# Shipping the Good Apples Out: A New Perspective

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**Abstract**

The Alchian and Allen substitution theorem posits that a per unit tax or shipping fee applied to similar goods will increase the *relative consumption* of the higher quality good. The usual explanation is that consumers substitute out of "bad apples" and into "good apples." This paper generalizes the Alchian and Allen result in an $n$-good world and provides an alternative explanation that is more cogent in situations where the two goods (for example \$500 and \$5 wines) are not close substitutes.

## 1 Introduction

The Alchian and Allen substitution theorem posits that a per unit tax or shipping fee applied to similar goods will increase the *relative consumption* of the higher quality good. Originally formulated in Alchian and Allen's

1964 textbook *University Economics*, the theorem is often called the "Shipping the Good Apples Out" theorem because of the empirical observation that supermarkets in apple-importing areas such as Indiana have a higher proportion of high quality apples (relative to low quality apples) than supermarkets in apple-growing areas such as Washington State. A Washington resident on holiday in Indiana might well conclude that the good apples are getting "shipped out."

The theoretical basis for the Alchian and Allen result was questioned by Gould and Segall (1969), who demonstrate that the result holds unequivocally only in a two-good world. Borcherding and Silberberg (1978) defend the Alchian and Allen result in an $n$-good world, but only when the two taxed goods are close substitutes. This special case appears to be all that can be salvaged in terms of theory.[1]

The purpose of this paper is to reinterpret the Alchian and Allen result in an $n$-good world. This reinterpretation shows that their result holds more broadly than suggested by Borcherding and Silberberg, and indeed more broadly than (though not as robustly as) originally claimed by Alchian and Allen.

[1] For further discussion, see Umbeck (1980).

## 2 Background

Consider a world with $n$ goods, $x_1, x_2, \ldots, x_n$, the first two of which can be thought of as, respectively, the high quality and standard quality versions of some product (e.g., good apples and bad apples). By assumption, then, $p_1 > p_2 > 0$. Following Borcherding and Silberberg, we phrase the Alchian and Allen thesis as $\frac{\partial\left(\frac{x_1}{x_2}\right)}{\partial t} > 0$, where $x_1(p_1, p_2, \ldots, U)$ and $x_2(p_1, p_2, \ldots, U)$ are Hicksian (income-compensated) demand functions[2] and $t$ is a per unit charge applied to both goods. The chain rule gives us $\frac{\partial x_i}{\partial t} = \frac{\partial x_i}{\partial p_1} + \frac{\partial x_i}{\partial p_2}$, and combining this with the quotient rule we get

$$\frac{\partial\left(\frac{x_1}{x_2}\right)}{\partial t} = \left(\frac{1}{x_2^2}\right)\left[x_2\left(\frac{\partial x_1}{\partial p_1} + \frac{\partial x_1}{\partial p_2}\right) - x_1\left(\frac{\partial x_2}{\partial p_1} + \frac{\partial x_2}{\partial p_2}\right)\right].$$

Substituting in the compensated elasticities, $\varepsilon_{ij} = \frac{p_j}{x_i} \cdot \frac{\partial x_i}{\partial p_j}$, we arrive at $\frac{\partial\left(\frac{x_1}{x_2}\right)}{\partial t} = \left(\frac{x_1}{x_2}\right)\left(\frac{\varepsilon_{11}}{p_1} + \frac{\varepsilon_{12}}{p_2} - \frac{\varepsilon_{21}}{p_1} - \frac{\varepsilon_{22}}{p_2}\right)$. The first term here is always positive, so we will focus our attention on the second term,

$$\frac{\varepsilon_{11}}{p_1} + \frac{\varepsilon_{12}}{p_2} - \frac{\varepsilon_{21}}{p_1} - \frac{\varepsilon_{22}}{p_2}. \tag{1}$$

The Alchian and Allen claim is that (1) is positive.

[2]The use of Hicksian demand curves is explained in Gould and Segall (1969).

