What Economics Majors and Economists Should Know About the Supply and Demand Model-Part 1: A Static and Qualitative Model.1-2-18

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FIRST DRAFT.
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I would value feedback on this draft.

I wish to thank Lorretta Palagi and Janna Marie Kilburn for their excellent copyediting of an earlier version of this draft, Calyn McCleod for skillfully re-drawing the diagrams, Krista Steuben for checking my math, and Ian Sleeman for his IT skills. They are not responsible for any remaining errors or infelicities.

What Economics Majors and Economists Should Know About the Supply and Demand Model: 1 A Static and Qualitative Model.

"Catch a parrot and teach him to say 'supply and demand', and you have an excellent economist." Attributed to Irving Fisher.[1]

INTRODUCTION

The supply and demand model has only *ex post* explanatory power, economists have never shown that the model is empirically valid, there are no possible price-quantity observations that could refute the model, and the model has very limited applicability to real world economies.

These are not the only limitations of the model; nonetheless, despite its many limitations the supply and demand model is not only the best known but also the most widely invoked economics model. Professional economists use the supply and demand model as their default model when faced with a microeconomics problem. Academic economists claim that the supply and demand model is one of the most powerful tools that they can put into the hands of economics majors. Politicians and media pundits seem to believe that the supply and demand model provides a firm theoretical foundation for their pro-market views.[2]

In this, the first of eight interrelated but largely independent papers[3], I tackle the two most important limitations of the supply and demand model; the model is static and it is qualitative.[4]

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[1] This quote is sometimes attributed to Thomas Carlyle but see http://quoteinvestigator.com/2013/07/19/parrot-econ/who.

[2] The supply and demand model is the only econo0mic model hat has name recognition with non-economists. To most non-economists, the supply and demand model is probably the only part of the discipline that they believe they "know" and many non-economists identify supply and demand with economics.

[3] See Sleeman (2017b-h).

My primary concern is with the way that the supply and demand model should be taught to undergraduates.[5] Most economists can give a lecture on supply and demand at the drop of a hat while standing on their heads, playing the bagpipes, and cracking walnuts between their toes. The lectures, which are largely standardized in content and presentation, are codified in the microeconomics textbooks. However, that standard exposition commits both errors of omission and commission, errors that have become almost invisible to economists because we are so familiar with the narrative. If, as is widely believed, the supply and model is an important economic tool, then the version that we teach must be as carefully honed and as free from flaws as possible. To wield the tool effectively, economics majors must know its weaknesses as well as its strengths.

There is a more important reason for making certain that economics students and especially economics majors fully master the supply and demand model. Professional economists when asked about a microeconomics question in a field outside of their research interests tend to resort to an explanation in terms of supply and demand. The default model they use is often the intermediate model but sometimes it is the single-good model taught in principles courses. The single-good principles model is easy to manipulate in ones head and it generates nice, precise, easily understood answers to many microeconomic policy questions. But our default model should be the best version available to us, the one that takes into account its limitations and the supply and demand model taught in principles courses is not that model.

The remainder of this paper is divided into three sections. In section 1 I stress the importance of models in economics. In section 2 of the paper I point out that the supply and demand model is a static model. I argue that much of the standard verbal narrative is not applicable to a static model. In section 3 of the paper I point out that the supply and demand model is a qualitative model. I include a diagram that properly emphasizes the qualitative nature of the analysis. I also argue that the small number of qualitative comparative static (QCS) exercises analyzed in the standard exposition give the impression that the model has greater predictive power than it actually has.

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[4] In the fifth paper I argue that all theoretical models are qualitative models, but that the nature of economic systems makes it difficult, if not impossible, to add quantitative flesh to the theoretical skeleton.

[5] Apart from a few diagrams economists have known most of the material in these papers for at least a half-century. But much of this material has still not made its way into the intermediate microeconomics texts and courses.

1. MODELS RULE

"Economic theory [is] as a sequence of conceptual models that seek to express in simplified form different aspects of an always more complicated reality." Tjalling Koopmans *Three Essays on the State of Economic Science* (1957, 142).

Any argument that hopes to attract the attention of a professional economist must be presented as a mathematical model: Whereof economists cannot model mathematically, thereof economists must be silent.[6] Mathematical models are the workhorses of economics because there is general agreement that only a mathematical model can set out a theoretical argument with the degree of precision that can eliminate the interminable debates that plague verbally formulated theories.[7]

Mathematical models lay out the assumptions that underlie a theory (what the theory means) and enable us to derive the logical implications of the assumptions (what the theory claims about the real world). If the assumptions of the model are stated explicitly then we can determine whether the assumptions are consistent and whether they are necessary and sufficient for the implications drawn from the model. However, consistency is a necessary, but a far from sufficient condition for an economic model to be worth studying; an economic model should also answer interesting questions – interesting economic questions not merely interesting mathematical ones – and should generate unexpected conclusions. The most important criterion for a good model is that the model should map closely to the real world system it attempts to mimic.[8]

Toy/Theoretical/Gedankenexperiment/Bookshelf/Exploratory/Teaching/Expository models. Realistic/Testable/Scientific/Serious models. Chameleon models.

Non-traditional economics. Play the game by our rules.

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[6] Rodrik's very readable book (Rodrik, 2015) has many interesting insights into economic models and economic modeling. See Rubinstein's review essay (Rubinstein, 2017).

[7] Koopmans (1957,178-179) and Archibald and Lipsey (1967, 10, n. 1) provide examples of the limitations of verbal analysis. See also Keynes (1924, 354-356) on the difficulty of reading Marshall's *Principles*.

[8] Models, by their very nature, must be simplifications of reality, the real issue is how well the simplifications work; a model holds a glass up to nature but we see through that glass only darkly. See Borges (1946/1975).

2. A STATIC MODEL

The supply and demand model concentrates on outcomes, not processes; economists focus on the characteristics of equilibria not on how those equilibria are achieved.[9] Although issues of adjustment to equilibrium have been a major research area for economists for almost 150 years, the conclusion of this research is that there is no reason to believe that supply and demand models are stable (see Part 6).

