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Lawrence R. Klein's Principles in Modeling and Contributions in Nowcasting, Real-Time Forecasting, and Machine Learning

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Abstract

Lawrence R. Klein (September 14, 1920 – October 20, 2013), Nobel Laureate in Economic Sciences in 1980, was one of the leading figures in macro-econometric modeling. Although his contributions to forecasting using simultaneous equations macro models were very well known, his contributions to nowcasting and real-time forecasting, that he worked on in the last 30 years of his life, were generally overlooked by many researchers. The reasons for the miss are related to the ambiguity in terminology, specifically, the terms nowcast or nowcasting, and the empirical, though very significant, nature of his contributions. This paper reviews L. R. Klein's guiding principles on modeling and his contributions to nowcasting and real-time forecasting, and discusses the connection of these contributions to the present state of fast evolving disciplines, such as economics, econometrics, statistics, data science, and machine learning. In so doing, we argue that L. R. Klein indeed expertly developed pioneering ideas and methodology for nowcasting and real-time forecasting; and the principles and contributions put forward by him are even more relevant now than ever.

Keywords: *Current Quarter Model, Dynamic Factor Models, Forecasting, High-Mixed-Frequency Data and Modeling, Machine Learning, Nowcasting, Principal Components*

JEL Classification: *B31, C18, C51, C52, C53, C55*

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1 Introduction

Lawrence R. Klein (September 14, 1920 – October 20, 2013), Nobel Laurate in Economic Sciences in 1980, was one of the leading figures in macro-econometric modeling. Although his contributions to forecasting using simultaneous equations macro models were very well known, his contributions to nowcasting and real-time forecasting were generally overlooked by many researchers. The reasons for the miss are related to the ambiguity in terminology, specifically, the terms nowcast or nowcasting, and the empirical, though very significant, nature of his contributions. This paper reviews L. R. Klein's guiding principles on modeling and his contributions to nowcasting and real-time forecasting, and discusses the connection of these contributions to the present state of fast evolving disciplines, such as economics, econometrics, statistics, data science, and machine learning. In so doing, we argue that L. R. Klein indeed expertly developed pioneering ideas and methodology for nowcasting and real-time forecasting; and the principles and contributions put forward by him are even more relevant now than ever.

There are excellent reviews of his work (Ball, 1981; Bjerkholt, 2014; Visco, 2014; Mariano, 2008; Klein & Mariano, 1987; Castilla, 2015; Castilla, Adolfo in collaboration with Alfredo Coutino, 2006; Coutino, 2015; Pulido, 2015; Pulido & Perez Garcia, 2006; Klein & Daza, 2013; Hall, Roudoi, Albu, Lupu, Calin, 2014; Dimand, 2020; Pinzon-Fuchs, 2017, 2018; Marwah (1997); and Klein, 1980)[1]. In this paper, we concentrate on his work related to nowcasting, and real-time forecasting, which he worked on in the last three decades of his life.

At this stage, it seems necessary to clarify some of the terminologies to alleviate confusions. It should be noted that statistical offices and individual researchers may have their own definitions on nowcasting (Mazzi & Cannata, 2017).

The term nowcast and nowcasting have been used in meteorology for a long time. According to National Weather Service Glossary, Nowcast is defined as "A short-term weather forecast, generally out to six hours or less. This is also called a 'Short Term Forecast'." (https://w1.weather.gov/glossary/index.php?word=nowcast). In economics, the first time the term was used in the title of an academic paper cited in Social Science Citation Index was in 2005. Any estimation geared towards understanding the current state of the economy (now), based on all available data may be regarded as a nowcasting. Since, some data are released with

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[1] Also, see, testimonials at the *Klein Legacy Dinner* on October 24, 2014 organized by the Department of Economics, University of Pennsylvania (Professor Roberto S. Mariano as the Master of Ceremonies), https://economics.sas.upenn.edu/sites/default/files/filevault/u4/Klein%20Testimonial%20Compilation-Final-2014_November.pdf, and *Centennial Celebration Honoring the Legacy of Lawrence R. Klein*, The University of Costa Rica, Department of Economics, Monday, September 14, 2020. http://economia.fce.ucr.ac.cr/index.php/es/evento/centenial-celebration-honoring-legacy-lawrence-r-klein. There is also a book by Students and Colleagues, *A Celebration of Lawrence R. Klein.* Publication date: 7/15/2013, ISBN: 9781304102461. "This book is dedicated to Dr. Lawrence R. Klein, from his students and colleagues. Dr. Klein has influenced our lives in many different ways. For most of us, Dr. Klein's willingness to help has been truly remarkable. Over the years, Dr. Klein has been our professor, dissertation supervisor, colleague, and co-author, but, more importantly, he has been a friend one can always rely on for intelligent and unbiased advice. In his very unique and humble way, Dr. Klein has shaped our research foundation, which helps us throughout our professional lives. We are forever grateful to Dr. Klein for the research vector he has instilled in us at the early stages of our careers." https://www.lulu.com/en/us/shop/students-and-colleagues/a-celebration-of-lawrence-r-klein/hardcover/product-1mwz5jy7.html

a lag, estimations may be for the recent past also. "Nowcasting is the prediction of the present, the very near future and the very recent past in economics" (Giannone, Reichlin, and Small, 2008; Banbura, Giannone, and Reichlin, 2011)[2]. For example, if the GDP for the first quarter is released at the end of April, which is the case for the US, then estimations for the first quarter made in the last week of March may be regarded as nowcast (or "current quarter"). The term "current quarter model" was used by Klein & Sojo (1987, 1989). The Federal Reserve Bank of Atlanta releases GDPNow, but in the text the term "current quarter" is used (Higgins, 2014). Higgins (2014) rightly gives the credit to Klein for bridge equations: "Bridge Equation Methods/Tracking Models: This approach, pioneered by Nobel Laureate Lawrence R. Klein; is discussed in Klein and Sojo (1989)."

Since, the term "nowcasting" refers to now, and since there are economic data released every second (stock prices, exchange rates, interest rates, etc.), in principle, estimations should be done continuously, in real-time. A definition of "nowcasting" should include "continuous re-estimation"; otherwise it is not complete. Continuous re-estimations require a completely different mindset. Earlier work (Klein & Ozmucur, weekly reports 2000-2013) taught us that forecasting on a weekly basis (52 times a year) is a completely different experience than forecasting once or twice a year. Although, techniques may be very similar or the same in nowcasting and forecasting, issues may be very different and arise at different frequencies.

Klein used the term "current" (such as "current quarter model") for what is currently called "nowcast" (such as "nowcasting model"). He did not use the term "nowcasting". The concept of forecasting is based on data points (Klein, 1971; Klein & Young, 1980). Any estimation for the period after the last data point available is called a forecast. Any estimation for the period before the first data point is called a back-cast (Box & Jenkins, 1976). Nowcast somewhat involves an additional dimension, i.e. when the estimation was done. That is why he probably did not use the term. He probably preferred the term forecast. Since nowcast and nowcasting became common terms in econometrics, and they match exactly what Klein did for the last 30 years of his life, they are used in the title. He did practice nowcasting maybe more than anyone else, and researchers should learn about the action regardless of the name he used.

The paper is organized as follows. The second section briefly describes the Current Quarter Model and summarizes some of the modeling principles adopted by Klein. Section 3 shows that Klein's bridge equations is the most appropriate way to deal with the problem at hand. Dynamic factor model and its relationship to Klein's principal components model is shown in Section 4. The relations of these methods to methods in machine learning are given in Section 5. The modeling efforts, and specifically the Global Model of Project LINK (https://www.rotman.utoronto.ca/FacultyAndResearch/ResearchCentres/ProjectLINK, https://www.un.org/development/desa/dpad/project-link.html) and its relevance in today's world is described in Section 6. Major conclusions are stated in Section 7.

[2] Box-Jenkins (1976) used the term back-casting, prediction for the past periods starting with the first data point used in the estimation. This was necessary for moving average processes.

2 Klein's Current Quarter Model - A System of Nowcasting and Forecasting

Klein's Current Quarter Model estimates real GDP and its components, nominal GDP and its components and GDP deflator and its components using three methods, namely expenditure, income, and production (or value added) methods. The model tries to mimic the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) national income and product accounts (NIPA). It is also based on the idea that not all data have to be released to have an estimate. If a monthly series related to a component of quarterly GDP (that is used in the calculation of it) is available, it may be used immediately. There is no need for researchers to wait for all data to be available to have a calculation, which is the job of statistical offices.

In short, there are two guiding principles. First, mimic exactly what Bureau of Economic Analysis does in calculating GDP and its components. Second, since the goal of CQM is to produce more timely estimates, and not an exact calculation of GDP, re-estimate the model as new data become available without waiting for all data to become available. Based on these principles, available data were used, and models were re-estimated almost after every release for own use, but reports were prepared and distributed once a week (typically, every Friday for the report dated following Monday).

Predictions are presented for two quarters following the last data point available. For example, GDP data for the second quarter of 2020 (2020Q2) are released on July 30, 2020. Forecasts for 2020Q3 and 2020Q4 will be given weekly. Forecasts for 2020Q3 is called the "Current Quarter Forecast" by Klein from July 1st to September 30th, which is now called "Nowcasts". During the same time span, forecasts for 2020Q4 are called "Forecasts", same as today.

Klein used data at different frequencies. His "Current Quarter Model" made use of daily, weekly, monthly and quarterly data. He related data at different frequencies with the help of "bridge equations". He may be the first person to use both "current quarter model" and "bridge equation" terms (provided forecasts weekly, from early 1980's to his last day in 2013). His bridge equations probably led to a more flexible mixed-data sampling (MIDAS) equations (Ghysels, Santa-Clara, and Valkanov, 2002). What he called "current" is called "nowcast", these days.

2.1 Expenditure Side Model – Bridge Equations

Expenditure side model includes major categories of personal consumption expendures, gross domestic private fixed investment, change in inventories, government expenditures and net exports. Each category has a number of sub categories (see Klein & Park, 1993, 1995; Klein & Ozmucur, 2008 for details). It is in parallel to categories given in Table 3 of BEA (2020). ARIMA models (Box & Jenkins, 1976) are used to get forecasts for monthly indicators. Bridge equations are used for the relationship between GDP categories and relevant monthly indicators. After estimating nominal GDP and corresponding price categories, real GDP categories are calculated.

2.2 Income Side Model – Bridge Equations

Income side model includes major personal icome categories such as compensation of employees, proprietors' income, rental income, personal income receipts on assets, and personal current transfers. These are then used in the relationship with gross domestic product, gross national income, and national income (Klein & Park, 1993, 1995; Klein & Ozmucur, 2008). It is in parallel to categories given in Tables 7 and 8 of BEA (2020). ARIMA models are used to get forecasts for monthly indicators. Bridge equations are used for the relationship between GDP categories and relevant monthly indicators.

2.3 Production Side Model – Principal Components

Since the prodution side of GDP (called GDP by industry) is released with almost a lag of almost 9 weeks (first quarter GDP was released on April 29, and first quarter GDP by industry was released on July 6th, https://www.bea.gov/news/schedule/full) a short-cut method, the method of principal components, is used to estimate real GDP and GDP Deflator.

The technique of principal component analysis was first described by Karl Pearson (1901), and computing methods were introduced by Hotelling (1933). The objective is to take k variables X_1, X_2, …X_k and find combinations of these to produce (unobserved) principal components, Z_1, Z_2, … Z_k which are uncorrelated (Anderson, 1984; Johnston, 1984; Manly, 1986; Morrison, 1976; Stone, 1947; Theil, 1971). The lack of correlation between Z's is a useful property because it means that principal components are to extract different information from data. These are ordered so that Z_1 displays the largest amount of variation, Z_2 displays the second largest amount of variation, and so on, i.e $Var(Z_1) \geq Var(Z_2) \ldots . \geq Var(Z_k)$. If the original variables are uncorrelated, the method of principal components does not contribute much to the problem of data reduction. The best results are obtained when the original variables are highly correlated. If that is the case, then hundreds of original indicators may be represented by a few principal components.

The problem is to determine linear combination of original variables which are pair-wise uncorrelated and of which the first will have maximum possible variance, the second the maximum possible variance among those uncorrelated with the first and so on.

$$z_{1t}=a_{11}x_{1t}+a_{21}x_{2t}+\ldots+a_{k1}x_{kt}, \quad t=1,2,\ldots .n$$

Professor Klein used two groups, one for real GDP, and another one for GDP deflator (Klein & Sojo, 1987,1989; Klein & Park, 1993,1995; Klein & Ozmucur, 2008). The following monthly indicators are used to form the principal components which are to be used in the estimation of real GDP: Real manufacturing shipments, real manufacturing orders, real manufacturing unfilled orders, real retail sales, real money supply, index of industrial production, non-farm payroll employment, average number of hours worked, housing starts, real effective exchange rate, federal funds rate, interest rate spread (prime rate – treasury bill rate), interest rate spread (10 year bond yield – 1 year bond yield). The following monthly indicators are used to form the principal components which are to be used in the estimation of the GDP deflator: consumer price index, producer price index (finished goods), producer price index (intermediate goods), import price index, farm price index, average number of hours worked, average hourly wages.

2.4 Forecast Averaging

The average of forecasts from the expenditure side, the income side and the production side are given as the final forecast. Now, averaging of the expenditure side and income side is used by the Bureau of Economic Analysis in their tables. Aruoba, Diebold, Nalewaik, Schorfheide, Song (2016) use the average of income side and expenditure side. Klein used to think that the expenditure side was more reliable, but recently there may be changes in data collection and reliability.

2.5 Prediction of Data Revisions

There is about a month between advance estimates of the Bureau of Economic Analysis (called flash estimates in Europe by Eurostat) and second estimates (called "preliminary estimates" in the past), and a month between second estimates and the third estimates (called "final estimates" in the past). However, there are higher frequency data published during the month. Klein wanted to see what the second estimate will be given these new monthly data. There was no need to wait for a month to get the second quarterly estimate.

Two approaches were adopted:

The first one is just look at the newly released monthly indicator, say exports, and its change since the previous release (the one that was used in advance estimates). These are available in a very detailed way, now (there are about 200 rows), compared with 5-10 in the past. Using these changes, calculate the new figure without running the model.

The second approach is using Engle-Granger (1987) type of error correction.

In the ideal case that the first set is perfect, and the advance and the final (third) estimates of real GDP are the same, i.e $F_t=A_t$. That relationship may not be the same in the short-run. In the short-run, there will be error correction:

$$\Delta F_t=\beta\Delta A_t + \alpha(F_{t-1}-A_{t-1})$$

This will be done for the second and the third estimates. The issue with this approach is annual revisions in July of every year. These numbers will change. A combination of both were used.

