Why Industrial Prices Move: A Multi-Disciplinary Approach*

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Abstract

While prices themselves are age-old phenomena, pricing analysis has been much neglected and has been mostly confined to very restrictive parables in economics that defy evidence and mislead policy makers. This paper draws on approaches from management, economics, surveys and econometric evidence to gain insights for business and economic policy on what make prices move. We supplement the traditional forces of demand and costs with the modern features of global influences, the recent financial crises and dynamic adjustment considerations.

* I pay special tribute to Ken Coutts of Cambridge who has worked with me intensively and harmoniously since 1993 on these pricing-econometric exercises, and to discussants at the Universities of Leeds, Cambridge and Strathclyde during 2010 on matters relating to this research, and to Geoff Harcourt who has encouraged this research approach. I have also benefitted from teaching Managerial Economics to graduate groups in Melbourne, Kuala Lumpur, and Bogota (Colombia).

There is a simple theme in this article: bring together insights from management science, economic analysis and empirical verification, or risk mis-describing industrial pricing and mis-prescribing economic and business policies based on undetected heresy. In a conference that combines experts from each of these subject areas, it seems fertile and apposite to make this our central theme.

1. Why Pricing Analysis?

Pricing is the process of forming and varying prices. Price is the amount of purchasing power (commonly monetary media) that a buyer relinquishes to acquire one unit of a 'product'. Pricing analysis is the discipline of studying and analysing how prices are formed and adjusted in response to various stimuli.

Pricing analysis offers rich insights into business behaviour. The pricing decision is among the most important and delicate of all business decisions. It depends on many factors internal to a business organisation and also on forces beyond it. Getting pricing (and pricing structures and sequences) right is a key consideration determining revenue, profits and business performance overall. The understanding of the pricing decision also carries immense significance for analysing economic events and the impact of economic policy. It casts light upon the process of inflation, the relative effectiveness of demand management (as opposed to cost-constraint) in limiting inflation, on predictions of price and cost movements and on the pass-through to the domestic economy of global pricing forces, such as trade policy and exchange rate changes.

If movements in industrial **demand pressure** lead quickly and directly (without the need for much further explanation) to product price adjustments in the same direction, then: (a) contractions in real product demand, such as those associated with the global financial crisis (GFC) since 2007, will act quickly and effectively to slow down industrial price movements; and (b) demand pressure in boom times will accelerate inflationary price movements. However, if price movements respond relatively more directly to domestic (per unit of production volume) **cost movements**, then economic policies directed to, and predictions of, price movements based on demand factors will be seriously in error.

To get insights and answers to these questions and issues, there is much to be gained by close study of literature in three different areas: (i) management approaches which are conscious of product varieties, life cycles and different business motives and circumstances behind the pricing decision; (ii) economic theory, which formally charts the links between goals, competitors, cost and demand representations; and (iii) empirical validation exercises including econometric studies that connect to data and real-world experiences of pricing processes and outcomes.

Very few published studies of pricing reflect a background and commitment to any more than one of these disciplines or approaches. This is disappointing, because as a crude summary, the management literature is rich without rigor, economic theory practises rigour without much resort to or respect for empirical support, and empirical studies are reality itself, but too often they are performed without the support of reasoned hypotheses that come from theory.

In the spirit of the multi-disciplinary approach adopted by the founders of this global business and economics conference series, we bring together in this one place inspirations and pointers from (i) management science, (ii) economic analysis (both conventional and heterodox) and from (iii) statistical verification (from both surveys of businesses and econometric analysis of pricing data).

2. A Quick look at pricing studies for the U.K.

We give particular attention in this work to evidence from the United Kingdom (UK). This is not simply because the UK is the host country for this conference in June 2011. It is predominantly because the UK has first-rate price data which has been collected for over a century, covering all manufacturing and parts of it, monthly, quarterly and annually, and divided as between home-market sales and export markets.

Authoritative studies for the UK using these data have been made by Neild for pricing data covering the period 1950-1961; by Godley and Nordhaus for data 1953-1969; by Coutts-Godley and Nordhaus on data 1957-1973; by Martin for data 1951-1991 and by Coutts and Norman for data 1970-2000. The citations are given fully in Coutts and Norman (2007). Each of these studies reveals a marked dominance of cost factors, supplemented by some tempering by the influence of rival import prices, with almost no explanatory support from demand shift considerations, despite the emphasis on demand factors in economic theory and its teaching. Herein we find our first pointer (P1):

P1: Basic evidence suggests that most economic analysis and teaching over-emphasises the role and relevance of demand forces in explaining price movements.

