4 SUPPLY SIDE: ECONOMIC RENT METHODOLOGY

The concept of economic rent is derived from basic Ricardian economic theory and provides a means of explaining the increased value of economic resources (land, labor and capital) and their change in value in different circumstances or market conditions. Accessibility is a key spatial variable that affects the likely uses of economic resources and, therefore, their value. Changes in accessibility result in changes in the economic rent that economic resources can command and, therefore, the value and character of the economic activities that take place at any location. As a result, for important economic welfare criteria (such as employment, household income, and property values), an evaluation can be made of the likely change in economic rent that will be associated with an improvement in accessibility generated by a given transportation investment.

Economic rent may be defined as the difference between what the factors, or productive services, of a resource-owner earns in their current occupation and the minimum sum he is willing to accept to stay there. It is then a measure of the resource-owner's gain from having the opportunity of placing his factors in the chosen occupation at the existing factor price, given the prices his factors would earn in all other occupations. It is the proper counterpart of consumers' surplus when this is regarded as the consumers' gain from having the opportunity of buying a particular good at the existing price, where all other prices are given. And like a change in the consumers' surplus, it is a measure of the change of his welfare when the relevant prices in the market are altered. Whereas the increase of consumers' surplus is a measure of his welfare gain for a fall in one or more product prices, the increase in that person's economic rent is a measure of his welfare gain from an increase in the price or the volume of the sale of his factors, i.e. increased sales should generate increased profit.

Conventionally, a persons' price-demand curve is drawn as sloping downward to the right, his price-supply curve as sloping upward to the right. If income effects are zero, the individual's demand curve must slope downward: it can slope upward—the characteristic of a so-called "Giffen good"—only if the income effect is negative, and largely relative to the substitution effect. Similar remarks apply to the individual's supply curve. If the income-effect or rather, the 'welfare effect'[18] is zero, the individual supply curve must slope upward: it can slope downward, or become 'backward-bending', only if the welfare effect is positive and largely relative to the substitution effect[19].

Typically, the level of economic rent can be calculated as follows:

[18] Assuming his money income constant, a fall in the price of a good, which makes a person better off, can be regarded as an increase in his real income. For there is some rise in his money income which (given all other prices constant) will be accepted by him as equivalent to a fall in the price of that good. Here, no difficulty arises in identifying the increase in his welfare with the income effect so measured. In the case of his supplying a service to the market, however, his money income cannot be assumed constant, since, obviously, it varies with the amount of the service he elects to supply at the price offered. What is more, a rise or fall in the resulting money income does not necessarily correspond with a rise or fall in his welfare. A rise in the wage rate, for instance, may result in workers choosing to reduce hours while maintaining the same income, notwithstanding which his welfare has increased: for his income is the same while he enjoys additional leisure. A positive welfare effect, that is, can be associated with no change in his money income or even with a reduction in his money income. For this reason, it is more sensible to talk of the 'welfare effect' resulting from a change in the supply price.

[19] An increase of welfare has a normal or positive welfare effect if the person offers less at any given price—if that is, he keeps more of the good he is offering for himself. A worker who came into an inheritance would supply less labor. Hence if the price of a good a person supplies is raised, the substitution effect induces him to supply more while a positive welfare effect causes him to supply less. As distinct then from the income effect on the demand side, the welfare effect on the supply side, if it is positive, works against the substitution effect.

Economic Rent (ER) = f (P_t, I_t, E_t, C_t, T_t) (4)

Where:

P_t is a measure of Population structure of an area in year t;

I_t is a measure of Industrial structure of an area in year t;

E_t is a measure of Education level of an area in year t;

C_t is a measure of Cultural characteristics of an area in year t;

T_t is a measure of Transportation efficiency of an area in year t.

Population: The population structure can affect the economic potential of an area positively or negatively. For example, an aging population could have a negative effect on the economy as the number of workers in the work force may fall. This can reduce productivity and as a result reduce the economic rent profile. The US may experience this problem in the second quarter of the 21st century as baby boomers age if technology improvements and increased output do not raise productivity sufficiently. Typically, the more productive the adult population of an area is, the higher the economic rent profile.

