MPRA

Munich Personal RePEc Archive

Data Estimation and Interpretation: An Analysis.

Meyer, Thomas K.

Simon's Rock College of Bard

12. December 2008

Data Estimation and Interpretation: An Analysis.

This paper examines a central aspect of the collection and interpretation of economic data[1] among developed and developing countries. This aspect illustrates that for developed economies the collection of figures is far superior relative to that found in emerging nations. Yet, it is these developing nations who have a superior interpretation of these statistics with regard to their developed counterparts.[2] Then, a discussion will be made concerning the importance of data in the economy. This will be accomplished through examining the expected price level within two at odds macroeconomic theories, Lucas and Rapping's Rational Expectations modeling strategy[3], and the Adaptive Expectations hypothesis of Friedman. Additionally, some of the postulates of *Price Theory* will be mentioned and employed for this examination. This will entail the inclusion of both equations and a non-mathematical explanation of these theories. Having established the importance of these figures, the implications of this seeming tradeoff between collection and interpretation in terms of the economic performance of individuals and firms will be mentioned. This analysis will be conducted using these three hypotheses.

Of the things which lend themselves to the abysmal state of data collection in developing countries, there are two essential factors: the state of infrastructure and telecommunication technological advancement.[4] Most generally in these nations one finds advanced communications technology to be provided through the mechanism of "technology transfer." This concept is described "Developing nations gain access to advanced technology mainly through technology transfer, that is, by 'importing' the fruits of successful foreign research and development efforts."[5]Yet, many emerging nations are enacting policies which purposely and severely limit the flow of these goods. Take for instance, the later half of the twentieth century, "However, as early as the 1960s, a number of developing countries began to adopt national policies regulating technological imports, with particular attention to transactions with Northern multinational corporations [included in this are corporations based in developed countries]."[6] Nevertheless, such protectionist policies, while the may have fostered domestic industry, have not allowed for much technological advancement in these nations. This is because the national firms are generally quite unsuited to produce technology of the caliber found in developed countries, and the international competition which might induce them to strongly innovate has been diminished.

---

[1] This paper refers only to economic data, such as CPI, or GDP, it is not used in the broad sense of the word.

[2] Here, ideal or hypothetical terms are used. The interpretation of data would be superior in developing countries, if there were much data to make inferences upon, which is highly unlikely. So, when this superiority is mentioned, it is assumed, theoretically, that there would be a sufficient quantity of data to interpret.

[3] It should be noted that Lucas and Rapping were not responsible for creating this theory, for it is attributed to John Muth who introduced it in his article entitled *Rational Expectations and the Theory of Price Movements*. The informal representation of his model for the expected price level is as follows:
$$P_t^* = E_{t-1} (p \mid I_{t-1}).$$

[4] When technology is referred to, it signifies telecommunications technology.

[5] American Academy of Social and Political Science; *Technology Transfer to Developing Countries: Implications of International Regulation*; International Regulation; Page One-Hundred and Eleven.

[6] American Academy of Social and Political Science; *Technology Transfer to Developing Countries: Implications of International Regulation*; International Regulation; Page One-Hundred and Eleven.

Compounding this deficiency in communications technology are problems of infrastructure, such as an insufficient or deplorable network of roads, ineffective electric companies, and little government administration. An example of these things can be found in the S.E.C. This organization mandates that in the sale of securities "investors receive financial and other significant information concerning securities being offered for public sale; and…[that the following is prohibited:] deceit, misrepresentations, and other fraud in the sale of securities."[7] In many developing countries, this sort of transparency or required publication of data, is impracticable, either because the governing body is fundamentally unable to enforce such an act, or because it has little interest in doing so. Another instance will serve to illustrate the implications for data collection that both a lack of communicational technology and poor infrastructure create when found together, as often occurs in these economies. Suppose, there exists an emerging nation with such a deplorable network of roads that, for some portions of the year, sections of this country remain isolated. Moreover, imagine that due to the poor state of telecommunications a good deal of time is spent when it is impossible to use either a phone or the internet. How, in this situation, would a community in an inaccessible sector be able to effectively transmit essential economic data, such as employment? The answer is straightforward, this would not be possible. This same situation holds true for firms needing to transmit sale figures, or the effective demand for their product(s), etc. As is stated in an article for the journal *The American Economic Review* entitled *Telecommunications Infrastructure and Economic Development: A Simultaneous Approach* "In addition, the economic returns to telecommunications infrastructure investment are much greater that the returns on just the telecommunication investment itself. Where the state of the telephone system is rudimentary, communications between firms is limited,"[8] however communications between these firms and agencies collecting data (if any exist) would also be limited. This presents the issue of non-response bias, which will be returned to in a later section.

