

HOW MUCH IS PASSED ON?

EXAMINING SOME COMMON MYTHS ABOUT THE RELATIONSHIP BETWEEN INDUSTRY CONCENTRATION AND COST PASS ON

PAUL ANDERSON and MICHAEL NICOLAOU

The authors are practicing regulatory and competition economists at Genesis Analytics. The views expressed in this paper are those of the authors and not necessarily Genesis Analytics.

Abstract

Efficiencies are playing an increasingly important role in competition analysis. Many jurisdictions explicitly require efficiencies to be passed on to consumers to save an otherwise anti-competitive merger. In South Africa, the consideration of efficiencies in a merger analysis and the pass-on requirement is more nuanced, but still the extent of efficiency pass-on can be an essential consideration in merger analysis. Furthermore, there have been some indications that the notion of pass-on could play an increasing part in South African merger evaluation in terms of public interest analysis. In this paper we begin to look at the idea of cost pass-on within the South African context with a particular focus on one key element over which there is often an air of misconception: the relationship between cost pass-on and concentration. We examine the commonly expressed view that industry concentration and pass-on are inversely related and highlight the mismatch between economic theory and this commonly-applied rule of thumb. In doing so we draw on a number of seminal papers from the area of industrial organisation economics and expose three apparent myths relating to the relationship between cost pass-on and concentration levels.

I INTRODUCTION

Competition policy around the world has a strong focus on the wellbeing and protection of the consumer. South Africa is no exception with one of the central objectives of the Competition Act squarely stated to be “*to provide consumers with competitive prices and product choices.*”¹

This concern over the price and quality choices faced by consumers is maybe most clearly manifested in the explicit “pass-on” requirement held across a number of jurisdictions when evaluating efficiencies expected to flow from a merger. The pass-on of efficiencies can also matter in South African merger-analysis, although its treatment is more nuanced, with the Tribunal suggesting that a showing of efficiency pass-on will be more relevant the less compelling the category of efficiency.² In addition, there are also indications in South African jurisprudence that the extent of pass-on to consumers may be a relevant factor in merger-analysis in terms of understanding whether certain cost savings, such as a reduction in employment costs, are likely to have a negative public interest impact.³

As the consideration of efficiencies and public interest concerns in merger analysis gain prominence in South Africa, so an understanding of the incentive and ability of firms to pass on certain cost-savings is likely to become more important. Until now this has not been a focus of significant debate in South Africa, neither in terms of conceptual applicability of cost pass-on nor how it should be assessed in practice. This paper begins to look at the notion of cost pass-on within the South African context with a particular focus on one key element over which there is often an air of misconception: the relationship between *cost-saving pass-on* and *concentration*.

So called “conventional wisdom” would seem to have it that an inverse relationship exists between the pass on of cost-savings and concentration i.e. the more concentrated the industry, the less pass on of cost-savings that will occur. The intuition – and admittedly quite appealing intuition – behind this view would seem to be that a firm with greater market power is more inclined to “pocket” any cost-savings as they are less disciplined by competitive forces. In

¹ The South African Competition Act, Act 89 of 1998 (“the Act”), Section 2 (a)

² *Trident Steel / Dorbyl* 2001 (89/LM/Oct00) (Comp. Trib.)

³ *Metropolitan Holdings / Momentum Group* 2010 (41/LM/Jul10) (Comp. Trib.)

line with this widely held intuition, the Tribunal in the recent *Pannar/Pioneer*⁴ merger seemed to apply a heuristic that an inverse relationship can be expected to exist between levels of market concentration and cost-saving pass-on. But South Africa is not the first competition jurisdiction where this rule of thumb has been applied: such a view would also seem to have been fairly pervasive in both Europe and the U.S. when these jurisdictions first began grappling with the notion of cost pass-on in the context of merger analysis. Indeed, to some extent, this view would still seem to colour some of the rhetoric pertaining to efficiency pass-on in these jurisdictions. However, in response to the use of this simplistic assumption in these foreign jurisdictions, a body of economic literature has been generated which shows that in many instances it cannot be assumed that the level of concentration has an inverse relationship with the extent to which cost savings are passed on to consumers. More so, this economic literature demonstrates under certain conditions the somewhat counter-intuitive result that, in fact, the *opposite* relationship between concentration and cost pass on exists, whereby cost pass on actually *decreases* the more competitive an industry.⁵

South Africa is in the somewhat fortunate position of being able to draw from lessons learned in these foreign jurisdictions. As such, this paper summarises some of key results from this body of economic literature, which largely discredits the apparent “conventional wisdom” that higher concentration leads to less pass on of cost-savings.

We begin this paper by first setting the scene as to what cost pass-on is and its relevance to competition law in South Africa. We proceed to examine the commonly expressed view that industry concentration and the pass on of cost savings are inversely related. In doing so, we draw on a number of seminal papers from the area of industrial organisation economics to

⁴ *Pioneer Hi-Bred International / Pannar Seed* 2010 (81/AM/Dec10) 332 (Comp. Trib.)

⁵ Jeremy I. Bulow & Paul Pfleiderer ‘A note on the effect of cost changes on prices’ (1983) 91 (1) *Journal of Political Economy* at 182-5 (“**Bulow and Pfleiderer**”); Paul L. Yde and Michael G. Vita ‘Merger efficiencies: Reconsidering the “passing-on” requirement’ (1996) 64 (3) *Antitrust LJ* at 735-47 (“**Yde and Vita**”); George J. Werden, Luke M. Froeb and Steven Tschantz ‘The effects of merger synergies on consumers of differentiated products’ (2001) *Vanderbilt University Law School Law & Economics*, Research Paper Number 01-9 (“**Werden, Froeb and Tschantz**”); Adriaan Ten Kate and Gunnar Niels ‘To what extent are cost savings passed on to consumers? An oligopoly approach’ (2005) 20 *European Journal of Law and Economics* at 323-37 (“**Ten Kate and Niels**”); Paul R. Zimmerman & Julie A. Carlson ‘Competition and cost pass-through in differentiated oligopolies’ (2010) *Munich Personal RePEc Archive*, available at <http://mpira.ub.uni-muenchen.de/25931> accessed on 14th September 2011 (“**Zimmerman and Carlson**”); and Johan Stennek & Frank Verboven ‘Merger control and enterprise competitiveness – Empirical analysis and policy recommendations’ (2001) *The Research Institute of Industrial Economics Working paper no. 556* (“**Stennek and Verboven**”).

highlight three apparent myths relating to this supposed relationship. We conclude by extracting some implications for the South Africa context.

II SETTING THE SCENE FOR UNDERSTANDING COST PASS ON

(a) What is meant by cost pass on?

Cost pass-on can be defined as the change in equilibrium price resulting from a change in a firm, or firms', costs. In this paper we focus on firm-specific savings in variable costs.

- *Firm-specific vs. industry-wide cost savings.* In the case of the cost change applying to only a single firm or a subset of firms, the cost change is termed *firm-specific*. When the cost change applies to the entire industry, it is termed *industry-wide*. Our primary interest for the rest of the paper is in *firm-specific* cost-savings as these are typically considered relevant to merger analysis. The reason for this is that costs savings can only qualify for consideration in merger analysis if they are merger-specific, and therefore almost by definition are not industry-wide.⁶ This distinction between firm and industry-wide cost savings is an important distinction (as we shall discuss later in the paper) as it impacts the incentive of firms to pass on the cost-saving.
- *Cost saving vs. cost increase.* In this paper we also focus on the pass on of a cost *saving*, as opposed to a cost *increase*, as this most closely reflects the scenario of a merger-specific efficiency gains which is the main area of relevance in South Africa for this paper.
- *Variable vs. fixed costs.* In static models, only variable costs are typically considered in pass-on analysis as changes in fixed costs are assumed not to be passed on in the short-run. Although this simplifying approach used in the economic models does have a reasonable basis, certain literature does also indicate that under certain circumstances changes in fixed cost may also be passed through to prices.⁷ The focus of this paper however remains savings in variable cost.

