Time and Cost: Remediying the Inadequacies of the Received Wisdom

Alan Abouchar*
University of Toronto

1. Introduction
For many years I tried hard to show my students the value of the modern microeconomic cost framework (MMCF) for analyzing serious economic problems. But some time ago I stopped trying to force the magnitudes which must be dealt with in the world outside into the cost framework which we preach inside the classroom, having concluded that the apparent precision of the MMCF was spurious and unhelpful for the challenges of cost measurement, pricing, and output optimization: it leads us astray and leaves us powerless to recognize when and how bad our solutions are. In this paper I try to remedy the inadequacies of the received wisdom.

The failure of the MMCF comes despite—or maybe because of—the increasing tendency to write economics in mathematical language, which the American Economic Association Commission on Graduate Education in Economics (COOEE) recently suggested might be hampering students’ general understanding of economic processes.¹ Today we try too hard to write economics in the language of mathematics and bother too little to wright it in the spirit of mathematics, shaping it in conformity with the true analytical rigor of that discipline. Where there is controversy today about substantive issues it is about esoteric properties like boundedness, boundaries, closure; disputes over methodology concern the degree of mathematical sophistication necessary to improve economic analysis, Sam Peltzman’s recent critique of the directions that industrial organization is taking being one of the most trenchant (1991). Unfortunately, however, controversy about such issues keeps us from looking below decks where we would see just how frail are the most fundamental constructs on which our modern cost analysis is based.

Doubts about our evolving cost paradigm go a long way back but they have inevitably been stifled by economists’ search for an all-inclusive framework. Thus did Clapham complain of the empty boxes that the analyst came up with when trying to squeeze the industrial world into our academic conceits (1922); Keynes worried about the increasing neglect of capital consumption as a component of incremental cost in 1936.² Today some of us—but far too few—wonder how to reconcile all our theoretic cost concepts with the magnitudes that businesspersons, accountants, lenders, investors and regulators have to deal with every day.

The main micro-theoretic difficulties that I have to deal with in the courses I teach arise in two sources: i) the fixed/variable cost dichotomy, which provides no way to distinguish capital expenditure from periodically recurring common cost or to distinguish among different types of capital (consumable with respect to time, consumable with respect to output, and non-consumable); and ii) our professional determination to concern ourselves with real forces and influences (including in the latter personal welfare, a hard-to-measure concept, but real nevertheless since it is the ultimate end of economic activity) and, since money is simply a convenient numéraire to relate prices of inputs and outputs and to rank utility levels, to abuse those magnitudes which are perceived as purely financial flows, like interest or bond repayments, which affect firm liquidity and viability, and depreciation, which affects profits.

Sometimes we recognize that the paradigm is not descriptively accurate about industrial operations since it disregards variables which seriously affect profit calculations, although profit by itself, tells us nothing about whether to stay open or close down since such decisions depend on the outlook over more than the single present period that we plot on the x-axis and which is a building block for general equilibrium. Stay/close decisions simply cannot be determined by way of our typical cost diagrams which give the impression that they depend simply on the relationship of price to marginal cost where marginal cost is always viewed as an incrementally purchased and incrementally consumed physical input (including labor time). The nature of the cessation of production —
permanent or temporary – is never discussed. To
do so would require investigation of the omitted
factors whose consideration would show how
helpless is the MMCF on its own: depreciation;
interest which depends on output; consumable
capital; interest which depends on time; etc.

Well, then, we muse, at least the MMCF is
useful normatively, something about opportunity
cost, for example. But when we see US bank
regulator approving the valuation of real estate
assets at values far greater than anyone would
willingly pay at the moment on the ground that
doing otherwise would cause a big banking
collapse (as was recently done), either we must
define ‘opportunity cost’ broadly enough to
anticipate the endless rounds of cost and benefit
effects to the whole economy, which would
render the concept non-operational from the
viewpoint of micro, firm-level analysis, or we
must say that the MMCF remains relevant but we
must add to the theoretic insight a number of
additional forces, influences, and considerations
in any particular case. This is the kind of theory
that Stephen Hawking, writing about grand
unified theories which exclude gravitational
forces, called ‘... not very satisfactory because
they contain a number of quantities, like the
relative masses of different particles, that cannot
be predicted from the theory but have to be
chosen to fit observations (1988, p. 156).

But surely, we reason, the MMCF is at least
useful metaphorically, giving us a message about
supply and demand determining value – the
incorporation of things like utility and scarcity
and welfare maximization, Adam Smith’s
paradox reconciled, and Marxist classical cost
thinking rejected. But even this is a hope
misplaced, since Marxian pricing – in the USSR
at any rate – long did take account of rent,
sacrifice, and discrimination of common costs
according to ability-to-pay in its pricemaking
policy, sometimes implicitly and sometimes
explicitly, while US capitalist pricing is replete
with distortions caused by subsidies.

This is a serious indictment of our venerable
traditions. But in the next section I show how
the MMCF fails the test of relevance even in the
simplest kind of production situation. Section 3
conjectures at the reasons for the persistence of
this inadequate model. Section 4 points the way
to overcoming its inadequacies by distinguishing
three senses of time as the basis for thinking
about production inputs. These prepare us to
accept the need for the three-way classification
of inputs in Section 5 (these classes are
illuminated by the three time senses, but do not
correspond to them in any direct relationship).
Section 6 gives some very varied examples of
the wrong results which we reach by insisting
on the primacy or validity of the MMCF.

2. Capital, Fixed Costs, and the MMCF

The behavior of observations may be
completely explained through N explanatory
variables. But this leaves zero degrees of freedom
and provides no help for estimating any single
observation. Or, as a Spanish philosopher,
Miguel de Unamuno, put it, “to understand
everything is to understand nothing.” Either way,
the point is that it is necessary to abstract from
various local influences on individual events in
order to reach some basic relationship to provide
insight into what may be expected in similar
circumstances the next time, some differences to
arise owing to special circumstances. Where, we
ask, would physics have reached without
abstracting from specific forces, like friction?
But in assuming a frictionless plane, physicists
violate no fundamental characteristics of the
world being observed. Friction coefficients may
be added to get answers for particular situations.

