

# The Estimates and Forecasts of Worldwide E-commerce

Jianzheng Yang

Business School of Donghua University, No 1882,  
West Yan'an Road, Shanghai China, (200051)  
Business School of University of Shanghai For  
Science & Technology, China, No 516, Jungong  
Road, Shanghai, China, (200093),  
Tel. 86-21-64745755  
Fax.86-21-54147186  
yangjz@citiz.net

Guangbin Miao

Business School of University of Shanghai For  
Science & Technology,  
China, No 516, Jungong Road, Shanghai, China,  
(200093)  
Tel. 86-21-65681856  
Fax. 86-21-54147186  
gary\_miao@163.com

## ABSTRACT

Estimate and forecast of e-commerce status in the world is an important subject in the development of e-commerce. The development status of e-commerce can be reflected by the Internet users' number and the per capita trade volume on net. On the basis of the data collected extensively and the reference of relevant materials, this paper is to give a forecast of the Internet user number in the coming years using the cubic curve and Logistic curve prediction method, and then to calculate the short-term and long-term forecasts of the value of on-line transactions, which is expected to provide scientific basis for Chinese e-commerce development decision-making.

## Keywords

Electronic commerce; Forecast; Polynomial Fit; Logistic curve

## 1. INTRODUCTION

Electronic commerce (e-commerce) emerged in 1970s. The use of EDI at the beginning of the 1980s boosted the development of the e-business greatly. To the middle period of 1990s, some countries, such as U.S.A., Canada, took the lead in developing e-commerce. Entered 21 century, e-commerce still develops very fast, and a lot of enterprises in western developed countries have got success in this area. According to the United States Census Bureau, total online retail sales for 2003 were \$55.99 billion. On current trends, retail e-commerce in the United States could amount to \$100 billion by mid-2006. In the European Union, e-commerce sales in 2002 are estimated at €30 billion. In Latin America, market research sources estimate the total of B2C e-commerce at \$4.5 billion in 2003. As for business-to-business e-commerce (B2B), B2B online sales in the United States amounted to \$1072 billion in 2002, amounted to 92.7 per cent of all e-commerce in the United States. Information compiled by Eurostat indicates that e-commerce sales made through the Internet by enterprises located in the European Union reached €95.6 billion in 2001. In Central and Eastern Europe B2B e-commerce could grow to \$17.6 billion by 2006. In the Asia-Pacific region, it should grow rapidly, from about \$200 billion in 2003 to about \$300 billion by 2004. [1] [2] There is also a good foundation for e-commerce application in China now. It is reported that China has become the largest online market in the Asian-Pacific area in 2003, with

the electronic trade volume of 3,566 million dollars. [3]

It is also important to understand e-commerce environment and to forecast the trend of e-commerce scientifically in China, not only in theory, but also in practice. Because Chinese national economy must be adapt to the rapid development of the e-business in the world, Chinese economy needs succeed in transferring from the industrial economy into knowledge economy, and Chinese enterprises need adjust management and marketing approaches and strengthen the ability of competition.

## 2. THE FORECAST OF THE E-COMMERCE DEVELOPMENT IN THE WORLD

The current situation of the e-commerce has aroused great concern to its development prospect. A lot of research companies and scholars have forecasted the market potential of Internet and the future development of e-commerce. IDC Research predicted that the value of on-line transactions would reach 4600 billion US dollars by 2005. [4] The Forrester Company predicted that value of on-line transactions would reach 9240 billion US dollars by 2005, and Forrester also predicted that the global e-commerce trade volume would reach 12837.3 billion dollars by 2006. [5] The Emakreter Inc. predicted that the total trade volume of global e-business B2B will reach 1408.57 billion US dollars by 2005, and 2367.47 billion US dollars by 2006. [6] Also, according to the US Trade and Development Agency, the number of Internet users of the world will reach 1 billion by 2005, eTForecasts company reported that will have 1.17 billion people in the whole world use Internet by 2005. The report of United Nations Conference on Trade and Development shows that the number of Internet users in the world reached 676 million in 2003. At the end of 2003, developing countries accounted for more than 36 per cent of the entire Internet users in the world. The number of Internet hosts worldwide reaching a total of over 233 million. In terms of number of websites, as of June 2004 there were over 51,635,284 websites worldwide. [7]

