Are 1920s Economic Fluctuations Driven by Demand or Supply: A Case Study of India Using Forecast Error Variance Decomposition in Vector Autoregressive Model

Lingkai Kong *
Izmir University of Economics, Izmir, Turkey
*Corresponding author

Yunxin Chang
Istanbul Commerce University, Istanbul, Turkey

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Abstract

Forecast error variance decomposition in the vector autoregressive model is used to investigate whether the supply shock or the demand shock was the primary factor that drove changes in the global economy throughout the 1920s. It is found that supply shocks are the primary factor in determining how much cotton fabric is produced in India, whereas changes in the cost of living for people are mostly the result of demand shocks.

JEL: C53, O53

Keywords: Forecast Error Variance Decomposition, Vector Autoregressive Model, Supply shock

1 Introduction

The instability of the global economy since the year 2022 brings to mind events that took place one hundred years ago: in the same way, geopolitical unrest
increased economic uncertainty and led to the beginning of the Great Depression in 1929. It is not unheard of to examine the financial crisis that occurred in the 1920s, but it is difficult for academics to come to an agreement about the influence of the supply side and the demand side on the economy. This is particularly true when considering individual nations and the various phases of historical growth, industrial product, and division of labor. In this study, we utilize the vector autoregressive model (VAR) model to investigate whether the supply shock or the demand shock was the primary factor that drove changes in the global economy throughout the 1920s. We utilize the monthly data from India from January 1925 until December 1934, a total of ten years, to study India's principal industrial product, which is type of fabric, as well as the changes in the cost of living of inhabitants of Bombay, referring to as the CPI roughly. We have found that supply shocks are the primary factor in determining how much cotton fabric is produced in India, whereas changes in the cost of living for people are mostly the result of demand shocks. In the long term, the output forecast error variation may be virtually entirely explained by the supply shock. Despite the fact that the demand shock accounts for the majority of the price error variation.

Matlab is used to build the complete estimate procedure, and we evaluate the research that was done by other academics in the past on VAR estimation and dynamic impacts analysis concerning aggregate demand and supply. We explain the dynamic picture of the economic variations that were occurring in India during that time period by combining the general condition of the global economy and politics during the 1920s with India's one-of-a-kind socioeconomic history. This paper is comprised of the following components in addition to the introduction: Part 2 is the literature review, which includes a discussion of the pertinent theoretical research and historical context; Part 3 is the methodology; Part 4 is the data description and graphs, along with a visual analysis of the impulse response results and a deconstruction of the forecast error variance; and Part 5 is where we present the conclusion.

2 Literature Review

1929 was the year when the global economy was struck a severe blow by the Great Depression (Bernstein, 1987; Robbins & Weidenbaum, 2017). Eggertsson (2012) proposed the contentious opinion that assisting the economy in some situations might be beneficial, which differs from the perspectives of other researchers who have researched Roosevelt's New Deal. It would be beneficial to find a solution to the argument if we have a more precise knowledge of the primary driving reasons of economic oscillations throughout the 1920s (Franco, 1986; Blümle & Goldschmidt, 2006). Shocks to the supply and demand sides of the economy both contribute to the overall volatility of economic activity. The impact on the supply side is primarily reflected in industrial production and agricultural production (Clingsmith & Williamson, 2008). Factors such as order order volume, raw material cost and transportation cost, and financing cost are all taken into account by businesses as the primary body of the equation. The demand shock is reflected on the consumer
Are 1920s economic fluctuations driven by demand or supply

side (Leduc & Liu, 2016). In the context of uncertain economic prospects, residents tend to reduce spending and increase savings, and the contraction of household consumption results in a negative demand shock (Uxó et al., 2011; Guerrieri & Lorenzoni, 2017), thereby exacerbating market uncertainty and pessimism.

The real economy may experience supply and demand shocks in alternating patterns, or they might become caught in a vicious spiral (Lorenzoni, 2009). Given that China is both an oil importer and an exporter of manufactured goods, Hu et al. (2018) conduct an analysis to determine how the volatility of oil prices affects China's financial market. This volatility represents a supply shock. The authors Gaulier and Vicard (2012) investigate the European current account deficit and demonstrate that demand shocks, not aggregate shocks, are the primary contributor to the problem. Jerger and Michaelis (2003) investigate the effect of two shocks, any of which may have a favorable or unfavorable influence on the earnings of workers. According to the theory put forward by Bashar (2011), it is possible for shocks to have long-lasting impacts on the mechanism of pricing and output interaction even after they have passed.