But the MMCF does not constitute an
illuminating abstraction consonant with essential
reality. Economists’ simplified cost structures
implicitly assume away fundamental variables
which transform the nature of the problem and
cannot be easily restored. This can easily be seen
by examining the technology and cost
characteristics to which the MMCF is limited
even in the simplest production processes. We
must conclude, either, that it changes the world
beyond recognition to a one-period time frame
where firms start up in the morning, produce
homogeneous products, and close at night; or that
it applies to situations which are incomplete or
simply unreasonable because it treats the capital
input so badly. The flaw exists even in the
simplest case of the one-product, one-plant firm.
But it is much more obvious when we attempt to
apply it to more lifelike processes. Demonstrate
the inadequacy for the simplest case will therefore
satisfy our needs. Consider
the three possibilities, starting with the last.3

1. Unreasonable application of MMCF. The
heart of the issue is the definition of fixed cost.
What is it? The technical definition is “cost
which is the same whether one or a very great
many units are produced each period.” In the
modern microeconomist’s view of the world, cost
is real physical stuff – assigned a dollar value

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merely for ease in adding up inputs and relating supply to consumer utilities, which are also denominated in dollars. The point that emerges as most important for students is that cost is not pecuniary. It is not a financial flow: not interest; not depreciation; not loan repayment. Fixed cost is something which is incrementally purchased and expended each period, and marginal cost (short-run) is the outlay following this item, varying in dependence on output level. Marginal cost (long-run) is the change in all costs per unit of output – fixed and variable – per unit time when producing optimally. This change includes some of the elements which are regarded as fixed and some which are regarded as variable. But it fails to reconcile the fixed assets, which last many years, with the fixed cost which is a time-incremental notion which recurs every year.

To see that this definition will not do, ask yourself what the fixed cost for a Portland cement plant is. Since the output is reasonably homogeneous, difficulties of common cost allocation do not arise. If we take the year as the time unit, we then have a situation in which there is no annual fixed cost (apart from certain administrative overhead, which we may neglect for the moment without afflicting the reasoning). But what happened to the plant, including the slurry ponds, rotary kilns, and crushers? Since so much of this comes to be considered as fixed – indistinguishably from buildings, which are “fixed” in place (which is why the word for buildings in Romance languages has the sense of “immovable”) – it is hard to avoid the trap of thinking of the investment expenditure in all the plant and equipment as the fixed cost. But if this is to be regarded as the fixed cost, the unit of time for which production is measured on the x-axis has to be the life of the plant, 22 years, say, and not one year. While this may be logically acceptable, it means that to determine the optimal plant size the demand curve must also be cast in terms of “quantity demanded per 22-year period,” which is still logically acceptable as long as all relative prices are fixed for 22 years. Since this is never the case, it is unreasonable to interpret fixed cost in this way.

ii. Incomplete application of MMCF. In this interpretation, the plant and equipment investment expenditure is simply omitted from further analysis. In this case, what is diagrammed is the periodically recurring situation rather than the whole investment. There is a periodically recurring fixed cost (a time-variable cost) and then a variable cost which varies with output within the time interval. This does the test of logic and is not entirely improbable, but it tells only a piece of the story. There is no way to depict an equilibrium output rule because no information is provided on what is certainly a major cost constituent – the initial production facility.

iii. Improbable application of MMCF. Finally, consider a production activity with no capital expenditure. The firm begins afresh in each period, undertaking various costs on behalf of all the units to be produced, further using other inputs for each additional unit. There is no problem of logic or – since we have written the script this way – no violation of truth either. But it’s hard to imagine such an activity in a modern industrialized economy. The closest we might get to it would be something like the work of a neighborhood handyman having no capital, using the homeowner’s tools, and having for fixed costs only his personal clean-up time.

Am I belaboring obvious errors which no self-respecting economist would commit? Is it possible that economists allow the MMCF into the textbooks as an abstract truth, but that when they want to deal with the theory behind any meaningful problem or analyze the specifics of any issue they resort to a more meaningful classification of costs. I think not. If we look at one important subject which practically became a profession in itself – the theory of second best – our worst fears are confirmed. For here the tradition is to neglect entirely the distinction between investment outlay and fixed cost by conducting the entire analysis in a one-period world! Indeed, some of the discussion of that topic was even conducted in terms of linear homogeneous cost functions! The examples of concrete problems in Section 6 further confirm that the microeconomic cost simplifications, at first so innocently embraced, come at a terrible cost to meaningful analysis.

Economists sometimes do slip into a treatment of fixed cost which comes closer to relevance, employing the notions of depreciation or capital cost allowance. But this diametrically opposes the marginalist spirit and conflicts with the profession’s determination to avoid financial categories; having been so critical of the concept of depreciation as an accountants’ convention, it is less than honourable for them to invoke it now to make up for the failings in their own conceptual armory. This then raises serious doubts about the usefulness of the theory to begin with.
In this interpretation, the fixed cost is the depreciation of the investment. Now, it is important to recognize that any investment includes in varying proportions three types of component: i) a part that wears out with respect to output per unit time (and/or with respect to different dimensions of use, e.g. rails which are impacted by train weight as well as number of trains; roads which are exponentially damaged - consumed - with respect to axle weight); ii) part which wears out with respect to the pure passage of time (which may reflect the weather); and iii) part which does not wear out at all, which I have called isochronic cost. We must consider two cases.