The standard exposition of the supply and demand model at the intermediate level begins by reviewing the concept of equilibrium taught in principles courses.[10] Equilibrium is said to occur when the market clears,[11] that is, when the quantity supplied, Q^s, is equal to the quantity demanded, Q^d. The standard supply and demand diagram is used to illustrate the argument (see Figure 1). At

[Figure 1 goes about here.]

any price above the equilibrium price, P^e, for example, P_H, there is excess supply (ES). (I assume that the model was initially in equilibrium at P_H but a change in an exogenous supply side variable shifted the supply curve from S_0 to S_1.) The standard narrative claims that those firms that cannot sell their new profit-maximizing outputs at P_H will have an incentive to bid down the price until the market clears. At any price below P^e, such as P_L, there is excess demand (ED). (I assume that the model was initially in equilibrium at P_L but a change in an exogenous demand side variable shifted the demand curve from D_0 to D_1.) The standard narrative claims that unsatisfied buyers, who cannot purchase their new utility maximizing quantities at P_L, will have an incentive to bid up the price until equilibrium is achieved.[12]

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[9] Economies appear to be evolving, complex, path-dependent, adaptive systems, although, to my knowledge, there has been little success in employing the tool set of nonlinear dynamics to explain the sorts of problems that economists and policy makers are actually interested in. But see Kirman (**2011 and 2016**).

[10] Some instructors do not lecture on supply and demand at the intermediate level. Instead, they ask their students to read the textbook chapter on their own to review what they learned in their principles course. I believe that this is an unfortunate choice.

[11] But see Section 7.9.

[12] The argument goes back at least to Smith (1776/1937) who writes: "When the quantity of any commodity brought to market falls short of the effectual demand … [a] competition begins … and the market price will rise … When the quantity brought to market exceeds the effectual demand, it cannot be all sold to those who are willing to pay the whole value … which must be paid in order to bring it thither... The market price will sink."

The standard narrative of how the actions of firms and households frustrated by unsatisfied supplies or demands restore equilibrium has the great merit that it tries to provide some economic motivation for how equilibrium is achieved providing, as Pooh-Bah would say, "corroborative detail, intended to give artistic verisimilitude to an otherwise bald and unconvincing narrative." (Gilbert (1895), Act 2). However, although Pooh-Bah's story is intuitively appealing and captures economists' intuitions about how markets work, it is logically incompatible with the verbal and mathematical versions of the supply and demand model that we teach majors.

The supply and demand model consists of two behavioral relations, the supply and demand functions,[13] and an equilibrium condition. The equilibrium condition is used to solve the model. Therefore, the model is always in equilibrium: It is a static model.[14] Configurations of the model in which there is excess supply or excess demand cannot exist. The price can never be anything other than the equilibrium price. If Q^s does not equal Q^d then the model has nothing to say; "it does not compute"; it is as mute as an "ex-parrot." To ask what happens if there is excess demand or supply is the equivalent of asking, "What was the universe like five seconds before the Big Bang occurred?" Although that question is a properly formulated English sentence, and although the question makes intuitive sense to most of us, an astrophysicist would say that the question is meaningless: Time starts with the Big Bang, there is no five seconds before the Big Bang occurred.

Pooh-Bah economics is, as Lucas would say, "Just pictures and talk". The Pooh-Bah story fails the implicit, but strictly enforced, litmus test that dominates academic economic discourse: Only propositions that can be formulated as a mathematical model have standing.[15]

Despite the fact that economists have used Pooh-Bah's argument in their lectures and textbooks for the best part of a century, and despite the fact that the argument is embedded in every economist's brain as "common sense", the argument is inadmissible according to the rules by which economics is played.

If Pooh-Bah's intuitively convincing story is to count as an economic argument,

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[13] Throughout the paper it is assumed that the supply and demand functions are affine, they are continuous and, almost always, monotonic. I ignore the possibility that the graphs of the demand, supply, or both functions are vertical or horizontal,

[14] The supply and demand model satisfies all of the properties of a static system in classical physics, see, Susskind and Hrabovsky (2014). In particular, the model is a time-reversible system; it can be run backward as well as forward in time although for a model in which there is no time this point is moot. But economics majors should at least be informed of this property of the model.

[15] See Part 1.

he must translate it into a mathematical model that allows for excess demand or excess supply in addition to equilibrium. The model must also explain how the transition between disequilibrium and equilibrium is achieved through the actions of maximizing economic agents. Pooh-Bah must write equations to specify what happens to Q and P during the period of adjustment; this was the program initiated by Samuelson in the *Foundations*. However, Samuelson did not show how maximizing economic agents' behaviors generate the adjustment paths traced out by his differential equations.[16]

If Pooh-Bah succeeded in formulating this disequilibrium process mathematically then he would have created a new version of the supply and demand model. In that model, there would be a variable referred to as time, although it might not have the temporal properties of clock time.

Even on their own terms, Pooh-Bah's conjectures leave much to be desired. If the ith firm cannot sell all of its output then according to Pooh-Bah's argument it has an incentive to cut its price. But Pooh-Bah has nothing to say about the size of the price cut.[17] What is the profit-maximizing price at any price between P_H and P^e? If all firms are identical, then which firm initiates the price cut?

Further, if firms or households are allowed to complete out-of-equilibrium transactions, then the size of the excess demand will continually change but the model has nothing to say about the economic effects of these changes. Consider Figure 2. Starting from an initial equilibrium (Q^e, P^e) assume there is an

[Figure 2 goes about here.]

increase in demand shifting the demand curve from D to D_1. The resulting excess demand (A-B) will lead to a Pooh-Bah increase in price. Because instantaneous adjustment appears to be far fetched assume that only partial adjustment is achieved, causing the price to rise temporarily to P_1 (with a smaller excess demand, C-F). Assume further that at this point supply increases from S to S_1, and that the increase in supply only eliminates part of the excess demand so that the excess demand is now equal to C'-F. Therefore, although supply has increased the price increases from P_1 to P_2 (where there is still excess demand equal to G-H). This sort of situation is likely to be the rule rather than the exception in actual economies. The standard supply and demand model does

[16] See sec 6.2.

