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Indirect Welfare Effects of Price Changes and Cost-Benefit Analysis

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Abstract
The effects of a policy measure often reach the consumer only after one or more intermediate steps, for instance because the measure lowers the cost of an input for an industry producing a consumer good. This paper is concerned with the question how to measure such indirect effects correctly under conditions of perfect and imperfect competition. Conventional CBA measures the indirect effects on consumers as the direct effect on other actors (e.g. the Marshallian consumer's surplus of the demand for the input whose price changes). Formal analysis establishes the correctness of this approach under perfect competition, provided that the demand curve is appropriately defined. Under less than perfect competition, the indirect effect can differ from the direct effect. Under monopoly the indirect effect is always larger than the direct effect. Under monopolistic competition it can be smaller, identical or larger, depending on the details of the model specification and on the possibility of entry.

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1 Introduction

Cost Benefit Analysis (CBA) tries to measure the effects of carrying out a policy measure (such as a tax reform or an investment in infrastructure) on welfare. Since consumers are the only actors that can experience welfare, this implies that CBA should determine the effects of the policy measure on consumers in their various roles of buyers of consumption goods, suppliers of production factors, receivers of external effects et cetera. If the policy measure concerns only consumers (for instance, a change in a tax on a consumption good) there is no need to consider the effects of the measure on other actors. However, in many cases a policy measure concerns both consumers and other actors. The effects of the policy measure on the other actors result ultimately also in effects on consumers. For instance, if the government improves traffic infrastructure, transport costs for firms decrease and this may result in higher profits and a lower price for the output of these firms. The consumers of these outputs and the owners of the capital invested in these firms experience a welfare effect of this investment in an indirect way. In order to carry out a complete CBA, one should therefore in principle investigate the ways in which the effects of the projects on non-consumers will ultimately be translated into effects on consumers.

If this would indeed have to be done, CBA would require a detailed understanding of all kinds of interrelations between the various actors in the economy. However, what is done usually, is to treat the direct effect on non-consumers as if they were effects on consumers. For instance, in the example of an improvement in traffic infrastructure one usually tries to estimate the effect of this measure on the demand for trips for various purposes and approximates the benefits by means of the change in the area under the relevant demand curves. This means that trips for business purposes are treated as if the actors concerned were persons, not firms. In other words: the indirect effects on persons are measured by direct effects on firms.

This practice is sometimes defended by arguing that CBA is a generalization of the way in which entrepreneurs take their investment decisions. Since entrepreneurs look only at the direct effects of their actions and ignore effects elsewhere in the economy, CBA should proceed in the same way, if only to avoid differences in evaluation only because a project is financed publicly and not privately. This evokes the more fundamental question whether it is desirable for society to let entrepreneurs take their investment decisions in this way. The standard answer is a reference to the first theorem of welfare economics according to which the equilibrium of a competitive economy is also a Pareto optimum. This means that profit-maximizing behavior of firms brings the economy to its efficiency frontier, if the assumptions of the Arrow-Debreu model are fulfilled. The argument suggests therefore that if CBA would mimic firm behavior, it could fulfill the same function for decisions that have to be taken by the government.

An important reason why private decisions of profit maximizing entrepreneurs lead to Pareto optimality in an Arrow-Debreu economy is that every industry operates under conditions of constant returns to scale and with prices equal to marginal cost. Every change in the economy that leads to lower unit costs of production automatically leads to lower prices and this means that such cost advantages are completely passed through to the customers of the firm's product and ultimately to the consumers. In this process the size of these advantages does not change: neither do they increase nor decrease. This is the reason why it is sufficient for the firms to take care of the effects of an investment on their own profits.

In the present paper we investigate two questions that are left open by this argument. The first concerns the appropriate definition of the demand curve that should be used to measure the direct effect on firms. The conventional demand curves for inputs take output volume as given. However, if the direct effect is used as an approximation of an indirect effect experienced by the consumers of the output, then this is clearly not appropriate. One may expect that the change in the input prices leads to a change in the output price because of profit maximization and/or competition. A change in the output price would lead to a change in output volume, invalidating the assumption that output remains constant.

The second question refers to situations that deviate from perfect competition because prices differ from marginal costs and/or there are (dis)economies of scale. Since such situations are absent in the Arrow-Debreu economy assumed by the argument for equality of direct and indirect effects, this question is still open. It is the purpose of this paper to look also at such situations in a relatively simple setting and see whether the usual argument still holds.

In recent years, it has been argued from different points of view that investments in public infrastructure might be more beneficial to society than is usually thought. First, Aschauer (1989) argued that the social benefits of such public expenditure were very high. Although his results have been criticized by a number of other researchers (see Gramlich (1994) for a review of the debate), one important feature that has been highlighted is the stimulating effect that public infrastructure has on private investment (see Munnel, 1992). The existence of such an effect does not necessarily imply that conventional CBA is wrong, but it seems worthwhile to investigate the issue somewhat closer by means of a formal model that allows one to study the ‘forward linkages’ involved in such investments, as the present paper does. Second, the ‘new economic geography’ that recently emerged as a subfield of economics incorporates agglomeration effects that were traditionally difficult to deal with in economic models. It does so by assuming that there is imperfect competition in some industries. Venables and Gasiorek (1998) provide simulation results that suggest that in such an economy the results of transport improvements might be substantially larger than is suggested by conventional CBA. On the other hand, Newbery (1998) provides some examples that show that in some situations conventional CBA might overestimate the welfare gains from public investment. In the sections that follow we try to uncover the reasons why conventional CBA might be biased in a context that allows us to derive analytical results.

The paper is organized as follows. In section 2 some preliminary steps are taken for the modeling exercises that follow. Section 3 considers the situation of perfect competition and verifies the equality between direct and indirect effects under these circumstances. Section 4 looks at a monopoly situation and analyses the possible difference between direct and indirect effects in such a situation. The main result is that the correctly measured welfare effects are in this situation always larger than the direct effect. In section 5 we study the intermediate situation in which there is imperfect competition. The Dixit-Stiglitz and logit models are considered with a given number of firms as well as with free entry. We obtain remarkably different results for the various cases we consider. Section 6 concludes.

2 Preliminaries

In this section we will introduce some terminology, give a simple example of the analysis to be carried out in more generality in later sections and provide an outline the model of the firm that will be used.

