

Retrospectives

Whatever Happened to the Cambridge Capital Theory Controversies?

Avi J. Cohen and G. C. Harcourt

This feature addresses the history of economic words and ideas. The hope is to deepen the workaday dialogue of economists, while perhaps also casting new light on ongoing questions. If you have suggestions for future topics or authors, please write to Joseph Persky, c/o *Journal of Economic Perspectives*, Department of Economics (M/C 144), University of Illinois at Chicago, 601 South Morgan Street, Room 2103, Chicago, Illinois 60607-7121.

Preliminaries: Joan Robinson's Complaints

In "The Production Function and the Theory of Capital," Joan Robinson (1953–1954, p. 81) wrote:

... the production function has been a powerful instrument of miseducation. The student of economic theory is taught to write $Q = f(L, K)$ where L is a quantity of labor, K a quantity of capital and Q a rate of output of commodities. He is instructed to assume all workers alike, and to measure L in man-hours of labor; he is told something about the index-number problem in choosing a unit of output; and then he is hurried on to the next question, in the hope that he will forget to ask in what units K is measured. Before he ever does ask, he has become a professor, and so sloppy habits of thought are handed on from one generation to the next.

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Her article precipitated into the public domain the Cambridge controversies in capital theory, so-called by Harcourt (1969) because the protagonists were principally associated directly or indirectly with Cambridge, England, or Cambridge, Massachusetts. The controversies raged from the mid-1950s through the mid-1970s, with highly prominent protagonists—Piero Sraffa, Joan Robinson, Luigi Pasinetti and Pierangelo Garegnani in the “English” corner, versus Paul Samuelson, Robert Solow, Frank Hahn and Christopher Bliss in the “American” or neoclassical corner¹—slugging it out in first-rank journals such as the *Quarterly Journal of Economics*, the *Review of Economic Studies* and the *Economic Journal*. Blaug (1975) and Harcourt (1972, 1976) cover both sides of the controversy.

The Cambridge controversies, if remembered at all, are usually portrayed today as a tempest in a teapot over anomalies involving the measurement of capital in aggregate production function models, having as little significance for the neoclassical marginal productivity theory of distribution as do Giffen good anomalies for the law of demand. When theories of endogenous growth and real business cycles took off in the 1980s using aggregate production functions, contributors usually wrote as if the controversies had never occurred and the Cambridge, England contributors had never existed. (Robinson and Sraffa obliged by dying in 1983.) Since neoclassical theory has survived and the challengers have largely disappeared, the usual conclusion is that the “English” Cantabrigians were clearly wrong or wrong-headed.

Did the Cambridge controversies identify “sloppy habits of thought” that have been handed down to yet another generation, or were they a teapot tempest of concern now only to historians of economics? In this article, our aim is to put into perspective what was at stake and to argue that the controversies were but the latest in a series of still-unresolved controversies over three deep issues. The first is the meaning and, as a corollary, the measurement of the concept of capital in the analysis of industrial capitalist societies. The second is Joan Robinson’s complaint that equilibrium was not the outcome of an economic process and therefore an inadequate tool for analyzing processes of capital accumulation and growth. The third issue is the role of ideology and vision in fuelling controversy when the results of simple models are not robust. Our aim is to convince the reader of the importance and relevance today of these issues, which, we predict, will inevitably erupt in future controversy.²

¹ Sraffa, Robinson and Pasinetti were at the University of Cambridge. Pasinetti and Garegnani had both been Ph.D. students there in the 1950s. On the “American” side, Samuelson and Solow were at MIT, Hahn was actually at the University of Cambridge, and Bliss, though at Essex and then Oxford, had been an undergraduate and university teacher at Cambridge.

² 2003 marks numerous anniversaries—the 50th of Robinson’s original paper, the 100th of her birth and the 20th of Robinson’s and Sraffa’s deaths.

