Classification of former Soviet Union States

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in

Baourakis G. (ed.).
The Common Agricultural Policy of the European Union: New market trends

Chania : CIHEAM
Cahiers Options Méditerranéennes; n. 29

1998
pages 191-202

CLASSIFICATIONS OF FORMER SOVIET UNION STATES

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Keywords: *USSR, Agriculture, European Union, Environment.*

1. INTRODUCTION

Various studies have investigated the existence of consumer income differentials among regions or countries. The irrefutable conclusion is that they both exist and persist for long periods of time, e.g., Bellante (1979), Johnson (1983), and Eberts and Stone (1986). Within a neoclassical framework in which regions and factors are identical and all economic agents are free to move these differentials cannot be explained, unless institutional barriers and other impediments to free mobility are introduced into the analysis.

Where there is free mobility, consumer income differentials can persist because some factors are inherently immobile, e.g., the environmental and climatic characteristics that are unique to a region. It is possible that several regions share the same site-specific characteristics, but it is unlikely that their distribution will be exactly the same.

Economic agents would be willing to pay or accept different levels of incomes depending on the value they place on these characteristics. For example, a transportation company may find that its location in a region with good airport(s), port(s), and intra- and intercity transport system saves time and reduces its production costs. This implies that this particular firm can offer relatively higher incomes to its employees and still remain competitive with other transportation companies located in lower-income regions since the characteristics of the transport system of the region is offering it a cost advantage. Since office space and other facilities in the area are limited, the companies attracted by the transport system of the region will increase the demand for both labor and office space. The increases in the prices of labor and office space will continue until in equilibrium they have completely offset the cost advantage of the transport system of the region. Incomes and rents will vary across regions according to the value companies place on the region-specific attributes in each region and their ability to substitute between factors of production.

Similarly, for their own reasons consumers put their own value on a region. Consumers consider the overall environmental quality of a region when they make a decision concerning the place they will live in; where the environmental quality is defined to include all aspects of the environment (natural and non-natural) of a consumer. They are assumed to consider the distribution of the characteristics of the natural environment and of all regional amenities, including cultural, public services, transport, and other opportunities. The region, for example, with the good transport system that offered a cost advantage to some firms may be attractive to consumers because of reduced travel time to work. Consequently, as more consumers move into the area, the supply of labor increases as well as the demand for housing. Thus rents increase and wages fall until, individuals in equilibrium no longer willing to accept moving to a region with a better transport system and a better overall environmental quality as compensation for lower wages and higher rents.

The final income differentials between two geographical areas one with a good transport system and one without, depends upon the relative size of the demand and supply responses to site characteristics. If incomes are observed to be higher in the good transport system area than in the other, then the firm's response dominates the rent determination process. If incomes are relatively lower in the good transport system area, then the consumer's response dominates the process. In both cases rents will be higher because both households and firms value a good transport system. Rents would be lower than in otherwise comparable geographical areas if the regional transport system was not important to both parties. Consequently, by observing relative consumer incomes and rents, or by observing other variables having a monotonic relationship with them, it is possible to identify whether a region's bundle of environmental and other characteristics has a greater net effect on company location decisions or consumer location decisions.

The purpose of this paper is to identify the Former Soviet Union countries according to the extend they are dominated by supply and demand responses to their net bundle of country-specific attributes. The countries are then classified into four groups based on the relative values of a country's per capita income and environmental quality. The countries are then identified as high amenity (low consumer income, high environmental quality), low amenity (high consumer income, low environmental quality), high productivity (high consumer income, high environmental quality), and low productivity (low consumer income, low environmental quality). This classification is useful because it provides information about the relative attractiveness to consumers and companies of the total bundle of environmental and other attributes indigenous to each country of the Former Soviet Union.

2. THE THEORETICAL MODEL.

In the following, a model of the effects of interregional differences in amenities and productivity on incomes and rents is presented. We then show how this theoretical framework can be used to determine the relative importance of amenity and productivity differences as sources of income differentials across countries in the European Union.

