

## THE ANALYSIS AND MEASUREMENT OF ECONOMIC GROWTH

A review of A. Maddison, *Explaining the Economic Performance of Nations. Essays in Time and Space*, Edward Elgar Publishing, Aldershot, 1995, and A. Maddison, *Monitoring the World Economy 1820–1992*, OECD Development Centre, Paris, 1995.

Angus Maddison entitled his autobiographical note for the *BNL Quarterly Review* 'Confessions of a Chiffrephile,' indicating the general tendency for quantification of economic phenomena that characterizes his work. Maddison is known for the construction and analysis of long time series of GDP, used mainly in work on economic growth. *Monitoring the World Economy 1820–1992* (referred to as MWE below), extends this line of analysis from the industrialized world to many of the developing or newly industrializing countries. The collection of his works published by Edward Elgar (*Explaining the Economic Performance of Nations*, referred to as EEPN below) shows, however, that this work on growth fits into a whole range of broader topics that have occupied Maddison throughout his career, all centered around the broad question as to what determines "the wealth of nations."

In all of Maddison's work, the common denominator is the desire to quantify economics. Maddison talks about what can be measured, and he attempts to measure that which is interesting to talk about. The latter implies that his measurement, as that of all scholars in the field, is often crude. However the "Chiffrephile" method has the advantage that it starts from the bare facts, which provides a solid basis for discussion of the underlying causal mechanisms. This review will start by discussing Maddison's work on the measurement of economic performance, before proceeding to the issue of what drives economic growth, and a discussion of the role of backwardness and catch-up driven growth. Finally, Maddison's ideas about different phases of economic growth and the changing role of policy will be discussed.

In the art of measuring economic growth, two main toolkits are employed. One is concerned with measuring comparative levels of economic performance, and the other with accounting for growth. In Maddison's work, both streams feature prominently.

In order to compare levels of GDP per capita between different nations, the crucial issue is exchange rates. Actual exchange rates hardly ever correspond to purchasing power parities, implying that some adjustment for price differentials between nations is necessary even when GDP is expressed in a common currency such as the U.S. dollar. Maddison's approach to the problem differs from the expenditure based approach of Kravis and collaborators (embodied in the International Comparison Project and the Penn World Tables of Summers and Heston). Maddison starts from the supply-side rather than the demand-side, and calculates unit-value ratios for individual products (i.e., the value of production

divided through by the physical quantities). These unit value ratios are then considered as "prices," and weighted using quantity weights to get PPP-indices (although this term is less obvious than in an expenditure based approach, it is still being used). When compared to the ICP expenditure approach, this production-side approach is just as plausible on *a priori* grounds. Which one is preferable obviously depends on the aim of the analysis. For example, if one is comparing living standards between countries, it makes sense to look at expenditures, whereas if the focus is on productivity, Maddison's production-related approach makes more sense.

Chapter 7 in EEPN describes the two methods. The production-side approach to estimating PPP-indices was implemented in a research programme that Maddison set up at the University of Groningen (the so-called International Comparisons of Output and Productivity, or ICOP programme). This project has collected a very rich database from census data in many countries, and Maddison applies this data in bilateral comparisons of countries to the United States. Unfortunately, in many cases the overlap between the production structures of the two countries is rather small. The resulting PPP indices are thus often based on only a small sample of the products, which necessarily has to be considered as "representative" for the industry as a whole. Especially when comparing countries at very different levels of development, one may expect a small overlap of products.

If one views the results of the ICOP research programme in conjunction with the ICP project and its most widely known output, the Penn World Tables, the value added of ICOP is the detailed sectoral data it supplies. Where the Penn World Tables only provide estimates of GDP per worker or GDP per capita, the ICOP approach makes detailed sectoral comparisons of productivity possible, as for example shown in Pilat (1996). For the work in the area of convergence of GDP per capita or productivity levels between countries (see below), the ICOP work is thus a major step forward. For example as shown in Dollar and Wolff (1992), convergence trends at the sectoral level differ significantly from aggregate convergence trends, due to in some cases different technological opportunities between sectors or different specialization patterns between countries. Until the publication of ICOP results, sectoral productivity comparisons were rather unreliable as compared to GDP per capita estimates based on ICP results. It can be expected that the research in this field will gain a new stimulus with the data from Pilat (1996).

