

Near Equilibrium – A Research Report on Cyclic Growth

András Bródy

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In the 1970s, a group of NYU students (Chakraborty, Morris, Viet and I) read and discussed András Bródy's *Proportions, Prices, and Planning: A Mathematical Restatement of the Labor Theory of Value*. Ever since, Bródy is on my radar screen and I have looked forward to his recent *Near Equilibrium*, the book that consolidates ten years of fundamental research.

The centerpiece of economics is the theory of value, which attempts to explain the quantities and prices of transactions. There are competing variants. Ricardo and Marx reduce value to labor services. Sraffa and von Neumann use a standard commodity bundle. Smith and Walras bring in demand as a co-determinant. All authors explain the 'natural' state of the economy, which means equilibrium or at least steady state growth. Marx's analysis of the capitalist dynamics is the exception, but it is imprecise and Bródy's aforementioned restatement focuses on the stable relationships. What remains to be explained are the fluctuations of prices and quantities.

The Walras' tâtonnement comes close to a dynamic theory of value, but its objective is to explain a tendency towards equilibrium, whereas Bródy argues at length and convincingly that the natural state of an economy, be it free-market, centrally planned, or mixed, is not equilibrium, but fluctuation. In his view, business cycles are not transient but persistent. Fluctuations are intrinsic to the economic system and ought to be explained head-on on the basis of the fundamentals, where the latter are represented by the input–output coefficients of the flows and the stocks in production and consumption.

Bródy fills this gap in the history of economic thought in a subtle manner. Let me introduce his theory via the Walras' tâtonnement, $\dot{p} = z(p)$, where p is the price vector, and z the excess demand function (demand minus supply). Here p is not necessarily the equilibrium price (for which excess demand is zero) and, therefore, supply and demand may be off-equilibrium as well. Now if this is the case, a gradual adjustment of price takes place (by the auctioneer). The quantities, however, are immediately in tune with the prices. Producers select inputs and outputs which instantaneously maximize profit. The author draws our attention to the distinction between levels, changes, and rates of variables. For example, it makes a difference if one maximizes profit, moves in the most profitable direction, or maximizes present value. These differences plague Walras' tâtonnement. Prices are changed according to market conditions, but quantities are set at the right level. Bródy argues, again at length and convincingly, that quantities should not be treated asymmetrically. Quantities *adjust*. It takes time to install machinery and equipment and to hire and fire workers. Implicitly, Walras assumes that prices are more sluggish than quantities. His auctioneer adjusts prices, but producers and consumers instantaneously reformulate their supplies and demands. Bródy says: let excess supply ($-z$) adjust in the direction of price: $-\dot{z} = p$. He thus replaces the single first-order differential equation by a pair of coupled differential equations.

His insight kills two birds with one stone. First, it resolves the outstanding issue in the theory of value that supply (and hence price adjustment) is ill-defined in the

important case of constant returns to scale. If the price of output is greater than, smaller than, or equal to the price of the input bundle, supply is infinite, zero, or indeterminate, respectively. This situation cannot be described by a supply function. Strictly speaking, the tâtonnement process requires diminishing returns to scale, which is a big limitation. How does Bródy's approach solve this problem? In its simplest form, his model runs as follows. The quantities supplied are given by vector x . Let A be the matrix of input–output coefficients, including the (consumption) coefficients of the households. Then the quantities demanded are Ax . The prices are given by vector p . Hence, the costs are $A'p$, where the prime denotes transposition. Prices adjust in response to excess demand: $\dot{p} = Ax - x$, and quantities adjust in response to profitability: $\dot{x} = p - A'p$. This is ingenious. Unlike supply, the direction of profit *is* well defined for economies with constant returns to scale. Moreover, the coupling of the price and quantity systems can be seen as a fix of input–output analysis.

The symmetric treatment of prices and quantities has dramatic impact. I come to the second bird Bródy kills. The convergence of Walras' tâtonnement to equilibrium – at least under weak gross substitutability as shown by Arrow and Hahn – is replaced by persistent cycling around the equilibrium. Indeed, the anti-symmetry in the coupled adjustment process generates only cyclic solutions besides the steady state growth path. The spectrum of frequencies is determined by the A -matrix.

Bródy presents and analyzes two important variations on the basic model. One is the replacement of derivatives by elasticities. It is reasonable to assume that excess demand and profitability *rates* propel entrepreneurs or planners. The linear differential equations become nonlinear; the consequent Lotka–Volterra equations are analyzed and found to produce similar cyclic solutions. The other variation is the introduction of Leontief's stock coefficients. As in Bródy (1974), he assumes a relationship between flow and stock coefficients (via the turnover period), a condition that I gave a theoretical foundation in my *Structural Economics* book (ten Raa, 2004).

Applying the analysis to the US economy, Bródy finds six cycles, namely the seasonal cycle, a five-year inventory cycle, a diminishing seven-year cycle, a 19-year Kuznets cycle, a 27-year demographic cycle and 60+ years Kondratiev wave. The spectrum is the same for the two input–output structures he investigates, namely the 1947 and 1958 Harvard Economic Research Project tables. He also compares to the actual performance of the US economy and finds that the model explains half of the fluctuations.

In the third part, the author shares his insights in the methodology of science. As in physics, the causal model is equivalent to a teleological approach. In fact, he uncovers the objective function of which the minimization replicates the dynamics of the price–quantity adjustment process; it is Sraffa's stipulation of the discrepancy between nominal surplus (paper profits) and their accumulation.

The author is an artist. With broad brushes he paints the quintessence of the theory of value – prices, quantities, and their fluctuations – and shows their applicability. I miss some mathematical and econometric detail, but have the feeling the results are correct. This book is a goldmine of ideas. With a single, elegant principle – the symmetric treatment of prices and quantities – he unifies the theories of value, growth and the business cycle.

András Bródy is an independent thinker who has not been treated too well by the political and scientific authorities under communism or after. Yet he has superseded himself. *Near Equilibrium* makes a lasting imprint.

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References

- Bródy, A. (1974) *Proportions, Prices and Planning: A Mathematical Restatement of the Labor Theory of Value* (Amsterdam: North-Holland).
- ten Raa, T. (2004) *Structural Economics* (London: Routledge).