A firm will be willing to supply into a market as long as the price it receives covers its marginal cost of supply; this effectively determines the supply curve of a firm. A reduction in variable cost results in a downward shift of this supply curve and means that the firm would be willing to supply any previous quantity at a lower price if the firm possesses at least some market power.

⁶ If however, the efficiencies from the merger have some form of externality effects whereby they impact the costs of the entire industry, then it may be more appropriate to consider industry-wide cost savings in the pass-on analysis. However such situations are likely to be rare.

⁷ Phillip E Areeda & Herbert Hovenkamp *Antitrust Law* (2004) at 974d and Robert N. Rubiovitz 'Acquisitions that create efficiencies: Merger analysis and the treatment of reductions in fixed costs' 2008 *Antitrust Insights*.

Profit maximisation is the force driving pass-on. Ten Kate and Niels pin down the economic logic quite succinctly:

“[I]n most circumstances, a cost saving firm that keeps price at the pre-savings level does not maximize its profits. By lowering price, and thus passing on some of the benefits to its customers, the firm usually does not sacrifice profits but enhances them. This is because a price reduction usually leads to an extension of the consumer base from which additional profits can be extracted and these additional profits may more than compensate the loss of profits from the existing consumers. Hence, profit-maximizing firms can reasonably be expected to pass on at least part of their cost savings to consumers”⁸

(b) The relevance of cost pass on to competition policy

Foreign jurisdictions

The notion of cost pass-on has played an increasingly important role in competition analysis in foreign jurisdictions over the last few decades. This has occurred in mainly three areas of competition law: merger analysis, exemptions for prohibited agreements and estimation of damages from overcharging.

Merger analysis. A number of leading competition jurisdictions, including Europe and the U.S., have indicated that only efficiencies which are likely to be passed on to consumers can qualify for consideration as part of a so-called “efficiency defence” in a merger analysis. In an efficiency defence, the anti-competitive effects of a merger, namely the likely rise in market power of the merged entity, are typically weighed up in some manner against the pro-competitive gains, such as potential efficiencies, of the merger. If the efficiencies are found to be of sufficient character and magnitude to offset any anti-competitive harm then such efficiencies may save an otherwise problematic merger from being prohibited. The logic of this approach would seem to be largely centred round a prerequisite that the merger would not result in higher prices being paid by the consumer,⁹ with any increase in price due to an enhancement of concentration and market power needing to be sufficiently offset by an incentive and ability to lower price due to the efficiencies. This approach therefore largely

⁸ Ten Kate and Niels at 323.

⁹ In some instances where the efficiency benefit has a quality dimension this would be the quality-adjusted price.

equates to the adoption of a consumer welfare standard in terms of assessing an efficiency defence in merger analysis.

- In Europe, this approach can be seen in the guidelines to the assessment of horizontal mergers where it is stated “The relevant benchmark in assessing efficiency claims is that consumers will not be worse off as a result of the merger. For that purpose efficiencies should be substantial and timely, and should, in principle, benefit consumers in those markets where it is otherwise likely that competition concerns would occur.”¹⁰
- In the U.S., the Horizontal Merger Guidelines specify that “Agencies consider whether cognizable efficiencies likely would be sufficient to reverse the merger’s potential to harm customers in the relevant market i.e. by preventing pricing increases in the market.”¹¹

Exemptions for prohibited agreements. In Europe, Article 101 of the Treaty on the Functioning of the European Union allows an exemption for agreements that restrict competition on the basis that certain efficiency benefits may be attained from the agreement. This exemption explicitly requires consumers to receive a “fair share” of the resulting benefits of any such efficiencies.¹²

Calculation of damages from overcharging. More recently, the notion of pass on has begun to play an important role in the estimation of damages flowing from cases of overcharging in Europe, e.g. claims against members of a discovered cartel. In that jurisdiction, when a downstream company brings a damage claim against an upstream supplier for overcharging, the upstream company may be able to raise a so-called “pass through” defence to limit the claim amount. This essentially involves the defendant arguing that the complainant passed through the higher prices to consumers and therefore did not suffer the full cost of the overcharging and therefore is not eligible to seek these damages.

¹⁰European Commission’s ‘Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings’, 2004 *Official Journal of the European Union* 2004/C 31/03 79.

¹¹ U.S. Department of Justice and Federal Trade Commission ‘Horizontal Merger Guidelines’ (2010), available at <http://www.justice.gov/atr/public/guidelines/hmg-2010.pdf>, accessed 15th August 2012 at 30.

¹² European Commission’s ‘Guidelines on the application of Article 81(3) of the Treaty’ 2004 C101/08 *Official Journal of the European Union* 97.

Relevance of pass-on in South Africa

Within South Africa, the notion of cost pass-on also has some relevance in terms of how efficiencies from a merger are weighed up against the potential anti-competitive effects of a merger. The role of pass-on here is however more nuanced than would seem to be the case in Europe or the U.S. In *Trident Steel/Dorbyl*, the Tribunal suggested that a showing of efficiency pass-on will be more relevant the less compelling the category of efficiency:

*“We propose the following test – where efficiencies constitute “real” efficiencies and there is evidence to verify them of a quantitative or qualitative nature, evidence that the efficiencies will benefit consumers, is less compelling. On the other hand, where efficiencies demonstrate less compelling economies, evidence of a pass through to consumers should be demonstrated and although no threshold for this is suggested, they to be more than trivial, but neither is it necessary that they are wholly passed on. The test is thus one where real economies and benefit to consumers exist in an inverse relationship. The more compelling the former the less compelling need be the later.”*¹³

One further area unique to South Africa where pass-on of cost saving have been indicated to be relevant is in relation to *public interest* concerns in merger analysis. The South African Competition Act, quite distinctively, provides that a merger which does not raise any competition concerns can still be prohibited on public interest grounds. In particular, the Competition Act requires that if it does not appear that the merger will substantially prevent or lessen competition then the competition authorities should:

*“... determine whether the merger can or cannot be justified on substantial public interest grounds by assessing the factors set out in subsection (3).”*¹⁴

The factors to be taken into account in terms a public interest concern, as set out in Section 12A(3) of the Competition Act, are the effect that the merger will have on: (i) a particular industry, sector or region; (ii) employment; (iii) the ability of small business, or firms controlled or owned by historically disadvantaged persons, to become competitive; and (iv) the ability of national industries to compete in international markets.¹⁵

¹³ *Trident Steel / Dorbyl* op cit note 2 at 81.

¹⁴ The Act, Section 12A(1)(b).