Research comparing levels of per capita GDP has flourished recently, while the growth accounting field dates from Denison's work in the 1960s. The neo-classical interpretation of growth accounting, associated with the names of Dale Jorgenson and Zvi Griliches, is based on strong assumptions about market equilibrium and optimizing behavior of firms, with factor prices reflecting marginal revenues of the factors. Maddison's approach, as Denison's, is more pragmatic and provides the necessary degrees of freedom for interesting explorations on issues that are not easy to link to theory. The effects of embodied technical progress on economic growth, i.e., the combined effect of technical progress and investment, is one example. Where theoretical vintage models lead one into all sorts of complications which make clear-cut conclusions on the issue rather difficult, Maddison's pragmatic assumptions on embodiment show the

order of magnitude of the effect, while at the same time making clear that the sensitivity of the outcomes with respect to the assumptions made is limited.

An important input into Maddison's growth accounting is his work on measuring capital stocks. The dominant approach here is the so-called perpetual inventory method, which calculates the capital stock as the sum of investments made in the past. One may either assume that investment depreciates according to some fixed rate each year, or that, once bought, equipment (or buildings) stay fully operational for a fixed period, going out of service abruptly after this period. Mainly due to problems associated with estimating a fixed depreciation rate, Maddison chooses the second approach, i.e., a fixed service life. Across different nations, however, the service life times used by the statistical agencies vary widely, and the empirical basis for the particular choice of a service life times is often weak. Differences in capital stocks across nations are to a certain extent related to these differences.

Maddison's estimates of the capital stock use a standardized life time across countries. This smooths the problems associated with the artificial differences in service life times across countries, but it leaves open other important problems of the perpetual inventory method. For example, service life time may be a function of economic variables such as the wage rate. Assuming a fixed service life time over a long period of time, as Maddison does, may thus obscure such endogenous factors explaining depreciation. It may also obscure more secular factors leading to a declining service life time, such as the impact of accelerations in technical progress (e.g., an assumed service life time of a decade or more seems rather long for modern computer equipment). All of these problems illustrate the basic difficulties still associated with measuring the stock of capital used in the production process.

In a critical review of the growth accounting method in general, Fagerberg (1988, p. 435) asserts that "most of the variables which the growth accountants take into account are interdependent, and without a theory of how these variables interact, decompositions cannot claim to be more than mere illustrations of the growth process . . . it would be necessary to distinguish between 'active factors' ('engines of growth'), and more 'passive factors' which . . . cannot themselves be regarded as causal, explanatory factors." In a nutshell, Fagerberg, as do other critics of growth accounting, argues that this method consists of "measurement without theory." What drives Maddison's growth accounting work, however, is indeed a search for what Fagerberg calls the "active factors." Throughout the two volumes reviewed here, a distinction between "ultimate" and "proximate" causality is systematically made. Ultimate causality relates to Fagerberg's "active factors," i.e., factors such as technological change, institutions, and macroeconomic policies. The growth accounts provide estimates of how these ultimate causes operate in terms of quantifiable phenomena.

In Chapter 3 of *EEP*N, Maddison sets out his basic scheme for ultimate causality behind the economic growth process. Three factors are presented as central: the "basic social order" (as characterized by institutions, belief and ideology), the degree of sociopolitical conflict, and macroeconomic policies for growth and stability. These three factors are influenced by "significant historical events"

(among others, revolutions and wars), and, in turn, have an impact on the country's distance from the technological frontier. This covers ultimate causality. Proximate causality is defined in terms of the production function, in which three production factors play a role: natural resources, human capital and physical capital. Each of these three proximate factors is augmented by the ultimate factors: physical capital and natural resources mainly by technological change, human capital by the educational and health systems.

