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Analysis

# Weak support for weak sustainability: Genuine savings and long-term wellbeing in Sweden, 1850–2000

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ABSTRACT

We study genuine savings as an indicator of long-term welfare for Sweden for the period 1850 to 2000. Sweden has developed long series of comprehensive 'green' national accounts for this entire period and is, therefore, interesting as a testing ground for the hypotheses linking green accounting and sustainability. We find support for the weakest of the hypotheses in the theoretical literature on weak sustainability and genuine savings, namely that genuine savings are correlated with future economic well-being. However, the stronger hypotheses in this literature are not supported: there is no one-to-one relationship between genuine savings and prosperity, there is no indication that the relationship becomes stronger for longer time horizons, or with more comprehensive savings measures. The findings suggest that genuine savings, at least as currently measured in national accounts and satellite accounts, may not be a good forward-looking indicator of future prosperity.

## 1. Introduction

In this paper, we study the relationship between a number of indicators of Swedish genuine savings and the country's long-run economic development. Genuine savings, the net change in a country's aggregate capital stock, is often used as an indicator of how sustainable its development is. Sweden's well-developed time series for physical, natural and human capital stocks over extended periods make it a natural choice among countries in which to study whether the theoretically hypothesised relationships between genuine savings and long-term welfare hold empirically, given the methods currently used to measure changes in different types of capital stocks. We find little empirical support for many of the hypothesised relationships.

There is a considerable theoretical literature on the relationship between changes in a country's capital stock(s) and its long-run economic welfare. Indeed, it has been theoretically and empirically determined for decades that changes in a country's stock of physical capital affect its gross domestic product (GDP) and income in the long run. That this relationship becomes even stronger when other forms of capital, such as natural or human capital, are included is also, by now, uncontroversial. However, much of the theoretical literature on links between changes in capital stocks and long-run development makes stronger claims. Weitzman (1976) showed theoretically that a comprehensive net national product measure should, in principle, measure the discounted value of all future utility. Subsequent theoretical work – see e.g. Pearce and Atkinson (1993), Hamilton (1994, 1996), and Dasgupta (2001) for seminal contributions – showed that *genuine savings*, defined as net changes in a country's aggregate stock of all types of capital, should be equal to the net discounted value of future changes in well-being. However, as Aronsson et al. (1997) show, a comprehensive genuine savings measure would also need to include technological progress for this relationship to hold.

Empirical literature testing these theoretical hypotheses has also developed. Key contributions in this regard include Ferreira and Vincent (2005), the World Bank (2006), and Ferreira et al. (2008), who use World-Bank-developed genuine savings data for large numbers of countries to assess to what extent genuine savings measures track changes in the discounted value of future consumption. These studies find some correlation between genuine savings and changes in future consumption, which suggests, among other things, that resource-rich countries concerned about sustainable development can compensate for depleted natural capital by reinvesting in other forms of capital. Generally speaking, these studies find, in line with theory, that the empirical link between net investment and changes in future consumption strengthens as the investment measure becomes more comprehensive. However, these studies do not find support for the one-to-one

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relationship predicted by theory, even for the most comprehensive investment measures used, and even when adjustment is made for other factors such as population growth.

These as well as most other studies of the relationship between genuine savings and long-term economic welfare (e.g. Arrow et al., 2012) have been limited to cross-country panel studies that have covered several – sometimes even large numbers of – countries, but that have been of relatively short duration. The studies usually cover only a few decades and rely on World-Bank-developed data rather than on countries' own national accounts. A number of authors (e.g. Jerven, 2013) have criticised the reliance on World Bank macroeconomic time series in cross-country studies in general. However, even more importantly in this context, there are obvious problems with measuring long-term sustainability using time series that are – at best – only a few decades long. The hypothesised relationship between genuine savings and long-term economic welfare refers to welfare over an infinite time horizon, with the theory permitting substantial deviations from this relationship in the short run. Hence, trying to capture the hypothesised relationship using short time horizons can be considered a dubious endeavour.

A key exception to the prevalence of analyses using short time spans is Greasley et al. (2014), who study British genuine savings from 1765 onward, comparing them to long-term changes in real wages and consumption. They find stronger support for the genuine savings hypotheses than the shorter panel data studies do, suggesting – in line with the theoretical predictions – that their longer time horizons are able to capture more fully the impacts of genuine savings on long-term well-being. However, their estimates of natural capita depletion (their estimation methods are reported in more detail in a related paper, McLaughlin et al., 2014) did not follow the recommendations in United Nations (2014) and used only rough proxy estimates of costs rather than actual cost data, making estimates of resource rents (and thus also stock values for natural capital) highly uncertain. Moreover, it may be problematic to draw conclusions from what pertains in Great Britain and assume that these results will necessarily hold for other countries. Great Britain was the first country to industrialise, and thus its experiences from investment in different types of capital are not necessarily typical for the development that other countries have experienced or can expect to experience in the future. Moreover, the British Empire, with its strong economic ties to Great Britain and its colonies and dominions, affected British capital formation and the flow of both raw materials and capital incomes from abroad. Britain's leading position in the gold standard may well have affected its capital formation too. During the period studied, the country was involved in the Napoleonic wars and two World Wars, all three of which disrupted savings and capital formation patterns substantially and may have affected the relationship between long-term savings and long-term well-being predicted by theory. In short, Britain's historical exceptionalism limits the scope for generalising the insights from their experience to countries that industrialised later. Thus, studying later industrialisers can contribute to a broader picture of long-term sustainability and may provide more guidance to sustainability policies in currently developing countries.