¹⁵ The Act, Section 12A(3)

In the *Metropolitan/Momentum*¹⁶, the Tribunal dealt with the role that public interest concerns could play in a merger. In that particular case, the Tribunal found that the job losses of some 1 000 employees was sufficient for the proposed transaction in its current form to be blocked – even though it raised no competition concerns.¹⁷ In this decision, the Tribunal indicated that once a *prima facie* case of a substantial adverse effect on public interest had been established, the parties then had an evidentiary burden of showing, amongst other requirements, that:

*“the public interest in preventing employment loss is balanced by an equally weighty, but countervailing public interest, justifying the job loss and which is cognisable under the Act.”*¹⁸

Therefore, it would seem that the Tribunal envisioned that any negative public interest effect could be nullified by demonstrating a sufficient countervailing public interest benefit flowing from the merger. The Tribunal was also clear that cost saving efficiencies from the merger may qualify as such a countervailing public interest concern – but only if these cost savings were passed on to consumers.¹⁹ This is most clearly seen in the Tribunal’s discussion below:

“[71] Thus even if the merging parties make a good efficiency argument for job losses, this efficiency gain must, if the job losses are substantial, be justified on a ground that is public in nature to countervail the public interest in preserving jobs. This is because the Act refers to a public interest which must be distinguished from a private interest. Thus although a firm may be able to demonstrate that employment loss is rationally connected to an efficiency claim this would on its own not be sufficient if the efficiency gain is a private one. By way of example an employment loss cost saving which is justified solely by a gain to shareholders and to no one else, could not be regarded as a countervailing interest. Gains to shareholders on this scenario would be purely private. If gains to shareholders as a result of efficiencies introduced through job reduction were regarded as a public interest this would have received express mention in the Act. The Act is silent on this point.

[72] From the structure of section 12A it would appear that purely private efficiency gains are only to be taken into account as countervailing a loss to competition but not a loss to the

¹⁶ *Metropolitan Holdings / Momentum Group* 2010 (41/LM/Jul10) (Comp. Trib.).

¹⁷ This transaction was approved but with very stringent conditions relating to job losses.

¹⁸ *Metropolitan Holdings / Momentum Group* op cit note 16 at 70.

¹⁹ This would also seem to have been the approach taken in the recent *Walmart / Massmart* 2010 (73/LM/Dec10) (Comp. Trib.).

public interest. This is because the Act requires that a merger which has been justified on efficiency grounds should still be evaluated on the public interest grounds.”²⁰

The Tribunal went on to confirm that a possible public interest justification may indeed be that the merger:

*“will lead to lower prices for consumers because of the merged firm’s lower cost base and that this lower cost base can only come about or is materially dependent upon, the contemplated employment reduction.”*²¹

In the *Metropolitan/Momentum* case the efficiency benefits from the employment reduction were not considered as a countervailing public interest benefit because, amongst other reasons, there was insufficient evidence that they would have been passed on to the customers in the form of lower premiums.

It is interesting to note that most of the major public interest concerns which have been raised at the Tribunal have themselves been largely centred on forms of cost savings to the merging parties, such as reductions in employment²² or cheaper sourcing from international markets.²³ This suggests that the debates around efficiency pass-on may become common in public interest analysis because the very causes of public interest concern may also be shown as a countervailing public interest benefit *if* they can be shown to be passed on to consumers in lower prices.

Therefore, based on this approach set out by the Tribunal, it would appear clear that in a merger analysis a demonstration that cost saving would be passed through to lower prices may be relevant, not only for an efficiency defence in terms of the competition analysis as would be in the case in other jurisdictions, but also in terms of a public interest assessment.

It may be that cost pass-on also starts to play a role in damages assessment related to overcharging to the extent that such claims begin to be made in South Africa. Furthermore, there may be scope for the notion of cost pass-on to be relevant to certain prohibited practices in the Competition Act which allow for some form of efficiency defence such as section

²⁰ *Metropolitan Holdings / Momentum Group* op cit note 18 at 71-2.

²¹ *Ibid* at 77

²² *Ibid*

²³ See *Walmart / Massmart* op cit note 19.

4(1)(a), 5(1) and 8, however, until now there has been no indication that this is necessarily the case.

(c) The need to understand the drivers of cost pass through, in particular the relationship between concentration and pass-on

An analysis of efficiencies is becoming a more prominent and commonplace feature of merger assessment worldwide.²⁴ South Africa would not seem to be an exception. At the same time, the role of public interest considerations in South African merger assessment also seem to have been gaining steam over recent years with strong indications that this trend is likely to continue. These factors suggest that the notion of cost pass-on is likely to also become a more important aspect to competition law in South Africa. Although, pass on is only relevant for merger assessments under particular circumstances. A question may be raised as to what are the drivers of pass-on and how should they be assessed? Indeed, until now an understanding of the incentive and ability of firms to pass on certain cost savings has not been a focus of significant debate in South Africa.

Pass-on is most relevant in the South African context in terms of merger analysis where a general weighing up of two offsetting effects will be conducted. In terms of an efficiency defence, this is a weighing up of the efficiencies against the anti-competitive effect of a merger, whilst in terms of a public interest assessment this will often be a weighing up of two counteracting public interest effects. As such, in most instances it will probably not be necessary to calculate the exact rate of pass-on down to the last rand and cent; rather typically what will be required is a sense of magnitude.²⁵ Therefore, full theoretical or empirical models will often not be required to predict and calculate exact pass-on rates, but at the very least, a clear understanding of the key drivers of cost pass-on is required to be able to gauge its likelihood and significance.²⁶

²⁴ Lars-Hendrik Röller, Johan Stennek and Frank Verboven 'Efficiency gains from mergers' 2000 *The Research Institute of Industrial Economics*, Working Paper No. 543, available at <http://swopec.hhs.se/iuiwop/papers/iuiwop0543.pdf> accessed on 17 July 2012 at 6.

²⁵ This would also seem to be the general approach followed in the U.S. and Europe in terms of looking at pass-on of efficiencies in merger analysis although in some cases where the pass-on rate was highly contested and important for the outcome of the investigation detailed empirical studies were conducted. For example see *FTC vs. Staples Inc.* 970 F.Supp 1066,1090 (D.D.C 1997).

²⁶ To the extent that cost pass-on becomes more relevant in South Africa in terms of calculating damages claims, then this point may no longer hold. In such a scenario, it may be required to estimate the pass-on rate more exactly so as to calculate the applicable damage amount.

The remainder of this paper considers in detail one of the key factors which is often cited as a leading determinant of cost pass-on, namely the extent of concentration exhibited in a market. We focus on this one particular aspect of theory relating to the pass-on of costs for three primary reasons.

First, the influence of market concentration is likely to be particularly pertinent in at least one of the contexts in which pass-on is most likely to be considered, namely as an efficiency defence in merger analysis. The reason for this is that the efficiency defence would only apply in cases where the merger was problematic, which in most instances would suggest concentrated markets. Further, any merger, by its very nature, would imply some degree of increase in concentration levels.

Second, in foreign jurisdictions this has been an area rife with misconception: a misconception which our own Tribunal would seem to have applied in the recent *Pioneer/Pannar* merger decision (as discussed in the next section). In particular, there would seem to be a mismatch between economic theory and much of the so called “conventional wisdom” in terms of the relationship between pass-on and level of concentration in the market.

Third, this is an area which has caused significant debate in foreign jurisdictions and ultimately provoked a body economic literature on the topic. Therefore, this is an element of pass-on theory where it is helpful to consider some of the economic results and lessons learnt from these jurisdictions.

III THE RELATIONSHIP BETWEEN CONCENTRATION AND PASS-ON

The relationship between concentration and cost pass-on is often misunderstood. In particular, there would seem to be a commonly held view that as concentration of a market *increases* so would the extent of pass-on *decrease*. This view is appealing in its apparent intuition that a firm with market power would be more likely to “pocket” any cost savings in the form of additional margin given that it is not disciplined by competitive forces but rather has some degree of control over the price it charges its customers. Indeed the typical definition of market power is the ability to charge prices unrelated to cost. It may seem reasonable, on the other end of the spectrum, to assume that in a highly competitive market, prices are competed down to cost, and therefore any cost-savings are competed away. Because of this appealing intuition, in some quarters it has become almost “conventional wisdom” that an inverse relationship exists between the pass on of cost-savings and concentration i.e. the more concentrated the industry the less pass on of cost-savings that will occur.

