led to better real economy outcomes, they would also have forced the US off the gold standard. As adherence to the gold standard was a political decision, the Federal Reserve could not have implemented these policies in the absence of political consent.

The paper is structured as follows. The next section provides a brief overview of the historical background. Section 3 outlines the methodology used in this paper, and discusses the data. The key results are presented in Section 4. Section 5 concludes.

2. Historical background

In this section, we outline the context in which the purchases took place. Figure 1a shows consumer prices (excluding food prices) and industrial production indexed to 1 at the peak of industrial production in July 1929 up to the end of 1935. Figure 1b shows the year-on-year growth rates in these variables alongside the unemployment rate, over the same period.[10]

Industrial production was already slowing in the late-summer of 1929, prior to the stock market crash of October. However, the crash marked the start of a rapid decline in industrial production (indeed Figure 1a shows that by the start of the asset purchases in April 1932, total production had declined by over 50 percent). With something of a lag, businesses began to fail, in greater

[10] We use the unemployment rate here for ease of interpretation; however, in our estimation we use employment data, as discussed in Section 3.1.

and greater numbers. As a result, the unemployment rate, remained relatively steady through much of the first half of 1930, but began to increase rapidly in second half of the year (Figure 1b). Banks came under increasing pressure as both corporate and personal loans began to default in large numbers.[11] A wave of bank panics took place in fall 1930, followed by a second wave in spring 1931. The banking system became dysfunctional, and credit to the real economy slowed dramatically.[12] Simultaneously, the money supply contracted sharply, declining almost a quarter by early 1932 (Figure 1a).[13] By the time the Federal Reserve began purchases in 1932 the unemployment rate was over 20 percent.

Although some at the time argued that the Federal Reserve should respond strongly to this unfolding crisis, in contrast to today, this was by no means the prevailing wisdom at the time. As noted by Chandler (1971 p. 117), commercial loan theorists and other 'accommodationists' believed that credit should be allowed to decline in line with the decreasing needs of trade, while 'liquidationists' believed the Federal Reserve should actually hasten the liquidation of credit, and that any attempts to expand money and credit would simply prolong the depression. Others felt that the Federal Reserve banks should be very liquid, and that government securities (and loans secured on these) were not self-liquidating and should not account for a large portion of the Federal Reserve's balance sheet.[14]

Against this background, it was the passing of the Banking Act of 1932, rather than the economic environment, which prompted the Federal Reserve's response.[15] Indeed, many members of the Open Market Policy Conference (OMPC), the precursor of the Federal Open Market Committee, were in fact reluctant to undertake these purchases, but the Act substantially changed the Federal Reserve's collateral requirements. Whereas before the Act, the Federal Reserve had to hold gold as backing for 40 percent of notes (and held more in practice), after the Act, it could use government securities as collateral for notes. This freed up its gold reserves, which could now be used to increase the money supply, prompting what Chandler (1970, p.118) refers to as *'the largest program of open-market purchases in [the Fed's] history up to that time'*.

[11] Bernanke (2000b).
[12] Bernanke (2000b) identifies this as one of the main causes for the length and depth of the Depression in the US.
[13] Part of this contraction was due to the 40 percent reserve requirement that the Federal Reserve was obligated to employ, as a result of which any gold outflow was matched by a reduction in the money supply of 2.5 times the value of the outflow (Bernanke (2000b, p. 75)).
[14] Chandler (1971, p. 121) cites George W. Dowrie, professor of economics at Stanford in relation to this opinion.
[15] While the OMPC agreed to make the purchases at its meeting in February 1932 prior to the official passing of the Banking Act, it was clear at that time that the Act would be passed, and it was agreed that purchases would only begin once this had happened (Chandler (1971, p. 193)).

Thus, in February 1932 and under pressure from Congress[16], the OMPC authorised the purchase of $250 million in government securities at a rate of approximately $25 million per week.[17] In April, however, the OMPC increased its planned purchases by a further $500 million and recommended *'that these purchases, at least in the initial weeks, should be at a rate as rapid as may be practicable'*.[18] This led to a temporary acceleration in purchases, although by May the rate of purchases had reverted to approximately $50 million per week. However, enthusiasm for the programme, never strong among some members of the OMPC, waned, with Governor McDougal of the Reserve Bank of Chicago arguing at the 9 July meeting that:

> *'…we believe that the additional purchases made were much too large and have resulted in creating abnormally low rates for short-term US Government securities.'*[19]

By early July, purchases were reduced to about $15 million dollars a week, and were effectively zero by the end of the month.

Thus ended the first 'quantitative easing' programme. However, Friedman and Schwartz (1963) pointed to this episode as one which successfully stemmed the decline in money supply and bank failures and coincided with a general economic improvement in the form of a tapering of the declines in variables (rather than an absolute reversal in trend).[20] Figure 1b illustrates this point: the unemployment rate stabilized from late summer 1932, although it remained at close to 25 per cent. Similarly, industrial production also stabilized, and even rose through the second half of 1932, but the year-on-year growth rate continued to be negative. In terms of consumer prices, although the year-on-year change stabilized, deflation of close to 10 per cent continued.

This is perhaps unsurprising given the relatively short period of purchases, and the severity of the crisis. Despite the programme, and as noted by Chandler (1970, p.119), between September 1931 and December 1932, total bank reserves increased only $60 million, and bank debts to the Federal Reserve actually increased by $4 million. Indeed, it was not until mid-1933 that the economy began to markedly improve. This period marked the start of an extraordinary expansion in the money supply (Figure 1a), which lasted until the early-1940s.

The inflow coincided with a change in government policy. In March 1933, the newly inaugurated President Roosevelt instituted a bank holiday, nationalized all gold and proceeded to drive up

[16] Friedman and Schwarz (1963, p.322).
[17] Also referred to as the Glass-Steagall Act of 1932 for the Congressmen who drove the legislation forward. However, this should not be confused with the more Glass-Steagall Act of 1933, which is the more famous banking legislation.
[18] Harrison Papers, "Meeting of Joint Conference of the Federal Reserve Board and the Open Market Policy Conference," 12 April 1932, p. 5.
[19] Minutes of the OMPC, July 14, 1932.
[20] Friedman and Schwarz (1963, p.324).

the dollar price of gold, effectively devaluing the dollar[21] (although it was not until January 1933 that the official dollar price of gold was revalued).[22] This coincided with an initial fall in the money supply, however, from July 1933 the money supply began to increase sharply.[23] The growth in the money supply was most rapid in the period 1934 to 1936, when the decision was made not to sterilize gold inflows[24], although later flows appear to have resulted from political instability in Europe[25].

A number of studies have suggested the crucial importance of leaving the gold standard, and thus being able to control the money supply, in the recovery. Temin and Wigmore (1990) argue that leaving the gold standard signalled an end to the deflationary regime and started the recovery. Taking an international perspective, a number of studies have noted the importance of leaving the gold standard for explaining the timing of the economic recovery of countries following the Great Depression.[26] More broadly, Friedman and Schwarz's (1963) central argument is that the monetary stimulus during this period was the key to US economic recovery.

The question thus arises, what would have happened if the increase in money supply had taken place sooner? More aggressively expansionary monetary policy, including interest rate cuts and a continuation of the 1932 purchases of government securities, would probably have substantially increased the money supply. We next turn our attention to measuring the possible impact of an extension both on the real economy, and on the commitment of the US to the gold standard.

[21] See Chandler (1970), Chapter 10 for a discussion.
[22] A number of measures were also taken to reform the financial sector, including the establishment of the FDIC and the better-known Glass-Steagall Act of 1933. As noted by Anderson (2010), in early April 1933, Congress passed legislation that (i) permitted the Fed to purchase up to $3 billion in securities directly from the Treasury (direct purchases were not typically permitted) and, if the Fed did not, (ii) also authorized President Roosevelt to issue up to $3 billion in currency. This led initially to further purchases by the Fed, and subsequently, through purchases by the Treasury of gold on international markets.
[23] Bernanke (2000a p. 15) argues that the somewhat counterintuitive inflow of gold to the US following the devaluation was a result of improved investor confidence. Specifically, he argues that inflows like this to countries which abandoned the gold standard, reflected investors beliefs about the sustainability of the gold standard elsewhere.
[24] Although this decision arose, at least in part, from technical problems with the sterilization process following the Gold Reserve Act of 1934 (Romer (1992)).
[25] Friedman and Schwarz (1963), Bloomfield (1950).
[26] See, for instance, Bernanke and James (2000), Eichengreen and Sachs (1985) and Choudhri and Kochin (1980).

3. Data and Methodology

3.1 Data

To address this issue, we estimate a Bayesian VAR with seventeen variables. We use only variables that are available on a monthly frequency for the period 1919M1 – 1934M7. The data fall into six broad categories: prices, business cycle variables, labour market variables, financial variables, measures of economic and financial stress and monetary policy variables. This information set is common in studies of more recent monetary policy measures; however, we have modified some of the variables within the categories to reflect the different structure of the economy at the time. In selecting variables we rely, among other sources, on the Federal Reserve Bulletins from 1932. We believe these variables are particularly appropriate for inclusion since they were closely watched by the Federal Reserve and therefore probably influenced policy (Iversen et al., (2014)).

The price variables we use capture both producer and consumer prices. For producer prices, we include the wholesale price index (now referred to as the producer price index of all commodities). This variable was included in the National Summary of Business Conditions section of the Federal Reserve Bulletin (hereafter referred to as 'National Summary'), and captures the decline in commodity prices at this time. We also include the wholesale price of fuel and lighting, since we want to capture the cost of production.