Round 1: Meaning and Measurement of Capital in the Scarcity Theory of Price

With the marginal revolution, Jevons, Menger and Walras developed pure exchange models in the 1870s that shifted the explanation of price away from the classical difficulty-of-production focus to the neoclassical focus on utility and relative scarcity. Adam Smith's diamond-water paradox was no longer a paradox, since price was explained as proportional to marginal utility, which depended on scarcity. Neoclassical capital theory was the arena for extending the general principle of relative scarcity to explain *all* prices, including factor prices in models with production and time (Hennings, 1985).

A common starting point for the neoclassical perspective on capital is a one-commodity Samuelson/Solow/Swan aggregate production function model:

$$Q = f(K, L),$$

where the one produced good (Q) can be consumed directly or stockpiled for use as a capital good (K). With the usual assumptions, like exogenously given resources and technology, constant returns to scale, diminishing marginal productivity and competitive equilibrium, this simple model exhibits what Samuelson (1962) called three key "parables": 1) The real return on capital (the rate of interest) is determined by the technical properties of the diminishing marginal productivity of capital; 2) a greater quantity of capital leads to a lower marginal product of additional capital and thus to a lower rate of interest, and the same inverse, monotonic relation with the rate of interest also holds for the capital/output ratio and sustainable levels of consumption per head; 3) the distribution of income between laborers and capitalists is explained by relative factor scarcities/supplies and marginal products. The price of capital services (the rate of interest) is determined by the relative scarcity and marginal productivity of aggregate capital, and the price of labor services (the wage rate) is determined by the relative scarcity and marginal productivity of labor (L).

The three parables of this one-commodity model depend on a physical conception of capital (and labor) for their one-way causation—changes in factor quantities cause inverse changes in factor prices, allowing powerful, unambiguous predictions like parable 2.

But problems for these parables arise in more general models with heterogeneous capital goods. Heterogeneous capital goods cannot be measured and aggregated in physical units; instead, capital valuation must be used, as Wicksell (1911 [1934]) volume 1, p. 149) told us long ago. Their value can be measured either as the cost of production, which takes time, or the present value of the future output stream they produce. In either case, since the measure involves time, it presumes a rate of interest—which, in the simple model, is determined in a one-way manner by the quantity of capital. This additional circularity, or interdependence, causes

Wicksell effects. Wicksell effects involve changes in the value of the capital stock associated with different interest rates, arising from either inventory revaluations of the same physical stock due to new capital goods prices (price Wicksell effects) or differences in the physical stock of capital goods (real Wicksell effects).

In the Cambridge controversies, the problems created for the neoclassical parables by Wicksell effects were termed reswitching and capital-reversing. Reswitching occurs when the same technique—a particular physical capital/labor ratio—is preferred at two or more rates of interest while other techniques are preferred at intermediate rates. At lower values of the interest rate, the cost-minimizing technique “switches” from *a* to *b* and then (“reswitches”) back to *a*. The same physical technique is associated with two different interest rates, violating parables 1 and 2.

With capital-reversing, a lower capital/labor ratio is associated with a lower interest rate. In comparing two steady-state equilibrium positions, it is as though capital services have a *lower* price when capital is “more scarce.” Capital-reversing implies that the demand curve for capital is *not* always downward sloping, violating parables 2 and 3.

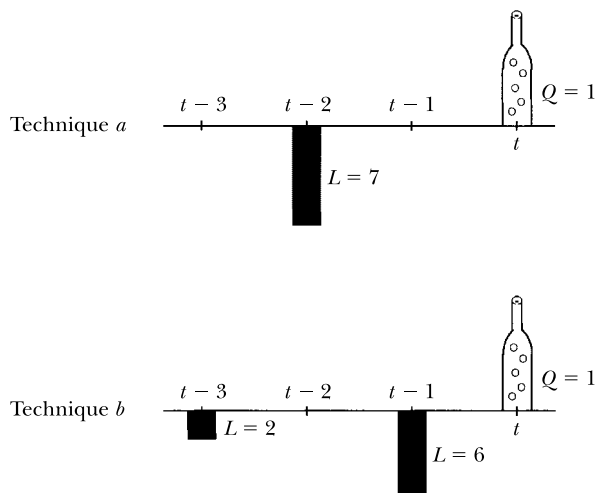
Why do reswitching and capital-reversing occur? Samuelson (1966) provides the intuition using the Austrian conception of *capital as time*, so that the productivity of capital is the productivity of time itself. Figure 1 illustrates two techniques for making champagne using only labor and time (and free grapes). In technique *a*, 7 units of labor make 1 unit of brandy in one period, which ferments into 1 unit of champagne in another period. In technique *b*, 2 units of labor make 1 unit of grape juice in one period, which ripens into wine in another period. Then 6 units of labor shaking the wine produce 1 unit of champagne in a third period.

