

# ECONOMIC STATES ON NEURONIC MAPS

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## *Object*

We test the idea of visualizing economic statistics data on self-organization related maps, which are the LLE, ISOMAP and GTM maps. We report initial results of this work. These three maps all have distinguished theoretical foundations. The statistic data usually span high-dimensional space, sometimes more than 10 dimensions. To perceive these data as a whole and to foresee future trends, perspective visualization

assistance is an important issue. We use economic statistics for the United States over the past 26 years (1977 to Oct.2002) and apply them on the maps. The results from these three maps display historic events along with their trends and significance.

## *Method*

We used economic data for the United States over the

past 26 years (1977 to Oct. 2002) in all our simulations, which included eleven statistics: the averaged gross national product (GNP), consumer price index (CPI) growth rate, unemployment rate, foreign currency reserve, foreign exchange rate, prime rate, export growth rate, import growth rate, economic growth rate, balance of international payments and money supply growth rate.

Some of these data were in the percentage format, and some of them were in the numerical format spread over various large ranges. We normalized each range so that each statistic made an equal contribution. Three processing steps, as listed below, were used to construct 2-D maps of the economic data:

1. Normalize each statistic data range to 1.
2. Feed these normalized data into the dimensionality reduction algorithms LLE, ISOMAP and GTM.
3. Retrieve 2-D results and plot them on the plane.

## *Data Source*

We list web sites of which our data come from.

Prime Rate:

Updated to OCT. 2002.

<http://www.neatideas.com/prime.htm>

<http://www.moea.gov.tw/~mecostat/four/a-15.htm>

Unemployment Rate:

Updated to OCT. 2002.

<http://www.bls.gov/>

Percent changes in Consumer Price Index:

Updated to OCT. 2002.

<http://www.moea.gov.tw/~mecostat/four/a-14.htm>

<http://www.bls.gov/news.release/cpi.toc.htm>

Money Supply Growth Rate:

Updated to OCT. 2002.

<http://www.federalreserve.gov/releases/h6/hist/h6hist1.txt>

Foreign Currency Reserve:

Updated to SEP. 2002.

<http://www.moea.gov.tw/~mecostat/four/a-19.htm>

Exchange Rate:

Singapore/US. , Updated to OCT. 2002.

<http://research.stlouisfed.org/fred2/data/EXSIUS.txt>

Import Growth Rate:

Updated to OCT. 2002.

<http://www.moea.gov.tw/~mecostat/four/a-8.htm>

Export Growth Rate:

Updated to OCT. 2002.

<http://www.moea.gov.tw/~mecostat/four/a-7.htm>

Economic Growth Rate:

Updated to OCT. 2002.

<http://www.moea.gov.tw/~mecostat/four/a-1.htm>

Gross National Product:

Use predicted value from Market Vector. Company.

<http://www.bea.gov/bea/newsrel/gdpnewsrelease.htm>  
<http://www.marketvector.com/leading-indicator/gnp.htm>

Balance of International Payments:  
Updated to Second Quarter 2002.  
<http://www.bea.doc.gov/bea/newsrel/transnewsrelease.htm>

## ***Important Events***

We list important events in past 25 years. These events may be the turning points shown in our result figures.

| <b>Date</b>      | <b>Event</b>                       |
|------------------|------------------------------------|
| <b>1978~1982</b> | <b>Second Oil Crisis</b>           |
| <b>1987.10</b>   | <b>New York Stock Crash</b>        |
| <b>1990.8</b>    | <b>Gulf War</b>                    |
| <b>1994~1995</b> | <b>High Inflation Exceeds 3.5%</b> |
| <b>1997.12</b>   | <b>Asian Economic Storm</b>        |
| <b>2001</b>      | <b>Economic deterioration</b>      |
| <b>2002.9</b>    | <b>West Coast Port Closed</b>      |

Table. 1: Important events in the US during the past 25 years.

## ***Comparison***

We summarize significant features on the maps. Comparing the results shown in Figs.1,2, and 3, we find historic events and list them in Table 1. We point out several indications on the maps. All events are more or less emphasized on the maps. When economic conditions deteriorate, the states in the figure sway outward from the cluster center to the edges or make a large jump, such as for the 1982 Second Oil Crisis indicated in Fig. 2, the 1987 New York Stock Market Crash indicated in Figs. 1, and the 2001 economic deterioration indicated in Figs. 1, 2 and 3. We observe that the years close to the cluster center have very stable economic states, and that the years on the edges or corners have bad economic states. The years that move toward the cluster centers show how effective the economic policies were. By means of these maps, we

can perceive economic states and foresee their trends.

