"Economic Growth and the Natural World"

Wesson, Joseph

20 October 2014

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Joseph P. Wesson, Ph.D.

Normandale College

Bloomington, MN

ABSTRACT: This is a survey of some ideas relating to the theory of economic growth and how economic growth impacts the natural world.

I

There are two basic ideas relating the sustainability (i.e. – viability) of a society and its economy in relation to its available natural resources.

Proposition one: For any given technology, there is a population size small enough that the technology, and the economy that uses it, are economically sustainable.

Proposition two: Given a large enough population size, no technology is economically sustainable.

This of course still does not pin down what we mean by the term, 'sustainable.' Do we mean, "Human activity should have no effect on the natural environment."? This is whimsical. Since we are a part of the natural environment, we must have an impact on it. Do we mean, "Our actions should be those that maximize the mean time until the extinction of life on Earth."? Perhaps, but that is a bit grandiose. Do we mean, "Our actions should be those that maximize the mean time until the extinction of the human race.", once again, maybe. Do we mean, "The environment on Earth should be maintained in a way that reflects human aesthetic sensibilities."? This final statement is likely the one that most closely reflects the functional reality of what people, in general, desire. I would expect this notion to be rejected out of hand by most people. Why? It is because of factors of cultural bias. In Western culture we seem to believe that objective criteria are the only valid concepts to use in decision making, and that, subjective criteria are invalid. This is based on the false idea that to be rational is to be objective. And since we cherish some subjective concepts so deeply, we pretend that they are objective concepts. This attitude has the consequence of making all our discussions nonsensical.[1] However, what we should recognize is that subjective concepts are also rational and are actually the basis for all choices. A study of Economic theory reveals that all

[1] While I wish I could blithely proceed without further discussion on this point, since it is not a central point in the discussion, the manner in which policy is discussed today precludes that approach. We use words such as 'freedom' or 'fairness' as though they communicate well defined concepts when they do not. So, if someone were to make the statement, "We have a duty to protect Nature." And I was then to ask, "Why?" And the reply was, "Because if we don't we'll be destroyed." Then that is not a 'duty.' That is simply the instinct of self-preservation. Someone with an alternative strategy for human self-preservation has an equally strong case for their method under that criterion. The Natural World is a common pool and is subject to all the concerns that situation represents. It is an asset and it has economic value. It should be used wisely. But, that is the crux of this point, what do we mean by 'wisely.'

choices are made based on subjective criteria. What term would we use to describe a self-consistent structure of subjective criteria? That term would be 'an aesthetic.'[2]

Given propositions one and two, we can see that the question of sustainability revolves primarily around the size of the population and secondarily around the particular technology being used. When moved into the context of growth theory, then our concerns are population growth and the process of technological change.

II

As we address questions of Economic growth and its impact on the natural world. Our first goal should be to highlight relationships between technological change and population growth.

Let us begin with a discussion of technological change.

When is a technological change adopted? When it lowers opportunity costs. This decrease can come in two forms; first, it can decrease the cost of producing a good as it is currently produced, second, it can result in the replacement of a previously produced good by a new good that more fully satisfies a human desire. The second also has to lower opportunity costs since, if it did not, people would prefer consumption of more of the old good to the consumption of less of the new good. Otherwise, the adoption of the new good shifts the Production Possibilities Hyper-plane inward rather than outward, thus resulting in lower total benefits. Technological changes will be adopted only if they increase benefits, any change that raises opportunity costs (and as such, decreases total benefits) will be ignored. The opportunity cost of production represents a usage of resources. When that cost decreases, the average use of resources per unit of a good also decreases. So, for an Economy as a whole, given static income levels and income distribution, it uses more total resources per person over time only when the population increases at a rate larger than the rate of technological change. Since each person has only a finite amount of time to spend on goods and leisure time (24 hours in a day, 7 days in a week, 52 weeks in a year, 80 years in an average

[2] If you are unclear on the usage of the word technology here, it's meaning is 'the method of production used for the goods in the economy being discussed.'