[17] Arrow (1959) quotes Reder (1947, 17): "Under conditions of disequilibrium, there is no reason that there should be a single market price, and we may very well expect that each firm will charge a different price."

not analyze such situations satisfactorily, and students' expectations that the increase in supply will cause the price to fall are incorrect.[18]

Majors should also be aware that because there is no time in a static model, the supply and demand model cannot address crucial policy issues such as these: (1) Will the model achieve an equilibrium if there is a policy (parameter) change?[19] Or (2) what path (monotonic or oscillatory, convergent or explosive) will the variables follow when disturbed from an initial equilibrium?[20] Or (3) how long will it take to achieve equilibrium if the system is disturbed in some way?[21] Samuelson (1947, 263, n. 8) dismissed these concerns as, "the commonplace criticism of comparative statics that it does not do what it is not aimed to do, namely describe the transition paths between equilibria." Samuelson was, of course, correct but, seventy years after the publication of the *Foundations*, economics majors should at least be made aware of that the supply and demand model cannot address these questions.

In a static model since all transactions are equilibrium transactions the transactions can be made by barter. The complex interactions between real-world markets for goods and services and financial markets are completely absent from standard supply and demand analysis. Although such interactions are too difficult to be handled at the intermediate level, our students should be aware that they are discussing a barter system.

All of these problems are minor flaws compared to the fact that the supply and demand model is supposed to represent a perfectly competitive market where, by assumption, all firms and households are price takers. This problem has been known to economists for sixty years (see Koopmans (1957) and Arrow (1959)), but it seems to be ignored when teaching economics majors.[22] Candor requires that we at least address these problems if only to follow the time-hallowed academic tradition of looking the problem squarely in the eye before rapidly passing on to the next topic.

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[18] See Arrow (1959, p. 46)

[19] This is not a meaningful question because the model is always in equilibrium.

[20] The model is always in equilibrium; therefore there is no path.

[21] Even the answer "instantaneously" is, strictly, incorrect.

[22] Boland (2017, chap 2) provides an extensive coverage of Arrow's paper. Perfect competition, which means price taking, is the crucial assumption of the supply and demand model; only in perfect competition do we have well-defined supply curves.

3. A QUALITATIVE MODEL[23]

Having dealt with equilibrium, textbooks turn to how the equilibrium changes if there are changes in the factors that cause the supply and demand curves to shift – qualitative comparative statics (QCS). The usual suspects are: (on the demand side of the market) the prices of substitutes and complements, real disposable income(s), preferences, and the number of buyers, and (on the supply side of the market) input prices, technology, government actions (taxes and subsidies, regulation, tariffs, quotas, etc.), "weather" (anything that changes crop yields or the size of livestock herds), and the number of suppliers.[24] QCS exercises consist of deriving predictions about the behavior of the equilibrium price and quantity transacted when one, or more than one, of the supply and demand determinants changes causing shifts and/or pivots in the supply or demand curves.[25]

Figure 3 shows the standard textbook diagram used to illustrate the effects of an increase in demand. One problem with Figure 3 is that the demand curve has been shifted by the amount A, but all that we can legitimately say is that the new demand curve is somewhere to the right of the old one. The supply and demand model is a qualitative system; only the direction of changes, not the magnitude of those changes, can be known; that is, we know the signs, but not the sizes, of the parameter shifts.

The diagram also suggests that the supply and demand model is more informative than it actually is. The diagram shows that P^e has changed by $\Delta P^e = P^e_1 - P^e$, but all we know is that P^e_1 is higher than the P^e generated with the initial parameter values. The diagram also shows that Q^e has changed by $\Delta Q^e = Q^e_1 - Q^e$, when all we know is that Q^e_1 is larger than Q^e. It is easy for majors to

[23] As Lipsey (2001, 172) observes: "The great insights of economics are all qualitative." But, all theory is qualitative and so economics is not different from, say, physics in this respect. I will return to this issue in Part 5, especially Section 5.4.

[24] Sometimes expected prices are included on the demand side of this list. But I do not see how price expectations fit into a static model. If, for example, I expect the price of whiskey to rise permanently next week then I may stockpile the 52 cases of Scotch that will fit into my garage. After a year I will have exhausted my reserves and will have to decide on the size of my weekly purchase of whiskey at whatever price actually prevails. Although my demand increases dramatically in week 1, it will drop to zero for the next 51 weeks. Price expectations will have only transitory impacts on the price and quantity transacted. This is Pooh-Bah economics; where do these expectations come from and how are they formed? They are clearly not part of the standard model.

[25] See Kehoe (1987).

overlook these facts. Because the axes are not usually calibrated we have no idea how big these changes are.

[Figures 3 and 4 go about here.]

I believe that Figure 4 illustrates the qualitative nature of the analysis better than Figure 3 does. Figure 4 makes it clear that we do not know by how much demand has increased, and, although it shows that both P^e and Q^e must increase, it is clear that we do not know the size of those increases. All we can say is that the solution set is the set of points on the supply curve above and to the right of the original equilibrium.

Care must be taken even in these simple exercises. For example, Figure 3 seems to allow for infinite increases in the price and output of the good or service, but in a world of scarce inputs and a given technology, the quantity produced cannot exceed real GDP. Figures 5(a) to 5(c) show other bounds on

[Figures 5(a)–5(c) go about here.]

what can happen to the equilibrium price and quantity. In Figures 5(a) and 5(b), the bound is the result of the assumption that the price must at least cover minimum average variable cost (P_{min}), while the bound in Figure 5(c) is the consumer's maximum willingness to pay.