This view seems to have been fairly pervasive in both Europe and the U.S. with an inverse relationship between levels of market concentration and cost-saving pass-on often considered a form of general heuristic which could be applied to competition law analysis.

In the U.S., the extent to which pass-on should be required of efficiency benefits in merger analysis has been a source of debate for almost three decades. In this context, an inverse relationship between pass-on and concentration level or market power has often been assumed. Some examples of such instances, as previously documented by Yde and Vita²⁷, are shown below.

- As early as 1984, the Federal Trade Commission in *American Medical International* (AMI) held that because of its high degree of market power post-merger, it would be unlikely that AMI could show that market forces would oblige it to pass cost saving efficiencies on to consumers.²⁸
- The Chairman of the FTC, Robert Pitofsky, held the view that requiring a pass-on requirement for efficiencies was a killer qualification on the following basis:

²⁷ For additional examples not provided here, see Yde and Vita at 736-40.

²⁸ *Federal Trade Commission vs. American Medical International Inc.*, FTC, 104 ,213-220, 1984 (as reported in Yde and Vita at 736).

“The only sure way of making such a showing would be to prove that the merger is taking place in a near perfectly competitive market, and therefore that market forces would require that the efficiency be passed on to consumers. But if that were the case – if the market were competitive – the merger would not have been a matter of concern in the first place.”²⁹

- The National Association of Attorneys General (NAAG) Horizontal Merger Guidelines make the statement :

“However, to the extent that a merger increases market power, there is less likelihood that any productive efficiencies would be passed along to consumers.”³⁰

This assumption of an inverse relationship between concentration levels and pass-on rates has also been fairly prevalent in Europe, even colouring the language of the European Commission’s guidelines on the application of Article 81(3) which states that:

“The greater the degree of residual competition the more likely it is that individual undertakings will try to increase their sales by passing on cost efficiencies.”³¹

South Africa has not been immune from the effect of this commonly held view. In the recent *Pannar/Pioneer* merger decision the Tribunal applied this very logic suggesting that the increase in concentration from the merger may lead to lower efficiency pass-on rates:

“Furthermore, we point out that the merger itself may affect the pass-through rate of gains to consumers. Given that this merger significantly reduces the level of competition in the market by creating a post-merger duopolistic market structure, and given that the market is characterised by material demand inelasticity (see paragraph 25 above), it is possible that the post-merger pass-through to consumer [sic] could be lower than historic levels when there was greater competition in the market.”³²

The application of this apparent intuition that an increase in concentration reduces levels of cost pass-on in the U.S. and European jurisdictions has been met with a wave of economic literature looking more closely at its underlying economic foundation. This body of economic literature largely discredits the use of any such heuristic and clearly demonstrates that in

²⁹ Robert Pitofsky ‘Proposals for revised United States merger enforcement in a global economy’ 1993 *Georgetown LJ* 81 at 207-8 (as reported in Yde and Vita at 739).

³⁰ National Association of Attorneys General ‘National Association of Attorneys General: Horizontal Merger Guidelines’ available at <http://apps.americanbar.org/antitrust/at-committees/at-state/pdf/state-practices/mergerguides.pdf>, accessed on 23 July 2012.

³¹ Op cit note 12.

³² *Pioneer Hi-Bred International / Pannar Seed* op cit note 4 332.

many instances it cannot be assumed that the level of concentration has an inverse relationship with the extent to which cost savings are passed on to consumers. More so, this economic literature demonstrates under certain conditions the somewhat counter-intuitive result that, in fact, cost pass on actually *decreases* the more competitive an industry.³³

Due to the fact that this body of economic literature directly addresses the heuristic applied by the Tribunal in *Pannar/Pioneer*, it is instructive to summarise the main findings of this economic work and draw some implications for competition policy in South Africa. We do this by considering the economic reality behind three common myths relating to the relationship between concentration levels and cost-savings pass-on.

(i) Myth #1: Monopolists do not pass-on any firm-specific cost-savings

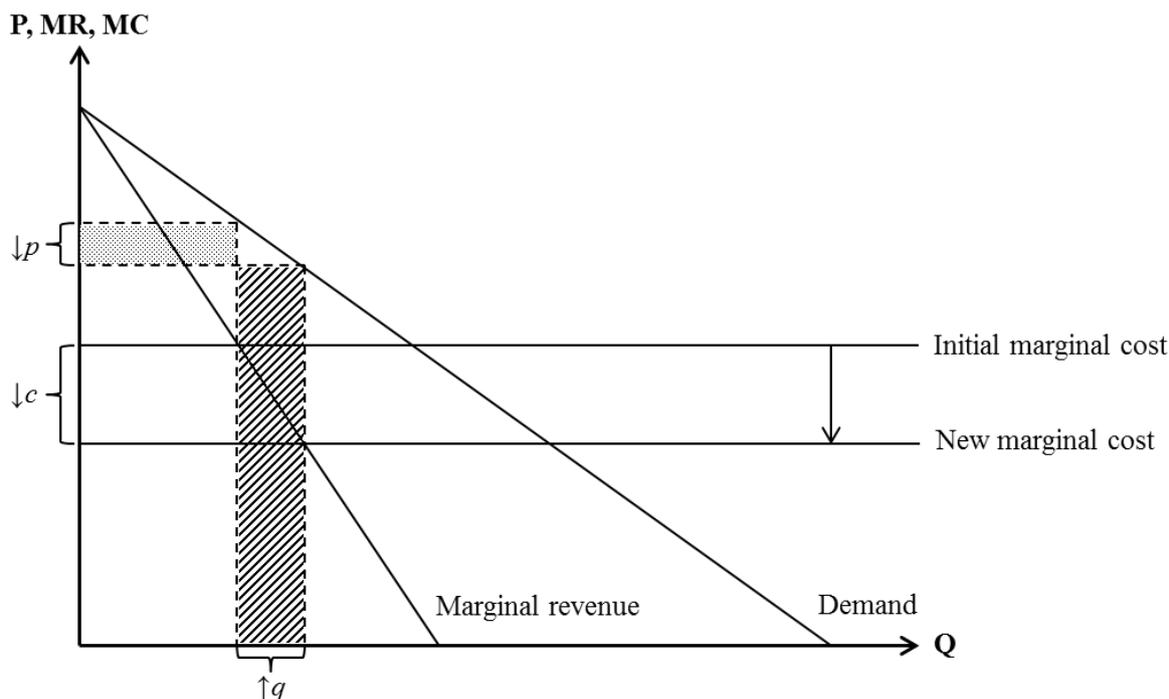
It might be believed that a monopolist would retain the entirety of any cost-savings it experiences because it has control over the price it can charge its customers and that any cost-saving is absorbed by the monopolist as additional profit margin. Bulow and Pfleiderer were the first authors to point out that this intuition is in fact incorrect.³⁴ They show that a monopolist will maximise profits by passing on cost-changes and that this pass-on rate is 50 per cent under the assumption of linear demand.

Figure 1 below depicts the pass on situation where the firm has market power. A reduction in firm-specific marginal cost (c) results in an increase in the quantity supplied (q) when the monopolist re-equates marginal revenue with the lower marginal cost. In order to sell this higher level of output, the monopolist decreases the price (p) at which it sells its goods. The monopolist thus passes on some of this cost reduction to its consumers in the form of a lower price.