Industrial: The nature of the industrial structure and resource base defines the potential economic rent profile of an area, e.g., manufacturing, commercial, agricultural, residential, and service industry. The higher the value added by industry, the higher the area's economic rent profile. For example, the "new economy" jobs in biotech, computers and finance all have very high incomes and economic rent profiles associated with them. The City of Toronto in the 1970s and 1980s was saved from a major loss of economic rent associated with the failing metal manufacturing industry and its associated jobs by a massive infusion of financial sector jobs [16].

Education: Educational levels can have a dramatic impact on economic rent potential of an area. Typically, a higher education level (especially Ph.D.'s or other high degrees) will increase the wealth generated by the population. The Baltimore-Washington region for example boasts one of the highest concentrations of Ph.D.'s in the US, which supports the growth of high tech industry in the region. According to the data assembled by the Metropolitan Washington Council of Governments (source: US Census Bureau), 20.6% of individuals over the age of 25 residing in the Baltimore-Washington region have a graduate or professional degree. This is well above the national average of 8.9%.

Cultural: Differences in cultural, ethnic and other social characteristics of an area can impact its economic potential. For example, cultural belief systems can impact the ability of a population to work at certain jobs or in a certain way and, therefore, the level of economic rent that can be attained. A recent survey by the United Nations of the economic growth potential of Arab countries found that the low level of freedom, limited Internet use and the absence of women in the workforce have had a marked negative impact on economic productivity [17].

Transportation: Transportation efficiency can greatly affect the economic potential of an area. The more effective a transportation system in moving people and goods, the greater its ability to generate wealth if the economy is responsive to the opportunity presented. It is no coincidence that most of the US's large east coast cities grew as "break of bulk" ports at

locations that had good harbors, and good access to the interior resources and markets. Since the quality of a transportation system is a management variable and can be changed in the short term, investment in the transportation system can generate economic development if the investment is made in a growing and vibrant economy. The level of response that the economy will have to a transportation investment is measured by the economic rent profile, which is discussed in Appendix B.

Where it is important to recognize that education, population, industry, structure, and culture can change over time changing the economic rent profile, these are not factors that typically change rapidly. Only if an area experiences a significant dislocation or migration associated with rapid and dramatic population and industrial base shifts will it experience a radical change in its economic rent profile. For example, the influx of Hong Kong residents to Vancouver, Canada, in the 1980s dramatically changed the economic rent profile of several areas of the city's downtown. The effect was largely due to the wealth and "entrepreneurial" capability of this new population. One of the issues for the Midwest is the fact that while it has some of the countries leading academic institutes, it is still losing much of this talent because is not developing the New Economy businesses at a sufficient rate.

In the absence of a major dislocation, we can assume that the economic rent factors I_t, E_t, P_t, and C_t will remain largely unchanged. However, transportation efficiency can change significantly in the "short term." Major transportation infrastructure projects can dramatically change the accessibility of markets and the opportunity for economic growth. This can apply to the measurement of goods in a manufacturing-dominated economy or to the movement of people in a service industry-dominated economy. The economic rent generated by transportation improvements (T_t) has driven the desire to move people more quickly and cost-effectively over time. As a result, our economic rent model reduces to:

$$ER = f(T_t) \qquad (5)$$

By using socioeconomic variables (SEi) as a proxy for economic welfare and generalized cost ($GC_{i)}$) as a specific metric for transportation efficiency[20] measured in terms of time and cost the economic rent equation can be rewritten as:

$$SE_i = \beta_o GC_i^{\beta 1} \qquad (6)$$

Where:

SE_i - Economic Rent factors – i.e. socioeconomic measures such as employment, income, property value of zone I;

GC_i - Weighted generalized cost of travel by all modes and for all purposes from (to) zone i to (from) other zones in region n;

β_o and β_1 - Calibration parameters.

The resulting curve generated by this function is the economic rent profile for transportation accessibility. For public modes (rail, bus, air) and private modes (auto), the

[20] In certain cases it is important to use travel utility as a metric for transportation efficiency included into Economic Rent model (see chapter 5).

generalized cost of travel includes all aspects of travel time (access/egress time and in-vehicle time), travel cost (fares, tolls, parking charges), and service frequency.