Formally, QCS simply consists of exercises in which we manipulate one or more of the four parameters (the vertical intercepts and slopes of the demand and supply functions) that specify with which of the infinite number of possible supply and demand models we are dealing. Economic theory has little to say about the slopes or shapes of the supply and demand curves.[26] Although there is little reason to believe that the supply and demand curve shifts are always parallel shifts this is usually the assumption in the standard narrative. Few textbooks discuss the cases in which the supply curve pivots, or the demand curve pivots, or both curves pivot, or cases where there are both shifts and pivots in the curves.

[26] The slopes and shapes of the supply and demand curves depend on preferences and technology. Consumer preferences and technology are treated as shift parameters at the intermediate level, but students should be aware that technically these fundamental economic forces are embodied in the functional forms of the supply and demand functions. (The curvatures of the supply and demand curves have insignificant effects on the QCS results.) Economists often use specific functional forms that guarantee nice tractable results but without providing any empirical evidence to support those formulations.

Figures 6(a)–(d) show what happens in the standard diagram when the supply and demand curves pivot individually. Note that in Figures 6(a) and 6(b) the demand curve pivots around its horizontal intercept.[27] In Figure 6(b) because the

[Figure 6 goes about here.]

demand curve is negatively sloped it can only pivot upwards until it becomes almost vertical. In Figure 6(b) and 6(c), the downward pivot cannot drive the price below P_{min}. In Figure 6(d) the maximum value of the households' willingness to pay (WTP) places an upper bound on the upward pivot. In the cases in which there are single pivots of the curves the changes in both P^e and Q^e are determinate, indeed the shift and pivot QCS results are qualitatively identical.

In the standard exposition of the supply and demand model, the next order of business is to shift the supply and demand curves simultaneously. Figure 7 shows the standard approach to a simultaneous increase in supply and demand. The analysis emphasizes that we can predict what happens to Q^e – it increases – but that the sign of ΔP^e is indeterminate because what happens to P^e depends on the relative sizes of the shifts in the supply and demand curves. When the curves shift in opposite directions then the sign of ΔP^e is determinate, but the sign of ΔQ^e is indeterminate.

The standard analysis is deficient on two counts. In the first place, Figure 7 fails to emphasize the qualitative nature of the analysis. (I believe that Figure 8 does

[Figures 7 and 8 go about here.]

a better job of emphasizing the qualitative nature of the analysis than does Figure 7). Secondly, the standard analysis usually fails to address the question of why the sign of ΔQ^e is determinate if the curves shift in the same direction, whereas it is the sign of ΔP^e that is determinate if they shift in opposite directions.

There is a simple Pooh-Bah explanation for this difference. An increase in demand can be interpreted in two ways: Consumers wish to buy more (an increase in the Q^d) at each and every price, or equivalently they are willing to pay higher prices for each and every quantity offered (their WTP is higher at each Q). Similarly, an increase in supply means that firms are willing to supply larger quantities at each and every price (an increase in the Q^s), or equivalently that they are willing to accept lower prices for any quantity they supply (a

[27] This is because, as I show in Part 3, the diagram illustrates the Inverse supply and demand model although the analysis is implicitly based on the Walrasian model.

decrease in WTA at each Q). Therefore, when supply and demand both increase, households and firms agree that more of the good should be transacted, but they disagree about what should happen to the price of the good. If supply increases and demand decreases, then households and firms agree that the price must fall, but they disagree about how much of the good should be bought and sold. The same argument can be used to explain exercises involving both curves pivoting, or one curve shifting and the other pivoting.

The standard intermediate microeconomics textbook QCS single-market exercises give an exaggerated view of the predictive power of the supply and demand model; they cover only a limited number of possibilities and they fail to stress that when both curves shift and/or pivot, the likely case in real economic situations, the supply and demand model usually loses half, and sometimes all, of its predictive power. Situations in which the changes in both ΔP^e and ΔQ^e can be signed are the exception rather than the rule.[28]

The model has two variables, and four parameters that can be either increased or decreased and so there are 160 QCS exercises generated by altering one, two, three or all four of the parameters simultaneously.[29] The effects of increasing and decreasing the parameters are symmetrical except for their signs, and so we concentrate on the 80 cases where the first parameter increases, while all other parameters change either positively or negatively. We are usually interested in what happens to both P^e and Q^e, which leaves us with 40 QCS experiments to explore (these include the two cases usually covered in the

[28] Samuelson's *Foundations* is the canonical source for QCS. In chapter 2 Samuelson points out that the QCS results of an equilibrium model are the model's testable predictions. Samuelson's analysis is much more general than anything I will attempt; he uses general functional forms rather than affine functions. In chapter 3 Samuelson asks: When can the sign patterns of the model's partial derivatives allow us to sign the effects of changing a shift parameter? Lancaster (1962) re-examined this question. (Lancaster's interest in the subject was probably sparked by the attempts of the members of the M^2T seminar at the London School of Economics in the late 1950s and early 1960s to derive testable predictions from economic models.) Gorman (1964) corrected Lancaster's theorems. Anyone interested in this literature should consult Bassett *et al.* (1968) and the references cited there. This literature is confined to a limited set of parameter/variable shifts and does not cover all the cases that interest us. Chapter 9 of the *Foundations* contains Samuelson's seminal discussion of economic dynamics and the relationship between QCS and dynamic stability conditions, what he refers to as the "Correspondence Principle".