2.6 Estimations in Extreme Cases

On September 11, 2001, Klein had to make some changes to the model to have accurate nowcasts and forecasts. The key equation he was worried about was the capital consumption equation. There was no way, that equation as it stood had a chance to give a reliable forecast. He wanted to get the best information available. He called a former student or a colleguea at the Burea of Economic Analysis to get an estimate. They cited him the insurance figure of $55 billion. We had to make an adjustment for the third quarter. The issue was like a constant adjustment or an add-factor. The original equation (say CFC1) is estimated using data up to 2001Q2 as usual and forecasts are obtained. The second equation (is essentially an identity, CFC2=55 for 2001Q3, and =0 for all other periods including forecast periods). Forecasts are obatined as the some of forecasts from CFC1+CFC2. This continued until the end of October, when BEA released its capital consumption figures for the third quarter along with GDP and related figures. This was a clear indication of Klein's respect for an expert opinion and the willingness to use of all available information. At the time, expert opinion seemed more reliable than a model forecast, he adjusted the latter.

2.7 Software

There were several programs used in CQM modeling. AREMOS, the flagsip software of Wharton Econometric Forecasting (WEFA), then Global Insight, and now IHS Markit, was used in database management, regressions, and models. RATS was used for ARIMA and VAR models in the system. TSP was used in principal components analysis. In time, as Eviews incorporated these techniques, most were moved into Eviews. Later, IHS Markit acquired Quantitative Micro Software (parent company of Eviews), now Eviews is the software and AREMOS is no longer supported. This was also an indication that he was willing to use the best available information, data or software.

2.8 A Model/System

Lawrence R. Klein's guiding philosophy was to look at a problem as a system (Mariano & Ozmucur, 2020d). Then, use all available information to analyze the problem and solve it. This philosophy could be observed in his research and his daily life.

L. R. Klein's major contributions stem from the fact that he sees the entire global system, and not just parts of it, and builds models to explain the behavior of consumers, firms, government and foreign agents. This requires more relationships (more equations in models), and all data available at the time. He incorporated input/output and flow-of-funds into standard Keynesian type macro models that he pioneered (Klein with Welfe, 1983). The system may include macro-econometric models, statistical relationships and the Current Quarter Model, and the global linkages and the Project LINK model.

Klein was one of first to see the importance of global linkages. He was also one of the first to note that economic models are to explain systematic relationships, and therefore these relationships are best known by local economists and econometricians. This philosophy led to a global model, Project LINK, which started in 1968 with a few countries, and after 50 years with more than 100 countries. Now, United Nations, Economic analysis and Policy Division, Department of Economic and Social Affairs (DESA) keeps updating forecasts from these models and use them in the UN global flagship publication, the World Economic Situation and Prospects (WESP).

2.9 Use All Available Information and Data and Go by the Numbers

The other goal he preached and practiced was to use all available information for policy making and forecasting. This led to the use of data with different frequencies (mixed data), daily, weekly, monthly, and quarterly. He used all available survey data. He made extensive use of survey data on consumers, producers, and their expectations (called "soft data", as opposed to officially released quantitative "hard data") because of their timeliness (Klein & Ozmucur, 2010). The "Survey Corner" included several survey results to predict key economic variables such as the non-farm payrolls (Klein & Ozmucur, 2003-2006). ARIMA models are used to forecast indicators which are released with a lag. This problem is widely known as ragged-edge data. In principle, any data with a lag more than 3 months are not included because that requires many nowcasts and forecasts. If data are not available, and may be useful in a model, Klein estimated those in early years, such as capacity (Klein, 1958).

2.10 Econometrician and an Economist

Klein was not just interested in very short-term forecasts (he called "current quarter", but recently the term "nowcast" is becoming popular), but also medium term in his quarterly econometric models, and the very long-term such as the one on "Great Ratios in Economics" (Klein & Kosobud, 1961). He built system-wide models primarily in macroeconomics, but also in microeconomics such as "linear expenditure system" like the one built by Stone (Klein & Rubin, 1947). His Ph.D. thesis at MIT was entitled "Keynesian Revolution" (Klein, 1944). His "An Introduction to Econometrics" include five chapters: Statistical Demand Analysis, Statistical Production and Cost Analysis, The Distribution of Income and Wealth, Statistical Models of Economic Growth and Trade Cycles, and Applications in Macroeconomics (Klein, 1962). His modesty and humility can be observed once again in the following statements: "I have based the presentation mainly on the work of the great masters" (Klein, 1962, pp. vi). He named Henry Schultz, Paul Douglas, Joel Dean, Wassily Leontief, Vilfredo Pareto, Jan Tinbergen and Ragnar Frisch as masters that his book relied on. He concluded the Preface by thanking his students at Oxford University and at the University of Pennsylvania (Klein, 1962, pp. vi): "I am indebted to these students for teaching me how to teach them and their successors."

He wrote: "Econometrics may help in pinpointing and recognizing such problems, but they must be tackled in a straightforward way by the econometrician just as any other economic analyst would do." (Klein, 1962, pp. 269).

2.11 Repeated Rapid Estimates

Vast amount of data and fast computers enable real-time forecasts and nowcasts. Klein's CQM results were released weekly, but in fact the model was estimated more frequently, as new data become available or as needed (Klein & Ozmucur, 2000-2009, 2009-2013)[3]. Another example is the monthly reports based on several survey results entitled, "Survey Corner" (Klein & Ozmucur, 2003-2006).

Klein (1962, pp. 268) "In the complex modern industrial society, one-part of the economy is strong while another is weak; one aspect is now of key importance and another will be tomorrow." He continued: "econometric approach cannot be applied once and for all and then left as a machine problem for clerks." (Klein, 1962, pp. 269).

He managed to show that it is possible to provide real-time forecasts in a paper forecasting the yield curve (Klein & Ozmucur, 2006, 2009). Forecasts were provided every 10 minutes.

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[3] There are weekly reports before these by Klein and his collaborators, maybe going back to 1980 s.

Technically, it is possible to provide new forecasts every second, but because of estimation and checking results, every 10 minutes seemed more reasonable and feasible.

2.12 Replicable Models

One of the principal features that Klein was looking in a model was replicability. This concept is becoming very important as we see academic journals provide data and computer programs (or code) used in a paper. Klein did not just preach it, but he practiced it. He provided data and methods in all research. Klein Model I, which was published in his 1950 book, is a practice model in econometrics texts and statistical software (for example, Greene's, Econometric Analysis, Stata and Eviews among others). The Klein & Goldberger model of 1955 was studied extensively (including research using other estimation methods by Fox (1956) and the research on impact and dynamic multipliers by Adelman & Adelman (1959)) by other researchers with the help of data provided in their book. A FORTRAN program for matrix operations is also provided (Klein, 1974), which may seem trivial today, but not so at the time.

3 Klein's Bridge Equations – A Special Case of MIDAS Regressions with Some Additional Advantages

The method of mixed data sampling (MIDAS) regressions are considered to be a very powerful tool and a viable alternative to a state space model (Ghysels, 2016a, 2016b; Ghysels, Santa-Clara, and Valkanov, 2002, 206; Armesto, Engemann, and Owyang, 2010; Andreou, Ghysels, and Kourtellos, 2013). MIDAS models may have very general lag structure and bridge equations may be regarded as a MIDAS regression with equal weights.

There are five weighting methods, which are common alternatives on high-frequency indicator in MIDAS regressions. A bridge equation (step weights), proposed and widely used by L. R. Klein, is one of the alternatives. It is not a completely different approach. It is part of a more general approach. Here, we will show that under certain conditions, bridge equation or "equal weights" may be the most appropriate weighting.

Since, Klein's major goal was to mimic national income and product accounts (NIPA) before their publication, as soon as high frequency data become available, examples given here are also geared towards that goal.

A simple aggregation approach may use the equally weighted average or sum of high frequency data:

$Y_t=\beta_0\ (X_t+X_{t-1}+X_{t-2})+\ \varepsilon_t$

In this equation, there is a single parameter (β_0) to be estimated. This is a typical bridge equation (called the "step" option in Eviews). Data set in the quarterly page will look like the following:

	Y	X(t)+X(t-1)+X(t-2)
…..	…..	…..
2019Q1	Q1	M03+M02+M01

2019Q2	Q2	M06+M05+M04
2019Q3	Q3	M09+M08+M07
2019Q4	Q4	M12+M11+M10

Another approach is to estimate an equation without "equal weight" restrictions. In a regression with quarterly and monthly data, the equation will be (Y is quarterly, X is monthly):

$Y_t=\beta_0 X_t+ \beta_1 X_{t-1}+\beta_2 X_{t-2} +\varepsilon_t$

The first regressor contains values for the last month in the corresponding quarter (March, June, September, or December). The second regressor contains values for the second month in the corresponding quarter (February, May, August, or November). The third regressor contains values for the first month in the corresponding quarter (January, April, July, or October). Data set in the quarterly page will look like the following:

	Y	X(t)	X(t-1)	X(t-2)
…..	…..	…..	…..	…..
2019Q1	Q1	M03	M02	M01
2019Q2	Q2	M06	M05	M04
2019Q3	Q3	M09	M08	M07
2019Q4	Q4	M12	M11	M10

Since there are no restrictions on lags, this model is called the unrestricted MIDAS (U_MIDAS). If the number of lags is larger than three, say 12, there may be estimation issues related to distributed lags, typically multicollinearity, which may lead to high standard errors and low t-ratios for regression coefficients. In extreme multicollinearity (perfect correlation between two or more lags), it may not even be possible to estimate the equation. It was shown that this simple representation does relatively well in cases where the ratio of frequencies is small (3, if quarterly and monthly).

Almon weighting, due to Almon (1965), which is widely used in distribured lag models may be used in a mixed frequency faremework. This weighting significantly reduces the number of parameters to be estimated. For example, if there are 12 lags and the Almon lag with power of 3, the equation to be estimated is:

$Y_t=\beta_0(X_t+X_{t-1}+X_{t-2}+X_{t-3}+X_{t-4}+X_{t-5}+X_{t-6}+X_{t-7}+X_{t-8}+X_{t-9}+X_{t-10}+X_{t-11})$
$+\beta_1(X_t+2X_{t-1}+3X_{t-2}+4X_{t-3}+5X_{t-4}+6X_{t-5}+7X_{t-6}+8X_{t-7}+9X_{t-8}+10X_{t-9}+11X_{t-10}+12X_{t-11})$
$+\beta_2(X_t+4X_{t-1}+9X_{t-2}+16X_{t-3}+25X_{t-4}+36X_{t-5}+49X_{t-6}+64X_{t-7}+81X_{t-8}+100X_{t-9}+121X_{t-10}+144X_{t-11})+\varepsilon_t$

It is clear that number of parameters to be estimated is reduced from 12 to 3. This may have important ramifications on problems of multicollinearity, and low t-ratios and hence statistical significance. Howevever, this advantage may be reduced if the number of lags to be used in the original model is only three. The model with Almon lags also have 3 parameters to be estimated as shown below:

$Y_t=\beta_0(X_t+X_{t-1}+X_{t-2})$
$+\beta_1(X_t+2X_{t-1}+3X_{t-2})$

$+\beta_2(X_t+4X_{t-1}+9X_{t-2})+\varepsilon_t$

The exponential Almon weighting with a chosen lag uses a 2nd degree lag polynomial and exponential weights. Since the equation is highly non-linear in parameters, there may be convergence issues. The equation to be estimated is (using the fact that exp(0)=1, resemblance to Almon lags should be clear if there is no normalization, i.e. no denominator terms):

$Y_t=\lambda*[1/(1+\exp(\theta_1+\theta_2)+\exp(2\theta_1+4\theta_2))*X_t$

$+\exp(\theta_1+\theta_2)/(1+\exp(\theta_1+\theta_2)+\exp(2\theta_1+4\theta_2))*X_{t-1}$

$+\exp(2\theta_1+4\theta_2)/(1+\exp(\theta_1+\theta_2)+\exp(2\theta_1+4\theta_2))*X_{t-2}\ ]$

where, λ is the slope coefficient that is common accross lags and θ_1 and θ_2 are the major source of differential responses. Still, because of high non-linearity in parameters convergence may be an issue.

Another weighting is based on the Beta function. Normalized beta weighting is based on the beta function which is very flexible. As in exponential Almon weighting, there is the slope coeffcient, λ, which is common accross lags. There are two other parameters (shape and end-point). However, without restrictions on these two parameters, convergence may be a very common problem because of high non-linearity.

There are several advantages to Klein's bridge equations in a national income and products accounts (NIPA) framework. In that framework, only three lags (months in a quarter) are in play.

1. In the United States, personal income and personal consumption expenditures are available monthly. Personal consumption expenditures, which is the major component in the expenditure side model, make 67.9% of GDP in 2019 (BEA, 2020, Table 3). On the other hand, personal income, which is the major component in the income side model, make 86.6% of GDP (BEA, 2020, Table 8). Once they become available for the month in the current quarter, they will be used after taking the averages of available monthly figures. There is no need to estimate them. Their 3-month averages will give the quarterly figures. Howrey (1991) provided a good alternative. According to him, one determines the relationship between the first month data on personal income and the quarterly personal income, i.e. $Q=f_1(M_1)$, also the relationship between the average of the first two months and the quarterly figure, i.e. $Q=f_2(M_1+M_2)/2)$. Use these relationships as new monthly data become available. Obviously, there is no estimation needed if data on all three months become available because quarterly figure is just the average of three monthly figures, i.e. $Q =[(M_1+M_2+M_3)/3]$.

2. Seasonally adjusted data are used. By construction, seasonal variations are eliminated in seasonally adjusted data. Therefore, monthly variations within a quarter are reduced compared with unadjusted data. This indicates that shares of monthly values within a quarter approach towards one third (1/3). Hence, averaging may be the better option. Without loss of generality, an example on shares of quarterly GDP is to be used here. In the year 2019, shares of quarters in seasonally unadjusted GDP are: 0.2411, 0.2587, 0.2526, and 0.2550. On the other hand, shares of quarters are: 0.2482, 0.2509, 0.2516,

and 0.2515 for seasonally adjusted GDP (BEA, 2020, Table 3 and Appendix Table B). The numbers are clearly closer in the second group.