# 3 A Two-Good World

With only two goods, Hicks's (1946, pages 310-311) third law

$$\sum_j \varepsilon_{ij} = 0$$

reduces to $\varepsilon_{ij} = -\varepsilon_{ii}$ and we can substitute for $\varepsilon_{11}$ and $\varepsilon_{21}$ in (1) to get

$$(\varepsilon_{12} - \varepsilon_{22}) \left( \frac{1}{p_2} - \frac{1}{p_1} \right). \tag{2}$$

The first term here is positive because the two goods in a two-good world must be substitutes ($\varepsilon_{12} > 0$) and own-price elasticities are negative ($\varepsilon_{22} < 0$). The second term is positive from the assumption that good apples are more expensive than bad apples ($p_1 > p_2 > 0$). We therefore get the Alchian and Allen result: $\dfrac{\partial \left( \frac{x_1}{x_2} \right)}{\partial t} > 0$. The intuitively compelling story is that consumers are substituting out of bad apples and into good apples.

# 4 An $n$-Good World

With $n$ goods, using Hicks's third law to substitute for $\varepsilon_{11}$ and $\varepsilon_{21}$ in (1) yields

$$\frac{\varepsilon_{11}}{p_1} + \frac{\varepsilon_{12}}{p_2} - \frac{\varepsilon_{21}}{p_1} - \frac{\varepsilon_{22}}{p_2} = \frac{-\sum\limits_{j \neq 1} \varepsilon_{1j}}{p_1} + \frac{\varepsilon_{12}}{p_2} - \frac{-\sum\limits_{j \neq 1} \varepsilon_{2j}}{p_1} - \frac{\varepsilon_{22}}{p_2},$$

which we can rewrite as

$$(\varepsilon_{12} - \varepsilon_{22}) \left( \frac{1}{p_2} - \frac{1}{p_1} \right) + \frac{1}{p_1} \sum_{j \geq 3} (\varepsilon_{2j} - \varepsilon_{1j}) \,. \tag{3}$$

The two terms in equation 3, which we will call (3a) and (3b), identify the key factors underlying the Alchian and Allen result in an $n$-good world.

Let us begin by comparing the result in the $n$-good world (3) with that in the two-good world (2). The only mathematical difference is the addition of (3b), so ignoring this term appears to bring the $n$-good result in line with that for two goods. However, there is an important difference between (2) and (3a). In a two-good world, the two goods are forced to be substitutes, so we necessarily have $\varepsilon_{12} > 0$ and can conclude that (2) is positive.

In an $n$-good world, the two taxed goods do not have to be substitutes, and we can see that *substitutability is a sufficient condition for (3a) to be positive, but it is not a necessary condition.* The necessary condition is $\varepsilon_{12} > \varepsilon_{22}$, which requires only that the two goods not be close complements. Provided that this (not particularly onerous) condition is met, the Alchian and Allen result will hold as long as (3b) is either positive or small in magnitude compared to (3a).

Previous research has focused on substitutability between goods $x_1$ and $x_2$ in order to show that (3b) is smaller in magnitude than (3a). For example, Borcherding and Silberberg (1978) argue that two goods that are very close substitutes for each other must necessarily be evenly matched in terms of substitutability with other goods. In this case, each term in (3b) will be close to zero and therefore (3b) will be dominated by (3a). Intuitively, the assumption of close substitutability between goods 1 and 2 returns us to a two-good world: other goods don't matter, and consumers are substituting out of bad apples and into good apples.

But there is another possibility: returning to (3), we can see that (3b) will be close to zero if $p_1$ is large relative to $p_2$. There is therefore a (previously unexplored) set of sufficient conditions for the Alchian and Allen result: *if two goods are not close complements (or, more specifically, if $\varepsilon_{12} > \varepsilon_{22}$) and are not close in price ($p_1 \gg p_2$), then the imposition of a per unit charge will increase the relative consumption of the higher priced good, i.e., the higher priced good will be "shipped out."*

# 5 Intuition and Applications

The intuition behind this result is simply that the imposition of a per unit charge $t$ has a different *percentage* impact on goods with different prices: the lower the price of the good, the greater the incentive to purchase substitutes. *It does not matter what those substitutes are*: the "shipping out" of good apples might well occur because consumers substitute out of good and bad apples and into (respectively) good oranges and bad pears. The Alchian and Allen result arises because the relative price changes that lead to those substitutions are more pronounced for cheaper products.[3]

For a numerical example, consider the Alchian and Allen prediction that the consumption of good ($500/bottle) French wine relative to bad ($5/bottle) French wine will be higher in the United States than in France because of transportation costs. It is difficult to argue (à la Borcherding and Silberberg) that these goods are close substitutes, and the idea that consumers substitute out of $5 wine and into $500 wine defies belief. A more palatable explanation is that transportation costs induce American consumers to substitute out of good and bad French wines and into (respectively) good and bad California wines.