One field where "ultimate causality" enters the picture, is economic backwardness. Explaining economic backwardness is a difficult task, especially if one aims to perform this task, as Maddison does, from a purely objective and predominantly quantitative point of view. EEPN includes work on three different countries: India, Indonesia and Mexico. For Indonesia, Maddison's work relates mainly to the debate on the impact of colonialism on the development of the domestic Indonesian economy, while for Mexico and India the focus is somewhat broader. For these two countries, factors such as the social and political dimensions of the Indian and Mexican societies are also taken into account. These topics are obviously politically sensitive, both in domestic discussions in the former colonial powers, and in the countries themselves. In these political issues, Maddison does not hide behind a purely quantitative approach. For example, after discussing Indian economic history, he speculates on the fate of India had it been colonized by the Portuguese or Dutch instead of the British, or had it been under Indian rule.

This work on the origins of backwardness will probably be read mainly by an audience of economic historians, and much less by economists interested in economic growth, or by development economists interested in present-day performance of third world countries. This is indeed a pity, because Maddison's work in this field shows how social and political factors from the past have a lasting influence on many of today's economies, and how theories of economic growth are at best only a very stylized representation of the growth process.

Economic backwardness is interesting from a historical point of view and also because it provides a crucial perspective on modern economic growth, and the role of technological change. This emerges from the work of Gerschenkron, which eventually led to the so-called catching-up theory of economic growth (see, e.g., Fagerberg, 1994). The idea behind catch-up driven growth is that relatively backward economies may exploit a large backlog of knowledge developed by the technologically leading nations. International technology diffusion thus becomes the crucial factor explaining international differences in economic growth rates. Maddison's work on this issue is most clearly reflected in Chapters 1 and 2 of MWE, and Chapter 4 in EEPN.

For Maddison, the idea of catching-up goes quite far. He argues, for example, that for most nations (the United States is the only real exception), technological progress is essentially an exogenous phenomenon. Frontier technology is developed in the United States, and from there it diffuses to other nations. Productivity growth then becomes a function of the technology gap, which can be measured by differences in GDP per capita relative to the United States. Although physical and human capital accumulation play important roles as proximate causes through which technology diffusion has its impact on economic growth, the nature

and effect of technological development remains exogenous for the following countries.

In the catching up (or "technology gap") theory of economic growth as summarized by Fagerberg (1994), social capability and technological congruence (Abramovitz, 1986) are the two factors which determine how "efficient" the process of technology diffusion takes place. Thus, technology, or at least its adoption, becomes endogenous again. The factors which have an impact on social capability are exactly those which figure as ultimate causality in Maddison's work (education, institutions).

Endogenous growth as a concept has recently gained attention in the "new growth theory," but is less relevant to Maddison's concept of technology. In these models, technological change results from investment in research and development by firms, and (international) diffusion plays a less important role. In fact, one may argue that part of the reason for the statistical evidence being in contrast with the predictions of new growth theory (see, e.g., Jones, 1995) lies in the importance of technology diffusion as stressed by the technology gap theory and Maddison's growth accounts.

With the publication of the Penn World Tables, convergence of GDP per capita levels became a very fashionable topic. What emerged from this literature is essentially that there is strong convergence between some countries, but certainly not for the world as a whole. Most prominently, the distance between developing and developed countries has become larger over 1960-90, while differences in the levels of GDP per capita among OECD countries became much smaller over the same period. The data in Maddison's MWE provide a very important addition to these stylized facts about growth. From his long-run data on developed countries (Maddison, 1992) it was already apparent that little convergence took place between OECD countries before the Second World War. MWE extends the long run picture to more than 60 countries, and now includes data on all continents and world regions. For students of convergence, the result is perhaps disappointing, because it shows little convergence for the world as a whole for the periods before the Second World War.

