EXCHANGE RATES AND CONSUMER CHOICE: COMPENSATING GOVERNMENT WORKERS FOR DECLINES IN THE DOLLAR

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ABSTRACT

Traditional indifference curve theory is limited to explaining consumer choice between two goods or groups of goods; however, in the latter case the groups are seldom well-defined or relevant. The current article evaluates consumer adjustment between two relevant, well-defined groups of commodities, one denominated in U.S. dollars, the other in Deutsch marks. Changes in currency exchange rates and resultant changes in consumer behavior are easily analyzed using traditional indifference curve analysis. Additionally, compensation schemes customarily used to offset fluctuations are shown not to be welfare neutral.

INTRODUCTION

The modern theory of the consumer is centered around the notion that the consumer maximizes utility subject to income and price constraints. The consumer's preferences for goods determine his utility function, which serves as a maximand. Relative prices and a limited income, however, typically beyond the individual's control, are determined in this market, and serve as constraints to the maximization of utility. Americans working overseas for the military, however, have access to two separate markets for goods and services, a case which provides an interesting twist to the traditional theory of the consumer. These Americans have access, via their military ID cards, to all the goods and services available on the base, including those in the exchange, the commissary, etc; all of the goods and services purchased on the base are priced in dollars, and government and related workers are paid in dollars. In addition to items purchased on the base, Americans also have access to the stores and services available in their host country; these goods are priced in terms of the currency of the host country. While many of the items are available in both markets, there are some goods which are only available in either one market or the other.

Assume the individual living and working overseas has a utility function of the form:

$$U = f[Q(A\$),Q(GDM)] \tag{1}$$

where Q(A$) represents goods bought on the military base, i.e. American goods priced in dollars and Q(GDM) represents German goods, i.e. those goods purchased on the German economy and priced in DMs. Thus the individual receives utility from both American and German goods. Further assume that all the standard assumptions regarding utility functions apply [1]; i.e. the function is continuous and (twice) differentiable, such that

$$dU/d[Q(A)] > 0 \quad ddU/d[Q(A)\ Q(A)] < 0 \tag{2}$$

$$dU/d[Q(G)] > 0 \quad ddU/d[Q(G)\ Q(G)] < 0 \tag{3}$$

From the utility function as specified above, an indifference curve mapping for an individual can be derived. Such a mapping will give an indication of the individual's preferences for German and American goods. The marginal rate of commodity substitution along a particular indifference curve

determines the willingness of the consumer to trade off German and American goods, total utility remaining constant.

Income constraints for the current model are of the form

$$QG(\$/DM)(PGDM) + (QA)(PA\$) = Y\$ \qquad (4)$$

where:

QG = Quantity of German goods
Y\$ = Income in Dollars
\$/DM = Exchange rate
PGDM = Price of German goods, in marks
QA = Quantity of American goods, and
PA\$ = Price of American goods in dollars.

Price fluctuations will impact the budget constraint in the usual manner, i.e., an increase in the price of one good will lessen the value of the intercept of the axis measuring the units of the good. However relative price changes will also occur if the exchange rate changes, i.e., a decrease in the value of the mark (vis-a-vis the dollar) results in an increase in the rate of exchange, \$/DM, and an outward pivot along the German-goods axis.

An example of the ramifications from exchange rate fluctuations concerns people stationed on American military bases abroad. While an appreciation of the dollar pivots the budget constraint out (along the German-goods axis) a devaluation would pivot it inward; thus lowering the real income of these individuals. The degree to which these individuals are made worse off depends primarily on 1) the percentage of income allocated to German goods and 2) the adjustment in dollar pay, if any, intended specifically to counteract the change of exchange rates.

Clearly, the greater the percentage of income the individual allocates to German goods, the greater the impact of exchange rate changes will be; in the polar cases, if all income is spent on German goods, the loss in real income is proportionate to the change in exchange rates; if no income is spent on German goods (a typical "corner solution") there will be no impact on the individual's real income. Intermediate cases, however, are more complicated than simple proportionality (linearity) since they depend on the degree of diminishing marginal rates of substitution between two goods.

The second consideration, that of compensation for exchange rate induced changes in real income, is of more interest since most American operations abroad make some attempt to compensate employees for such changes. There are, in traditional theory, two alternative criteria which can be used to compensate the individual: the first is to compensate him sufficiently to allow him to purchase the same bundle of goods he purchased before the change (known as the Slutsky solution) [2]. This solution is relatively easy to administer since, all relevant values can be ascertained empirically.

Given the budget constraint

$$Y\$ = (QG)\$/DM(PGDM) + QA(PA\$) \qquad (5)$$

differentiating with respect to \$/DM, holding QG and QA constant, a change in the exchange rate will result in an appropriate change in income of

$$dY\$/d(\$/DM) = QG(PGDM) \qquad (6)$$

Hence, as expected, appropriate compensation is a function only of the percentage of income spent in the German economy.