In the construction of a model the relationship between interregional differences in amenities and productivity and interregional differences in incomes and rents, it is assumed that consumers have identical tastes and skills and are completely mobile, that migration is without cost, capital is completely mobile, production technologies are identical across companies and exhibit constant returns to scale, and, finally, companies and consumers have chosen locations that they would not prosper more even if they were to relocate.

In our analysis, regions or countries are fully described by a bundle of environmental and other attributes. These specify the environmental quality index of a country or region, EQ, which includes all aspects of natural and non-natural environment of a consumer's life. EQ affects the utility of consumers, U(.), and the cost of production for firms, C(.). Individuals in these regions are assumed to consume and produce the numeraire good, X, which is a composite good with a price that is equal to one. Each consumer supplies one unit of labor and receives his income, I, in return. His income is assumed to be a function of the environmental quality of the region, I = I(EQ), and is spent on housing and the numeraire good. The rental price of a house is a function of the vector of housing characteristics, h, and the environmental quality of the region, EQ, that is, the rental price of a house is specified by the following function: P = P(h,EQ). It is assumed that P(h,EQ) = R(EQ) h', where h' is the transpose of h, and R(EQ) is the vector of implicit prices for each housing characteristic. An equilibrium must be characterized by equal utility for identical consumers and equal unit costs for firms across all regions.

A utility maximizing consumer solves the following optimization problem:

max U(h,X,EQ)

with respect to h,X,EQ

subject to I(EQ) = R(EQ) h' + X

where I(.) and P(.) are the equilibrium income and rental hedonic equations, respectively.

Let EQ^*, h^*, and X^* be the solutions to the above utility maximization problem specifying, respectively, the region he will be, EQ^*, the kind of house he will live in, h^*, and how much of the numeraire good he will be able to consume, X^*. As a result of it, we have that the income of the consumer will be: $I^* = I(EQ^*)$, and the rent he will pay for his house is: $P^* = P(h^*,EQ^*) = R^*\, h^{*\prime}$, where $R^* = R(EQ^*)$. Equivalently, the problem can be stated in terms of an indirect utility function V(.) where,

$V(I^*,EQ^*,R^*) = \max U(h,X,EQ^*)$

with respect to h,X

subject to $I^* = R^*\, h' + X$

Equilibrium for consumers requires that utility is the same at all regions, that is, V(I,EQ,R) = v, where v is a constant. This equilibrium condition implies that individuals in regions with better environmental quality pay for it through reductions in real income in the form of higher rent and lower wage income.

A cost minimizing firm solves the following problem:

min I(EQ) L + r K + R(EQ) h'

with respect to L, K, h, EQ

subject to X = f(K,L,h,EQ)

where K is capital, L is labor, I(.), and P(.) are the equilibrium income and rental hedonic equations, respectively, r is the unit price of capital, and f(.) is a constant returns to scale production in K and L.

Let EQ^*, h^*, K^* and L^* be the solutions to the above cost minimization problem specifying, respectively, the region the production activity takes place, EQ^*, the kind of building or office the company will use, h^*, and how much of capital and labor will employee (K^*,L^*). As a result of it we have that the income that the company will pay to the consumer will be: $I^* = I(EQ^*)$, and the rent he will pay for the building facilities it uses: $P^* = P(h^*,EQ^*) = R^* h^{*\prime}$, where $R^* = R(EQ^*)$. Equivalently, the problem can be stated in terms of a unit cost function C(.) where,

$$C(I^*,EQ^*,R^*) = \min I^* L + r K + R^* h'$$

with respect to L, K, h

subject to $X = f(K,L,h,EQ^*)$

Equilibrium for producers requires that unit cost is the same at all countries, that is, C(I,EQ,R) = c. If the overall environmental quality of a region provides a net productivity advantage to firms, they will pay for it in terms of higher incomes and rents. Wages and rents in each region are finally determined by the interaction of the location decisions of households and firms.