3. A major criticism of a bridge equation is a possible misspecification error, which may lead to biased estimators. If forecast accuracy is based on the mean square error of target variables, then mean square error of estimators in a forecasting equation become a key statistic. This statistic is based on both bias and variance, i.e. MSE (b)=Var(b)+[bias(b)]^2. If estimators in a bridge equation are biased but have variances that are smaller than the variances in an unrestricted model, then mean square error for estimators in a bridge equation may be smaller when compared to an unrestricted model. There is no guarantee for that, but it is an empirical issue. In an unrestricted model with lags, it is very likely that lagged values of the explanatory variable will be correlated, which leads to higher standard errors and lower t-ratios. The variances of estimated parameters are directly related to correlation between lags (if there are two lagged variables, with a factor of $(1/(1- r^2))$, compared with the case that X(t) and X(t-1) are orthogonal, r = correlation between X(t) and X(t-1)). The higher the correlation between X(t) and X(t-1), the higher the variance of coefficients associated with X(t) and X(t-1). In the extreme case, where the correlation between lags is perfect (perfect multicollinearity), it may not even be possible to estimate the model. In summary, bias issue in this specific case may not be as big as it is made to be.

4. End of day for interest rates and exchange rates are also incorporated in the model. Averages of daily data are used to get the monthly data before estimating in the model. For example, if there are five days of data in September, their average will be used as the monthly figure for September. September figure is not going to be forecasted. Five observations may be regarded as too few for the average for the month. The advantage is no need to forecast the September figure with data up to August. The number of days used is not constant, but it changes from month to month. The benchmark is the release of non-farm payrolls data (employment situation). For example, if August non-farm payrolls data is released on September 4th, then daily figures from September 1 to 4 are to be used for the first run. The following week, daily data from September 1 to 11 are to be used. What is the advantage of this averaging approach to MIDAS? The process outlined above may not be possible if MIDAS model uses more than 4 lags because there are only 4 daily observations for September. Therefore, a MIDAS model cannot utilize daily data for September. Hence, September forecasts should be based on data ending in August. This may be clear advantage for Klein type bridge equation model. In cases, where there may be less than 4 daily observations for the month, Klein model may be regarded as relying quite heavily on a few daily observations, but that does not happen very often. Over the years, there were experiments with using data as it became available, even a single observation for the month. There were also experiments using ARIMA models and daily data to get the estimated data for missing days of the month and use the average for the month. The final version (post-2000), summarized above, involved moving the end-of-date post as the month that the latest release of non-farm payrolls data. In balance, we think that using available data for the current month has an added advantage.

5. We fully agree with Ghysels & Marcellino (2018, pp. 502), who reached the following conclusion after carefully studying mixed-frequency VAR, bridge equations, and MIDAS regressions: “In conclusion, it is difficult to provide unique ranking of the alternative mixed-frequency models, the choice should be based on the specific

empirical application. However, any of the three methods we have considered is in general better than the use of temporally aggregated data, since it permits to exploit all the available information in a timely way."

6. We will even go a step further and argue that if one is working with seasonally adjusted data and trying to mimic a national income and product accounts (NIPA) in which some larger components are available at a higher frequency, then L. R. Klein type of bridge equation models, that he pioneered almost four decades ago, make more sense than other close alternatives. It should be noted that it is also the MIDAS model with equal weights.

4 Klein's Principal Components – A Special Case of Dynamic Factor Models

Factor analysis is due to Charles Spearman (1904). Spearman noticed correlations among student test scores (observed variables). He concluded that there is a common factor (intelligence), which is unobserved, deriving these scores. He proposed the model:

$X_i = \alpha_i F + \varepsilon_i$,

where X_i is the standardized test score, F is a common factor with mean zero and unit standard deviation, ε_i is the part specific to ith test, α_i is called factor loading, its square is the proportion of the variance of X accounted for by the factor F.

Later, this model is extended to several factors:

$X_i = \alpha_{i1}F_1 + \alpha_{i2}F_2 + \ldots.. \alpha_{ik}F_k + \varepsilon_i$.

The sum of squares of factor loadings represent the proportion of the variance of X that is accounted for by common factors (called communality). The variance of ε_i is the specificity, also called uniqueness (for detailed treatment of factor analysis, see Anderson, 1984; Harman, 1976; Manly, 1986; Morrison, 1976).

The factor model was used widely in cross sectional studies. Geweke(1977) extended the factor model so that it can be used in a time series framework. He coined the term "dynamic factor model" (Geweke, 1977, pp. 366). Dynamic factor models are commonly used in current econometric forecasting environments (some examples include Gweke, 1977, Aruoba, Diebold, Scotti (2009), Stock & Watson (1989, 2002a, 2002b), Doz, Giannone & Reichlin (2011), Ghysels & Marcellino (2018), Mariano & Murasawa (2003, 2010), and Mariano & Ozmucur (2015, 2018, 2020a, 2020b, 2020c; Barhoumi, Darné and Ferrara, 2017; Castle, Hendry and Kitov, 2017; Foroni and Marcellino, 2017; Ladiray, Mazzi and Gatto, 2017).

$X_t = AF_t + \varepsilon_t$, X is the vector of indicators, F is the vector of factors,

$F_t = B(L)F_{t-1} + \nu_t$, B(L) is polynomial lag operator in a typical VAR model

$\varepsilon_t = C(L)\, \varepsilon_{t-1} + \gamma_t$, C(L) is polynomial lag operator in a typical VAR model

The model may be extended to include exogenous variables. Another modification may be necessary if the number of indicators is very large. Instead of forecasting X, a subset of X's or variables other than those in X (called Y- target variables) can be forecasted (fourth set of equations). Using lagged value of factors (F), enables that.

$X_t = AF_t + GW_t + \varepsilon_t$, X is the vector of indicators, F is the vector of factors, W is the vector of exogenous variables

$F_t = B(L)F_{t-1} + \nu_t$, B(L) is polynomial lag operator in a typical VAR model

$\varepsilon_t = C(L)\, \varepsilon_{t-1} + \gamma_t$, C(L) is polynomial lag operator in a typical VAR model

$Y_t = DF\text{^}_{t-1} + \phi_t$,Y is the vector of target variables, F^ is estimated value of F

There may be some restrictions on this general model. For example, a VAR for ε_t may not be included.

$X_t = AF_t + \varepsilon_t$

$F_t = B(L)F_{t-1} + \nu_t$

$Y_t = DF\text{^}_{t-1} + \phi_t$

The standard dynamic factor models are very powerful tools for models with small number of variables. If the number of variables is large, it may be difficult to get convergence in a state space framework. Stock & Watson (2002a, 2002b), and Doz, C., D. Giannone, and L. Reichlin (2011) introduce methods dealing with large data sets. In general, the first step is to use factor analysis (or principal components) to reduce the number of indicators. The second step is to use these factors in a VAR framework. In the third step, predicted values of factors from the VAR model is used to forecast the target variables. The third step involves the use of Kalman filter to allow for varying coefficients. The method of least squares also yields consistent estimators in the second and third steps.

Furthermore, if there is a single common factor, there is no need for the VAR. This common factor may be assumed to be an AR (2) process as in Stock & Watson (1989). Then, the model is simplified as (F is replaced by f, to show the difference in the special case of one-factor; and A is replaced by H, and D is replaced by J to point to the difference in dimensions):

$X_t = Hf_t + \varepsilon_t$

$f_t = \beta_1 f_{t-1} + \beta_2 f_{t-2} + \nu_t$

$Y_t = Jf\text{^}_{t-1} + \phi_t$

This is the model very similar, almost identical, to the one that Professor Klein have used in his CQM (Current Quarter Model). In this model, there is a large number of indicators, the number of indicators is larger than the number of observations so that it is not possible to use the method of maximum likelihood in factor analysis, and only one common factor is extracted. Professor Klein's model is a special case of a very general dynamic factor model.

In cases of large number of indicators, generally the method of principal factors is used. In that case, the first step in factor analysis and the principal components analysis is the same. However, note that there is a very fundamental difference between the two methods. Suppose the model is: X=AF+u. In factor analysis, X is observed, and F is unobserved. F's are extracted from the model. In principal components, there is not such a formal model. Furthermore, F is observed, but X is unobserved. X's are constructed based on the proportion of total variance of the group explained by variables on the right-hand side.

Professor Klein used two groups (one for real GDP, and another one for GDP deflator). He also used principal components analysis and not factor analysis. The number of indicators were much less than the number of observations (there were generally 500-600 monthly observations, and over 100 quarterly observations). Although there were experiments with monthly observations, in the post-2000 version of the CQM, principal components were extracted from quarterly averages of monthly indicators. After extracting principal components, forecasts of those are obtained using ARIMA (p, d, q) and not just AR(p) models. Generally, for one-quarter ahead forecast, actual values are available, and they will be used. In the target variable equations, the first principal component with 3 lags, or first three principal components, with one lag each, are included in the equation. Other principal components may also be included in the equation based on stepwise regressions (forward selection, with a p-value of 0.05). Although, there are differences, basic equations are almost the same. It should be noted that, in the target variable equation, the contemporaneous principal component is used and not the lagged one. The reason for that is that none of the target variables are included in the group of indicators. The other reason is related to using quarterly averages of monthly data. Data on period t may include just the data for the first month, or for the first two months. In a way, they are lagged in months.

$$PC_t = MX_t + \varepsilon_t$$

$$PC_t = \beta_1 PC_{t-1} + \beta_2 PC_{t-2} + ... + \beta_p PC_{t-p} + \nu_t + \alpha_1 \nu_{t-1} + \alpha_2 \nu_{t-2} + ... \alpha_q \nu_{t-q}$$

$$Y_t = SPC^{\wedge}_t + \phi_t$$

where, PC – principal components, M (factor loadings) and S are corresponding matrices.

Determination of orders, using Box-Jenkins methodology, in an ARIMA (p, d, q) may lead to AR (p, 0, 0) or simply AR(p). If it is AR (2), the first two equations in Klein's principal components and dynamic factor model with a single common factor are the same. The third equation is also the same if there are no additional principal components selected in a stepwise regression. Occasionally, there may be some additional principal component(s) selected in the equation. Since this process is repeated at least once a week, it may not possible to identify the final equation for all those periods. It is hard to determine the actual effect of those added components and see the difference between two approaches.

There may be some interesting questions to be addressed: Is there a similarity between the forecasts from the two principal components extracted from two different groups and forecasts from the case where two factors extracted in factor analysis, also with the VAR system? If principal components are used, is there much gain in using VAR as opposed to several AR equations because of orthogonality of contemporaneous principal components?

5 Klein's Bridge Equations and Principal Components: Examples of Supervised and Unsupervised Learning in Machine Learning

Human beings are supposed to learn from own experiences or studying experiences of others, and past occurances. In a similar way, computers can be taught (or programmed) to learn from past occurrances, or data (for data mining, learning, and artificial intelligence, see Alpaydin, 2010; Bishop, 2006; Goodfellow, Bengio and Courville, 2016; Hastie, Tibshirani and Friedman, 2008; James, Witten, Hastie and Tibshirani, 2017; Murphy, 2012; Müller and Guido, 2016; Nilsson, 2010).

Machine learning is essentially a form of applied statistics with increased emphasis on the use of computers (Goodfellow, Bengio and Courville, 2016, pp. 96). There are some terminology used in machine learning that has to be clarified to see the similarities with some of the techniques in econometrics. If data are available with known target variables, attributes, classes, or labels (Y), in addition inputs (X), then these may be used as training data. When new inputs become available, this may be used to get the target variables. Training data (generally in-sample data in econometrics), inputs (explanatory variables in econometrics), target variables, attributes, or classes (the dependent variable in econometrics) are the terminology used in machine learning. New inputs are post-sample explanatory variables (X's), and new target variables (Y) are forecasts in econometrics. There are many techniques under supervised learning, these definitions given here are geared towards the techniques of regressions and logistic regressions with binary dependent variables. It should be clear that logistic regression is very common in machine learning because of importance of classification. For example, an e-mail is to be checked if that is a spam or not. There are known inputs from past occurrances which distinguish the two. Use those characteristics, to determine if the new comer is a spam or not. Given the symptomps of past patients, some have to be treated for COVID-19, and some are to be treated for regular flu or other illnesses. Vast amount of data (blood samples, and others) for many patients may not be studied very easily by human beings. With data on the new patients, health care professionals may put them in groups of COVID or others. That is like forecasting in econometrics.

Regressions and principal components are widely used in machine learning literature. Regression is one of the methods among supervised learning, and principal components is a very common technique under unsupervised learning or dimensionality reductions in machine learning literature. Since the development of closer relationships between econometrics, data science and machine learning, a familiarity with some common techniques became more apparent. If no class values or attributes are available, i.e. there is no dependent variable, then the problem is unsupervised learning. Klein's contributions to regressions (Klein, 1947) and principal components (Klein, 1955) both predate the popularity of the term machine learning (Samuel, 1959), who was considered to be a pioneer in the field of computer gaming and artificial intelligence and the person who popularized the term "machine learning".[4]

[4] Samuel (1959, pp. 223, footnote 3) stated that the first operating checker program was written in 1952, and the first program with learning was completed in 1955.

Bridge equations are examples of regressions. Principal components also becoming popular as a data reduction technique in econometrics as vast amount of data become available. Klein widely used the method of principal components (Klein & Goldberger, 1955; Klein & Park, 1993, 1995; Klein & Ozmucur, 2001, 2002, 2003, 2004, 2008). Klein & Goldberger (1955) was quite significant because of using it in a macro econometric model. The method of two-stage least squares requires the knowledge of all exogeneous variables in the model, and not necessarily the specification of all the equations as in the three-stage least squares. However, since the first stage involves regressing the explanatory variables, one by one, in the equation on all the exogeneous variables in the model, one may run into a case where there are insufficient number of observations. With annual data, that was the issue in Klein & Goldberger (1955) model. They wanted to reduce the number of exogenous variables by using the method of principal components. They applied the method to all the exogeneous variables in the model and extracted principal components. It turned out the model with four principal components performed better than others. This was a very successful use of the technique. The method was criticized by some because of difficulty in interpretations of components, but it has gained popularity because of its usefulness,

Klein's Current Quarter Model was almost fully automated. One had to start a series of programs every Friday. Now, it is possible to have the program start at a predetermined date and time and make it fully automated. Release dates may be scraped from the internet and may be used in the programs. It should be noted that even that can be an issue. For example, during the government shut down, some statistics were not released at the scheduled time. If the program is based on those release dates, that can create an issue. There is probably a requirement for a human intervention in the work we do.

