# 1 Parallel Visual Explorer at work in the money markets

This demo was designed to show some of the core capabilities of Parallel Visual Explorer(PVE), and to illustrate how it would be used by a financial researcher. The content is real financial data taken from the global money markets, but it can just as easily be medical research results, marketing data or information from a wide range of research disciplines. To initiate the demo program at the shell prompt enter "**demopve**". This invokes the demo program. The message, "**Please wait - initializing ...**" appears on the screen. Then the PVE display and the Version dialog box appears. To remove the Version dialog box, click the left mouse button on "**OK**".

Figure 1 shows the parallel coordinate display of the money market data. This data is collected every Monday – from the last Monday in 1985 through the first Monday of May 1993. Variables (or columns) are represented on parallel axes. Each variable is scaled using its respective minimum and maximum value obtained over the eight-year period. The data values for the currencies are measured as US $/unit currency (i.e. US $/Yen etc.). The variables are WEEK, MNTH (1-January, 12-December), YEAR, BPS (British Pound Sterling), GDM (Deutsche Mark), YEN, TB3M (3 Month Treasury Bill Yields), TB30Y (30 Year Treasury Bill Yields), GOLD ($/ounce) and SP500 (Standard and Poors index).

To examine how a data point (row) is represented in parallel coordinates, do the following:

1. Click the left mouse button on the "**Select**" option button to the right of "**Pointer Setting**" in the Creation mode option box. A pop-up menu appears.

2. Click the left mouse button on "**Set Range**" and then position the mouse cursor on the "**TB30Y**" axis a little above the highest point of intersection on the axis with the data points. Press the left mouse button and while holding on to it drag the mouse donwards to select the data point at the highest point on the "**TB30Y**" axis. On releasing the left mouse button, your display should look similar to Figure 2.

Data values are measured on the respective axis and are joined by a polygonal line. The polygonal line in yellow shows the data point for the third Monday of October 1987. Note the gap between the top two data values on "**TB30Y**". This was the week when the stock market crashed and the Treasury Bill jumped abruptly when money shifted from stocks to bonds!

Let's clear the current query and then define a couple of queries for looking at the data points for two different years.

1. First click the left mouse button on the "**Query**" item on the menu bar. From the pull-down menu that appears, click on "**Clear visible queries**". The display is refreshed so that all the data points are colored in black. The definition for query "**q1**" is cleared.

2. Choose "**Set range**" under "**Pointer setting**" and then press the left mouse button a little above the second cluster of data points on the "**YEAR**" axis from the bottom of the display and drag it to include the the cluster. On releasing the left mouse button, you should see all the data points for year 1986 colored in yellow on the parallel coordinate display.

3. Next, click the left mouse button on "**Show one**" in the "**Summary**" group box and from the pop-up menu that appears choose "**Show many**".

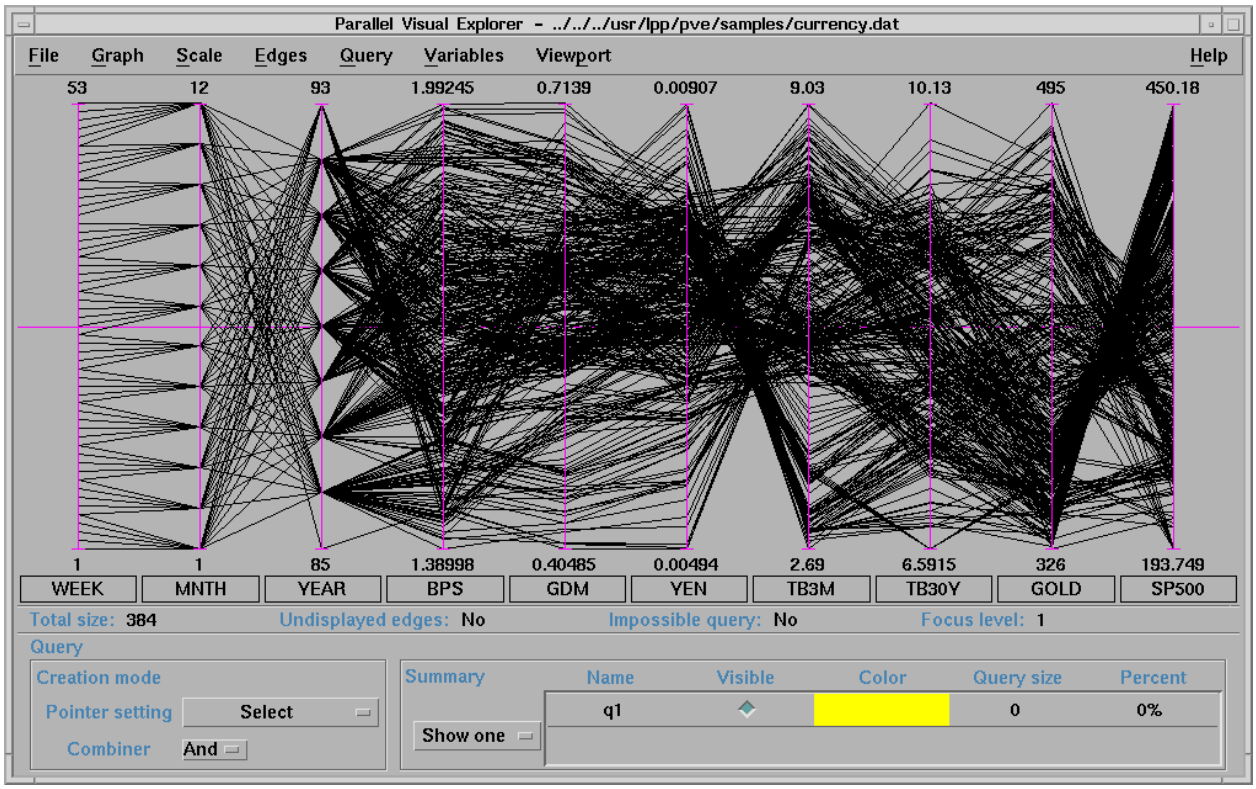


Figure 1: Data collected from the New York currency markets from 1985 to 1993.