Some terminology
We consider the situation in which the price of a particular commodity changes because of some policy measure. If the price change concerns a consumption good, all its welfare effects are *direct*, in the sense that the consequences for the utility of consumers are caused by the price change itself. If the commodity is not, or not exclusively, a consumption good some of its welfare effects are *indirect*, in the sense that they realize themselves via a causal chain of reactions from the original price change to changes in other prices. For instance, if transport infrastructure is improved, drivers of private cars benefit as well as firms that have to pay lower transportation costs for their inputs and outputs.
In order to focus in the indirect effect of a price change, we assume throughout the paper that the commodity whose price changes because of the policy measure is used as input in an industry whose output is a consumption good. Moreover, we assume for simplicity that the commodity is only used as an intermediary good in this industry and cannot be consumed directly.
The direct effect of the policy measure is determined as the change in the area under the industry's demand curve for the input. The indirect effect of the policy measure is the effect that this price change has on (a) the profits of the firm and (b) the welfare of its customers. The latter effect occurs as a consequence of a change in the price of the firms output in reaction to the input price. We usually assume that the effect on consumers can be described accurately by the Marshallian consumer surplus. Note that one of the two components of the indirect effect can be zero. The indirect effects might induce further changes in the economy, but these are not taken into account in the present paper.
The question in which we are interested here is: are the indirect effects of the policy measure accurately measured by the direct effects? The difference between the direct and the indirect effects will be referred to as the *additional indirect effect* (AIE). It is clear that such an additional indirect effect, which may be of either sign, should be taken into account in CBA.
In order to introduce the analysis we will be carrying out, we consider a simple example.

A simple example
As mentioned above, we assume that a policy measure results in a change in the price of a commodity that is used as an input in a particular industry. A CBA is carried out which takes into account the direct effects only. We denote the demand for the input whose price changes as *x* and indicate the situation in which the measure is taken by means of a superscript 1 and the situation in which it is not taken by means of a superscript 0. For both situations the demand is estimated. These estimates provide two points of the demand curve for the product. The price of the commodity is denoted as *p*. If the direct effect of the price change is measured by the familiar 'rule of one half' we find for the direct effect *DS*:

$$\Delta S = .5\,(x^0 + x^1)\,(p^0 - p^1) \qquad \textbf{1}$$

The change in consumer's surplus that is the result of the change in the input price is measured on the basis of the demand for the industry's output in the two situations. We denote this demand by *y*. Demand will only change if the price of this ouptut, which we denote as *r*, changes. If this happens, the change in consumer surplus *DCS* can also be computed on the basis of the 'rule of half':

$$\Delta CS = .5\,(y^0 + y^1)\,(r^0 - r^1) \qquad \mathbf{2}$$

Will the changes in both surpluses be equal to each other? In order to answer this question we make some additional simplifying assumptions (which will be relaxed later on). First, we assume that the price of the output is equal to its marginal cost. Second, we assume that production technology has fixed technical coefficients. We denote the quantity of the input needed to produce one unit of output as *a* and we should have: $x^0=ay^0$ and $x^1=ay^1$. The change in unit cost (which is equal to marginal cost and output price) is equal to $a(p^0-p^1)$. We can use these relationships to elaborate on the change in consumer's surplus:

$$\begin{aligned}\Delta CS &= .5\,(y^0 + y^1)\,(r^0 - r^1)\\ &= .5(y^0 + y^1)a(p^0 - p^1)\\ &= .5\left(\frac{x^0}{a} + \frac{x^1}{a}\right)a\left(p^0 - p^1\right)\\ &= .5(x^0 + x^1)(p^0 - p^1).\end{aligned} \qquad \mathbf{3}$$

The second line of this expression uses the expression for the change in the output price, the third makes use of the fixed technical coefficients, the fourth line gives a simplification of the third. Since the fourth line give the expression for the surplus *DS*, it establishes the equality of the direct and indirect effect for this case. It should be noted that in order to do so, we had to take into account the change in output volume that occurred as a consequence of the change in the output price because of the change in the input price. If the surplus *DS* had been measured on the basis of a demand curve that assumed the output volume to be constant, it would have been equal to $x^0(p^0-p^1)$, which underestimates the actual effect.

Below we will generalize this analysis to situations in which the 'rule of one half'(which is exact only for linear demand curves) is not used, in which there can be substitution between inputs and also to situations in which there are no constant returns to scale and prices may differ from marginal cost. For these situations we use a more general model of the firm that is outlined below.

The model of the firm

We consider a firm that produces a scalar output *y*. from a vector of inputs *x*; by means of a production function *F*:

$$y = F(x) \qquad \mathbf{4}$$

Profits *Z* are the difference between revenues and costs:

$$Z = ry - px. \qquad \mathbf{5}$$

where *r* is the unit price of the output and *p* input price. We assume from now on that the price of a single input, the *i*-th, changes because of the policy measure, whereas the price of all other inputs remain constant.

Profit maximization implies that the firm wants to minimize its costs *K*:

$$K = px \qquad \textbf{6}$$

for a given output volume y^* :

$$F(x) = y^* \qquad \textbf{7}$$

Demand functions for inputs, which are conditioned upon the output level, can be derived from this minimization problem. Substitution of these demand functions into the definition of costs in equation 6 leads to the cost function *K*(*p,y*), which gives total costs as a function of the input prices and output volume. Conventional demand functions can be derived from the cost function by means of Shephard's lemma:

$$x_i(p, y) = \frac{\partial K(p, y)}{\partial p_i} \qquad \textbf{8}$$

These demand functions describe movements along a single isoquant (determined by output volume *y*). This implies that they reflect the substitution between inputs that will take place as a result of the change in the price of input *i*.
It has been argued above that output volume cannot be taken to be constant for the analysis to be carried out in the present paper. The effect of the change in the price of input *i* on output price *r* is important: If the output price remains constant, there will be no be no change in consumer's surplus, but only an effect on the firm's profits. If the output price changes, there will also be a change in output volume and therefore also in the demand for input *i*. This change in demand is causally related to the change in the price of input *i* and is therefore part of its direct effect.
In order to derive the appropriate demand function for the present purposes, we should take into account that the firm's output y^F is a function of the input prices *p* because the price of the output is a function of the input prices. We write:

$$y^F = y^F(p) \qquad \textbf{9}$$

Equation 9 implies that, given the prices of all other inputs, there is one particular output level for any value of the price p_i. The demand function that takes this into account can be written as:

$$x_i(p, y^F(p)) = \frac{\partial K(p, y^F(p))}{\partial p_i} \qquad \textbf{10}$$

If the demand function given in eq. 7 is summed over the number of firms in the industry, we arrive at the demand function that is used in conventional CBA.
In the sections that follow, we will apply this model of the firm and its demand for outputs in various market structures.