However, none of the studies cited above has, because of their timing, been able to examine the impact of a severe collapse of aggregate demand and purchasing power, as arising from the GFC in the period 2007-2010. One of our objectives is thus to update these analyses and to report a study carried out in 2010 in Cambridge itself, a sketch of it without much detail being given in Coutts and Norman (2011). In this case, the data base covers the period from the early 1970s to the end of 2010 the results that had ended at the year 2000 as reported in Coutts and Norman (2007).

3. Pricing Pointers from the Management and Economics Literatures

The management literature concerning pricing and related business decisions is divisible into three main strands: (a) economics texts rehashed for a growing business audience, focused mainly on perfect competition and with little relevance to modern-style firms and business situations; (b) case studies and descriptive situations for modern multi-product complex organizations, including smaller businesses, but with little formal theory or generalization possible; and (c) some advanced mathematical models of strategic business decisions, often in a game-theoretic setting, which remain very restrictive and normally beyond the reach of readers without detailed technical skills. A good compromise that encompasses much of all of the above is found in Williamson (2005) which cherry-picks the salient economics, supplements it with management considerations, and even a smattering of basic econometrics. The book uses examples and problems in an interactive way. While following in the same multi-disciplinary philosophy, we have much more specifically to add in relation to pricing as such.

While sections of Williamson (2005) recount parts of economic theory that fail our multi-disciplinary test, of learning from management science and evidence (such as chapter 3 on Demand Analysis, pp. 73-121), every such section is appended with caveats and limitations that clearly do pass the test. For example, alternative approaches from a more general setting with risk, modern settings with regulation and strategic interaction with other firms and products are incorporated INSIDE each such chapter (such as at pp. 88-98).

Williamson (2005) gives more attention to imperfect competition than perfect competition, which is clearly appropriate, and also provides an entire chapter on Pricing Strategy (Ch. 10, pp., 383-429.) Some of the topics covered there include market positioning, market segmentation and specific need targeting, price discrimination and multi-product pricing, transfer pricing (involving hypothetical valuations for implied product prices at designated points crossing national boundaries or functional stages of production within a firm). One also finds considerable recognition given to the marketing mix and a host of dynamic aspects associated with the pricing decision, including product life-cycle approaches, imperfect perceptions and explicit risk management. None of these factors features in the basic economic analysis that is normally presented in economics courses and which becomes the basis for understanding and policy prescriptions. Instead there is a static, mostly profit-maximization approach which depends heavily on firms knowing exactly their demand functions and which dominates modern economics of industry. A summary and technical proof of such an approach is provided in the technical appendix.

P2: Never forget the complexity and diversity of business situations, as demonstrated in Roberts and Supina (2000).

P3: Seek the rigor of economic theory where possible.

In broad terms, economic theory focuses on a single variable "P" which is determined from an optimizing process, where the goal is commonly one-period profit-maximization, and all the data to make this decision towards the best price are known exactly: meaning demand and cost conditions are presumed to be known and to remain in given positions. Explicit and mathematically-amenable demand and cost functions are invoked and the pricing decision is solved. There are given (linear, inverse) demand functions known to the firm, and simple (constant, marginal) cost functions, in the standard mainstream model that dominates modern industrial economics, as in Martin (2001). **Both** demand and cost changes generate price adjustments, but the percentage price response can NEVER be as high even as one half as any given percentage cost change involvement in the price adjustment. These assertions are proved in the appendix.

Turning to global considerations, there is a particular adaptation of mainstream pricing economics that is even more extreme, and even less credible in the face of evidence. The standard trade and tariff pricing model of mainstream, economics has perfectly competitive firms producing a perfect substitute in competition with imports. Any movements on foreign prices, tariff rates or exchange rate adjustment leads to a fully proportional response in prices, in the direction of the change in the (foreign-based) generator. This time, domestic demand and costs play **NO ROLE** whatever in the pricing decision. Again, the demonstrations are technical and are given in the appendix.