[29] There are four cases in which there are changes in a single parameter; twelve cases where we simultaneously change any two parameters; sixteen cases where any three parameters are changed; and eight cases where all four parameters are simultaneously increased or decreased. These QCS exercises provide a good source of exam questions.

standard narrative).[30] Only 6 of the cases are determinate in the sense that we can sign the changes in both variables. In 19 cases the model is semi-determinate; we can sign only ΔP^e or ΔQ^e. The remaining 15 cases are indeterminate because it is not possible to sign the changes in either variable.[31] Although many of the 40 QCS experiments are of purely academic interest, this is an academic exercise. Further, these QCS results are the testable predictions of the supply and demand model. All of these exercises presume that the demand and supply curves have their conventional slopes; if this is not true we need to worry about stability conditions, an issue discussed in Part 5.[32]

From a strictly theoretical point of view, the whole of the previous analysis is misleading. The supply and demand model is static and therefore timeless; there is no before and after; nothing changes in the usual sense of the term. There is not even instantaneous change; all adjustment is an illusion; there are only different equilibria.[33] The "comparative" in qualitative comparative statics refers to a comparison of different equilibrium solutions of the supply and demand model that arise when different values are assigned to the parameters of the model. As we have seen the supply and demand model is concerned only with outcomes; it ignores processes; it does not model how profit-maximizing sellers and utility-maximizing buyers respond to changes in the parameter values; it merely contrasts the equilibrium values of the price and quantity transacted under two different parameter regimes (tacitly assuming constrained maximization by consumers and producers). However, human beings understand the world by organizing their observations of it into temporal, cause-and-effect, narratives; we are inveterate storytellers. Economists tell their Pooh-Bah stories, even though the model underlying the stories provides no analytical support for those stories.

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[30] Confining the analysis to the cases in which the results are determinate, or, if both curves shift, semi-determinate as is usually done in textbooks gives a spurious appearance of predictive precision to the model.

[31] "In general, we should not expect to be able to determine the sign of the rates of change of our variables on the basis of simple *a priori* qualitative restrictions on our equilibrium equations." Samuelson (1947, 19)

[32] We will always ignore the possibility that demand curves and supply curves can be vertical or horizontal.

[33] Silverberg and Wing (2002, 15) claim that comparative statics is not really static analysis because it involves changes between equilibria – from one equilibrium to another equilibrium – but they implicitly assume a before and after temporal sequence. However, there is no time variable in the textbook supply and demand model, and therefore no functional dependence on time; the defining characteristic of what is usually meant by the term "dynamics".

Figure 9 attempts to counteract this habitual way of thinking by emphasizing the atemporal nature of the analysis, arranging the panels so that the student

[Figure 9 goes about here.]

does not inadvertently order them in a temporal sequence (left coming before right and top coming before bottom – at least in the Western world), and labeling them with temporally neutral symbols such as # and @, not 1 and 2 or (a) and (b), which our minds interpret as 1 comes before 2 and (a) comes before (b). In each case, the equilibrium price and quantity are generated by a particular set of parameter values, for example, $d_{1\$}$, $d_{11\$}$, $s_{1\$}$, and $s_{11\$}$ generate $P^e_{\$}$ and $Q^e_{\$}$. If the $s_{1\$}$ parameter incorporates the effect of a $2 lump sum sales tax and the $s_{1@}$ parameter does not then, strictly speaking, we cannot say that moving between the @ and the $ configurations of the model represent the effect of introducing the tax, although that is what we wish to say, nor, much as we wish to, can we say the moving from the set of $ parameter values to the @ parameters represents the effect of removing the tax.

CONCLUDING REMARKS

It is not my intention to attack the supply and demand model but to criticize the way that the model is taught to students and how we present the model to non-economists can cause them to draw questionable inferences about the efficiency of markets (see Sleeman 2017g.)

As in other disciplines, in economics it takes a model to defeat a model. I do not have a model to replace the supply and demand model – there are no contenders waiting in the wings. However I do believe that we should make clear to our students, at least at the intermediate level (see Sleeman 2017h sec 3) that the model is static and qualitative and how this limits what we can say about the model.

While economists work on building the model that we need if we are ever to deal with the immensely important problems that beset real economies,[34] we will necessarily continue to teach the supply and demand model.[35] But we should teach the model, "warts and all". We should have the courage to acknowledge

[34] This task may require the "rare *combination* of gifts" that Keynes (1924, 322) attributes to the master-economist and which perhaps only Keynes has ever possessed.

[35] And we will also continue to teach consumer and producer surplus.

the limitations of the model, and have the humility to admit to our students, and to policy makers who come to us for counsel, the existence of those limitations.

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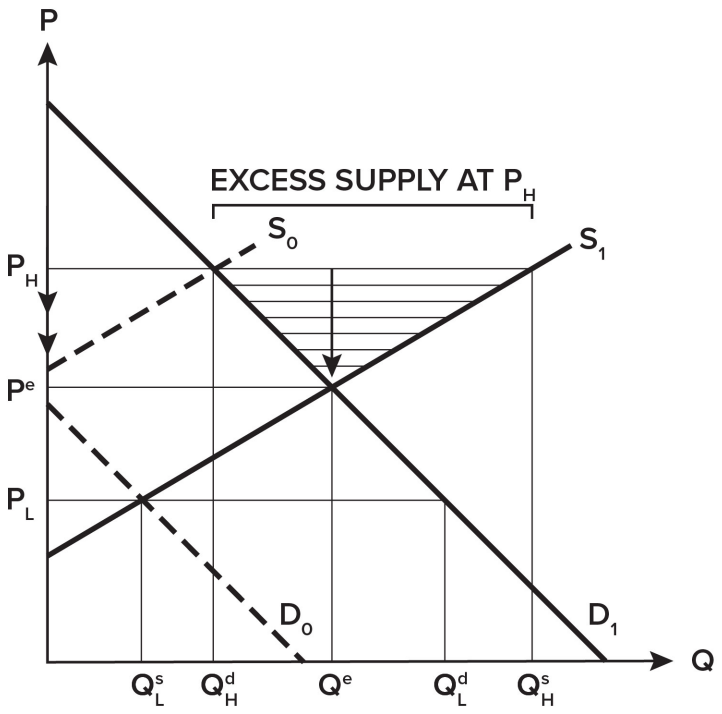
FIGURES