In Fig.1, the years from 1978 to 1982, swaying near the edges, reflect the Second Oil Crisis. Tracing the dots to 1986, we see that they lead to a big jump to 1987, reflecting the October 1987 New York Stock Market Crash. In the next year (1988), in the same figure, the dots approach the edge and return in 1989. Years smoothly approach the cluster center during 1990-1993 but move toward outside the cluster center during 1994-1995. The years 1994-1995 have heavy inflation. From 1998 to 2001, the dots sway near the edge and have big jumps, indicating economic deterioration. Oct. 2002 still makes big jump and falls on the edge but reveals moving toward cluster center.

The Isomap reveals many significant economic features as described above. We next show how LLE works. In Fig.2, the dots for the years 1977 to 1982 approach the edge, reflecting the Second Oil Crisis.

From 1987 to 1988, the dots jump to the edge, reflecting the New York Stock Market Crash. The dots return for 1989, and stay in the center until 1994, which was the year high inflation. Following on to 1997-2001, the dots drop to outside of the cluster center, showing unstable economic situation. Oct. 2002 still makes big jump.

In Fig.3, the dot for 1981 at the upper-right jumps to the upper-left in 1982, indicating Second Oil Crisis. The dot of 1986 makes a big jump to 1987 a bottom right, indicating a dangerous situation, the New York Stock Market crash in October 1987. We may presume that big jumps in GTM mean dangerous situations. The dot of 1997 jumps to 1998 reflecting Asian Economic Storm. From 2000 to 2001, there is a big jump, corresponding to economic deterioration in 2001. Indeed, the Nasdaq index dropped to a low level in 2001. Oct. 2002 stays at the edge revealing unstable situation.