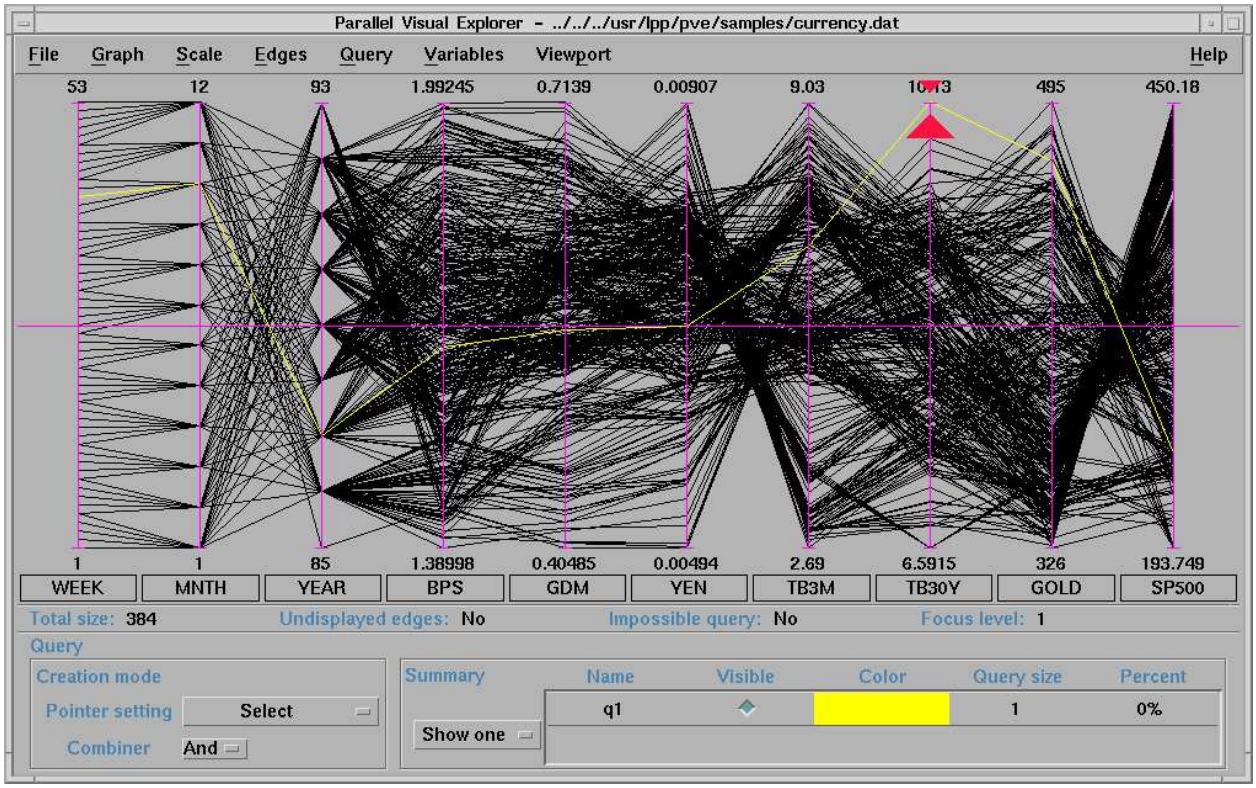


Figure 2: A data point (row of data) is represented as a polygonal line, in yellow.

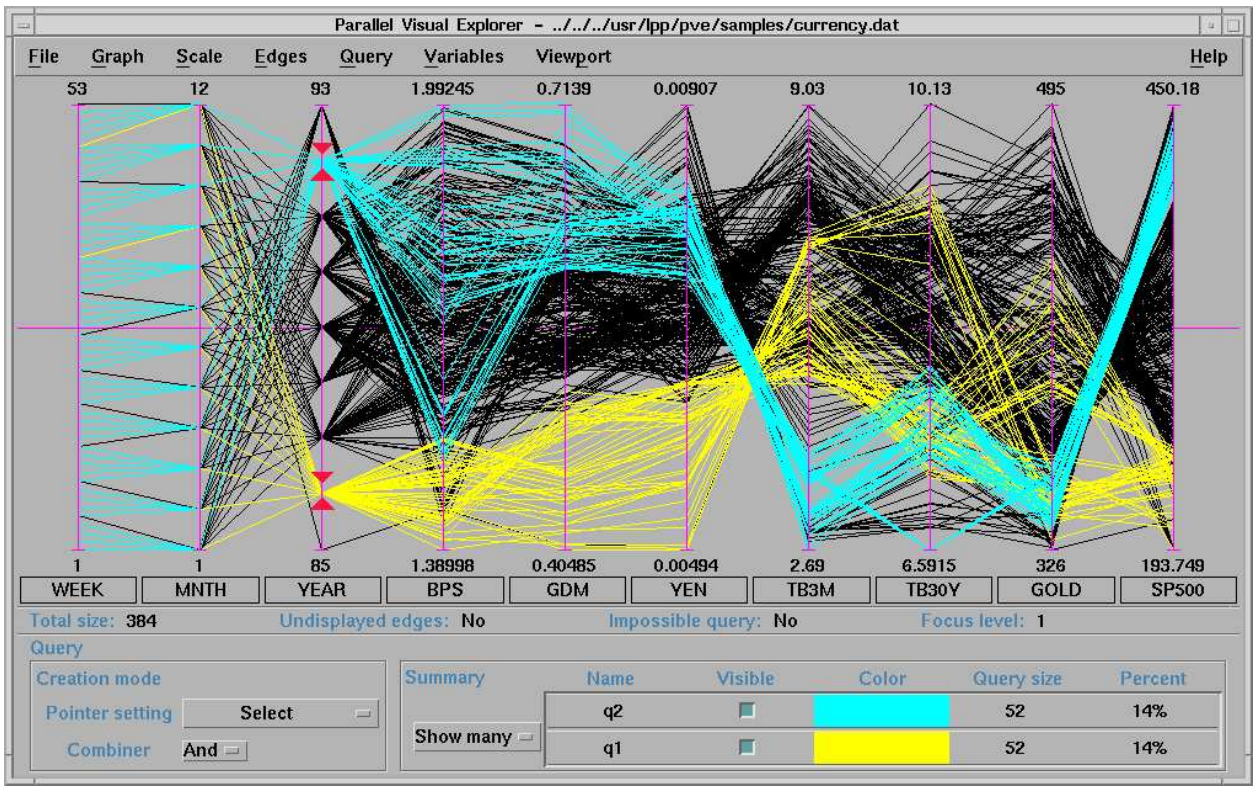


Figure 3: Contrast of two different years.

4. Click the left mouse button on "**Query**" on the menu bar and from the pull-down menu that appears select "**Add new query**". Choose "Set range" under "Pointer setting" and then select the second cluster of data points on the "YEAR" axis from the top of the display. On releasing the left mouse button, you should see the data points for year 1992 colored in blue on the parallel coordinte display. The display should now look similar to Figure 3.

In Figure 3 1986 data points are displayed in yellow, whereas the 1992 data points are displayed in blue. In 1986 the Yen was the most volatile currency among the three; the stocks were low; the bonds were medium; and there was a *gap* in the gold prices. In 1992 the BPS was the most volatile currency, the bonds and gold were low, and stocks were high.

To investigate the data points for only 1986 (Figure 4):

1. Click the left mouse button on the "**Visible**" button (in the "**Summary**" group box) to the right of query "**q2**". Now only query "**q1**" should be displayed in yellow.