3 Perfect competition

In this section we will consider the measurement of direct and indirect effects in the context of perfect competition and investigate the equality of both. Although it is

common sense among economists that under perfect competition there will be no indirect effects, a formal analysis of this question seems to be lacking.
Under perfect competition output price r is equal to the average cost k. The average costs function $k(y,p)$ can be derived from this total cost function K by taking its ratio with the output volume:

$$k(p,y) = \frac{K(p,y)}{y} \qquad \textbf{11}$$

and we have for the output price:

$$r = k(p,y) \qquad \textbf{12}$$

All firms produce the output volume y^{PC} at which unit costs are minimal:

$$y^{PC}(p) = \arg\min_{y}\{k(p,y)\} \qquad \textbf{13}$$

The volume at which unit costs are minimal may be dependent on the input prices. If we substitute the optimal output level into eq. 12 we arrive at a more specific relation between output price and input prices:

$$r = k(p, y^{PC}(p)) \qquad \textbf{14}$$

Total demand for the product of the industry is described by means of an aggregate demand function:

$$y = y(r) \qquad \textbf{15}$$

Total demand y should be equal to total output and the number of firms n can therefore be computed as:

$$n(p) = y / y^{PC} \qquad \textbf{16}$$

This equation does not guarantee that n is integer valued, but we ignore any complications that might be result from this approximation.
The cost function for the industry as a whole can be written as:

$$K^*(p,y) = y\, k(p, y^{PC}(p)) \qquad \textbf{17}$$

which shows that it operates under constant returns to scale (CRS). The market functions in such a way that the total costs K^* are minimized for a given output level we may derive the total demand for input i by using Shephard's lemma. Moreover taking into account the possible effects of a change in p_i on y^{PC} we write the demand function for input i that is used in CBA as:

$$x_i^{CBA}(p) = y(r(p)) \frac{\partial k(p, y^{PC}(p))}{\partial p_i} \qquad \textbf{18}$$

It should be noted that this demand function takes into account three possible effects of a change in the price of input *i* on its demand:
- a substitution effect
- an effect on the optimal output volume of a single firm y^{PC}
- an effect on the demand for the industry's output *y*.

The direct effect of the change in p_i is a change in the area under the demand function given in eq. 18 and above the prevailing price. This area will be denoted as the surplus *S* and we have:

$$S = \int_{p_i}^{\infty} x_i^{CBA}(z)dz \,. \qquad \textbf{19}$$

Consumer's surplus *CS* is defined as:

$$CS = \int_{r}^{\infty} y(z)dz \qquad \textbf{20}$$

There are no profits and therefore no producer's surplus. Social surplus is therefore equal to consumer's surplus.
The change in consumer's surplus that occurs because of the policy measure is:

$$\Delta CS = \int_{r^1}^{r^0} y(r)dr \qquad \textbf{21}$$

whereas the change in the surplus *S* is equal to:

$$\Delta S = \int_{p_i^1}^{p_i^0} x_i^{CBA}(p)dp_i \,. \qquad \textbf{22}$$

In order to establish the equality of both, we take three steps.
1) Since the price of the output is equal to its average cost, we can change the variable over which integration takes place from *r* to *k* and rewrite eq. 21 as:

$$\Delta CS = \int_{k^1}^{k^0} y(k)dk \qquad \textbf{23}$$

where k^0 denotes unit cost in the situation without the project and and k^1 in the situation in which the project is carried out.
2) The only reason for the change in the unit cost is the change in the price of input *i*. We change the variable over which the integration take place again, viz. from *k* to p_i:

$$\Delta CS = \int_{p_i^1}^{p_i^0} y(k(p_i)) \frac{\partial k(p, y^{PC}(p))}{\partial p_i} dp_i \qquad \textbf{24}$$

Note that we have taken into account that the optimal output volume of an individual firm and the output volume of the industry might change as a consequence of the change in p_i.
3) Next, we observe that average cost equals output price and compare eq. 24 with eq. 18.
In conclusion, we find that under perfect competition it is justified to measure indirect effects on consumers by means of direct effects on firms, since the latter are carried through to the consumers without any change. It should be noted that for this equality to hold, the appropriate demand function for input *i* should be used which incorporates not only the effects of substitution, but also the effect of a change in demand for the industry's output. The latter occurs as a result of a change in the industry's output price evoked by the change in p_i.

4 Monopoly
In this section we consider a monopoly situation and analyze the existence of AIE under these circumstances. If an AIE exist, it seems natural to look for it in a monopoly, since it is the opposite to perfect competition.
We use the same model for the individual firm as in the previous section, but now we assume that there is only one firm in the industry. This firm takes the demand function for its product as given and is able to determine its own price. It does so in order to maximize its profits, which are defined as:

$$Z = ry - px \qquad \textbf{25}$$

The maximization problem can be considered as consisting of two parts: minimization of the costs by a given output volume and determination of the optimal output volume. Cost minimization has already been considered above. Substitution of the firm's cost function into the definition of profits leads to the firm's profit function, which has the price *r* as the firm's only remaining decision variable:

$$Z = ry(r) - K(p, y) \qquad \textbf{26}$$

The first order condition for profit maximization is:

$$y + r\frac{\partial y}{\partial r} - \frac{\partial K}{\partial y}\frac{\partial y}{\partial r} = 0 \qquad \textbf{27}$$

which can be rewritten as::

$$\frac{r - mc}{r} = \frac{1}{e} \qquad \textbf{28}$$

where *mc* denotes marginal cost (*mc*=¶*K*/¶*y*) and *e* is the absolute value of the price elasticity of demand. Equation 28 give the familiar condition for profit maximization according to which the mark-up (expressed as a fraction of the price) should be equal to minus the inverse of the price elasticity of demand.
The sum of the changes in consumer's surplus and profits is the change in social surplus ΔSS:

$$\Delta SS = \Delta CS + \Delta Z \qquad \mathbf{29}$$

The change in consumer's surplus is defined in eq. 21, whereas the change in profits equals:

$$\begin{aligned}\Delta Z &= -\int_{p_i^1}^{p_i^0} \frac{\partial Z}{\partial p_i} dp_i \\ &= -\int_{p_i^1}^{p_i^0} y(r)\frac{dr}{dp_i} dp_i - \int_{p_i^1}^{p_i^0} (r - mc)\frac{\partial y}{\partial r}\frac{\partial r}{\partial p_i} dp_i + \int_{p_i^1}^{p_i^0} \frac{\partial K}{\partial p_i} dp_i\end{aligned} \qquad \mathbf{30}$$

where the second line makes use of eq. 26 and takes into account that the output price *r* depends on p_i, and also that output volume *y* is influenced by p_i. The change in output volume influences revenues as well as costs.