Not all economists subscribe to this marginalist or neo-classical portrayal of the pricing decision. There is a minority group called Keynesians, Post-Keynesians or Heterodox economists who have quite different visions of the pricing process and how economic theory should present it. Let's call the minority approach PK for Post Keynesian. An historical survey and fuller development of the PK approach is in Lee (1998) and in Coutts and Norman (2011). The alternative set commences with a different industrial environment and information base presumed to be enjoyed by the price-making firms. These firms are either fledglings with limited start-up information, or experienced firms with good information about their costs and only partial information about what mainstream economists might call a demand

curve. As existing operators they would know a starting price and volume of sales. They are uncertain where the demand schedule goes beyond the current trading range, or even if it might remain where it is for very long. They can form expectations of a reliable or normal range for their output volume and compute unit variable costs relevant to that normal range. This is the normal unit cost that is central to Post-Keynesian pricing theory.

These firms have the power to set and adjust prices and are always conscious of making mistakes, though they are not paranoid about this. The firms see price as a means of covering their operating unit costs and providing a margin for profit, overheads and internal financing of business investment. Such a price can be crudely represented by a mark-up equation that in plain words simple says:
(Post-Keynesian) Price *equals* Normal unit cost *plus* a (contribution) margin.

The manner in which this price is determined and adjusted is best described in words and does not easily fit into mathematical rationale preferred by mainstream economists as in our technical appendix here. The normal unit costs (NUC) are not output-dependent and shift only when factor prices like wage rates, materials prices or technology move them. We can also count indirect taxes as a cost. Some of the forces generating these factor price and technology changes are longer-term and can be assumed constant in short periods; some may reflect movements in economic policy, such as taxes, tariffs and regulation. In this approach, short-term movements in the rate of demand for product in the domain considered here do not by definition affect NUC. Nor do they affect the costing margin, which is arrived at through experience and if a stable relationship, perhaps in percentage terms, reflecting the competitive situation and market power of the enterprises involved. This is a central feature of PK pricing approaches, because by definition, neither of the two components of the PK price is demand-dependent. Put differently, fluctuations in demand reflected in sales volumes of the PK firms do **not** occasion the need for price revisions.

Cost movements, meaning shifts in NUC itself, **always** lead to price adjustment in the same direction as the cost changes. In the most rigid form of PK pricing models, the percentage mark-up model, the percentage change in the PK price equals the percentage change in NUC, preserving proportionality between the two at all times.

What, then, is the connection between other firms' prices and those of our subject firms in the immediate domain? The extreme answer to this is one of fierce resistance: maintain prices rigidly when rival prices move theirs, because the consequences of wrongly guessing the outcome of shifting their own prices are too severe. However, if unit costs shift the implicit understanding among rivals is that all have similar cost experiences and little risk attached to moving prices when costs move. This can be called 'implicit collusion' or 'conscious parallelism' or asymmetrical information; each captures the essence of PK pricing. This is also its rationale in as simple a manner as it can possibly be explained. In the **global pricing domain**, the same PK explanation prevails: home firms gear their prices to their own NUCs which are unaffected by tariff and exchange rate changes impacting on rival products; however, tariff and exchange rate changes can affect NUCs, in which case, consistently, prices DO move, in proportion to the cost shift. This approach has been expounded in Norman (1996).

P4: Economists are divided on pricing matters, irreconcilably.

We can succinctly tabulate the main distinction and differences between these two radically different economist approaches to pricing.