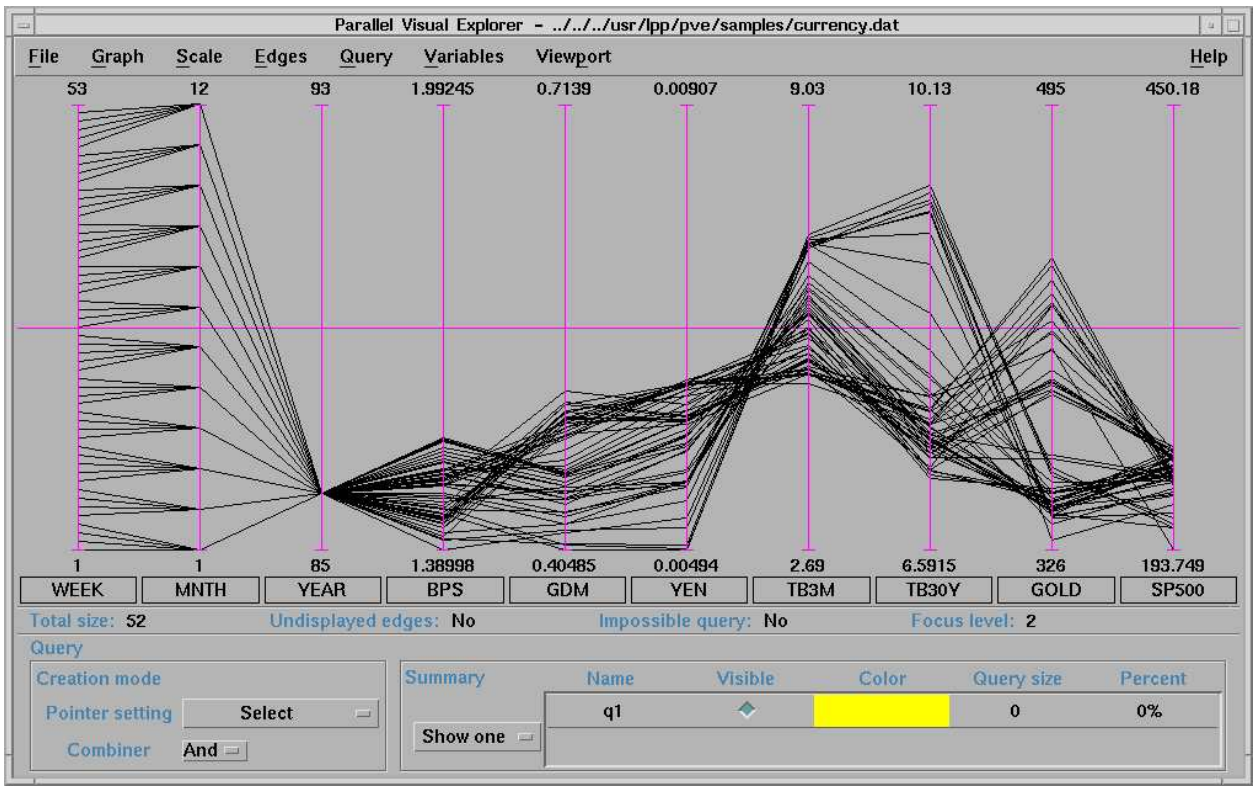


Figure 4: Isolating the 1986 data points to investigate the gap on gold.

2. Click the left mouse button on "**Graph**" in the menu bar and then choose "**Focus**" from the pull-down menu. This isolates the 1986 data points and only displays them on the parallel coordinate window. The *gap* on Gold prices can now be seen clearly.

Let's look at the first five weeks of 1986 to see the prices for the different financial instruments. Choose "**Set range**" under "**Pointer setting**" and then press and drag the left mouse button so as to include the lowest five data points on the "**WEEK**" axis. The display should like Figure 5:

We can see that the currencies, gold and stocks started off low in 1986, whereas the bonds were high. To get a feel for how the market changed with time do the following:

1. First, make sure that the "**Pointer setting**" is on "**Select**". Next, press the left mouse button a little above and to the left of the upper arrow on the "**WEEK**" axis and then drag it down to the left so as to enclose both the arrows in the dashed rubber-band rectangle. You'll see both the arrows are now drawn bigger.

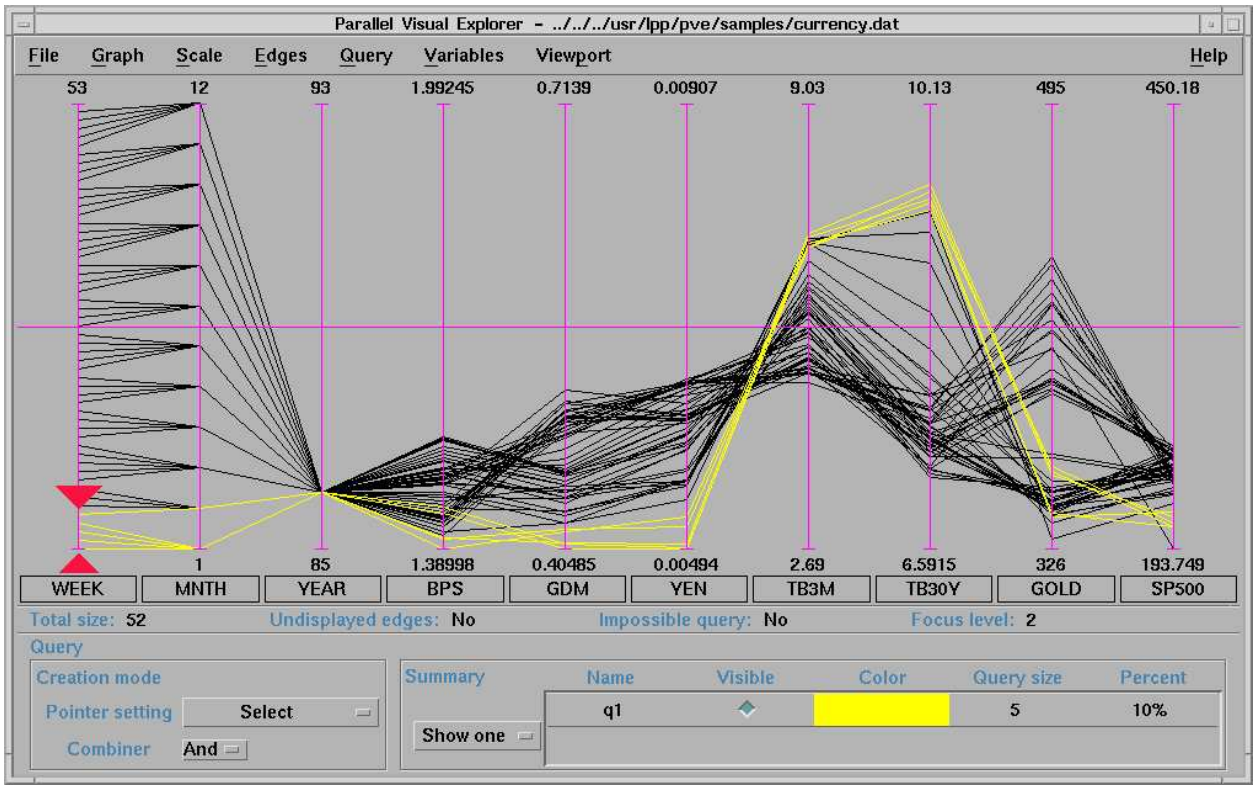


Figure 5: The first five weeks of 1986 are selected using a query on "**WEEK**", and are displayed in yellow.