In practice, however, such adjustment is simply calculated on a "typical" basket of goods and applied to all individuals (standard "indexing" procedure) rather than considering each separate case. Under this scheme the all-American-goods consumer, who requires no compensation, is over-compensated while the all German consumer, who requires proportionate compensation, is under-compensated. Moreover, the situation in which the individual is just adequately compensated to purchase his original bundle results in an increase of his welfare since the change in relative prices would usually result in some product substitution from the original bundle. Hence, to some extent, the Slutsky compensation scheme, even under ideal circumstances, will still over compensate the individual, i.e., make him better off.

The second compensation scheme takes this substitution effect into account and compensates the individual only to the extent the initial level of welfare can be reattained (known as the Hicks solution) [3]. While theoretically more pure in the sense the utility level is held constant, the solution is virtually impossible to administer since the

individual's valuation of the goods (indifference map) must be known; such knowledge is seldom available to the individual, much less so to another party. Hence the selection of the appropriate compensation scheme depends on which is more heavily weighed: theory or practicality.

Exhibit one presents the two alternative compensation schemes, the "Slutsky" solution and the "Hicks" solution, for a typical consumer of German and American goods. Assume the consumer faces relative prices of (PA$)/(PGDM), an exchange rate of $/DM, and dollar income of Y$; the initial utility maximizing position should be point A. If the dollar depreciates, lowering $/DM, the budget constraint pivots and the individual would move to point B, clearly at a lower level of welfare. To compensate the individual, the Hicks solution would require an income adjustment to Y$', placing the consumer at point C; the Slutsky solution would increase income to Y$" enabling the consumer to be at point A, but this is no longer a utility maximizing point. It is clear that a smaller income adjustment is necessary to return the consumer to her initial indifference curve than that necessary to enable her to purchase the initial market basket. Although the Hicks compensation criterion is impossible to administer without knowledge of the utility functions, the Slutsky solution is not without its practical difficulties. Since the appropriate compensation depends on the amount of German goods in the individuals' consumption bundle, compensation based on typical or average consumers will be distorting to

Exhibit 1
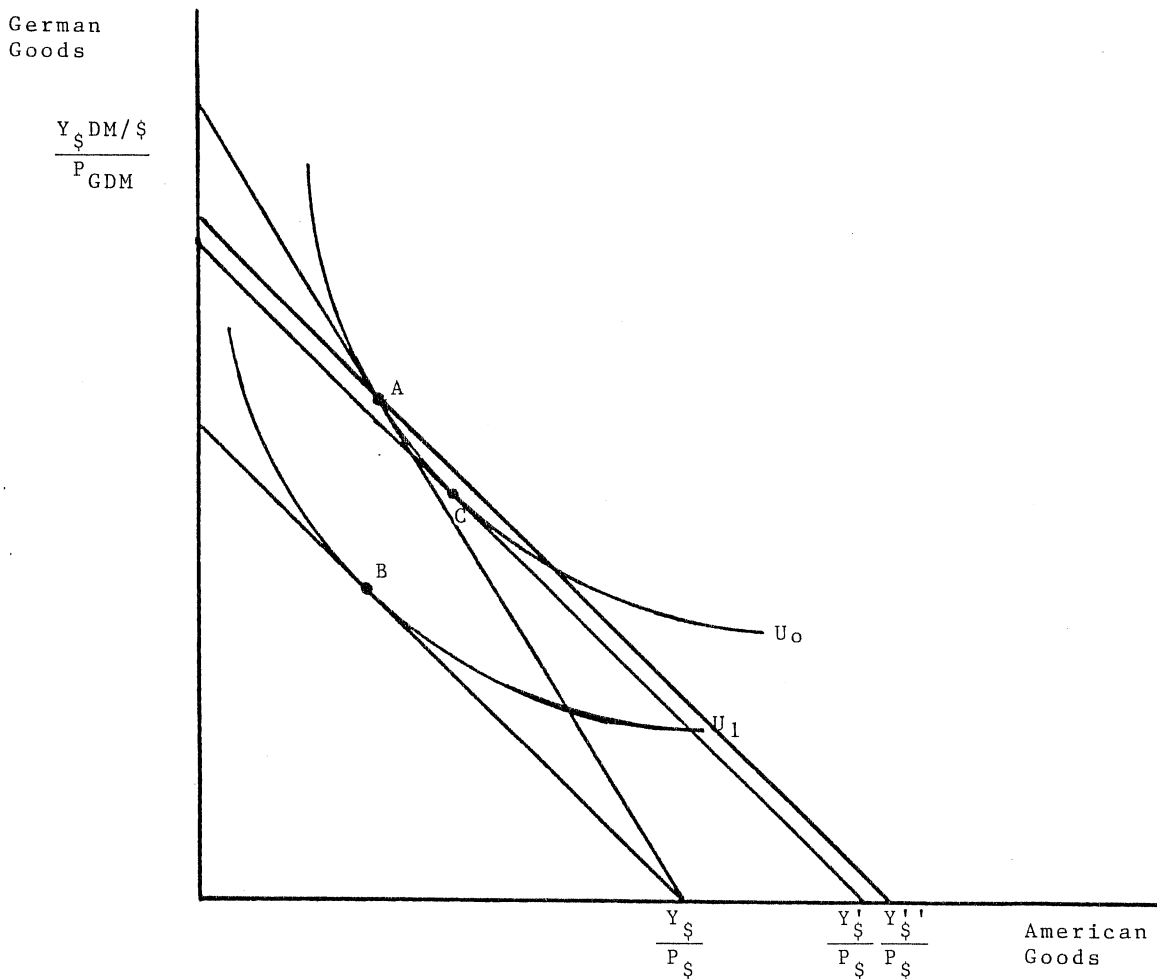
some degree; individuals with a taste for German goods will be under compensated while those favoring American goods will be overcompensated.