The collection of data in developed countries however, is far superior. This is due to the absence of the two factors named as causing the compilation of figures to be poor. In the case concerning "technology transfer" it was stated that the now developed nations foster the most advanced telecommunications technology, which they in turn had attempted to provide to their less developed counter parts. Thus, there is no fundamental lack of innovation. In terms of infrastructural issues, there tend to be none. Again, as was cited above, take the agency known in the United States as the S.E.C, which coerces the publication of certain data. This has permutations in many other developed countries. Furthermore, it is inconceivable that a portion of the United States, or Britain, etc. would be isolated and powerless to communicate with the remainder of the nation on a consistent basis.

The interpretation of data however, is a different matter, for here it is the developed countries which suffer, and the developing ones which succeed. In this discussion the statistical principle that correlation does not imply causation, or the bounds of the linear correlation model, is heavily relied on. This law is most succinctly stated "The second limitation of the theory [of correlation] is that although the correlation coefficient is a measure of the covariability of variables it does not necessarily imply any

[7] http://www.sec.gov/about/laws.shtml
[8] The American Economic Review; *Telecommunications Infrastructure and Economic Development: A Simultaneous Approach*; Pages Nine-Hundred and Nine to Nine-Hundred and Ten.

functional relationship between the variables concerned. Correlation theory does not establish, and/or prove any causal relationship between the variables."[9] To demonstrate the insufficient collection of statistics inherent in emergent countries, two factors were isolated. Here however, there is only a single feature which causes the explanation of figures to be unsound in developed nations, the presence of "innumerable variable elements." This is stated most succinctly by Persons who maintains "The cause and effect relation existing between economic events is especially difficult to ascertain because of the presence of innumerable variable elements."[10] In effect, an immense complexity has arisen in the developed economies, seeing as many new institutions and means have been created with which to influence certain aspects of the markets. This makes it seemingly difficult to attribute some effect to a particular cause. The number of variables which could possibly influence any one thing is immeasurable in these nations due to their enormous quantity. For an example of these notions, the opinions of different macroeconomic schools regarding the causes of the Great Depression will be utilized. Robert E. Lucas Jr., one of the central figures of new classical economics, stated:

> "If you just think of an economy in competitive equilibrium you wouldn't expect its output series to be completely smooth…If intelligent actors pursuing their own self-interest are going through the same mistake over and over again…we are led to think of informational difficulties…If you look back at the 1929 to 1933 episode, there were a lot of decisions made that, after the fact, people wished they had not made…there were a lot of jobs people quit that they wished they had hung on to… I don't see what's *hard* about people making mistakes in the business cycle. From the individual point of view, it's obvious."[11]

Thus, he attributes the Great Depression to three economic variables, problems of information, poor decisions on the part of economic actors, and an inherent fluctuation of growth. The Keynesian interpretation is somewhat different. It is described as "The contraction [Great Depression], set in train, on this view [Keynesian economics], by a collapse of investment or by a shortage of investment opportunities or by stubborn thriftiness."[12] In direct contrast to the Lucas interpretation, a single variable is identified, the decrease in investment expenditure. The monetarist or at least Friedman's interpretation of "The Great Contraction" consists (at least in part) of what follows:

> "the U.S. monetary authorities followed highly deflationary policies. The quantity of money in the United States fell by one-third in the course of the contraction. And it fell not because there were no willing borrowers-not because the horse would not drink. It fell because the Federal Reserve System forced or permitted a sharp reduction in the monetary base, because it failed to exercise the responsibilities assigned to it in the Federal Reserve Act to provide liquidity to the banking system."[13]

---

[9] *Theory of Econometrics*; Correlation Theory: The Simple Linear Regression Model; Limitations of the Theory of Linear Correlation; Page Forty-Four.
[10] Publications of the American Statistical Association; *The Correlation of Economic Statistics*; Page Two-Hundred and Eighty-Seven.
[11] *Conversations with Economists*; Conversations with New Classical Economists; Robert E. Lucas Jr.; Pages Forty to Forty-One.
[12] The American Economic Review; *The Role of Monetary Policy*; Page Two.
[13] The American Economic Review; *The Role of Monetary Policy*; Page Three.