2. Press the middle mouse button and then move the mouse upwards. You'll see how the market changes as you walk along time! The long term bond ("**TB30Y**") yields fall sharply and money moves out of that instrument into others such as the currencies and stocks (since all three currencies as well as S&P500 index goes up). Notice that the "**GOLD**" prices don't change very much. As we move the arrows up to include the last 3 weeks of July and then first two weeks of August we see an abrupt jump in the "**GOLD**" prices. Figure 6 shows the jump (about 25$/ounce).

3. You can now investigate the jump by looking at a smaller time frame (say the first 2 weeks of August). To reduce the time frame, first click the left mouse button on the parallel coordinate display to unselect the arrows (the are now drawn smaller). Next press the left mouse button on the lower arrow and drag it up so as to place it just below the intercept of the data point for the first week of August on the "**WEEK**" axis. On releasing the mouse button, you should see only the first two weeks of August drawn in yellow. Note that the currency prices as well the bond yields didn't change much. Only the "**GOLD**" prices and the "**SP500**" index went up. There must have been some other financial instrument that we are not measuring that went down. Speaking to financial experts, we found out that "Oil futures" had slumped during that period!

Having seen some time related patterns, let's look for relationships between the instruments. First, let us observe the relationship between "**GDM**", "**YEN**" and "**GOLD**".

1. Click on "**Unfocus**" under "**Graph**" menu item and then select "**Clear visible queries**" from the "**Query**" menu. This clears the definition of query "**q1**".

2. Choose "**Set range**" from the pop-up menu beside "**Pointer setting**". Press the left mouse button on top of the "**YEN**" axis and drag it downwards so as to include several data points that have parallel lines between "**GDM**" and "**YEN**" axes. As you drag the mouse downwards with the left button pressed, you can see that every time the line connecting "**GDM**" and "**YEN**" changes direction abruptly from upward to downward or vice-versa, there is an abrupt jump in "**GOLD**" price and it then settles down as the lines stay closely parallel. Figure 7 through Figure 10 explain the effect of the relationship between "**GDM**" and "**YEN**" axes on "**GOLD**".

Next, let's look at the relationship between currencies, short term bond and gold.

1. First, clear the query "**q1**" by clicking on "**Clear visible queries**" under the pull-down menu for "**Query**" item.

2. Next, choose "**Set range**" under "**Pointer setting**" and define a range query element on the upper third of the "**YEN**" axis. Adjust the range query element so as to select a narrow range on "**YEN**" and a relatively wider range on "**GDM**" as shown on Figure 11.

3. Click on "**Focus**" under "**Graph**". Jsing the "**Set range**" query element select the data points on top of the "**GDM**" axis. Notice, these polygonal lines pass through the low end of "**TB3M**" (short-term bond yields).

4. Choose "**Add new query**" under the pull-down menu for "**Query**". This adds a new query item "**q1**" to the query list. Select "**Show many**" under the "**Summary**" group box. Next click on the "**Visible**" box for query "**q1**", so that both "**q2**" as well as "**q1**" is visible.

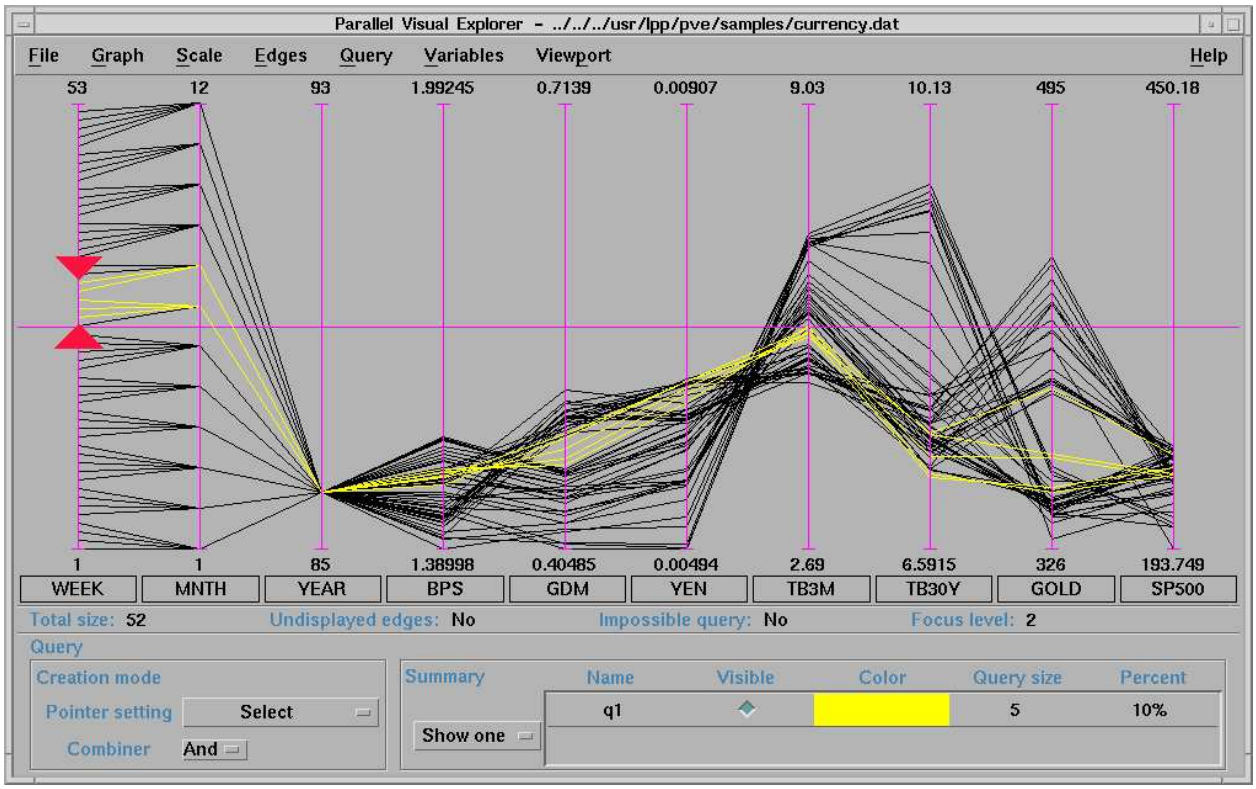


Figure 6: Moving the query upwards on "**WEEK**", the last three Mondays of July and the first two Mondays of August are selected. Notice the jump in "**GOLD**" during this time period.