The model described above is illustrated in Figure 1. The downward sloping curve in Figure 1, labeled V(I,EQ;R), shows combinations of I and EQ for which utility is equal to v. The slope of these curves is the trade-off that households are willing to make between wage income and environmental quality for any given level of implicit prices for housing characteristics (R) and the given utility level v. Along each curve, the implicit prices of housing characteristics is fixed and the curves shift up (down) as the implicit prices of the housing characteristics increase (decrease). The implicit prices of housing characteristics in the region labeled 2 is greater than the ones in the region labeled 1, since individuals enjoying a higher environmental quality at every level of income must have in equilibrium their utility equal to v, so that there is no incentive for moving to other regions.

Combinations of EQ and I for which the unit costs of firms are equal are depicted in Figure 2. The value of the environmental characteristics of the region to firms is fixed along each iso-cost curve, and the curves shift up (down) as the environmental characteristics of a region increase (decrease) the productivity of firms and the implicit prices, R, of the real estate market. According to Figure 2, the implicit prices in region 2 are greater than those of region 1, since firms facing a higher environmental quality and having as a result of it a higher productivity at every level of wage income must have in equilibrium their unit cost equal to c, so that there is no incentive for moving to other regions.

Each region is characterized by an environmental quality index and a vector of implicit rental prices that are associated with a specific pair of iso-cost and iso-utility curves as in Figures 1 and 2. The intersection of any two curves for each region **at the level of its environmental quality** then determines the relative income and the implicit prices of the real estate market in equilibrium. In Figure 3, in region 1, where environmental quality equals EQ_1, the equilibrium income will be I_1 and the equilibrium implicit rental prices R_1. Using region 1 as a reference point, which could be thought as the average region, we can see in the following how interregional differences in environmental quality will be reflected in differences in incomes and implicit rental prices.

Let us consider a region 2 that differs from 1 only in that the environmental quality of the former is valued more by consumers than the environmental quality of the latter. This implies that, ceteris paribus, rents in region 2 will be relatively higher than rents in region 1. In Figure 3, this is illustrated by $V(R_2)$ lying above $V(R_1)$. Assuming there is no difference in environmental quality between the two regions from the firms' point of view, we have that in equilibrium incomes in region 2 must be lower relative to region 1. The latter implies (i) that $C(R_2)$ lies above $C(R_1)$ as shown in Figure 3, and (ii) that $C(R_2)$ has moved up relatively more than $V(R_2)$. As a matter of fact, the greater the decrease in income, the greater the shift of the $C(R_2)$ curve relative to that of the $V(R_2)$ curve; please note that equal shifts of the two curves would imply that the point of their intersection is on the I_1O' line of Figure 3. The higher rents and lower incomes reflect the amount consumers are willing to pay to locate in region 2 rather than 1 and, therefore, the amenity value of EQ_2 relative to the average region. Moreover, since from the firm's point of view there is no difference in environmental quality between the two regions, the effects of higher rents and lower incomes on costs offset each other so that unit costs remain in equilibrium equal to c.

Let us consider another region, designated region 3, that differs from 1 only in that the environmental quality EQ_3 provides a greater productivity advantage to firms. This implies that, ceteris paribus, rents in region 3 will be relatively higher than rents in region 1. This relationship is illustrated in Figure 4, where region 3 is represented by $C(R_3)$ which is to the left of $C(R_1)$. If no amenity differences exist from a consumer's point of view, we have that in equilibrium incomes in region 3 must be higher relative to region 1. The latter implies that $V(R_3)$ lies above $V(R_1)$ as shown in Figure 4, and (ii) that $V(R_3)$ has moved up relatively more than $C(R_3)$. As a matter of fact, the greater the increase in income, the greater the shift of the $V(R_3)$ curve relative to that of the $C(R_3)$ curve; please note that equal shifts of the two curves would imply that the point of their intersection is on the I_1O' line of Figure 4. The higher rents and incomes reflect the amount firms are willing to pay to locate in region 3 rather than 1, and, therefore, the productivity value of EQ_3 relative to the average region. Moreover, since from the consumer's point of view there is no difference in environmental quality between regions 1 and 3, the effects of higher rents and incomes on the maximum utility of a consumer offset each other so that the maximum utility that a consumer enjoys in equilibrium remains equal to v.

