

CREATING SIMULATION CONDITIONS BASED ON REAL WORLD DATA

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ABSTRACT

This article describes the author's use of "real world" data to help create the environment in a simulation. Sources are provided to easily obtain the data, as well as, discussion of some issues to consider.

INTRODUCTION

A few years ago, at the end of the semester, a student from my senior-level capstone course in which we had used a simulation, commented that the experience would have been enhanced if there had been more data that could be analyzed to determine economic and market trends. He believed I could do this in a way that would add more realism to the simulation. I decided that he had a valid point, so the next time I taught the course I decided to provide more data, particularly with respect to general economic conditions. I also recalled Dick Cotter responding one year to a student who questioned the realism of the data used during the International Collegiate Business Strategy Competition (www.ICBSC.org). The student stated that the interest rates Dick had used were impossible. Dick responded that the student should look at what had actually happened in the early 1980's when interest rates sky rocketed. I decided, therefore, that I would use data from the "real world" to create conditions that reflected a specific point in time in order to create an environment that had a valid historical basis. This article briefly describes the aspects of the simulation that are relevant to this article, and then addresses what data were used and the sources for the data, and how the data were used in the simulation.

SIMULATION DESCRIPTION

The simulation used was Micromatic (Scott, Kaliski, and Anderson, nd). The firm the participants are operating is basically a start-up since there is only one quarter of historical data (quarter 4 of year 0). In the simulation, as I configured it, the firms operated in three regions, two in the US and one in Europe. The game administrator sets unit sales potentials for each quarter of operations as an average per firm by sales region, and the industry sales potential in each region is obtained by multiplying the average by the number of firms in the industry. Participants can purchase region by region sales potentials for any one or all of the next four quarters. In creating the sales potentials I set up one region as fairly unpredictable and two regions with

fairly predictable seasonal sales potentials, as shown in Exhibit 1. To add some further uncertainty and force participants to engage in analysis of the data the game administrator can also modify the sales potentials actually used prior to running each quarter. Each quarter the game administrator can also vary the exchange rate, the short term loan interest rate, the long term bond rate, and the rate firms can obtain by investing excess cash. Thus, the game administrator has a great amount of choice related to parameters that relate to the general economic environment the firms face. The simulation also permits the administrator to provide a news bulletin each quarter.

THE DATA USED AND THE SOURCES FOR THE DATA

For the US I obtained data for Gross Domestic Product (GDP), Corporate Bond Rates, 3-Year Rates, Bank Prime to Business Rates, 3-Month CD Rates, and US Treasury 20 Year Yield Rates. For the international region I used the Euro Exchange Rate and GDP for a specific country. Since all borrowing takes place in the US I did not provide data related to financial instruments for the other country. The decision periods represent a quarter of a year in the Micromatic simulation so I obtained "real world" data for each of the items on a quarterly basis. In all cases I was able to import the data directly into an excel file.

A great deal of data for the US can be found at the U.S. Department of Commerce: Bureau of Economic Analysis web site (<http://www.bea.gov/National/>). The Current-dollar and "real" GDP link provides an excel download that contains GDP in billions of current dollars and GDP in billions of chained dollars annually from 1929 to the most recent date for which data are available, and quarterly from quarter 1 of 1947 to the most recent date for which data are available. There are a number of sources for GDP for other countries, such as the International Monetary Fund (IMF - <http://www.imf.org>); World Bank (<http://www.worldbank.org/>); CIA World Factbook (<https://www.cia.gov/library/publications/the-world-factbook/>); and the Organization for Economic Co-operation and Development (OECD - <http://www.oecd.org/>). In a similar manner I obtained quarterly GDP data for Germany for 1999 through 2005. Unfortunately, when preparing this article I was not able to locate the original data source I used to create the German GDP Index. When I checked the Organization for Economic Co-operation and Development (OECD) database (<http://stats.oecd.org/Index.aspx?QueryId=350>), I thought I had used, I was not able to find the same data set I had used. I did locate a quarterly GDP for Germany

database at the St. Louis Federal Reserve Economic Data (FRED) site ([http://research.stlouisfed.org/fred2/graph/?s\[1\]\[id\]=DEURGDPODSNAQ](http://research.stlouisfed.org/fred2/graph/?s[1][id]=DEURGDPODSNAQ)). This site provides a chart with annual data from 1991 to 2011 with an option to download the data in the graph that generates an excel file with the quarterly data for 1991 through 2011 based upon Millions of Chained 2005 Euros, Quarterly, Seasonally Adjusted.