The first expression on the right-hand-side in the second line of eq. 30 is equal to minus the change in consumer's surplus. The change in social surplus is therefore equal to the sum of the second and third term:

$$\Delta SS = -\int_{p_i^1}^{p_i^0} (r - mc)\frac{\partial y}{\partial r}\frac{\partial r}{\partial p_i} dz + \int_{p_i^1}^{p_i^0} \frac{\partial K}{\partial p_i} dz \qquad \mathbf{31}$$

The first term on the right-hand-side of eq. 31 (including the minus-sign) is positive when the price exceeds marginal cost, since the demand curve is negatively sloped and the output price is an increasing function of the input price.[1] The second term is equal to ΔS:

$$\begin{aligned}\Delta S &= \int_{p_i^1}^{p_i^0} x_i^{KBA}(p, y(p)) dp_i \\ &= \int_{p_i^1}^{p_i^0} \frac{\partial K(p, y(p))}{\partial p_i} dp_i .\end{aligned} \qquad \mathbf{32}$$

The second line states that the change in *S* is equal to the integral in the partial derivative of the cost function with respect to p_i. It should be taken into account, when performing the integration, that the output volume at which the partial derivative is evaluated is itself a function of p_i.

We conclude therefore that the first term on the right hand side of eq. 31 is an AIE, i.e. an indirect effect that is not properly taken into account by the measurement of the direct effect.

$$AIE = -\int_{p_i^1}^{p_i^0} (r - mc)\frac{\partial y}{\partial r}\frac{\partial r}{\partial p_i} dp_i . \qquad \mathbf{33}$$

[1] This follows from the first order condition for profit maximization if marginal cost is increasing in the price of input *i*.

Since the *AIE* is positive, it follows that conventional CBA underestimates the true welfare effect of the change in price p_i. In other words, the common sense that it is sufficient to take into account direct effects is not valid if the industry is a monopoly. Below it will be shown that the size of the *AIE* can be determined with greater precision if we are willing to make additional assumptions.

Some special cases

We now consider some special cases:

- Linear demand function, CRS. We write down the demand function as:

$$y = A - ar \qquad \mathbf{34}$$

  Marginal cost is equal to average cost k, and a function of the prices of all inputs. The direct effect can be written as:

$$\begin{aligned}\Delta S &= \int_{p_i^1}^{p_i^0} \frac{\partial K}{\partial p_i} dp_i \\ &= \int_{p_i^1}^{p_i^0} y(r) \frac{\partial k}{\partial p_i} dp_i \\ &= \frac{1}{2} \int_{p_i^1}^{p_i^0} (A - ak(p)) \frac{\partial k}{\partial p_i} dp_i\end{aligned} \qquad \mathbf{35}$$

  where the second line makes use of the CRS, and the third of the facts that the demand function is linear and that the profit maximizing output price equals: $r=(A/a+k(p))/2$.
  The *AIE* can now be written as:

$$\begin{aligned}AIE &= -\int_{p_i^1}^{p_i^0} (r - mc) \frac{\partial y}{\partial r} \frac{\partial r}{\partial p_i} dp_i \\ &= \frac{1}{4} \int_{p_i^1}^{p_i^0} (A - ak(p)) \frac{\partial k}{\partial p_i} dp_i\end{aligned} \qquad \mathbf{36}$$

  where use is made of the expression for the profit maximizing price. Comparison of the direct effect with the additional indirect effect shows the latter to be equal to one half of the former: In this case the additional indirect effect is 50% of the direct effect.

- Linear demand function, linear cost function. We write the cost function as:

$$K(p, y) = F(p) + y\,v(p) \qquad \mathbf{37}$$

  where the fixed cost F is non-decreasing in input prices. We find for the direct effect (using eq. 35 and the linearity of the demand function):

$$\Delta S = \int_{p_i^1}^{p_i^0} \left(\frac{\partial F}{\partial p_i} + \frac{1}{2}(A - ak(p)) \frac{\partial v}{\partial p_i} \right) dp_i \qquad \textbf{38}$$

For the AIE, the expression given in eq. 36 remains valid, with *k*(*p*) replaced by *v*(*p*). We may therefore conclude that in this case the additional indirect effect is positive and at most equal to 50% of the direct effect.

- Loglinear demand function, linear cost function. We write the demand function as:

$$y = Ar^{-e}, \qquad \textbf{39}$$

the cost function is given in eq. 33. The direct effect is:

$$\Delta S = \int_{p_i^1}^{p_i^0} \left(\frac{\partial F}{\partial p_i} + y \frac{\partial v}{\partial p_i} \right) dp_i \qquad \textbf{40}$$

and the additional indirect effect equals:

$$\begin{aligned} AIE &= -\int_{p_i^1}^{p_i^0} (r - mc) \frac{\partial y}{\partial r} \frac{\partial r}{\partial p_i} dp_i \\ &= \frac{e}{e-1} \int_{p_i^1}^{p_i^0} y \frac{\partial v}{\partial p_i} dp_i . \end{aligned} \qquad \textbf{41}$$

where use has been made of the fact that the profit maximizing price equals (*e/*(*e*-1))*v*(*p*). In the special case in which fixed costs are independent of the price of input *i* the additional indirect effect equals *e /*(*e-1*) times the direct effect. The additional indirect effect is then always larger than (more than 100% of) the direct effect, and especially so if the elasticity of demand is just above 1.[2]

Effects on consumer's surplus

It is useful to pay special attention to the change in consumer's surplus that occurs as a consequence of the policy measure. Most politicians would be more interested in the effects of their policy on consumers than on the owners of the capital invested in firms. Moreover, it can be argued that a social welfare function would also give a larger weight to the utility of consumers than to that of capital owners, for instance because consumers have on average lower incomes than capital owners.