From above information we can find that different predictors have different forecasts. Because there is no unanimous view on the concept of the e-commerce, the data of e-commerce statistics comes from different sources, the factor analysis that influences the e-commerce are not systematic, and the factors which influence the development speed of e-commerce is numerous (such as the number of Internet users, Internet users' purchasing power and so on), so it is difficult to forecast the development of e-commerce. In addition, the rapid development of information technology has caused great impact on e-commerce; it is also very difficult to describe the future of the new thing accurately. However, just like the other

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things in economic life, the e-commerce has some rules to follow. It presents some characteristics, such as fluctuation, inertia, correlation, system and random. As long as we master the nature of e-commerce, we can hold the developing state of e-commerce to a certain extent and carry on comparatively accurate prediction to the e-commerce.

### 3. DATA GATHERING AND ANGLE OF FORECAST

We think, the Internet users' number and the per capita trade volume on net can be collected relatively easily and can be used to reflect the overall state of e-commerce development. From this point of view, we design the forecast route in the paper. First, we forecast the number of Internet user in the world and per capita trade volume, and then forecast the value of online trade. With this method, we can have a research in the short-term and long-term prediction of the e-commerce development. Table 1 reflects the world historical data of Internet user number and the trade volume on net.

From Table 1 we can calculate the per capita trade volume of the world from 1995 to 2003(see Table 2).

And according to the data of Table 1 and Table 2, we can make their tendency curve respectively (see Figure 1 and Figure 2) .

**Table 1. The historical data of the internet user number and the trade volume on net.**

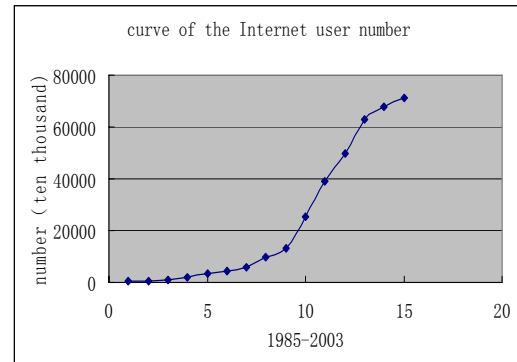
| year | user number<br>(ten thousand) | trade volume (billion<br>US dollar) |
|------|-------------------------------|-------------------------------------|
| 1985 | 18                            |                                     |
| 1986 | 30                            |                                     |
| 1987 | 50                            |                                     |
| 1988 | 90                            |                                     |
| 1989 | 170                           |                                     |
| 1990 | 400                           |                                     |
| 1991 | 600                           |                                     |
| 1992 | 1100                          |                                     |
| 1993 | 2100                          |                                     |
| 1994 | 3400                          |                                     |
| 1995 | 4300                          | 0.20                                |
| 1996 | 6000                          | 0.71                                |
| 1997 | 9000                          | 2.60                                |
| 1998 | 13300                         | 43.00                               |
| 1999 | 25500                         | 113.20                              |
| 2000 | 38800                         | 278.20                              |
| 2001 | 49600                         | 474.30                              |
| 2002 | 62700                         | 823.50                              |
| 2003 | 67600                         | 1408.60                             |

Source: eMarketer (2002a), ITU (2004) data and UNCTAD calculations.

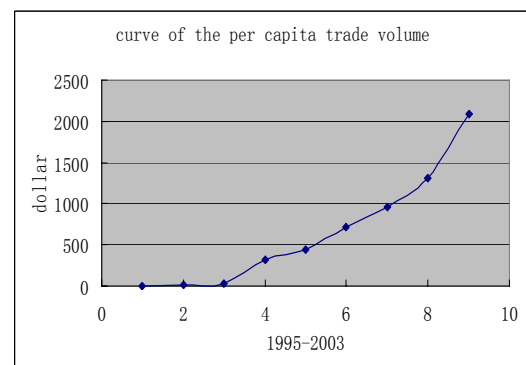
From the historical data and the curve we can find that the number of Internet users will increase steadily after the rapid expansion, while the online trade volume will experience fast growth because the development of e-commerce lags behind that of Internet. So we can describe them with the Logistic curve and Polynomial curve separately.