HOW THE “REAL WORLD” DATA WERE USED

The GDP for the USA and Germany was used to create an index for each country. The 4th quarter of 2000 was selected as the base quarter (Index of 1.000) that corresponded to quarter 4 of year 0 in the simulation. The index for all other quarters was obtained by dividing the GDP value by the GDP of the base quarter. The GDP index was used to modify the sales potentials each quarter. Thus, if the GDP Index was greater than 1.0 the industry sales potential was increased and, if lower, decreased. The “real world” interest rates and the exchange rate, as obtained from the data sources, were used for the corresponding rates in the simulation. Exhibit 2 in provides the GDP indices and the interest rates that were used and the same data are presented graphically in Exhibits 3 and 4.

Prior to the start of the simulation participants were provided the information shown in Exhibit 5 concerning the GDP indices and financial instruments. Each quarter as part of the Bulletin an updated table was provided. The updated table showed the prior four quarters of actual data and estimates for the next four quarters. The estimates were revised each quarter and as is mentioned in the table, the variability of the estimates is greater the further one goes into the future.

CONCLUSIONS

Providing this data required work and time so one must ask, “Was it worth it?” I do know that some, if not all of the participants, looked at the data since I received a number of inquiries about the data. From discussions with a few participants I know that they were using the data to forecast future conditions and trends. Many of the students looked at the exchange rate since, as first year students four years earlier about 75% of them had spent a week in London so they had dealt with this issue. My view is that it was worth the effort since at least some of the students used the data for analysis and decision making. If I were to undertake this activity again I would identify some measures to assess the extent to which participants used the data and what type of impact such use had on decisions and results.