Characteristic	Mainstream Economist Approach to pricing	Post-Keynesian Approach to Pricing
1. Purpose of the pricing hypothesis	Explain price determination and the causes and effects of price movements	Explain price determination and the causes and effects of price movements
2. Treatment of time	Usually one-period models; some advanced approaches use dynamic optimisation techniques.	Historical time with past and future consciousness of decision-makers; any single period is a selection from explicit history
3. Supposed business motivation goal	Single-period profit maximisation, mostly. Can be sales maximisation. In advanced models, the present-value of a profit stream will be commonly assumed.	Can include profit maximisation, always with past learning and future consciousness; risk consciousness is paramount, especially in relation to uncertainties surrounding demand factors.
4. Information base for pricing decisions	Core models assume full and complete information about all relevant causative factors (usually demand and cost functions) and their connections to the business goal.	Imperfect knowledge, especially about demand shifts, competitive strategies and their consequences for own-firm demand conditions; good knowledge about costs which thus becomes a reliable base for pricing decisions.
5. Economy-wide backdrop	No explicit connection to the macro economy; the broader economy is presumed to be irrelevant or neutral to business pricing decisions.	Inherent potential macro-economic instability; distorted determination of prices and wages through the economy.
6. Industry conditions and link to competitors/rivals	Neo-classical imperfect competition models presume market power and consciousness of rivals and risks of entry (where permitted) in setting prices. Capital equipment is tuned to uses and fully utilised	Imperfect competition and information; distortions about in product and factor markets; significant rival consciousness. Demand uncertainty causes all firms deliberately to create significant excess productive **capacity, the normal conditi**on in industry.
7. Sensitivity of price to demand shifts	Positive and significant link from demand movements to price adjustments in all neo-classical models	Mark-up models imply zero response of prices in relation to movements in industry and macro demand pressure.
8. Sensitivity of price to (foreign) rival prices as affected by exchange rates, tariffs and world price movements	Home producers match duty/exchange corrected rival import prices and price movements; the law of "one price" prevails everywhere	Domestic producers set prices according to costs with little or no reference to rival (imperfectly-substitutable) import prices.
9. Sensitivity of price in relation to sustained unit cost shifts	Partial positive shifting of indirect taxes (costs) into	Full (100%) shifting of any and all (normal) cost changes into prices.
10. Sensitivity of prices in relation to indirect tax shifts.	Partial positive shifting of indirect taxes (costs) into prices: never 100% shifting	Full (100%) shifting of indirect taxes (seen as costs) into prices.

Close study of this table will reveal significant differences in the set-up and especially the implications of these variants of pricing hypothesis. In any specific mainstream pricing model, cost **and** demand influences impact significantly on price, roughly equally. Shifts in what PK economists might call normal costs, or taxes, are only partially shifted into prices (c.f. full shifting in PK approaches); while prices PK models, prices are demand insensitive. An important difference is that the PK approaches basically arose by economists talking to management, from the 1930s, while the mainstream theory was conceived in other places and presented to management as dicta.

In an extreme version of the mainstream pricing model with linear demand (average revenue) functions presumed known to firms (a proposition obnoxious to PK approaches), an x% shift in unit costs cannot manifest in anything as great as an (x/2)% change in price: in PK models we expect x% to presume the rough proportionality between prices and unit costs. This is proved in the appendix.

As a prelude to our empirical verification exercise, it thus follows that we have a clear choice between PK and mainstream models in relation to the role and significance of demand and cost factors; they are simply not reconcilable.

In tabular form the differences become very evident.

Feature of pricing approach	**Mainstream pricing**	**PK pricing**
Demand curve information base	Known exactly, so slopes and elasticities can be computed and known by all forms making prices and used in optimization exercises to derive profit-maximising prices	Risky and unreliable demand base, and this is understood by the firm, even those with considerable market power; thus they seek to base pricing decisions mainly upon more reliable cost information.
Demand fluctuations effects	Positive correlation with prices	Weak or zero correlation with prices: too risky to use demand movements as a basis for price making.
Unit cost shift of x% (e.g. a 10% increase therein)	Less than (x/2) % shift in price in the same direction (e.g. less than 5%)	Close to x% price shift to preserve proportionality with costs (e.g. close to 10%)

As these differences are **not** reconcilable, let the evidence speak. We thus present in the next section both a survey and original interpretation of the evidence, including work done in Cambridge in 2010, in order to make professional tests of these divergent pricing hypotheses.

4. The Validation and Testing of Pricing Approaches.

The next turn in our multi-disciplinary journey is to swing to the survey and statistical approach, using broad theory to give insights into the questions to be posed, but letting the real world give the answers. Theorists sometimes wince at approaching things this way. One manner of securing the answers is to ask firms themselves, a technique that has been common in applied economics since the Oxford Research Group began this approach in the 1930s.

A large part of what we know about the way prices are set in many manufacturing and service firms comes from the evidence of surveys, such as those detailed in Lee (1998) and Coutts and Norman (2011). Lee surveys

some 25 accounting/costing studies and 71 empirical pricing studies all cited at sections A and B of Lee (1998) at pp. 232-240. Lee finds a predominance of sticky or administered prices and close attention to unit cost computations at a normal or budgeted output, just as the Oxford Group found decades earlier. While the degree of competition influences the extent to which firms take account of competitors' prices, mark up pricing is still prevalent in most industrial markets.