In this paper, we study the Swedish experience. Sweden's industrial breakthrough was associated with the so-called second industrial revolution, meaning that her industrialisation occurred later than that of many other Western European countries (see e.g. Schön, 2012). The Swedish industrialisation was also largely based on domestic natural resources – timber, iron ore and hydropower. In addition, Sweden has developed an extended time series of national accounts as well as satellite accounts (see Schön and Krantz, 2012 for the national accounts, and see e.g. Lindmark and Acar, 2013 for the satellite accounts), such that the data necessary to test the genuine savings hypotheses are available from 1850 onward. Moreover, the Swedish natural and human capital stock measurements are broader than those used in Greasley et al. (2014); according to the theoretical framework, this should make the link between genuine savings and long-run welfare even stronger than in the British study.

## 2. Theoretical and empirical framework for testing genuine savings

Dasgupta (2001), Hamilton and Hartwick (2005), and Ferreira et al. (2008) have shown that genuine savings per capita, correctly measured, will under restrictive circumstances be equal to the change in the present value of future consumption. A key assumption in this literature is that natural, manufactured, and human capital are essentially substitutable in the types of services that they can provide and that an economy is sustainable as long as genuine savings are zero or positive and the overall capital stock is maintained, the *weak sustainability* assumption. Empirical studies, including Ferreira et al. (2008) and Greasley et al. (2014), have operationalized the theoretical relationship between genuine savings and future consumption in order to permit empirical testing. An additional key assumption made in the empirical literature is that national accounting data, suitably adjusted for changes in natural and human capital using the accounting methods developed in United Nations (2014) and related methodological work on "greening" the national accounts, reflect underlying economic values sufficiently closely that they can be used to test the theoretical assumptions.

Both these key assumptions have been subject to criticism. In contrast to the weak sustainability concept, numerous authors (see e.g. Ekins et al., 2003, or Pelenc and Ballet, 2015) have suggested the more restrictive *strong sustainability* concept, according to which natural capital is qualitatively different from other forms of capital in that it is subject to threshold effects when reduced below key levels, irreversibility issues when a resource is depleted to extinction, and – because it is key for the production of other capital forms – frequently acts as a complement rather than a substitute to other forms of capital. Moreover, even if the weak sustainability paradigm was correct in principle such that these problems could be overcome, it would still be the case that the market prices used in national accounting, even after the adjustments typically made in green national accounting, are so distorted by various market and institutional failures that the genuine savings indicator is misleading and cannot provide useful information on whether the underlying economy is following a sustainable trajectory or not. The fact that the empirical genuine savings studies either study special cases that may not be representative, do not actually follow the valuation recommendations in the green accounting literature, or study relatively short time periods makes it difficult to draw firm conclusions about whether the theoretical and empirical assumptions underlying the genuine savings literature hold true. It is therefore of considerable academic and practical interest to study time series developed according to current green accounting practices and long enough to permit reasonably firm conclusions about the outcomes of the empirical tests, and we attempt to do this.

In our framework, we follow Ferreira et al. (2008) and Greasley et al. (2014) closely in order to permit easy comparison with results from the previous literature. Ferreira et al. (2008) draw on results from Hamilton and Hartwick (2005) and show that, if the theoretical relationship between genuine savings and future economic welfare holds, the per-capita genuine savings $g$ at time $t$ can be written as

$$g_t = \sum_{\nu=t+1}^{\infty} \frac{\left(\frac{C_{\nu+1}}{N_{\nu+1}} - \frac{C_\nu}{N_\nu}\right) + (\gamma_{\nu+1} - \gamma_\nu)\frac{W_\nu}{N_\nu}}{\prod_{j=t+1}^{\nu}(1 + \rho - \gamma_j)} \quad (1)$$

where $C_t$ is consumption at time $t$, $N_t$ is population at time $t$, $\gamma_t$ is population growth at time $t$, $W_t$ is aggregate wealth (including natural and human capital) at time $t$, and $\rho$ is the discount rate. (For tractability, Ferreira et al., 2008 and Greasley et al., 2014 assume $\rho$ to be constant over time, and we follow their approach here.) An empirical test of this