³³ See note 5 above.

³⁴ Bulow and Pfleiderer frame their discussion in terms of a marginal cost increase which has symmetrical outcomes for a marginal cost reduction.

Figure 1: Pure monopoly firm-specific cost-savings pass-on



The intuition of this outcome is as follows. When a monopolist experiences some form of cost-saving, there is an inherent trade-off which presents itself. In its attempt to maximise profits, the monopolist can either keep its production levels unchanged, earning a higher profit margin on each unit of output sold, or it could lower its price on each unit sold to sell more units of output than it previously did before the cost reduction took place. It can be shown with relative ease that the latter option produces the greatest absolute level of profit for the monopolist.

As can be seen in Figure 1, when the monopolist lowers its price, total revenue increases by the revenue paid over by the newly-attracted customers at the lower price (the hatched area in Figure 1 above) but is diminished by the difference in price over all previous units sold (the dotted area in Figure 1 above). Since the monopolist always operates on the elastic portion of its demand curve³⁵, the percentage increase in the customer base (i.e. the positive force acting on total revenue) exceeds the percentage decrease in the price brought about by the cost saving (i.e. the negative force acting on total revenue). Geometrically, the hatched area exceeds the dotted area in the figure above. Consequently, total revenue increases at the new

³⁵ According to the profit-maximisation principle, a monopolist will only ever operate along the elastic portion of its demand curve since it is only over this portion of demand that marginal revenue is positive. Mathematically, the price elasticity of demand is the percentage change in quantity brought about by a unit percentage change in price. Demand is said to be elastic when the price elasticity of demand exceeds unity.

price level, and with lower per-unit costs being applied to a larger customer base, it implies that total profit must be greater than before the price change occurred. Therefore, a monopolist has incentive to sell its product at a *lower* price (i.e. pass-on) which takes the form of additional profit³⁶.

For a monopolist, the extent of pass-on is relatively predictable. An interesting result from it is that firm-specific cost-saving pass-on for a monopolist facing linear demand and constant marginal costs is always 50 per cent. Appendix I contains the derivation algebraically linking pass-on to the slopes of the demand and marginal revenue curves. A demand curve with general curvature is employed ($p = f(q)$):

$$\tau_i = \frac{f'(q)}{2f'(q) + f''(q) \cdot q} \quad (1)$$

When demand is linear and curvature is zero ($f''(q) = 0$), it is easy to see that pass on is always one half. With convex demand ($f''(q) > 0$ by definition), pass-on increases since $f'(q) < 0$ and is thus greater than 50 per cent. Similarly, when demand is concave ($f''(q) < 0$ by definition), pass-on decreases and is less than 50 per cent.³⁷ Some authors note that demand is more likely to be convex, and therefore, pass-on rates of greater than 50 per cent can be expected.³⁸

Therefore, economic theory predicts that monopolists will pass on a portion of cost-savings to consumers in the form of lower prices and this portion can be expected to be as much as 50 per cent.

(ii) Myth #2: Perfectly competitive firms pass on all of their firm-specific cost-savings

It may be suggested that, because in perfect competition firms compete down to cost, that a perfectly-competitive firm would be compelled to share all of any firm-specific costs savings. This is true if cost-savings are experienced by all the firms in an industry (e.g. resource price cut). However, if cost-savings are firm-specific, economic theory suggests that in fact

³⁶ Whilst it is true that the monopolist is not constrained by competition, it is constrained by another force – the need to maximise profits. The lower cost base affords the monopolist the opportunity to increase profits. This will drive pass-on.

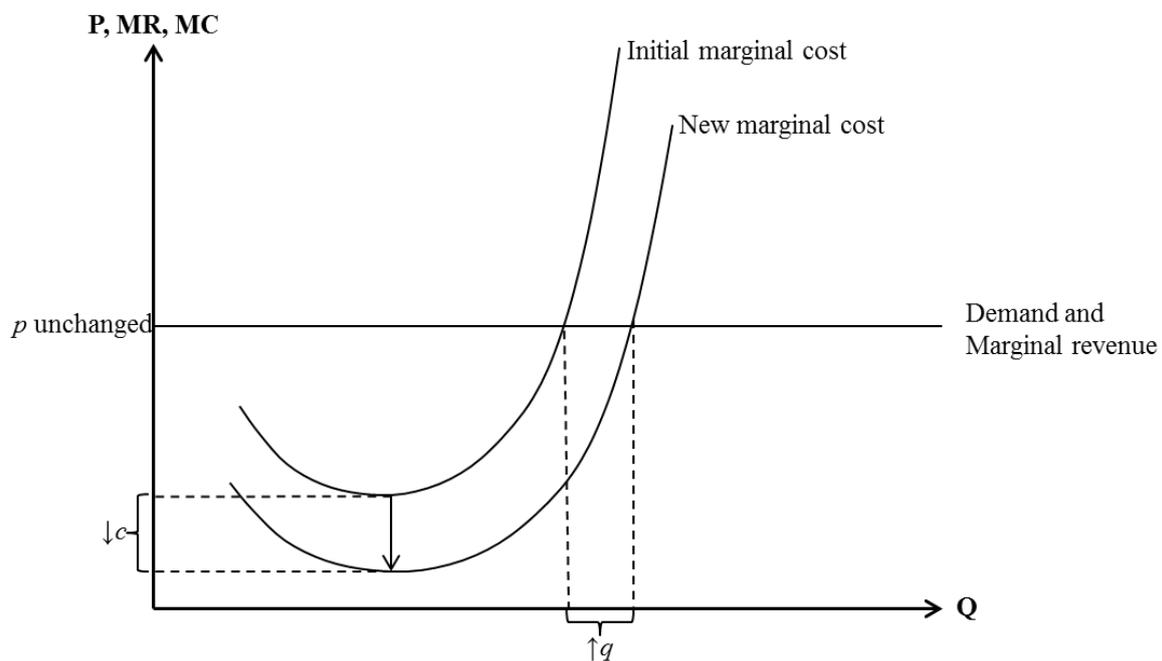
³⁷ Similar qualitative outcomes are also true for the other market structures.

³⁸ Ten Kate and Niels at 328. It should also be noted that pass-on rates are likely to be less (greater) than 50 per cent under the assumption of increasing (decreasing) marginal costs.

perfectly-competitive firms do not pass on any cost-savings. Many authors identify this key distinction as the source of confusion which has led to the adoption of the common heuristic. In general, the outcomes for firm-specific pass-on are reversed when cost-savings are industry-wide. That is, as market concentration decreases so does industry-wide cost-saving pass-on. We discuss *firm-specific* cost-savings as these are relevant to mergers (i.e. merger-specificity requirement).

Once again, a graphic proves instructive in analysing a firm-specific cost-saving under perfect competition:

Figure 2: Perfect competition firm-specific cost-savings pass-on



Under perfect competition, all firms are price-takers and face a perfectly-elastic demand curve. Each profit-maximising produces where marginal revenue equals marginal cost. A reduction in variable costs of production (i.e. firm-specific cost-saving) shifts the firm's marginal curve down. At the original level of production, marginal revenue exceeds marginal cost and the firm is prompted to expand production and capture the additional profit (as an efficiency rent).³⁹ Thus, none of the firm's cost-saving has been passed onto consumers in the form of a lower price.

³⁹ This requires marginal costs to be increasing in output otherwise the firm would produce an infinite amount of output.