This passage maintains that, as in the Keynesian analysis, a sole variable contributed to this depression, the deflationary activities of the Federal Reserve which caused a reduction in the monetary base. Thus, each school of macroeconomic thought attributes different variables in addition to differing quantities of variables to the cause of the Great Depression, which serves to illustrate the difficulty experienced in the assigning of causation and the interpretation of data.

However, these problems of data interpretation are mitigated within the context of a developing economy. This is because these markets lack the complexity found in developed nations. Initially, these countries concentrated their efforts on relatively few commodities, say one or two. Such a focus did not warrant intricacy in the marketplace, and merely a very few variables could influence an economic event(s). Ostensibly, in many of these nations the situation has changed. For instance, each country has a central bank and many have been able to attract, or allow for, foreign investment. Yet, they have still not achieved the complexity found in the economy of the developed nations. Moreover, while the quantity of variables capable of influencing events has increased, it too has not attained the amount found in developed nations.

Yet, it appears necessary to perform a thorough examination of the role data plays in certain macroeconomic and microeconomic models. To this end, three specific theories have been selected; one assuming Rational Expectations, another, Adaptive Expectations, and the third involves the central postulates of Friedman's *Price Theory*. In this analysis the emphasis will be on the expected price level found in each hypothesis, its formation, and its association with data. Subsequently, in a following section, the majority of these equations will be analyzed using the implications of these issues of data interpretation and collection. First, they must be stated formally. The Lucas supply function is given by the following equation:

$$(1.)\ Y_t = K_t + \gamma\,(P_t - P^*_t) + \lambda Y_{t-1}.\text{[14]}$$

Here Y_t signifies output at time t, P_t the price level at time t, and P^*_t the expected price level at time t. Furthermore, K_t is described as "a growth term" with γ and λ serving as parameters. In this equation, though there are three variables directly influenced by data, one is focused on, namely P^*_t. The expected price level is almost entirely determined by known past price levels. This relationship between results and expectations is formally represented in this equation concerning the predicted price level by Lucas and Rapping:

$$(2.)\ ln\,(P^*_t) = b_0\,ln\,(P_t) + b_1\,ln\,(P_{t-1}) + ...+ b_r\,ln\,(P_{t-r}) + a_1\,ln\,(P^*_{t-1}) + ...+ a_s\,ln\,(P^*_{t-s}).\text{[15]}$$

Here we see a firm representation of the Rational Expectations hypothesis, for this relation is contextualized by the statement that "the hypothesis that $ln\,(P^*_t)$ is a '*rationally* [italics added] distributed lag function' of past actual values…we impose the condition:

$$b_0 +...+ b_r + a_1 +...a_s = 1,$$

so that a proportional change in *all* past prices would imply a change in P^*_t of the same proportion."[16] In brief, the assumption is made that the agent forming expectations

[14] *Conversations with Economists*; A Background for the Conversations; Page Eighteen.

[15] The American Economic Review; *Price Expectations and the Phillips Curve*; Page Three-Hundred and Forty-Five.

[16] The American Economic Review; *Price Expectations and the Phillips Curve*; Page Three-Hundred and Forty-Four to Forty-Five

directly and rationally bases them entirely upon data, namely past and current price levels. Within this, it is supposed that each economic actor employs the most optimal data set.

Another presentation of forming an expected price level, presupposing the Rational Expectations hypothesis, is:

$$(3.)\ P^*_t = E_t\ (P_t \mid I_t).[17]$$

Here, E_t is portrayed as the *optimal* expectations of P_t at time $_t$. I_t characterizes all available information in this same instant and has a functional relationship with these most favorable anticipations, in that it directly informs them. Discernibly, data is intrinsic within this variable and another, P_t, seeing as both are represented as figures. This equation, while much simpler than (2.), holds no less significance given that it too demonstrates the role of past and current figures in the determination of the expected price level.