Data were downloaded with the help of a program. ARIMA models are estimated and forecasts from these equations are obtained. These forecasts are used in bridge equations if the indicator data are not available, yet. For example, if August numbers are available, they will be used. If the latest figure available for an indicator is for July, then August figure will be forecasted. Every week, these will be forecasted up to the end of the forecast period for quarterly variables. If the latest available GDP figure is for the second quarter, then third quarter and fourth quarter GDP figures are to be forecasted. Similarly, forecasts for monthly indicators up to December will be obtained, so that they can be used in bridge equations to forecast GDP and its components. Bridge equations for the expenditure side model and the income side model were estimated, and they were put into a model of about 200 equations including identities. The model is then solved for the third and fourth quarters. The principal components analysis used to extract as many principal components as the number of indicators, and not just the first one. ARIMA models are used to get forecasts for all the principal components (actually, two sets of principal components, one for real GDP, another one for GDP deflator). Real GDP and GDP deflator equations with principal components are estimated using stepwise regressions. The first principal component is included in the equation. Others will be added, and retained, if they have a p-value of 0.05. It is possible to have a principal component, say the 10th, in the equation. There were also experiments with lags 0, 1, and 2 of the first principal component as the variables always used in the equation. Forecasts for real GDP and GDP deflator were then exported to be put in the same table as forecasts for the expenditure side and income side models. Tables and graphs were produced, and they were then imported into a word file, using macros, for the weekly report.

6 Klein Paved the Way for Others: Macro-Econometric Models, Its Descendants/Alternatives and the Project LINK

Macro models built after the world war II were based on constant coefficients (for example, Klein, 1947, 1950; Klein & Goldberger, 1955; Duesenberry, Fromm, Klein, Kuh, 1965, Evans & Klein, 1968, the influences of Frisch (1933), Haavelmo (1943, 1944), and Tinbergen (1937, 1939)) on these models should be noted). In that way, it was possible to determine systematic relationships, and understand the behavioral patterns of agents in the economy and make use of a model for a policy analysis (see Pauly, 2018 for an excellent evaluation). They were very successfully used in structural analysis, policy making, and forecast for some time. A set of oil price shocks in 1970 s changed most of the existing structural relationships in economies all over the world. Models based on constant coefficients could not adjust to changes fast enough. Their forecasts did not perform that well. These models, and builders of these models, were criticized severely.

Although, all these new models may seem like they have nothing in common with Klein type standard macro econometric models, they all tried to address the limitations of standard models, and came up with their solutions, but not necessarily without any problems of their own. The discussions generated by Klein type of models and their accomplishments on econometric theory and methods of estimations were among the primary causes of existence of these models. It is no coincident that all competitors of Klein type of models appeared and become more popular after 1980 s.

The critics of standard macro econometric models, simultaneous equations models, proposed alternative models. These alternatives paved way to vector autoregressive models (VAR), which have lower number of equations and variables, and less restrictions on coefficients. However, after a few years, issues with these models also surfaced. Variations of these models such as Bayesian VAR, VAR with restrictions, and Structural VAR, Vector error correction (VEC) had to be developed.

Somewhat eclectic nature of existing models at the time also required some consistency in the long-run relationship between variables. Cointegration and error correction models (ECM) are geared towards imposing some long-term theoretical relationship between variables in the model. A multivariate version of this principle and a VAR system led to Vector error correction (VEC) models.

The behavior of agents (individual or micro level) and data provided at a macro level have always been an issue for economists. Dynamic stochastic general equilibrium models (DSGE) try to bridge the gap between micro and macro theories and data.

During 2017-2019, we have attended many meetings organized by universities, research institutes, international organizations, academics, private sector, Central Banks, and other public authorities with prominent participants from all over the world. They all have different models covering a wide spectrum of modeling techniques and data sources. We have not heard a single negative growth prediction for the US or for the world economy for the medium-run forecast horizon (2020-2021) (we apologize to every single individual who had a negative growth forecast, but we missed it).

All models failed to capture the downturn, probably not fully but mostly related to COVID-19. Is this like models failing to provide accurate forecasts because of oil price shocks of 1970 s or wars?

Is appearance of COVID-19 really a random event? or an ignored or missed event, given earlier outbreaks? SARS, MERS, H1N1, Ebola, Swine flu, etc. How many observations do we need to have some positive number in the empirical probabilities of such events? A regional climate model with appearance of virus or bacteria may have predicted an outbreak or pandemic, maybe not the exact timing? Although, we think we know a lot about the world, we probably ignored the degree of interrelatedness. Did we miss an event because of lack of understanding of today's world? These questions have been asked. Hopefully, researchers will work on these and alleviate some of the pain in the future. The coordination of international community appears to be the key in all aspects of the issues we deal with.

The new corona virus brought about the ugly truth about the leading economies. It also brought about the inconvenient truth about econometric models that all may have to be adjusted. After all, models are supposed to be the simpler representations of the real world.

An advantage is that recent data includes with big decreases in GDP and significant increases in the rate of unemployment. Empirical probabilities will change because of these large movements. The likelihood of capturing a downturn may be higher, now. On the other side, modelers may realize large number of underestimations of growth and overestimations of unemployment rate. We hope that these will be temporary, but with the current situation we cannot be sure of that. Large fluctuations and volatility at the end of the period may also contaminate some of the forecasts.

There are more fundamental issues related to modeling and data. In general, it is very difficult econometric models to maneuver because of constant coefficients, or coefficients varying but in a systematic way. It becomes difficult to capture a turning point. In modeling, a population relationship is assumed to be composed of a systematic relation and a disturbance term. Other terms besides these may have to be considered in the relationship to stand for other unknowns.

Similar concerns are present for data use. If it is a different world, there may be other data series that researchers have to use. Data which may be relevant in 1980, may no longer be relevant in 2020. There are other indicators to be searched for and utilized. There are plenty of wrong information (garbage) on the web so one must be very careful, but if one knows exactly what s/he is looking for, web may be a good source to start for data not provided by official sources. It should also be remembered that most, if not all, of these internet-based data are not based on random sampling.

In a more interrelated world as seen by L. R. Klein, one must look at the whole picture and not just parts of it. Interregional input/output tables, flow-of-funds all become very relevant. In addition to standard coverage, econometric models should explicitly include population, migration, environmental, weather, health, natural disasters. They do not all have to be in the same model; they may be in closely interrelated several models. This seems like a necessity for forecast accuracy and comprehensiveness in a globalized environment.

All this virus or modeling related new developments is another reminder of Klein's visionary approach in starting Project LINK with Bert Hickman. Project LINK is based on the idea that researchers in a country have a better understanding of their own country than any other person in a different part of the world. If it is possible to bring prominent researchers from different countries, it may be possible to learn more about all those countries and solve problems associated with them. These issues may be related to modeling, data, policy making or any other issue that may come up during the meetings.

The models are linked with a trade matrix, export prices and imports. In addition to flow of goods, there were experiments with flow-of funds, and tourism to capture global linkages. There were also individual efforts on global value chains, and other topics of interest to global community. There were LINK model simulations presented by Peter Pauly and others on the effect of certain policies such as arms race or interest rate reductions on the global economy. This is probably the time that such a group is needed the most. Project LINK may now include models, or satellite models, on population, political science, environment, weather, and health related issues. These efforts require funding by visionaries.

7 Conclusion

The Nobel Committee summarized Klein's impact: "Through his publications and through his extensive guidance to groups of research workers in different countries, Klein has, to a high degree, stimulated research on econometric forecasting models and on the possibilities of using such models for practical analysis of economic policies. Thanks to Klein's contributions, the building of econometric models has attained a widespread, not to say, universal use. It is now to be found all through the world, not only at scientific institutions, but also in public administration, political organizations and large enterprises. Few, if any, research workers in the empirical field of economic science, have had so many successors and such a large impact as Lawrence Klein." (Source: Press release. NobelPrize.org. Nobel Media AB 2018. Fri. 14 Sep 2018. https://www.nobelprize.org/prizes/economics/1980/summary/)

We had the pleasure of knowing a decent human being with unmatched qualities and the honor of working with a great econometrician and an economist. Therefore, it may seem rather difficult for us to be completely objective, but we believe we are impartial, and very confident with almost perfect certainty to make the following two claims:

1. The result of a test between Alexander Graham Bell's first telephone and a most developed cell phone may be obvious, but that does not take anything away from Bell's telephone. High quality modeling efforts with greater computing power and vast data availability are admirable, but surely owe a lot to pioneers in modeling and forecasting, including L. R. Klein.
2. There are probably millions of research papers/books, which take a world that is round, and gravity as given. Those two facts are well known for centuries, thanks to Aristotle and Newton. L. R. Klein is somewhat in a similar position in the field of econometrics. During the last 50 years, there are a lot of research in econometrics, by researchers even not knowing his contributions, that are based on ideas and examples put forward by L. R. Klein.

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9 Appendix: Klein's Last Weekly Report of the Current Quarter Model for the US (dated October 21, 2013, distributed on October 18, 2013)

http://web.sas.upenn.edu/ozmucur/2020/08/23/klein-ozmucur-weekly-update-on-the-u-s-economy-october-21-2013/

Current Quarter Model of the United States Economy

FORECAST SUMMARY

by L. R. Klein and S. Ozmucur

Based on the Current Quarter Model methodology originally developed by Professor Lawrence R. Klein in 1980s at the University of Pennsylvania, we have established statistical relationships between some 200 monthly economic and financial indicators and the main entries in the quarterly national income and product accounts (NIPA). This is a purely econometric system with no personal data adjustment. We update, on a weekly basis, partial information on the United States economy from high-frequency indicators, as they become available, and revise our current (and next) quarter forecasts, on a forward rolling basis.

In addition to economic forecasting at high-frequency intervals, our Current Quarter Model features the combination of GDP forecasts from three approaches -- from bridge equations of both the product (expenditure) side and the income side of the NIPA, and from regressions of GDP on the principal components of selected major indicators.

- The results of Freddie Mac's Primary Mortgage Market Survey of October 17th showed average fixed mortgage rates edging higher. The 30-year fixed mortgage rate averaged 4.28% for the week ending October 17, up from last week when it averaged 4.23%.
- Mortgage applications increased 0.3% from a week earlier, according to data from Mortgage Bankers Association's (MBA) Weekly Applications Survey for the week ending October 11th.
- The October 2013 Empire State Manufacturing Survey indicated that business conditions held steady for New York manufacturers.
- The Philadelphia FED business outlook survey for October reported increased manufacturing activity.
- The FED's "Beige Book" indicated that overall economic activity continued to expand at a modest to moderate pace during the reporting period of September through early October.
- The Current Quarter Model's average forecast for growth in the third quarter real GDP was revised slightly downward, from 1.80% to 1.75%. The consumption deflator growth forecast was unchanged at 2.45%. There were little changes in forecasts primarily due to limited number of data releases.

Table of Contents

The Week's Economic Highlights

- Due to government shutdown, there were only a few data releases.
- The advance figure for initial claims for unemployment insurance decreased 15 thousand to 358 thousand in the week ending October 12th.

FORECAST UPDATE OVERVIEW

This forecast incorporates the following National Income and Product Accounts:

SEP26 GDP(based on Chain 2009 Weights) for (2013Q2) (2.48%)
SEP27 Personal Income and Consumption for (AUG) (0.4,0.3%)

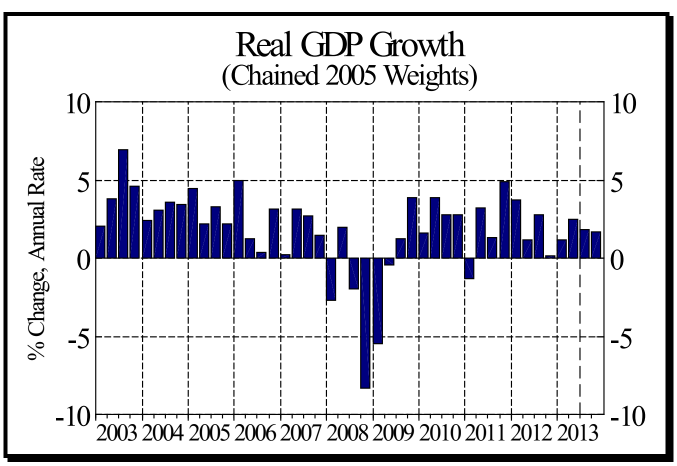
This forecast incorporates new items of information (marked in bold) that were not included in the most recent previous forecast:

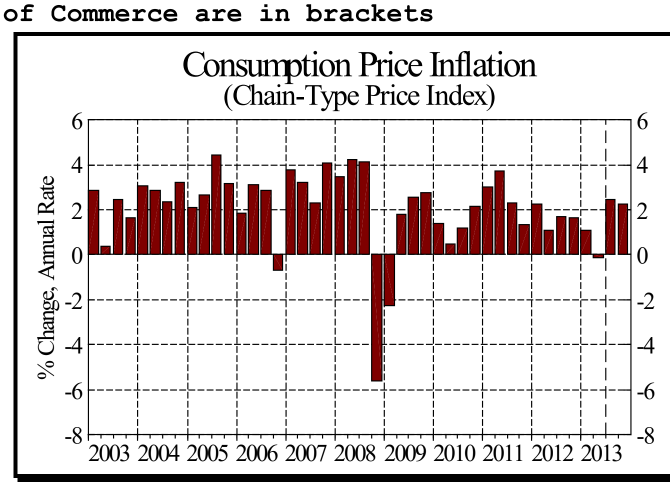
			Latest Month	Prior Month
SEP03	New Construction...............for	(JUL)	$900.8B(0.6%)	895.7B(-0.04%)
SEP05	Domestic Auto Sales............for	(AUG)	5.528M(0.3%)	5.512M(0.0%)
SEP06	Nonfarm Payroll Employment.....for	(AUG)	136.133(169T)	135.964(104T)
OCT07	Consumer Credit Outstanding....for	(AUG)	$3036.9M(0.4%)	$3023.3M(0.3%)
SEP12	Export/Import Price Index......for	(AUG)	(-0.5%/0.0%)	(-0.1%/0.1%)
SEP13	Producer Price Index...........for	(AUG)	197.9(0.3%)	197.3(0.8%)
SEP13	Retail Sales...................for	(AUG)	$380.7B(0.2%)	$379.9B(0.4%)
SEP16	Industrial Production Index....for	(AUG)	99.4(0.4%)	99.0(0.0%)
SEP13	Business Inventories...........for	(JUN)	$1661.9B(0.4%)	$1655.7B(0.1%)
SEP17	Consumer Price Index...........for	(AUG)	233.5(0.2%)	233.3(0.2%)
SEP18	Housing Starts.................for	(AUG)	891T(0.9%)	883T(5.7%)
SEP04	Net Exports (BOP Basis)........for	(JUL)	-$39.1B(-4.6B)	-$34.5B(9.2B)
SEP25	Durable Goods Orders...........for	(AUG)	$224.96B(0.1%)	$224.6B(-8.1%)
SEP05	Manuf Ships, Inv, & Orders.....for	(JUL)	(1.1%,0.2%,-2.4%)	(-0.3%,0.2%,1.6%)

Weekly forecasts of the annual growth rates of Real GDP (RGDP) and annual inflation rates of the (Chain-Type) Price Index of Personal Consumption Expenditures (PPCE):

