CAN ECONOMISTS FORECAST ACCURATELY

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Can economists forecast accurately? My answer is yes. In this paper I will discuss when and how accurate economic forecasts can be made and generalize the method of forecasting for the prediction of non-repetitive or unique events. Skeptics have doubts that economists can predict. They point to the forecasting errors that economists have made. They can also point to different forecasts, and different opinions in general, from different economists. I will provide evidence below, however, that knowledge of economics is useful for making accurate forecasts. My general view can be illustrated by comparing economists with medical doctors. Both have knowledge to make forecasts, but they have different opinions on their respective subjects sometimes. Some make mistakes more often than others. The better economists or doctors are correct more often. Like economists who make inaccurate forecasts, doctors also make wrong diagnosis and prescribe wrong treatments.

The outline of this paper is the following.

1. Examples of Economic Forecasts by Quantitative Methods
2. What Kinds of Economic Events are Predictable?
3. Methods of Prediction: Quantitative and Qualitative
4. Examples of Predicting Unique Historical Events
5. Usefulness of Forecasting
6. Conclusions

Examples of Economic Forecasts by Quantitative Methods

It is convenient to draw examples of successful economic forecasts using standard quantitative methods from my own research experience.

Demand for automobiles in the US from 1958 to 1968.

For my PhD thesis at the University of Chicago I developed a theory of demand for durable goods based on the simple but essential idea that the theory of demand for non-durable goods is applicable to explaining the demand for the consumption, or the ownership, of durables in the long-run. The demand for purchase of new durable goods is derived from the need to adjust the amount of existing stock to the desired level based on the above demand for consumption. According to this theory when income changes the demand for stock or ownership changes. As in the case of demand for non-durables, the most important variables explaining the demand for ownership of automobiles are the relative price of automobiles and real income of the consumers. Using historical data from 1921 to 1953 in the United States, I estimated the effects of price and income on the demand for ownership. An important factor contributing to the accuracy of the estimates of these effects was my collection of data on actual transaction prices in used car markets as recorded in newspaper advertisements, rather than using official list prices which were inaccurate for the period of World War II. After I completed my dissertation, others at the University of Chicago applied the same theory to explain the demand for other durables including non-farm housing, refrigerators, farm tractors and corporate investment goods with success. In 1958, Arnold Harberger, adviser of these theses, decided to incorporate them in a book, Harberger (1960). I was asked to contribute a chapter. Since my dissertation had already been published as a book, Chow (1957), I had to write a new essay for that volume. My essay was "Statistical demand functions for automobiles and their use for forecasting," Chow (1960).

Table 2 of Chow (1960, p. 164) provides the annual purchase of new car equivalents per 100 persons for the four years 1954-1957 to be 3.452, 3.730, 3.630, and 3.270 respectively. The corresponding errors of forecasts from my equation explaining annual purchase (based on data up to 1953) were -.0.044, 0.608, -0.087 and 0.226. These forecasting errors appear small. I then provided a statistical test to find out whether the four out-of sample observations are consistent with the assumption that the equation estimated by using data from 1922 to 1953 remained valid in 1954-1957. The results of applying this test was reported in Chow (1960a) and its statistical method more fully discussed in Chow (1960b) – the latter is now known as the Chow test.

Not only was the model capable of providing accurate forecasts of annual sales, it was also useful in forecasting long-term sales. In the late 1950's annual sales of new cars were in the order of five million, and many observers considered that this quantity would not increase substantially because the market was saturated. Writing in early 1958, I projected a reasonable per capita disposable income in the US for 1968, and applied the effect of income on automobile demand which had been estimated in Chow (1957, 1960a) to make a 10-year forecast for 1968. The resulting forecast, reported in Chow (1960a, p.173) was over 8 million cars, as compared with 5 million in 1958. The above forecast was considered very optimistic, but history showed that it was quite accurate. This forecast was based on economic theory and econometric analysis. The reason for success is that the effects of price and income on demand are stable economic parameters from the 20's to the 60's. The General Motors Corporation in its internally circulated documents prepared by Andrew Court also used my equation to forecast annual automobile sales with reasonably accurate results.

Demand for computers.