In his work *Price Theory*, Friedman maintains that "Prices, therefore, do three kinds of things in solving the above five problems [Knight's outline of the five interrelated problems of economics]. They transmit information, they provide an incentive to users of resources to be guided by this information, and they provide an incentive to owners of resources to follow this information."[18] In particular, the first purpose he assigns to prices is of interest. The mechanism which he ascribes to this process is a model which assumes adaptive expectations:

$$(4.)\ P^*_t = P_{t-1} + \varphi\ (P_{t-1} - P^*_{t-1}).[19]$$

The symbol φ serves as a coefficient. Friedman exemplifies two concepts with this equation, the first of which is that "someone corrects an error for only a fraction."[20] Also, he illustrates "expectations of P_t…are determined by past observations of the price level only."[21] Thus, he creates a relation wherein "people adjust their current expectations to correct expectation errors made in previous periods,"[22] and in which the expected price level is informed solely by past data and a fractional correction of past expectations. Therefore, both models assuming Rational and Adaptive Expectations employ statistics concerning price levels to inform the expected price level, though the equations of Lucas utilize both past and present data, while Friedman uses only past numbers.

Since either the Adaptive or Rational Expectations hypothesis apply data, it is logical to assume that they are subjected to the issues concerning these figures, namely the relationship between data collection and interpretation and whether or not a nation is developed or emergent. As has been stated previously, the compilation of statistics in the developing world is quite unsatisfactory due to both infrastructural and telecommunication problems. Yet, this perceptibly lends itself to a poor quality of data. For instance:

> "Unfortunately…the reliability of the index [of industrial production] has declined steadily in many developing countries. In some countries the inaccuracies in the index are so large that it is no longer possible to

---

[17] *Conversations with Economists*; A Background for the Conversations; Page Nineteen.

[18] *Price Theory*; Introduction; Page Ten.

[19] *Conversations with Economists*; A Background for the Conversations; Page Thirteen.

[20] *Conversations with Economists*; A Background for the Conversations; Page Thirteen.

[21] *Conversations with Economists*; A Background for the Conversations; Page Thirteen.

[22] *Conversations with Economists*; A Background for the Conversations; Page Thirteen.

distinguish year-to-year changes in the volume of output from the size of average error to which the index is subject…In some cases, the omission of new products (industries) may lead to a downward bias in the index for total manufacturing."[23]

Thus, the difficulty in this instance and on the whole, is not that there is an absolute lack of economic data, but that there is much non-response bias which negatively affects the set of figures as a whole both in terms of their applicability and credibility. The implications of this error also harmfully influence the hypotheses described above. Take equation (2.), which assumes Rational Expectations in deriving the expected price level P^*_t. The assumption is made that this expectation depends upon the current and past price levels, which are in and of themselves data. Yet, even though it is presumed that through acting rationally economic agents will employ the optimal set of data, it is quite probable that this data has also a large degree of error. If such error is contained within these figures, as it most likely is, one could quite possibly be basing their expectations on a large amount of erroneous numbers (ln (P_{t-1})… ln (P_{t-r})), which signifies that your expectations of the current price level are also erroneous and quite different from the actually realized point. In equation (1.), Lucas and Rapping present this as having a dire consequence on output:

$$(1.) \ Y_t = K_t + \gamma \ (P_t - P^*_t) + \lambda Y_{t-1}.$$

In the adaptive expectations equation (4.), Friedman illustrates that to form the expectation of the current price level at time $_t$, one utilizes the past price level of time $_{t-1}$ in addition to a fractional correction of assumptions. Here, the past price level for $_{t-1}$ could be incorrect which would, as is the case above, lead to an erroneous formation of expectations for the current price level. Furthermore, if the past price level is incorrect, that would signify that the correction of expectations is also invalid, leading to more damaging effects on the current price level. All of this would serve to have a negative result on output. Aside from these mathematical models, this issue of error in data has consequences for the central postulate of *Price Theory*. It is not to be disputed that prices convey information, but that ambiguous or false information is conveyed.