	RGDP(%)				**PPCE(%)**				***Official***
	13Q1	13Q2	13Q3	13Q4	13Q1	13Q2	13Q3	13Q4	*Releases*
JUN03	[2.39]	2.19	2.88		[0.99]	1.21	2.07		<=2nd 13Q1
JUN10	2.39	1.90	2.70		0.99	1.21	2.07		
JUN17	2.39	1.83	2.73		0.99	1.21	2.07		
JUN24	2.39	1.74	2.64		0.99	1.40	2.29		
JUL01	[1.78]	1.77	2.45		[1.00]	1.21	2.31		<=3rd 13Q1
JUL08	1.78	2.14	2.42		1.00	1.21	2.31		
JUL15	1.78	2.46	2.71		1.00	1.21	2.31		
JUL22	1.78	2.43	2.47		1.00	1.40	3.06		
JUL29	1.78	2.42	2.45		1.00	1.40	3.06		
AUG05	1.15	[1.67]	1.36	1.76	1.08	[0.03]	3.02	2.58	<=1st 13Q2
AUG12	1.15	[1.67]	1.69	2.23	1.08	[0.03]	3.02	2.58	
AUG19	1.15	[1.67]	1.61	2.27	1.08	[0.03]	2.55	2.35	
AUG26	1.15	[1.67]	1.61	2.27	1.08	[0.03]	2.55	2.35	
SEP02	1.15	[2.52]	1.24	2.00	1.08	[0.03]	2.55	2.35	<=2nd 13Q2
SEP09	1.15	[2.52]	1.07	1.81	1.08	[0.03]	2.55	2.35	
SEP16	1.15	[2.52]	1.22	1.83	1.08	[0.03]	2.55	2.35	
SEP23	1.15	[2.52]	1.26	1.86	1.08	[0.03]	2.46	2.24	
SEP30	1.15	[2.48]	1.81	1.67	1.08	[-0.12]	2.45	2.23	<=3rd 13Q2
OCT07	1.15	2.48	1.81	1.63	1.08	-0.12	2.45	2.23	
OCT14	1.15	2.48	1.80	1.62	1.08	-0.12	2.45	2.23	
=> OCT21	**1.15**	**2.48**	**1.75**	**1.58**	**1.08**	**-0.12**	**2.45**	**2.23**	

Official figures released by the Department of Commerce are in brackets

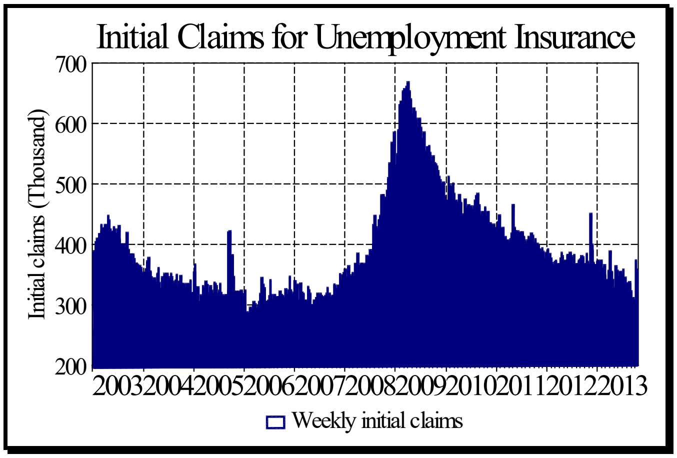




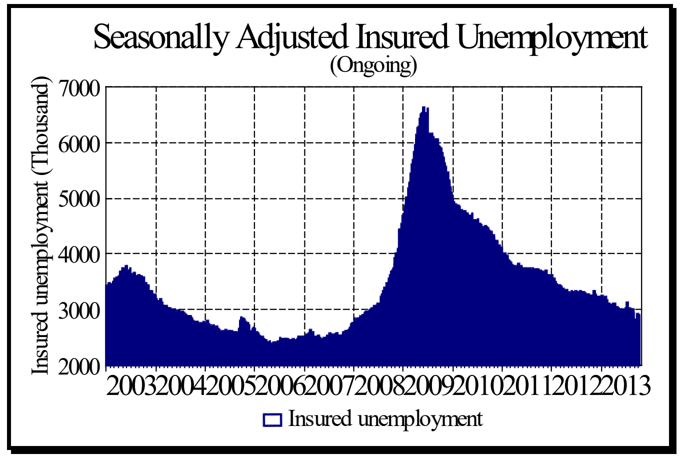
High Frequency Indicators

The Week in Review (Oct 14 – Oct 18)

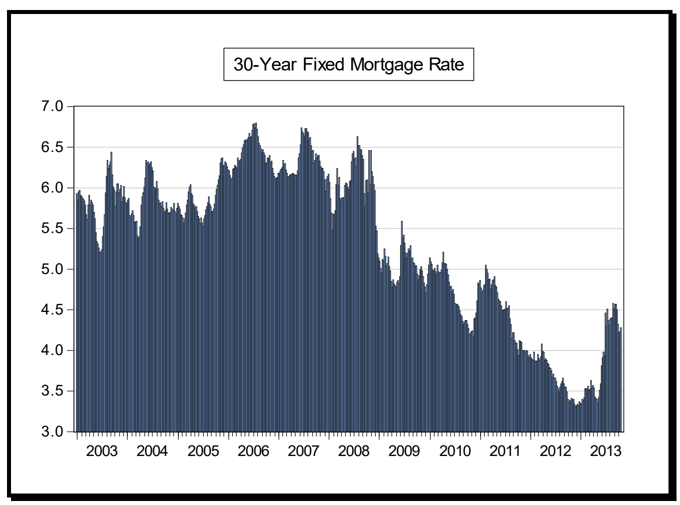
The advance figure for **initial claims for unemployment insurance** was 358 thousand in the week ending October 12, a decrease of 15 thousand from the previous week's revised figure of 373 thousand, according to U.S. Department of Labor. The four-week moving average was 336.5 thousand, an increase of 11.75 thousand from the previous week's revised average of 324.75 thousand.



The advance number for seasonally adjusted **insured unemployment** during the week ending October 5 was 2,859 thousand, a decrease of 43 thousand from the previous week's revised level of 2,902 thousand. The four-week moving average was 2,875.75 thousand, an increase of 17.75 thousand from the previous week's revised average of 2,858 thousand.



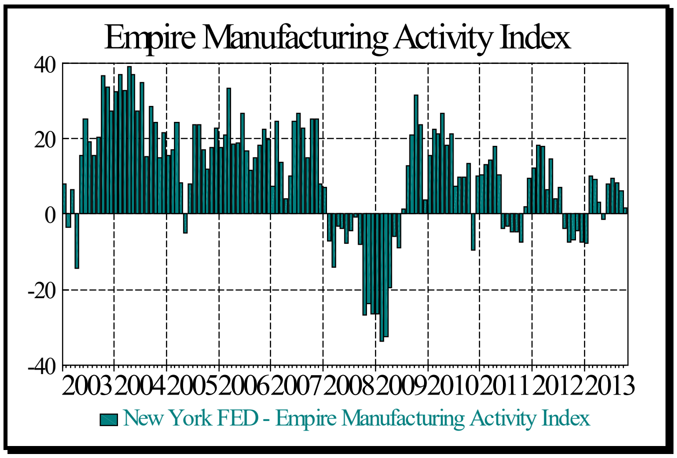
The results of Freddie Mac's Primary Mortgage Market Survey of October 17th showed average fixed mortgage rates edging higher. The 30-year fixed **mortgage rate** averaged 4.28% with an average 0.7 point for the week ending October 17, up from last week when it averaged 4.23%. Last year at this time, the 30-year fixed rate was 3.37%. The 15-year fixed-rate mortgage averaged 3.33% with an average of 0.7 point, up from last week when it averaged 3.31%. A year ago at this time, the 15-year fixed-rate mortgage averaged 2.66%. The 5-year Treasury-indexed hybrid adjustable-rate mortgage (ARM) averaged 3.07% with an average of 0.4 point, up from last week when it averaged 3.05%. A year ago at this time, the 5-year ARM averaged 2.75%.



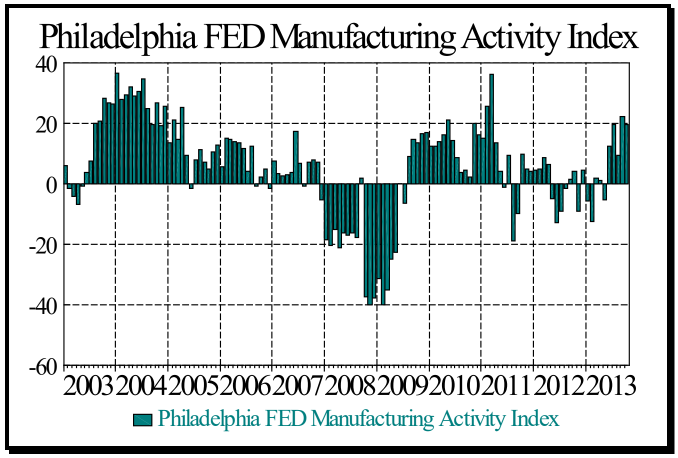
Mortgage applications increased 0.3% from a week earlier, according to data from Mortgage

Bankers Association's (MBA) Weekly Applications Survey for the week ending October 11th. The average contract interest rate for 30-year fixed mortgages with conforming loan balances ($417,500 or less) increased to 4.46% from 4.42%, with points decreasing to 0.31 from 0.44 (including the origination fee) for 80% loan-to-value ratio loan. The average contract interest rate for 15-year fixed mortgages with conforming loan balances ($417,500 or less) increased to 3.53% from 3.52%, with points decreasing to 0.31 from 0.34 (including the origination fee) for 80% loan-to-value ratio loan.

The October 2013 **Empire State** Manufacturing Survey indicated that business conditions held steady for New York manufacturers. The general business conditions index was 1.52 in October, compared to 6.29 in September. The prices paid index inched up to 21.69, from 21.51.



The **Philadelphia FED** business outlook survey for October reported increased manufacturing activity. The current activity diffusion index was 19.8 in October (positive numbers indicate increasing activity), compared with 22.3 in the previous month. The diffusion index of prices paid decreased to 21.7, from 25.3.



The FED's "**Beige Book**" indicated that overall economic activity continued to expand at a modest to moderate pace during the reporting period of September through early October. Eight Districts reported similar growth rates in economic activity as during the previous reporting period, while growth slowed some in the Philadelphia, Richmond, Chicago, and Kansas City Districts. Consumer spending continued to increase and activity in the travel and tourism sector expanded in most Districts. Demand for nonfinancial services increased slightly. Manufacturing activity expanded modestly. Residential real estate activity continued to increase at a moderate pace, and nonresidential real estate expanded at a slower rate. Lending activity remained modest in most Districts. There were mixed reports for agriculture. Energy and mining activity expanded or maintained high levels. Hiring held steady or increased modestly. Price and wage pressures were again limited.

The Week in Preview (Oct 21 – Oct 25)

The report on **existing home sales** for September will be released on October 21 (Monday). The **Federal Housing Finance Agency (FHFA) house price index** for August will be released on October 23 (Wednesday). Reports on **new home sales** and **durable goods orders** for September will be released on October 25 (Friday). The Reuters/University of Michigan **index of consumer sentiment** for October will be released on the same day.

Current Quarter Forecasts

There were little changes in forecasts primarily due to limited number of data releases. The Current Quarter Model's average forecast for growth in the third quarter real GDP was revised slightly downward, from 1.80% to 1.75%. The expenditure side model forecast was revised slightly downward, while the income side model and the principal components model forecasts held steady.

The average forecast for growth in the third quarter GDP deflator was unchanged at 1.22%. The consumption deflator (chain-type) growth forecast was unchanged at 2.45%.

The average forecast for nominal GDP was revised slightly downward, from $16,771.5 billion to 16,769.8 billion. This indicates an annualized increase of 2.63% from the previous quarter, and an increase of 2.53% from a year before.

The expenditure side model forecast for growth in third quarter real GDP was revised slightly downward, from 1.65% to 1.51%. The income side model forecast was unchanged at 1.89%. The principal components model forecast was unchanged at 1.86%.

The expenditure side and income side model GDP deflator forecasts were unchanged at 1.40%. The principal component GDP deflator forecast was unchanged at 0.85%.

Real GDP growth rate forecast for the year 2013 is 1.53%. The consumption deflator (chain-type) growth forecast for 2013 is 1.27%, and the GDP deflator forecast is 1.34%.

If you have any questions, comments, or suggestions, please feel free to contact us at E-mail: ozmucur@econ.upenn.edu.