i. **Case 1. Investment all isochronic.** When the investment is all isochronic, there is no pure calendar-related cost and there is no output-related capital consumption. Since there is no pure calendar-related cost, there is no cost which requires at least one of production - depreciation must be charged even with zero output so that depreciation charges cannot meet the definition of "fixed cost" in the MMCF. Moreover, even if the depreciation is coordinated with some financial payment - investor repayment, with interest, say - in which case a time-related outlay does take place, it is contrary to the marginalist spirit to introduce it as fixed cost since it takes place even if zero units are produced.

ii. **Case 2. Investment not all isochronic.** Most investment outlays include a component which is consumable with respect to output per unit time (and/or with respect to various dimensions of output when activity is heterogeneous). It is entirely consistent with the marginalist spirit of counting only physical stuff to include this part of the capital investment in variable cost. But nobody does this. or, at least, I know of no textbook which admits of treatment of capital in this manner. Note that, if the depreciation is simply taken as the fixed cost and none of this annual depreciation expense is treated as a variable cost (so that it does not influence the $srmc = price$ rule in which only post-investment purchases may qualify for treatment as variable cost), there is a fundamental flaw in the conventional solution of producing at the point at which price equals short-run marginal cost subject to the qualification that it be rising and exceed the minimum value of the corresponding **traditionally defined** variable cost (incrementally purchased and consumed inputs). The reason is that in this case "variable cost" is measured to exclude any capital consumption at all, while the sum of this variable capital consumption component and other variable inputs (labor, fuel, intermediates) could easily exceed $srmc = price$, creating a large incremental real loss for the firm!

Bringing into the analysis the periodically recurring fixed inputs - those which are purchased as well as consumed - after the initial investment is made puts still greater distance between the world outside and the MMCF. Furthermore, recognizing interest as a necessary cost of production adds yet another analytical burden (though doing so might have led observers to question recent Bank of Canada policy - see Section 61!). The picture is further complicated by noting that a firm usually consists of more than one plant, which requires us to deal with layers on layers of fixed administration expense and obviates a stay/close decision (which we have already noted to be beyond the capabilities of the MMCF in any event). Finally, what of the heterogeneity of output even within single plants, not to speak of firms? While scholarly articles sometimes do distinguish "joint" from "common" - and both of these from others - I have not seen the expression "common cost" in a standard economics textbook in many years: indeed, the profession has turned a blind eye to these categories and tried to replace them with the notion of "public good" which, Sæmonul's insistence to the contrary notwithstanding, the profession has come to associate with public sector activity and expenditure. But if we were to recognize that such characteristics are very common to private sector operations, including trucking, condominium development, manufacturing, etc., we could find a way to promote rational policies for pricing and supply.

One searches the literature in vain for recognition of the distinctions among the categories which must be dealt with: investment outlay; inputs purchased once but deteriorating purely with respect to time; inputs periodically purchased and expended in common; factors homogeneously dependent upon output/unit time; fixed interest payments; and so on.

It is absolutely remarkable that Viner, who appeared to codify everything so neatly in the mid-30s, never explained what “fixed cost” was supposed to include, and the profession has closely held to this non-committal tradition ever since. The gravity of the issue is nicely captured in a recent work by two accounting scholars, Thomas Johnson and Robert Kaplan, in their
1987 work, *Relevance Lost*. They complain (p.15) that modern economics led economists, researchers, and accountants astray through its "... simple one-product settings ... [and] ... never fully addressed the question of where fixed costs came from and how these costs needed to be covered by each of the products in the corporations' repertoire ... [and] ... the academic literature concentrated on increasingly sophisticated approaches to analyzing costs for single-product, single-process firm ..."

Little good can come of an analytical apparatus that wanders so far from life and omits so many crucial considerations. But if we hope to improve upon this model, we must understand why it has managed to hold sway for so long.

3. Why Has Our Straitened Legacy Persisted?

The appeal of the *MMCF* first was felt by those among us who came to intellectual age through the 1950s, especially if our first degree was earned at institutionalist-oriented economics departments. We often despised that economics, because of the constant exceptions and qualifications to every principle and rule of economic behavior which we strove to learn, would ever fulfill the promise with which it first seduced us. This was true both in the historically-descriptive-institutional courses themselves and also in those analytical writings through the early 1900s which we read in the usually mandatory History-of-Thought courses. Like me, others must have cried "Eureka!" on finding the demand and cost analysis of the microeconomics that was then abutting and was being revealed to us in our first graduate courses, whether through readings like Viner's attempt to pin Marshall down, or in the heavily diagrammed textbooks then beginning to issue forth, showing the many variations on the marginal equivalence theme supported by the unassailable language of Newton and Leibnitz.

At last economics was seen as a science. Marshall, whose insistence on demand and supply as determinants of market price, but whose reluctance to restrict himself to situations which could lead to absolute once-for-all rules, had worn out his welcome: the *Principles* was just one more in a long line of heavily footnoted textbooks, too cumbersome to slide into an envelope, too circumlocutious for easy citation, and too weighed down with variations for ready reference in class, courtroom, or consulting house.

One of Marshall's early critics, Herbert Davenport, scolded him for not pursuing what he believed to be the most fundamental principle of mathematics: "... the ideal of *no two terms for one thing and no two things for one term* ..."); (Davenport, 1935, p.164 – emphasis in original). In his criticism Davenport found company with Schumpeter who lamented the fact that Marshall was a mathematician to start with and only took up economics after he became an academic – had the equipment to advance economics as a science far beyond the norms of his day but chose instead to leave the mathematics for his appendices, writing the body proper in prose. And so their successors have tried to do the job for him, striving first for one-to-one correspondences between "things" and "terms", which was thought to be the minimum necessary to put to right the simple kinds of thing like costs and time that Marshall kept stumbling over; and then going on to seek ever greater mathematical sophistication for economic models in the belief that this, rather than allowing for the greater complexity of the real world, would bring us to some ultimate truth. With our attention increasingly devoted to mathematical sophistication, most of us have succumbed to the belief that all the simpler problems in constructing the basic apparatus have been resolved. Today, even for doubters, the methodology is too deeply ingrained to easily lay aside.