If there is a change in the price *r* it is a reaction to the change in p_i. The profit maximizing price is a function of all input prices. Since the price of the *i*-th input is the only one that changes, we can write *r* as a function of p_i:

$$r = f(p_i) \qquad \textbf{42}$$

and use this to rewrite eq. 21 as:

[2] In absolute value; note that monopoly pricing requires demand to be elastic.

$$\Delta CS = \int_{p_{1i}^1}^{p_i^0} y(p) f'(p_i) dp_i \ , \qquad \textbf{43}$$

In general there is no reason why $y(p_i)f'(p_i)$ should, in the present circumstances, be equal to x_i^{KBA} as is required for equality with the direct effect We can derive an expression for $f'(p_i)$ from the first order condition (eq. 27). Since this condition should be valid before and after the price change, the change in r, dr, should compensate exactly for the effects of the change in p_i, dp_i. This enables us to determine the differential ratio dr/dp_i which equals $f'(p_i)$:

$$f'(p_i) = \frac{\dfrac{\partial mc}{\partial p_i}}{2 - \dfrac{\partial mc}{\partial y}\dfrac{\partial y}{\partial r} + (r - mc)\dfrac{\partial^2 y}{\partial r^2} \Big/ \dfrac{\partial y}{\partial r}} \qquad \textbf{44}$$

Under perfect competition the numerator of the expression on the right hand side of the analogous equation was equal to $\partial k/\partial p_i$, the derivative of *average* cost to the price. In the absence of constant return to scale, there is in general no necessary relation between the derivatives of the average and marginal cost.

The denominator looks complicated. The slope of the demand curve is negative. The partial derivative of the marginal cost to output volume can be positive (decreasing returns to scale) as well as negative (increasing returns to scale). If we assume the demand function to be convex (as is often done), then $\partial^2 y/\partial r$ is positive. This implies that scale effects determine the sign of the second term in the denominator. The sign of the third term is negative, leaving the sign of the denominator as a whole undetermined.

If we are willing to make additional simplifying assumptions, the analysis gives more definite results:

- linear demand function, CRS. In this case the marginal costs are equal to the average costs and are the second and third terms in the denominator equal to 0. This allows us to simplify eq. 44 to:

$$f'(p_i) = \frac{\dfrac{\partial k}{\partial p_i}}{2}. \qquad \textbf{45}$$

  Substitution of this results in eq. 43 and comparison of the result with eq. 35 leads to the conclusion that the change in consumer's surplus is half as large as the change in the surplus under the demand function for input *i*.[3] The direct effect gives therefore an overestimate of the effect of the price change on consumer's surplus, whereas we saw earlier that it gives an underestimate of the total effect.
- linear demand function, linear cost function. The marginal costs are in this case equal to the variable cost $v(p)$, which is independent of production volume. Eq. 44 can now be written as:

[3] Output written as a function of the price is $y(p)=[A-ak(p)]/2$.

$$f'(p_i) = \frac{\frac{\partial v}{\partial p_i}}{2} \qquad \textbf{46}$$

Substitution in eq. 43, and comparison with eq. 38 leads to the conclusion that the change in consumer's surplus will in this case be at most one half of the change in surplus *DS*.

- Loglinear demand function, linear cost function. Since marginal cost is independent of p_i and the price elasticity is constant, we can write $f'(p_i)$ as:

$$f'(p_i) = \frac{\frac{\partial v}{\partial p_i}}{1 - 1/e} \qquad \textbf{47}$$

Where the linearity of the cost function has been used. Again, we substitute this result in eq. 43. We compare the result with eq. 40. If the fixed cost is independent of the price of input *i* ($\partial F/\partial p_i=0$), then $f'(p_i)$ the change in consumer's surplus is larger than the change in the surplus measured under the demand curve for input *i*. If the fixed cost depends on input price p_i it may be smaller.

Discussion

The analysis of this section has shown that under monopoly the indirect effects of a policy measure that lowers the price of an input are always larger than the direct effects. Such an industry generates a positive AIE that may be large in comparison to the direct effect. Two remarks are in order.

First, it is well known that it welfare increases when a monopolist is subsidized. This 'paradoxical result' (Tirole, 1988, p. 68) is related to the analysis of this section. If a policy measure results in a lower input price for the monopolist, it has a similar effect as a subsidy.

Second, from our discussion of special cases it appears that the size of the AIE depends on the details of the specific model at hand. In particular, the use of a linear or a loglinear demand curve makes a lot of difference. In combination with CRS, the former leads to an AIE that is 50% of the direct effect, the later to an AIE that is at least 100% of the direct effect. In order to measure the size of the AIE correctly, it seems to be of crucial importance to know not only how the level of demand changes with the price (i.e. the slope of the demand curve), but also how the price elasticity changes with the price (i.e. the second order derivative of the demand curve). In practice it may not be easy to get the relevant information.

5 Monopolistic competition

In this section we will investigate the existence of *AIE*'s on markets with monopolistic competition. In recent years models that describe markets with differentiated products by means of Nash equilibria have been used intensively in theoretical and empirical research. An important reason for this is the opinion that actual markets are neither perfectly competitive, nor perfectly monopolistic. It seems therefore of importance to investigate the possible existence and size of *AIE*'s on such markets. The present section does so for two popular models: the Dixit Stiglitz model and the logit model.

Results of the previous section, and the fact that in monopolisitc competition all firms have some market power lead to the conjecture that *AIE*'s will be detected.

The Dixit-Stiglitz model with a given number of firms
Dixit and Stiglitz (1977) model the demand for a differentiated product by means of a representative consumer. We specify the utility of this consumer as:[4]

$$U = y_0^a \left(\sum_{j=1}^{n} y_j^r \right)^{1/r} \qquad \textbf{48}$$

where a and r should be positive, moreover r should be smaller than 1.
In this equation $y_1 \ldots y_n$ denote the quantities consumed of the n varieties of the differentiated product, and y_0 that of another, composite consumption good. Utility is maximized under a budget restriction:

$$y_0 + \sum_{j=1}^{n} r_j y_j = X \qquad \textbf{49}$$

The demand functions that result from this problem are:

$$y_j = \frac{r_j^{1/(r-1)}}{\sum_k r_k^{r/(r-1)}} \frac{X}{1+a} \qquad \textbf{50}$$

All firms have an identical linear cost function as given by eq. 37 above:

$$K_j(y_j, p) = F(p) + y_j v(p) \qquad \textbf{51}$$

and maximize their profits:

$$Z_j = r_j y_j - K_j(y_j, p) \qquad \textbf{52}$$

by setting their price and producing the corresponding market demand. Dixit and Stiglitz assume that firms take the denominator of the first term of demand function in eq. 50 as given. The price set by such firms can be derived as:

$$r_j = \frac{v(p)}{r} \qquad \textbf{53}$$

Since the cost and demand functions and the behavior of all firms are identical, they will all set the same price r and produce the same output volume y. This output volume can be determined as $y = X/(1+a)nr$. Using these results, we find that profits are equal to:

[4] Dixit and Stiglitz consider two generalizations of this utility function.