If the above cases of Figures 3 and 4 on the same graph, see Figure 5, it is seen that: (i) when environmental quality is valued more by consumers, ceteris paribus, $C(R_2)$ and $V(R_2)$ have both been moved up and $C(R_2)$ has moved up relatively more, and (ii) when environmental quality is valued more by firms, ceteris paribus, $C(R_3)$ and $V(R_3)$ have both moved up and $V(R_3)$ has moved up relatively more.

Within this simple framework in which regions differ only in their environmental quality, we can determine whether environmental quality and income differences reflect interregional differences in amenities or productivity by examining the patterns of environmental quality and incomes across regions. If environmental quality and income differences primarily reflect amenity differences across regions, we would see a negative relationship between environmental quality and incomes. If they reflect productivity differences, the relationship would be positive.

Within the same framework, we can also classify individual regions on the basis of whether their incomes and environmental quality differ from the average because of above average amenities, below average amenities, above average productivity, or below average productivity. These classifications are summarized in Table 1 and Figure 6. Environmental quality is higher than the average in the high amenity and high productivity regions, and lower than the average in the low amenity and low productivity ones. On the other hand, incomes are relatively higher in the high productivity and low amenity regions

Each region is characterized by an environmental quality index, EQ, whose effect on household utility and production costs differs from region to region. The problem of classifying regions by the relative magnitude of these two effects becomes one of identifying the environmental quality and income differences in equilibrium relative to the shifts in each curve. This can be done by identifying the combinations of EQ and I in equilibrium that are associated with equal shifts of both curves and determining how incomes and environmental quality change relative to these shifts. The (EQ,I) equilibrium combinations associated with equal shifts of both curves would coincide with the EQ_1O and I_1O' lines in Figure 5, 6, and 7, where EQ_1 is the mean environmental quality and I_1 is the mean income.

For any region with above average incomes and environmental quality, the shift of the C(R) (productivity) curve must be less than the shift of the V(R) (amenity curve). The less the direct effect of environmental quality on utility, the greater the increase in consumer income needed to offset the increase in rents and, consequently, the greater the shift of the V(R) curve needed to keep the maximum utility level unchanged and equal to v in equilibrium. Therefore, any region with environmental quality and income combinations in quadrant A in Figure 6 is classified as "high productivity" region, because the primary reason that this region incomes, environmental quality, and rents differ from those of the average region is the above-average productivity effects of environmental quality. This above-average productivity effect is reflected in the ability of producers in these regions to pay above average incomes and rents for having at their disposal a greater than the average environmental quality.

Similarly regions with below average incomes and environmental quality (quadrant C in Figure 6) are classified as "low productivity" regions, since firms in these regions are compensated for the below average environmental quality effect on productivity with below-average rental prices and income.

Above average amenity effects of a region are associated with increases in rents and decreases in incomes reflecting consumers' willingness to pay relatively more for the effects of the regional characteristics embodied in the region's environmental quality. Quadrant D then identifies regions where the environmental quality is greater then the average and the dominant factor determining relative incomes and rents is the high amenity effect. For regions in quadrant B, the dominant factor is their below-average amenity value.

These labels may be misleading in that what we are referring to as "high productivity" regions are not necessarily more or less attractive to households than the "high amenity" regions. A region like the one represented by point A in Figure 7 is relatively more attractive to households and firms than region 1. This relationship can been seen by the position of $C(R_A)$ and $V(R_A)$ relative to the average region. The effects that dominates, however, is the productivity effect, since the shift of the V(R) curve is relatively greater than the shift of the C(R) curve. If the shift of the V(R) curve were equal to that of $C(R_A)$, that is, if it had moved to the position $V(R_{A'})$ instead of $V(R_A)$, the equilibrium would be at point A' and the region would not be able to be characterised neither as high or low amenity nor as high or low productivity.