The intuition for this is that since each firm's supply is insignificant relative to total market demand, they are able to supply as much as they please to the market at the going equilibrium price. That is, there is no incentive for the firm to lower its price to sell more of its output when faced with lower marginal costs. Therefore, there is no firm-specific cost-saving pass-on under perfect competition. To put this result in perspective, consider the merger of two wheat farms that experiences some form of cost saving and which is specific to the expansion of their production (e.g. more efficiently exploiting an underground reservoir bordering the two properties).⁴⁰ Since agricultural wheat markets are typically approximated by perfect competition, there is no incentive for this newly-merged entity to lower its price to sell this additional output because it can already do so at the going wheat price. Thus, none of the cost-saving experienced is passed on to consumers.

(iii) Myth #3: Competition is the driving force behind cost-savings pass-on

An underlying assumption in the view that market concentration and firm-specific pass-on are inversely related would seem to be that pass-on is generated by competition. From the above, we see that this is not the case with monopoly passing on some of its cost-savings and firms under perfect competition pass on none. But these are not special results and also apply to oligopoly more generally.

Homogeneous product

Assuming a Cournot, non-cooperative, one-shot oligopoly game for homogeneous goods, Ten Kate and Niels derive results for oligopoly pass-on under various assumptions of demand and marginal cost. Specifically for the case of linear demand and constant marginal costs, they show that oligopoly firm-specific pass-on is:⁴¹

$$\tau_i = (N + 1)^{-1} \tag{2}$$

Here, N is the number of competing firms. It is relatively straightforward to see that as the number of competing firms increase so the firm-specific pass-on *decreases*. Furthermore, firm-specific cost-savings are passed on *less* than in the case of pure monopoly ($N = 1$) and

⁴⁰ Yde and Vita at 742.

⁴¹ We layout the derivation of this result in Appendix II. Under Cournot competition, each firm chooses the level of output it wishes to supply taking its competitors output levels as given (i.e. its decision is independent of the output levels chosen by its competitors). That is, competition takes place based on output supplied as opposed to price offered as is the case under Bertrand competition.

more than that under perfect competition ($N \rightarrow \infty$). Thus, as competition becomes fiercer, firms pass on less of any given specific cost-savings, and in the limit, pass on none which is consistent with the case of perfect competition. Therefore, the findings for the oligopoly case under these assumptions are in line with expectations based on the cases of pure monopoly and perfect competition, but are completely contrary to the heuristic commonly applied.

The above result is consistent with the findings of Yde and Vita where the authors relax the assumption of perfect competition to graphically illustrate the outcome of a highly-competitive market.⁴² They show that the relative price reduction is still significantly less than the marginal-cost saving being passed on, suggesting that the counter-intuitive relationship appears to hold between the extremities of pure monopoly and perfect competition. In a highly-competitive (but not perfectly-competitive) market, small price cuts can attract substantial sales away from rivals. Similarly, a slight price increase can result in substantial sales losses. For example, one may see this for competing petrol stations within close proximity where fuel prices are unregulated. Most of any cost-saving reduction is reflected in an output increase of the cost-saving firm, and not in price. Thus even in highly-competitive markets, firm-specific pass-on is small relative to the output response for any cost-saving.

A comprehensive overview of pass-on is undertaken by Stennek and Verboven. They too conclude that, for homogeneous products, the more firms there are, the lower is the degree of firm-specific pass-on.

Differentiated products

With product differentiation, the outcome for pass-on is less clear.⁴³ Werden, Froeb and Tschantz consider pass-on within the context of product differentiation and Bertrand competition. They find a wide range of pass-on rates under various plausible demand conditions which is consistent with a conclusion of Stennek and Verboven that no general relationship can be teased out for differentiated product markets. Consequently, for the

⁴² Yde and Vita at 743.

⁴³ Product differentiation introduces a price-quality trade-off for consumers and affords individual firms a degree of market power depending on the extent of product differentiation. This, in turn, affects the responses of consumers and competing firms to rivals' price cuts which ultimately determine the new equilibrium price after a cost-saving.

analysis of merger efficiencies Werden, Froeb and Tschantz advocate the use of compensating marginal cost reductions which uses information on prices, market shares and demand elasticities to determine exactly what cost-reductions are necessary to offset the likely price-increasing effects of a merger. In more general terms, they argue that less intense competition leads to greater pass-on.

More recent work by Carlson and Zimmerman consider product differentiation to expand on the findings of the authors above. Under Cournot competition with linear demand, differentiated products and asymmetric costs, there is a critical range of firms over which firm-specific pass-on is decreasing in the number of firms. Beyond this critical range, pass-on monotonically increases and approaches 50 per cent in the limit. When goods are unrelated, pass-on tends to 50 per cent as the number of firms increase. Conversely, when all goods are homogeneous firm-specific pass-on declines monotonically from 50 per cent as the number of firms increase which is consistent with Ten Kate and Niels.⁴⁴ The intuition behind these results is that introduction of product differentiation affords each firm a degree of market power over their product and as this differentiation increases, firms' behaviours approximate that of a monopolist (i.e. increases the incentive to pass-on). Changing the form of competition to Bertrand (with product differentiation) results in cost pass-on which is monotonically declining in the number of firms in the market.⁴⁵

Intuitively, when there are numerous firms in the market, there is a greater degree of competition and individual firms which experience a cost-saving are likely to pass-on less of their cost-saving since this situation more closely approximates that of perfect competition. Pass-on must necessarily be less since firms have less control over the market price level because they service a relatively smaller proportion of total market demand if they are symmetric.⁴⁶ Conversely, when there are relatively fewer firms competing within an oligopoly market structure, the situation is more closely approximated by the case of pure monopoly since each individual firm has greater control over the market price level because of the share of the market they supply. Consequently, profit maximisation in this case dictates a greater level of pass-on of individual firm cost-savings.

⁴⁴ See Figure 1 of Zimmerman & Carlson at 11.

⁴⁵ Ibid at 18.

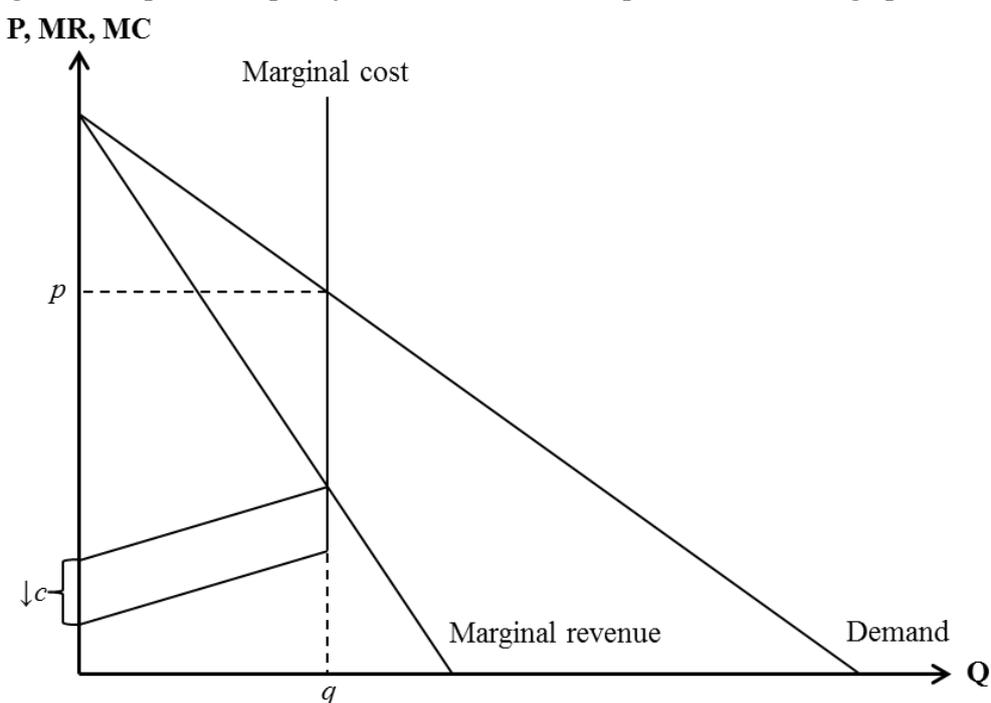
⁴⁶ The authors attempt to argue that their result is independent of the symmetry of the firms' market shares within the industry. However, their intuition for this outcome on page 329 isn't so clear to us.