Manufacturing firms typically plan a production capacity that enables them to operate with spare capacity. As a consequence, unit direct costs for levels of production below full capacity are typically falling or fairly constant, except possibly when working at full capacity. Competition between firms does not lead to the elimination of spare capacity. Firms typically meet changes in demand within the business cycle by some combination of increasing production levels from existing capacity, inventory changes and lengthening or shortening of order books – price changes are relatively unimportant. Increases in the cost of wages, materials, energy etc. appear to be more important in causing price increases than short-run demand fluctuations. Some surveys find evidence for **asymmetry** in price increases compared with price reductions, with demand factors tending to influence price reductions more than price increases.

The degree of competition does appear to influence the extent to which firms take into account the prices of rivals, but even in markets with a high degree of competition, mark-up price setting appears to be a common practice.

Recent survey evidence for UK in Bank of England (1999), for the Euro area in Fabiani et al. (2006) and for Australia in Park, Rayner and D'Arcy (2010) affirms the central role of cost factors, the lesser role of import prices, and the insignificant role of demand pressure, in industrial price movements in practice.

It has been mentioned above, and proved in the appendix, that (non-mainstream) PK theory implies that demand changes have a much smaller influence on price than cost changes, in the short run. By contrast, the (mainstream) marginalist theory always implies that demand has some significant effect (otherwise firms would not be profit-maximizing). These different predictions from the PK and mainstream theory are eminently testable hypotheses.

Tests can be performed using statistical analysis that ranges from basic regression analysis to advanced econometrics. The approach broadly is to assemble data that will (statistically) explain the behaviour (variance) in a (dependent variable) series of product prices. The candidate explanatory variables are evident from our survey of the literatures in both management and economics: domestic materials and labour costs, domestic demand pressure, (rival or adjacent) import prices, trade policy and exchange rates, especially. In simple terms, we are seeking to estimate the size and significance of various coefficients that link each of these explanatory variables to the prices we are explaining. There are then cross-checks and diagnostic procedures to follow. When these tests are satisfied, we should be able to resolve many disputes and differences evident from the assembly of hypotheses above. To take an example, in the global setting, mainstream economic theory posits that ONLY the coefficient attaching to the import price term will be strong and significant, and it should imply 100% pass-through to domestic product prices. PK theory asserts the opposite: little or no role for import prices, but dominance from the (domestic) cost coefficient. The management literature is not designed to set up specifications for econometrics, but it implies a wider and richer

array of explanatory variables than the econometric techniques can handle.

There is a battery of econometric results summarized in Coutts and Norman (2011), which can be stated synoptically as: ".. cost-oriented pricing is the dominant mode of behaviour. Econometrically, demand is found to have little, if any, influence on prices outside the auction market for materials." "Considerable evidence has accumulated that industrial firms tend to set prices as a markup on *normal* unit costs (his emphasis) …Faced with temporary changes in demand, firms generally alter production and employment rather than price."

Much interest attaches to the elasticity version of a coefficient linking foreign and domestic prices. Full pass-through consistent with mainstream theory requires the value to be near 1.0, while the PK alternative approach would place it at zero. Coutts and Norman (2011) provide a number of such results, ranging from 0.08 to around 0.32 for UK manufacturing overall. These results strongly affirm the PK approach as compared with mainstream analyses, suggesting that the PK conditions mirror reality much more closely than the mainstream theories. The import price effects contributes to the explanation and cannot be ignored, despite the similar and more extreme findings of Brinkman (1999) at p. 162, that "tariffs and non-tariff barriers were mostly insignificant and appeared with positive as well as negative signs. These results challenge the conventional emphasis on policy-induced trade barriers as an explanation for high price levels and its corollary trade liberalization as the solution to high price levels." The most detail previous exploration of this matter, econometrically, is in Coutts and Norman (2007), which found for UK data 1970-2000 import price coefficients mainly around 0.3, which are quite damaging to the presumed universality of conventional theory assuming that coefficient to be 1.0.

Consistent with the management literature, Coutts and Norman (2007) report a considerable diversity of experience within the manufacturing sector that is worth citing in some detail.

"We identified three broad categories of price adjustment for the later 1990s and early 2000s:

a) Sectors that produce mainly homogeneous products traded at international prices. The chemicals and base metals sectors largely belong to this group. In both sectors, the sterling prices of imported goods fell in line with exchange rate appreciation between 1996 and 2000, and domestic prices fell substantially.
b) Sectors in which international competitor prices fell in line with the exchange rate rise, but in which domestic prices increased, or fell by modest amounts.
c) Sectors whose competitor prices fell by only about 8% or less, while domestic prices increased, or fell by only modest amounts.

