Econometrics

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What is econometrics

Econometrics means “economic measurement”. the scope of econometrics is much broader, as can be seen from the following definition:

“Econometrics may be defined as the social science in which the tools of economic theory, mathematics, and statistical inference are applied to the analysis of economic phenomena” (Goldberger 1964).

Econometrics is the all about Considering Economic theory, Collecting data for the variable of economic theory and applying statistical tools on the data while testing some hypothesis and drawn some conclusion that is helpful in the policy making.

Why a separate discipline

The econometrics is an amalgam economic theory, mathematical economics, economic statistics and mathematical statistics.

The subject deserves to be studied in its own right.

Economic theory makes statements or hypotheses that are mostly qualitative in nature.

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- For example of microeconomic theory states that other thing remaining the same
- A reduction of the price of a commodity it is expected to increase the quantity demanded of that commodity. The economic theory just indicate the relationship where the it is positive or negative ,but the theory it self do not provide any numerical measure of the relationship between the two.
- is the job of the econometrician to provide such numerical estimates.

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- The main concern of mathematical economics is to express economic theory in mathematical form (equations) without regard to measurability or empirical verification of the theory. Econometrics, as noted previously, is mainly interested in the empirical verification of economic theory. As we shall see, the econometrician often uses the mathematical equations proposed by the mathematical economist but puts these equations in such a form that they lend themselves to empirical testing.

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- Economic statistics is mainly concerned with collecting, processing, and presenting economic data in the form of charts and tables. These are the jobs of the economic statistician. But the economic statistician does not go any further, not being concerned with using the collected data to test economic theories. Of course, one who does that becomes an econometrician.
- Although mathematical statistics provides many tools used in the trade, the econometrician often needs special methods in view of the unique nature of most economic data.

Methodology of econometrics

- How do econometricians proceed in their analysis of an economic problem? That is, what is their methodology? Although there are several schools of thought on econometric methodology, we present here the **traditional** or **classical** methodology, which still dominates empirical research in economics and other social and behavioral sciences

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- Broadly speaking, traditional econometric methodology proceeds along the following lines:

1. Statement of theory or hypothesis.
2. Specification of the mathematical model of the theory.
3. Specification of the statistical, or econometric, model.
4. Obtaining the data.
5. Estimation of the parameters of the econometric model.
6. Hypothesis testing.
7. Forecasting or prediction.
8. Using the model for control or policy purposes.

- To illustrate the preceding steps, let us consider the well-known Keynesian theory of consumption.

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1. Statement of Economic Theory or Hypothesis

Keynes states that on average, consumers increase their consumption as their income increases, but not as much as the increase in their income. (MPC < 1).

MPC= Rate of change consumption(say in $) by change in income.

2. Specification of the Mathematical Model of Consumption (single-equation model)

$$Y = a + \beta 1X \qquad 0 < \beta 1 < 1 \qquad (I.3.1)$$

Y = consumption expenditure and (dependent variable)