In the 1960's while working at the IBM Research Center in Yorktown Height, New York, I completed a study of the demand for computers, consisting of two main ideas. First, a Gompertz growth curve shows how the computer users adjust their computers to an equilibrium level. Second, the equilibrium level is constantly moved upward because the price of computers (adjusted for computing utility) is being reduced by some 20 percent per year. Combining these two concepts into an equation and using suitable data, I estimated a demand equation that was useful for forecasting, as reported in Chow (1967). IBM used it for several years and found the forecasts to be reasonably accurate, but the forecasts were circulated in internal corporate documents only.

Forecast of inflation in China.

In June 1985 I conducted a macro-economic workshop in China under the sponsorship of the Chinese State Education Commission. The workshop was held at the People's University (Renda) in Beijing and almost one hundred economics teachers and

government researchers attended. At the beginning of the workshop, the office of Premier Zhao Ziyang contacted me to ask whether the 50 percent increase in currency in circulation in 1984 might cause serious inflation in China and whether I could provide a forecast of the rate of inflation in 1985. I formulated an equation to explain inflation in China based on two ideas. The first is the quantity theory of money, which suggests using the ratio M/GDP of the quantity of money M to real GDP as the main variable to explain the price level p.

$$\ln p = a + b \ln (M/GDP) + u$$

where M is the quantity of currency in circulation as checking accounts were not used in China. The second idea is that in the short run there is a dynamic adjustment process that specifies how the change in the price level or the inflation rate, $y(t) = \ln p(t) - \ln p(t-1)$, is affected by past inflation rate $y(t-1)$ and by the change in the explanatory variable in the above equation, i.e., by $x(t) = \ln(M/GDP)(t) - \ln(M/GDP)(t-1)$. The equation allowing for such a dynamic adjustment is estimated to be

$$y(t) = 0.00422 + 0.1430\, x(t) + 0.2176\, y(t-1) - 0.3086\, u(t-1)$$

as reported in equation (17) of Chow (1987). The third explanatory variable $u(t-1)$ is the residual of the equilibrium relation between lnp and ln(M/GDP). It has a coefficient of –0.3086, showing that if in the last year the level of lnp was above the norm, with $u(t-1)$ being positive, it has an effect to depress $y(t) = \ln p(t) - \ln p(t-1)$. This negative effect is the well-known error correction mechanism in the literature on cointegration. When a preliminary version of the above equation was used to forecast China's inflation rate in 1985, the result was no more than 9 percent. Premier Zhao was somewhat relieved by this result which later turned out to be correct. In 1984, money in circulation in mainland China increased by 50 percent. The reason why its effect on inflation in 1985 was so small was that, according to the dynamic adjustment process of the second equation, inflation in 1985 is influenced by inertia, namely, past changes in the explanatory variable x which were small before 1984.

I don't know whether Premier Zhao or some of his economics staff got the idea from my study that a substantial increase in money supply would lead only to a moderate rate of inflation. If so, it would have been a very serious misinterpretation of my finding. In

1985, there was a large increase in money supply for only one previous year 1984, while the increases in the earlier years were small. But in 1986-88, money supplied continued to increase at a high rate, in the order of 30 to 35 percent per year. As a result inflation in the fall of 1988 reached about 30 percent per year. Serious inflation and corruption were considered two major factors contributing to discontent and demonstrations in Tiananmen Square in 1989.

The acceleration principle

As formulated in my demand equation for automobiles in the United States this principle was applied to explain the demand of investment goods in the US and in China. See Chow (1960a, 1967a, 1985a, p. 236, and 1985b). According to this principle the demand for the purchase of new durable consumer or investment goods depends not on the level but on the rate of change of income. The purchase of new automobiles is the change in the quantity of automobile ownership and hence depends on the rate of change in income. If income continues to increase but at a slower rate we will find the purchase of new durable goods to decrease, while the purchase or consumption or purchase of non-durables and services will continue to increase but at a slower rate. This principle was statistically confirmed by numerous studies using data of the US and the Chinese economy cited above. It can explain the reduction of consumption expenditures on durable goods in China in 1998. In 1998 China had a 7.8 percent growth in GDP, but this rate of increase was smaller than the rate in 1997, thus leading to a reduction in the purchase of consumer durables in 1998.