Exhibit 1
Average per Firm Sales Potential Pre-GDP by Region by Quarter

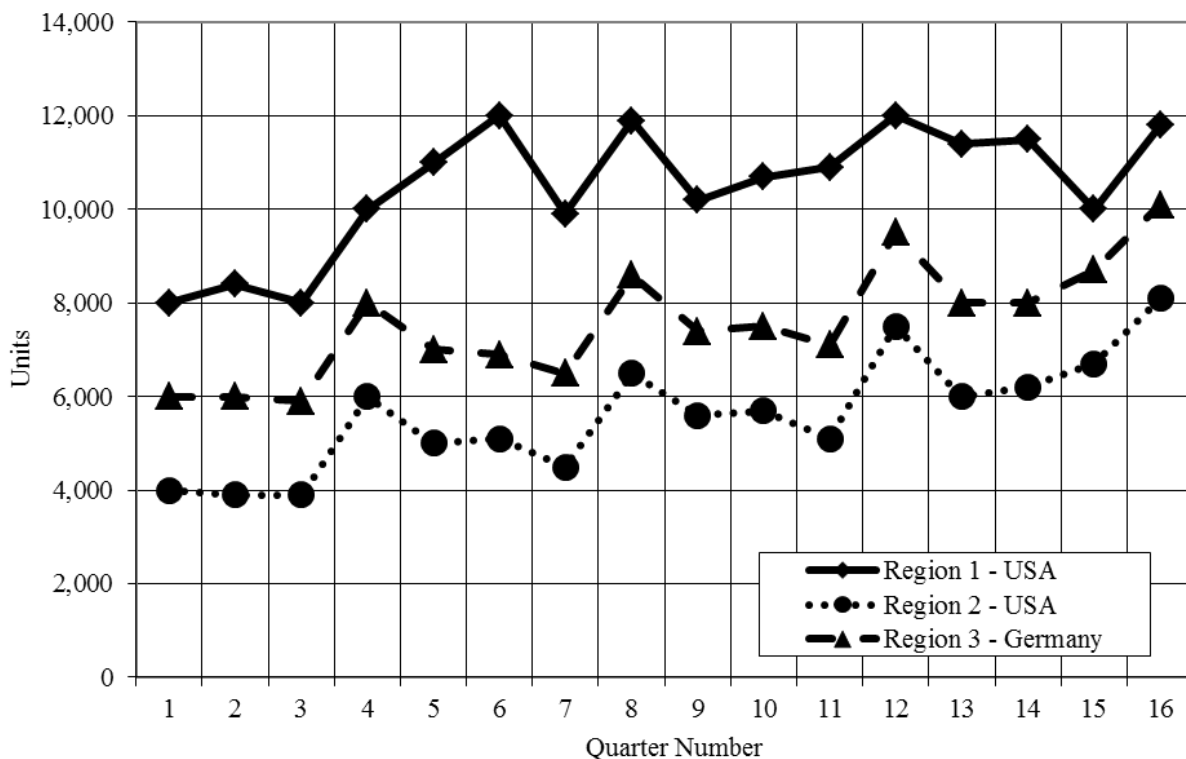


Exhibit 2
Data Set for All Quarters

Real Yr/Qtr	Data Year	Data Qtr	Run Qtr	USA GDP Index	Germany GDP Index	Euro Exchange	Corporate Bond	3 year rates	Bank Prime to Business	3 mo CD's	US Treasury 20 Yr Yield
2000q1	0	1	-3	0.981	0.987	0.980	7.78	7.53	8.50	5.95	6.86
2000q2	0	2	-2	0.996	0.999	0.920	7.68	7.16	8.73	6.01	6.54
2000q3	0	3	-1	0.995	0.998	0.950	7.68	7.16	8.83	6.14	6.38
2000q4	0	4	0	1.000	1.000	0.898	7.64	7.01	9.00	6.28	6.18
2001q1	1	1	1	0.999	1.009	0.922	7.99	8.33	9.24	6.71	6.55
2001q2	1	2	2	1.002	1.010	0.874	7.67	7.12	9.50	6.73	6.28
2001q3	1	3	3	0.998	1.008	0.891	7.65	7.14	9.50	6.67	6.20
2001q4	1	4	4	1.002	1.011	0.895	7.55	6.99	9.50	6.61	6.02
2002q1	2	1	5	1.009	1.007	0.877	7.62	6.81	9.50	6.60	6.09
2002q2	2	2	6	1.015	1.008	0.920	7.55	6.67	9.50	6.67	6.04
2002q3	2	3	7	1.021	1.012	0.984	7.45	6.61	9.50	6.65	5.98
2002q4	2	4	8	1.021	1.011	1.001	7.21	6.07	9.50	6.45	5.64
2003q1	3	1	9	1.024	1.007	1.073	7.15	5.56	9.05	5.62	5.65
2003q2	3	2	10	1.033	1.003	1.136	7.10	5.44	8.50	5.26	5.62
2003q3	3	3	11	1.052	1.007	1.126	6.98	5.17	8.32	4.89	5.49
2003q4	3	4	12	1.059	1.013	1.190	7.20	5.12	7.80	4.53	5.78
2004q1	4	1	13	1.069	1.017	1.251	7.29	5.19	7.24	4.02	5.92
2004q2	4	2	14	1.079	1.016	1.205	7.18	5.08	6.98	3.74	5.82
2004q3	4	3	15	1.088	1.014	1.223	7.13	5.05	6.75	3.66	5.75
2004q4	4	4	16	1.095	1.015	1.297	7.02	4.74	6.67	3.48	5.58
2005q1	5	1	17	1.104	1.021	1.306	7.17	4.20	6.28	2.87	5.53
2005q2	5	2	18	1.113	1.024	1.240	7.03	3.80	5.53	2.31	5.34
2005q3	5	3	19	1.124	1.029	1.219	6.97	3.84	5.10	2.03	5.33
2005q4	5	4	20	1.129	1.032	1.189	6.77	4.33	4.84	1.83	5.76
Item						Used for					
GDP (USA)						Index to adjust Region 1 and 2 Sales Potentials					
GDP (Germany)						Index to adjust Region 3 Sales Potentials					
Euro Exchange Rate						Exchange rate					
Corporate Bonds AAA						Bond Rates					
Bank Prime Loan Rate (short term of Business)						Short Term Rates					
3 Month CD's						CD Rates					
US Treasury 20-Year Yield						to provide context					
3 Year Rates						to provide context					

Exhibit 3
Economic Data (US and Germany GDP Indices and Exchange Rate)

