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Teaching the Production Possibilities Curve with the American Experience of World War II

The production possibilities curve is an important tool of economics pedagogy. Textbook presentations of this construct, however, appear to rely exclusively on theoretical examples and exercises to demonstrate such concepts as scarcity, unemployment, inefficiency, opportunity cost, and economic growth. We believe that students may benefit from an empirical or "real world" demonstration of these ideas. Therefore, this paper employs macroeconomic data of the United States from 1940 to 1946 to demonstrate the properties of the production possibilities curve. The data indeed may be interpreted to show movements of the economy from inside the curve to the curve itself, movements along the curve, and rightward shifts of the curve.

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1. Introduction

The production possibilities curve or frontier, also called the transformation curve, is one of the most important and pervasive pedagogical tools of economics. Indeed, this particular theoretical construct is found in virtually all principles of economics texts and also appears in many books for upper-division courses such as intermediate microeconomics, international trade, and public finance. This extensive use and discussion are surely warranted as this singular apparatus effectively demonstrates numerous core economic ideas such as scarcity, the efficiency and inefficiency of resource use, opportunity cost, the law of increasing opportunity cost, economic growth and contraction, unemployment, and the importance of time and dynamics in economics.

For this paper, we surveyed more than a dozen textbooks and found complete reliance upon hypothetical examples utilizing a wide array of goods and services to examine the important concepts mentioned previously within the production possibilities model. The variety of goods chosen for teaching purposes includes guns and butter (Colander, 2013, Samuelson, & Nordhaus, 2013), computers and cars (Mankiw, 2017), food and clothing (Hyman, 2008, Pindyck, & Rubinfeld, 2013), fig leaves and apples (Rosen, 2014), pizza and wings (Mateer & Coppock, 2021), robots and pizzas (McConnell, 2012), airplanes and auto parts (Krugman & Wells, 2013), trucks and tanks (Schiller, 2013), pancakes and cereal (Goolsbee, Levitt, & Syverson, 2016), fish and tomatoes (Landsburg, 2008), wheat and cloth (Salvatore, 2007), and wheat and autos (Carbaugh, 2011).

While the strict reliance on, and exhaustive treatment of, the theoretical aspects of the production possibilities curve is of course useful, we suspect that students may benefit additionally from an empirical or 'real world' application of this teaching instrument. We are unaware, however, of any pedagogical presentation of the production possibilities curve that adopts this particular approach. Therefore, this paper employs macroeconomic data from the United States for the time period 1940 to 1946 (those years just prior to, during, and immediately after World War II), to demonstrate the alignment and fundamental characteristics of the production possibilities curve. Section II details our suggested approach and Section III provides a concluding statement.

2. The Analysis

Our discussion of the production possibilities curve immediately follows the introduction of the economic problem of scarcity and the concept of opportunity cost in the principles of macroeconomics class.[1] We begin with the standard definition of the production possibilities curve found in most textbooks.[2] Then, to transition later to our specific empirical exposition, we define the two representative goods like guns and butter or, more generally, defense goods and civilian goods. At this point, we specify that the curve is negatively sloped since the finite resources, full employment, and fixed technology assumptions imply opportunity cost, i.e., that in order to produce more of one good the production of another good must be decreased. This thought is logically extended to explain the concavity of the curve due to specialized resources and increasing opportunity costs. Next, we proceed with the distinction between points on the curve that represent fully employed resources and efficiency, compared to points inside the curve that demonstrate unemployed resources and/or inefficiency. Points outside the curve are

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[1]Although this paper uses macroeconomic data to illustrate the production possibilities curve, we believe our analysis is also suitable for use in principles of microeconomics courses.