Another region like the one represented by point B may be less attractive to both firms and households than region A (again reflected in the relative positions of the amenity and productivity curves). However, the dominant trait of region B is its amenity, which is above average.

To apply the above theory the environmental quality can be defined as follows:

$EQ_j = Ó_{i=1}^{N} (w_i a_{ij}) / Ó_{i=1}^{N} (w_i)$ for $j = 1, 2, 3, ..., m$

where a_{ij} is the ith environmental characteristic of region j, w_i is the weight for the characteristic i, N is the number of environmental and other characteristics considered, and m is the number of regions being examined. The weights w_i can be all equal to 1/N or be assigned atheoritically using principal component or survey results. However, in all cases the weights should be the same across regions, that is, they should not be indexed by j.

3. AN AMENITY-PRODUCTIVITY CLASSIFICATION WITHIN THE EUROPEAN UNION.

The implications of the above theoretical analysis can be used for a classification of the Former Soviet Union (FSU) member states. To compute the environmental quality, EQ, for each country, the following variables have been considered:

1. Life expectancy at birth
2. Adult literacy rate
3. Mean years of schooling
4. Literacy index
5. Maternal mortality rate per 100,000 live births
6. Population per doctor

To compute an environmental quality or quality of life index we usually consider a variety of variables. However, this variety of variables was not available for the case of the FSU states. Only the above Human Development Report (1993) variables were available for all states. Therefore, these were eventually the variables considered. The variables included in our index give a sufficient description of two important aspects of life in the regions considered, namely knowledge and health. Certainly, more information is needed before global quality of life or environmental quality indices are estimated.

The above variables for each country are scaled from 0 to 100. The scaling is such that all scaled variables are having a positive relationship with the environmental quality index, that is, the greater the value of the scaled variable, the greater the EQ value.

Finally, to compute EQ for each country we have (i) used the scaled variables, (ii) used data from the Human Development 1993, and (iii) assumed that the weights of all environmental and other variables in the above definition of EQ are equal to 1/N, that is, $w_i = 1/N$ for all i characteristics in all regions j.

The environmental quality and per capita income combinations, (EQ,I), for all Former Soviet Union member states are given in Table 2. Table 2 and the results of our theoretical analysis imply the positioning mapping of Figure 8. This identifies three group of countries, namely, the high-productivity: Lithuania, Estonia, Latvia, Belarus, Russia, and Ukraine, the low-productivity: Moldova, Georgia, Tajikistan, Armenia, Uzbekistan, Kyrgyzstan, Kazakhstan, and Turkmenista, and the high-amenity: Azerbaijan; none of the countries is characterised as low amenity.

4. CONCLUSIONS.

The theory presented here is offered for the establishment of an amenity-productivity classification of regions based on environmental quality and income differentials. This kind of classification is useful because it provides information about the relative attractiveness to consumers and producers of the total bundle of environmental and other attributes indigenous to each region. The theory is applied to position the Former Soviet Union member states on an amenity-productivity map. The analysis shows that none of the countries is characterised as low-amenity according to the adopted criterion. Among the rest Lithuania, Estonia, Latvia, Belarus, Russia, and Ukraine are high-productivity, Moldova, Georgia, Tajikistan, Armenia, Uzbekistan, Kyrgyzstan, Kazakhstan, and Turkmenista are low-productivity and Azerbaijan is high-amenity country.

TABLE 1

CLASSIFICATION OF REGIONS	I	EQ	SHIFT
HIGH AMENITY	Low	High	Both curves up and $C(R_i)$ relatively more
LOW AMENITY	High	Low	Both curves down and $C(R_i)$ relatively more
HIGH PRODUCTIVITY	High	High	Both curves up and $V(R_i)$ relatively more
LOW PRODUCTIVITY	Low	Low	Both curves down and $V(R_i)$ relatively more