**Table 2. The per capita trade volume (dollar)**

| year | Per capita trade |
|------|------------------|
| 1995 | 4.65             |
| 1996 | 11.83            |
| 1997 | 28.89            |
| 1998 | 323.31           |
| 1999 | 443.92           |
| 2000 | 717.01           |
| 2001 | 956.25           |
| 2002 | 1313.40          |
| 2003 | 2083.72          |



**Figure 1. Curve of the Internet user number**



**Figure 2. Curve of the per capita trade volume**

### 4. THE FORECAST OF THE PER CAPITA TRADE VOLUME

When the forecast object at the stage of growing up, the forecast number observed increases very fast and its growth rate is steady, which can not appear the unexpected change. Under this condition we can not consider the prediction model of the exponential curve or Polynomial curve. From Figure 2 it can be seen that the per capita trade volume of e-commerce is at the stage of rapid growth, we can forecast the per capita trade volume of the following several years with the exponential function or Polynomial curve. Of course, because the curve has the property of limitless growth, it only effects in a short period. Now we begin to forecast the following several years trade volume of e-commerce with exponential curve, quadratic curve and cubic curve separately.

We can describe the per capita trade volume with the forecast models as:

$$\text{Exponential Model(EXP): } \hat{y}_t = b_0 e^{b_1 t}$$

Quadratic Model(QUA):  $\hat{y}_t = b_0 + b_1t + b_2t^2$

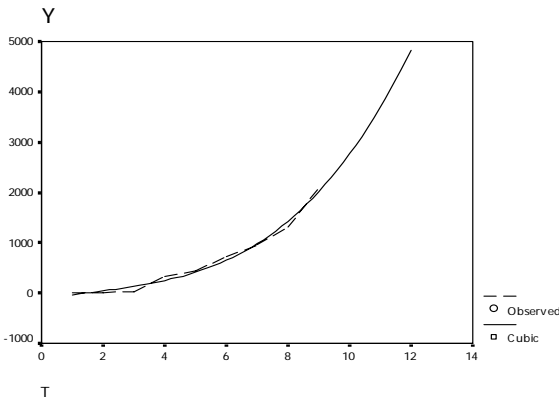
Cubic Model(CUB):  $\hat{y}_t = b_0 + b_1t + b_2t^2 + b_3t^3$

Calculate the parameters with Statistic Software SPSS, we can get the output as Table 3.

**Table 3. The output from SPSS**

| MODEL: MOD_13.    |     |       |       |        |       |           |           |          |        |
|-------------------|-----|-------|-------|--------|-------|-----------|-----------|----------|--------|
| Independent: Time |     |       |       |        |       |           |           |          |        |
| Dependent         | Mth | Rsqr  | d. f. | F      | Sigf  | b0        | b1        | b2       | b3     |
| Y                 | EXP | 0.898 | 7     | 61.63  | 0.000 | 4.1220    | 0.7724    |          |        |
| Y                 | QUA | 0.984 | 6     | 185.37 | 0.000 | 108.7140  | -119.3000 | 36.0455  |        |
| Y                 | CUB | 0.989 | 5     | 150.05 | 0.000 | -135.5600 | 114.6170  | -19.4720 | 3.7012 |

Model Checking: After get all the parameters, calculate the latest three years' error of each model, we can get the MAPE separately, are 35.66, 8.75 and 4.95(the least), combine with the Coefficient of Determination (Rsqr: 0.898, 0.984 and 0.989), we choose the Cubic Model to forecast the trade volume of e-commerce finally and get Figure 3.