FORECAST SUMMARY TABLE

Monthly Economic Indicators

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	2013Q2 Actual	2013Q3 Forecast
PRODUCTION								
Industrial Production Index (2007=	98.75	98.86	98.99	98.96	99.36	99.58	98.86	99.30
% Change	-0.3	0.1	0.1	-0.0	0.4	0.2		
% Change, Annual Rate	-4.0	1.4	1.5	-0.4	5.0	2.7	0.7	1.8
% Change, Year Ago	2.0	1.8	1.9	1.4	2.7	2.7	1.9	2.3
New Orders for Manufactured Goods	475.04	489.11	497.06	485.05	492.44	494.36	487.07	490.62
% Change	1.3	3.0	1.6	-2.4	1.5	0.4		
% Change, Annual Rate	16.2	41.9	21.4	-25.4	19.9	4.8	7.6	2.9
% Change, Year Ago	0.8	4.5	6.9	1.4	8.7	3.7	4.0	4.5
Nondefense Capital Goods Shipments	71.39	75.86	74.52	73.50	73.81	74.43	73.93	73.91
% Change	-3.5	6.3	-1.8	-1.4	0.4	0.8		
% Change, Annual Rate	-35.0	107.2	-19.3	-15.4	5.2	10.6	5.7	-0.1
% Change, Year Ago	-0.4	4.7	3.7	2.0	4.2	3.2	4.0	4.5
Nonfarm Payroll Employment (Mil)	135.512	135.688	135.860	135.964	136.133	136.276	135.687	136.124
+ Difference	0.199	0.176	0.172	0.104	0.169	0.143	0.579	0.438
% Change, Annual Rate	1.8	1.6	1.5	0.9	1.5	1.3	1.7	1.3
% Change, Year Ago	1.6	1.6	1.7	1.6	1.6	1.6	1.6	1.6
PRICES								
PPI, Finished Goods (1982=100)	194.8	195.8	197.3	197.3	197.9	198.3	196.0	197.8
% Change	-0.7	0.5	0.8	0.0	0.3	0.2		
% Change, Annual Rate	-8.2	6.3	9.6	0.0	3.7	2.6	-1.2	3.9
% Change, Year Ago	0.6	1.8	2.5	2.1	1.4	0.6	1.6	1.4
CPI, All-Urban (1982-84=100)	231.5	231.8	232.9	233.3	233.5	233.9	232.1	233.6
% Change	-0.4	0.1	0.5	0.2	0.1	0.1		
% Change, Annual Rate	-4.3	1.8	5.9	1.9	1.1	1.7	-0.0	2.6
% Change, Year Ago	1.1	1.4	1.8	2.0	1.5	1.1	1.4	1.5
DEMAND AND SPENDING								
Retail Sales (Bil$)	372.87	375.25	378.36	379.94	380.69	382.65	375.50	381.09
% Change	0.1	0.6	0.8	0.4	0.2	0.5		
% Change, Annual Rate	0.9	7.9	10.4	5.1	2.4	6.4	3.6	6.1
% Change, Year Ago	3.5	4.4	6.3	6.0	4.8	4.1	4.7	5.0
Housing Starts (Mil)	0.852	0.919	0.835	0.883	0.891	0.874	0.869	0.883
% Change	-15.2	7.9	-9.1	5.7	0.9	-1.9		
% Change, Annual Rate	-86.2	148.0	-68.3	95.6	11.4	-20.3	-32.2	6.6
% Change, Year Ago	13.0	29.3	10.3	19.2	19.0	2.4	17.3	13.0
Sales of Domestic Passenger Cars (	5.26	5.28	5.51	5.51	5.52	5.24	5.35	5.42
% Change	-2.0	0.4	4.3	0.0	0.1	-5.1		
% Change, Annual Rate	-21.3	4.9	66.0	0.4	1.8	-46.5	-5.8	5.6
% Change, Year Ago	3.4	7.1	9.8	11.0	7.0	1.5	6.7	6.4
Business Inventories (Bil$)	1655.63	1654.77	1655.70	1661.89	1664.60	1667.30	1655.36	1664.60
% Change	0.2	-0.1	0.1	0.4	0.2	0.2		
% Change, Year Ago	4.1	3.7	3.5	3.2	2.9	2.4	3.8	2.8
+ Difference, Annual Rate	34.6	-10.3	11.2	74.3	32.5	32.4	8.7	36.9
EXTERNAL SECTOR								
Merchandise Trade Balance, Census	-57.29	-62.03	-52.44	-57.46	-58.82	-55.86	-687.04	-688.58
+ Difference	-3.1	-4.7	9.6	-5.0	-1.4	3.0		
+ Difference, Annual Rate	-37.5	-56.9	115.1	-60.3	-16.4	35.5	13.56	-1.54
+ Difference, year ago	5.6	0.2	5.9	1.2	0.9	2.1		

FORECAST SUMMARY TABLE
Gross Domestic Product
Billions of (Chained 2009) Dollars,
Seasonally Adjusted, Annual Rate

	2012Q4	2013Q1	2013Q2	2013Q3	2013Q4
	< a c t u a l >			< forecast >	
Real GDP					
(i) Expenditure Side GDP	15539.6	15583.9	15679.7	15738.7	15789.2
% Previous Q, A.R.	0.14	1.15	2.48	1.51	1.29
% Year before	1.95	1.32	1.63	1.32	1.61
(ii) Income Side GDP	15539.6	15583.9	15679.7	15753.4	15790.6
% Previous Q, A.R.	0.14	1.15	2.48	1.89	0.95
% Year before	1.95	1.32	1.63	1.41	1.62
(iii) Principal Components est. GDP	15539.6	15583.9	15679.7	15752.0	15850.0
% Previous Q, A.R.	0.14	1.15	2.48	1.86	2.51
% Year before	1.95	1.32	1.63	1.40	2.00
Average Real GDP	15539.6	15583.9	15679.7	15748.0	15809.9
% Previous Q, A.R.	0.14	1.15	2.48	1.75	1.58
% Year before	1.95	1.32	1.63	1.38	1.74
GDP Deflator (2009=100)					
(i) Expenditure Side PGDP	105.6	106.0	106.2	106.5	107.0
% Previous Q, A.R.	1.12	1.35	0.65	1.40	1.63
% Year before	1.79	1.63	1.35	1.13	1.26
(ii) Income Side PGDP: Same as (i)	105.6	106.0	106.2	106.5	107.0
% Previous Q, A.R.	1.12	1.35	0.65	1.40	1.63
% Year before	1.79	1.63	1.35	1.13	1.26
(iii) Principal Components est. PGDP	105.6	106.0	106.2	106.4	106.8
% Previous Q, A.R.	1.12	1.35	0.65	0.85	1.39
% Year before	1.79	1.63	1.35	0.99	1.06
Average GDP Deflator	105.6	106.0	106.2	106.5	106.9
% Previous Q, A.R.	1.12	1.35	0.65	1.22	1.55
% Year before	1.79	1.63	1.35	1.08	1.19
Nominal GDP					
(i) Expenditure Side GDP$	16420.3	16535.3	16661.0	16767.3	16889.1
% Previous Q, A.R.	1.58	2.83	3.08	2.58	2.94
% Year before	3.80	3.08	3.10	2.51	2.86
(ii) Income Side GDP$	16420.3	16535.3	16661.0	16783.0	16890.6
% Previous Q, A.R.	1.58	2.83	3.08	2.96	2.59
% Year before	3.80	3.08	3.10	2.61	2.86
(iii) Principal Components est. GDP$	16420.3	16535.3	16661.0	16758.6	16921.2
% Previous Q, A.R.	1.58	2.83	3.08	2.36	3.94
% Year before	3.80	3.08	3.10	2.46	3.05
Average Nominal GDP	16420.3	16535.3	16661.0	16769.6	16900.3
% Previous Q, A.R.	1.58	2.83	3.08	2.63	3.15
% Year before	3.80	3.08	3.10	2.53	2.92

EXPENDITURE SIDE

Real Gross Domestic Product

Billions of Chained (2009) Dollars, SAAR

	2012Q4	2013Q1	2013Q2	2013Q3	2013Q4
Gross Domestic Product	15539.60	15583.90	15679.70	15738.70	15789.24
Total Demand	17918.70	17966.60	18102.60	17781.95	17836.28
Domestic Demand	15950.80	16005.80	16104.10	15771.27	15792.12
Domestic Final Demand	15939.70	15958.60	16041.00	15727.43	15757.65
Final Demand	15528.30	15536.40	15616.20	15316.58	15352.12
Personal Consumption Expenditures	10584.80	10644.00	10691.90	10708.88	10722.41
Durable Goods	1285.20	1303.50	1323.20	1337.82	1346.91
Nondurable Goods	2306.70	2322.20	2331.70	2368.02	2392.97
Services	7004.70	7031.10	7051.50	7021.18	7003.84
Gross Private Domestic Investment	2441.80	2470.10	2524.90	2124.88	2130.60
Fixed Investment	2429.10	2420.00	2458.40	2081.02	2096.16
Nonresidential	1971.90	1949.00	1971.30	1558.41	1570.66
Equipment	918.80	922.50	929.90	629.71	632.05
Intellectual Property	614.90	620.60	618.30	490.81	498.18
Structures	439.40	407.90	424.80	471.71	474.57
Residential	457.50	471.20	487.10	476.26	478.95
Change In Business Inventories	7.30	42.20	56.60	43.84	34.45
Farm	-9.60	16.00	19.50	17.36	8.12
Nonfarm	20.30	22.20	32.70	26.47	26.33
Net Exports	-412.10	-422.30	-424.40	-410.83	-405.52
Exports	1967.00	1960.50	1998.40	2010.68	2044.22
Imports	2379.10	2382.70	2422.90	2421.51	2449.74
Government Purchases	2938.80	2907.40	2904.50	2937.52	2939.10
Federal	1198.90	1172.80	1168.20	1164.77	1157.72
State and Local	1739.80	1734.30	1736.00	1772.74	1781.36

Percent Change, Annual Rate

	2012Q4	2013Q1	2013Q2	2013Q3	2013Q4
Gross Domestic Product	0.14	1.15	2.48	1.51	1.29
Total Demand	-0.30	1.07	3.06	-6.90	1.23
Domestic Demand	-0.51	1.39	2.48	-8.01	0.53
Domestic Final Demand	1.44	0.48	2.08	-7.59	0.77
Final Demand	2.18	0.21	2.07	-7.46	0.93
Personal Consumption Expenditures	1.67	2.26	1.81	0.64	0.51
Durable Goods	10.54	5.82	6.18	4.49	2.75
Nondurable Goods	0.64	2.72	1.65	6.38	4.28
Services	0.65	1.52	1.17	-1.71	-0.98
Gross Private Domestic Investment					
Fixed Investment	11.57	-1.49	6.50	-48.66	2.94
Nonresidential	9.79	-4.56	4.66	-60.94	3.18
Equipment	8.86	1.62	3.25	-78.97	1.50
Intellectual Property	5.73	3.76	-1.47	-60.29	6.15
Structures	17.54	-25.74	17.63	52.04	2.45
Residential	19.80	12.53	14.20	-8.61	2.28
Exports	1.11	-1.32	7.96	2.48	6.84
Imports	-3.12	0.61	6.92	-0.23	4.74
Government Purchases	-6.53	-4.21	-0.40	4.62	0.22
Federal	-13.90	-8.43	-1.56	-1.17	-2.40
State and Local	-1.03	-1.26	0.39	8.74	1.96

EXPENDITURE SIDE

Nominal Gross Domestic Product

Billions of Dollars, SAAR

	2012Q4	2013Q1	2013Q2	2013Q3	2013Q4
Gross Domestic Product	16420.30	16535.30	16661.00	16767.32	16889.11
Total Demand	19149.80	19272.60	19408.90	19522.47	19666.44
Domestic Demand	16936.10	17058.40	17170.00	17263.99	17376.21
Domestic Final Demand	16923.10	16995.00	17092.80	17216.14	17338.40
Final Demand	16407.30	16471.90	16583.80	16719.47	16851.30
Personal Consumption Expenditures	11285.50	11379.20	11427.10	11514.87	11593.13
Durable Goods	1230.70	1244.80	1257.50	1267.28	1275.60
Nondurable Goods	2595.40	2607.00	2591.00	2635.53	2656.70
Services	7459.40	7527.40	7578.60	7612.06	7660.83
Gross Private Domestic Investment	2499.90	2555.10	2621.00	2618.13	2637.56
Fixed Investment	2486.90	2491.70	2543.80	2570.28	2599.74
Nonresidential	2018.20	2001.40	2030.60	2046.23	2069.90
Equipment	925.00	928.00	934.60	929.49	934.53
Intellectual Property	635.40	644.30	643.50	654.41	667.00
Structures	457.80	429.10	452.60	462.39	468.39
Residential	468.80	490.30	513.20	524.05	529.84
Change In Business Inventories	13.00	63.40	77.20	47.85	37.81
Farm	-15.60	38.90	40.40	18.95	8.92
Nonfarm	28.60	24.50	36.90	28.90	28.90
Net Exports	-515.80	-523.10	-509.00	-496.67	-487.10
Exports	2213.70	2214.20	2238.90	2258.47	2290.23
Imports	2729.50	2737.30	2747.90	2755.14	2777.33
Government Purchases	3150.70	3124.10	3121.90	3131.00	3145.53
Federal	1275.20	1255.00	1252.60	1249.46	1248.20
State and Local	1875.40	1869.10	1869.30	1881.54	1897.32

Percent Change, Annual Rate

	2012Q4	2013Q1	2013Q2	2013Q3	2013Q4
Gross Domestic Product	1.58	2.83	3.08	2.58	2.94
Total Demand	1.48	2.59	2.86	2.36	2.98
Domestic Demand	1.33	2.92	2.64	2.21	2.63
Domestic Final Demand	2.99	1.71	2.32	2.92	2.87
Final Demand	3.31	1.58	2.75	3.31	3.19
Personal Consumption Expenditures	3.32	3.36	1.69	3.11	2.75
Durable Goods	8.27	4.66	4.14	3.15	2.65
Nondurable Goods	2.66	1.80	-2.43	7.05	3.25
Services	2.77	3.70	2.75	1.78	2.59
Gross Private Domestic Investment	1.06	9.13	10.72	-0.44	3.00
Fixed Investment	13.07	0.77	8.63	4.23	4.67
Nonresidential	10.60	-3.29	5.96	3.11	4.71
Equipment	10.50	1.30	2.88	-2.17	2.18
Intellectual Property	5.13	5.72	-0.50	6.96	7.92
Structures	19.02	-22.82	23.77	8.94	5.29
Residential	24.62	19.65	20.03	8.73	4.50
Exports	2.66	0.09	4.54	3.54	5.74
Imports	0.88	1.15	1.56	1.06	3.26
Government Purchases	-5.25	-3.33	-0.28	1.17	1.87
Federal	-13.45	-6.19	-0.76	-1.00	-0.40
State and Local	0.86	-1.34	0.04	2.65	3.40

EXPENDITURE SIDE

Gross Domestic Product Chain-Type Price Index

Index 2009=100

	2012Q4	2013Q1	2013Q2	2013Q3	2013Q4
Gross Domestic Product	105.64	105.99	106.17	106.54	106.97
Total Demand	106.87	107.27	107.22	109.79	110.26
Domestic Demand	106.15	106.47	106.53	109.46	110.03
Domestic Final Demand	106.17	106.50	106.56	109.47	110.03
Final Demand	105.66	106.02	106.20	109.16	109.77
Personal Consumption Expenditures	106.62	106.91	106.88	107.53	108.12
Durable Goods	95.75	95.49	95.02	94.73	94.71
Nondurable Goods	112.52	112.26	111.13	111.30	111.02
Services	106.49	107.06	107.48	108.42	109.38
Gross Private Domestic Investment	102.20	102.73	103.21	123.21	123.80
Fixed Investment	121.98	122.52	123.04	123.51	124.02
Nonresidential	129.85	130.37	130.87	131.30	131.79
Equipment	146.86	147.11	147.36	147.61	147.86
Intellectual Property	131.61	132.18	132.79	133.33	133.89
Structures	96.07	96.87	97.52	98.02	98.70
Residential	108.32	108.91	109.48	110.03	110.63
Exports	114.11	113.83	112.28	112.32	112.03
Imports	114.35	114.14	114.13	113.78	113.37
Government Purchases	107.21	107.45	107.49	106.59	107.02
Federal	106.37	107.01	107.23	107.27	107.80
State and Local	107.80	107.78	107.68	106.14	106.51