Researchers before have made use of the VAR model in order to carry out dynamic research on aggregate supply and aggregate demand. Blanchard and Quah (1989) investigate the cyclical nature of both the gross national product and the unemployment rate. They refer to anything as a supply shock if the effect it has on production lasts for an extended period of time; in any other case, they call it a demand shock. They operate on the presumption that there is no link between shifts in supply and demand. Cover et al. (2006) further broaden the theory by investigating the influence on variance decomposition under the circumstance when the correlation between supply and demand shocks is not zero. Dhakal et al. (1993) make use of VAR to investigate the connection that exists between the availability of money and stock prices. In their 2009 study, Biagi and Pulina (2009) investigate the Granger causality of supply and demand in the tourism industry. In order to illustrate how the supply and demand shock affected the economy in the 1920s, we will utilize India as a case study. India has seen significant growth in its cotton sector over the course of the previous century (Morris, 1965). Because of Great Britain, the economy of India was able to become integrated into the economy of the globe before its independence (Saxonhouse & Wright, 2010). Despite this, the labor productivity of the Indian textile sector expanded slowly and faced competition from overseas producers (Roy, 2008). As a result, the economy of India had challenges following the year 1929 (Arthi et al., 2020). The Indian economy is both universal and specialized, which makes it an ideal representative sample for the research that we are doing.

3 The Model

We employ a conventional VAR. We immediately established the model as a known condition, despite the fact that both the setup of the content and the premise of this model are very many and complicated.
Because of this, the variation of $y$ is represented by

$$\Delta y_t = \sum_{j=1}^{p} A_j y_{t-j} + u_t$$

(2)

To express the similarity, the letter $x$ is written as follows: $\Delta x_t = \Xi \Delta c_t + \nu_t$, in another form:

$$x_t - x_{t-1} = \Xi(x_{t-1} - x_{t-2}) + \nu_t$$
$$x_t = x_{t-1} + \Xi x_{t-2} + \Xi x_{t-3} + \nu_t$$
$$= (I_{np} + \Xi) x_{t-1} + \Xi x_{t-2} + \nu_t$$

(3)

We calculate $x_1$ and $x_2...x_t$, and after several stages, we have:

$$x_t = (I_{np} + \Xi + \Xi^2 + ... + \Xi^{n}) \nu_0$$

(4)

where $y_t$ is a 2×1 vector of dependent variables - Industrial Product (IP) output growth and Consumer Price Index (CPI) fluctuations. We can simplify Equation (1) to: $Y = AZ + U$, where $Y$, $A$, $Z$, and $U$ are all considered to be vectors. By vectorizing the above formula, we are able to define ordinary least squares estimation and locate the variance covariance matrix of the OLS estimator of $A$. Matlab treats both the selection matrix $J$ and the definitions of OLS estimation as separate functions in all of its defining documentation. After completing the work necessary for preparation, we use the Blanchard-Quah decomposition (Blanchard & Quah, 1989) and the definitions of supply shock and demand shock that are quite close to one another. After that, we go on to the next step, which is the calculation and plotting of the impulse response, followed by the forecast error variance deconstruction.

Consider a one-step-ahead forecast for the VAR representation of a two variables VAR($p$) model, with 2×2 structural parameter matrices $C_j, j = 0,1,...$, and a forecast horizon of $h: \hat{x}_{t+h} = \Xi x_t$. The observed $x_{t+1} = \Xi x_t + \nu_{t+1}$, and the forecast error is $x_{t+1} - \hat{x}_{t+1} = \nu_{t+1}$. In the case of the VAR($p$) representation, the forecast error is

$$y_{t+1} - \hat{y}_{t+1} = J\nu_{t+1} + u_{t+1} = SE_{t+1} = CE_{t+1}$$

with variance-covariance matrix $E[(y_{t+1} - \hat{y}_{t+1})(y_{t+1} - \hat{y}_{t+1})'] = \Sigma = SS' = C_0 C_0'$. The forecast errors for the two variables are:

$$y_{t+1} - \hat{y}_{t+1} = e_k u_{t+1} = e_k SE_{t+1} = e_k C_0 CE_{t+1}; \ k = 1,2$$

(5)

where $e_1 = (1 \ 0); e_2 = (0 \ 1)$. As for decomposing the forecast error, we get for Variable 1:
Are 1920s economic fluctuations driven by demand or supply

\[ y_{t,1} = \hat{y}_{t,1} + e_{t} \]
\[ = (1,0) \begin{pmatrix} e_{0,1} \\ e_{0,2} \end{pmatrix} + \epsilon_{t} = (1,0) \begin{pmatrix} e_{0,1} \\ e_{0,2} \end{pmatrix} + \begin{pmatrix} e_{2,t} \end{pmatrix} \]
\[ = (1,0) \begin{pmatrix} e_{0,1} + e_{0,2} \epsilon_{t} \\ e_{0,2} \end{pmatrix} \]
\[ = e_{0,1} \epsilon_{t} + e_{0,2} \epsilon_{t} \]

\[ (6) \]