In terms of consumer prices, we include consumer prices excluding food, and food prices. While no consumer prices are included in the National Summary, they were referenced elsewhere in the Bulletins.[27] Although consumer prices fell sharply during the Great Depression, food prices fell more so. Since we expect food to have been a large share of household expenditure during this period, it seems reasonable to include it as a separate variable in its own right. Furthermore, the collapse in food prices during this period caused difficulties for the agricultural sector, which was already under pressure due to drought in the mid-West.

The business cycle variables used are department store sales and industrial production. The Bulletin's National Summary includes regular information on department store sales. Industrial production is widely used as a measure of output during this period, since its monthly frequency makes it far more appealing than GDP data.

Our labour market variables are also drawn from the National Summery: we use factory employment factory wages. These are the main indicators referred to in the National Summary.

[27] For instance, in June 1932, the Bulletin notes: 'Prices to the consumer have also tended downward in recent months' on page 335.

The financial variables we use are the money stock, S&P composite stock price index, yield spread (10y interest rate-3m interest rate) and bilateral exchange rate with the Swiss Franc. As noted, money supply is a key variable in much of the discussions of the causes of the Great Depression. The money stock measure we use includes currency held by the public and demand and time deposits at all commercial banks. Stock market data and the yield spread capture general financial market conditions. In choosing the US dollar-Franc exchange rate we follow Romer and Hsieh (2006, p.150), who argue that the Swiss Franc was understood to be firmly wedded to the gold standard during the period. Thus, movements in the exchange rate should reflect expectations of the US commitment to the gold standard.

The level of stress is captured by three indicators: liabilities of commercial business failures, the spread between Baa-rated corporate bonds and long-term government bonds, and the spread between secured and unsecured money market rates[28]. The first indicator captures stress in the real economy which would also be reflected in non-performing loans in the banking sector. The second indicator is proposed by Bernanke (2000b), who shows that this spread rises markedly around times of banking crises during the Great Depression. He argues that it is, perhaps, the best indicator of dysfunctionality and distress in the banking system. The interest rate spread captures the risk premium charged for unsecured lending.

In order to analyse the stance of monetary policy, we include the Federal Reserve Bank of New York's discount rate as a proxy for the policy rate. While there was no one, official central bank rate in the US at the time, the interest rates set by the individual Federal Reserve banks generally follow a similar pattern, albeit there are differences in the level. Nonetheless, the New York Fed was one of the more dovish Reserve banks during this period. However, the importance of New York as a financial centre means that it is often used in the literature to capture the policy rate.[29] Additionally, we include the purchase of government securities as a measure for unconventional monetary policy.

The data are sourced from the Federal Reserve's FRED, ALFRED and Fraser databases, with the exception of long-term interest rates and stock prices for which we rely on data provided by Shiller on his website[30] and the exchange rate which we obtain from the Swiss National Bank's historical exchange rates database[31].

[28] Specifically, the spread between call money rates (mixed collateral) and bankers' acceptance rates in New York.
[29] See for instance, Bordo and Haubrich (2010) and Sims (1998).
[30] http://www.econ.yale.edu/~shiller/data.htm
[31] Available through the SNB's data portal: https://data.snb.ch/en

3.2 The Bayesian Vector Autoregression

For our analysis, we rely on a medium scale Bayesian Vector Autoregressive (VAR) models, as described in Garabedian (2018) and close in spirit to Beauchemin and Zaman (2011). As with all VARs, this model contains equations that link the current value of each variable to past values of all the variables in the model, thus giving us a better understanding of the historical statistical relationships between the variables. These historical correlations allow us to project forward the path of macroeconomic variables (Tallman and Zaman, 2012).

The literature suggests that, in order to provide an accurate forecast of the macroeconomic variables in our VAR, we need to include a large number of time series (Banbura et al., 2015). Moreover, Gambacorta et al. (2014) highlight the benefit of including variables capturing uncertainty, financial turmoil and economic risk to capture spillovers between the real and financial economy. This enables us to distinguish better between exogenous changes in the central bank balance sheet and endogenous interventions. Thus, in our analysis, as previously noted, we use data on 17 variables between 1919M1 and 1932M7. Since we are using monthly data, we include twelve lags of the variables, to appropriately account for the typical lags in the transmission mechanism.

Problematically, including many macro variables inevitably leads to the "curse of dimensionality", which refers to the large number of parameters[32] that have to be estimated in such systems. Hence, we are faced with a trade-off between misspecification and forecast inaccuracy (which is likely in excessively simple models), and collinearity and overfitting (large estimation uncertainty) (Beauchemin and Zaman, 2011; Banbura et al., 2010). However, although a large number of parameters cannot be well estimated by ordinary least squares[33], recent developments in Bayesian macroeconometrics enable us to deal with the complexity of such large datasets (Giannone et al., 2018)

This is because Bayesian VARs implement parameter 'shrinkage', the intuition of which is to blend the likelihood from the over-parametrized VAR framework with a prior distribution for the parameters that is simplistic but allows for parsimony, thus yielding coefficients that are 'shrunk' toward their prior beliefs[34] (Banbura et al., 2015). De Mol et al. (2008) argue that for data that is strongly collinear, large Bayesian VARs can forecast well.[35] This is because all the data carry a similar type of signal (as they are close to collinear), and thus the relevant

[32] q = n (np + m), n being the number of endogenous variables, p the number of lags, and m the number of exogenous variables.
[33] Since the typical macro data set involves a small number of observation.
[34] These are characteristically set to zero.
[35] Indeed, controlling for over-fitting while keeping the information contained in the sample, is possible by incorporating a degree of shrinkage (Bloor and Matheson, 2016).

information for forecasting can be obtained from a sizeable information set if combined with the right amount of shrinkage needed to filter out the random part from the signal (Banbura et al., 2015; Koop, 2010).

The specific method of shrinkage that we employ follows Blake and Mumtaz (2012), who use a variation of the classic Minnesota prior, referred to as a dummy observation prior. Intuitively, this prior can be interpreted as generating artificial data[36] from the model assumed under the prior, and combining this with the existing data. The biggest advantage of this methodology is that we can match the Minnesota moments (without problems of matrix inversion), while concurrently being consistent with unit root and/or cointegration processes.[37]

In our estimations, we use data transformed to annualized log levels (taking logs and multiplying by twelve), with the exception of those already expressed in terms of annualized rates (interest rates, etc.). The latter are simply incorporated in levels Therefore, for our non-stationary variables, which are often differenced, we use a random walk prior, while for our stationary variables, we use the white noise prior.

Next, using the model with the estimated parameters, we forecast all the macro-economic variables in our samples for a year and a half (18 months) starting from 1932M8 to 1934M1 (Tallman and Zaman, 2012).

[36] The artificial observations are created using a set of hyperparameters. Firstly, we control the overall tightness of the prior. Secondly, we adjust the tightness of the prior on higher lags. Similarly, the tightness of the prior on constants is set by such a hyperparameter. Finally, the standard deviation of the error terms from the OLS estimates of the AR regression for each variable in the model are also incorporated. We follow Giannone et al. (2015), in choosing the priors for the hyperparameters, as they provide the optimal values for similar mid-scale VARs.

[37] Specifically, as discussed in Banbura et al. (2010), these dummy observations for a general *N* variable VAR with *P* lags are given as:

$$Y_D = \begin{pmatrix} diag(\chi_1\sigma_1 \dots \chi_N\sigma_N) \\ 0_{N\times(P-1)\times N} \\ \dots\dots\dots\dots\dots \\ diag(\sigma_1 \dots \sigma_N) \\ \dots\dots\dots\dots\dots \\ 0_{1\times N} \end{pmatrix}, X_D = \begin{pmatrix} \frac{J_P \otimes diag(\sigma_1 \dots \sigma_N)}{\tau} & 0_{NP\times 1} \\ 0_{N\times NP} & 0_{N\times 1} \\ \dots\dots\dots\dots\dots\dots\dots & \dots\dots\dots \\ 0_{1\times NP} & c \end{pmatrix}$$

Where χ_i are the prior means for the coefficients on the first lags of the dependent variables (which can be different from 1) and $J_P = diag(1 \dots P)$.

4. Would a large-scale asset purchase programme have eased the Great Depression?

4.1 Conditional forecasting - scenarios

In our conditional forecasts, we analyse the effect of a combined conventional (continuation of the gradual cut in interest rates) and unconventional monetary policy (continuation of the short-lived government securities purchase program during the first part of 1932) package on the other variables in our VAR. To do so, we apply the conditional forecasting techniques developed by Waggoner and Zha (1999), which allow us to incorporate exogenous restrictions or impose shocks to any variable in the model. In addition and importantly, these methods do not depend on the assumption of stationarity.[38]

Furthermore, since our conditional forecasting is applied on the reduced-form VARs, identification of the structural shocks is not necessary.[39] Thus, we simply rely on the correlation structure between the variables in our VAR to gauge future conditional paths. Banbura et al., (2015) and Antolin-Diaz et al. (2018) refer to this methodology as the "conditional-on-observables" forecast. Hence, the research question we are analysing is what the likely outcome for our set of macro-financial variables will be, given the path we impose for the policy rate and the central bank's purchases of government securities.