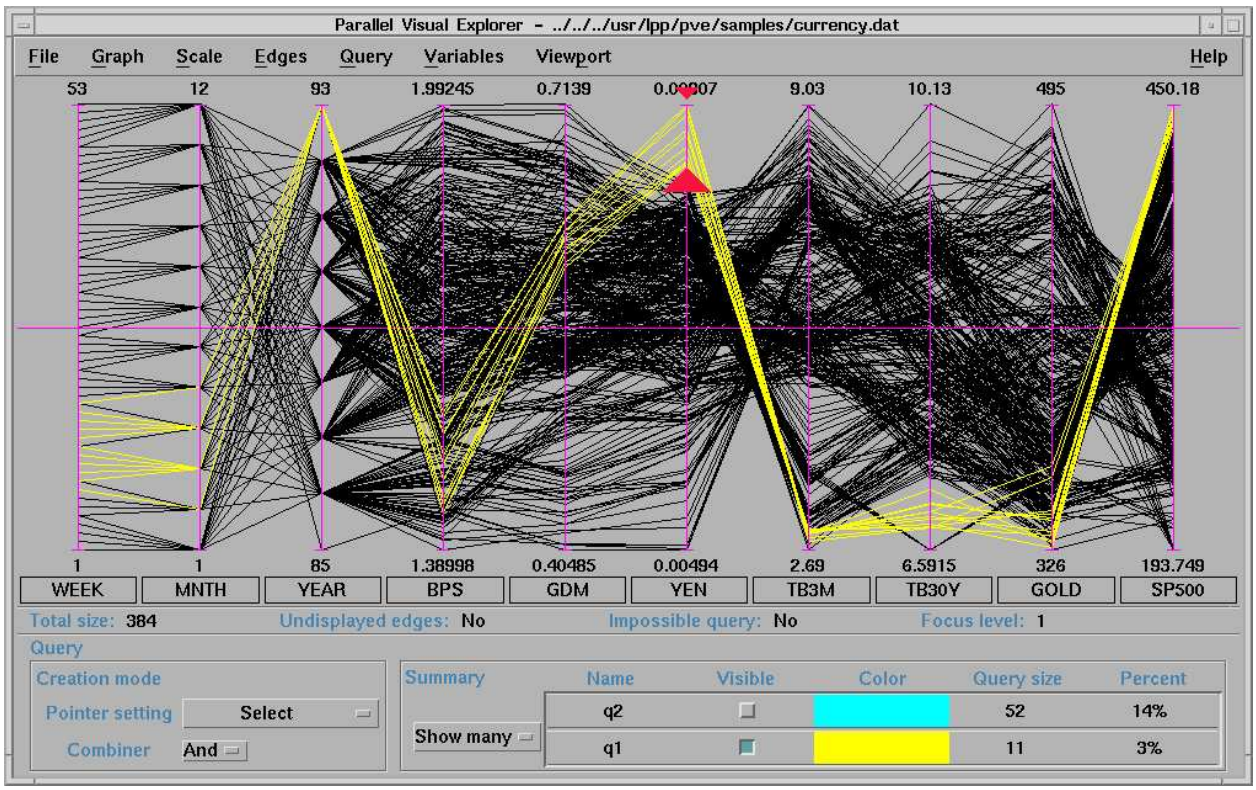


Figure 7: Starting from the high values of "**YEN**", as long as the lines connecting the "**GDM**" and "**YEN**" (drawn in yellow) are closely parallel, the market is stable and there are no sharp changes in other variables.

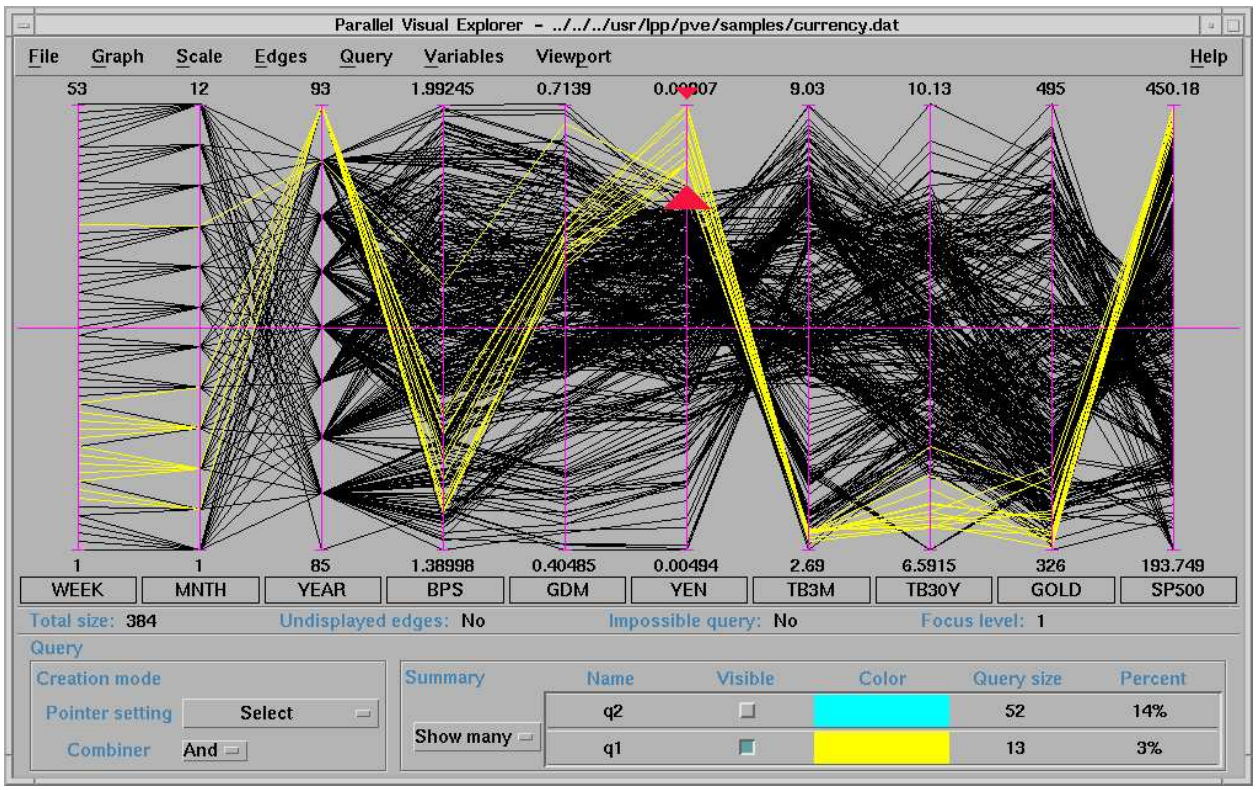


Figure 8: At the first abrupt change of direction of yellow lines between "**GDM**" vs. "**YEN**" (it jumps from upward inclined to downward inclined) there is a jump in "**GOLD**".