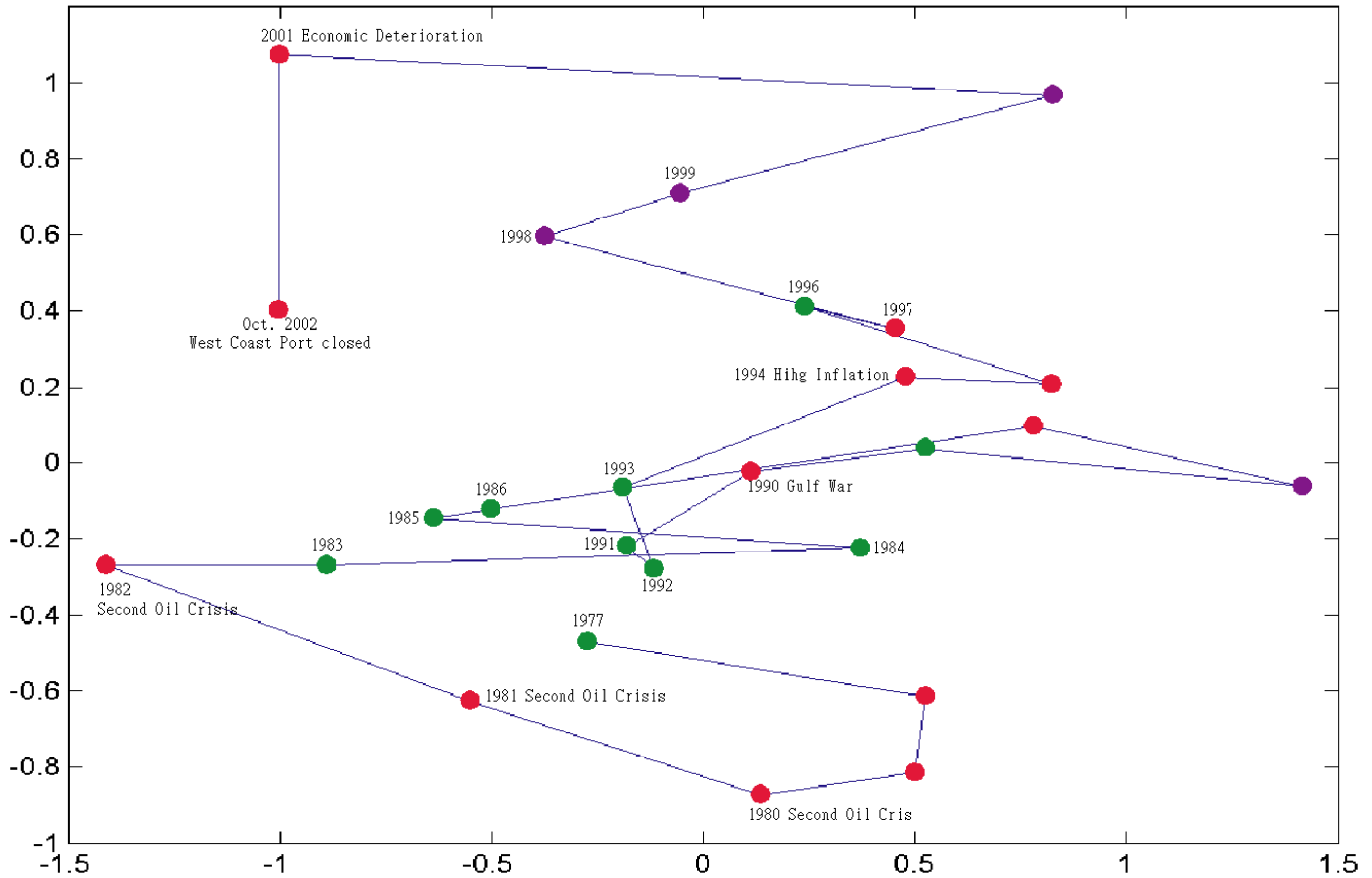


Fig. 2: U.S. economic statistic embedded from 11-D to 2-D using Isomap method. The neighborhood factor is set to 25. Red dots are years with important events. Green dots are years in the cluster center. Purple dots are years that fall to the edge.

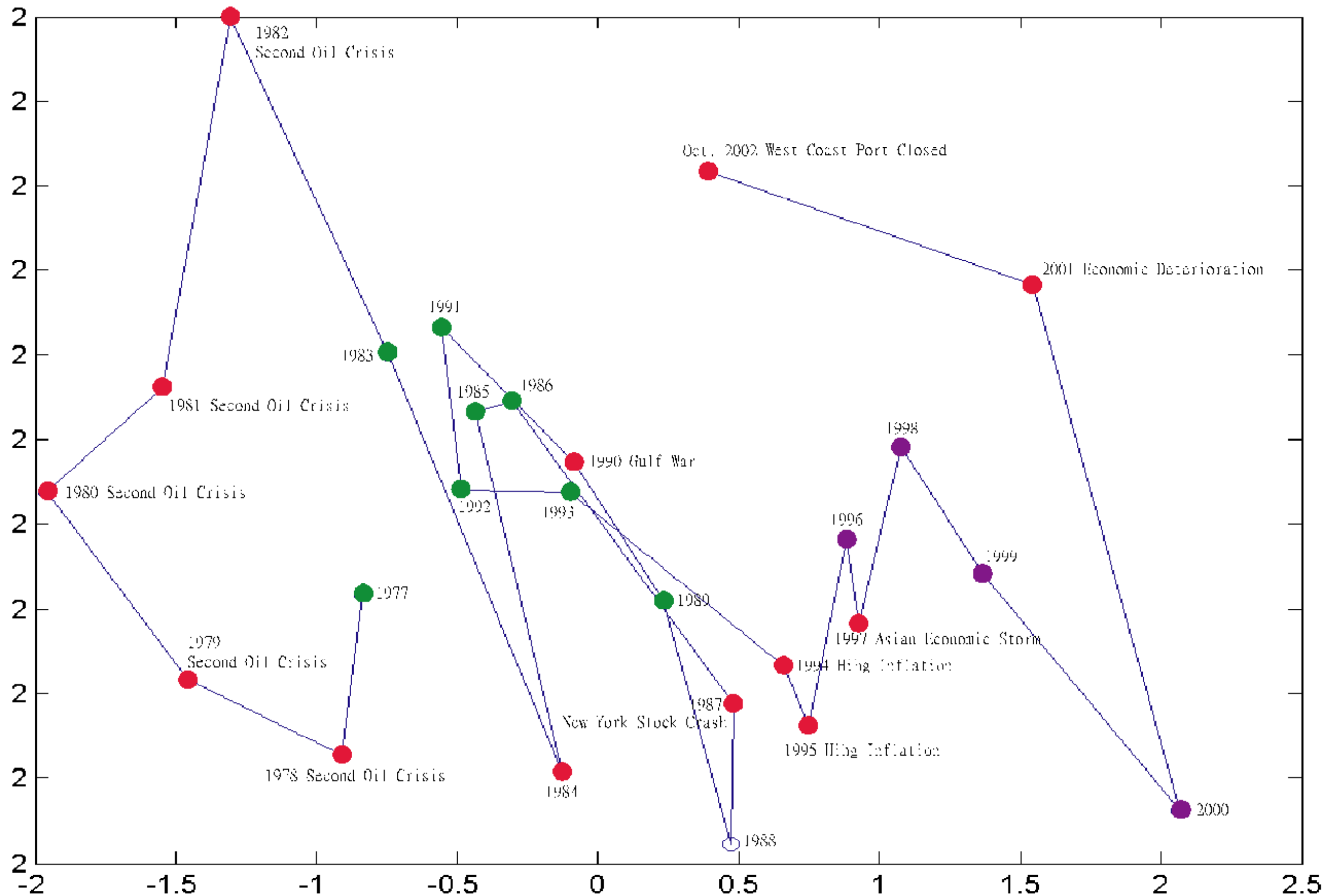


Fig. 3: U.S. Economic statistic embedded from 11-D to 2-D using LLE. The neighborhood factor is set to 10. Red dots are years with important events. Green dots are years in the cluster center. Purple dots are years that fall to the edge.