Alternatively, we could examine what would happen if a series of monetary policy surprises would lead to the above paths, and thus perform a "structural scenario analysis" (Antolin-Diaz et al., 2018; Baumeister and Kilian, 2013). However, we consider it unlikely that a series of monetary policy shocks would keep the interest rate or the government security purchases at its prescribed path for the full length of our two-year forecast horizon. Even with more recent asset purchases, the monetary policy surprises usually occur at the start (announcement or change) of the program (Rogers et al., 2014). Hence, it is useful for policymakers to understand

[38] Practically, the methodology of Waggoner and Zha (1999) consists of a Gibbs sampling algorithm that yields parameter estimates conditional on the constraints set in the model. The method involves drawing complete paths of reduced form shocks, which fit with the conditional path on the variables. In particular, we repeat the following steps. Firstly, estimation of the parameters of the VAR. Secondly, forecasting with the reduced form model. Thirdly, re-estimating the parameters conditional on the forecast constraints. Finally, forecasting with the newly fitted reduced form model (Bloor and Matheson, 2016). The results are based on 50000 draws from the Gibbs sampler, with a burn-in of 40000 iterations.

[39] The posterior predictive density allows us to evaluate the degree of forecast uncertainty. More specifically, we incorporate two sources of uncertainty: uncertainty about the "true" parameters and uncertainty coming from exogenous random shocks in the system (Waggoner and Zha, 1999), and the likelihood of forecasts that fulfil a set of conditions or specific sets of future disturbances. Given that the predictive density assigns likelihoods to all imaginable forecast paths, the Monte Carlo methods used to generate the estimated numerical density yield the likelihoods of specific sets of certain prescribed paths (Beauchemin and Zaman, 2011).

the effect of the program beyond these initial shocks, by conditioning on the observables. Moreover, specifically for our historic context, Hsieh and Romer (2006) highlight that the public did not expect the program of 1932 to end after four months. We therefore consider the extension of the 1932-program not to be a monetary policy surprise, but simply a continuation of the expected policy path. As a result, although a 'structural scenario analysis' would be an interesting exercise[40], we examine what the impact would be of the other variables in our VAR-framework if both the policy rate and the government security purchases were set to a similar (though more pronounced) path as in 1921, 1924, 1927, or the short-lived period in 1932.[41]

Similar applications of scenario analysis for policy purposes can be found in Bloor and Matheson (2016), Beauchemin and Zaman (2011), Tallman and Zaman (2012), Giannone et al. (2014), Jarocinski and Bobeica (2016). In the context of monetary policy scenarios, Baumeister and Benati (2013), Kapetanios et al. (2012), Pascual and Wieladek (2016), Gambetti and Musso (2017) have further popularized conditional forecasts.

In our baseline scenario, we extend the 1932 asset purchases and reduce the interest rate. (In Section 4.3 we also include some alternative scenarios to this baseline.) The average monthly amount of government securities bought by the Federal Reserve between April and June 1932 was approximately $250 million, but varied from $121 million to $399 million. In order to simulate a realistic path for the monthly purchases of government securities, we gauge the effect of purchasing a similar amount of government securities - $220 million per month – for an additional 12 months, from July 1932 to July 1933 (grey line, Figure 2a).[42] In addition, we allow the measures to taper as with recent purchase programmes, rather than abruptly stopping them. Overall, the level of purchases is decreased for the following 6 months until just $105 million of purchases are made in January 1934.[43]

The level of purchases in this scenario are chosen to be similar to the first quantitative easing (QE1) programme instituted by the Federal Reserve following the recent financial crisis. That

[40] Antolin-Diaz et al. (2018) emphasize that conditional-on-observable forecasts might suffer from the strong positive correlation found in the data between interest rates and both inflation and output. Similar comments are prevalent in the Neo-Fisherian literature (Uribe, 2017). However, this observation is often found in small scale VARs, and is likely due to missing variables (similar to the price puzzle). The inclusion of financial, stress and uncertainty variables enables us to disentangle crisis moments (and their ensuing policy responses), and therefore allows us to identify a more plausible correlation structure, and thus to condition on observables.

[41] For a comprehensive discussion of the asset purchases of the Federal Reserve during the 1920s and 1930s, see Carlson and Duygan-Bump (2018).

[42] In contrast to much of the existing literature evaluation the effect of asset purchases by central banks, we follow Boeckx et al. (2017) and use the balance sheet directly in order to identify the path, instead of indirectly gauging the effect of the balance sheet through its effect on long-term spreads.

[43] Specifically, purchases are decreased to $180 million in August 1933, and then by $15 million per month thereafter for the following 5 months.

programme lasted for about 1.5 years, similar in length to our scenario.[44] In addition, the QE1 programme and our scenario involve purchases of approximately 20-25% of outstanding purchasable securities as measured at the start of the programme.[45] Of course, the programmes are not identical: purchases under QE1 included other assets in addition to government securities[46], while relative to GDP our scenario is much smaller than QE1. However, we believe that the two programmes are reasonably similar.

Figure 2b shows the size of the Federal Reserve's holdings of government securities over the course of our scenario (dashed lines), relative to the actual data (solid lines). The holdings are measured relative to both actual GDP and actual total outstanding government securities, two common benchmarks. At the end of the programme, the Federal Reserve would have been holding over 20% of outstanding government securities. This compares to its actual holdings in the absence of the programme of approximately 10% of outstanding securities. Relative to GDP, the Federal Reserve's holdings of securities would have been equivalent to just less than 10% of GDP, compared to just less than 5% of GDP in the absence of purchases. By both measures, the holdings decline by the end of our scenario, because both GDP and outstanding securities grew strongly at that time.

In addition, recalling that the Federal Reserve never cut rates below 1.5 percent, we study the effect of reducing the interest rate to the zero lower bound. From Figure 2c, the path of the NY Fed discount rate gradually declines from 2 percent at the start of the forecasting window in August 1932 to a rate of 0.25 percent in August 1933, which we consider the the zero lower bound. We set the interest rate to decline by at most 50bps in any given month, reflecting the scale of interest rate cuts observed in the data in the period before 1932.

4.2 Conditional forecasting results

The results of our exercise are presented in the panels of Figure 3. Although the BVAR is estimated in levels, the data here are presented in growth rates for ease of interpretation. Each panel contains the actual data for the period from the peak of industrial production in July 1929. After the beginning of the forecast period in 1932M8, we also include the conditional forecast. The figures then show the evolution of both series until the end of the forecast period 18 months later. Since we want to extract sensible policy lessons from our conditional forecasting exercise we need to incorporate a probabilistic assessment of alternative outcomes. Therefore, we also

[44] See Gagnon et al., (2011) for a discussion of QE1.
[45] See https://www.treasurydirect.gov/govt/reports/pd/histdebt/histdebt_histo3.htm for information on Treasuries outstanding since 1900.
[46] In particular, QE1 purchases included mortgage backed securities. In this respect, the euro area purchase programme, which is dominated by public sector asset purchases, is closer to our scenario.

include 68% confidence bands, which are standard in the literature[47], around the median conditional forecasts in Figure 3.

We have also included a vertical black line to indicate the bank holiday in March 1933 and changing policies towards the gold standard, which marked a turning point in the US recovery. After this point, many variables began to improve markedly, however, this change in policy is not captured in our scenario and thus provides a tough comparison for our monetary policy scenario. Nonetheless, looking across the panels, it is clear that the extended purchase programme results in a shorter, less deep downturn in the real economy. In the interests of brevity, we focus on eight particularly relevant variables in the panels of Figure 3.

In terms of prices, forecasted consumer price inflation picks up immediately, and remains stronger than actual inflation throughout the forecast period. By the vertical line, inflation is over 7 percentage points higher in our scenario compared to the actual data. As a result, the economy comes out of deflation earlier than otherwise. Nonetheless, by the end of the sample period, inflation under the conditional forecast is levelling off, and similar to the actual level of inflation at this time (Figure 3a). Moreover, the cumulative effect of the higher inflation rates under the scenario leads to a significantly higher price level by the end of the forecast period than in the actual data. Not shown here, producer price inflation and food price inflation also begin to increase sooner under the conditional forecast than they otherwise would have.

In the real economy, the conditional forecast for industrial production growth (Figure 3b) shows that the downturn is reversed faster; growth in industrial production turns positive in December 1932 (whereas without purchases this is only the case in April 1933). In the actual data, industrial production grows rapidly immediately after the change in policy in March 1933, however, by the end of the sample, the conditional forecast indicates stronger growth, even though it does not take into account these policies.[48] Department store sales (Figure 3c) show a similar pattern: growth picks up earlier under the conditional forecast until March 1933 when the actual data perform about as well as the conditional forecast.

Turning to the labour market, factory employment is slow to increase under the conditional forecast, but begins to grow more strongly than otherwise in the period before March 1933 (Figure 3d). Thereafter the two follow a similar trend, although the conditional forecast lags growth in the actual data somewhat. Nonetheless, by the end of the forecast period, growth in employment under the conditional forecast is well above what it would have been otherwise. In

[47] Many authors (Wauters, 2016; Stock and Watson, 2012) apply similar bands when reporting their results. Similarly, Tallman and Zaman (2012) report mean values together with 70 and 90 percent probability bands.
[48] This remark similarly holds for the other variables we present in our conditional forecasting exercise.

terms of wages, the actual and forecasted real factory wages follow a somewhat similar pattern throughout the sample period (Figure 3e). However, bearing in mind that consumer price inflation is stronger under the conditional forecast, the overall effect is higher nominal wage growth.

These results for prices and output suggest that, in terms of the real economy at least, more aggressive monetary policy could have markedly improved outcomes.

Turning to financial stress, Figure 3f shows the spread between secured and unsecured money market rates which captures the risk premium charged on uncollateralised lending. The rate declines markedly over the sample period, and more quickly than the actual data. Not shown here, the spread between Baa-rated corporate bonds and long-term government bonds - the indicator of financial stress proposed by Bernanke (2000b) - also declines over the forecast horizon. However, interestingly, the decline is not as strong as in the actual data.[49] The fall in the actual spread arises from a very large reduction in the yield on Baa-rated bonds, rather than long-term government bonds, which it appears is not captured in our model.