[3]As in Alchian and Allen's original discussion, it is *relative* price changes that matter. To see this mathematically, consider some good $x$ (e.g., apples), the unit price of which is $q$ units of some substitute $y$ (e.g., pears), so that $p_x = qp_y$. If a tax $t$ is applied to good $x$, its unit price rises to $q\left(1+\frac{t}{p_x}\right)$ units of $y$. The magnitude of this relative price change varies inversely with $p_x$.

To continue the numerical example, assume that California wines are produced at the same cost as French wines ($500 for good wine, $5 for bad) and that trans-Atlantic shipping costs are $10 per bottle. In the United States, then, one bottle of bad French wine costs three bottles of bad California wine; one bottle of good French wine costs only 1.02 bottles of good California wine. It is the substitution out of French wines and into California wines, and not the substitution out of bad French wines and into good French wines, that produces the Alchian and Allen result.

For another application, consider the tricky problem of "shipping the good tourists out," i.e. problems in which the *customer* is transported to the *good* rather than the good to the customer. As noted by Cowen and Tabarrok (1995), good $x_1$ in this situation could be a week-long trip to "live the good life" somewhere else (say, in Maine); good $x_2$ could be a week-long trip to "live the mediocre life" in Maine; and the charge $t$ could be the airfare or other fixed cost of getting to Maine.

The Alchian and Allen prediction here is that an increase in travel costs will increase the proportion of good-living vacations relative to mediocre-living vacations; or, as Borcherding and Silberberg (1978) put it, that "tourists in Maine will consume, on average, higher quality lobsters than natives. . . ."

Empirical support comes from Bertonazzi, Maloney, and McCormick (1993), who show that football fans who travel greater distances tend to buy higher quality tickets, and from Brown et al. (1999), who find that Americans vacationing in Africa go on relatively more high quality safaris than Europeans.

The standard explanation here is that tourists facing higher travel costs substitute out of low-quality trips and into high-quality trips. But "good-living vacations" and "mediocre-living vacations" are unlikely to be close substitutes for each other. The alternative explanation advanced in this paper is that the close substitutes for good and mediocre living in Maine are, respectively, good and mediocre living at home (or in some other vacation spot). When travel costs to Maine rise, some potential visitors substitute out of good living in Maine and into good living at home, and others substitute out of mediocre living in Maine and into mediocre living at home. The Alchian and Allen result—that the "good living" tourists get shipped out—arises because the substitution effect is stronger for the latter group.

# References

Alchian, Armen A., and William R. Allen. 1964. *University Economics.* Belmont, Calif.: Wadsworth.

Bertonazzi, Eric P., Michael T. Maloney, and Robert E. McCormick. 1993. "Some Evidence on the Alchian and Allen Theorem: The Third Law of Demand?" *Economic Inquiry* 31:383–93.

Borcherding, Thomas E., and Eugene Silberberg. 1978. "Shipping the Good Apples Out: The Alchian and Allen Theorem Reconsidered." *Journal of Political Economy* 86:131–38.

Brown, Gardner, Tim Swanson, Michael Ward, and Dominic Moran. 1999. "Optimally Pricing Game Parks in Kenya." Unpublished.

Cowen, Tyler, and Alexander Tabarrok. 1995. "Good Grapes and Bad Lobsters: Applying the Alchian and Allen Theorem." *Economic Inquiry* 33:253–56.

Gould, John P., and Joel Segall. 1969. "The Substitution Effects of Transportation Costs." *Journal of Political Economy* 77:130–37.

Hicks, J.R. 1946. *Value and Capital, 2nd ed.* Oxford: Oxford Univ. Press.

Umbeck, John. 1980. "Shipping the Good Apples Out: Some Ambiguities in the Interpretation of 'Fixed Charge'." *Journal of Political Economy* 88:199–208.