The cost-minimizing technique depends on relative factor prices. At high interest rates ($r > 100$ percent), compounded interest on the 2 units of labor invested for 3 periods makes *b* more expensive, so *a* is chosen. At zero interest, only labor costs count, so *a* is also cheaper. But at interest rates between 50 percent and 100 percent, *b* is cheaper. The corresponding demand for capital curve would look like Figure 2. First, notice that at different values of r along any discreet downward-sloping segment, the value of the “capital” is different for a physically unchanging technique, due to price Wicksell effects. Notice also that at lower values of r , the technique switches from *a* to *b* and then reswitches back to *a*, due to real Wicksell effects. And at a value of r just below 100 percent, capital-reversing occurs as a lower r is associated with a lower capital/labor ratio.

Because of Wicksell effects, in models with heterogeneous capital goods (or heterogeneous output), the rate of interest depends not only on exogenous technical properties of capital, but also on endogenously determined prices like the interest rate. The endogeneity of prices allows multiple equilibria, which complicates the one-way parable explanations of income distribution. Differences in quantities no longer yield unambiguously signed price effects. The power and simplicity of one-commodity models emanates from eliminating these endogenous price effects and measurement problems (Cohen, 1989).

Figure 1

Samuelson's (1966) Example of Wicksell Effects in a Simple Austrian Model



The cost equations are:

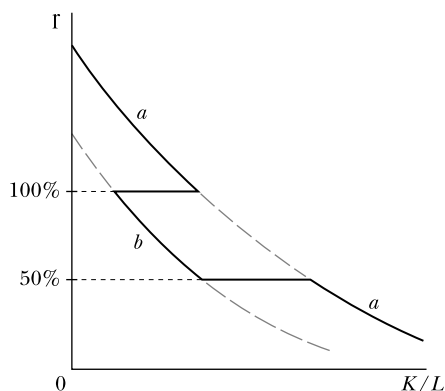
Technique *a* $7L(1+r)^2$

Technique *b* $2L(1+r)^3 + 6L(1+r)$

When comparing costs, *L* cancels out for both techniques. Switchpoints occur when the costs are equal.

Figure 2

Demand for Capital (Per Unit of Labor) in Samuelson's (1966) Example



As early as 1936, Sraffa wrote a letter to Robinson explaining the essence of this complication for neoclassical capital theory. Reswitching and capital-reversing were noted in the 1950s by David Champernowne (1953–1954) and Robinson, but their full significance was realized only with Sraffa's 1960 book. Sraffa (1962, p. 479) posed the key question regarding the meaning and measurement of capital: "What is the good of a quantity of capital . . . which, since it depends on the rate of

interest, cannot be used for its traditional purpose . . . to determine the rate of interest[?]"³

Round 2: Equilibrium and Time, Differences Versus Changes

Capital is fundamentally intertwined with issues of time. As Bliss (1975, p. 39) wrote: "One of the essential tasks of a theory of capital is . . . to make clear why a purely static and timeless economic theory could not be adequate." Questions about the measurement of capital in aggregate production function growth models segued to questions about how, if at all, may dynamic processes of accumulation and distribution be analyzed within an essentially static equilibrium framework.