As it happens, however, it is the Davenport conception of mathematics which is very badly flawed. One-to-one correspondences between things and terms is the last obligation felt by any mathematician: the diversity of things to which the term "field" relates (e.g. vector field, real number field); the multiple meanings of "vector" and, conversely, the existence of different terms for the thing "vector space" (e.g., mxn matrices, nth degree polynomials, ordinary Euclidean vectors); and the numerous completely unrelated meanings of space (topological space, Euclidean space, probability space, vector space [which may be a sub-space], half-space [which is not a sub-space], or tangent space, to all of which economists add consumption space and production space) are a few examples. No mathematician would feel compromised by accepting as cono sets of infinitely long lines intersecting at the origin of Cartesian coordinates, and also defining cones as
something closer to what you’d get at the ice cream store when going to the next lecture on conic sections! Even in individual disciplines like statistics the things which the same terms refer to need have nothing to do with one another — normal distributions and normal estimating equations, for example. “Random sample” has two completely distinct meanings (which instructors would do well to recognize). Similarly, mathematical subfields, like topology, where bounded sets may have boundary while, at the other extreme, unbounded sets may consist entirely of boundary points.

The simple truth is that mathematicians are quite comfortable allowing single terms for many things. As well as several terms for the same thing. All provided only that they be clearly defined in context. But what mathematicians will not allow themselves the luxury of doing is applying rules or theorems which are developed for certain terms defined one way to the same terms which relate to completely different things which happen to be called by the same name.

Economists’ false notion of mathematics affects the subject of this paper first of all in the analysis of items which negatively affect the firm’s cash flow statement: investment expenditures and non-interest post-investment expenditures are all regarded as costs. Having been so defined, they must be either fixed costs or variable costs. Meanwhile, interest is left aside as a cost11 and depreciation is depreciated as an accountant’s term with no “real” relevance.12 But it is the difference between revenue and expenses, which include depreciation as well as post-investment outlays for physical inputs, as well as interest payments, which determines whether a profit has been made.

If we wish to employ the term “costs” to cover these several influences on profit, we must recognize that they are of very different nature and we must learn to call them by different names — names which have an independent legitimacy in the everyday dealings of business — since if the profession persisted in its exclusive use of the word “cost” with the understanding that this could refer to financial flows as necessary, it would be misled back into false thought patterns engendered by the putative superiority of a “one thing-one term” mathematics.

4. Three Senses of Time

If the doubts being raised about the treatment of time related simply to the question of how long the length of the short period should be, as some have thought, the modern cost framework could be easily defended as Stigler did by formally incorporating the idea of different short periods into an early graphical analysis (1939). We would have a theory which was parametrically true, and which could be made to accommodate specific situations, just like the physicist’s frictionless plane.

But the present objections to the MMCF have absolutely nothing to do with period length. They relate, rather, to the different dimensions with respect to which we are making our calculations: within time, on the one hand; and over times, on the other. Decisions reached within one context have nothing to do with behavioral rules about the other, although we treat them as though they did.

What precisely is meant by “long-run marginal cost”? Shelves of intermediate and advanced microeconomic theory textbooks fail to define the term unequivocally and it is made to mean anything we want it to. Well, why not? Shouldn’t an advocate of the mathematician’s spirit of flexible definition be the last person to find fault with this? No, definitely not, because mathematicians are careful not to use results derived under one definition in contexts where different definitions prevail, as noted previously. But economists take the results about Irmc defined in one context and apply them to a completely different “thing” which goes under the same “term” in a different context!

Among the several definitions of Irmc in the literature, four stand out: i) the rate of change of all costs with respect to output per unit time under optimal technology; ii) average total cost including a capital component, presumably its physical consumption; iii) post-investment annual incremental average cost; and iv) expanding and operating an existing plant. The characteristics of the four constructs follow.

i. Rate of change of total cost using plant capacities optimally designed and built for each output. This definition is the one most consistent with the MMCF, relying as it does on the average cost envelope which corresponds to the Irmc function which represents the total cost of producing each capacity, assuming that the firm employs optimal capacity and technology for each output. However, few writers treat Irmc explicitly in this fashion. Frank (1991, p. 319) and Koutsoyiannis (1979, p. 113) are explicit to the extent of defining the Irmc curve as the locus of points on the family of smrc curves.
corresponding to the tangencies of the respective srac curves with the irac curve. The topic is not usually dwelt upon in textbooks, however. None - not even Frank or Koutsoyiannis, explains how any single year's irmc curve relates to those for other years or how the investment expenditure should be reconciled with fixed costs. The annual fixed cost, of course, could include part of the investment outlay (the pure time-related consumption of capital), but it will also include periodically purchased and consumed resources (such as the plant heating or lighting; administration), while part of the initial investment must be viewed as a variable cost in the sense of being incrementally consumed with respect to output per unit time. This irmc has nothing to do with the passage of time. The analysis is conducted in terms of alternatives before the fact, and it is unfortunate that the words "long-run" ever came into it, especially since most people outside profession - and many inside it - are prone to think of long-run as chronological concept.

ii. Average total cost including capital consumption. This definition occurs frequently in utility pricing where the capital component is often called "capacity cost" (e.g. Williamson, 1966), although it is never made clear how the investment is to be put on a periodic basis. It should be obvious that any inference about irmc in sense i) above has nothing to offer an analysis which uses this definition of irmc. The preceding context regards the rate of change of all costs, assuming different technologies, although it presents no way to put capital outlays on a periodic basis which is necessary to determine how that component differs between technological variants; this treatment looks at the average cost including capital outlay, but still gives no way to periodize the capital.