Forecast of China's GDP in 2020

The next example taken from Chow (2002a) is a forecast of the future and therefore cannot be considered successful at the present time, but I have full confidence in it because it satisfies the conditions for successful econometric predictions to be discussed below. The prediction is that total real output of China measured by 1998 US dollars (based on calculation of the World Bank, 2000, table 1, p. 230) will exceed that of the US by the year 2020. The future GDP of China can be forecast using a simple econometric model. The main equation is a Cobb-Douglas production function that specifies the

relation between the total output Y and capital input K, labor input L and total factor productivity A.

$$Y = A K^{b} L^{1-b}$$

Assume further that the exponents of capital and labor inputs sum to one as indicated in the above equation and that total factor productivity A increases by a constant percentage α per year. The first assumption is supported by statistical evidence using output and income data in China and elsewhere. Under these two assumptions there are only two parameters to be estimated: the capital exponent b and the rate of increase α in total factor productivity.

Chinese output and input data from 1952 to 1998 are used to estimate these two parameters, giving approximately b= 0.6; α=0.027 (after 1979); and α=0 (before 1979). That is, one percent increase in capital input alone raises output by 0.6 percent; on average total output increases by 2.7 percent per year after 1979 even if the quantities of the inputs are constant. The accuracy of the estimate 0.6 was supported by three other pieces of evidence, (1) a study by Mankiw, Roemer and Weil (1992), (2) an estimate based on data for state enterprises in Chow (1985a, p. 125) and (3) an estimate of 0.4 for the labor exponent based on Buck (1930). In a competitive market economy, wage paid to a laborer equals the value of the marginal output which he/she can produce using his labor, with other inputs fixed. The marginal output is the partial derivative of Y with respect to L, which equals (1-b)Y/L by the above equation. Setting this equal to wage w, we have (1-b) = wL/Y, where wL/Y is the share of output paid to labor. Buck (1930) surveyed 2866 farms in 17 localities in 7 provinces in China and reported value added Y per farm to be 336.13 yuan and payment for labor to be 127.99. The ratio 127.99/336.13 is 0.38 for (1-b), very close to the value estimated by using the above production function. If the estimate of 0.6 for the exponent of capital is accurate, the only remaining parameter α, the annual rate of change in total factor productivity, can be accurately estimated by output and input data spanning over several decades from 1952 to 1998 since the problem of multicolinearity is avoided by using an accurate and independent estimate of the first parameter. Given the reliability of these two parameters I can be confident of my forecast of China's total output up to 2020 based on the above

production function, combined with reasonable assumptions on the fraction of output devoted to the accumulation of capital, on the rate of growth of the labor force and on the possible reduction of the rate of increase in total factor productivity, all somewhat conservatively estimated to yield a low growth rate of total output for China for the above forecast for 2020.

In fact by projecting historical trends, I succeeded in forecasting, in late June 1989 right after the Tiananmen tragic incident, a continuation of rapid economic growth in China in the decade of the 1990's as recorded in an article reproduced in Chow (1994, chapter 7) .

Forecasting Taiwan's economic growth

A similar exercise using an aggregate production function to forecast Taiwan's economic growth from 2000 to 2010 is reported Chow and Lin (2002) using data from 1951 to 1999. I am less confident of the forecasts because my institutional knowledge of the Taiwan economy is very limited. The same analysis as reported in the previous example was applied to Taiwan mainly to provide a framework for economists to air their possible differences. For Taiwan, the two essential parameters b and α are estimated to be respectively 0.3 and 0.03. The value 0.3 for the exponent of capital is close to the value for the United States. China has a much larger value 0.6 because capital is relatively scarce and labor is abundant. As an economy develops and the amount of capital becomes large relative to the quantity of labor, the exponent of capital will gradually decrease and the exponent of labor will gradually increase, as illustrated by the gradually increasing share of payment to labor from total income recorded in Chow and Lin (2002). Using this production function Chow and Lin (2002) forecast an average rate of growth of real GDP for Taiwan to be about 6 per cent per year from 2000 to 2010. Whether this forecast will turn out to be correct depends on whether (1) the two parameters b and α will remain constant and (2) the assumptions about the rate of growth of labor force and the rate of savings as a fraction of GDP are correct. One can easily question the validity of the forecast of 6 percent annual growth on average, in view of the slow growth of about only 3 percent in 2000-2002. There are valid reasons for this