The generalized cost of travel is typically defined in travel time rather than dollars. Costs are converted to time by applying appropriate conversion factors. The generalized cost of travel between zones i and j for mode m and purpose p is calculated as follows[21]:

$$GC_{ijmp} = TT_{ijm} + \frac{TC_{ijmp}}{VOT_{mp}} + \frac{VOF_{mp} * OH}{VOT_{mp} * F_{ijm}} \qquad (7)$$

Where:

TT_{ijm} = Travel time between zones i and j for mode m (in-vehicle time + waiting time + delay time + connect time + access/egress time + interchange penalty), with waiting, delay, connect and access/egress time multiplied by two to account for additional disutility felt by travelers for these activities[22];

TC_{ijmp} = Travel cost between zones i and j for mode m and purpose p (fare + access/egress cost for public modes, operating cost for auto);

VOT_{mp} = Value of Time for mode m and purpose p;

VOF_{mp} = Value of Frequency for mode m and purpose p;

F_{jjm} = Frequency in departures per week between zones i and j for mode m;

OH = Operating Hours per week.

The Economic Rent theory builds from the findings in Urban Economics, and Economics of Location that support the Central Place Theory. Central Place Theory argues that in normal circumstances places that are closer to the "center" have a higher value or economic rent. This can be expressed in economic terms, particularly jobs, income, and property value. There is a relationship between economic rent factors (as represented by employment, income, and property value) and impedance to travel to market centers (as measured by generalized cost). As a result, lower generalized costs associated with a transport system improvement leads to greater transportation efficiencies, and increased accessibility. This in turn results in lower business costs/higher productivity per and, consequently, an increase in economic rent. This is represented by moving from point B to point A in Exhibit 4.1.

It should be noted that the shape of the economic rent curve reflects the responsiveness of the economy to an improvement in accessibility. Large cities typically have very steep curves, which indicate more significant economic impacts due to a transportation improvement; smaller communities have less steep curves, and rural areas have very flat curves that indicate lower economic responsiveness (see Exhibit 4.2).

[21] In comparison with formula (1) formula (7) includes not only value of time, but also value of frequency. For certain regions generalized cost might also include value of reliability and/or value of seasonality.

[22] Issues of travel time calculation, including the weighting factor for travel time is broadly discussed in the literature. See, for example: [18], [19]:

Given that the economic rent profiles exist in all directions from a given market center it is inevitable that the rent profiles will link into 'rent tents', and that the rent tents will merge across the study area into a 'rent surface' which measures the economic rent for the whole study area. As the economy grows so the rent tents become higher and the economic rent profiles steeper. (See Exhibit 4.3)