An implication of these results is relevant to the transmission of inflation and (via the terms of trade) to swings in aggregate demand. Although a floating exchange rate will directly influence the prices of finished goods imported into domestic markets, we find that the impact on competing domestic goods is rather small. Explanations of the pricing decisions of manufacturing firms will remain defective until trade and tariff theory incorporates partial price adjustment rather than import price dominance as the typical circumstance."

Many of these findings produce a coefficient on the import price term explaining domestic price movements in the range 15-30%, which would be zero in an extreme mark-up model (as in Norman (1996)), but 100% in the conventional trade-tariff-exchange model that still dominates economics textbooks. Unpublished research by the authors for Australian data finds similar results. This is a useful test because the Australian currency appreciated markedly in the years 2005-8 and domestic-product prices did *not* fall much, thus maintaining quite fully their relationship

to unit costs as Post-Keynesian approaches would have predicted. In all these tests the demand pressure variable emphasized in mainstream theory was NEVER significant in the face of price-movement explanations from cost and import price factors.

In 2010, Coutts and Norman performed additional econometric tests on updated data, to the year 2010, a full decade beyond the data base for Coutts and Norman (2007), during which the GFC took hold and gave considerable scope to investigate the underlying factors bearing on price adjustments in industry, especially the role of severe and sustained compression of demand and purchasing power. Leaving aside the technical details and diagnostic tests, these latest findings can be reported in four quite definite short statements:

1. Through the first decade of the 21st century, the relative importance of the import price term from mainstream theory became progressively greater and higher in value, the long-run coefficient coming towards 40% in some cases. The most probable explanations are the supply-side disappearance of firms and the demand-side increasing price consciousness of buyers during the GFC.

2. Despite the embodied role of the GFC in the updated data, demand pressure as such still NEVER plays any significant role in the pricing process, affirming proposition **P1** above.

3. While numerically lower than before 2000, the cost coefficient remains largest and reflects the continued and most important role for costs, despite them having zero consideration in mainstream global pricing theory.

4. The attention to diversity of experience within the industry sector, as emphasized in the management literature, remains urgently necessary.

5. Conclusions and Pointers derived for Explaining Price Movements

We can now assemble the overall results of our multi-disciplinary integration exercise.

- Pricing remains important in analytical work associated with management decisions, economic theory, economic policy, trade policy and econometric and survey-based research. Alas, the practitioners of these diverse approaches are not evidently talking to or heeding each other in any serious fashion. The perpetuation of in textbooks and in undergraduate teaching of theory that is not supported by evidence affirms this directly

- The **message FROM management analysts** is to remember and seek to incorporate complexity and diversity within and between products and firms in economics and econometric exercises. The **message TO management analysts** is to seek formalisation (the stand-out feature of economic theory) and build on statistical evidence about pricing that is generated by economists.

- The **message to mainstream economists** is to incorporate the modern dynamic features of today's industrial world into pricing models and to heed the overwhelming evidence that global mainstream pricing models have become misleading and redundant.

- The **message to Post-Keynesian economists** is that, while their general approach accords more closely with today's pricing realities than mainstream theory, they have uphill tasks to perform (i) to convince mainstream economists of this; (ii) to incorporate some independent influences of rival foreign prices into their mainly mark-up pricing models; and (ii) to embrace genuinely dynamic approaches consistent with supporting results already found in time-series econometrics and survey methods.

- The **message to teachers of pricing principles** in the diverse areas in which it is taught is to study the evidence and the other messages in this demonstration. Then consider the responsibility of propounding principles and theory that may be contradicted by evidence and may be supported mainly (or only) by elegance and simplicity.

- The **message to policy makers** is two-fold: (a) expect the price effects of trade policy changes and exchange rate movements to be far ***smaller***, in general, than mainstream economists will advise you; and (b) do not expect demand pressure to cause inflation, or its restraint to curb inflation, as potently as mainstream advisers will tell you, and do not readily discount the role and relevance of incomes policies that can operate directly to limit cost increases that may operate independently of demand pressure in modern economies.

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Technical Appendix: Price Predictions from Economic Theory

We have argued in the text that economic theory practises rigor that is often missing from 'management' approaches, but in the course of doing this it tends to confine itself to a very restrictive world which is quite unrealistic and can be fatal for practical pricing analysis. Let us illustrate.