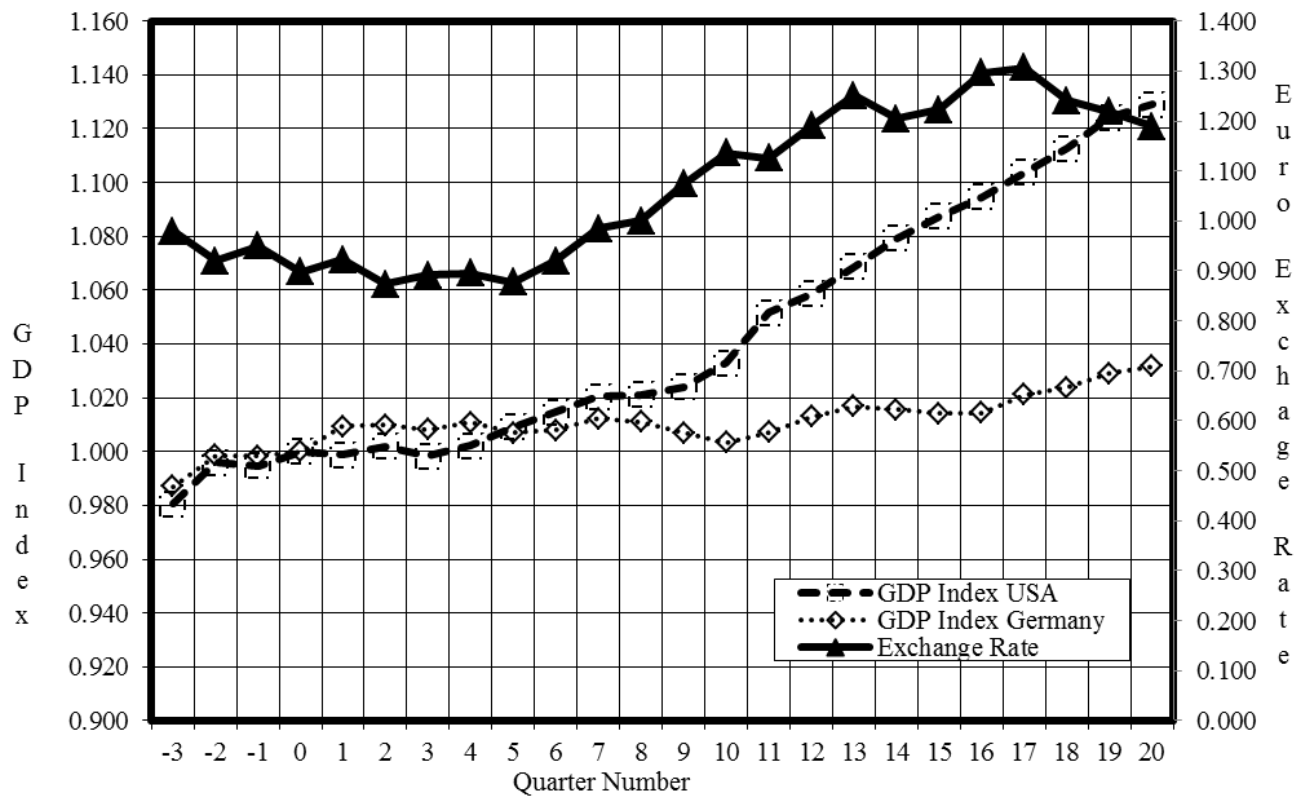
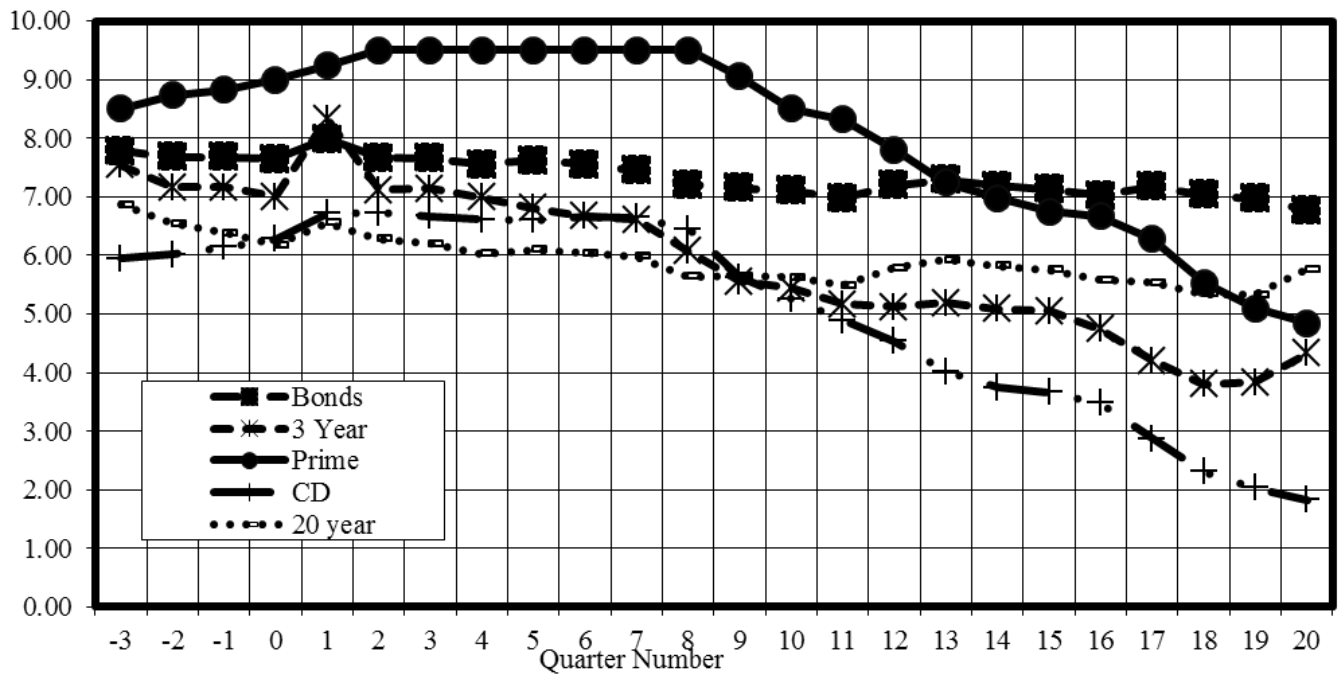