In this paper we have demonstrated that changes in the dollar/D mark exchange rate affect not only the choice set of German and American goods available to persons having access to both markets, but also some of the problems inherent in trying to compensate individuals for the loss of real income due to the depreciation of the dollar. While virtually any attempt to compensate military and other persons working overseas for the depreciation of the dollar would enable them to attain a higher level of utility than no compensation scheme, an attempt to alter compensation schemes to take into account the proportion of income spent on German goods would provide greater equity and might also lead to reductions in payroll costs.[4]

This is especially true in the military since personnel living off base paying rent, utilities, etc. in D marks to German landlords see their real income decline faster as the dollar falls than a soldier of similar rank who lives on the base. The following numerical example will serve to demonstrate the range of compensation income necessary to make a person at least as well off after a depreciation of the dollar. Assume an individual has a monthly income (after tax) of $2,000. If he spends his entire income on German goods and if the exchange rate is $.50 = 1DM, from equations 5 and 6, he will have a spendable income of 4000DM ($2000/$.5/1DM). If, however, the exchange rate falls to $.75 = 1DM, his real income falls to 3500DM. Thus at the lower value of the dollar, he will require an income adjustment of 500DM (or $375 at the new exchange rate) in order to make up for lost purchasing power. At the other extreme, the American goods only buyer will not require any income compensation. In order to enable the individual whose monthly income of $2000 is divided between German and American goods, an income adjustment between $0 and $375 is necessary. Clearly the larger the share of expenditure on German goods, the larger the necessary compensation. A pay structure which recognizes such differences could go a long way to alleviate some of the hardships Americans living and working overseas have had to endure as a result of the instability in the currency market.

Footnotes

1. See James Henderson and Richard Quandt, *Microeconomic Theory, A Mathematical Approach*, 2nd ed. New York: McGraw Hill Book Company, pp. 13-16.
2. For a detailed discussion of the Slutsky concept of compensation see R.G.D. Allen, "Professor Slutsky's Theory of Consumer's Choice," *Review of Economic Studies*, 1936 and Eugene Slutsky. "On the Theory of the Budget of the Consumer." *Giornab degtli Economisti*, July 1915. reprinted in Kenneth Boulding and George Stigler (eds.) *Readings in Price Theory*. Homewood, IL: Richard D. Irwin, Inc., 1952.
3. For an exhaustive discussion of Hicksian compensation, see Fritz Machlup, "Professor Hick's Revision of Demand Theory," *American Economic Review*, March 1957, pp. 119-135.
4. For example, the University of Maryland European Division pays its annually appointed lecturers a "currency adjustment" to offset the effects of the decline of the dollar. The amount of the 'adjustment' is based on a DM/$ conversion rate and is a lump sum adjustment paid monthly to all annually appointed faculty <u>irrespective of income</u>.

References

1. Allen, R. G. D., "Professor Slutsky's Theory of Consumer's Choice." *Review of Economic Studies*, 1936. Reprinted in Kenneth Boulding and George Stigler (eds.) *Readings in Price Theory*. Homewood, IL: Richard D. Irwin, Inc., 1952.
2. Henderson, James and Quandt, Richard, *Microeconomic Theory: A Mathematical Approach*, 3rd edition. New York: McGraw Hill Book Company, 1980.
3. Machlup, Fritz, "Professor Hicks' Revision of Demand Theory," *American Economic Review*. March 1957, 119-135.
4. Slutsky, Eugene, "On the Theory of the Budget of the Consumer," *Giornab degtli Economisti*, July 1915. Reprinted in Kenneth Boulding and George Stigler (eds.) *Readings in Price Theory*. Homewood, IL: Richard D. Irwin, Inc., 1952.