**Figure 3. The fitting curve of cubic compare with the observed**

According to Table 3, the equation of this cubic curve prediction model is:

$$\tilde{y}_t = -135.56 + 114.617t - 19.472t^2 + 3.7012t^3 \dots (4-1)$$

Use (4-1), we can forecast the per capita trade volume (dollar) of the following 3 years are:

$$\tilde{y}_{2004} = 2764.56$$

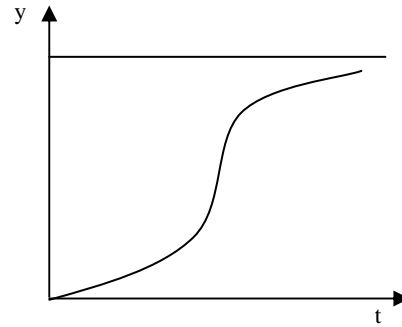
$$\tilde{y}_{2005} = 3695.35$$

$$\tilde{y}_{2006} = 4831.47$$

## 5. THE FORECAST MODEL OF THE INTERNET USER NUMBER AND THE RESULT

The Logistic curve is found out by P.F.vehulst, a Belgium Mathematician, while studying population's multiplication law in 1938. It is successful to describe a prediction, which has “grow up” trend. The prediction equation can be showed as (5-1) and the curve is shown as Figure 4.

$$\tilde{y}_t = \frac{1}{K + ab^t} \quad (5-1)$$



**Figure 4. The Logistic curve**

From the Logistic curve (Figure 4) we can find that the curve is similar with the curve of the Internet user number (Figure 1), both of them will follow the following track: at first fast development, then slow development, and in the end reaching extremum. So we can set up the forecast model with the Logistic curve to describe the number of Internet user and using the model to predict Internet user number of the following years.

According to the Logistic curve, we can define the model of the Internet user number as the form as (5-1), take the reciprocal of the equation, we can get:

$$\frac{1}{y_t} = K + ab^t \quad (5-2)$$

Its parameter estimates is:

$$b = \sqrt[n]{\frac{\sum_3 \frac{1}{y_t} - \sum_2 \frac{1}{y_t}}{\sum_2 \frac{1}{y_t} - \sum_1 \frac{1}{y_t}}} \quad \text{and}$$

$$a = \frac{b-1}{(b^n-1)^2 b} (\sum_2 \frac{1}{y_t} - \sum_1 \frac{1}{y_t}) \quad (5-3)$$

$$K = \frac{1}{n} \left[ \frac{(\sum_1 \frac{1}{y_t})(\sum_3 \frac{1}{y_t}) - (\sum_2 \frac{1}{y_t})^2}{\sum_1 \frac{1}{y_t} + \sum_3 \frac{1}{y_t} - 2\sum_2 \frac{1}{y_t}} \right] \quad (5-4)$$

Among them :  $n = \frac{T}{3}$  (the “ $T$ ” is the number of the historical data)

We can estimate the “a, b and K” use the formulae above ( $n = 3$  here), the concrete data is as Table 4.

**Table 4. the internet user number of the world (ten thousand) and  $\sum_1, \sum_2, \sum_3$**

| year | number | $\sum_1 \frac{1}{y_t} = 5.0339147 \times 10^{-4}$  |
|------|--------|--|
| 1995 | 4300   |  |
| 1996 | 6000   |  |
| 1997 | 9600   |  |
| year | number | $\sum_2 \frac{1}{y_t} = 14.0176852 \times 10^{-5}$ |
| 1998 | 13300  |  |
| 1999 | 25500  |  |
| 2000 | 38800  |  |
| year | number | $\sum_3 \frac{1}{y_t} = 5.09031481 \times 10^{-5}$ |
| 2001 | 49600  |  |
| 2002 | 62700  |  |
| 2003 | 67600  |  |

We can get the result:

$$a = 3.808262077997 \times 10^{-4}$$

$$b = 0.626402396509$$

$$K = 7.27001147198 \times 10^{-6}$$

So the prediction equation of the Logistic curve is:

$$\hat{y}_t = \frac{1}{7.27001147198 \times 10^{-6} + (3.808262077997)(0.626402396509)^t \times 10^{-4}} \quad (5-5)$$

According to (5-5), let  $t = 7, t = 8, t = 9$  separately, we can get the prediction number of the Internet user of 2001, 2002 and 2003:

$$\tilde{y}_{2001} = \tilde{y}_7 = 46123$$

$$\tilde{y}_{2002} = \tilde{y}_8 = 61360$$

$$\tilde{y}_{2003} = \tilde{y}_9 = 77371$$

Compare the forecast number with the actual ones using the difference analysis method, we can find that the models are very ideal (Table 5).