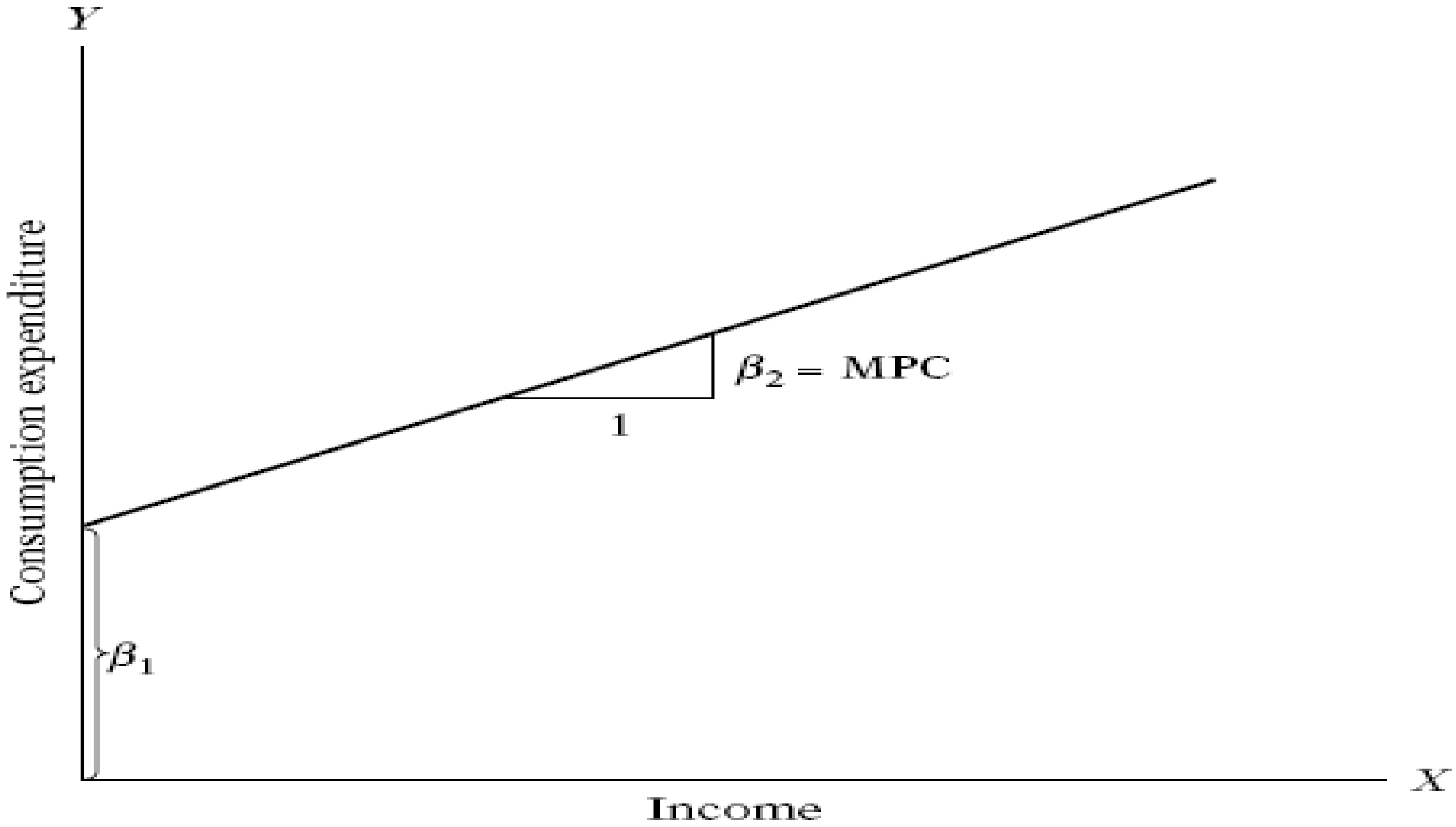
X = income, (independent, or explanatory variable)

a = the intercept

β1 = the slope coefficient

- The slope coefficient β1 measures the MPC.

Figure 1.1 Keynesian Consumption Function



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3. Specification of the Econometric Model of Consumption

The relationships between economic variables are generally inexact. In addition to income, other variables affect consumption expenditure. For example, size of family, ages of the members in the family, family religion, etc., are likely to exert some influence on consumption.