Exhibit 4.1: Economic Rent Illustration

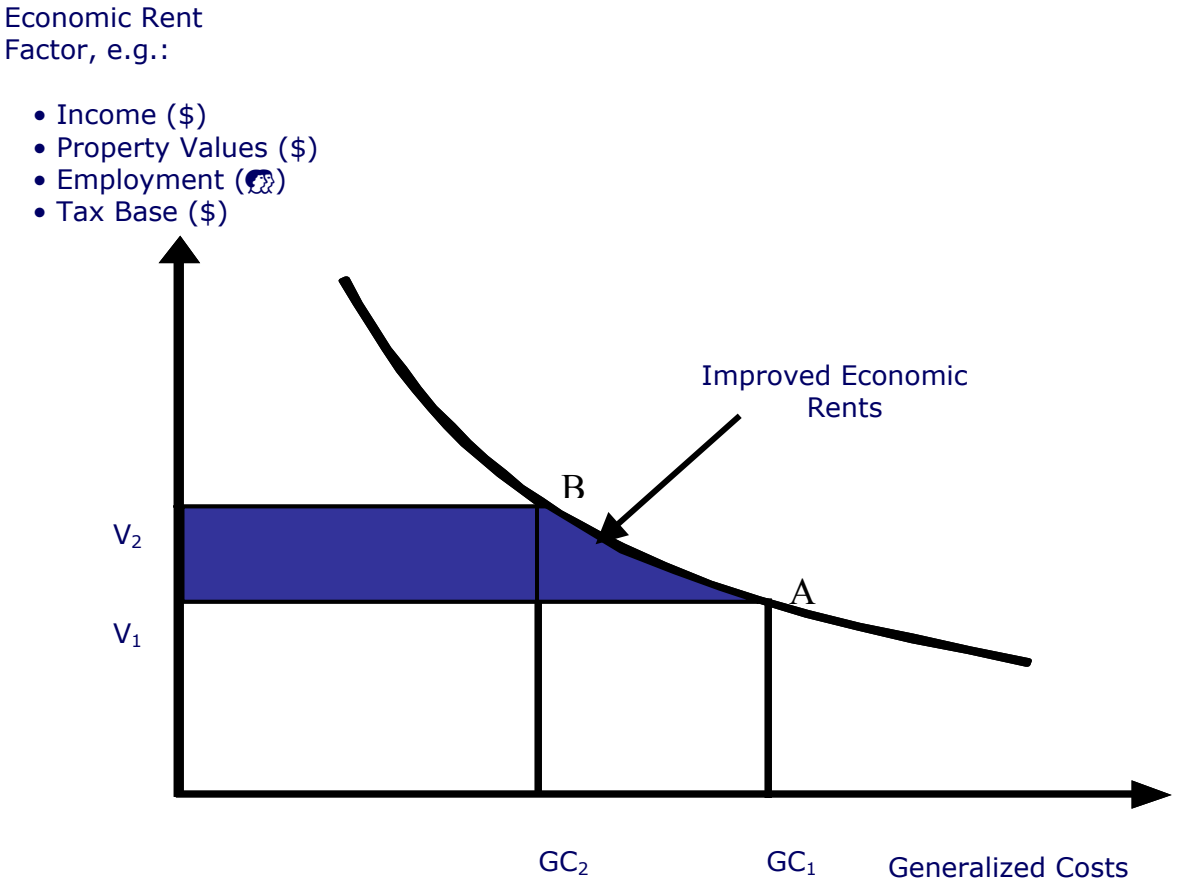

Exhibit 4.2: Types of Economic Rent Curve

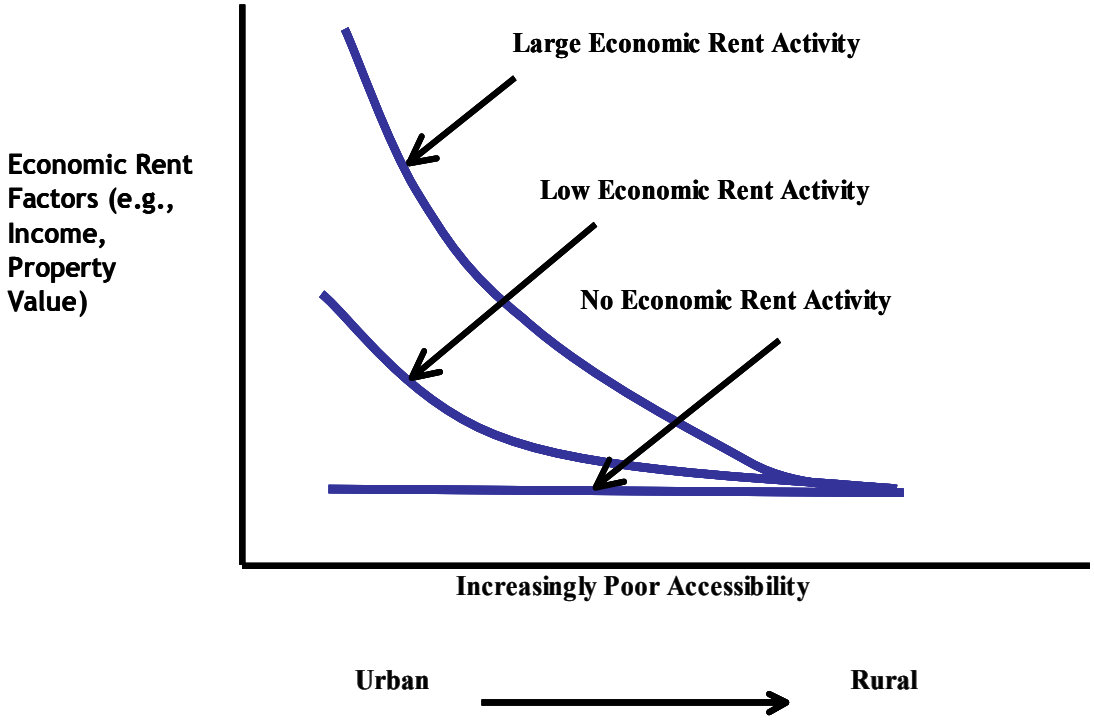

Exhibit 4.3: Interaction of Economic Rent Profiles Creates Economic Rent Tents
(Cleveland Area Economic Rent Tent)