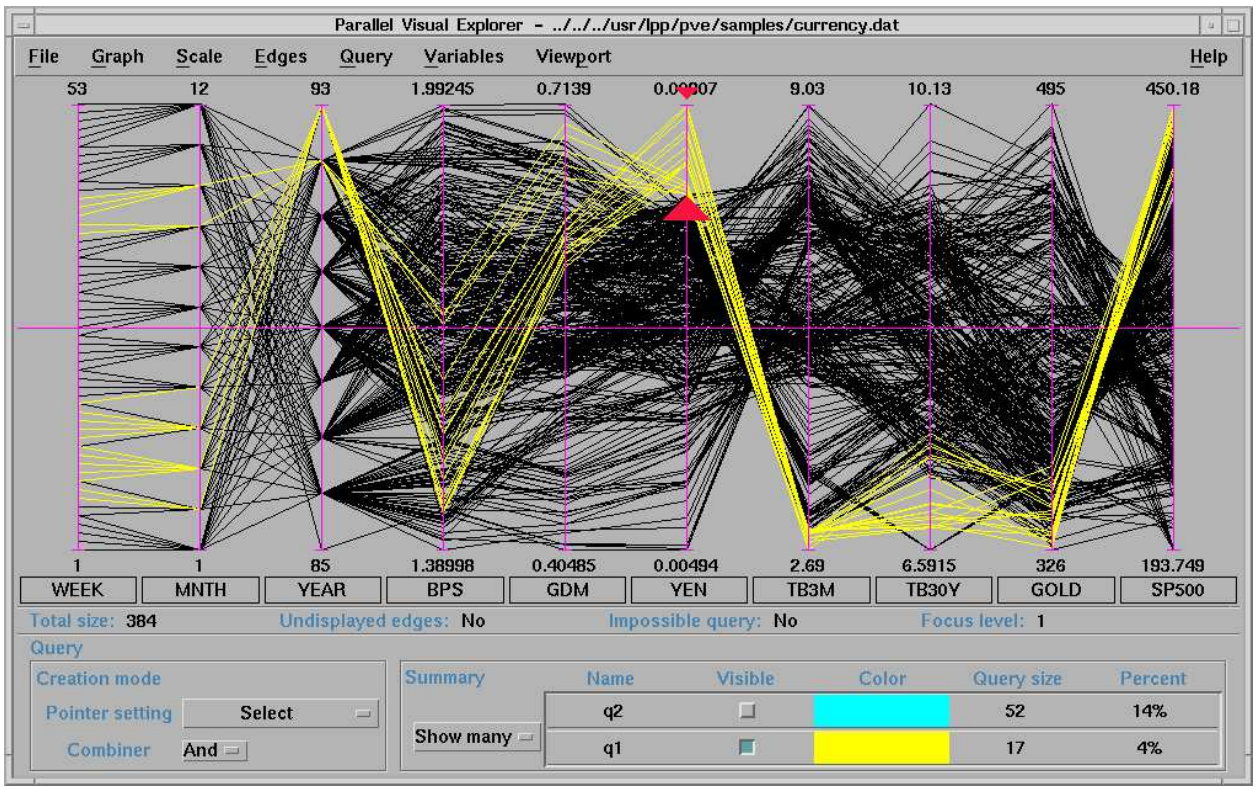


Figure 9: Things settle down again as further lines are selected between "**GDM**" and "**YEN**", which are closely parallel to the new direction (inclined downward).

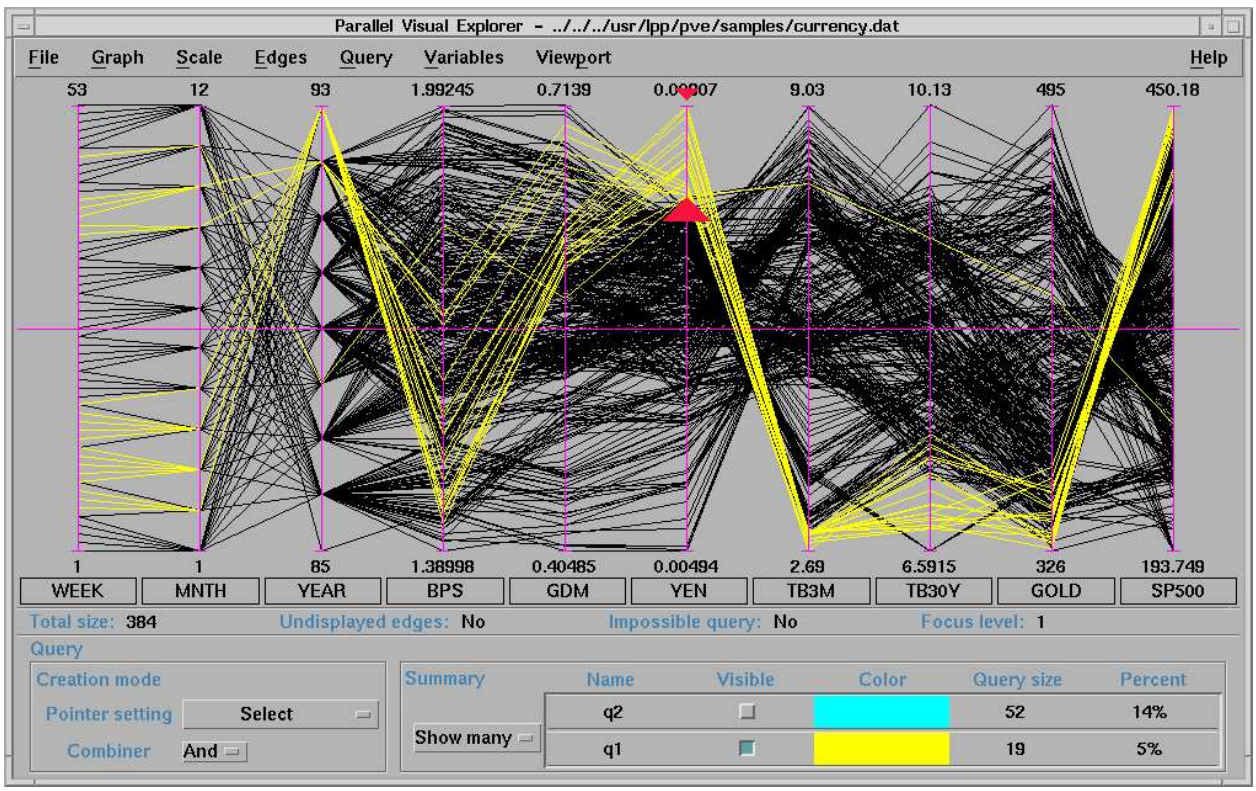


Figure 10: At the next abrupt change of direction (from pointing downward back to pointing upward), gold jumps again.

5. Define a "**Set range**" query element on "**GDM**" so as to select the data points on the lower end of the spread on the "**GDM**" axis. You'll notice that these polygonal lines (drawn in blue) pass through the upper end of "**TB3M**" axis. So we have a negative correlation between "**GDM**" and "**TB3M**" when the relative volatility of "**YEN**" in contrast to "**GDM**" is quite low.

Notice the 3 distinct regions on variables "**TB3M**" and "**GOLD**" in Figure 11. To investigate this further:

1. First, click on the "**Visible**" button for query "**q2**" so that only query "**q1**" is visible. Next, click on "**Clear visible queries**" under "**Query**" menu option.

2. Choose "**Set range**" query element under "**Pointer setting**" and define a range so as to select the data points passing through the mid region on "**TB3M**" as in Figure 12

Finally, let's observe the market trends during very high "**GOLD**" prices (supposedly when the market is unstable!).

1. Click on "**Unfocus**" under "**Graph**" menu item and then select "**Clear visible queries**" from the "**Query**" menu.