TABLE 2

COUNTRY	EQ	REAL GDP PER CAPITA $)
LITHUANIA	68,79	4913
ESTONIA	64,87	6438
LATVIA	64,76	6457
BELARUS	60,14	5727
RUSSIA	55,5	7968
UKRAINE	52,51	5433
AZERBAIJAN	51,62	3977
MOLDOVA	48,23	3896
GEORGIA	47,38	4572
TAJIKISTAN	46,18	2558
ARMENIA	44,65	4741
UZBEKISTAN	43,83	3115
KAZAKHSTAN	37,43	4716
KYRGYZSTAN	37,22	3114
TURKMENISTAN	36,98	4230
Mean	50,67	4790

FIGURE 1

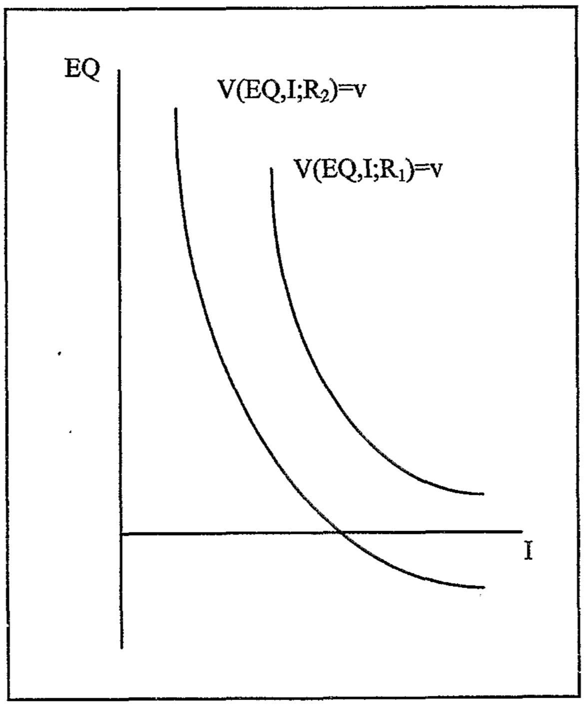


FIGURE 2

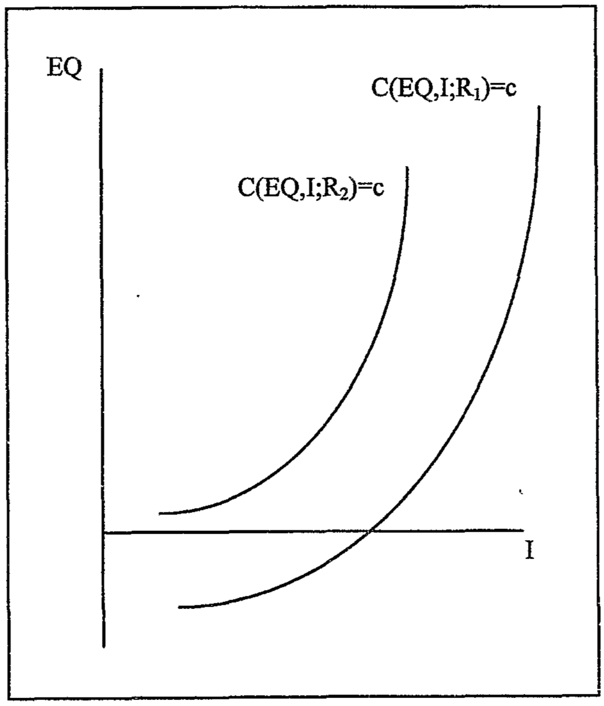


FIGURE 3

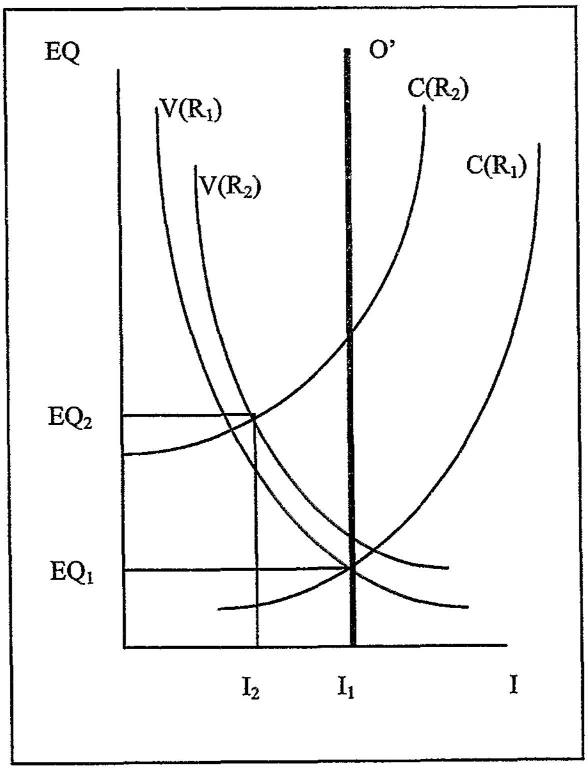