The neoclassical approach to capital commonly examines accumulation and rates of return using comparative statics exercises—including comparisons of steady-state growth paths—which reflect differences in initial conditions. Robinson insisted that such comparisons did not reveal anything about *processes* of accumulation and growth, even their ultimate outcomes. She "frequently had occasion to complain of the inability of neoclassical writers to distinguish between a *difference* in the parameters of an equilibrium model and the effects of a *change* taking place at a moment of time" (Robinson, 1980, volume 5, p. vii). Her phrase "history versus equilibrium" summed up this methodological critique. Robinson (1974 [1980], p. 57) argued:

The real source of trouble is the confusion between comparisons of equilibrium positions and the history of a process of accumulation. We might suppose that we can take a number of still photographs of economies each in stationary equilibrium; . . . This is an allowable thought experiment. But it is not allowable to flip the stills through a projector to obtain a moving picture of a process of accumulation.

Thus, many years ago, Robinson (1953, p. 590) put back on the agenda what we now call path-dependent equilibria: "the very process of moving has an effect upon the destination of the movement, so that there is no such thing as a position of long-run equilibrium which exists independently of the course which the economy is following at a particular date." The title of her 1975 paper, "The Unimportance of Reswitching" (Robinson, 1975a), reflected her belief that while reswitching and capital-reversing were problematic for neoclassical capital theory, her methodological critique was far more important.

³ Do similar valuation problems arise for heterogeneous labor? The crucial difference with capital is that there is no theoretical presumption that competition will equalize wages across different types of labor, in the way that rates of return will equalize (adjusted for risk) across investments in different capital goods/industries. To the extent that heterogeneous labor reflects differences in human capital, the valuation problems for the neoclassical parables due to interest rate changes are only exacerbated.

The neoclassical comparative statics exercises are clearly an abstraction, as are all economic models. The crucial question is whether the abstraction of comparative statics *captures* or *obscures* essential features of the accumulation process.⁴

Round 3: Neoclassicals Fight Back: Aggregate Production Functions—1956–1966

Solow (1955–1956) immediately recognized that problems in measuring aggregate capital due to Wicksell effects could be overcome only “in very special cases” and presciently commented that “the real difficulty of [capital] comes not from the physical diversity of capital goods. It comes from the intertwining of past, present and future . . .” He countered with an *empirical* defense of one-commodity models as capturing the essential features of the growth process, a position held consistently to this day (Solow, 2000; but see also Pasinetti, 2000). With characteristic wit, he defends his choice by saying that “if God had meant there to be more than two factors of production, He would have made it easier for us to draw three-dimensional diagrams.” Solow’s (1956, 1957) one-commodity production function model enabled him to measure the respective contributions of capital deepening and technical progress to growth in output per head over time.

There were also three, less successful, *theoretical* attempts during the period from about 1956 to 1966 to fend off the problems of heterogeneous capital. First, Swan (1956) introduced into this round of capital controversies what came to be known as the metaphor of “putty capital.” He collapsed the ever present tension between capital as physically heterogeneous capital goods and as homogeneous funds flowing to equalize rates of return through his metaphor of meccano sets, the pieces of which can be timelessly and costlessly reshaped into appropriate quantities of “capital” in response to the pull of relative factor prices. These metaphors originated with Böhm-Bawerk (1907, p. 280), who wrote in the context of his controversy with J.B. Clark: “Clark thinks of capital as a quantum of value ‘imputed’ in material goods. He strips off everything which may suggest material existence, and retains only a value jelly, existing eternally.” Subsequent metaphors included “leets” (steel spelled backward), butter, lego and putty (as opposed to clay). But all of these metaphoric feints, which effectively collapse heterogeneous capital goods into a one all-purpose commodity, only avoid, but do not solve, Wicksell’s problems.