Turning to the financial variables, the yield spread is shown in Figure 3g: it clearly widens more under the conditional forecast, a somewhat surprising result which suggests that the level of risk in the economy is increasing. Similarly, growth in the stock market (not shown here) is lower under the conditional forecast than otherwise.[50] Of particular interest is the change in the money supply, since it is argued that the Fed's inaction at the time impacted the economy through the shrinking of the money supply. As is evident from Figure 3h, the programme markedly expands the money supply compared to the actual data. This is the case even in the period after March 1933, when Roosevelt's policies were driving up the dollar price of gold.[51] At the same time Figure 3i indicates that the effect on the exchange rate was similar to that experienced after March 1933: there is a strong devaluation in the dollar. Thus, it seems that the asset purchase programme would have resulted in the US abandoning the gold standard sooner than it did.

Overall, therefore, our findings suggest that in terms of the real economy -- prices, output and the labour market -- more aggressive policy on the part of the Federal Reserve could have significantly improved outcomes. However, our results also suggest that the impact on the

[49] A similar pattern is found with business failures: under the conditional forecasts, business failures decline, but not as strongly as in the actual data.

[50] Studies of more recent low interest rate policies suggest their impact on profitability could affect stock market performance (see for instance Arteta et al., 2018).

[51] Although it is notable that the US did not pursue an aggressively expansionary monetary policy in the wake of its effective devaluation, unlike other countries at the time (Bernanke and Mihov (2000) and Romer (1992)).

exchange rate would have resulted in the US abandoning the gold standard sooner than it did. Since it was a political decision whether or not to leave the Gold Standard, our findings suggest that Federal Reserve was constrained by the Gold Standard from implementing these policies.

4.3 The effect of programme size

In this Section we detail two alternative scenarios, both involving different levels of asset purchases. In the first, we consider the impact of a reduction in the size of the purchase programme. Since the OMPC was reluctant to undertake purchases, it seems reasonable that any alternative to the baseline scenario should involve a reduction, rather than an increase, in the level of purchases. In the second scenario, we consider the impact of just a reduction in the interest rate, exclusive of the impact of the asset purchase programme. Thus, by comparing this scenario with the baseline, we can gauge the relative contributions of the interest rate cuts and the asset purchase programme.

Specifically, under the first alternative scenario, instead of purchasing $220 million per month for 12 months, we set purchases at $180million per month. After twelve months, we allow purchases to taper for 6 months, reaching $65 million in the final month of the forecast period.[52] In the second alternative scenario, we use the same interest rate path as is depicted in Figure 2c, but place no constraint on the balance sheet. As a result, our conditional forecasts show the impact of an interest rate cut, but no asset purchase programme.

In Figure 4 we compare the impact of these alternate scenarios (yellow lines) with that of the baseline scenario (grey line) discussed above. For brevity, we focus on the conditional forecasts for consumer price inflation and industrial production growth. We do not include 68% confidence bands in Figure 4 for ease of reading the graph, however, all scenario forecasts are within the confidence band for the baseline scenario.

As is evidenced by Figure 4a, consumer price inflation follows a similar path under both the baseline and alternative scenarios through the first part of the forecast period. However, inflation is always lower under the first, lower purchases scenario than under the baseline scenario. Nonetheless, the difference in inflation rates are not dramatic: by the end of the forecast period, inflation under the first alternative scenario is 2.5% compared to 3.7% under the baseline. Comparing the baseline scenario with the second alternative scenario in which no purchases take place, it is interesting to note that only in early 1933 is there a clear divergence in the level of inflation between the two scenarios. However, thereafter, the forecast under the

[52] Specifically, purchases decline to $140 million in the first month of tapering, and by a further $15 million per month thereafter.

baseline scenario shows a clear higher rate of inflation: by the end of the forecast period, inflation is 0.4% under the alternative scenario compared to 3.7% under the baseline.

A similar pattern is evident in the conditional forecasts for industrial production growth (Figure 4b). The level of growth is very similar for all three scenarios for much of the period up to mid-1933. Only thereafter is a divergence evident: the baseline scenario grows fastest, followed by the first and second alternative scenarios, respectively. Industrial production is a very volatile series throughout the sample period. Nonetheless, the differences in growth arising from the various scenarios is marked: at the end of the forecast period, growth is 42.6% under the baseline scenario compared with 31.1% under the first, lower purchases alternative scenario, and 20.3% under the second, no purchases scenario.

We believe that the delayed impact of the asset purchases evident in Figures 4a and 4b (and also evident for most variables not shown here) most likely reflects the lack of an announcement of the asset purchase programme. Without an announcement, the launch of the programme has little initial impact on sentiment or expectations for the future, which is a channel identified in more recent purchases programmes as resulting in immediate effects on the broader economy. Thus, the effect of purchases in our scenarios must be transmitted to the real economy only through other channels. Since we expect that these channels operate with more of a lag than sentiment, it is unsurprising that the purchases take an extended period of time to affect macroeconomic variables.

Overall, the results from these alternative scenarios suggests that both the interest rate reductions and the purchases have marked effects on inflation and output.

5. Conclusions

Since Friedman and Schwartz (1963), the Federal Reserve's role in controlling the supply of money has been seen as a key factor in the duration and depth of the Great Depression. In this paper, we studied the four month period in which the Federal Reserve actively expanded the money supply by purchasing government securities. In particular, we asked what the effect of more aggressively cutting interest rates and extending these purchases over a longer horizon would have been.

To answer this question, we used a Bayesian VAR framework, incorporating 17 variables to capture prices, output, the labour market and financial markets. We used this model to calculate forecasts that are conditional on the path of monetary policy variables. Specifically, we assumed that the Federal Reserve cut rates and maintained a similar average monthly level of purchases

of government securities in the 12 months after June 1932, as it did during the previous four months.[53] We then estimated the path of the other variables in the model based on these assumptions over monetary policy to evaluate the effect that an extension of the Federal Reserve's 1932 purchases would have had on the economy.

A novel aspect of the paper is that since the Federal Reserve's purchases at this time were conducted without communicating decisions to the public or financial markets. In comparison, more recent programmes are widely publicized in advance of their implementation. As a result, studies of more recent quantitative easing programmes are generally tainted by the fact that central banks simultaneously issued communications, such as forward guidance. As such, our results are good indicators of the impact of monetary policy exclusive of forward guidance.

The main finding of the paper is that the downturn in the economy would have reversed much more quickly if monetary policy had been more expansionary. Specifically, both prices and output would have returned to positive growth rates more quickly. As such, it appears that by simply maintaining the level of purchases of government securities for an extended period, the Federal Reserve could have significantly improved economic outcomes.

However, we also show that asset purchases would have increased the money supply substantially. This is perhaps unsurprising, but in line with Friedman and Schwartz's prescription for the time. Nonetheless, this expansion of the money supply would have had a large impact on the exchange rate, most likely forcing the US off the gold standard earlier than otherwise. Since this was a political decision, rather than one the Federal Reserve could make, the results suggest the Federal Reserve was constrained by the Gold Standard in implementing such policies.

[53] We then allow the purchases to taper over the following 6 months, rather than end them abruptly.

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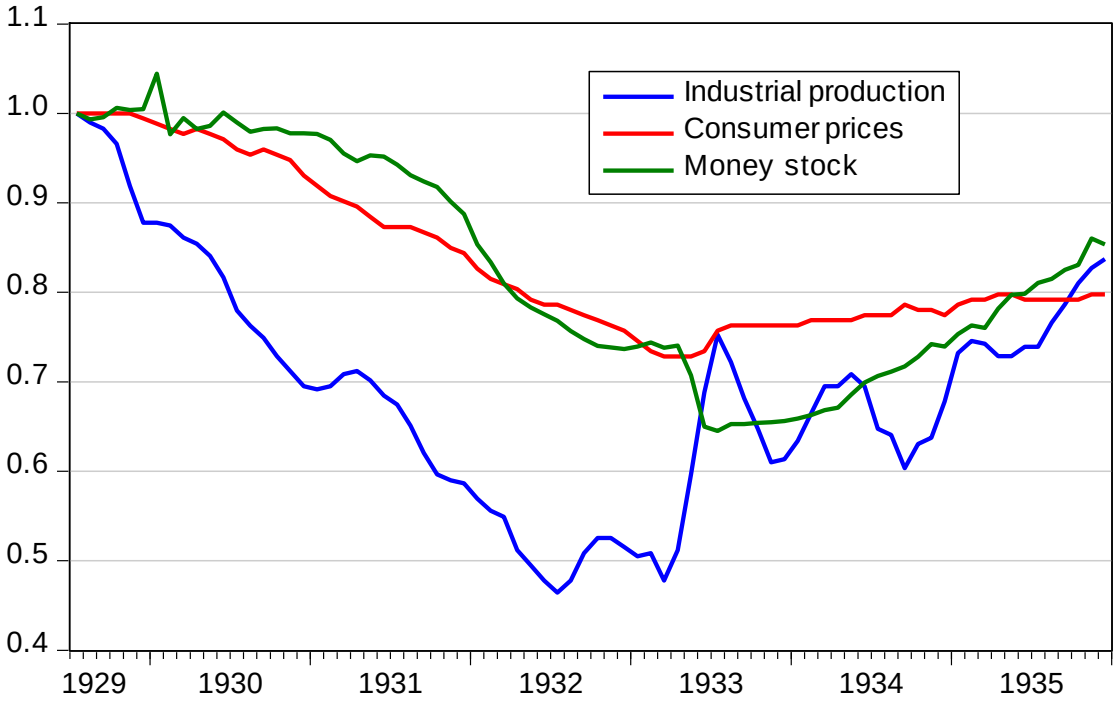
FIGURE 1: KEY VARIABLES – EVOLUTION JULY 1929 TO DECEMBER 1935