Exhibit 4
Economic Data (US Interest Rates)



There are a few cautions related to using this approach. First, does one run the risk that participants will identify the real timeframe used and base decisions on that information rather than engaging in analysis of all the information they have available? The fact is that any simulation is a replication so the “real world” is not represented 100%. One way to mask the data would be to modify the values by some constant amount so that the participants would not be able to find the actual values, although they still might identify patterns. Second, how does one address participant questions that might fully identify the timeframe used? If you tell them it is real data, it is relatively easy for them to find the real timeframe. If you don’t tell them, you miss a teaching opportunity to point out how things like exchange rates or interest rates change over time. Do students of 2012 have any sense that interest rates can be above 5%, 10%, 15% or more? Finally, one problem I encountered that I should have foreseen but did not was that the simulation might have set minimums or maximums for some values that were beyond the real world data. I had to adjust slightly a few of the final values to stay within the simulation limits.

REFERENCES

Scott, T. W., Kaliski, J. A., & Anderson, P. H. (nd). *Micromatic: A Strategic Management Simulation*. Available at <http://oaktreesim.com/>.

EXHIBIT 5 INFORMATION PROVIDED TO PARTICIPANTS

The table below, which will be updated quarterly, shows actual and estimated interest rates for a variety of financial instruments, and GDP Indexes for the US and Europe. The GDP Indexes will influence the projected sales potentials. Some economists are convinced that the economies will grow at a rapid rate; others believe that growth will be slow or even decline. It is currently unclear what will happen and what actions, if any, the Federal Government and/or the FED will take.

Quarterly Actual and Estimated GDP and Financial Instruments

The table below provides actual and forecast data for a number of economic indicators. The GDP Indexes for US and Europe are used to modify the Sales Potential forecasts that can be purchased as marketing information through the simulation. If the index is less than 1.000 actual sales potentials would be lower than the forecast; if it is above 1.000 then actual sales potentials would be above the forecast. The further into the future the forecasts go the greater the uncertainty: four quarters out is plus or minus 20%; three quarters, plus or minus 10%; two quarters plus or minus 5%; and one quarter, plus or minus 2%.

Qtr #	Cumulative Quarter #	Actual				Estimate			
		-3	-2	-1	0	1	2	3	4
0	GDP US	0.981	0.996	0.995	1.000	0.999	1.012	1.048	0.902
	GDP Europe	0.987	0.999	0.998	1.000	1.009	1.020	1.059	0.910
	Prime	8.500	8.730	8.830	9.000	9.240	9.595	9.975	8.550
	20 Year	6.860	6.540	6.380	6.180	6.550	6.343	6.510	5.418
	3 Year	7.535	7.157	7.157	7.006	8.327	7.191	7.497	6.291
	Bond	7.780	7.680	7.680	7.640	7.990	7.747	8.033	6.795
	Euro	0.980	0.920	0.950	0.898	0.922	0.882	0.936	0.805
	3 Month CD	5.950	6.010	6.140	6.280	6.710	6.797	7.004	5.949