Another important ultimate factor explaining economic growth is policy. One way in which this factor enters the two volumes reviewed here, is in the work on phases of economic growth. Where Maddison (1992) discusses five phases of growth in the "Western world" over the period 1820-1990, Chapter 3 of MWE takes the discussion a major step forward by providing a truly global perspective. Maddison's phases of growth stem from the empirical observations on the basis of his estimations of GDP data and growth accounting based on them. The periodization of the phases is done by looking at the growth record, in combination with important historical events such as the two World Wars. What results is a very practical interpretation of the economic history of the world since 1820.

In this practical discussion of economic growth, macroeconomic policies, such as trade policies, domestic demand management policies, exchange rate management and development aid, play a prominent role. Not only do they enter as one of the ultimate causal factors explaining growth performance during each phase, the discussion also shows how different policies emerge from the economic context itself. In other words, the causal relationship between policy and growth

is a dual one. Among other things, Maddison describes the two major forms of "globalization" over the period 1820-1913 (Phases I and II): trade liberalization, which started in Phase I in Western Europe, and colonialism. With the data for Eastern Europe, Latin-America, Asia and Africa added to the known trends from Maddison (1992) for Western Europe and its offshoots, this historic "globalization" trend now becomes much more vivid.

In phase III (1913-50), the attitudes towards trade liberalization change drastically. With the Great Depression sweeping through the Western (offshoots) economies, governments turn to devaluation and protectionism as a defense. For the first time since the Industrial Revolution, growth in terms of per capita GDP is now more rapid in other parts of the world (most prominently Latin America) than in the Western (offshoots) economies. Although policies became much more favorable in the next Phase (1950-73), the Western world does not regain its growth leadership. This position is now taken over by Asia, where first Japan and later first- and second-tier tigers are growing relatively rapidly. Among the policies favorable for growth in this Phase are domestic demand management policies and (renewed) trade openness, along with increased communication between the nations of the world.

Three of Maddison's papers in EEPN specifically aimed at economic policy. The first (Chapter 1) describes the impact of foreign aid and investment in development. Here Maddison brings together evidence on a large number of developing countries and compares this with the evidence for some of the more developed nations. In a traditional growth accounting analysis, he relates foreign aid and domestic policy in the developing countries to the size of the residual, sometimes using quite heroic assumptions. However, these assumptions are always very transparent, and the interested reader may easily make calculations with alternative assumptions.

Two other chapters in EEPN address policy in developed countries. One (written in 1984) deals specifically with the impact of the welfare state, a topic which is still high on the agenda of economic policy makers and politicians. Maddison's conclusion here is that the quantitative evidence does not warrant any strong position on the impact of the welfare state on economic performance. As a true "Chiffrephile," he argues that any position on the economic benefits of the welfare state is an ideological one, and he thus refuses to take one. Almost 15 years after the original publication of this essay, these words do not seem to have lost their meaning.

The last "policy chapter" in EEPN deals specifically with the swing in macro-economic policies from Phase IV (1950-73) to Phase V (post-1973), specifically the changes in attitudes towards macro demand management and monetary policies. Written in 1983, the essay predicts that growth over the period until the end of the century will be modest, and that the unemployment problem will not be solved. For Europe at least, these predictions proved to be rather accurate.

In conclusion, the two volumes reviewed here cover a very broad range of issues, all linked to the question as to what determines the wealth of nations. "Chiffrephile" is Maddison's own invented terminology to describe the student of this broad set of approaches, issues, methods and conclusions. This broadness is not something to be critical about. Although the approach has its limitations,

which mostly lie in its limited concern with theory as a goal in itself, the volumes reviewed here show that it leads to many insightful conclusions and perspectives. Its strongest point is perhaps the large potential for stimulating ideas in many different fields of economics. Theoreticians as well as policy makers can learn from the quantitative exercises in these two volumes.

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