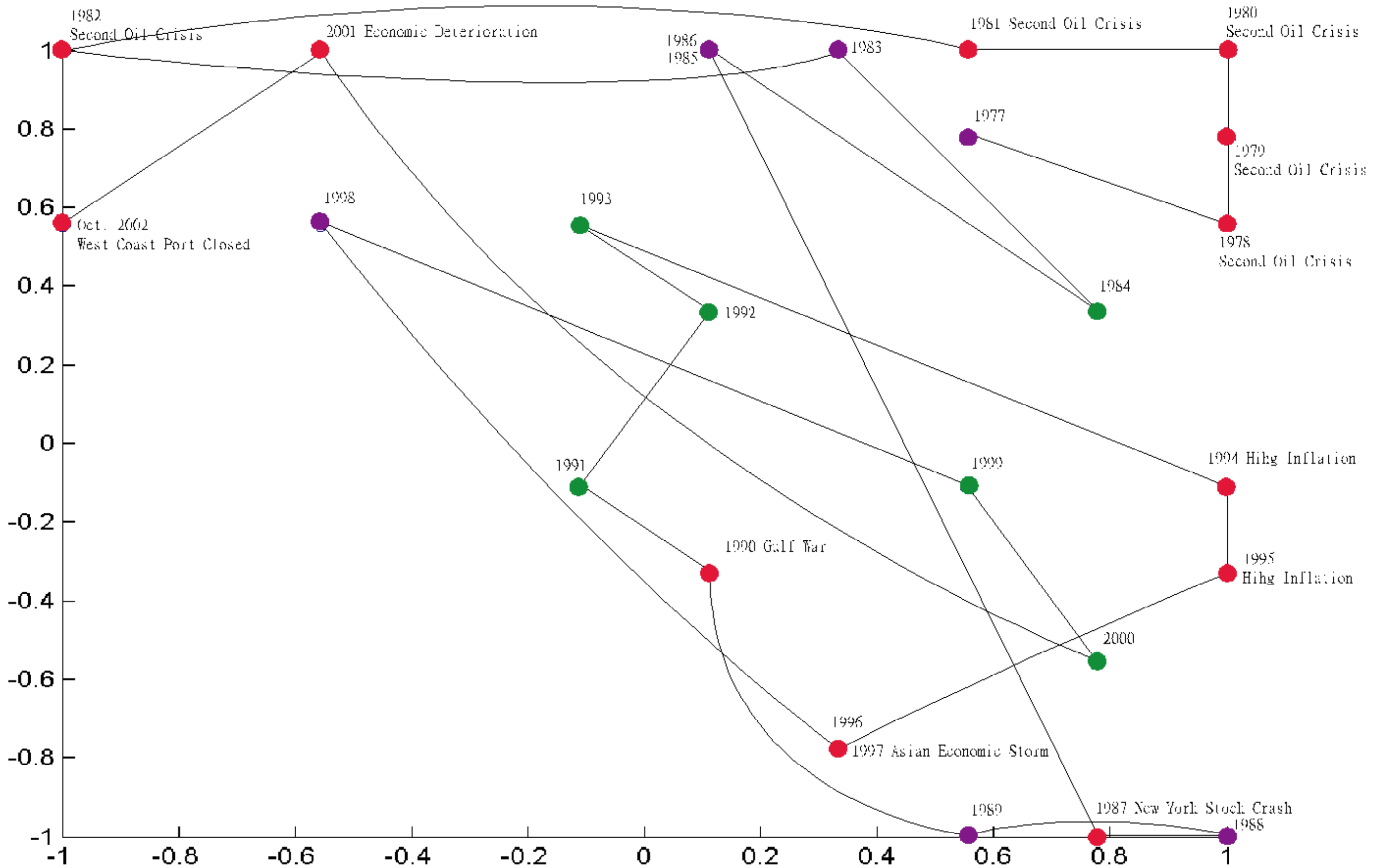


Fig. 4: U.S. Economic statistic embedded from 11-D to 2-D using GTM. The number of latent variable is set to 100. The number of basis function is set to 36 and the width of basis function is set to 4. Red dots are years with important events. Green dots are years in the cluster center. Purple dots are years that fall to the edge.