A PATH TOWARDS STRONG SUSTAINABILITY

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Overview

There are diverse and seemingly conflicting concepts in sustainability as it is evident that studies based on different concepts yield contrasting results.. For example, the Environmental Sustainability Index showed that 73 nations are unsustainable while the World Bank's ranking of sustainability showed that only 32 nations are unsustainable (Yale, 2005; World Bank, 2006). The study assumes that a score of less than 50 on the Environmental Sustainability Index implies an un-sustainability. The confusion is further compounded when nations such as Russia and Ecuador are shown sustainable on the Environmental Sustainability Index, but are considered unsustainable by World Bank. The root of this confusion is because there is a lack of agreement on the path to take towards achieving sustainable development (SD).

The two main branches of SD are weak sustainability (WS) and strong sustainability (SS). Weak and strong sustainability approaches are fundamentally different as the former assumes that man-made capital is substitutable for natural resources, with the latter assuming otherwise. As such, proponents of either model are not agreeable with one another on how to achieve sustainable development. Currently, the WS approach is dominated by the Solow-Hartwick sustainability model and developments in this area are mainly to improve upon the original model. SS on the other hand, is not dominated by any models and there are numerous models that adopt the SS approach. Contrasting assumptions between WS and SS resulted in few attempts to reconcile the models of weak and strong sustainability, one of these few attempts were from Common and Perrings and their verdict is that WS is both insufficient and unnecessary for SD (Common and Perrings, 1992). However, there has been very little research following Common and Perrings' work as literatures on SD have developed separately and exclusively along the path of weak or strong sustainability. This paper seeks to use approaches from both weak and strong sustainability and find out if there exists a way to achieve both states so that there is a more agreeable path towards SD.

This study revisits the Solow-Hartwick model (Solow, 1974 and 1986; Hartwick, 1977, 1978a and 1978b) and shows that an economy can achieve intergenerational equity by mandating the Hartwick rule of "investing all rents from natural capital into renewable capital". It derives a more general form of the Hartwick rule by relaxing the assumptions of constant population and no technological progress. The Hybrid Sustainability Model (HSM) incorporates both WS and SS approaches to provide a less contentious path for SD and resolves the confusion surrounding the path towards SD due to the differing assumptions of WS and SS. Using this result, it derives the HSM investment rule and shows how weak sustainability can be attained. It further extends the HSM and explains how the residual Hotelling rents should be utilized in order to achieve strong sustainability. Lastly, it discusses the policy implications and critiques for the HSM and presents directions for future research.

Methods

The Solow-Hartwick model for sustainable consumption is modified and a Hybrid Sustainability Model is constructed.

Results

From the HSM constructed, five propositions relating to the investment rules for ensuring weak sustainability are derived, the numerical simulations of the HSM investment rules are carried out and some policy implications are drawn.

Proposition (1): If an economy has positive population growth rate and constant level of technology, $(n > 0, g_A = 0)$, then the amount of investment in man-made capital needed to maintain per capita output at the current period level is more than the total Hotelling rents.

Proposition (2): If an economy has constant population and positive technological progress, $(n = 0, g_A > 0)$, then the amount of investment in man-made capital needed to maintain per capita output at the current period level is less than the Hotelling rents.

Proposition (3): If an economy has constant population and negative technological progress, $(n = 0, g_A < 0)$, such that $(|g_A| < \alpha)$, then the amount of investment in man-made capital needed to maintain per capita output at the current period level is more than the Hotelling rents.

Proposition (4): If an economy has positive population growth and technological progress, $(n, g_A > 0)$ such that the population growth-augmented level of capital is less than or equal to the technological progress-augmented level of the Hotelling rents,

$\left[nK \le \left(\frac{g_A}{g_A + \alpha} \right) (Y_R - a) R \right]$, then the amount of investment in man-made capital needed to maintain per capita output at the current period level is never more than the entire Hotelling rents.

Proposition (5): If an economy has positive population growth and technological progress, $(n, g_A > 0)$ such that $\left[nK > \left(\frac{g_A}{g_A + \alpha} \right) (Y_R - a) R \right]$, then the amount of investment in man-made capital needed to maintain per capita output at the current period level is more than the entire Hotelling rents.

Conclusions

This study constructs the Hybrid Sustainability Model (HSM) by extending the Solow-Hartwick model to include population and technological changes and derived an investment rule. The most interesting result of the HSM investment rule is that economies with positive population growth and technological progress are generally 'more' than weakly sustainable. This tells us that most economies need not use all of their Hotelling rents to ensure for weak sustainability (WS). The HSM also suggests that the residual Hotelling rents must be invested in renewable natural resources towards the Safe Minimum Standards (SMS) level to achieve strong sustainability (SS). The focus is on renewable natural resources because ecological goods and services are not used in a sustainable manner due to their common resources and pure public goods characteristics (Dasgupta, *et al*., 2000; Hardin, 1968). This is in direct contrast to the Solow-Hartwick model where renewable natural resources are believed to be used in a sustainable manner (Hartwick and Olewiler, 1998). To make up for this undervaluation and at the same time achieve SS, the HSM suggests that the residual Hotelling rents are to be invested in renewable natural resources towards the SMS level. Together, when these two conditions of WS and SS are met, sustainable development (SD) could be achievable.

Towards the two paths of WS and SS, some policy implications are discussed. First, technological progress should be promoted by allowing more people to access the markets and/or by having more research-friendly policies as rapid technological progress reduces the amount of required investment. Second, an international agency should be set up to provide directions such as determining the SMS level of resources. This agency could redistribute Hotelling rent from net importers of natural resources such as Singapore or Japan to countries that they import from. This serves to make up for the market undervaluation so that the exporters will have adequate amount to maintain their renewable natural resources towards the SMS level.

An insight from the HSM is that WS and SS are both individually necessary but insufficient conditions for SD. This follows that, while WS ensures a non-declining per capital output, no solutions are offered for the over-consumption of renewable natural resources. On the other hand, while SS ensures that renewable natural resources are not depleted beyond the SMS level, it does not ensure a constant per capita output nor does it suggest a source for the funds to maintain the stock renewable natural resources. It is more likely that SD can be achieved when economies follow both paths of WS and SS, rather than exclusively down any individual path.

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