$$Z = \frac{X}{1+a}\frac{1}{n}(1-r) - F \qquad \mathbf{54}$$

and therefore independent of the marginal cost $v(p)$.
Since the utility function of eq. 48 is homothetic, the sum of the consumer's surpluses provides a correct welfare measure as long as income does not change (Chipman and Moore, 1980).[5] The change in consumer's surplus that is the result of the change in the price of input i is:

$$\begin{aligned}\Delta CS &= n\int_{r_i^1}^{r_i^0} y(r)dr \\ &= n\int \frac{1}{nr}\frac{X}{1+a}dr \\ &= \frac{X}{1+a}\int \frac{1}{r}dr \\ &= \frac{X}{1+a}\int \frac{1}{v(p)}\frac{\partial v}{\partial p_i}dp_i\end{aligned} \qquad \mathbf{55}$$

Our welfare measure is the change in social surplus SS which is again defined as the sum of the changes in consumer's surplus and profits. Using equations 55 and 54, we can write:

$$\begin{aligned}\Delta SS &= \Delta CS + n\Delta Z \\ &= \frac{X}{1+a}\int_{p_i^1}^{p_i^0} \frac{1}{v(p)}\frac{\partial v}{\partial p_i}dp_i + n\int_{p_i^1}^{p_i^0}\frac{\partial F}{\partial p_i}dp_i\end{aligned} \qquad \mathbf{56}$$

This gives the correct expression for the benefits associated with a change in the price of input i in the present circumstances.
The direct effects of the change in the input price can be measured in the same way as was done in the previous sections, viz. as the change in the area under the demand curve for input i:

$$\begin{aligned}\Delta S &= n\int_{p_i^1}^{p_i^0}\frac{\partial K}{\partial p_i}dp_i \\ &= n\int_{p_i^1}^{p_i^0}\left(\frac{\partial F}{\partial p_i} + y_j\frac{\partial v}{\partial p_i}\right)dp_i \\ &= n\int_{p_i^1}^{p_i^0}\frac{\partial F}{\partial p_i}dp_i + \frac{X}{1+a}\ r\int_{p_i^1}^{p_i^0}\frac{1}{v(p)}\frac{\partial v}{\partial p_i}dp_i.\end{aligned} \qquad \mathbf{57}$$

---

[5] However, it should be noted that in te change in consumer's surplus is not equal to the compensating variation CV). The two are related as follows: CV/X=1-exp(-ΔCS/X) (see Chipman and Moore, 1980, p.945), This implies that different results with respect to the AIE will be reached if the CV is used.

The difference between the social surplus and the direct effect is therefore equal to:

$$\begin{aligned} AIE &= \Delta SS - \Delta S \\ &= (1-r)\frac{X}{1+a}\int_{p_i^1}^{p_i^0}\frac{1}{v(p)}\frac{\partial v}{\partial p_i}dp_i \end{aligned} \qquad \textbf{58}$$

This shows that there will always be a positive *AIE*. If the fixed cost is independent of the price of input *i* the *AIE* will be a fraction $(1-r)/r$ of the direct effect, which may vary from 0 to infinity and will be larger than 1 if $r<.5$.
In order to interpret this result, we note that r is inversely related to the 'preference for diversity' of the representative consumer. A strong preference for diversity leads to a relatively large monopoly power for the individual firms (cf. eq. 53) and this makes the industry with monopolistic competition more or less equal to the monopoly studied in the previous section.

Dixit-Stiglitz model with free entry
Now we assume that the number of firms, which we treat as a real number, adjusts so as to keep profits equal to zero. It is not hard to derive from eq. 54 that the number of firms will in this case be equal to:

$$n = (1-r)\frac{X}{1+a}\frac{1}{F} \qquad \textbf{59}$$

From this equation it is clear that the number of firms will only change if fixed cost *F* depends on the price of output *i*. If the number of firms changes, we should take the total consumer's surplus generated by the additional firms as part of the welfare change. This surplus must be evaluated at the prices in the situation with the policy measure (i.e. situation 1). Assume that one product, the *k*-th is added to the existing *n* ones. The consumer surplus *CS** generated by the new product is:

$$\begin{aligned} CS^* &= \int_{r_k^1}^{\infty}\frac{X}{1+a}\frac{r_k^{1/(r-1)}}{\sum_{j=1}^{n} r_j^{r/(r-1)} + r_k^{r/(r-1)}}dr_k \\ &= \frac{X}{1+a}\left(\frac{r-1}{r}\right)\left[\ln\left(\sum_{j=1}^{n} r_j^{r/(r-1)} + r_k^{r/(r-1)}\right)\right]_{r_k^1}^{\infty} \\ &= \frac{X}{1+a}\left(\frac{1-r}{r}\right)\left(\ln\left(\sum_{j=1}^{n} r_j^{r/(r-1)} + r_k^{r/(r-1)}\right) - \ln\left(\sum_{j=1}^{n} r_j^{r/(r-1)}\right)\right) \end{aligned} \qquad \textbf{60}$$

where all prices in the third line should be evaluated in situation 1.
Taking into account that all firms charge the same price for their product leads to the following simplification:

$$CS^* = \frac{X}{1+a}\ln\left(\frac{n+1}{n}\right) \qquad \textbf{61}$$

We generalize this formula to the case in which the number of firms changes from n^0 to n^1 as:

$$CS^* = \frac{X}{1+a}\ln\left(\frac{n^1}{n^0}\right) \qquad \textbf{61'}$$

and make use of eq. 59 in order to rewrite this as:

$$\begin{aligned} CS^* &= \frac{X}{1+a}\left(\ln F(p^0)) - \ln(F(p^1)\right) \\ &= \frac{X}{1+a}\int_{p_i^1}^{p_i^0}\frac{1}{F(p)}\frac{\partial F(p)}{\partial p_i}dp_i. \end{aligned} \qquad \textbf{62}$$

This should be added to the consumer surplus as derived in eq. 55. The total change in consumer surplus thus becomes:

$$\Delta CS = \frac{X}{1+a}\int_{p_i^1}^{p_i^0}\left(\frac{1}{v(p)}\frac{\partial v}{\partial p_i} + \frac{1}{F(p)}\frac{\partial F(p)}{\partial p_i}\right)dp_i. \qquad \textbf{63}$$