DERIVATION OF THE FORMAL PROPERTIES OF THE CORE (Mainstream) IMPERFECT COMPETITION MODEL

The "workhorse" pricing model that dominates modern industrial economic theory has representative firms facing linear, downward-sloping (inverse) demand functions and constant marginal costs defined on period rates of output, X. We can write these functions as:

(1) **AR** (average revenue) = **A – (S/2)X**, whence:

(2) **TR** (total revenue) = $\mathbf{AX - (S/2)X^2}$, and

(3) **MR** (marginal revenue) = **A – SX**, and

(4) **MC** (marginal cost) = **C**.

The parameters A (the choke-off price at and above which demand disappears), S (the slope of MC) and C (the initial, constant marginal cost, invariant with rates of output) are all given until varied or endogenised in this set-up. We need the constants (A,S) to be positive, X to be non-negative and the existence condition (A>C) to be met. Furthermore, the business goal is one of simple sole-period profit maximization. By contrast in the PK set-up the demand function is too difficult to discover, and even experimental knowledge of any set (P,X) is the product of conditions that can easily and unpredictable change. What separates PK and mainstream theorists is the belief of the latter that demand functions are confidently known by the price-setting firms.

Basic Propositions A: with given demand and cost functions

A.1: Profit maximisation implies MR=MC, or (3)=(4), which means A-SX=C or

(5) **X* = (A-C)/S**, using * to denote optimal values. Note that the second-order condition for a maximization is immediately satisfied with (-S)<0 (the output derivative of MC). To ensure this optimal rate of output applies to them, firms charge the corresponding optimal price (P*) derived by substituting X* into the demand function (1), whence we get

(6) **P* = (A+C)/2,** which is **property A.1**.

Notice four important properties of this optimal price solution specific to GLIC:

(i) A.1 implies (A-P*) = (P*-C), the optimal price-midpoint theorem: P* always bisects the interval (A-C);

(ii) P* requires ONLY knowledge of A and C: the slope coefficient of the demand function is irrelevant to the price solution and price effects under all uses of the model;

(iii) the ordinary price elasticity of demand (oped), or (e), is simply

(7) **e= -[(A+C)/(A-C)][1],** so once more the slope/position of the demand curve is not needed for analysis: just knowing A and C suffices, as it does to determine P*; and

(iv) writing the price-cost margin, M as (P*-C) [=A-P*], the Lerner index of monopoly power (LIMP)[2] is simply expressed as

(8) **LIMP = (P*-C)/P* = [(A-C)/(A+C)]** which is always **-1/(7) = -1/e**.

Notice that, as C approaches given A, LIMP falls as oped (e) rises in absolute magnitude:

[1] From (1) the direct demand curve is X={2(A-P)}/S, so dX/dP = -(2/S) and e = (dX/dP).(P/X) = -P(A-P), or using property A.1 for profit-maximising P*, e= [(A+C)/(A-C)] as stated.

[2] C.f. Martin (2001), p.119.

the familiar textbook observation about such elasticities with linear demand curves. The market power of the subject firms is measured to decrease; a cost reduction (say, through a technological advance or currency appreciation or tariff reduction affecting imported inputs) reduces demand elasticity and raises market power. In the extreme with C=0 as in some hi-technology areas these days, the measures of LIMP are unity (absolute market power) and e is (-)1. It is important to apprehend the technical properties of GLIC before seeking to apply it.

A.2: Profits in activity X are

(9) **(Profits) = (P-C) X, (=MX),**

while consumers' surplus is given easily in this model as

(10) **CS = (A-P) X/2**, **(=MX/2).**

Notice especially from the definition of M and the mid-point price property of GLIC, that CS is immediately and always in GLIC one half the value of profits: (9) = 2.(10).

Social welfare is commonly specified as the net return to consumers and producers, or just the aggregation of profits and consumer surplus, or from each X firm just the sum: (9) +(10), which is always 1.5 times profits. The corollary is simple: as profits, CS and welfare always remain in these proportions to each other, the percentage change in any one of them suffices for all.

A.3: at the optimal selection (P,X), the ordinary demand elasticity is given as:

e= ∂X/∂P.P/X =(-) [(A+C)/(A-C)], as derived above. Notice that e is always "elastic" (<-1) whenever production is ever feasible (A>C).