[2]For example, the production possibilities curve shows the maximum combinations of goods and services an economy can produce assuming a fixed amount of resources, full employment of those resources, a given state of technology, and a specified time period.

explained as presently unattainable with the given level of resources and state of technology. Lastly, we explain that economic growth, defined as the increased capacity of an economy to produce final goods and services that causes the production possibilities curve to shift to the right, may be caused by either an increase in the quantity or quality of resources, and that this economic growth may be balanced or unbalanced.[3] With regard to the former, we indicate that balanced economic growth constitutes a curvilinearly parallel rightward shift of the frontier while the latter is shown as a change in shape of the curve as it shifts or rotates to the right.

We now point out to our classes that many analyses and graphs that they encounter in economics courses are simplifications of reality and that these theoretical models, such as the one just discussed of the production possibilities curve, make the complex world more manageable. However, various important properties of the production possibilities curve may be demonstrated with actual data from the documented experience of the United States during World War II. We turn now to that discussion.

For convenience, we assume that all production in the United States economy from 1940 to 1946 may be classified discretely as either national defense goods, DEF, or civilian goods, CIV, with the data for each shown in Table 1. Civilian goods are measured as personal consumption expenditures plus gross private domestic investment, in billions of chained 2012 dollars, taken from the Bureau of Economic Analysis. National defense expenditures, also in billions of 2012 dollars, are obtained from the Office of Management and Budget.

Table 1

Year	$DEF	$CIV
1940	27.0	1102.8
1941	85.1	1202.4
1942	277.4	1101.7
1943	671.7	1093.8
1944	910.7	1134.8
1945	1050.2	1220.9
1946	566.1	1489.1

The information in Table 1 is then used to construct Figure 1, which can be interpreted as two production possibilities curves and the foundation of our exposition.

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[3]For this particular purpose, the distinction may be made between consumer goods and capital goods.

Figure 1
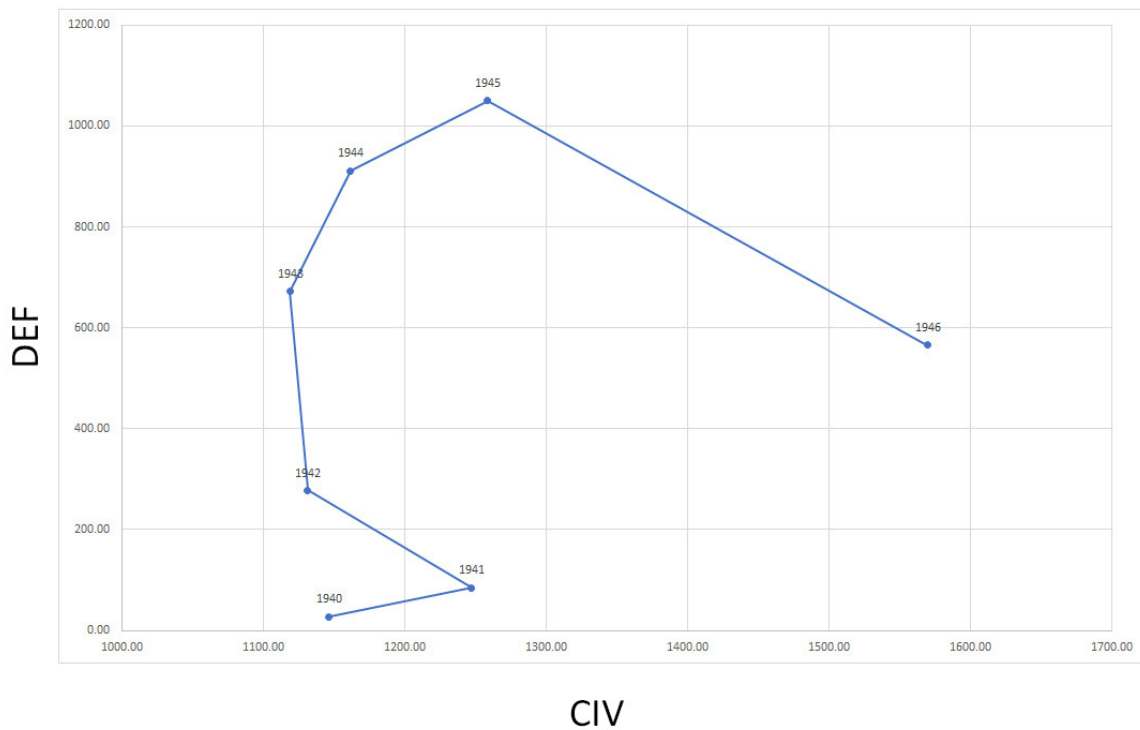
The point labeled '1940' is indicative of an economy producing primarily consumer goods as opposed to defense goods. Further, and because in 1940 the national unemployment rate was 14.6%, the point implies a large number of unemployed resources, i.e., a point lying inside a given production possibilities curve. Then, as the observed unemployment rate decreased from 1940 to 1941 during the early stages of war mobilization, the US was able to increase production of both defense and civilian goods shown by the movement up and to the right. The points 1941, 1942, and 1943 are then interpreted as being on the original production possibilities curve because these movements up and to the left necessarily demonstrate the opportunity cost of foregone civilian goods resulting from the production of more defense goods.[4] At this point, we inform our students that by 1943 the unemployment rate had decreased to 1.9%. Then, from 1943 to 1945, the movement up and to the right suggests the curve must have shifted outward as the result of economic growth. This economic growth, which resulted from both