**Table 5. Comparing the prediction number with the actual ones**

| year | Actual number<br>$y$ | Forecast number<br>$\tilde{y}$ | the error<br>$ y - \tilde{y} $ | the error rate (%) |
|------|----------------------|--------------------------------|--------------------------------|--------------------|
| 2001 | 49600                | 46123                          | 3477                           | 7                  |
| 2002 | 62700                | 61360                          | 1340                           | 2                  |
| 2003 | 67600                | 77371                          | 9771                           | 14                 |

So, we can predict the Internet users number in the future with this model.

Let  $t = 10, t = 11, t = 12, t = 16$  separately in the equation (5-6), we can get the Internet user number (ten thousand) of 2004, 2005, 2006 and 2010.

$$\tilde{y}_{2004} = \tilde{y}_{10} = 92489$$

$$\tilde{y}_{2005} = \tilde{y}_{11} = 105387$$

$$\tilde{y}_{2006} = \tilde{y}_{12} = 115474$$

$$\tilde{y}_{2008} = \tilde{y}_{14} = 127953$$

Especially, the Logistic curve will have a Maximum, which

is  $\frac{1}{K}$  ( $\lim_{t \rightarrow \infty} y_t = \frac{1}{K}$ ), in this model, the Maximum is

$$\tilde{y}_{\max} = \frac{1}{K} = 137551$$

It is the saturation number of Internet user in the world here.

According to the number of Internet user and per capita trade volume we have got, we can calculate the value of on-line trade.

## 6. THE EXPLANATION AND ANALYSIS OF THE RESULT

(1) According to prediction above, the number of the world Internet users will reach 924.89million and 1053.87 million in 2004 and 2005, in 2006 this number will reach 1154.74million, it will be more higher in 2008 (1279.53 million). And per capita trade volume on Internet in 2004, 2005 and 2006 will up to 2764.56, 3695.35 and 4831.17 US dollars. Combine the two kinds of forecast result, we can estimate that the global e-commerce trade volume of the following three years is 2556.9 billion, 3894.4 billion, and 5578.7 billion US dollars respectively. Considering the fluctuation of the social economic development, the development speed of e-commerce may be hindered, but it can not deviate from the forecast in a big proportion, the following years will also be harvest years for e-commerce.

(2) We can predict with the model of the Logistic curve, the e-commerce will keep on growing steadily in the coming years and will tend towards the relaxation gradually afterwards. By 2008, when the global number of Internet users is up to 1279.53 million, the growth rate of it will become very small. When the number reaches the Maximum of the Logistic curve 1375.51 million, the global number of Internet users will enter a saturation state, this kind of state will appear within the year

of 2012~2015, then global number of Internet users probably accounts for about 23% of world population (about two times of that in 2003) at this moment.

(3) The Chinese number of Internet users in the second quarter of 2004 has reached the height of 87.00 million, second only to that of the United States. But because of the huge population in China, the Internet users still account for a comparatively small percentage, while in the US, Japan, and the South Korea, the number of Internet users exceed a half of the whole population. Obviously, there is a large gap between China and those countries. However, we are deeply convinced that, guaranteed by good domestic economic basis and policy environment, the number of internet users in China will keep on increasing and as a result, bigger market potential is promoted for e-commerce development. Undoubtedly, China will become one of the regions with fastest growth rate and greatest potential concerning e-commerce.

## 7. CONCLUSION

Due to the irregularity of the e-commerce activities, it is sometimes influenced by many factors, such as politics, economic situation and people's psychology. All these irregular factors probably disturb the forecast and thus affect the accuracy of the forecast results, especially the long-term ones. Less data of statistic on the online trade volume makes it more difficult to forecast the development of e-commerce. In China, there is no statistic on the e-commerce transition volume until now, and accordingly, no improvement of the relevant forecast has been made. This is the problem that we are focusing on.

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