skepticism which will not be discussed here. This example illustrates that we cannot make accurate forecasts by projecting mechanically the relations estimated by past data. Parameters may change, and unexpected shocks could occur. For example, a reduction by 0.01 of the rate of annual growth of total factor productivity would reduce the forecast of a 6 percent growth rate to 5 percent. Institutional knowledge and good judgment are essential to making accurate forecasts.

What Kinds Of Economic Events Are Predictable?

Only some and not all economic events are predictable. The predictable events include those that obey some basic laws, as illustrated by the above examples. In addition unique and non-repetitive historical events can also be predicted if the factors affecting the event can be isolated and their influence on the outcome can be analyzed. The first kind of economic events can be predicted by the use of quantitative economic or econometric models. The second kind is predicted by economic as well as non-economic knowledge combined with sound judgment based on such knowledge.

Let me state a set of sufficient conditions for quantitative economic predictions to be accurate. The conditions include: (1) there is a random data generating process that will remain valid in the future; (2) the specification of this process by the economist is correct, and (3) the parameters are properly estimated using reasonably accurate data and appropriate econometric method. The assumption that certain economic data are generated by a repetitive random process is a bold one. It implies that future economic events are not significantly affected by unforeseen political or other circumstances but follow the same pattern probabilistically as in the past. Such a bold assumption is required to use econometric models. The second condition is most important. It is extremely difficult to specify correctly a quantitative economic model with constant parameters through time. If one variable is used as a predictor the relation may be stable, but if another is used it will not be. The third condition is also important. Inaccurate data or inappropriate method of estimation can spoil a well-specified model.

The above conditions imply that whether an economic event is predictable depends not only on the nature of the event but also on the person predicting it, just as whether a certain illness can be successfully treated depends on the skill of the physician. Economic prediction is an art as much as a science. It is an art to apply the appropriate economic laws. All trained economists have studied the basic textbooks and passed qualifying examinations. However only a few have the sound judgment to select the relevant part of economic theory to make an accurate analysis of the problem at hand. For example, what explains the Asian financial crisis in 1997-99? Was it due to an inherent weakness of the financial system of many Asian counties? In the West, such an alleged weakness is dubbed "phony capitalism." If this is the case a slow and incomplete recovery should be predicted because future growth would be limited by such fundamental weaknesses in economic institutions that cannot be changed easily. Was the crisis that first started in Thailand in 1997 the result of speculative bubbles similar in nature to those occurring in developed economies? If so, the affected Asian economies could be expected to recover fairly rapidly to their former growth paths in the same way that a developed economy recovers from a bubble, provided that no other important factors came to intervene, such as a downturn of the U. S. economy.

Methods Of Prediction

Given the above conditions for accurate predictions, economic events can be predicted by the use of quantitative economic models. We will also consider the forecasting of non-repetitive or unique events. Such events can also be forecasted if the factors affecting the outcome and the manner they affect it are corrected specified by the use of relevant economic and non-economic knowledge combined with sound judgment. We can describe methods of prediction suitable for the two types of problems.

A) Formal and quantitative. The use of a formal model is required. One can select a small number of important variables to make the forecast and rely on a few parameters to characterize the interactions of these variables with the variable to be forecast. The value of the parameters could be estimated by econometric methods or determined by judgment

based on prior knowledge of the forecaster. Some economists build large econometric models for forecasting. I do not have such competence; I am unable to specify so many equations correctly since there may be insufficient knowledge concerning some of the equations. The estimation of a large number of parameters may give rise to inaccurate estimates given a limited set of data. Furthermore, misspecification of some equations can affect the estimation accuracy of other equations and the predictive accuracy of the entire model. Hence I will leave to others to discuss how to forecast with models much larger than the one presented in Chow (1967a), while being content to answer the question raised in the title this paper by using the examples with which I am familiar.