2. Define a range query element to select the top 30 values on "**GOLD**" over the eight-year period. The field "**Query size**" in the "**Summary**" group box should show 30. Choose "**Focus**" under "**Graph**" to isolate the highlighted data points.

3. Next, choose "**Set flow**" under "**Pointer Setting**" and then click the left mouse button just to the left of the middle of "**GDM**" axis. Separate the arrows on the "**GDM**" axis to select the data points whose intercepts between the "**BPS**" and "**GDM**" axes converge to a point to the right of the "**GDM**" axis. Figure 13 shows the data points selected by "**Set flow**" in yellow.

4. Choose "**Focus**" under menu item "**Graph**". Press the left mouse button on the "**BPS**" label button and drag it to the right so as to select the variables "**BPS**" and "**GDM**". Next, choose "**Scatter plot**" under "**Viewport**" menu option. A scatter plot pops up showing the straight line relationship between "**BPS**" and "**GDM**" as in Figure 14. The line is at a diagonal slope of 45 degrees, which indicates that the relative changes in "**BPS**" were identical to relative changes in "**GDM**" (a constant rate of exchange between the two European currencies) when the "**GOLD**" prices were high. Seems like there still is a "Gold standard"!

5. To end the demo, click on "**Exit**" under "**File**" menu option and then confirm the exit by clicking on the "**OK**" push button.

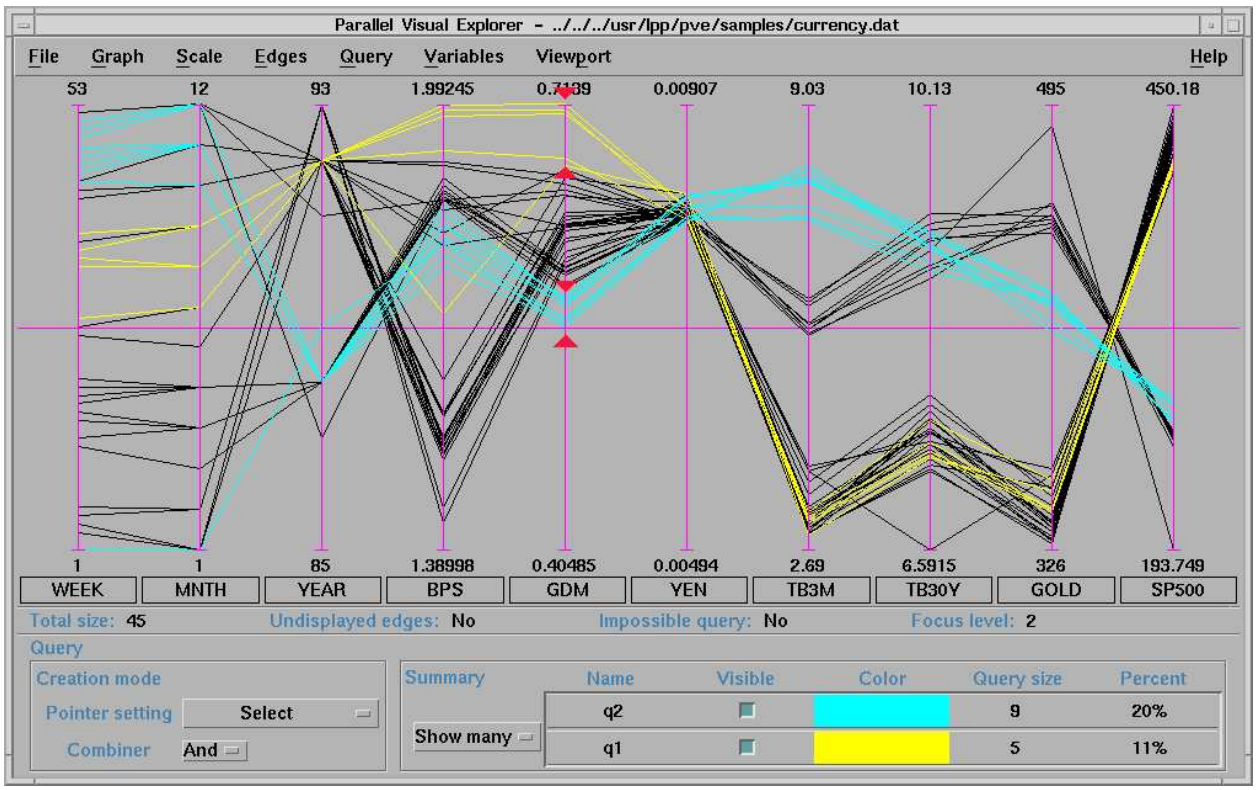


Figure 11: Here, a set of data points are selected where the "**YEN**" is very stable (narrow range), but the "**GDM**" is very volatile. Selecting data points on the upper and lower ranges on "**GDM**", with yellow and blue, respectively, we note the inverse relationship between "**GDM**" and "**TB3M**" (i.e., high "**GDM**" corresponds to low "**TB3M**" and vice-versa).