Solow (1963) re-entered the ring with a second theoretical response from the

⁴ Robinson also aimed this critique at her otherwise allies, Sraffa’s followers. Garegnani, for example, staunchly defends the view that rigorous results may only be established within a framework capturing the effects of persistent forces that characterize long-period positions—for example, the natural prices of the classical political economists, the prices of production of Marx and the long-period normal equilibrium prices of Marshall, the economist’s counterpart of the natural sciences’ traditional centers of gravitation. Garegnani’s (1970) insistence on using this long-period method is why Robinson directly and Kaldor indirectly fell out with the Sraffians.

neoclassicals, attempting to avoid problems of capital by focusing on the rate of return on investment. In the tradition of Irving Fisher (1930), this was capital theory without any mention of either “capital” or “its” marginal product. Solow’s model addressed the question “what is the expected marginal return to a little more saving/investment in a fully employed economy?” and served as the basis for empirical estimates of rates of return in actual economies. Pasinetti (1969, 1970) argued that neither Fisher’s nor Solow’s approach provided an intuitively satisfying explanation of the rate of return unless an “unobtrusive postulate” that disallowed capital-reversing was slipped into the analysis, although Solow (1970) disputed this.

The third theoretical neoclassical response attempted to extend the one-commodity results to more general heterogeneous commodity models. Samuelson’s (1962) attempt in the “surrogate production function” included what appeared to be a variety of physically distinct capital goods, but he also assumed equal factor proportions in all industries, making relative prices independent of changes in distribution between wages and profits. As Samuelson subsequently realized, this effectively collapsed his model back to one commodity.⁵

By the late 1960s, Samuelson’s (1966, p. 568) judicious “Summing Up” article admitted that outside of one-commodity models, reswitching and capital-reversing may be usual, rather than anomalous, theoretical results and that the three neoclassical parables “cannot be universally valid.” On a theoretical level, the “English” Cantabrigians won the round over aggregate production functions. Even neoclassicals like Hahn (1972, p. 8) showed no mercy for aggregate production functions, which “cannot be shown to follow from proper [general equilibrium] theory and in general [are] therefore open to severe logical objections.” They fell out of favor in the 1970s and early 1980s until their revival with endogenous growth and real business cycle theories.

Round 4: General Equilibrium—1966 and Beyond

A final neoclassical theoretical counteroffensive moved into the arena of general equilibrium, with Bliss and Hahn replacing Solow and Samuelson as key protagonists. General equilibrium models sustain the general neoclassical principle of explaining all prices, including factor prices, by relative scarcity, in that prices are determined by preferences, endowments and technology, and factor returns are *equal to* or *measured by* disaggregated marginal products. Competitive equilibrium prices are also consistent with a Pareto-efficient disposition of output.

The three parables, however—especially the inverse, monotonic relation between the quantity of capital and the rate of interest—were not rescued. Bliss’s 1975 book (which most observers consider the definitive neoclassical treatment of capital theory that ended the Cambridge controversies) examines this relation using

⁵ Ironically, Samuelson’s simplifying assumption also supported Marx’s labor theory of value!

intertemporal general equilibrium models to generate comparative static results.⁶ Bliss (1975, p. 85) concludes that “there is no support from the theory of general equilibrium for the proposition that an input to production will be cheaper in an economy where more of it is available.” Sraffians get the same result (Schefold, 2000).

The general equilibrium round was motivated by Samuelson’s quest, in his surrogate production function model, “to provide *some* rationalization for the validity of the simple J. B. Clark parables” (Samuelson, 1962, p. 194, emphasis in original). Clark (1891, p. 312) made straightforward one-way causal claims: “[A]s capital increases, while other things remained unchanged, interest falls and as the labor forces increases, if other things remain the same, wages fall.” Samuelson’s failure prompted a “retreat” to general equilibrium models. But the switch to general equilibrium, rather than saving the neoclassical parables, abandoned them for simultaneous equation price systems, and correct statements about factor returns being equal to or measured by disaggregated marginal productivities. Relinquished, however, were one-way causal claims about unambiguously signed differences in the interest rate associated with differences in the quantity of capital. As Hahn (1981, p. 128) put it, neoclassical general equilibrium “is not committed to a relative scarcity theory of distribution.”