B) Informal and qualitative. The use of econometric models for prediction assumes that the data are generated by a stochastic process that continues to generate data in the same manner as in the past. Therefore it is applicable only to repetitive economic events. Some economic events are not repetitive. One example is the introduction of economic reform in China in 1978. To forecast such events one cannot rely on an econometric model and statistical data to estimate its parameters, but the analytical framework is similar.

The method for forecasting non-repetitive or unique historical events is more general than econometric method. Both require the selection of important variables and the specification of how the variables affect the outcome. Econometrics is a special case when the variables can be conveniently measured numerically and when their effects can be formulated in a set of mathematical equations. For example, the degree of competence of certain political leaders and the quality of the Chinese workers and entrepreneurs affected the success of China's economic reform in the 1980's but these variables are difficult to quantify. By assigning numbers somewhat arbitrarily to these attributes may not improve forecast accuracy. The effects of these qualitative attributes or variables need not be embedded in mathematical equations. Specifying a set of mathematical equations may not be as effective as the use of judgment concerning the combined effects of the attributes as we shall demonstrate in an example below on predicting the future of Hong Kong. The computer has not yet surpassed the human brain in processing information for making important business and political predictions. Neither can the use of mathematics.

However, two general steps in the use of econometrics for forecasting are applicable in general. First, select the major "variables" relevant to the historical situation at hand, even if these "variables," like the ability and character of certain political leaders, are not measured quantitatively. Second, specify how the variables acting together will affect the outcome to be predicted.

Examples Of Predicting Unique Economic Events In China

My first example is the prediction of the future of Hong Kong's economic system before its return to China in 1997. A pessimistic forecast was based on the judgment that the government in Beijing would interfere with the free-market system. This judgment could have been derived from the history of the PRC government in destroying the capitalist system in Shanghai in the early 1950s. An optimistic forecast could have been based on the judgment that the Beijing government would honor its commitment to the "one-country two systems" policy and allow Hong Kong to maintain its existing capitalist system. This judgment could be based on the more recent record of the PRC government in pursuing economic reform and in keeping its promises since reform started. The major determining variable in this case is the behavior of the Chinese government. One forecaster may assign a positive value and another may assign a negative value to this variable. Given its value one may make a corresponding optimistic or pessimistic prediction concerning the preservation of capitalism in Hong Kong.

When more variables are considered, the forecasting process becomes more complicated. One such variable is the opinion and reaction of the international community as perceived by the Chinese government in the event that it fails to fulfill its promise to preserve Hong Kong's capitalist economy. Another is the reaction of the people and government of Taiwan to such an event as perceived by the PRC government. A forecast based on a negative assessment of the PRC government would have to be modified if the reaction of the world community and of the Taiwan people is taken into account. To do so may turn a pessimistic forecast of Hong Hong's economic system to an optimistic one. Whether this will happen depends on how severe the negative judgment of the PRC government is to begin with, and how much weight is given to the world

reaction or the Taiwan factor. A forecast can incorporate these factors without quantifying the negative value for the Chinese government, the weights it gives to world reaction and the Taiwan factor. All these factors can be incorporated into a forecast without the use of a set of mathematical equations. The forecaster simply examines these factors and weighs their influence using his judgment. A sound judgment in this case depends crucially on the forecaster's knowledge of the behavior of the Chinese government.

As a second example consider predicting the success of China's economic reform towards a more market-oriented economy which began in 1978. As demonstrated by the experience in Taiwan, Singapore, Hong Kong and South Korea, a functioning market economy that enables the citizens to make money by ingenuity and hard work, even though imperfect, together with sufficient high-quality human capital in the form of resourceful entrepreneurs and a hard-working labor force are sufficient conditions for rapid economic growth, provided that there is political stability. Knowing the above two sufficient conditions one should have predicted the success of China's economic reform at the beginning. However, most people, perhaps including the Chinese leaders, did not predict this outcome correctly because they did not understand the powerful force of a market economy or the high quality of the Chinese people. The powerful force of a market economy had to be demonstrated to the Chinese leaders by the rapid economic growth in China. So had the ability of the Chinese people to create wealth, even though this had been clearly demonstrated by their economic performance in several Southeast Asian economies.