Percent Change, Annual Rate

	2012Q4	2013Q1	2013Q2	2013Q3	2013Q4
Gross Domestic Product	1.12	1.35	0.65	1.40	1.63
Total Demand	1.78	1.50	-0.20	9.94	1.74
Domestic Demand	1.55	1.20	0.22	11.50	2.09
Domestic Final Demand	1.53	1.23	0.24	11.36	2.09
Final Demand	1.10	1.37	0.66	11.62	2.24
Personal Consumption Expenditures	1.63	1.08	-0.12	2.45	2.23
Durable Goods	-2.06	-1.08	-1.96	-1.21	-0.09
Nondurable Goods	2.01	-0.91	-3.99	0.62	-0.99
Services	2.11	2.15	1.57	3.54	3.61
Gross Private Domestic Investment	1.49	2.09	1.88	103.11	1.93
Fixed Investment	1.66	1.81	1.71	1.53	1.67
Nonresidential	1.46	1.63	1.53	1.33	1.48
Equipment	0.68	0.68	0.68	0.68	0.68
Intellectual Property	1.63	1.76	1.86	1.64	1.67
Structures	2.79	3.38	2.71	2.07	2.77
Residential	2.15	2.21	2.08	2.05	2.17
Exports	3.31	-0.95	-5.35	0.15	-1.03
Imports	-2.17	-0.74	-0.05	-1.22	-1.42
Government Purchases	1.35	0.92	0.12	-3.30	1.63
Federal	0.55	2.42	0.83	0.16	2.00
State and Local	1.92	-0.09	-0.37	-5.59	1.42

INCOME SIDE

GDP, National Income and Personal Income

	2012Q4	2013Q1	2013Q2	2013Q3	2013Q4
Billions of Current Dollars, SAAR					
Gross Domestic Product	16420.30	16535.30	16661.00	16782.99	16890.58
Plus:					
Receipts of Factor Income	829.80	813.30	817.00	826.63	836.17
Less:					
Payments of Factor Income	572.80	575.90	570.10	578.36	586.47
Equals: Gross National Product	16677.30	16772.70	16907.90	17031.26	17140.29
Less:					
Consumption of Fixed Capital	2575.00	2603.80	2631.90	2650.95	2668.81
Equals: Net National Product	14102.30	14168.90	14276.00	14380.31	14471.48
Indirect Business Taxes	1126.32	1140.70	1138.84	1149.92	1160.67
Business Transfers	99.50	121.90	125.80	125.99	126.18
Statistical Discrepancy	-101.70	-155.60	-162.50	-134.43	-110.93
Net Subsidies	57.70	58.00	58.90	58.43	58.13
National Income	14204.00	14324.50	14438.50	14514.74	14582.41
Corporate Profits	2047.20	2020.60	2087.40	2130.55	2171.22
Net Interest	430.30	477.00	444.00	433.71	431.68
Contribution for Soc. Ins.	967.90	1093.70	1100.30	1096.02	1081.67
Personal	443.90	567.90	571.70	566.01	549.38
Employer	524.00	525.80	528.60	530.02	532.28
Personal Interest Income	1218.40	1215.80	1225.60	1229.26	1228.01
Personal Dividend Income	844.30	720.00	768.40	799.37	897.16
Government Transfers	2347.90	2382.00	2386.50	2411.98	2429.86
Business Transfers	40.10	44.00	44.40	44.49	44.57
Personal Income	14073.10	13925.90	14065.00	14160.72	14309.38
Percent Change, Annual Rate					
Gross Domestic Product	1.58	2.83	3.08	2.96	2.59
Plus:					
Receipts of Factor Income	9.06	-7.72	1.83	4.80	4.70
Less:					
Payments of Factor Income	6.09	2.18	-3.97	5.92	5.72
Equals: Gross National Product	1.78	2.31	3.26	2.95	2.59
Less:					
Consumption of Fixed Capital	3.15	4.55	4.39	2.93	2.72
Equals: Net National Product	1.54	1.90	3.06	2.95	2.56
Indirect Business Taxes	2.73	5.20	-0.65	3.95	3.79
Business Transfers	-11.55	125.28	13.42	0.60	0.60
National Income	7.11	3.44	3.22	2.13	1.88
Corporate Profits	7.12	-5.10	13.89	8.53	7.86
Net Interest	-20.22	51.00	-24.93	-8.95	-1.86
Contribution for Social Insurance	8.94	63.03	2.44	-1.55	-5.14
Personal	8.24	167.88	2.70	-3.92	-11.24
Employer	9.54	1.38	2.15	1.08	1.72
Personal Interest Income	4.98	-0.85	3.26	1.20	-0.41
Personal Dividend Income	85.76	-47.11	29.72	17.13	58.66
Government Transfers	4.21	5.94	0.76	4.34	3.00
Business Transfers	-4.84	44.96	3.69	0.77	0.76
Personal Income	11.29	-4.12	4.06	2.75	4.27

GDP, National Income and Personal Income
Components of Personal Income

	2012Q4	2013Q1	2013Q2	2013Q3	2013Q4
Billions of Current Dollars, SAAR					
Wages and Salaries	7086.60	7040.40	7095.00	7116.45	7127.58
Commod Prod Industries	1167.00	1173.80	1185.40	1181.78	1150.97
Manufacturing	740.50	742.10	748.40	744.36	728.59
Others	426.50	431.70	437.00	437.43	422.37
Distributive Industries*	1114.20	1115.20	1124.50	1140.04	1157.04
Service Industries	3606.10	3555.50	3591.10	3602.97	3623.33
Government	1199.30	1195.80	1194.10	1191.64	1196.25
Other Labor Income	1700.90	1707.90	1716.20	1722.82	1733.40
Proprietors Income	1247.50	1334.60	1341.50	1324.34	1297.79
Farm	74.50	137.00	129.00	100.29	59.55
Business and Profess.	1173.00	1197.60	1212.50	1224.05	1238.25
Rental Income of Persons	555.40	574.90	587.70	604.93	622.57
Interest Paid by Persons	247.30	250.40	244.30	246.99	251.55
Other Interest	971.10	965.40	981.30	982.27	976.46
Transfer Payments	2388.00	2426.00	2430.90	2456.68	2474.84
Contributions for Social In	443.90	567.90	571.70	566.01	549.38
Personal Tax & Nontax P.	1552.76	1629.04	1664.83	1663.74	1654.52
Disposable Income	12520.40	12296.90	12400.10	12496.99	12654.86
Addendum:					
Domestic Final Sales	16907.5	17033.9	17133.1	17231.8	17339.9
Percent Change, Annual Rate					
Wages and Salaries	10.96	-2.58	3.14	1.21	0.63
Commod Prod Industries	7.27	2.35	4.01	-1.22	-10.03
Manufacturing	4.55	0.87	3.44	-2.14	-8.21
Others	12.20	4.97	5.00	0.39	-13.07
Distributive Industries*	9.18	0.36	3.38	5.64	6.10
Service Industries	16.23	-5.50	4.07	1.33	2.28
Government	1.41	-1.16	-0.57	-0.82	1.56
Other Labor Income	3.53	1.66	1.96	1.55	2.48
Proprietors Income	9.33	30.99	2.08	-5.02	-7.78
Farm	-4.18	1043.56	-21.39	-63.47	-87.57
Business and Profess.	10.26	8.66	5.07	3.86	4.72
Rental Income of Persons	6.52	14.80	9.21	12.26	12.19
Interest Paid by Persons	-5.32	5.11	-9.39	4.47	7.60
Other Interest	7.82	-2.33	6.75	0.40	-2.35
Transfer Payments	4.05	6.52	0.81	4.31	2.99
Contribution for Social Ins	8.24	167.88	2.70	-3.92	-11.24
Personal Tax & Nontax P.	15.93	21.15	9.08	-0.26	-2.20
Disposable Income	10.74	-6.95	3.40	3.16	5.15
Addendum:					
Domestic Final Sales	3.20	3.02	2.35	2.32	2.53

*Distributive Industries are Transportation, Public Utilities excluding the U.S. Postal Service, and Wholesale and Retail Trade

MONTHLY ECONOMIC INDICATORS for PERSONAL CONSUMPTION EXPENDITURES, GOVERNMENT PURCHASES, and CONSTRUCTION INVESTMENT

RETAIL SALES (RS), Billions of Current Dollars, SA

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
RS,Total Retail Sales	372.87	375.25	378.36	379.94	380.69	382.65	384.44	386.29	388.22
RS, Durable Goods Stores	120.61	122.33	124.45	124.45	125.05	125.71	126.27	126.85	127.44
RS, Bldg Materals, Hardware	26.04	26.33	26.01	26.48	26.23	26.42	26.63	26.70	26.74
RS, Auto Dealers	77.91	79.30	81.48	81.07	81.78	82.18	82.46	82.83	83.20
RS, Furn, Home Furn & Equip	8.26	8.31	8.52	8.46	8.54	8.59	8.63	8.66	8.71
RS, Nondurable Goods Stores	243.48	243.84	244.21	245.52	245.56	246.49	247.42	248.70	249.77
RS, Food Stores	53.50	53.82	54.13	54.35	54.42	54.58	54.73	54.87	55.02
RS, Gas Service Stations	44.97	45.12	45.33	45.64	45.63	45.67	45.69	46.38	47.16
RS, Apparel and Accessories	20.94	20.86	20.96	21.16	20.98	21.19	21.31	21.37	21.49
RS, New Domestic Cars, SAA	5.26	5.28	5.51	5.51	5.52	5.24	5.29	5.37	5.37
RS, New Dom Light Trucks,SAA	6.72	6.79	6.85	6.70	6.93	6.41	6.57	6.63	6.67

RECEIPTS AND OUTLAYS OF THE FEDERAL GOVERNMENT, Billions of Current Dollars, NSA

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
Federal Govt Total Outlays	278.18	346.21	166.72	309.55	318.90	224.49	324.25	256.44	241.68
Federal Govt Debt Outstanding	16791	16701	16697	16694	16694	16770	16891	16963	17043

HOUSING STARTS, Millions, SAAR

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
Housing Starts, Total	0.8520	0.9190	0.8350	0.8830	0.8910	0.8743	0.8691	0.8784	0.8581

NEW CONSTRUCTION PUT IN PLACE, Billions of Current Dollars, SAAR

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
New Const, Residential Bldgs	323.02	331.27	332.65	334.58	334.16	339.86	334.32	343.06	343.57
New Const, Nonresident Bldgs	291.56	295.68	292.99	296.83	298.51	298.40	299.88	300.43	300.75
New Const, Federal Government	23.75	23.90	23.79	24.04	24.08	24.08	24.28	24.27	24.37
New Const, State & Local Govt	240.06	245.28	246.32	245.38	246.51	247.50	248.40	249.28	250.13

Percent Change, Monthly Rate

RETAIL SALES (RS)

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
RS, Total Retail Sales	0.08	0.64	0.83	0.42	0.20	0.52	0.47	0.48	0.50
RS, Durable Goods Stores	1.47	1.43	1.73	-0.00	0.48	0.53	0.45	0.46	0.47
RS, Bldg Materials, Hardware	3.14	1.13	-1.21	1.81	-0.93	0.72	0.77	0.28	0.14
RS, Auto Dealers	1.00	1.79	2.74	-0.50	0.87	0.49	0.34	0.45	0.45
RS, Furn, Home Furn & Equip	0.61	0.54	2.58	-0.75	0.90	0.62	0.46	0.40	0.55
RS, Nondurable Goods Stores	-0.48	0.15	0.15	0.54	0.02	0.38	0.38	0.52	0.43
RS, Food Stores	-0.72	0.61	0.57	0.40	0.13	0.30	0.27	0.25	0.27
RS, Gas Service Stations	-3.07	0.33	0.47	0.68	-0.03	0.11	0.04	1.51	1.68
RS, Apparel and Acessories	1.48	-0.36	0.46	0.96	-0.85	1.01	0.57	0.26	0.59
RS, New Domestic Cars, SAAR	-1.98	0.40	4.32	0.04	0.15	-5.07	0.90	1.49	0.09
RS, New Dom Light Trucks, SA	0.64	1.03	0.87	-2.28	3.44	-7.45	2.47	1.03	0.50

RECEIPTS AND OUTLAYS OF THE FEDERAL GOVERNMENT

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
Federal Govt Total Outlays	5.14	24.46	-51.84	85.67	3.02	-29.61	44.44	-20.91	-5.75
Federal Govt Debt Outstanding	0.35	-0.54	-0.02	-0.02	0.00	0.46	0.72	0.42	0.47

HOUSING STARTS

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
Housing Starts, Total	-15.22	7.86	-9.14	5.75	0.91	-1.88	-0.59	1.07	-2.31

NEW CONSTRUCTION PUT IN PLACE

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
New Const, Residential Bldgs	1.35	2.55	0.42	0.58	-0.12	1.70	-1.63	2.61	0.15
New Const, Nonresidential Bldgs	2.20	1.41	-0.91	1.31	0.57	-0.04	0.49	0.18	0.11
New Const, Federal Government	0.98	0.64	-0.47	1.06	0.15	0.02	0.81	-0.04	0.44
New Const, State & Local Govt	-0.65	2.17	0.42	-0.38	0.46	0.40	0.36	0.35	0.34

MONTHLY ECONOMIC INDICATORS for GROSS PRIVATE DOMESTIC INVESTMENT and NET EXPORTS

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
	INDUSTRIAL PRODUCTION, Index 2007=100, SA								
Industrial Production, Total	98.75	98.86	98.99	98.96	99.36	99.58	99.81	99.96	100.18
	MANUFACTURERS' SHIPMENTS/INVENTORIES/ORDERS, Billions of Current Dollars, SA								
Manufacturers' New Orders	475.04	489.11	497.06	485.05	492.44	494.36	492.56	496.26	497.49
Manufacturers' Shipments	478.95	483.82	482.31	487.60	488.66	490.44	492.46	494.51	496.54
Manufacturers' Unfilled Orders	996.63	1008.42	1029.88	1033.91	1043.36	1048.58	1054.62	1061.20	1069.63
	MANUFACTURED DURABLE GOODS, Billions of Current Dollars, SA								
Nondefense Capital Goods Shipmt	71.39	75.86	74.52	73.50	73.81	74.43	74.01	74.82	74.49
	BUSINESS INVENTORIES, Billions of Current Dollars, SA								
Inventories, Manufacturers	627.52	626.94	628.18	629.71	630.93	632.51	634.16	635.86	637.66
Inventories, Merchant Wholesale	503.45	500.49	499.45	499.95	499.35	498.60	497.99	497.97	499.12
Inventories, Retail Traders	524.65	527.35	528.07	532.23	534.33	536.18	538.53	540.51	542.65
	U.S. MERCHANDISE TRADE, Millions of Current Dollars, SA								
Exports, FAS	130044	129054	133163	131762	132292	133758	134971	136055	136417
Imports, CIF	187336	191084	185602	189222	191116	189620	191582	193294	193189
Exports, Mach and Transp Equipm	42582	43993	43960	41712	43475	43133	43013	43016	43087
Imports, Mach and Transp Equipm	75750	75392	72733	75344	74528	74084	75732	75106	75526