Moreover, the general equilibrium approach revitalized Robinson’s concerns about equilibrium. Theoretical work, specifically, the disappointing Sonnenschein-Mantel-Debreu stability results, found no particular reason to believe in the stability of the general equilibrium outcome. In discussing these results, Hahn (1984, p. 53) wrote: “[T]he Arrow-Debreu construction . . . must relinquish the claim of providing necessary descriptions of terminal states of economic processes.” The lack of adequate stability results raised questions about the conception of equilibrium as the end of an economic process and the adequacy of comparative statics as explanations of the process of change following a parameter shift (Fisher, 1989; Ingrao and Israel, 1990).

And the Winner is . . . ?

Not so fast. The fight was far from over because *there was no agreement on the significance of all of these results*. The two sides used different criteria to judge the agreed upon outcomes of the controversy.

The different criteria involve another ongoing and unresolved controversy: Has there been continuity in the evolution of economic theory from Adam Smith to the present or discontinuity, with the marginal revolution setting neoclassical economics on a different path from earlier classical political economy and Marx (Bharadwaj, 1978)? The “English” Cantabridgians, who viewed Sraffa’s 1960 book

⁶ Dixit (1977) said in effect that Bliss’s arguments made the quasi-rents of most previous writing on capital theory either zero or, with regard to those of Cambridge, England, negative.

as a revival of classical theory (Sraffa also edited Ricardo's collected works), believe in discontinuity; most neoclassicals, in continuity.

While neoclassical economics envisions the lifetime utility-maximizing consumption decisions of individuals as the driving force of economic activity, with the allocation of given, scarce resources as the fundamental economic problem, the "English" Cantabrigians argue for a return to a classical political economy vision. There, profit-making decisions of capitalist firms are the driving force, with the fundamental economic problem being the allocation of surplus output to ensure reproduction and growth (Walsh and Gram, 1980). Because individuals depend on the market for their livelihoods, social class (their position within the division of labor) becomes the fundamental unit of analysis. The potential rate of profits on capital arises from differing power and social relationships in production, and the realization of profits is brought about by effective demand associated with saving and spending behaviors of the different classes and the "animal spirits" of capitalists. The rate of profits is thus an outcome of the accumulation process.⁷ Robinson argued—citing Veblen (1908) and raising the specter of Marx—that the meaning of capital lay in the property owned by the capitalist class, which confers on capitalists the legal right and economic authority to take a share of the surplus created by the production process.

Imagine for a moment the Cambridge controversies as a crucial thought experiment between two competing visions of economics. From a Cambridge, England, perspective, how much more decisive could the results have been? Capital theory was the arena for extending the principle of scarcity to explain the return to capital through marginal productivity. It was precisely on this key point of what determines the rate of return that the "anomalous" reswitching and capital-reversing results occurred. The three neoclassical capital parables were shown only to hold in a one-commodity model (where classical theory was equally valid). All attempts to extend the parable results to more general models of heterogeneous goods failed, because Wicksell effects made the links between capital and interest bidirectional rather than one-way. Moreover, the stability literature of general equilibrium called into question the neoclassical vision of the lifetime utility-maximizing decisions of individuals driving an optimal allocation of resources through the mechanism of prices as scarcity indexes. What else would it take to convince an economist to shift visions?

For neoclassicals, none of this was obvious. For them, the controversies were conducted largely in neoclassical terms about neoclassical models. Reswitching and capital-reversing prompted much useful neoclassical work to try and refine the theory through secondary hypotheses and additional assumptions; Burmeister's

⁷ In the neoclassical vision, rates of interest and profits are interchangeable terms. "English" Cantabrigians differentiate profits (the return on investment in capital goods) from interest (the hire price of finance) and stress the theoretical importance of profits. Outside the one-commodity model, the price of capital's services—its rental—is the rate of profits multiplied by the price per unit of capital goods (Harcourt, 1972, pp. 37–39).

(2000) “regular economies” are a good example. But there was little sense of a viable alternative vision waiting in the wings and even less sense that the neoclassical vision was at stake.