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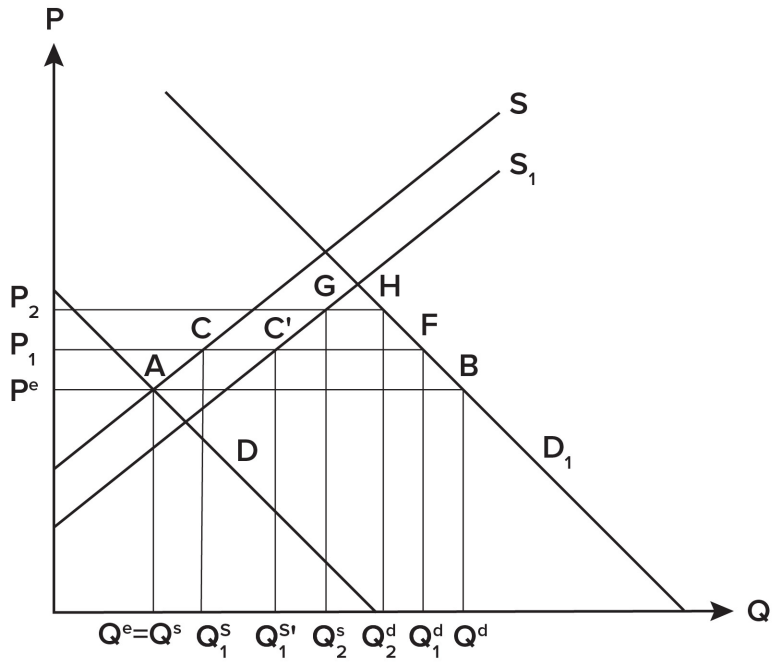

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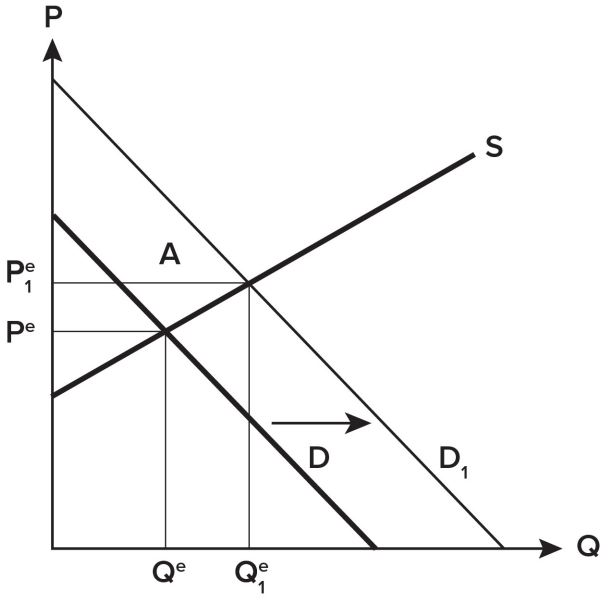

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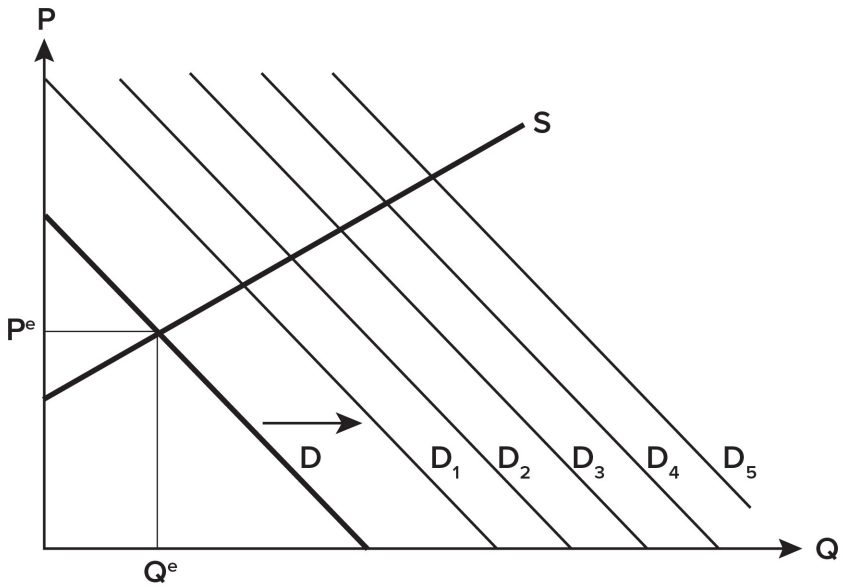

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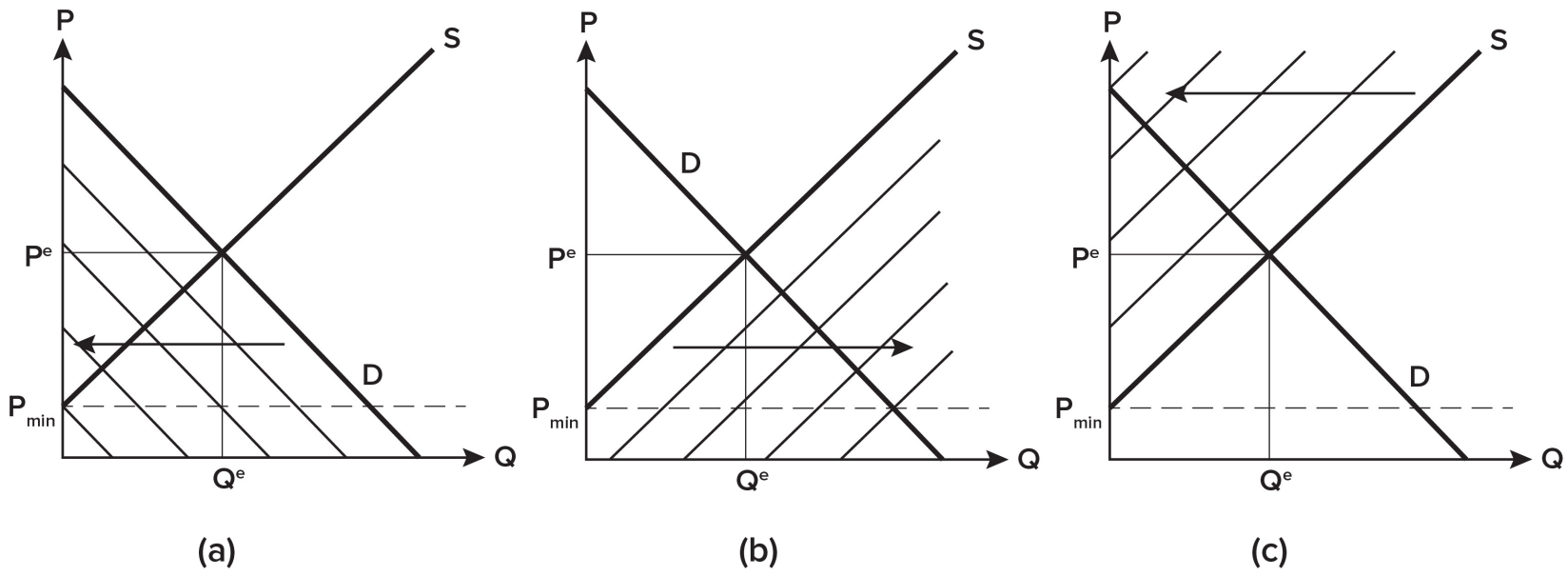