iii. Post-investment annual incremental average cost. Here "long-run" is employed in a temporal or chronological sense. Traditionally, railroads have been the classic illustration of a "decreasing cost" activity, with costs taken to be decreasing with respect to time. This need not occur, of course, since the capital will deteriorate with respect to both time and output per unit time. What is in fact intended by this is that outlays decrease with respect to time, which tells us nothing about the behavior of costs, which must be defined to reflect the consumption of capital even though this might be difficult to measure. Clearly, any pricing rule derived in either of the two preceding formulations has nothing to say about price policy in this context. We would be wildly off-base to apply the irmc = price, derived under context i), to the pattern of large outlays followed by small outlays over time, since costs each year are more reasonably interpreted to include the consumption of the capital purchased through the initial outlay.

iv. Expanding and operating an existing plant. This type of decision must frequently be dealt with and does not fall within any of the previous contexts. One text-book (Baumol and Blinder, 1979, p. 497) defines irmc as "... the supplier's total cost resulting from the supply of that output including whatever plant and equipment, is needed in the long run to provide that output. The inclusion of this marginal capital cost (the cost of the necessary additions to plant and equipment) is the crucial feature that distinguishes long-run marginal cost from shortrun marginal cost." This is clearly an important idea and just as clearly it is at odds with the preceding definitions. In common with the first and second, however, it begs the question of how the capital is to be annualized; the third definition never even puts the question.

Upon reflection, it is clear that the main weakness of the MMCF arises in its failure to distinguish among three very different concepts of time: i) drawing-board time; ii) chronological time; and iii) historical time. The MMCF limits its purview to drawing-board time alone, although most economic and business problems require the integration of chronological and historical time as well. Integrating these dimensions in turn requires economists to behave in a way which they are notably loath to do: introduce techniques of accounting and appreciate the distinctions among - and the importance of - expenditures, expenses, and costs, which we do in the following section (5).

i. Drawing-board time. This is the framework within which the cost implications of alternative production levels are evaluated and is the analytical context in which, not only short-run, but also long-run aspects of the MMCF are couched, although this fact is never recognized. We sometimes mistakenly think otherwise - that these terms are chronological in nature - because of statements to the effect that "... the short run is the time during which plant is fixed and cannot be expanded ..." or some such. But it remains the fact that the costs associated with variations in the production of a commodity represent the costs of different levels of production per period of time: long-run analysis, as conceived by Viner
(p. 222), and as adopted by many others since, as the appropriate contrast to short-run analysis, has nothing to do with the passage of time and also deals with costs of alternative outputs, i.e. drawing-board time. The challenge, of course, which has gone unanswered — and even unrecognized in the formal literature since the start of the modern era — is to incorporate into an analytic framework the capital expenditures which are required to purchase various kinds of capital which last more than one period. The reader is reminded that the relationship and difference between fixed cost and fixed facilities, or fixed cost and capital investment expenditure, are not dwelt upon. They are not said to be the same; they are not said to be different; they are not said, their discussion a black hole which writers carefully avoid.

ii. Chronological time. The passage of calendar time provides the context necessary to accommodate the expenditure and cost pattern which characterizes all economic activities: an investment outlay is made to purchase three kinds of capital, as noted earlier — one part consumed with respect to output per period; a second consumed with respect to time alone; and an isochronic part which is not consumed at all. Subsequently, there are periodically recurring fixed or common costs, such as heating fuel; and there are directly variable inputs, such as rolled steel sheet for household appliances. Acknowledging the chronological pattern in this way allows us to recognize the distinction between expenditures and costs which is, after all, something that businesses simply must do. It allows us to recognize expenditures which are not costs in the true economic sense (until the purchased resources are consumed) although they represent immobilization of resources.

Unfortunately, there has been a great deal of confusion between these time related expenditures and marginal cost. Keynes’s playful dictum that “in the long run we are all dead” has been so gratuitously repeated that it has thoroughly legitimized writers in confusing this chronological concept with the long-run/short-run distinctions of drawing-board theory. But there is a vital difference between the pattern of expenditures with respect to the passage of calendar time and the behavior of costs with respect to choice of output levels. Machinery is purchased and an expenditure made in year zero; but machinery cost must be regarded as occurring as it is consumed with respect to output in subsequent years. Speaking of Keynesian observations, how much we would profit by keeping before us his previously cited concern — alarm, indeed! — expressed in his Chapter 6 Appendix on user cost of capital about the way marginal cost was coming to be associated only with incrementally purchased resources, to the neglect of the consumption of inputs which were previously purchased (note 2).

iii. Historical time. This refers to the passage of time with all its consequences, whether they be easily anticipated or not. Any analysis of the growth and/or decline of industries and regions may be thought of as examples of analysis within historical time.

The differences among the three times and the need for all of them is particularly apparent when analyzing such things as urban efficiency and welfare under three distinct objectives: i) design of new towns; ii) consolidation of adjacent population areas; and iii) estimation of expected expenditures associated with cities of different size to get some idea of the expenditure levels which may be deemed reasonable for particular sizes (this analysis is developed in detail in Abouchar 1974).

Other examples of historical time include the effect on production costs of increasing pollution and the resulting mandated higher anti-pollution costs. Clearly, this does not fit into the drawing-board or chronological framework (as defined above).

Long and short stretches of chronological and historical time periods are sometimes confused with the long and short-run analysis MMCF, which is cast in drawing-board time. But they have nothing to do with them, and no conclusions drawn within the MMCF have any bearing on rules for pricing and output within the chronological and historical frameworks. To help avoid this confusion, I have long advocated the usage of “short-term” and “long-term” when calendar time is meant.