Figure 1a: Level of industrial production, prices and money supply, indexed to 1 in July 1929



Note: Figure is indexed to 1 at peak level of industrial production, July 1929

Figure 1b: Unemployment rate and year-on-year changes in industrial production, consumer prices and money stock

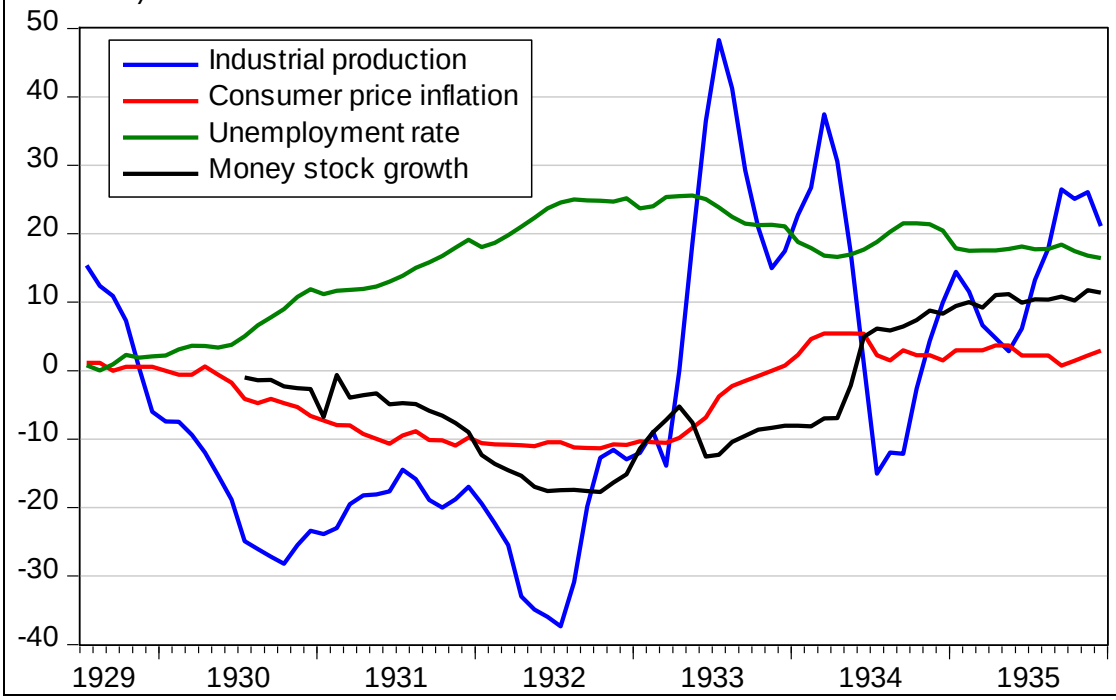
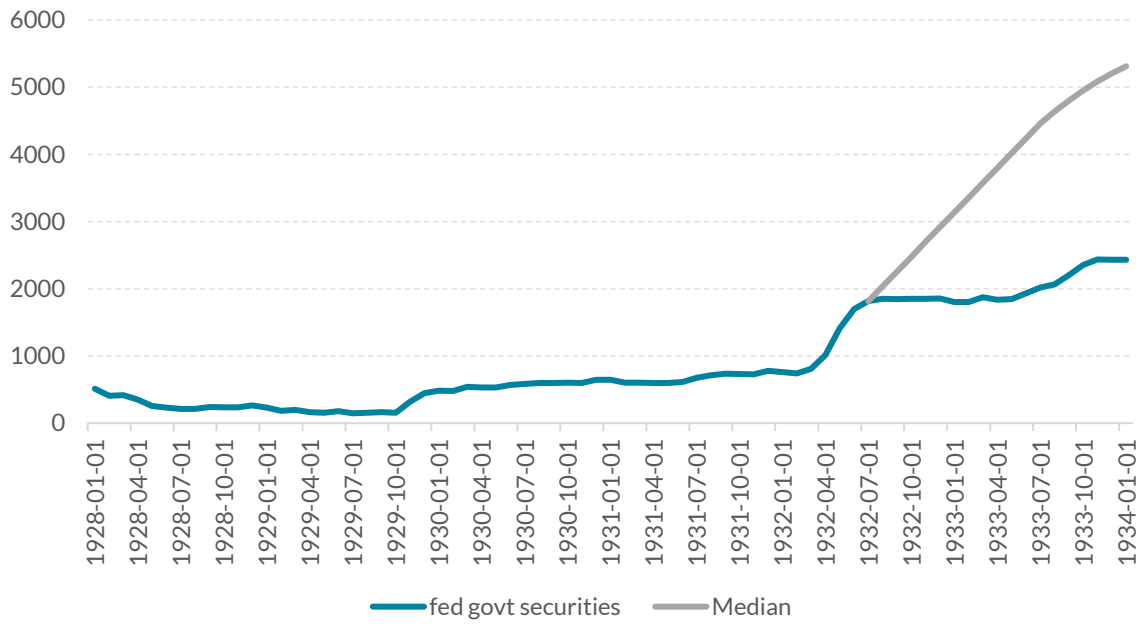


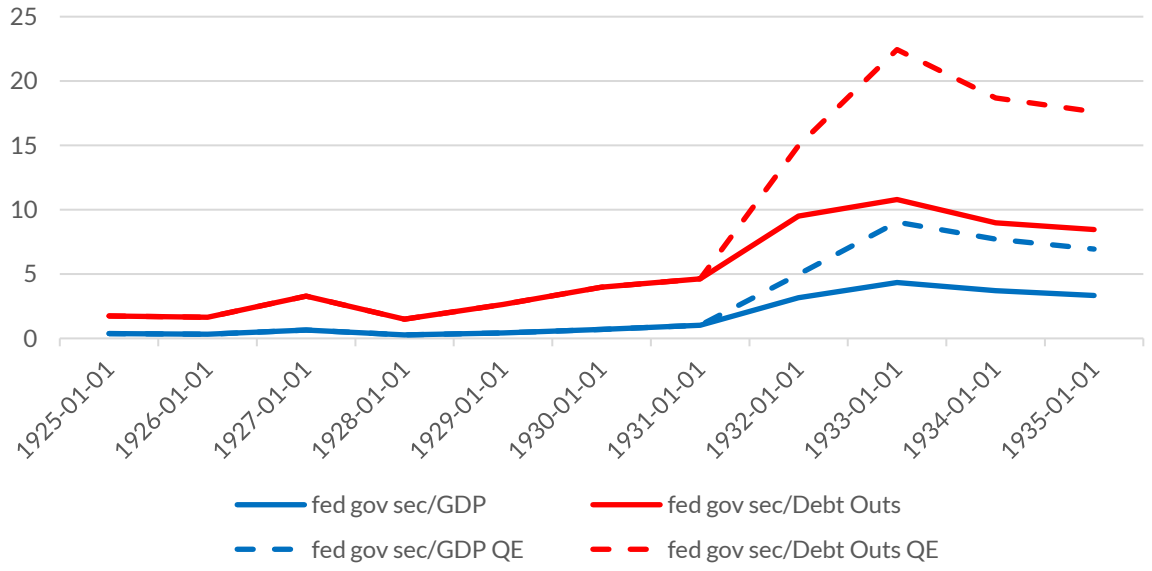
FIGURE 2: CONDITIONAL FORECASTING PATH FOR CONVENTIONAL AND UNCONVENTIONAL MONETARY POLICY

Figure 2a: Conditional forecasting path for government purchases by the Federal Reserve, expressed in billions of dollars.



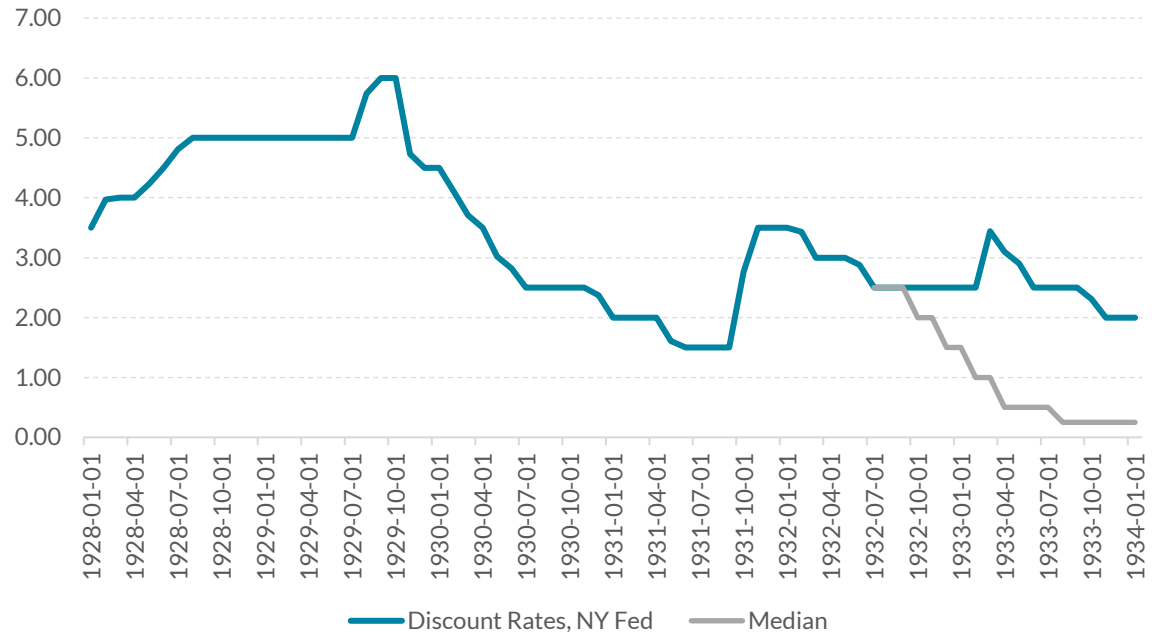
Note: The blue line depicts the historical values, whereas the grey line represents the conditional values incorporated in the forecast.