In developed countries, the interpretation of data, and not the data itself could perhaps be erroneous. Yet, this still has detrimental consequences. Though none of the macroeconomic models presented explicitly mention assigning an explanation to figures, it is still inherent within them. The Rational Expectations hypothesis assumes each agent will act *rationally* and *optimally*, but perhaps this may entail the omission of certain price levels in the formation of an expected price level for time $_t$. For instance, it seems consistent with the theory that if one interprets say P_{t-1} as being non-reflective of the overall pricing trend in that it is due to some variation which will never again occur, and if this is the most rational interpretation, it would be both acceptable and rational to omit this from the formation of expectations. Yet, even though this was the most rational interpretation and choice, perhaps P_{t-1} echoes a new as of yet unseen trend, signifying that this interpretation and subsequent decision to omit, is incorrect. Therefore, P^*_t would also be incorrect. By implication, many other economic variables would then be negatively affected. This same analysis can be projected onto the adaptive expectations hypothesis with minimal modification. Seeing as Friedman does not assume rationality,

---

[23] The Statistician; *Accuracy of Indices of Industrial Production in Developing Countries*; Page Two-Hundred and Ninety-Six.

and in fact assumes these economic agents will make mistakes, one can omit data from the formation of price expectations without it having to have the most rational interpretation of this data. In terms of prices communicating information, the economic actor may, as above consider this information and data to reflect an un-recurring and unreasonable deviation from the underlying pricing trend, and thus dismiss these figures and prices. If, this dismissal was unfounded, prices did in fact convey correct data, and this agent had planned otherwise, the consequences would be disastrous. For instance, suppose a firm had bindingly agreed to purchase some factor of production at a certain future time, for the market price dictated at this time, and that this corporation assumed prices were irrationally inflated and would decrease. However, some new economic paradigm meant that prices would only increase from this level. Thus, the speculating firm has lost valuable capital.

This paper examined the relationship between the collection and interpretation of data and whether or not a nation is developed or emergent. In this, the developing nations were superior in regards to the explanation of figures. This can be attributed to the economies found in these places lacking the complexity and presence of "innumerable variable elements" found in the developed countries which cause them to suffer in this respect. The developed world is far greater at compiling data however, because there are none, or very few of the infrastructural and telecommunications technology problems which plague the emergent nations. Thus, these issues are transmitted to any entity which includes them, such as the formation of expectations for the price level in either Adaptive and Rational Expectations, or the notion that prices convey information. Analyzed within the context of these equations and hypotheses, one can see that, regardless of the theory or model applied, these issues of data present a quite perceptible threat to economic growth and performance.

Index of Equations

1. $Y_t = K_t + \gamma (P_t - P^*_t) + \lambda Y_{t-1}$

2. $-ln (P^*_t) = b_0\, ln (P_t) + b_1\, ln (P_{t-1}) + ...+ b_r\, ln (P_{t-r}) + a_1\, ln (P^*_{t-1}) + ...+ a_s\, ln (P^*_{t-s})$

3. $P^*_t = E_t (P_t \mid I_t)$

4. $P^*_t = P_{t-1} + \varphi (P_{t-1} - P^*_{t-1})$

Also, Muth's simplified equation for the expected price level was presented. It is given as:
$$P_t^* = E_{t-1} (p \mid I_{t-1}).$$

Works Cited

-Rachel, McCulloch. "Technology Transfer to Developing Countries: Implications of International Regulation." *Annals of the American Academy of Political and Social Science* 458(1981): 110-122.

- Lars, Hendrik-Roller, Leonard Waverman. "Telecommunications Infrastructure and Economic Development: A Simultaneous Approach." *The American Economic Review* 91(2001): 909-923.

-Koutsoyiannis, A. *Theory of Econometrics*. Second Edition. Totowa: Barnes & Noble Books, 1977.

-Kmietowicz, Z.W. "Accuracy of Indices of Industrial Production in Developing Countries." *The Statistician* 44(1995): 295-307.

-Persons, Warren M. "The Correlation of Economic Statistics." *Publications of the American Statistical Association* 12(1910): 287-322.

-Klamer, Arjo. *Conversations with Economists: New Classical Economists and Opponents Speak Out on the Current Controversy in Macroeconomics*. First Edition. Totowa: Rowman & Allanheld, 1984.

-Friedman, Milton. *Price Theory*. First Edition. Chicago: Aldine Publishing Company, 1976.

-Lucas., Robert E. (Jr.) and Leonard A. Rapping. "Price Expectations and the Phillips Curve." *The American Economic Review* 59(1969): 342-350.

-Friedman, Milton. "The Role of Monetary Policy." *The American Economic Review* 58(1968): 1-17.