When extending an analysis to historical time, dynamics are allowed which are unthinkable in the MMCF of drawing board analysis. For example, changes in relative prices of both inputs and outputs may condition changes in the valuations of capital assets which must be dealt with. Economic rents are better justified as reflections of social costs; but since this may require writing up of asset values, sight cannot be lost of the income distribution implications of doing so, helping us to recognize the relevance of non-efficiency criteria, giving us a much richer and much better integrated analysis of economic
Thinking about time in this historical sense is foreign to the preferences of the profession because doing so disrupts its simplified models. Economists frequently answer critics that they are working with a "static model," as though professional jargon were enough to mask our ignoring of most of the difficult issues, such as the effects of differential industrial or sectoral development, population growth, or environmental change. These are the real challenge which the "static model" fails to address, abstracting as it does from historical time.

5. Expenditures, Expenses, and Costs

As part of the effort to purify and render economics more incisive, various categories of business payment have been consolidated and/ or eliminated, limiting in no small way the usefulness of cost theory.

First, through desire to think in terms of real rather than pecuniary magnitudes, the profession eschewed financial categories, most notably interest, debt repayment, and depreciation and efforts to integrate them into our analysis of cost, profits, and firm viability. Eschewing pecuniary effects also meant rejecting nominal differences, such as price change. While this makes sense in the context of general price movements, it has also led us to reject changes in relative prices even when these might be telling us something about the effect of increased production within the drawing-board framework on the availability of factor inputs!

We need language to express the wide variety of debit items in the firm's activity. As a start, we should recognize differences among expenditure, expense, and cost. These do not constitute an exhaustive list of useful rubrics, but they make an excellent start. And since they have direct relation to business firms' own classification, honoring them as separate categories will enable economists to develop more relevant recommendations and conclusions.

A few paragraphs about each follow.

i. Expenditures (or outlays). The money flowing out of a firm, including interest, principal payments against loans, bond repayments etc. Investment expenditure is also an outlay, but care must be exercised to guard against double counting when the investment is financed by bonds or other borrowing.

Two major gains may be reaped from distinguishing this category. First, it forces more recognition of the constraining influence of cash flow for business operations. An investment deemed profitable to a firm may not persuade lenders and the firm must project cash flow to determine its own ability to undertake it by means of past accumulations or current gains elsewhere. This whole issue of viability is one to which economics pays too little attention: for example, benefit/cost analysis as usually performed for public sector investments abstracts completely from methods of financing, being guided simply by a discount rate.

The other gain from explicit distinction between expenditure and cost is clearer thinking about common cost capital elements and traceable capital consumption. Since this issue was the primary subject of Section 2, we need not explore it further at this point.

Incidentally, random spot checks of introductory economics textbooks turn up no mention of "expenditure" used in this way. References to expenditure relate to macroeconomic models.

ii. Expenses. This is the usual accounting term and refers to individual operations or sets of operation, up to the total activity of the firm, which is the periodic counterweight which must be deducted from revenue to determine profit for that period.

Expenses include payments for all standard intermediate and labour inputs, as well as depreciation and interest (for short-term borrowing and long). The depreciation covers the three types of capital (output-consumable, time-consuming, and isochronous). Since the firm's measured profit performance depends on expenses, firm pricing policy must reflect these items. The chief value of stressing this as an item different from cost is to emphasize the need for its recovery.

iii. Costs. While expenditures and expenses are necessary categories for analyzing total firm performance, cost is the most closely identified with flows of physical inputs into production. This category includes directly traceable inputs (steel to cars; capital inputs such as track to movement of coal, grain, or men's clothing) as well as common costs. Care is needed to resist associating all investment in physical capacity as common or joint cost: much is traceable and only the non-traceable capital is a common cost which must be discriminatorily recovered.

Numerous sub-classes have been omitted from this 3-way classification. Common costs are an example of a subclass. Recognizing the parent
labels fosters better understanding and gives us a way to treat both incremental common costs, such as annual administration or inspection of the electrical system of the plant, and incremental (but non-incrementally purchased) common expenses, such as the weather-related deterioration of the building; the rusting of plant protective fence; that part of highway consumption related to the freezing cycle; and so on, not to speak of common isochronic costs which may be undertaken any time in the firm's life.

Non-economists for whom the need for "expenses" may have always been self-evident, may be surprised that economists should ever have neglected its use in the first place. On the other hand, economists may believe that any analytical improvement which could be contributed by insistence on these additional categories is negligible and/or is already part of the finishing touches that they would apply to their analyses in any event. Is it and do they? A few examples readily demonstrate the inadequacy of the standard analysis which attempts to fit reality into the MMCF.

6. Wrong Answers from the MMCF

We will look at four examples of how MMCF artificially constrains us and misdirects our quest for rational pricing: the analysis of monopoly, neglect of interest, misinterpretation of costs in public sector activities, and the traditional western critique of Soviet pricing.

i. Monopoly profit. Do monopolists earn excessive profits? While some excessive profits result from monopolistic/oligopolistic exploitation and collusion, we suggest that a large component of the traditionally construed monopoly profit arises from a wholly different and respectable factor which the MMCF keeps us from seeing.

Apart from natural monopolies, which are usually regulated (power supply, other utilities), firms which are monopolies achieve that status through some exclusive product or market simply because they got there first. But many later comers develop a competitive product. The investment, including research costs, which gave the monopolists their edge must be amortized over several years due to tax laws and the depreciation schedules and term for the monopoly-making capital is determined by analogy with comparable equipment in use elsewhere. This may be longer than its economically useful life and the machinery will lose its value several years before the end of term. Therefore, the "excessive" profit must cover, not only the standard capital cost allowance but a higher amount in order to recover the investment expenditure and generate profits which, however, turn out no greater than those for firms with comparable capital structure. The standard marginal revenue/marginal cost diagram obscures this because depreciation is never viewed as something to be recovered.

ii. Neglect of interest. In microeconomics texts the analysis of and with interest is usually left for the chapter on optimization over time. Interest on initial borrowing does not show up in the MMCF as a fixed cost. Neither does short-term interest expenses; most businesses do not carry around enough money to support daily operations and must resort to short-term loans of various types, including factoring finance which obviously depends directly on the amount of business being done — surely a variable cost if ever there was one — which must affect price.