Figure 2b: Size of purchases, expressed as %GDP and % outstanding securities



Note: The solid line depicts the historical values, whereas the dotted line represents the values arising from our conditional forecasting scenario.

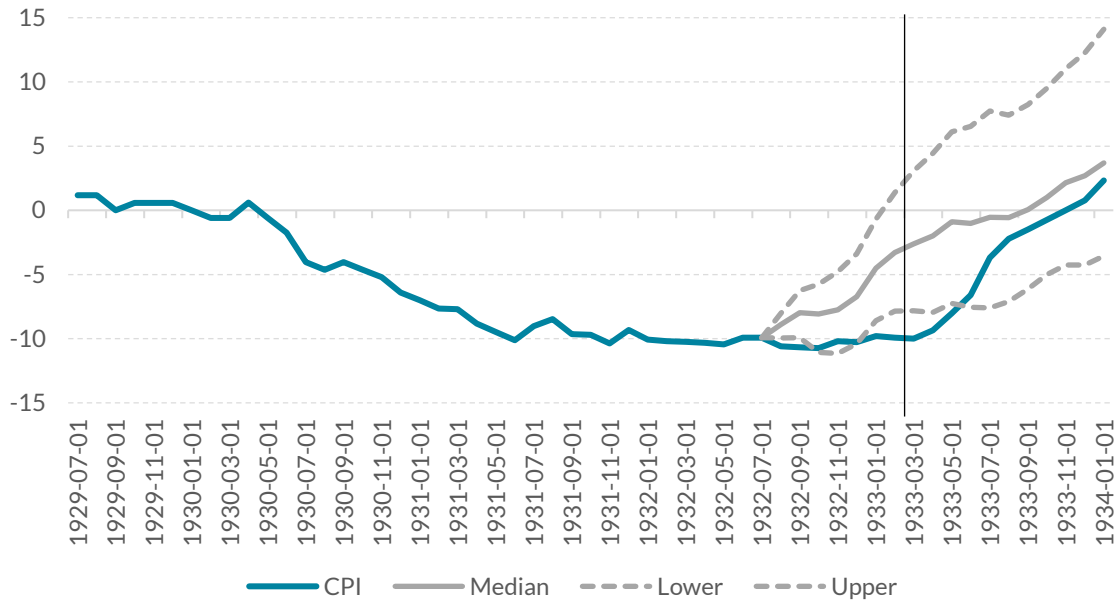
Figure 2c: Conditional forecasting path for NY Fed discount rate, expressed in percentages.



Note: The blue line depicts the historical values, whereas the grey line represents the conditional values incorporated in the forecast.

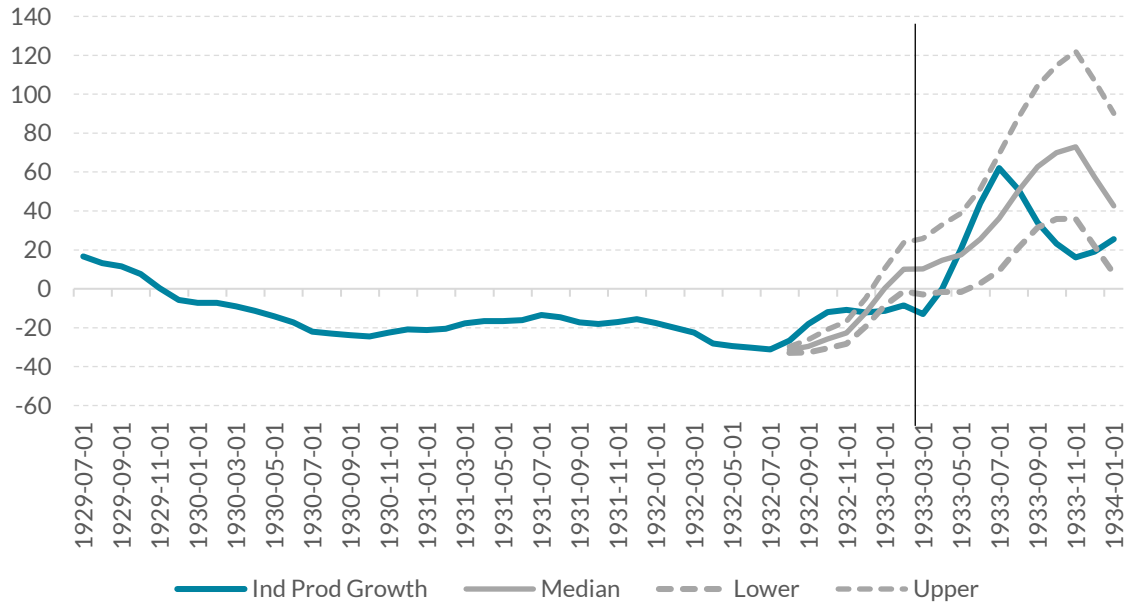
FIGURE 3: CONDITIONAL FORECASTS FOR CORE VARIABLES

Figure 3a: Conditional Forecasts for consumer price inflation



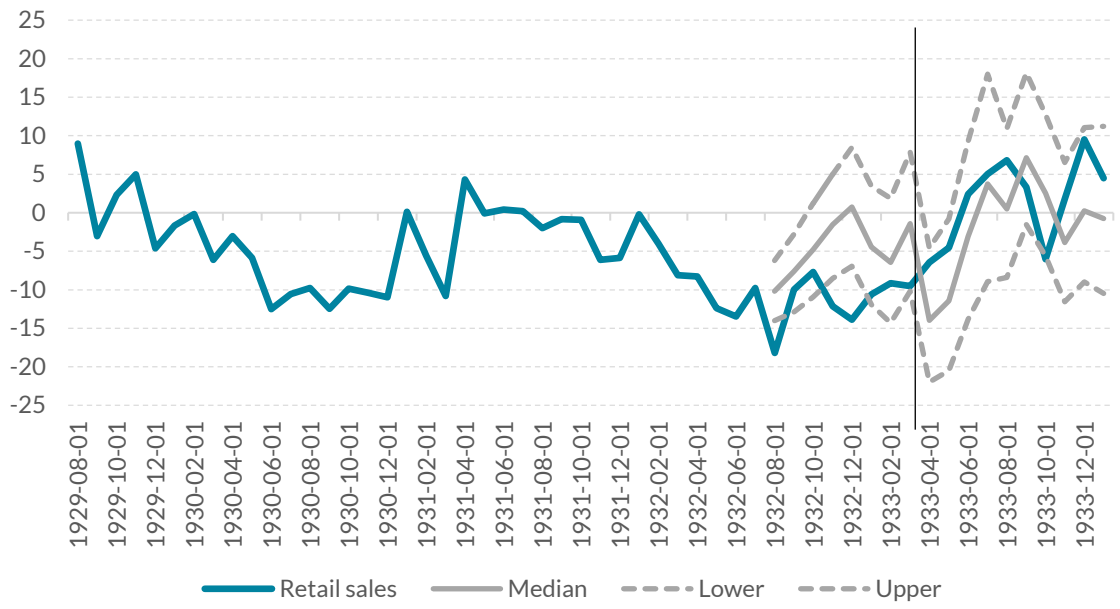
The blue line depicts the historical values. The solid grey line is the median forecast value for each variable, and the dotted lines are the confidence intervals, which describe the 68% credible set of the forecasting density.

Figure 3b: Conditional forecast for industrial production



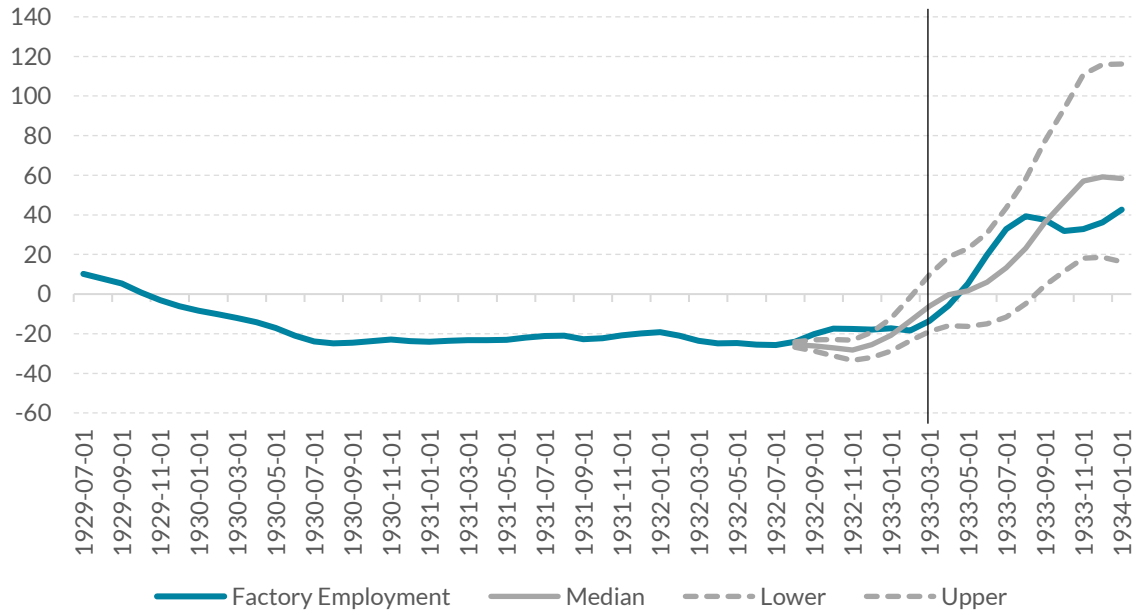
The blue line depicts the historical values. The solid grey line is the median forecast value for each variable, and the dotted lines are the confidence intervals, which describe the 68% credible set of the forecasting density.