FIGURE 4

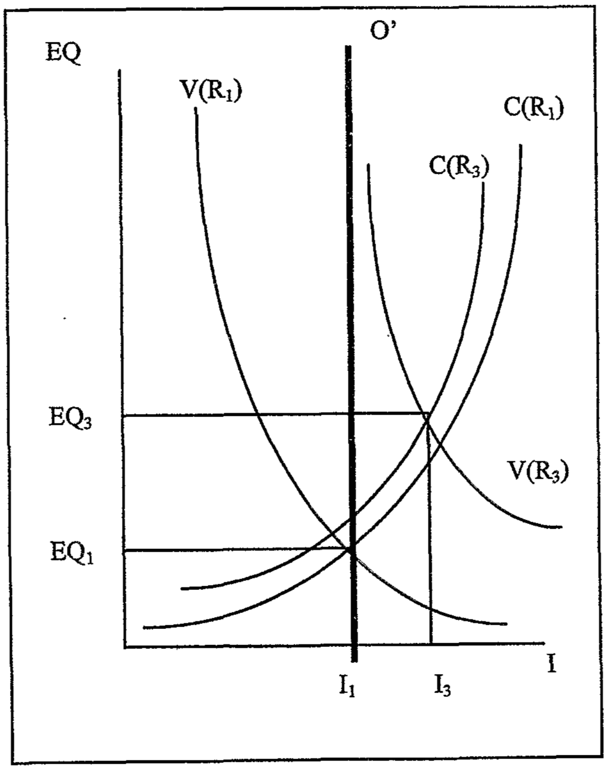


FIGURE 5

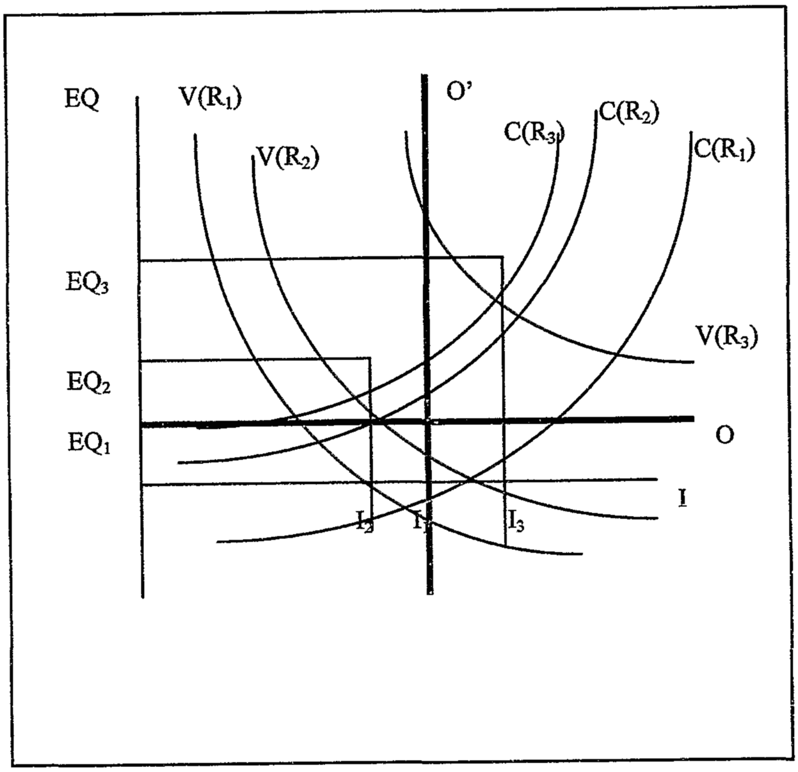


FIGURE 6

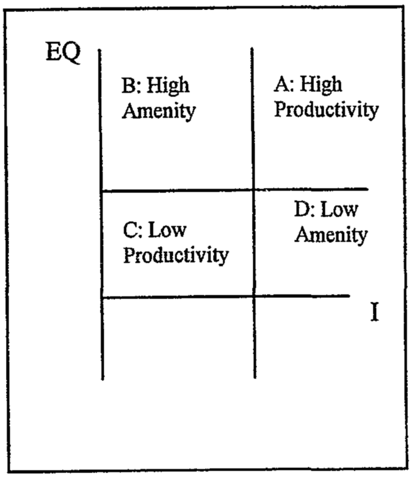
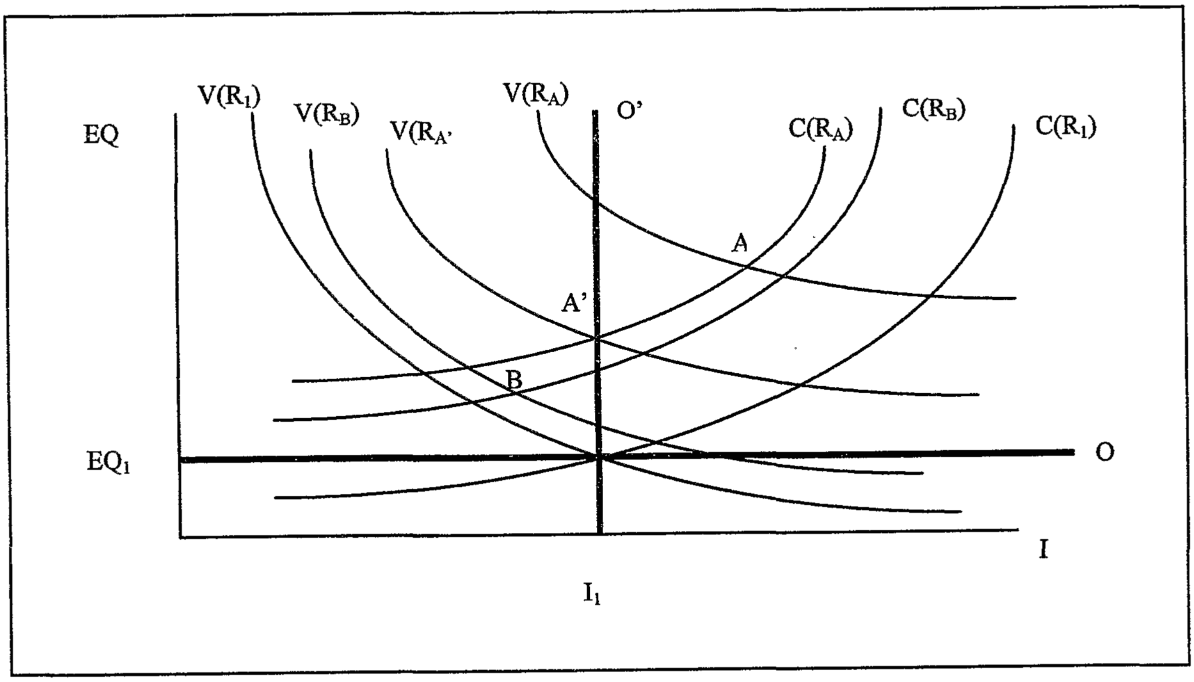


FIGURE 7



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