Demand and Supply Curves: Rotations versus Shifts

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"Pure economics has a remarkable way of producing rabbits out of a hat--apparently a priori propositions which apparently refer to reality. It is fascinating to try to discover how the rabbits got in, for those of us who do not believe in magic must be convinced that they got in somehow."

(John R. Hicks, Value and Capital, p.23)

I. Introduction

In keeping with Hicks' insight, we seek here to clarify the implicit assumptions that underlie the shifts in demand and supply curves as they are drawn in existing economics texts. The observations we make are fairly simple, although many teachers of economics may be unfamiliar with them: 1) If the demand relationship is assumed to be "constant elasticity" (the double logarithm specification), a change in a demand-shifting variable (e.g. income) will result in a rotation of the demand curve and not a parallel shift, while 2) If the demand relationship is assumed to be linear in its arguments, a change in a demand-shifting variable will result in a parallel shift in the demand curve. The clarification is of interest, in part, because virtually all graphs in principles, intermediate microeconomics, and other textbooks in the various field areas are drawn as parallel shifts, implicitly assuming a linear relation. A quick sample of a number of Intermediate Microeconomics texts confirms the potential for confusion--Pindyck and Rubinfeld, 2001; Perloff, 2001 (with the exception of his coverage of an ad valorem tax and a specific tax); Browning and Zupan, 1999; Landsburg, 1999; Salvatore, 1997 and Frank, 2000. Shifting the curves parallel is not, in itself, "wrong" but rather creates an impression in the student's mind that may lead to later confusion, as for example when the student thinks in terms of parallel shifts when employing a constant elasticity specification in an econometrics course. Beyond this, those
of us who teach regularly are likely to have students ask about why the various shifts "look" the way they do--is it always parallel or could it rotate? We suspect that many instructors will find themselves mumbling something like "anything can happen," rather than providing the easy response given here. The discussion here appears to "fall between the cracks" of the standard curriculum in the sense that, it is omitted from principles discussions as being (correctly, we feel) too advanced. But, in intermediate courses, supplementing the brief review of supply and demand material with material on the shapes and shifts of demand curves typically does not take place in the rush to get to price consumption paths, extension paths, calculus formalism, and the like. And, by the time future college teachers are in graduate school, the points made here will seem too pedestrian to get into the curriculum, despite the fact that most students are unaware of these observations. We are attempting, not to get these points formally incorporated into existing textbooks, but rather to familiarize those currently teaching economics with the implicit assumptions that underlie the various shifts.

II. Discussion

For simplicity all demand and supply curves are taken to be linear.\(^1\) At issue is how the curves move when a non-price variable changes its value. Virtually all principles and intermediate texts draw demand and supply curves as parallel shifts in such circumstances, which implicitly assumes that the demand relation is linear. But economists commonly speak of "the" income elasticity, as if it were constant (and not varying continuously as is the case with the linear specification). If the income elasticity is constant, then the demand curve must rotate when income changes. Consider Figure 1, which depicts an increase in demand, brought about by an increase in income (normal good), an increase in price of the substitute good, etc. If the income

\(^1\) Conclusions for the non-linear cases are essentially the same, being only a bit more complex; for example, the unitary elasticity demand curve has an "asymptotic rotation" in the face of an income increase.
elasticity or cross-price elasticity is any fixed number, say unity as in the familiar Cobb-Douglas utility function case, the demand curve rotates outward since the initial quantity--that is increases by some percentage--will be systematically larger at progressively lower prices.\(^2\)

The case of supply is slightly more subtle but is essentially the same. Figure 2 clarifies this case. As with demand, typical textbooks depict parallel or near-parallel shifts, which implicitly assumes linearity in the underlying relationship. Suppose, for example, that an important input into production falls in price. If the input price-output quantity elasticity is constant, \(S_1\) depicts the way in which the supply curve moves. Note that if only the undashed portion of the supply curves is drawn (the relevant portions above the minimum of the average variable cost curve) this movement may "look" like a non-parallel shift rather than the top portion of a rotation.\(^3\)

\(^2\) Note that it is certainly possible to have a pure shift without a rotation (e.g. the willingness-to-pay for any given quantity could rise by some amount as is the case for linear demand functions)-- but this does not happen when the exogenous variable has a constant elasticity.

\(^3\) Of course, all short-run supply curves would generally be drawn with curvature reflecting the law diminishing marginal product; but, as with demand, the central point is unaffected by this more realistic case.
III. Conclusion

The intent here is not to be critical of the way shifting demand and supply curves are drawn in existing books, but rather to let the careful student, and his or her teachers, know "how the rabbits got into the hat." Many teachers of economics are facile with much more sophisticated mathematics than present in our discussion; however, many of them have never thought much about the specific assumptions implicitly underlying demand and supply shifts, because such a discussion "fell between the cracks" of the various economics courses to which they were exposed.
REFERENCES


Figure 1. Demand rotation due to change in a non-price variable with constant elasticity

Figure 2. Supply rotation due to a change in a non-price variable with constant elasticity