And for Variable 2

\[ y_{2,t+1} = \hat{y}_{2,t+1} + e_{2} \]
\[ = (1,0) \begin{pmatrix} e_{0,1} \\ e_{0,2} \end{pmatrix} + \epsilon_{t} = (1,0) \begin{pmatrix} e_{0,1} \\ e_{0,2} \end{pmatrix} + \begin{pmatrix} e_{2,t} \end{pmatrix} \]
\[ = (1,0) \begin{pmatrix} e_{0,1} + e_{0,2} \epsilon_{t} \\ e_{0,2} \end{pmatrix} \]
\[ = e_{0,1} \epsilon_{t} + e_{0,2} \epsilon_{t} \]

\[ (7) \]

where the first item indicates the amount of shocks on the supply side, while the second comes from the side of shocks themselves. The fluctuating shift in the amount of production is the product of these two shocks working together. The following are the predicted error variances:

\[ E[(y_{1,t+1} - \hat{y}_{1,t+1})^2] = e_{0,1}^2 \]
\[ E[(y_{2,t+1} - \hat{y}_{2,t+1})^2] = e_{0,2}^2 \]
\[ (8) \]

where the first line represents a forecast of the level of production, and the second line is a prediction of the level of prices.

4 The Result

There are two primary factors that contribute to the decision to conduct research in India. First, if we see global economic swings from the point of view of emerging nations or even colonies, we may arrive at different conclusions than those reached by conventional Western economists. Second: while India was not an industrial nation at the time, it was extensively connected into the world's industrial system via its colonial home country Britain (Brockway, 1980), and India has established the cotton and linen industries with their respective centers located in Bombay and Kolkata (Infant, 2019).

We choose ten years' worth of monthly data, beginning in January 1925 and ending in December 1934, for the following categories: Cotton Fabric and Cotton Yarn, with 1000t serving as the unit of measurement for each; and Cost of Living in Bombay, serving as an approximation for the CPI, using the level reached in 1914 as the benchmark 100. Due to the fact that India is able to produce cotton goods (Roy, 1996), we consider cotton fabric to be the final industrial product (IP) and cotton yarn to be the main industrial product in our study. The chart that follows illustrates how these three things have changed throughout time.
Price index (CPI): Cost of Living in Bombay

Industrial Production:
- Final Industrial Production (IP)
- Primary Industrial Production (IP0)

Cotton Fabric (1000t)
Cotton Yarn (1000t)

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<th>Table 1. Main Concept and Unit Explanation</th>
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Figure 1. Main Industrial Production and CPI in India, from 1925 to 1935

We can observe that about a year before the beginning of the Great Depression in the United States, India's production of cotton fabric and cotton yarn started to go downhill. This, to some part, pointed to the impending monetary catastrophe that was to come. Data from India's cotton sector reveals that the world's supply of cotton for spinning is inadequate at that time, despite the fact that the stock market in the United States is still thriving at that point. In addition to this, it is possible that the Indian National Congress's promotion of an independent political movement is having an effect (Trivedi, 2003). In 1928, the emergence of its radical branch, the Indian Independence League headed by Jawaharlal Nehru, also strengthened the walkout of Indian workers (Chandavarkar, 2011). After 1929, however, both the production of cotton fabric and yarn saw fluctuations and increases (Brandis, 1951). It is probable that the production of cotton in India is not totally dependent on the market economy but rather on the colonial policy and managerial intensity of Great Britain. This is only one of the explanations for this phenomenon. In going through a period of economic expansion and inflation in the 1920s, we can see that after 1929, India's consumer price index dropped drastically, and by 1933 it had reached levels that were comparable to those in 1914. We are going to investigate the factors that led to India's CPI falling after 1929. Either a
Are 1920s economic fluctuations driven by demand or supply

rise in the production of industrial items will cause this, or a decrease in the demand from other countries would do this. Both scenarios are possible. Next, in order to investigate the primary factors that contribute to changes in CPI, we will demonstrate the magnitude of the impact and the forecast error variance for the two shocks.