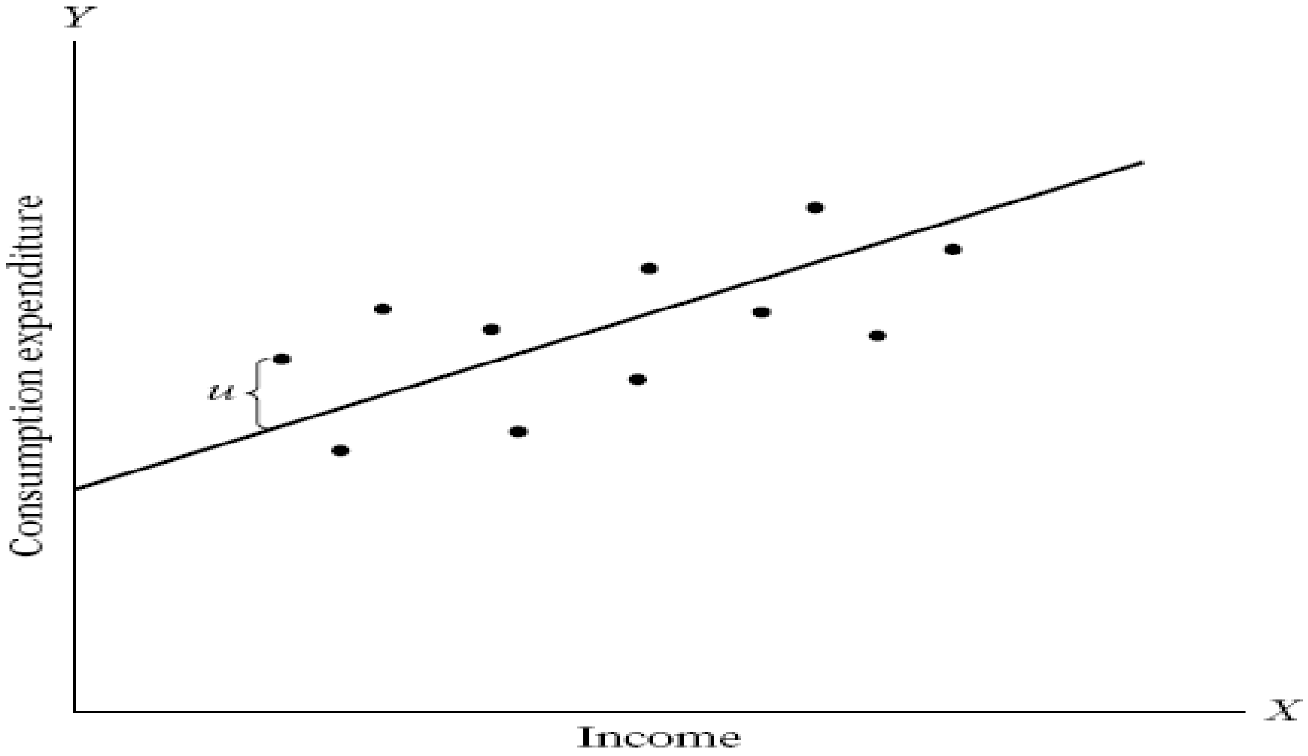
To allow for the inexact relationships between economic variables, (I.3.1) is modified as follows:

$$\mathbf{Y = a1 + \beta 1X + u} \qquad \text{(I.3.2)}$$

where u, known as the disturbance, or error, term, is a random (stochastic) variable. The disturbance term u may well represent all those factors that affect consumption but are not taken into account explicitly.

Figure 1.2 Econometric model k. con. function

(I.3.2) is an example of a linear regression model, i.e., it hypothesizes that Y is linearly related to X, but that the relationship between the two is not exact; it is subject to individual variation. The econometric model of (I.3.2) can be depicted as shown in Figure I.2.



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4. Obtaining Data

To estimate the econometric model given in Eq. (I.3.2), that is, to obtain the numerical values of $\beta 1$ and $\beta 2$, we need data. Although we will have more to say about the crucial importance of data for economic analysis in the next chapter, for now let us look at the data given in Table I.1, which relate to the U.S. economy for the period 1960–2005. The *Y* variable in this table is the *aggregate* (for the economy as a whole) **personal consumption expenditure (PCE)** and the *X* variable is **gross domestic product (GDP),** a measure of **aggregate income**, both measured in billions of 2000 dollars. Therefore, the data are in “real” terms; that is, they are measured in constant (2000) prices.

Table I.1 Data

Year	PCE(Y)	GDP(X)
1960	1597.4	2501.8
1961	1630.3	2560.0
1962	1711.1	2715.2
1963	1781.6	2834.0
1964	1888.4	2998.6
1965	2007.7	3191.1
1966	2121.8	3399.1
1967	2185.0	3484.6
1968	2310.5	3652.7
1969	2396.4	3765.4
1970	2451.9	3771.9
1971	2545.5	3898.6
1972	2701.3	4105.0
1973	2833.8	4341.5
1974	2812.3	4319.6
1975	2876.9	4311.2
1976	3035.5	4540.9
1977	3164.1	4750.5
1978	3303.1	5015.0
1979	3383.4	5173.4
1980	3374.1	5161.7
1981	3422.2	5291.7
1982	3470.3	5189.3
1983	3668.6	5423.8
1984	3863.3	5813.6
1985	4064.0	6053.7
1986	4228.9	6263.6
1987	4369.8	6475.1
1988	4546.9	6742.7
1989	4675.0	6981.4
1990	4770.3	7112.5
1991	4778.4	7100.5
1992	4934.8	7336.6
1993	5099.8	7532.7
1994	5290.7	7835.5
1995	5433.5	8031.7
1996	5619.4	8328.9
1997	5831.8	8703.5
1998	6125.8	9066.9
1999	6438.6	9470.3
2000	6739.4	9817.0
2001	6910.4	9890.7
2002	7099.3	10048.8
2003	7295.3	10301.0
2004	7577.1	10703.5
2005	7841.2	11048.6