Percent Change, Monthly Rate

	INDUSTRIAL PRODUCTION								
Industrial Production, Total	-0.34	0.12	0.13	-0.03	0.41	0.22	0.23	0.15	0.22
	MANUFACTURERS' SHIPMENTS/INVENTORIES/ORDERS								
Manufacturers' New Orders	1.26	2.96	1.63	-2.42	1.52	0.39	-0.37	0.75	0.25
Manufacturers' Shipments	-0.68	1.02	-0.31	1.10	0.22	0.36	0.41	0.42	0.41
Manufacturers' Unfilled Orders	0.33	1.18	2.13	0.39	0.91	0.50	0.58	0.62	0.79
	MANUFACTURED DURABLE GOODS								
Nondefense Capital Goods Shipmt	-3.53	6.26	-1.77	-1.38	0.42	0.84	-0.57	1.09	-0.44
	BUSINESS INVENTORIES								
Inventories, Manufacturers	0.11	-0.09	0.20	0.24	0.19	0.25	0.26	0.27	0.28
Inventories, Merchant Wholesale	-0.07	-0.59	-0.21	0.10	-0.12	-0.15	-0.12	-0.00	0.23
Inventories, Retail Traders	0.49	0.51	0.14	0.79	0.39	0.35	0.44	0.37	0.40
	U.S. MERCHANDISE TRADE								
Exports, FAS	1.35	-0.76	3.18	-1.05	0.40	1.11	0.91	0.80	0.27
Imports, CIF	2.66	2.00	-2.87	1.95	1.00	-0.78	1.03	0.89	-0.05
Exports, Mach and Transp Equip	1.97	3.31	-0.07	-5.12	4.23	-0.79	-0.28	0.01	0.16
Imports, Mach and Transp Equip	10.07	-0.47	-3.53	3.59	-1.08	-0.60	2.22	-0.83	0.56

MONTHLY ECONOMIC INDICATORS for CHAIN PRICE INDEXES

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
	CONSUMER PRICE INDEX (CPI), 1982-1984=100, SA								
CPI, All Urban Consumers	231.49	231.83	232.94	233.32	233.53	233.86	234.17	234.58	234.95
CPI, Durables	112.35	112.09	111.80	111.51	111.47	111.45	111.47	111.46	111.45
CPI, Furniture	119.71	119.57	119.84	119.09	118.86	118.93	118.99	119.02	119.09
CPI, Housekeeping Supplies	189.53	189.91	190.19	188.97	188.52	188.31	188.15	188.04	187.97
CPI, Nondurables	222.58	222.53	225.36	226.31	226.27	226.00	225.51	225.93	226.24
CPI, Apparel and Upkeep	126.14	126.45	127.58	128.34	128.46	128.65	128.86	129.07	129.28
CPI, Food and Beverages	236.60	236.35	236.75	237.13	237.45	237.89	238.32	238.79	239.26
CPI, Motor Oil, Fuel,	287.33	287.36	304.97	308.06	307.77	306.60	307.53	312.49	316.66
CPI, Services	276.60	277.37	277.80	278.13	278.46	278.92	279.43	279.94	280.50
CPI, New cars	145.53	145.53	145.95	146.05	146.12	146.32	146.53	146.75	146.97
	PRODUCER PRICE INDEX (PPI), 1982=100, SA								
PPI, Finished Goods	194.80	195.80	197.30	197.30	197.90	198.32	198.67	199.10	199.47
PPI, Capital Equipment	164.10	164.30	164.40	164.40	164.30	164.38	164.42	164.48	164.60
PPI, Intermediate Materials	199.80	199.90	200.90	200.90	201.00	201.27	201.63	202.05	202.53
PPI, Components for Construction	223.10	222.60	222.40	222.50	223.00	223.56	224.26	224.99	225.65
	PRICES RECEIVED BY FARMERS, Index, 1910-14=100, SA								
Index of Prices Recvd by Farmer	1217.00	1242.00	1270.00	1269.00	1201.00	1176.00	1189.92	1190.13	1194.54
	U.S. EXPORT/IMPORT PRICES, Index, 2000=100, SA								
U.S. Export Price Index	133.60	132.90	132.70	132.60	131.90	131.64	131.59	131.58	131.62
U.S. Import Price Index	140.20	139.40	138.80	138.90	138.90	138.98	139.11	139.27	139.44

Percent Change, Monthly Rate

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
	CONSUMER PRICE INDEX (CPI)								
CPI, All Urban Consumers	-0.37	0.15	0.48	0.16	0.09	0.14	0.13	0.18	0.16
CPI, Durables	-0.04	-0.23	-0.26	-0.26	-0.03	-0.01	0.01	-0.00	-0.01
CPI, Furniture	0.01	-0.12	0.23	-0.63	-0.19	0.06	0.05	0.03	0.06
CPI, Housekeeping Supplies	-0.21	0.20	0.14	-0.64	-0.24	-0.11	-0.08	-0.06	-0.04
CPI, Nondurables	-1.41	-0.02	1.27	0.42	-0.02	-0.12	-0.22	0.19	0.14
CPI, Apparel and Upkeep	-0.34	0.24	0.89	0.60	0.10	0.15	0.16	0.16	0.16
CPI, Food and Beverages	0.20	-0.10	0.17	0.16	0.14	0.19	0.18	0.20	0.20
CPI, Motor Oil, Fuel	-8.14	0.01	6.13	1.02	-0.09	-0.38	0.30	1.61	1.33
CPI, Services	0.15	0.28	0.15	0.12	0.12	0.17	0.18	0.18	0.20
CPI, New Cars	0.28	0.00	0.29	0.07	0.05	0.14	0.15	0.14	0.15
	PRODUCER PRICE INDEX (PPI)								
PPI, Finished Goods	-0.71	0.51	0.77	0.00	0.30	0.21	0.18	0.21	0.19
PPI, Capital Equipment	0.06	0.12	0.06	0.00	-0.06	0.05	0.03	0.04	0.07
PPI, Intermediate Materials	-0.65	0.05	0.50	0.00	0.05	0.13	0.18	0.21	0.23
PPI, Components for Construction	0.22	-0.22	-0.09	0.04	0.22	0.25	0.31	0.32	0.30
	PRICES RECEIVED BY FARMERS								
Index of Prices Recvd by Farmer	-4.55	2.05	2.25	-0.08	-5.36	-2.08	1.18	0.02	0.37
	U.S. EXPORT/IMPORT PRICES								
U.S. Export Price Index	-0.60	-0.52	-0.15	-0.08	-0.53	-0.19	-0.04	-0.01	0.03
U.S. Import Price Index	-0.71	-0.57	-0.43	0.07	0.00	0.06	0.09	0.11	0.12

MONTHLY ECONOMIC INDICATORS for PERSONAL INCOME

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
EMPLOYEES (EMP) on Nonfarm Payrolls, Millions, SA									
EMP, Total	135.512	135.688	135.860	135.964	136.133	136.276	136.424	136.566	136.707
EMP, Manufacturing	11.977	11.972	11.965	11.949	11.963	11.959	11.958	11.956	11.954
EMP, Services	116.877	117.057	117.223	117.344	117.495	117.659	117.820	117.997	118.176
EMP, Wholesale and Retail Trade	20.813	20.853	20.905	20.965	21.017	21.061	21.107	21.149	21.195
EMP, Government	21.870	21.859	21.837	21.814	21.831	21.826	21.819	21.817	21.811
EMP, Federal Government	2.174	2.166	2.158	2.149	2.149	2.148	2.150	2.151	2.151
EMP, State and Local Governme	18.635	18.631	18.637	18.620	18.638	18.642	18.645	18.645	18.642
Total Unemployed, Millions	11.659	11.760	11.777	11.514	11.316	11.306	11.231	11.222	11.156
AVERAGE WEEKLY HOURS (AWH) of Production Workers, SA									
AWH, Total Private	33.70	33.70	33.70	33.60	33.60	33.61	33.59	33.59	33.58
AWH, Manufacturing	41.80	41.80	41.80	41.70	41.90	41.84	41.84	41.84	41.86
AWH, Services	32.40	32.50	32.40	32.30	32.40	32.36	32.33	32.35	32.33
AWH, Wholesale and Retail Trade	33.60	33.80	33.60	33.60	33.70	33.64	33.62	33.63	33.61
AVERAGE HOURLY EARNINGS (AHE) of Prodution Workers, Current Dollars, SA									
AHE, Manufacturing	19.28	19.24	19.26	19.26	19.30	19.32	19.34	19.36	19.39
AHE, Services	19.88	19.76	19.85	19.78	19.75	19.84	19.90	19.96	20.03
AHE, Wholesale and Retail Trade	17.68	17.60	17.74	17.69	17.61	17.84	17.75	17.70	17.74
AVERAGE WEEKLY EARNINGS (AWE) of Production Workers, Current Dollars									
AWE, Total Private	676.36	676.70	679.06	677.38	678.72	680.45	681.22	682.39	683.59

Percent Change, Monthly Rate

EMPLOYEES (EMP) ON NONFARM PAYROLLS									
EMP, Total	0.147	0.130	0.127	0.077	0.124	0.105	0.109	0.103	0.104
EMP, Manufacturing	-0.058	-0.042	-0.058	-0.134	0.117	-0.034	-0.007	-0.021	-0.013
EMP, Services	0.185	0.154	0.142	0.103	0.129	0.140	0.137	0.150	0.152
EMP, Wholesale and Retail Trade	0.125	0.192	0.249	0.287	0.248	0.211	0.218	0.198	0.218
EMP, Government	0.050	-0.050	-0.101	-0.105	0.078	-0.023	-0.030	-0.013	-0.027
EMP, Federal Government	-0.321	-0.368	-0.369	-0.417	0.000	-0.035	0.069	0.072	0.007
EMP, State and Local Governme	-0.091	-0.021	0.032	-0.091	0.097	0.023	0.016	-0.001	-0.017
Total Unemployed, Millions	-0.707	0.866	0.145	-2.233	-1.720	-0.089	-0.658	-0.082	-0.587
AVERAGE WEEKLY HOURS (AWH) OF PRODUCTION WORKERS									
AWH, Total Private	-0.30	0.00	0.00	-0.30	0.00	0.03	-0.05	-0.02	-0.02
AWH, Manufacturing	0.00	0.00	0.00	-0.24	0.48	-0.14	-0.00	0.01	0.04
AWH, Services	-0.31	0.31	-0.31	-0.31	0.31	-0.12	-0.09	0.05	-0.04
AWH, Wholesale and Retail Trade	-0.59	0.60	-0.59	0.00	0.30	-0.19	-0.04	0.02	-0.05
AVERAGE HOURLY EARNINGS (AHE) OF PRODUCTION WORKERS									
AHE, Manufacturing	0.26	-0.21	0.10	0.00	0.21	0.11	0.10	0.12	0.12
AHE, Services	0.25	-0.60	0.46	-0.35	-0.15	0.44	0.31	0.31	0.37
AHE, Wholesale and Retail Trade	0.57	-0.45	0.80	-0.28	-0.45	1.31	-0.51	-0.28	0.25
AVERAGE WEEKLY EARNINGS (AWE) OF PRODUCTION WORKERS									
AWE, Total Private	-0.15	0.05	0.35	-0.25	0.20	0.25	0.11	0.17	0.18

MONTHLY FINANCIAL INDICATORS

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
MONEY SUPPLY, Billions of Dollars, SA									
Money Supply (M1)	2525.2	2536.2	2523.9	2550.6	2554.2	2575.9	2597.7	2609.9	2626.6
Money Supply (M2)	10541.2	10562.2	10601.5	10707.8	10767.9	10818.7	10879.4	10932.3	10990.9
INTEREST RATES (IR), Percent Per Annum									
IR, Treasury Bill, 6 Month	0.09	0.08	0.09	0.07	0.07	0.04	0.07	0.11	0.14
IR, Commercial Paper, 2 month	0.10	0.08	0.09	0.08	0.07	0.06	0.06	0.05	0.05
Yields, US Govt Bond, 1 year	0.13	0.12	0.14	0.12	0.13	0.12	0.12	0.11	0.10
Yileds, US Govt Bond, 10 Year	1.76	1.93	2.30	2.58	2.74	2.81	2.83	2.86	2.84
FOREIGN EXCHANGE VALUE, March 1973=100									
Weighted Average Value of US$	100.35	100.81	101.61	102.19	102.08	101.86	101.95	102.17	102.40
STOCK MARKET									
New York Stock Exchange Index	9089.92	9440.34	9204.10	9463.57	9496.63	9639.34	9687.51	9711.70	9729.81
Dividend to (Stock) Price Ratio	5.40	5.47	5.52	5.63	5.60	5.62	5.61	5.79	7.51
CONSUMER INSTALLMENT CREDIT, Millions of Dollars, SA									
Consumer Credit Outstanding	2980.22	2998.45	3012.89	3023.29	3036.91	3051.89	3067.03	3082.40	3098.06

Percent Change, Monthly Rate

	APR13	MAY13	JUN13	JUL13	AUG13	SEP13	OCT13	NOV13	DEC13
MONEY SUPPLY									
Money Supply, (M1)	2.37	0.44	-0.48	1.06	0.14	0.85	0.85	0.47	0.64
Money Supply, (M2)	0.55	0.20	0.37	1.00	0.56	0.47	0.56	0.49	0.54
INTEREST RATES (IR), Monthly Change									
IR, Treasury Bill, 6 Month	-0.02	-0.01	0.01	-0.01	-0.00	-0.03	0.03	0.03	0.03
IR, Commercial Paper, 6 Month	-0.03	-0.02	0.01	-0.01	-0.01	-0.01	-0.00	-0.00	-0.00
Yields, US Govt Bond, 1 Year	-0.02	-0.01	0.02	-0.02	0.01	-0.01	-0.00	-0.00	-0.02
Yields, US Govt Bond, 10 Year	-0.20	0.17	0.37	0.28	0.16	0.07	0.02	0.02	-0.02
FOREIGN EXCHANGE VALUE									
Weighted Average Value of US$	-0.33	0.46	0.79	0.58	-0.11	-0.22	0.09	0.21	0.23
STOCK MARKET									
New York Stock Exchange Index	0.57	3.86	-2.50	2.82	0.35	1.50	0.50	0.25	0.19
Dividend to (Stock) Price Ratio	1.22	1.37	0.91	2.05	-0.53	0.22	-0.07	3.24	29.59
CONSUMER INSTALLMENT CREDIT									
Consumer Credit Outstanding	0.36	0.61	0.48	0.35	0.45	0.49	0.50	0.50	0.51