Competitive interaction

This apparent general relationship between the extent of competition and firm-specific pass-on also appears to present when one considers different types of oligopoly competitive interactions.⁴⁷ More specifically, as progressively more competitive types of interaction are introduced (Stackelberg quantity leadership and Bertrand competition) firm-specific pass-on diminishes which is consistent with the result across the different market structures.

One observation, unrelated to competition, is that in order to pass on cost-savings, a firm needs to expand output. Therefore, other factors may also impact pass-on.⁴⁸ For example, *capacity constraints* (represented by the vertical portions of the marginal cost curves) may impede a firm from passing on any cost-savings, as is depicted below:

Figure 3: Impact of capacity constraints on firm-specific cost-savings pass-on



The message regarding market concentration and firm-specific cost-saving pass-on is consistent across the literature discussed. Under certain conditions, economic theory predicts that as market concentration increases, firm-specific pass-on is likely to *increase*. This is in

⁴⁷ Ten Kate and Niels at 331-33 and Zimmerman and Carlson at 18.

⁴⁸ Stennek and Verboven at 8 suggest that pass-on depends on the presence of capacity constraints, the price elasticity of demand, the degree of market power and the market shares of the merging firms.

contrast to the general heuristic commonly applied by competition authorities. Below we provide a brief summary of some of the key contributions of the body of literature which has made this point.

Table 1: Summary of some key findings from the literature for firm-specific pass-on

Paper	Year	Modelling approach	Key findings for firm-specific pass-on
Bulow & Pfleiderer	1983	Monopoly pass-on with various functional forms of demand: linear, concave and convex demand and constant marginal costs	<ul style="list-style-type: none"> Algebraic relationship between pass-on and slopes of demand and marginal revenue curves 50 per cent pass-on for monopoly case with linear demand
Yde & Vita	1996	Systematic graphical and intuitive explanation of economic theory with increasing and constant marginal costs across different market structures.	<ul style="list-style-type: none"> Sources of application of common heuristic suggesting that pass-on decreases with concentration Pointing out of contradiction between common heuristic and predictions of economic theory Prediction of market concentration resulting in more pass-on
Werden, Froeb & Tschantz	2001	Product differentiation under Bertrand competition. Empirical simulations of price effects using various functional forms of demand: linear, logit, AIDS and isoelastic demand.	<ul style="list-style-type: none"> Empirical illustration of wide-ranging pass-on estimates stemming from demand assumption Advocates use of compensating marginal cost reductions in practice Argues that less intense competition leads to greater pass-on
Stennek & Verboven	2001	Elasticity (relative pass-on) analysis of firm-specific pass-on across different market structures. Bertrand and Cournot oligopoly models with constant but not necessarily identical marginal costs. Homogeneous and differentiated products considered. Illustration of econometric technique to calculating pass-on in practice.	<ul style="list-style-type: none"> Significant consideration of pass-on Factors affecting pass-on include: capacity constraints, price elasticity of demand, degree of market power and the market shares of the merging firms Importance of distinguishing between industry-wide and firm-specific pass-on Intensified competition results in a lower degree of firm-specific pass-on. However, no general conclusions can be drawn for the non-identical firm case. Empirical evidence suggests that industry-wide pass-on is greater than firm-specific pass-on. Wide variation among firm-specific pass-on estimates.
Ten Kate & Niels	2005	Cournot, non-cooperative, one-shot oligopoly games for homogeneous goods. Linear, concave and convex demand. Constant, increasing and decreasing marginal costs.	<ul style="list-style-type: none"> In most circumstances, pass-on is independent of price elasticity of demand and market share of cost-saver. Competition weakens pass-on. Convex demand and decreasing

		Stackelberg and Bertrand models discussed.	<p>marginal cost <i>increase</i> pass-on relative to the linear demand and constant marginal cost cases.</p> <ul style="list-style-type: none"> • Concave demand and increasing marginal cost <i>decrease</i> pass-on relative to the linear demand and constant marginal cost cases.
Zimmerman & Carlson	2010	Oligopoly pass-on with product differentiation under Cournot and Bertrand competition. Linear demand assumed. Both symmetric and asymmetric costs considered.	<ul style="list-style-type: none"> • For Cournot and asymmetric costs, critical range over which pass-on decreases in the number of firms. Thereafter, pass-on continually increases and approaches 50 per cent. Critical range determined by extent of differentiation. • For Bertrand and asymmetric costs, pass-on monotonically decreases as the number of firms increase.

IV CONCLUSIONS AND DISCUSSION

Until now the notion of cost pass-on has not been a significant focus of debate in South Africa. Cost pass-on is however relevant in merger analysis in terms of both an efficiency defence and public interest considerations with its significance likely to increase as both these areas of analysis gain prominence. Therefore, an understanding of the incentive and ability of firms to pass on certain cost savings is likely to become more important over time in South Africa.

A specific area of pass-on theory, frequently characterised by a degree of misconception and faulty intuition, is the relationship between the pass-on of cost savings and market concentration. In particular, it is often claimed as a general rule that as the concentration of a market increases the extent of cost-savings which are passed on decreases. However, this “conventional wisdom” that an inverse relationship exists between the pass on of cost savings and concentration has drawn strong criticism from economic literature in both the U.S. and Europe. A review of this body of literature illustrates that in many instances it simply cannot be assumed that the level of concentration has an inverse relationship with the extent to which cost savings are passed on to consumers. Various contributors to this economic literature actually demonstrate under certain conditions the somewhat counter-intuitive result that firm-specific cost-savings pass-on actually *decreases* the more competitive an industry.

South Africa is in the somewhat fortunate position of being able to draw from lessons learned in the foreign jurisdictions that have already made significant progress in grappling with the relationship between concentration and pass-on. A clear lesson from the economic literature in these jurisdictions is that no reliable heuristic can be applied which assumes pass-on decreases as a market becomes more concentrated. This would seem contrary to the approach taken by the Tribunal in *Pannar/Pioneer*. The implication of this is that the pass-on of efficiencies needs to be considered carefully on a case-by-case basis and factors such as the type of competition between firms and responsiveness of demand to pass on of costs may need to be examined.

APPENDIX I

In this appendix, we provide the algebraic derivation linking firm-specific cost-saving pass-on to the slopes of the firm's demand and associated marginal revenue curves. We then apply this relationship to a general demand curve with curvature.