Propositions B: Cost Reductions from C to C' [= (1-c)C].

B.1: Using A.1, price is revised to P' = [{A + (1-c)C}]/2 = P-[cC/2], so price falls exactly by one-half of the cost reduction (cC).

B.2 Using B.1, the percentage price reduction, in X, is [cC/2]/[(A+C)
= (cC)/(A+C) which is less than c. As C cannot exceed A, the maximal value for C/(A+C) is one half.

B.3: Selected production volume rises to (A-C')/S = X+cC/S >X.

Using B.3 and A.1, the percentage gain in X, denoted x, is cC/(A-C).

B.4 As X has increased, profits will increase if unit profits (U) also rise. The necessary condition for this to occur is that costs decrease by more than prices decrease. This condition is always met as the cost decrease (cC) is double the price decrease (cC/2), using B.1. Unit profits therefore rise by one-half of the cost reduction. The percentage rise in unit profits is cC/(A-C), which is identical with the percentage gain in output established in B.3 above. Profits themselves, a component of welfare, rise proportionately by 2cC/(A-C), which is the same percentage gain experienced in both consumers' surplus and social welfare, consistent with A.2.

Propositions C: Demand Reduction, with Given Costs.

C.1: Given the GLIC midpoint theorem in A.1 above, the reduction in the choke-off price (inverse demand intercept) must be accompanied by a reduction to the extent of exactly one-half of this change in price. The intercept is reduced by aA and the price by (aA)/2.

C.2: Differentiating the solution value for production, ∂[(A-C)/S]/∂A = 1/S, a positive

relation, so when A falls, so does X, according to the inverse of the demand curve slope (S).

C.3: Remembering that profits and consumers' surplus rise and fall together, as established in A.1 above, we can slow that both fall with an inward (parallel) demand shift, despite the price fall which would normally benefit consumers. The height and width of the rectangle from which CS is derived each fall: the height because price falls less than the choke-off value, proved at C.1 above; the width, because volume is also reduced, as demonstrated in C.2. CS therefore necessarily falls, despite the price reduction.

A Summary of predictive differences in PK and mainstream pricing approaches

The core implications of the standard mainstream model are that:

(1) Price is ALWAYS demand sensitive: $(dP^*/dX) > 0$; and
(2) Cost changes are never fully shifted into prices: $(d\ln P^*/d\ln C) < 0.5$.

By sharp contrast, in a crude mark-up (PK) model of pricing for a selection of historical time:

CBP = k.NUC,

it clearly follows that

(1) Price is NEVER demand sensitive: (dCBP/dX = O, or it is undefined, depending on specification); and
(2) Costs (and taxes treated as costs) are ALWAYS fully shifted into (cost-based) prices, so CBP implies: $(d\ln CBP/d\ln C = 1)$. QED.

Global pricing considerations

In the trade-tariff (global) pricing model the price variable can be styled a 'domestic' price, Pd, meaning the prices of domestically-produced products that face competition from perfectly-substitutable imported (foreign) products, whose prices can be written Pf.

Given the presumed dominance of foreign prices, local producers have no alternative but to match them, thus Pd = Pf, always. This means that any shift in imported-product prices due to world-price conditions, trade policy or exchange rates manifested in percentage change pf to prices Pf will lead equivalently to domestic-product price changes pd = pf = p. Percentage tariff rates, t, or shifts in exchange rates e will drive all such prices without ANY influence from domestic demand OR cost variables.

Proof: By construction (mainstream postulates), Pd=Pf, … (1).

If tariff rate, t, is applied to (foreign) imported products it changes Pf to Pf(1+t), a percentage adjustment of t (=p), …(2). Because of identity (1), the percentage change in Pd, pd, is also t =p. Similarly for exchange rate movements, where percentage changes therein, e, is treated identically to t in (2).

A deliberately heterodox model was introduced to the literature by Norman (1996), employing an extreme version of the cost-based pricing hypothesis in place of the mainstream assumptions, and showing quite different results:

a. Product tariff: pd = 0 <t, completely contrary to mainstream results;

b. Input tariff: pd >0 <t , completely contrary to mainstream results; and

c. Domestic cost shift of c%: pd = c, preserving the cost-price ratio, completely contrary to mainstream results. We thus have real and significant differences to test in relation not only to the ***magnitudes*** of the price predictions but also in relation to the ***sources*** of price changes. Let the evidence speak.