Figure 3c: Conditional forecast for retail sales



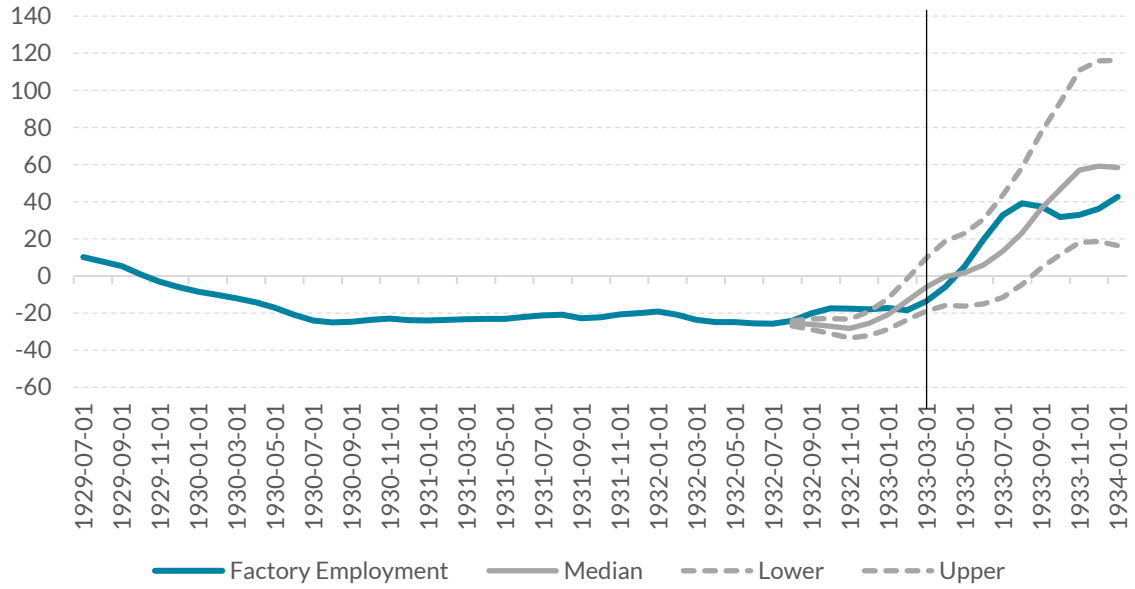
The blue line depicts the historical values. The solid grey line is the median forecast value for each variable, and the dotted lines are the confidence intervals, which describe the 68% credible set of the forecasting density.

Figure 3d: Conditional forecasts for factory employment



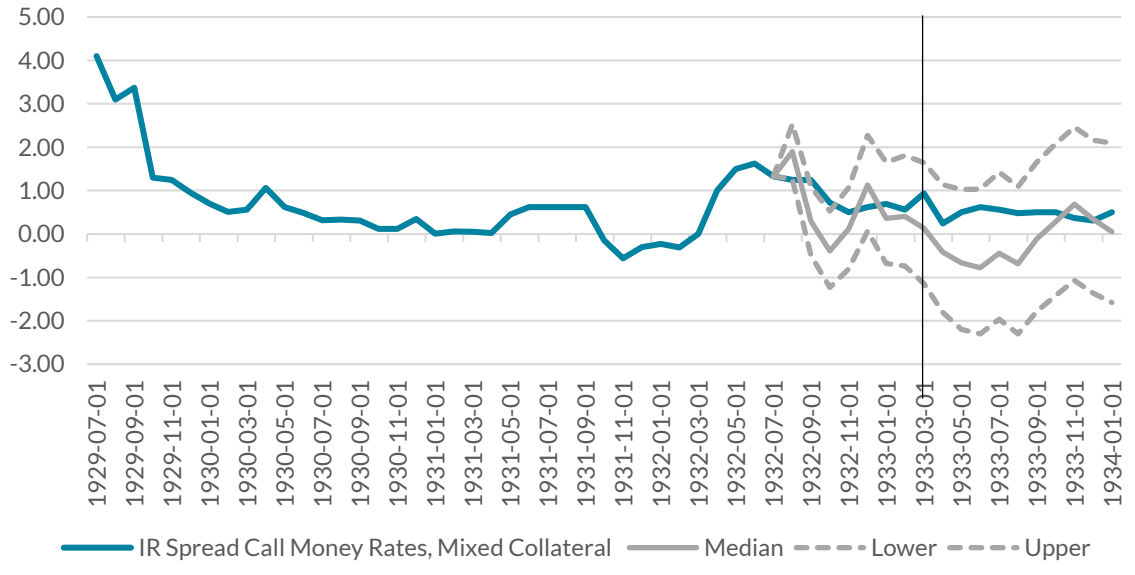
The blue line depicts the historical values. The solid grey line is the median forecast value for each variable, and the dotted lines are the confidence intervals, which describe the 68% credible set of the forecasting density.

Figure 3e: Conditional Forecasts for factory real wage growth



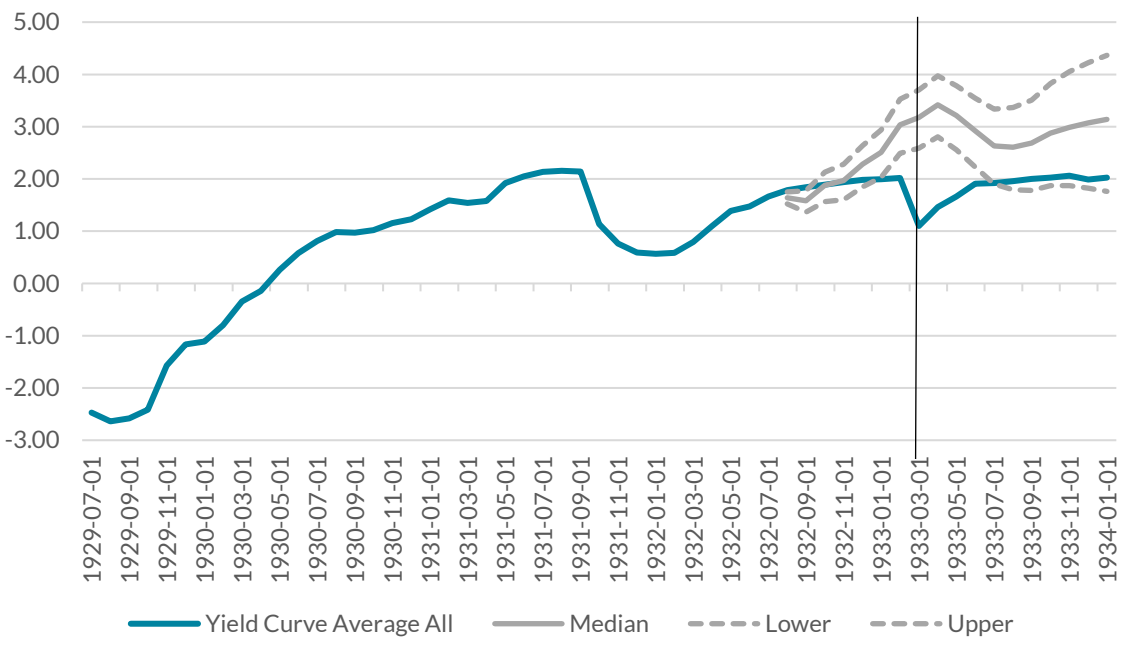
The blue line depicts the historical values. The solid grey line is the median forecast value for each variable, and the dotted lines are the confidence intervals, which describe the 68% credible set of the forecasting density.