Is this oversight important? I believe that it is and partly explains how the profession stood by while the Bank of Canada began its very tight interest policy in March 1988. With CPI inflation during the previous three months (December-February) running at an average annual rate of 2.6%, the Bank began raising its rate to fight inflation, being guided purely by considerations of demand-side pressures while the CPI annual rate reached 5% by April 1990 (Abouchar, 1990b). While other cost pressures must have been at work in raising the CPI inflation rate as well, the conclusion is unavoidable that higher interest rates played a part in raising prices from the cost-push side.

iii. Mis-specification of output-related costs in public sector activities. Pricing of numerous public sector activities, especially in transportation — airports, highways, and railroads — typically proceeds from the assumption that capital should not be built into the price base. Thus, in the face of clearly documented information to the contrary, motor vehicles are priced as though their use entailed no incremental cost, with recent studies in thirceen different states showing the median shortfall of price from cost imposed by big trucks being nearly 40% (Sinha et al., 1985, p. 46). Economic analysis of airport pricing, with only two exceptions of which I am aware (Levine, 1969; Quaye, 1988), is cast in terms of rationing limited capacity with no regard to capital consumption. Levine stresses the relevance of "footprint" (a function of weight
and landing gear configuration), which Quaye was the first to measure empirically, working within the context of the Toronto International Airport.

Another example of error induced by the MMCF is the analysis of cost and benefit in the paper by Sharp, Button, and Deadman (1986) which prescribes pricing policy for a small component of the network with no regard to questions of interrelatedness or, of course, capital consumption.

iv. False expectations concerning Soviet price policy. Finally, there is a long and strong tradition which imputes gross irrationality to Soviet prices because they are based on Marx rather than the modern neoclassical supply-demand context: scarcity – including scarcity of capital and appropriate charges for it – is believed neglected. In fact, Marx has always allowed for differential rent in agriculture to reflect scarcity (with the rent being transferred to the state), and, as I have argued, the Soviets have long had implicit capital scarcity premia due to the higher wages for comparable workers in priority production (mainly capital goods industries) (Abouchar, 1997).

To say that Soviet price-makers explicitly or implicitly allow for demand scarcity considerations does not mean that mistakes are never made. But, ironically, the recently gathering storm of criticism of Soviet prices is based on the subsidies believed responsible for the large budgetary deficit impacts, a criticism which amounts to exhortation that production costs should constitute the basis for pricing. It is safe to say that there has been too little empirical study to allow final judgment. However, two recent studies of the very important railroad sector (Abouchar 1991; Abouchar and Sahni, 1991) show that, until a 1990 rate reform, the rate structure was eminently rational in the sense of: i) recovering total cost (i.e., total annual expenses); ii) observing the objectively definable traceable cost relationships; and iii) discriminating common costs according to demand. This last is in effect an application of Ramsey pricing, which calls for discrimination of common costs only after the traceable costs have already been assigned (Ramsey, 1927) and it was superior to that which I have seen in a wide range of western countries where railroads are very heavily subsidized, as well as to that introduced in a 1990 reform.

7. Conclusion

The Modern Microeconomic Cost Framework simplifies too much to be useful to analyze costs and prices. The reason for this is the attempt of modern economics to fashion rules with the elegance and finality of mathematical theorems. But in this desire we have neglected the true essence of mathematics – that numerous definitions are possible but any rule derived under one set of definitions must be applied consistently and need have no relationship to the same terms when applied in different surroundings. Since the MMCF neglects to distinguish the different types of time – drawing board alternatives on one hand, and chronological time on the other (to say nothing of time historical) – rules formulated in terms of the MMCF have nothing to say about the treatment of expenses over time. It is as though economists have been reluctant to admit to their purview different situations which require separate analytical constructs lest their theory be thought less valid for being less absolute and have opted instead for the credit of achieving an absolute analytical framework, although it has no relevance.

In particular, the MMCF overlooks the role of capital as part of cost. Also confused is the role of interest, which does not appear consistently as a part of the basic setup cost or, for short term borrowing, as a part of variable cost, although the latter is often a function wholly of day-to-day production and shipments. As a result, the MMCF provides little reliable guidance to action since any situation lends itself to vastly different interpretations in terms of the cost classification of the MMCF, so that applying the recommendations which follow from it may give wholly different pricing recommendations, depending on the choice of interpretation of cost incrementality.

To be useful, our cost analytic framework must be expanded to allow for other senses of time – what I have called “chronological” and “historical” time – and also recognize distinct forms of outlay. Investment expenditure purchases capital some of which is not to be regarded as a cost until it is consumed. “Expenses” must be defined to include interest and depreciation, as well as costs more normally recognized by economists, such as labor and purchased intermediates.
Notes

1. "We think that all economists would agree that students must develop a keen understanding of the functions of markets and prices. But some critics of graduate education, including many respondents to the COGEE surveys, argue that our insistence on ever higher levels of mathematics has actually led to a shallower understanding of basic economic processes" (COGEE Report p. 15).

2. See J.M. Keynes, The General Theory..., in which he criticizes the equating of "short period supply price" with the "marginal (i.e. incrementally purchased and consumed) factor cost alone" (pp. 67,53).


4. This is the definition most consistent with the other notions of the MMCF, although it is rarely explicitly stated and several other concepts are used a great deal as well. One major objection to our whole cost theory is that the differences among definitions are seldom recognized and results are used ad libitum. See Section 4 below.