Furthermore, neoclassical one-commodity models remained intact and fruitful as a basis for empirical work. As explicit simplifications, they could get by with the less rigorous notion that relative scarcities must be the *empirically dominant* determinant of relative prices, even if Wicksell effects are theoretically possible.⁸ Solow’s rationale for his empirical work has always been straightforward and frank: assuming that the data may be regarded “as if” they were generated by the underlying simple model, the estimation procedures serve to provide orders of magnitude of the key parameters of the model. These “lowbrow” models remain heuristically important for the intuition they provide, as well as the basis for empirical work that can be tractable, fruitful and policy-relevant.⁹

In contrast, the “English” camp was sorely lacking empirical work on the causes and impact of capital investment. The Cambridge, England, rejoinder on the empirical issue, baffling to many “American” economists, was that the empirical likelihood of Wicksell-type feedback effects was beside the point. This was a theoretical debate, in which all models assume a given technology. Any time series or cross-country data would have different technology bases, which could be used to explain away any “contrary” empirical tests by advocates on either side.¹⁰ According to Sraffa (1961, pp. 305–306): “Theoretical measures require absolute precision. Any imperfections . . . were not merely upsetting, but knocked down the whole theoretical basis. . . . The work of J. B. Clark, Böhm-Bawerk and others was intended to produce pure definitions of capital, as required by their theories. If we found contradictions . . . these pointed to defects in the theory.”¹¹

Another weakness on the “English” side was that neither Robinson nor her fellow Cambridge critics developed an alternative set of theoretical (as opposed to descriptive) tools that avoid her concerns about the limitations of equilibrium analysis. Or even where they have—we think here of Kalecki’s (1968) and Good-

⁸ Following Stigler, Cohen (1993) argues that the neoclassicals held a “93% scarcity theory of value” after the Cambridge controversies, akin to Ricardo’s admission of a 93 percent labor theory of value after the effects of capital were taken into account.

⁹ There are important limitations on the empirical support for the neoclassical parables. Fisher (1971, p. 325) has shown that as long as factor income shares remain constant, an aggregate Cobb-Douglas production function will fit the data well “even though the underlying technical relationships are not consistent with the existence of any aggregate production function.”

¹⁰ The recent endogenous growth literature on convergence has grown out of the lack of empirical evidence for the predictions of the neoclassical one-commodity model (that is, countries with higher capital/labor ratios should, but do not, have lower rates of return and growth). Robinson’s (1975b, p. 54) comment presaged this literature: “In comparisons across countries, American industry is generally found to have the highest ratio of inputs per worker . . . but I do not know that anyone has ever suggested that the rate of profit on capital is exceptionally low in the United States.”

¹¹ David Laidler suggests that Sraffa was ahead of his time in pointing out that neoclassical models based on an aggregate production function lack proper microfoundations, because this is a far more telling criticism of modern real business cycle theory, whose exponents make strong claims about such matters, than it was of 1950s vintage growth models.

win's (1967) cyclical growth models, Kaldor's (1996) cumulative causation processes and Pasinetti's writings (1981, 1993)—the profession by and large ignored them.

Thus, the two Cambridges could not agree about the significance of either the results nor the supporting evidence. Such disagreements about significance are an endemic problem in economic analysis. What is the meaning of a simple model whose clear-cut results are not sustained when restrictive assumptions are loosened? Is it nonetheless a valuable parable, useful heuristically and empirically to isolate crucial tendencies that get obscured in more general models? Or is it a mistake whose insights must be discarded while searching for a better explanation in a completely different direction?

Blaug (in Caravale, 1976, p. 38) captured beautifully the typical neoclassical response to these questions: "The Cambridge School has this crazy idea, that if we have a rigorous simple theory, and then we discover one little flaw in it, that makes it more complicated to use it, we are finished. If we need five tyres to run a car instead of four tyres, we haven't got a car any more, so we must give up everything and start using an aeroplane."