The last example of a successful forecast is taken from Taiwan's experience. This forecast was made by using only qualitative and elementary economic analysis. I refer to a forecast of excess supply of rice in Taiwan in the late 1970s. At that time, the Taiwan government had a price support program for farmers producing rice. The farmers were guaranteed a minimum price at which they could sell rice to the government. As the world supply of rice began to increase several economists including the author suggested to the highest government authority to terminate the price support program but the suggestion was not accepted. A year later, the world price of rice continued to be depressed. The Taiwan farmers could benefit from buying cheap rice from the world

market and selling it at a higher guaranteed price to the government for a profit. As a result the government was forced to buy a very large quantity of rice, so large that much of it was piled up on high-school basket ball courts, only to become rotten. This forecast was based simply on elementary economics: increase in world supply leads to a lower price; and a price differential under the price support program induces the farmers to buy low and sell high, forcing the government to purchase a large quantity of rice. Later the government had to change its support policy by allowing each farmer to sell only a fixed amount to the government at the guaranteed price, which amounted to providing a fixed subsidy to each farmer. This new policy limited the total amount that the government needed to buy and solved its huge financing and storage problems.

Usefulness Of Forecasting

Economic forecasts are made partly to test whether certain economic theories or models are valid, but also to solve practical problems. Government policy makers, business executives and private individuals can all benefit from accurate economic forecasts. The two examples of forecasting automobile and computer demand benefited decision makers in the General Motors and IBM corporations. The third and fourth examples on forecasting inflation and the demand for durable goods are relevant for economic decision makers in China. Knowing the effects of increasing money supply on the inflation rate can help economic officials decide how rapidly the supply of money should be allowed to increase. If the slow-down in demand for consumer goods in 1998-1999 was due to the accelerations principle, the government should reconsider its ad hoc policies to influence stock prices in order to increase demand.

The two examples of forecasting future economic growth in mainland China and in Taiwan are useful for decision makers on both sides of the Taiwan Strict. On the Taiwan side it is important to have a correct assessment of China's economic future no matter whether one likes its political institutions. Needless to say, understanding the economic fundamentals that may affect Taiwan's future is relevant for policy making by the government and the business community of Taiwan. The example of forecasting Hong

Kong's economic system after 1997 could be used to form a judgment on whether Hong Kong stocks were undervalued. In 1989, the price earning ratio of Hong Kong stocks was about 11 while it was about 35 for Japanese stocks, when both economies were growing at about the same rate of 5 to 6 percent per year. The low price earning ratio for Hong Kong reflected the pessimism of the investors regarding Hong Kong's economic future, based on a negative assessment of the PRC government. If this negative assessment were unfounded, the prices of Hong Kong stocks would increase, as they actually did in the period up to July 1997, before the onset of the Asian financial crisis. An optimistic forecast of Hong Kong's economic future based on a correct assessment of the behavior of the Chinese government would have allowed an investor to profit handsomely. The last example on forecasting the excess supply of rice in Taiwan in the late 1970's, if taken seriously, could have prevented the need to spend government resources to purchase a large amount of rice, only to store it on high school basket ball courts to become rotten. It could also have saved the government from embarrassment in having to change the policy later.

Conclusions

In this paper, I have tried to answer the question, "What kinds of economic events are predictable and how to predict them?" Economic events are predictable if there exist valid economic principles governing them and if the forecaster has sufficient knowledge and sound judgment to apply the relevant economic laws, to select the important factors or variables and to specify the mechanism by which these factors influence the outcome. The factors and the mechanism may be specified quantitatively or qualitatively. Quantitative variables and relations are suitable for repetitive economic events. In the case of predicting unique events, qualitative variables and relations can be specified and applied by the use of sound judgment. I have provided examples of predicting both repetitive and unique events mainly in economics, but the method is also applicable to predicting non-economic events such as the political future of Hong Kong or the political relation between mainland China and Taiwan as in Chow (2002b). Examples of successful forecasts have been given. Their usefulness to government officials, to business executives and individual citizens has been illustrated. Forecasting is an art as

well as a science. Good judgment in this case is the hallmark of a good economist. It takes a good economist to be able to forecast accurately, just as it takes a good doctor to treat difficult illnesses successfully.

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