5. The contributions to the discussion are too numerous to catalogue. Representative papers by Allingham and Archibald, Jewitt, Lancaster and Lipsey, and McManus are cited in the bibliography.

6. In a survey of twelve microeconomy textbooks appealing to a wide range of markets (Abouchar, 1983), only four had an index entry for depreciation, and of these, three included it as a fixed cost. The other (Nicholson, 1982) treated it and accounting in general in a condescending economists-know-best fashion, appealing to opportunity cost. It was never explained how opportunity cost could be reckoned without having an idea of the remaining life of an asset as well as other factors, all of which are what the reported depreciation depends on in the first place.

7. Today economics contains no word or phrase to describe this category. It is not the same as fixed cost, which recurs each period. The other possible candidate, sunk cost, is inappropriate for two reasons: i) we may wish to discuss a future investment for which we could scarcely speak of anything as sunk; ii) the expression "sunk cost" tends to get confused with the entire investment, clouding recognition of the existence of some capital components whose destruction is traceable to specific activities, as well as the fact that there may be some pure time-related consumption. The word is proposed here to capture the essence of this component of the physical capital - that it does not change over time (calendar time) or within time (described below as drawing-board time). Since these are measured in completely different units the isochronic cost component may be said to wear out the same with respect to both variables by not wearing out at all. As an example, consider a railroad passage through a tunnel: drilling the tunnel is an isochronic component; the concrete revetment suffers damage with respect to calendar time (calcium seepage and encrustation), as well as damage due to output per unit time; and the rails deteriorate with respect to output per unit time (and some due purely to passage of time).

8. These issues are discussed at length in my paper "Anoprosthetic Demand, Public Expenditures, and Full Cost Recovery, Eastern Economic Journal, Oct. 1979. The neologism which I have substituted for "public good" was coined to refer to upward additiveness of demand curves in an effort to avoid the association of such activities with the public sector and to show that such activities could belong in the private sector as well. I have since gone further in questioning this whole construct: the anoprosthetic curve can refer only to demands which may be added together, e.g. forward- and back-haul on railroads. But the real challenge is to deal with common costs, which are undertaken on behalf of different activities or outputs whose demand curves do not come in the same dimension, e.g. chair and table production; a locomotive pulling mixed freight; etc. You cannot plot tables and chairs on the same axis. The lumber storage facility will represent a common cost whose imputation may change irregularly over time depending on individual product demands.


10. A sample from a population of N physical things in which each element has probability 1/N of being selected; ii) a sample from a probability distribution in which the probability of occurrence of any number within any interval is equal to the area under the area under the density function over that interval (with appropriate adjustments for discrete variables). I believe that instructors and textbook writers fail to recognize this explicitly, perhaps out of fear of compromising students' trust by allowing supposedly concretely specified mathematical notions to mean more than one thing. But this treatment leaves student confused and less appreciative of rigorous notions such as random variables.

11. Lip service is paid to it as the return on capital which is "...implicitly taken account in the form of entrepreneurial return..." or some such phrase.

12. Interestingly, a few economists - very eminent ones at that - do appreciate the contribution that accounting can make to economic analysis. Nobelist John Hicks in an interview with Arjo Klamer who asked "Would you like to be remembered as the accountant of the economics profession?" gave as a reply "I would not in the least. Not in the least."

13. A telling example of the professional difficulty in making these transitions is the following: In a new paper on Soviet railroad pricing and profits (Abouchar, 1991) I carefully analyzed the Soviet railroad balance sheet and flow to the central budget and stated that: "If we are correct in assuming that: i) a depreciation component for all capital investment by the railroads themselves is included in sebestoimost" [n.b., "prime cost"]; ii) the depreciation schedules are reasonable; iii) all railroad capital is included in the basic capital funds which are being depreciated; and iv) the other input prices are not distorted, the difference between revenue and expense may be regarded as a true measure of profit. What about it?" A referee at a leading journal, one, moreover with a strong business school constituency, said simply that this was tautological: if revenues exceed costs, there is necessarily a profit, misinterpreting my careful delineation of "expense" vs. "cost."

14. Marshall did not dwell on the question of how long the short period should be, speaking of various short periods
which were relevant to different business decisions, and many who followed in his tracks pointed to this as a weakness. The idea gained acceptance that period length was a question best solved within the context of a particular problem and did not impugn the essence of the analytical notion.

15. A professional reminiscence may be in order. I once received a pedagogical slap on the wrist by a leading microeconomic theorist at a conference for observing that a firm's input costs would rise as that firm grew and took more of the available resources. No, I was told: that would be a pecuniary and not a real cost. Can any economics which subscribes to decreasing marginal utility of almost everything truly hold that rising prices of (even temporarily) limited supply which would force others consumers to restrict consumption (either directly or through reduced production of intermediate inputs for their consumption needs) is not a true cost?

16. As is well known outside the economics profession, most damage is related to vehicle use: not, however, to numbers alone, but to rig design and weight, which we are unable to see because of our desire to reduce all such analysis to a two-dimensional diagram. The same is true for aircraft and airport runways (see Abouchar, 1987 and Quayle, 1988).

17. Their example is a water crossing which is part of, but not recognized as being part of, a network. Incidentally, the Dupuit article from which so much of the modern theory of marginal cost pricing stems deals with footbridges, which are not part of carriage networks, and so yield results which are not applicable to the more general situation with annual expansion caused by network demand growth and deterioration of capital caused by carriages, individual persons imposing no such cost (Abouchar, 1976). It should also be noted that the father of marginal-cost-pricing took a much different view of things than he is often credited for: he qualified the zero-price as long as there was no annual payment, such as a loan or interest repayment or annual upkeep, which, for a footbridge, would be time-related common cost rather than output-related (Dupuit, 1844).

References
Sharp, Clifford, Kenneth Button, and Derek Deadman, *The Economics of Tollored Road Crossings," *Journal of*