With neither side able to deliver a knockout punch, issues of faith and ideology entered the ring with claims about the significance of the results and competing visions of economics. When one-commodity results are not robust in more general models, the lack of definitive evidence leaves room for ideology to play a role in the decision to hang on to a theory or vision. The intensity and passion of the Cambridge controversies were generated not by abstract technical questions about Wicksell effects, but by strong ideological undercurrents like the ethical justification of the return to capital and fundamental methodological questions about comparing deeply differing visions of economics and the extent to which equilibrium is a useful tool of economic analysis. Ideology and methodology, two subjects most economists would rather avoid, were pervasive undercurrents fueling the controversies (Bliss, 1975, chapter 15).

Whence and Whither the Cambridge Capital Theory Controversies?

The Cambridge controversies were the last of three great twentieth-century capital theory controversies. Earlier controversies occurred at the turn of that century among Böhm-Bawerk, J. B. Clark, Irving Fisher and Veblen and then in the 1930s among Knight, Hayek and Kaldor. Similar issues recurred in all three controversies, and we will sketch some examples here.¹²

At the turn of the twentieth century, J. B. Clark and Böhm-Bawerk were consciously countering Marx's theory that the return to capital involved exploita-

¹² Cohen and Harcourt (forthcoming) provide a fuller treatment of these early episodes and more detail on all arguments in this paper.

tion of labor.¹³ Clark's response, that wages and interest were simply prices stemming from the respective marginal products of labor and capital, is best expressed in his famous claim that "what a social class gets is, under natural law, what it contributes to the general output of industry" (Clark, 1891, p. 312). Veblen disputed Clark's marginal productivity theory, arguing instead that profit was institutionally grounded in the social power of the capitalists that enabled them to appropriate the technological achievements of the society as a whole. Irving Fisher (1907) believed that the interest rate could be viewed as the equilibrium outcome of simultaneous equations. Böhm-Bawerk disagreed, arguing that simultaneous equations, while useful, involved circular reasoning and failed to provide a causal explanation of interest. Böhm-Bawerk, in defending an alternative Austrian vision of economics, sought a one-way explanation tracing interest determination back to the original physical factors of labor and land.

In the 1930s controversies, Hayek insisted that decreases in the interest rate prompt more roundabout, capital-intensive production, even though he could not prove this in heterogeneous goods models. Hayek (1941, pp. 141–142) freely acknowledged: "All attempts to reduce the complex structure of waiting periods . . . are bound to fail, because the different waiting periods cannot be reduced to a common denominator in purely technical terms." Kaldor and Knight agreed that the inverse, monotonic relation between capital intensity and the interest rate is not sustained in heterogeneous commodity models. They disagreed about which of their respective one-commodity models provided better insights. All three authors (Böhm-Bawerk and Veblen, too) expressed concerns about equilibrium. For example, Hayek's (1941, p. 17) "dynamics" emphasized historical causation over mutual interdependence. Kaldor (1938, p. 14) argued against comparative statics and for a "process of change." Knight (1931, p. 210) believed that capital and growth are "long-run historical changes [that] must be faced as problems of historical causality and treated in terms of concepts very different from those of given supply and demand functions and a tendency toward equilibrium under given conditions."

Looking back over this intellectual history, Solow (1963, p. 10) suggested that "when a theoretical question remains debatable after 80 years there is a presumption that the question is badly posed—or very deep indeed." Solow defended the "badly posed" answer, but we believe that the questions at issue in the recurring capital controversies are "very deep indeed."

The Cambridge controversies were *not* a tempest in a teapot. We agree with Bliss's conclusion (1975, p. 346) in viewing "the theory of capital not as some quite separate section of economic theory, only tenuously related to the rest, but . . . as an extension of equilibrium theory and production theory to take into account the role of time." Major issues—explaining (and justifying) the return to capital, visions of accumulation, limitations of equilibrium tools—were and are at stake. While many of the key Cambridge, England, combatants stopped asking questions

¹³ For a short introduction to the earliest controversy in this journal, with a focus on Clark but some discussion of the other participants, see Persky (2000).

because they died, the questions have not been resolved, only buried. When economists decide to delve again, we predict controversies over these questions will be revisited, just as they were time and again in the 80 years prior to the Cambridge controversies.

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