For the change in the area under the demand curve for input *i* we find:

$$\begin{aligned} \Delta S &= \int_{p_i^1}^{p_i^0} n\frac{\partial K}{\partial p_i}dp_i \\ &= \int n\left(y\frac{\partial v}{\partial p_i} + \frac{\partial F}{\partial p_i}\right)dp_i \\ &= \int n\left(\frac{X}{1+a}\frac{1}{nr}\frac{\partial v}{\partial p_i} + \frac{\partial F}{\partial p_i}\right)dp_i \\ &= \int\left(\frac{X}{1+a}\frac{1}{r}\frac{\partial v}{\partial p_i} + n\frac{\partial F}{\partial p_i}\right)dp_i \\ &= \int\left(\frac{X}{1+a}\frac{r}{v(p)}\frac{\partial v}{\partial p_i} + (1-r)\frac{X}{1+a}\frac{1}{F(p)}\frac{\partial F}{\partial p_i}\right)dp_i \\ &= \frac{X}{1+a}\int\left(r\frac{1}{v(p)}\frac{\partial v}{\partial p_i} + (1-r)\frac{1}{F(p)}\frac{\partial F(p)}{\partial p_i}\right)dp_i \end{aligned} \qquad \textbf{64}$$

The AIE is therefore equal to:

$$AIE = \Delta CS - \Delta S$$

$$= (1-r)\frac{X}{1+a}\int_{p_i^1}^{p_i^0}\frac{1}{v(p)}\frac{\partial v}{\partial p_i}dp_i + r\int_{p_i^1}^{p_i^0}\frac{1}{F(p)}\frac{\partial F(p)}{\partial p_i}dp_i \qquad \textbf{65}$$

Comparison with eq. 58 shows that an additional term is added, which represents the effect of entry. This term is different from zero only if the fixed cost depends on the price of input *i*. This implies that there will be no (nonzero) additional term under CRS.

We conclude that the direct effect underestimates the indirect welfare effects of the policy measure. Only a fraction r of he effect that occurs via the change in the variable cost is measured and only a fraction (1-r) of the effect that occurs via the change in the fixed cost. Note that the former effect is measured correctly by the direct effect if the preference for diversity is small (r close to 1)

The logit model with a given number of firms

We will now consider the logit model as an alternative model for product differentiation. McFadden (1981) developed a representative consumer theory for the logit model and Anderson, de Palma and Thisse (1992, and earlier papers referred to in this book) used the model in order to study an industry with differentiated products. The indirect utility function of the representative consumer is:

$$\begin{aligned} V &= \ln\left(\sum_{j=1}^{n}\exp\left(\frac{X-p_j}{m}\right)\right) \\ &= \frac{X}{m} + \ln\left(\sum_j \exp\left(-\frac{p_j}{m}\right)\right) \end{aligned} \qquad \textbf{66}$$

The representative consumer buys one unit of the product per period and the size of the market is equal to *N*. The probability that variety *k* will be chosen is:

$$p_j = \frac{e^{-p_j/m}}{\sum_k e^{-p_k/m}} \qquad \textbf{67}$$

The expected demand for the product *j* is therefore equal to Np_j. We treat the p_j's as (deterministic) market shares.

We assume that all firms have identical linear cost functions, as in the Dixit-Stiglitz model. Profits of firm *j* are equal to:

$$Z_j = Np_j\left(r_j - v(p)\right) - F(p) \qquad \textbf{68}$$

where we have used the now familiar assumption that all firms have identical linear cost functions. The first-order condition for profit maximization leads to the following expression for the optimal price:

$$r_j = v(p) + \frac{m}{1 - p_j} \qquad \textbf{69}$$

Since all firms have identical demand and cost functions, they all set the same prices and their market shares will be equal to 1/*n*.
Substitution of the profit-maximizing price in the profit function leads to the following expression:

$$Z = N\frac{m}{n-1} - F(p) \qquad \textbf{70}$$

Note that, as in the Dixit-Stiglitz model, profits are independent of the variable cost *v*. The change in profits that results form a change in input price *i* is:

$$\Delta Z = \int_{p_i^0}^{p_i^1} \frac{\partial F}{\partial p_i} dp_i. \qquad \textbf{71}$$

Substitution of the profit maximizing prices in the utility function leads to the following expression for the utility of the representative consumer:

$$V = \frac{X}{m} + \ln(n) - \left(\frac{n}{n-1} + \frac{v(p)}{m}\right) \qquad \textbf{72}$$

This expression can be used to derive the compensating variation of a change in the price of input *i* as:

$$CV = \int_{p_i^1}^{p_i^0} \frac{\partial v}{\partial p_i} dp_i. \qquad \textbf{73}$$

Chipman and More (1976, 1980) have shown that for the indirect utility function of eq. 66 compensating variation is exactly equal to the sum of the consumer surpluses.[6]
The change in social surplus is equal to *N* times the compensating variation plus *n* times the change in profits:

$$\Delta SS = N\int_{p_i^1}^{p_i^0} \frac{\partial v}{\partial p_i} dp_i + n\int_{p_i^1}^{p_i^0} \frac{\partial F}{\partial p_i} dp_i. \qquad \textbf{74}$$

The change in the area under the demand curve for input *i* equals:

[6] As long as we measure all prices relative to those of a numeraire outside consumption good whose price is kept constant.

$$
\begin{aligned}
\Delta S &= n\int_{p_i^1}^{p_i^0} \frac{\partial K}{\partial p_i} \\
&= n\int\left(y\frac{\partial v}{\partial p_i} + \frac{\partial F}{\partial p_i}\right) dp_i \\
&= n\int\left(\frac{N}{n}\frac{\partial v}{\partial p_i} + \frac{\partial F}{\partial p_i}\right) dp_i \\
&= \Delta SS.
\end{aligned}
\qquad \mathbf{75}
$$

We conclude therefore that in this case the indirect effect is correctly measured by the direct effect.

The logit model with free entry

With free entry, profits are equal to zero, and this allows us to determine the number of firms from eq. 70 as:

$$
n = \frac{Nm}{F} + 1 \qquad \mathbf{76}
$$

Note that, just as in the Dixit-Stiglitz model, the variable (marginal) cost does not appear in this expression.