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- **5. Estimation of the Econometric Model**

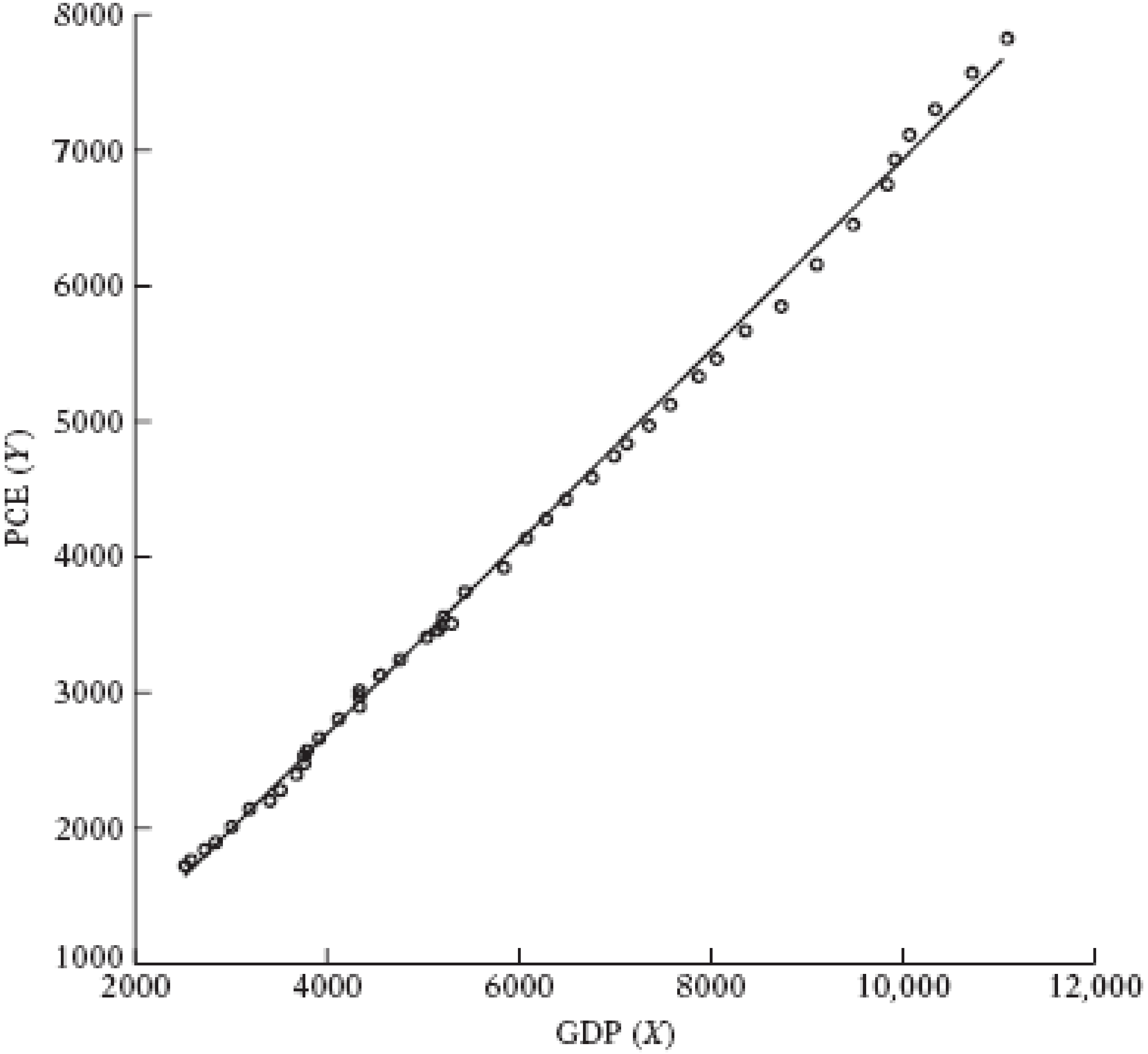
Now that we have the data, our next task is to estimate the parameters of the consumption function. The numerical estimates of the parameters give empirical content to the consumption function. note that the statistical technique of **regression analysis** is the main tool used to obtain the estimates. Using this technique and the data given in Table I.1, we obtain the following estimates of β_1 and β_2, namely, **−299.5913** and **0.7218**. Thus, the estimated consumption function is:

$$\hat{Y}_t = -299.5913 + 0.7218X_t \quad \ldots\ldots\ldots\ldots\ldots \quad \text{(I.3.3)}$$

The hat on the *Y* indicates that it is an estimate. The estimated consumption function (i.e., regression line) is shown in Figure I.3.

Figure I.3 Personal con. & GDP

As Figure I.3 shows, the regression line fits the data quite well in that the data points are very close to the regression line. From this figure we see that for the period 1960–2005 the slope coefficient (i.e., the **MPC**) was about 0.72, suggesting that for the sample period an increase in real income of one dollar led, *on average,* to an increase of about 72 cents in real consumption expenditure.



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6. Hypothesis Testing

That is to find out whether the estimates obtained in, Eq. (I.3.3) are in accord with the expectations of the theory that is being tested. Keynes expected the MPC to be positive but less than 1. In our example we found the MPC to be about 0.72. But before we accept this finding as confirmation of Keynesian consumption theory, we must enquire whether this estimate is sufficiently below unity. In other words, is 0.72 statistically less than 1? If it is, it may support Keynes' theory.

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7. Forecasting or Prediction

- If the chosen model does not refute the hypothesis or theory under consideration, we may use it to predict the future value(s) of the dependent, or forecast, variable Y on the basis of the known or expected future value(s) of the explanatory, or predictor, variable X.
- To illustrate, suppose we want to predict the mean consumption expenditure for 2006. The GDP value for 2006 was 11319.4 billion dollars.14 Putting this GDP figure on the right-hand side of Eq. (I.3.3), we obtain:
- $\hat{Y}_{2006} = -299.5913 + 0.7218\ (11319.4)$
- $= 7870.7516$

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- Thus, given the value of the GDP, the mean, or average, forecast consumption expenditure is about 7870 billion dollars. The actual value of the consumption expenditure reported in 2006 was 8044 billion dollars. The estimated model Eq. (I.3.3) thus **underpredicted** the actual consumption expenditure by about 174 billion dollars. We could say the **forecast error** is about 174 billion dollars, which is about 1.5 percent of the actual GDP value for 2006.

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- Suppose that, as a result of the proposed policy change, investment expenditure increases. What will be the effect on the economy? As macroeconomic theory shows, the change in income following, say, a dollar's worth of change in investment expenditure is given by the **income multiplier *M*,** which is defined as

$$M = 1/\ 1 - \text{MPC} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \textbf{(I.3.5)}$$

If we use the MPC of 0.72 obtained in Eq. (I.3.3), this multiplier becomes about $M = 3.57$. That is, an increase (decrease) of a dollar in investment will *eventually* lead to more than a threefold increase (decrease) in income; note that it takes time for the multiplier to work.

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- **8. Use of the Model for Control or Policy Purposes**

Suppose we have the estimated consumption function given in Eq. (I.3.3). Suppose further the government believes that consumer expenditure of about **8750** (billions of 2000 dollars) will keep the unemployment rate at its current level of about **4.2 percent** (early 2006). What level of income will guarantee the target amount of consumption expenditure? If the regression results given in Eq. (I.3.3) seem reasonable, simple arithmetic will show that

$$8750 = -299.5913 + 0.7218(GDP2006) \quad \textbf{(I.3.6)}$$

which gives $X = 12537$, approximately. That is, an income level of about 12537 (billion) dollars, given an MPC of about 0.72, will produce an expenditure of about 8750 billion dollars.

As these calculations suggest, an estimated model may be used for control, or policy, purposes. By appropriate fiscal and monetary policy mix, the government can manipulate the **control variable *X*** to produce the desired level of the **target variable *Y*.**

Methodology of the Econometrics