By definition, the cost pass-on associated with firm i (i.e. *firm-specific* cost pass-on) is given by:

$$\tau_i = \frac{\Delta p}{\Delta c_i} \quad (3)$$

where Δp is the change in equilibrium price of the good or service under investigation
 Δc_i is the change in firm i 's constant marginal cost (i.e. output independent)

Dividing both the numerator and denominator by an infinitesimally small change in quantity (which is equivalent to multiplying the expression by unity), we arrive at:

$$\begin{aligned} \tau_i &= \frac{\Delta p}{\Delta c_i} = \frac{(p_2 - p_1)}{(c_{i,2} - c_{i,1})} = \frac{(p_2 - p_1)/(q_2 - q_1)}{(c_{i,2} - c_{i,1})/(q_2 - q_1)} \\ &\Rightarrow \tau_i = \frac{\text{slope of demand curve}}{\text{slope of marginal revenue curve}} \end{aligned} \quad (4)$$

Some additional explanation is required for the denominators of the second-last and last equalities. A profit-maximising firm produces up to the point where marginal revenue is equated to marginal cost. Before the change in marginal cost came about, the firm would have been producing at such a point. Once the change in marginal cost takes place, this condition no longer holds, and the required change in marginal revenue must exactly equal the change in marginal cost for equality to be restored once again. Since this change takes place along the *same* marginal revenue curve, the change in marginal revenue divided by the consequent change in quantity supplied is, by definition, the slope of the marginal revenue curve itself.

We now apply a general demand function with curvature to the last equation above. Assume a twice-differentiable inverse demand function linking price and quantity:

$$\begin{aligned}
 p &= f(q) \\
 \Rightarrow f'(q) &< 0 \\
 \Rightarrow f''(q) &\neq 0
 \end{aligned}
 \tag{5}$$

Total revenue, marginal revenue and the slope of marginal revenue are then given by:

$$\begin{aligned}
 TR &= p \cdot q = f(q) \cdot q \\
 \Rightarrow MR &= \frac{dTR}{dq} = f'(q) \cdot q + f(q) \\
 \Rightarrow \text{Slope of MR} &= \frac{dMR}{dq} = 2f'(q) + f''(q) \cdot q
 \end{aligned}
 \tag{6}$$

Applying the general formula linking pass-on to the slopes of demand and marginal revenue:

$$\boxed{\tau_i = \frac{f'(q)}{2f'(q) + f''(q) \cdot q}}
 \tag{7}$$

APPENDIX II

In this appendix, we provide the algebraic derivation of oligopoly pass-on under Cournot competition with linear demand and constant marginal costs as per Ten Kate and Niels.⁴⁹ This result is a special case of the authors' more general result derived under nonlinear demand and non-constant marginal costs.

The market supply function is given by:

$$q = q_1 + q_2 + q_3 + \dots + q_N \quad (8)$$

where q is the total market supply

q_i is the supply of firm i

N is the total number of firms in the market

Inverse demand function is given by:

$$p = a - bq = a - b(q_1 + q_2 + q_3 + \dots + q_N) \quad (9)$$

where a is a positive parameter representing autonomous demand

b is a positive parameter representing the slope of the inverse demand function

Profit function for each firm is given by:

$$\begin{aligned} \Pi_i(q_1, q_2, q_3, \dots, q_N) &= (p - c_i)q_i \\ \Rightarrow \Pi_i &= [a - b(q_1 + q_2 + q_3 + \dots + q_N) - c_i]q_i \quad \forall i = 1 \dots N \end{aligned} \quad (10)$$

where Π_i is firm i 's profit function

c_i is firm i 's marginal cost

For each profit-maximising firm, the following reaction function can be derived:

$$\begin{aligned} \frac{\partial \Pi_i}{\partial q_i} &= 0 \quad \forall i = 1 \dots N \\ \Rightarrow -bq_i + [a - b(q_1 + q_2 + q_3 + \dots + q_N) - c_i] &= 0 \\ \Rightarrow a - b(q_1 + \dots + 2q_i + \dots + q_N) - c_i &= 0 \\ \Rightarrow q_1 + \dots + 2q_i + \dots + q_N &= \frac{a - c_i}{b} \quad \forall i = 1 \dots N \end{aligned} \quad (11)$$

⁴⁹ Ten Kate and Niels at 329.

The N equations in N unknowns can be solved to get the equilibrium quantities using matrix algebra:

$$\begin{aligned}
& \begin{pmatrix} 2 & \cdots & 1 \\ \vdots & \ddots & \vdots \\ 1 & \cdots & 2 \end{pmatrix} \begin{pmatrix} q_1 \\ \vdots \\ q_N \end{pmatrix} = \frac{a - c_i}{b} \begin{pmatrix} 1 \\ \vdots \\ 1 \end{pmatrix} \quad i = 1 \dots N \\
& \Rightarrow \mathbf{q}^* = \begin{pmatrix} q_1^* \\ \vdots \\ q_N^* \end{pmatrix} = \left(\frac{a - c_i}{b} \right) \begin{pmatrix} 1 \\ \vdots \\ 1 \end{pmatrix} \begin{pmatrix} N & \cdots & -1 \\ \vdots & \ddots & \vdots \\ -1 & \cdots & N \end{pmatrix} \begin{pmatrix} 1 \\ \vdots \\ 1 \end{pmatrix} \\
& \Rightarrow \mathbf{q}^* = \frac{a - c_i}{b(N + 1)} \begin{pmatrix} 1 \\ \vdots \\ 1 \end{pmatrix} \quad i = 1 \dots N
\end{aligned} \tag{12}$$

Therefore, market supply is given by:

$$\begin{aligned}
q^* &= q_1^* + q_2^* + \cdots + q_N^* \\
\Rightarrow q^* &= \frac{1}{b(N + 1)} [(a - c_1) + (a - c_2) + \cdots + (a - c_N)] \\
\Rightarrow q^* &= \frac{1}{b(N + 1)} [aN - (c_1 + c_2 + \cdots + c_N)]
\end{aligned} \tag{13}$$

Substituting into the inverse demand function provides the equilibrium price:

$$\begin{aligned}
p^* &= a - bq^* \\
\Rightarrow p^* &= a - b \left\{ \frac{1}{b(N + 1)} [aN - (c_1 + c_2 + \cdots + c_N)] \right\} \\
\Rightarrow p^* &= a - \frac{aN}{N + 1} + \frac{1}{N + 1} (c_1 + c_2 + \cdots + c_N) \\
\Rightarrow p^* &= \frac{1}{N + 1} (a + c_1 + c_2 + \cdots + c_N)
\end{aligned} \tag{14}$$

Equilibrium price is thus the unweighted average of the sum of autonomous demand and the sum of each firm's marginal cost.

Suppose that the initial and new equilibrium prices are given by p_0^* and p_1^* , respectively. Therefore, for a given change in firm i 's marginal cost, Δc_i , firm-specific pass-on is given by:

$$p_0^* = \frac{1}{N+1} (a + c_1 + c_2 + \dots + c_N) \text{ and}$$

$$p_1^* = \frac{1}{N+1} (a + c_1 + c_2 + \dots + c_i + \Delta c_i + \dots + c_N)$$

$$p_1^* = \frac{a + c_1 + c_2 + \dots + c_i + \dots + c_N}{N+1} + \frac{\Delta c_i}{N+1}$$

$$\Rightarrow p_1^* = p_0^* + \frac{\Delta c_i}{N+1}$$

$$\Rightarrow \Delta p^* = p_1^* - p_0^* = \frac{\Delta c_i}{N+1}$$

$$\Rightarrow \tau_i = \frac{\Delta p^*}{\Delta c_i} = \frac{\Delta c_i}{N+1} / \Delta c_i$$

$$\boxed{\Rightarrow \tau_i = (N+1)^{-1}}$$

(15)