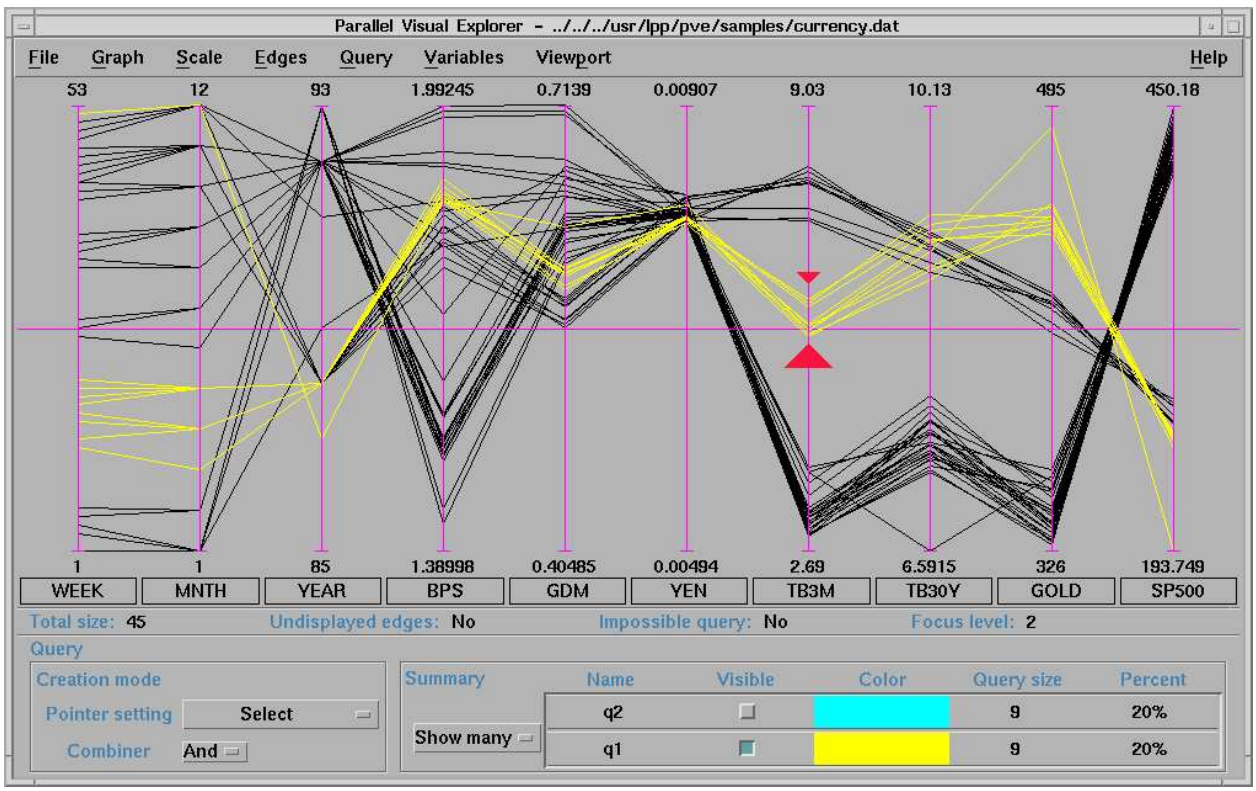


Figure 12: The middle range in "**TB3M**" corresponds to the upper range in "**GOLD**", the upper range in "**TB3M**" corresponds to middle range in "**GOLD**", and the lower range corresponds to the lower range.

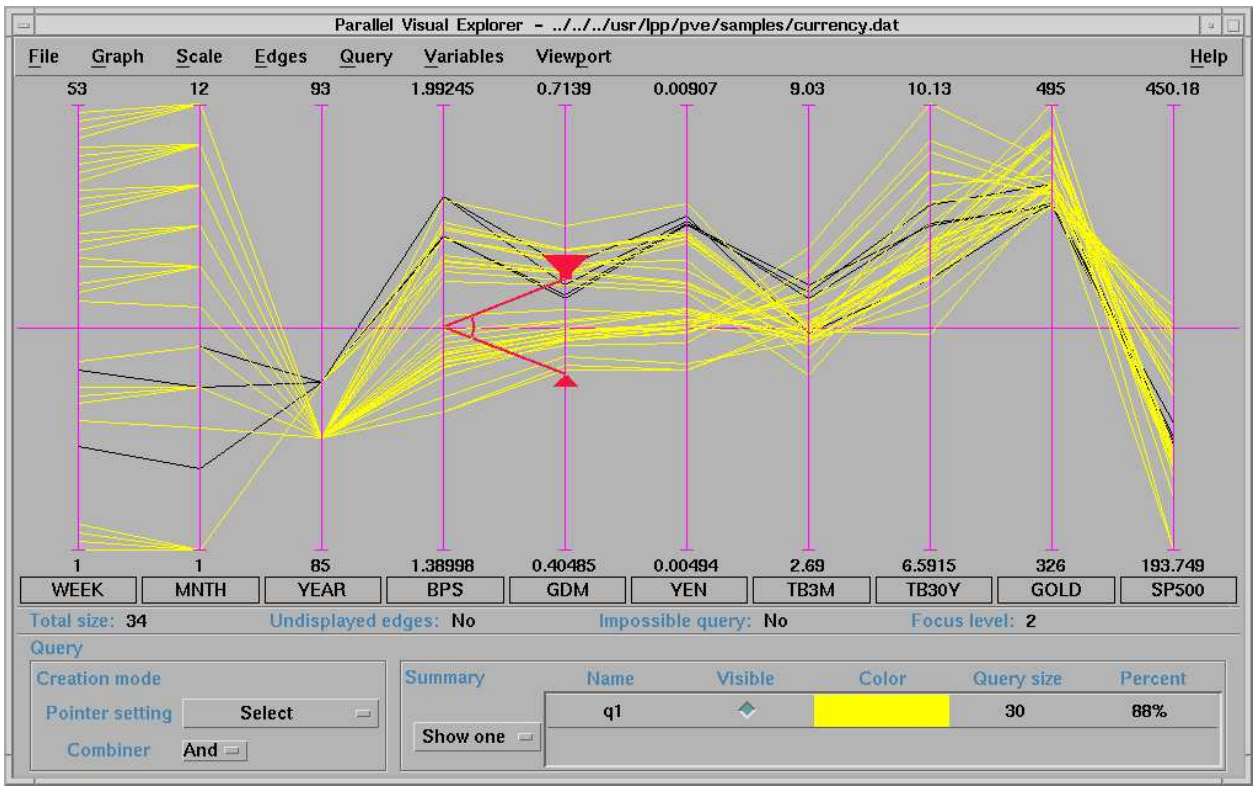


Figure 13: Top 30 values of "**GOLD**" prices. The lines between "**BPS**" and "**GDM**" are convergent (visualize it like a pencil of light rays that converge to a point when extended to the right of of "**GDM**" axis), with a few exceptions (shown in black).

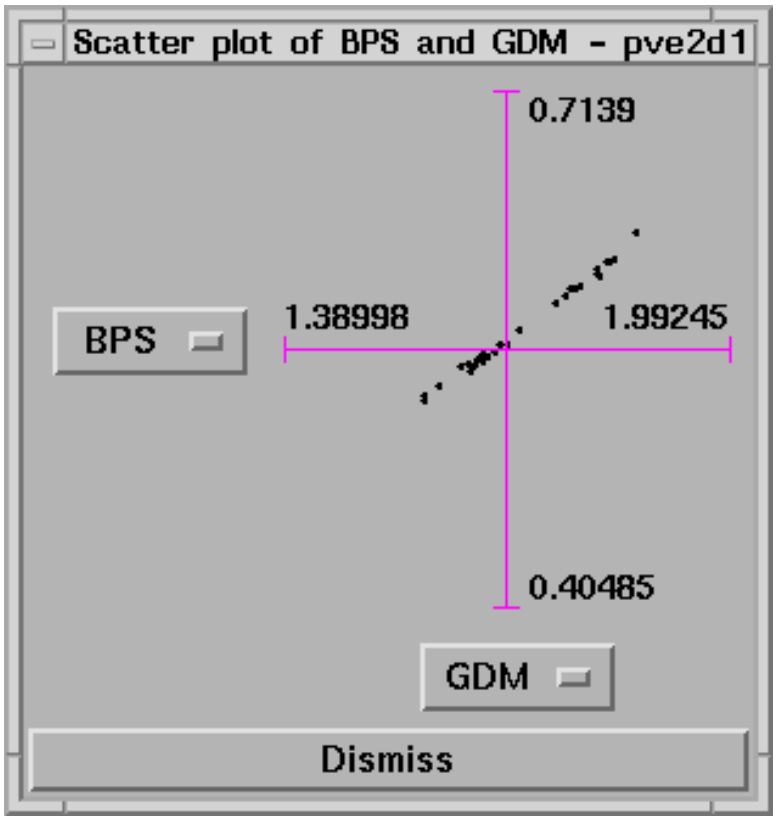


Figure 14: The data points in yellow in Figure 13 are isolated and then shown in a scatter plot for variables "**BPS**" and "**GDM**". Notice the strong linear relationship between "**BPS**" and "**GDM**"!