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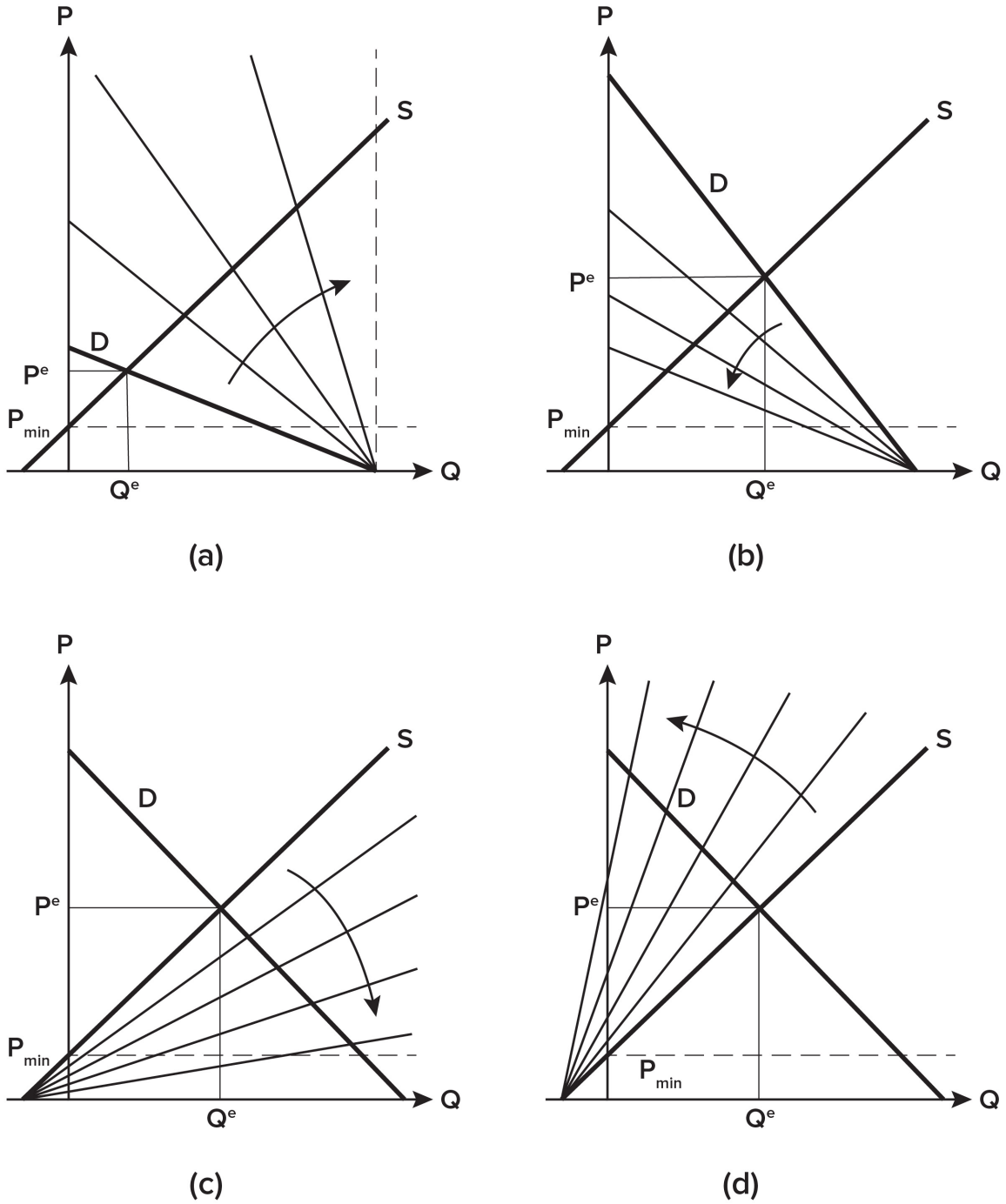
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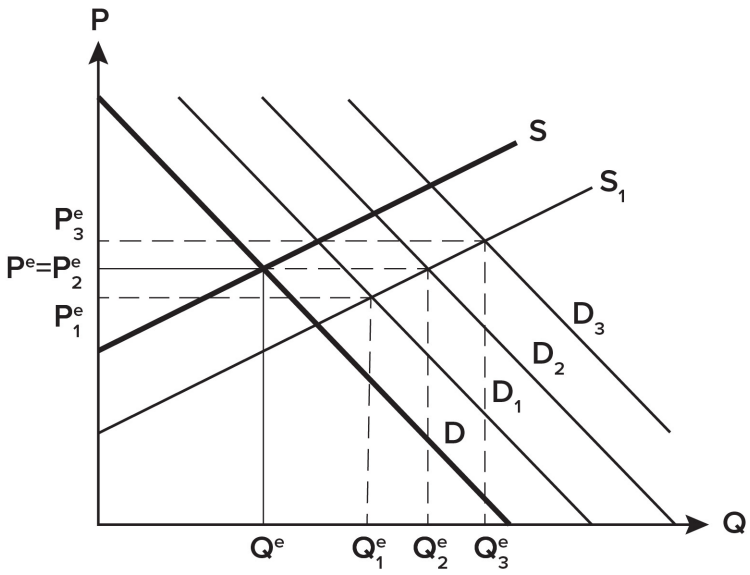
Figure 6