It follows from eq. 69 that prices will be equal to:

$$
\begin{aligned}
r &= v(p) + m\left(\frac{Nm}{F(p)} + 1 \right) \Big/ \frac{Nm}{F(p)} \\
&= v(p) + m\left(\frac{F(p)}{Nm} + 1 \right)
\end{aligned}
\qquad \mathbf{74}
$$

and from eq. 72 that the utility of the representative consumer is:

$$
V = \frac{X}{m} + \ln\left(\frac{Nm}{F(p)} + 1 \right) - \left(1 + \frac{F(p)}{Nm} + \frac{v(p)}{m} \right). \qquad \mathbf{75}
$$

Since profits are equal to zero, the change in social surplus equals *N* times the compensating variation of the representative consumer:

$$\Delta SS = -Nm \int_{p_i^1}^{p_i^0} \frac{\partial V}{\partial p_i} dp_i$$

$$= N \int \frac{\partial v}{\partial p_i} dp_i + N \int \left(\frac{1}{\frac{Nm}{F(p)} + 1} \frac{Nm^2}{F(p)^2} + \frac{1}{N} \right) \frac{\partial F}{\partial p_i} dp_i \qquad \textbf{76}$$

$$= N \int \frac{\partial v}{\partial p_i} dp_i + N \int \left(\frac{Nm}{Nm + F(p)} \frac{m}{F(p)} + \frac{1}{N} \right) \frac{\partial F}{\partial p_i} dp_i$$

The change in the area under the demand curve for input *i* can be computed as follows:

$$\Delta S = \int_{p_i^1}^{p_i^0} n \frac{\partial K}{\partial p_i} dp_i$$

$$= \int n \left(y \frac{\partial v}{\partial p_i} + \frac{\partial F}{\partial p_i} \right) dp_i$$

$$= \int n \left(\frac{N}{n} \frac{\partial v}{\partial p_i} + \frac{\partial F}{\partial p_i} \right) dp_i \qquad \textbf{77}$$

$$= \int \left(N \frac{\partial v}{\partial p_i} + \left(\frac{Nm}{F(p)} + 1 \right) \frac{\partial F}{\partial p_i} \right) dp_i$$

$$= N \int \frac{\partial v}{\partial p_i} dp_i + N \int \left(\frac{m}{F(p)} + \frac{1}{N} \right) \frac{\partial F}{\partial p_i} dp_i .$$

Comparison of eqs. 77 and 76 allows us to determine the AIE as:

$$AIE = \Delta SS - \Delta S$$

$$= \int_{p_i^1}^{p_i^0} \left(-\frac{F(p)}{Nm + F(p)} \right) \frac{\partial F}{\partial p_i} dp_i \qquad \textbf{78}$$

The most surprising aspect of eq. 78 is its sign: the additional indirect effect turns out to be negative in this case. The direct effect overestimates the benefits of the project. The bias in the direct effect is small if the preference for diversity (measured by m), and/or the size of the market is large, and if the fixed cost is small, which implies that the industry operates close to CRS. The bias is of course absent if fixed costs are independent of the price of input *i*.

Discussion

In this section we analyzed the additional indirect effects that result when a decrease in the price of an input reaches the consumers and capital owners via an industry that is imperfectly competitive. We used two models that are widely used in theoretical

analyses of markets with differentiated products, the Dixit-Stiglitz model and the logit model.
Perhaps the most striking result from the analysis is that the results with respect to existence and size of AIE’s are so different for these two types of models. There are many similarities between the two models (see Anderson, de Palma and Thisse, 1992, for a discussion) and one would therefore expect that both would lead to similar conclusions with respect to AIE’s. However, this is not the case. In our analysis of a monopoly situation we found that the details of the demand specification were important for the conclusions. This is confirmed by the results of the present section, which uses models in which the cost functions are identical and only the demand specifications differ.
A second result is that our expectation that markets with monopolistic competition would lead to results that are somewhere in between those for monopoly and perfect competition was equally invalid. For the logit model with free entry, a negative AIE was found, implying that conventional CBA would overestimate the welfare effects of the policy measure.
One may argue that the simple models used here are not appropriate for the task at hand in real world situations. The logit model tends to provide an overestimate the importance of new products because of the ‘red bus, blue bus’ phenomenon. For instance, Hausman (1997) has argued that the logit model, because of its IIA property, ‘typically leads to a vast overestimate of the consumer’s surplus from a new good’ (p. 230). He prefers the CES model, that is part of the Dixit-Stiglitz model. Also for that model he concludes that the effect of new goods is estimated as an unrealistically large value. However, for the purposes of the present paper, the important fact is that the Dixit-Stiglitz and logit models are two of the most popular ones for studying monopolisitc competition. We have no reason for assuming that the direct effect as measured by the increase in the area under the demand curve does a better job in estimating the ‘true’ effect of the introduction of new goods in other models of monopolistic competition. In the analytical setting used above the true (indirect) effects are given by determined by the CES- and logit-specifications and we found that they cannot be properly measured by the direct effect. The basic problem therefore seems to be that there is no systematic relationship between the size of the direct effect and that of the indirect effect in situations with monopolistic competition. If true, this inplies that there isno guarantee that the measurement of direct effects will give better results under less stylized conditions that make it harder to determine the true indirect effects based on the correct model.

6 Conclusion

Apart from the case of perfect competition there is no reason to assume that the direct effects are a correct or even a reasonably good proxy for the indirect effects. The conventional approach in CBA to measure indirect effects by means of direct effects can only be justified on the basis of the assumption that the economy is perfectly competitive. The analysis of the present paper suggests that even ‘minor’ discrepancies from perfect competition as occur under monopolistic competition are able to cause substantial *AIE*’s that may be positive as well as negative. In the situation of a monopoly, the direct effect always underestimates the indirect effect by a fraction that depends crucially in the details of the specification of the demand function.
The analysis offered in the previous sections shows that *AIE*’s will in general exist, may be substantial and that their sign and size depends crucially on the details of the

situation. The conventional shortcut provided by the measurement of indirect effects as if they were direct effects can only be justified on the basis of an unrealistic assumption.

The implication of this conclusion is, of course, that CBA becomes much more complicated and requires a study of the way the effects of policy measures pass through the economy to the consumers, even if one is willing to undertake a partial equilibrium analysis only. Often this would require knowledge of the functioning of markets with imperfect competition. In recent years the modeling of such markets, for instance those for automobiles and ready-to-eat cereals, has received a lot of interest (see Berry, Levinsohn and Pakes, 1995, Nevo, 2001) and substantial progress has been made.

A possible argument against the incorporation *AIE*'s in CBA is that they are only the result of market imperfections, which should be cured preferably by other means than policy measures intended to reach other goals. Inclusion of positive *AIE*'s that are the result of such market imperfections could possibly diminish the incentive to treat these imperfections by other means. However, it must be noted that the *AIE*'s are as real as the imperfectly competitive industries that generate them and as long as the latter exist, it is hard to see why the former should be ignored. One might argue as well that the existence of imperfectly competitive industries shows that (additional) intervention to increase competitiveness would be unjustified from a policy making perspective. Their presence and its consequences, including the existence of possibly substantial *AIE*'s should therefore be taken as a fact of life that has to be dealt with appropriately instead of being ignored.

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