Figure 3f: Conditional forecasts for risk premium (spread between collateralized and uncollateralized rates)



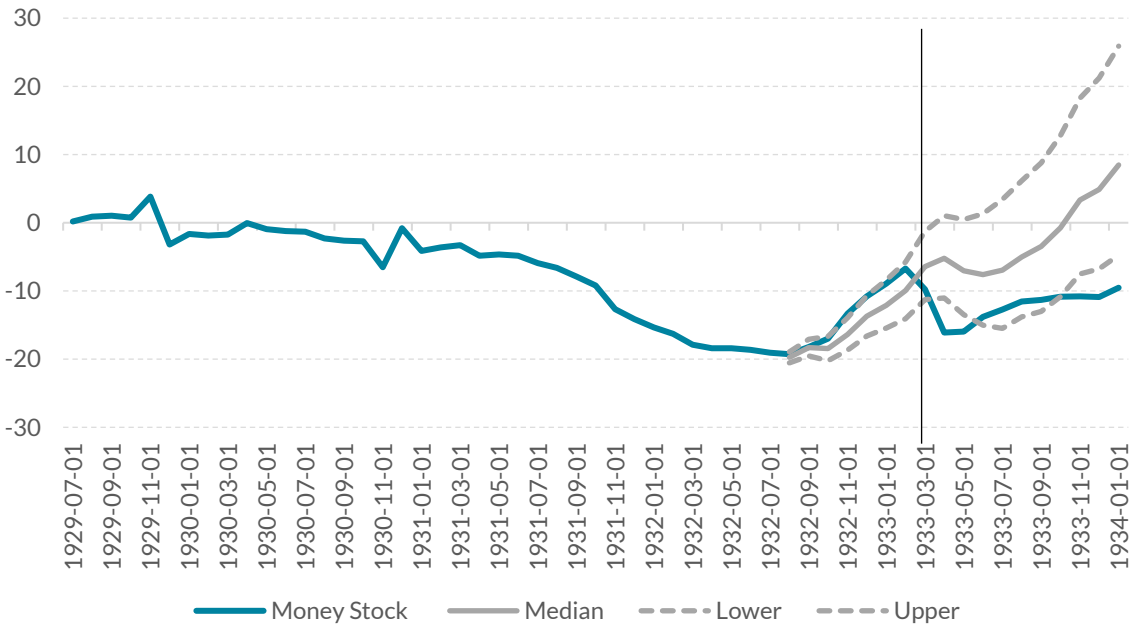
The blue line depicts the historical values. The solid grey line is the median forecast value for each variable, and the dotted lines are the confidence intervals, which describe the 68% credible set of the forecasting density.

Figure 3g: Conditional forecasts for yield spread (10y interest rate-3m interest rate)



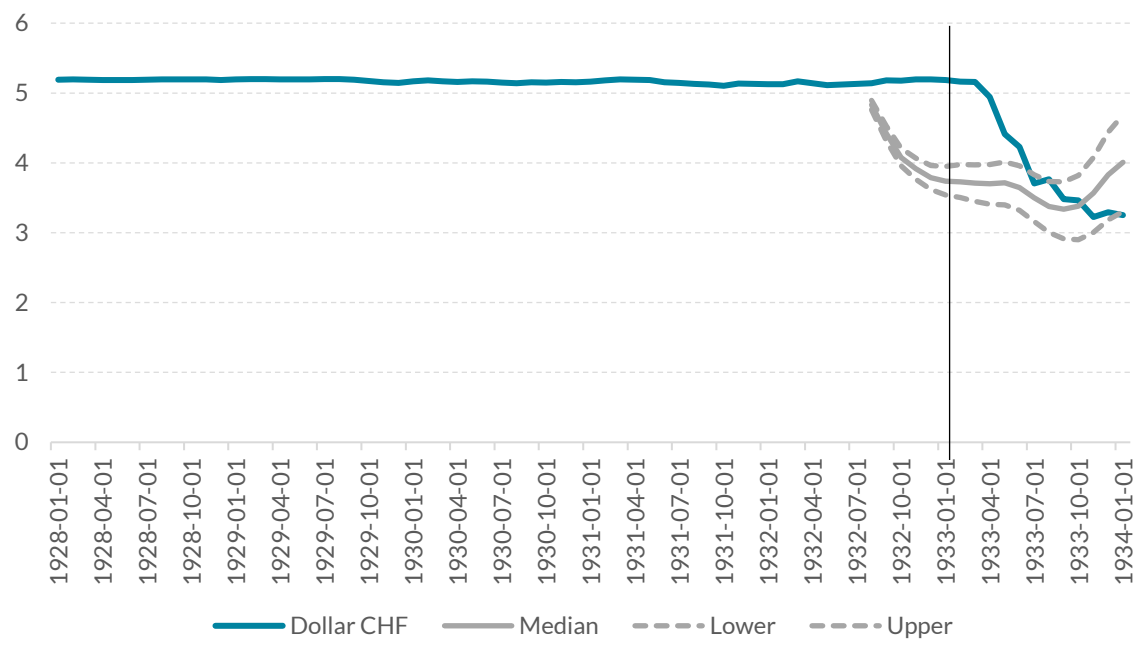
The blue line depicts the historical values. The solid grey line is the median forecast value for each variable, and the dotted lines are the confidence intervals, which describe the 68% credible set of the forecasting density.

Figure 3h: Conditional forecasts for money stock



The blue line depicts the historical values. The solid grey line is the median forecast value for each variable, and the dotted lines are the confidence intervals, which describe the 68% credible set of the forecasting density.

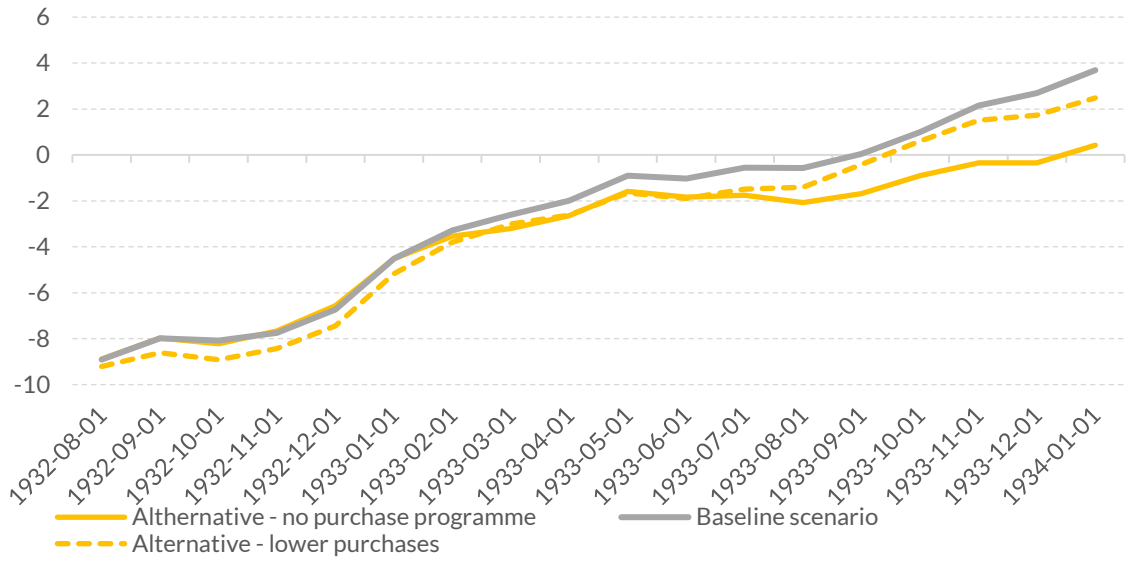
Figure 3i: Conditional forecasts for Dollar-Swiss Franc exchange rate



The blue line depicts the historical values. The solid grey line is the median forecast value for each variable, and the dotted lines are the confidence intervals, which describe the 68% credible set of the forecasting density.

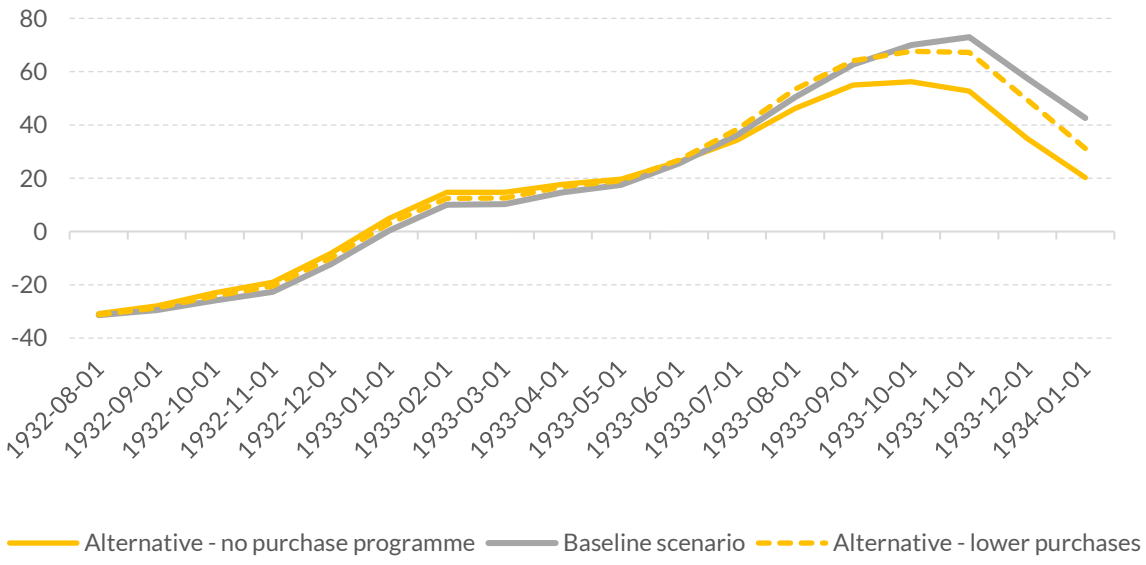
FIGURE 4: CONDITIONAL FORECASTS UNDER BASELINE AND ALTERNATIVE SCENARIOS

Figure 4a: Conditional Forecasts for consumer price inflation – interest rate cut only



The grey line depicts the baseline scenario in which there is both an interest rate cut and an asset purchase programme. The dashed yellow line depicts the alternative scenario in which asset purchases are lower, and the solid yellow line depicts the alternative scenario with no purchases.

Figure 4b: Conditional forecast for industrial production



The grey line depicts the baseline scenario in which there is both an interest rate cut and an asset purchase programme. The dashed yellow line depicts the alternative scenario in which asset purchases are lower, and the solid yellow line depicts the alternative scenario with no purchases.

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