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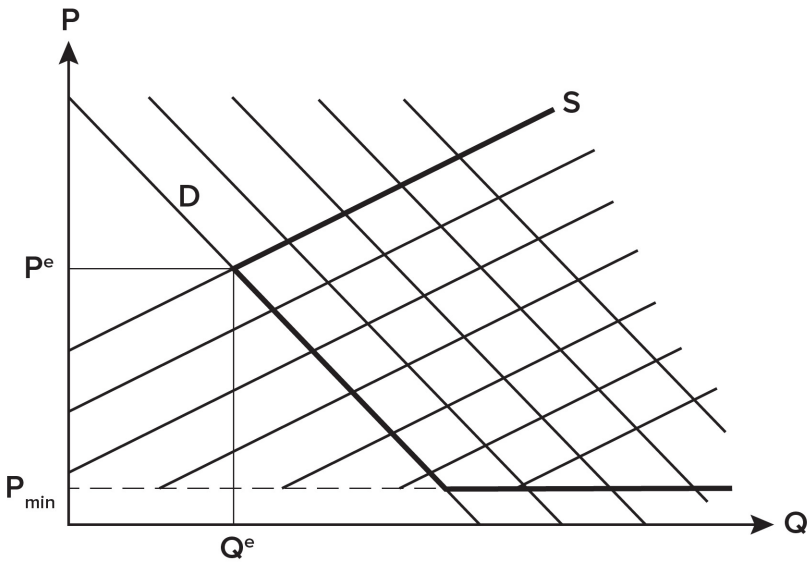

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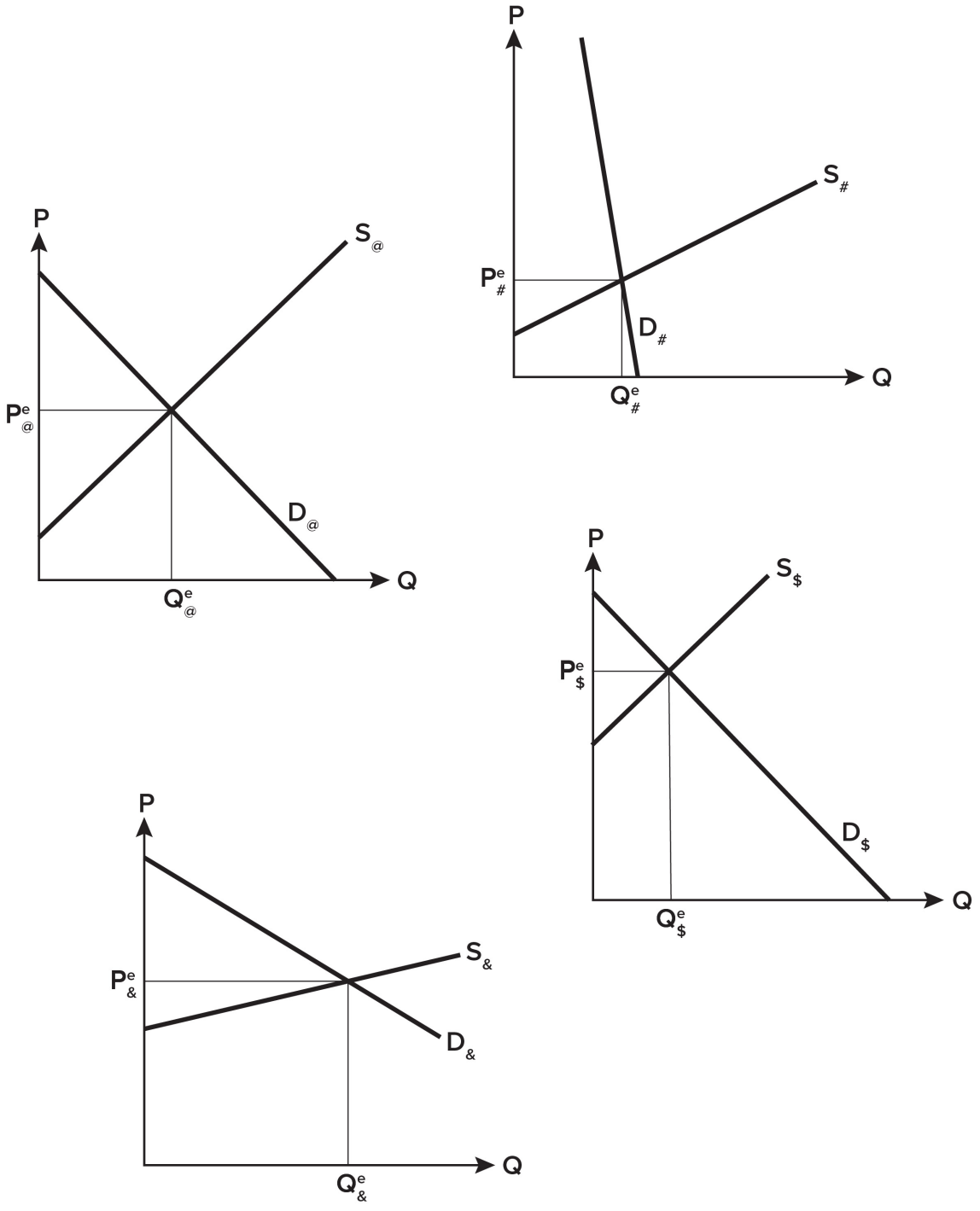

Figure 9