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[4]President Eisenhower (1953) described this opportunity cost particularly well: "Every gun that is made, every warship launched, every rocket fired signifies, in the final sense, a theft from those who hunger and are not fed, those who are cold and are not clothed. The cost of one heavy bomber is this: a modern brick school in more than 30 cities. It is two electric power plants, each serving a town of 60,000 population. It is two fine, fully equipped hospitals. It is some fifty miles of concrete pavements. We pay for a single fighter with a half-million bushels of wheat. We pay for a single destroyer with new homes that could have housed more than 8,000 people. ..."

increased efficiency[5] and more capital,[6] as well as continued low unemployment,[7] allowed an increase in the production of both defense and civilian goods.[8,9] Finally, the movement down and to the right from 1945 to 1946 may be interpreted as occurring along the new production possibilities curve and demonstrates increased civilian goods production and decreased defense production as World War II came to an end.

3. Conclusion

This paper has used macroeconomic data from the experience of the United States during World War II to empirically expand and hopefully complement and strengthen traditional classroom references to the production possibilities curve. Data points are analyzed chronologically and are developed to clarify sequential points that constitute a movement along a static production frontier versus those points reflecting a shift in the frontier.

Student reaction to our pedagogical approach to the production possibilities curve in general and regarding Figure 1 has been favorable. Our classes seem to appreciate the "real world" empirical example of World War II as an extension to the customary and purely theoretical technique of teaching the production possibilities curve. Moreover, Figure 1 does not appear to present any troubling issues for students as they seek to better understand the numerous foundational concepts contained within the production possibilities frontier. Henceforth, we hope that other economics instructors will have similarly positive results and overall success with our approach to teaching the production possibilities curve presented in this paper.

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[5]For example, Ford's Willow Run plant that produced B-24 bombers, "… became more efficient as the war ground on, turning out 75 planes a month in February 1943, 150 a month in November 1943, and, at its peak, 432 a month in August 1944." See Greenspan and Wooldridge (2018: 269).
[6]"The country's stock of machine tools doubled from 1940 to 1945". Greenspan and Wooldridge (2018: 270).
[7]Indeed, the 1.2% unemployment rate in 1944 is the lowest in American history.
[8]"The U.S. economy was so productive that it could turn out consumer goods as well as war machines. In Britain and Germany, the consumer economies all but collapsed during the war." Greenspan and Wooldridge (2018: 270).
[9]This increased production of consumer and defense goods was likely because "… during the war, America had refrained from nationalizing its big industries, preferring instead to provide private companies with bulk orders and let them come up with the goods." Greenspan and Wooldrige (2018: 277).

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