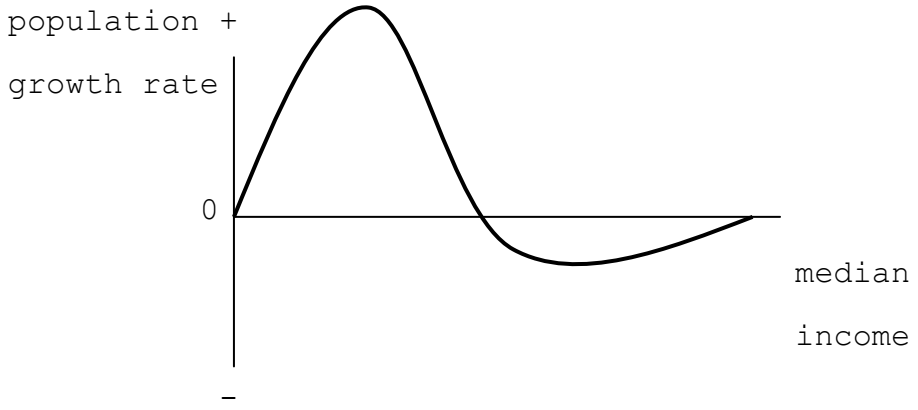
lifetime) there is an upper bound on what they will desire to consume.

III

There are two places in the economy where this effect stands in stark relief, in Labor Supply and in Savings Functions.

First, we will consider Labor Supply. As the above discussion suggests, there are two important elements, one is a discussion of population growth[3] and the second is the traditional Economic principles of the income effect and the substitution effect.[4]

Over time the empirical evidence on the relationship between population growth rates and individual (or average) incomes appears to show the pattern depicted in the graph below.



So as the population size stabilizes and the age profile of the population stabilizes, the labor supply curve will stabilize.

If all goods (including leisure) display a pattern of diminishing marginal utility, labor supply from the individual will begin to decrease when, as the wage increases, the utility of the goods purchased (either now or in the future) with the income earned in the marginal hour of work is less than the utility of that hour used as leisure. Since technological change will raise wages over time, eventually a society of ever higher incomes will reach a point where each individual supplies an ever decreasing quantity of labor. This combined with the

[3] Myrskyla, Mikko, Kohler, Hans-Peter, and Billari, Francesco C., "Advances in Development Reverse Fertility Declines, Nature 460, pps 741-743, August 6, 2009

[4] OI, Walter, "Labor as a quasi-fixed factor," Journal of Political Economy, vol. 70, no. 6, December, 1962, pps. 538-555

stabilization of the labor supply curve, will give us the familiar backward bending labor supply curve.

So, then the use of resources will increase only if the growth rate of income exceeds the rate of technological change.

Now consider savings. First, people save/dis-save (borrow) in order to allocate consumption actions over time. This is the normally used paradigm for savings behavior in Economic theory. Second, people save because they are satiated in goods. This is usually ignored in Economic theory.

Interest rate changes change the relative price of goods in the present to goods in the future. As the interest rate rises goods in the future fall in price and goods in the present rise in price, each relative to the other (and vice versa for interest rate decreases). This should make people buy more goods in the future (save more or borrow less) and fewer goods today. This change also has an income effect, so that if you are a net saver, you can buy more goods both in the future and in the present with a higher interest rate than at the lower interest rate. However, if you are a net borrower, it is the fall in the interest rate that will allow you to buy more goods both in the future and in the present.

The individual incomes of people also increase for reasons exogenous to the interest rate. This also effects savings. As an individual's income increases, they will buy more present goods and save more. As their income increases, one by one, eventually, the marginal utility of the final unit of each good in the present will reach zero, once this has occurred, then all increases in income will be savings. As this is occurring, the individual is saving larger and larger amounts, so they are able to buy more goods in the future. The marginal utility of the final unit of each good in the future will also be decreasing and for each future good will also reach zero at high enough income levels. At this point, purchases of goods and services by that individual will not increase. And any addition to income will be savings and that individual's savings rate will increase. So, what is the purpose of earning a higher level of income in this situation? It would seem the only things left would seem to be goals of power, social position, and prestige.[5] These are also ordinary human goals.[6]

[5] If you have qualms about treating things such as these differently than we would treat shoes, computers, automobiles, etc. Please, I beg you, describe the production function with fixed and variable factors of production that produces these things, or, a functional form that approximates it.

[6] Veblen, Thorstein, The Theory of the Leisure class, 1899, The Modern Library, New York, N.Y.

So, as the median income in an economy increases, the growth rate of consumption per person over time will grow at a slower and slower rate until it would eventually fall to zero.

IV

So, the population growth rate converges to zero. That being true then the growth rate of the aggregate capital stock will also converge to zero. The growth rate of aggregate consumption converges to zero. Technological change continues to occur. Therefore, resource use falls over time at the rate of technological change.[7]

So, present and future circumstances could easily fall within those described by proposition one. Which leaves the author with hope for the future.

[7] Solow, Robert, "A Contribution to the Theory of Economic Growth," The Quarterly Journal Of Economics, vol. 70, no. 1, Feb. 1956, pps. 65-94
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