![Scaled Trend of Yarn and Fabric Production](image)

**Figure 2. Scaled Trend of Yarn and Fabric Production**

Following the completion of the calculation of the average of IP and the average of IP0, we get the scaled value of each variable by dividing it by its respective average, after which we display the results. We observe that their tendencies are rather comparable to one another. The ttest2 is then used to determine whether or not the IP and IP0 are statistically distinct from one another. In Matlab, we use the following formula: \([H,P,CI] = \text{ttest2} (\text{scaled IP}, \text{scaled IP0})\), where the \(H\) represents whether or not the null hypothesis can be rejected with a degree of confidence of 5%. If the answer to \(H\) is zero, then we can not argue that we can reject the hypothesis that there is no statistical trend difference between scaled IP and IP0. This is because the hypothesis states that there is no difference. If the answer to \(H\)'s question is 1, then the inverse is true. The value of \(H\) that we get as a consequence is zero, and the confidence interval is \((-0.045750,0.045750)\). We are unable to conclude that the hypothesis that scaled IP and IP0 do not vary in terms of their statistical trend should be rejected. Therefore, in the next study of impulse response and FEVD, we simply use IP to replace the IP0. We are able to simplify the model by reducing it to just consist of two variables: IP and CPI.

The term "supply shock" may be defined as the development of new fabric technology or the increased capacity of social organizations. The term "demand shock" refers to the simultaneous increase in demand in local and international markets, as well as the pressure placed on the British Empire to continue its control over India. Our research shows that supply shocks have a more significant effect on production, and this effect will be both long-lasting and irreversible. The effect of demand shocks on production is often negative in the beginning. The influence was no longer noticeable after many quarters' worth of swings. And the detrimental effect was just a negligible 2.5% in the first several months. When compared to the shock to the supply, the beneficial effect is rather minor.
Figure 3. Impulse Responses of Price and Output

Demand shocks are a far more significant factor in the influence that they have on the price index. After about five months, the reaction rate of the price index reaches its highest point, where it remains for an extended period of time. The impact of supply shocks has gradually stabilized at a relatively low level after experiencing severe fluctuations in the early stage, and its effect is so minimal that it can even be considered as zero. After going through these extreme fluctuations, the impact of supply shocks has gradually settled at a relatively low level.

In order to conduct an analysis of forecast error variance decomposition (FEVD), we decide that a maximum prediction time of 30 periods would be appropriate. The 0-30 range on the horizontal axis reflects the impact that supply and demand shocks have made to the variance of prediction inaccuracy over the next 0-30 periods. It seems that supply shocks are responsible for the majority of the variation in production prediction inaccuracy during the near run. This figure continues to rise to about one hundred percent in the medium and long future, which demonstrates the predominance of supply shocks in production projections. The contribution of supply shocks accounts for around 15% at the beginning of the medium and short term (0-10 period ahead) price projections, but this number progressively settles down to 10% during the course of the forecast. Demand shocks are responsible for
Are 1920s economic fluctuations driven by demand or supply

A certain percentage of the forecasted volatility in short-term production, which comes in at about 8%. It demonstrates that there will be an effect that demand will have on the production of industrial items in the near future. On the other hand, the influence of demand shocks is nullified when a greater number of prediction periods are included. In terms of the price index, the percentage of short-term demand shocks is subject to a degree of volatility; nevertheless, after ten periods, the value tends to progressively settle at 90%.

Figure 4. Forecast Error Variance Decomposition

In the 1920s, we think that supply shocks were primarily responsible for the changes in the Indian economy that were measured in terms of industrial production. This is based on our study of the relative significance of demand and supply shocks. Not only is the size of the effect of supply shocks bigger, but it also occupies a higher percentage in forecasting the future. This is because supply shocks are more likely to occur. Demand shocks are the primary factor that contribute to price changes. The amount of the effect that supply shocks have is negligible in comparison to the impact that demand shocks have, demand shocks are responsible for a significant percentage of the price variations that occur.
5 Conclusion

When it comes to doing an analysis of the current state of the economy in a nation that has a distinct economic structure, the Forecast Error Variance Decomposition model is very useful. The FEVD model performs an indicative and antecedent function in the study of the susceptibility of the country's economy based on the price changes of its primary economic outputs. This role is important since the FEVD model can be used to determine how vulnerable the economy is. In this research, India is used as an example to investigate the primary factors that drove production changes as well as price fluctuations throughout the 1920s. Supply shocks are primarily responsible for driving fluctuations in the prices of industrial items, whereas demand shocks play a more significant role in describing how the CPI in India changed. The collapse in production from 1929 to 1930 was mostly attributable to supply shocks, whereas the fall in price was primarily attributable to a weakening of demand (as a result of the financial crisis, persons who lost savings experienced a reduction in their ability to make purchases and the probably worker strikes or lower factory operating rates). The analysis is still applicable to the current worldwide political and economic crises, which is taking place at a time when the population's confidence and desire to spend are vitally crucial for the economy to remain stable.

References


Are 1920s economic fluctuations driven by demand or supply


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