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JEL codes: E21, E22, N50, Q00, Q01, Q20, Q30, Q50

A Sustainable Century?

Genuine Savings in developing and developed countries, 1900-2000*

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Abstract

This chapter traces the long-run development of Genuine Savings (GS) using a panel of eleven countries during the twentieth century. This panel covers a number of developed countries (Great Britain, Germany, Switzerland, France, the US, and Australia) as well as a set of resource-abundant countries in Latin America (Argentina, Brazil, Chile, Colombia, and Mexico). These countries represent approximately 50 percent of the world's output in terms of Gross Domestic Product (GDP) by 1950, and include large economies and small open economies, and resource-rich and resource-scarce countries, thus allowing us to compare their historical experiences. Components of GS considered include physical and human capital as well as resource extraction and pollution damages. Generally, we find evidence of positive GS over the course of the twentieth century, although the two World Wars and the Great Depression left considerable marks. Also, we found striking differences between Latin American and developed countries when Total Factor Productivity (TFP) is included; this could be a signal of natural resource curse or technological gaps unnoticed in previous works.

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1 Introduction

Over the past quarter-century, Genuine Savings (GS henceforth), or Adjusted Net Savings (ANS), has emerged as an important indicator of sustainable development. It is based on the concept of wealth accounting, and it is argued that it addresses shortcomings in conventional metrics of economic development by incorporating broader measures of saving and investment (Hamilton and Hepburn, 2014; Stiglitz et al., 2009).[1] GS measures year-on-year changes in total capital stocks (physical, natural, social, institutional & human). Following the pioneering studies of Pearce and Atkinson (1993) and Hamilton (1994), the World Bank has published estimates of GS from the mid-1990s to the present World Bank (2011, 1997, 2015). Hamilton and Clemens (1999) and World Bank (2006, 2011) illustrate the nature of these estimates for almost all countries in the world and show how a negative GS indicator can be interpreted as a signal of unsustainable development. Current World Bank GS data at the country level stretches back to the 1970s, and provides empirical evidence of the level of sustainable/unsustainable economic development throughout the world:[2] the recent 2013 global average GS rate was 8.35 per cent of Gross National Income, however there was considerable variation in the data with values ranging from -49.89 to 36.41 per cent of Gross National Income.

The question of sustainability is inherently about scale. Should our focus be on a global, national or local scale? The World Bank publishes national indicators of sustainability, but arguably it is global sustainability that is a more pressing concern given that issues such as climate change are caused by global externalities. The issue of scale is at the centre of Pezzey and Burke (2014) who seek to understand why national GS indicators (generally positive) give conflicting signals compared to alternative ecological based indicators of sustainability (overwhelmingly negative). Their answer lies in how pollution damages (primarily carbon) were accounted for. Rather than using literature derived prices they instead re-estimate the underlying DICE models and derive new estimates of the social costs of carbon prices. They find that models assuming future CO_2 emissions are controlled lead to indicators of sustainability not too dissimilar from the World Bank, whilst the business as usual assumption leads to an indicator of unsustainability. While global estimates may be the ideal to gauge sustainability paths, economic and environmental policy are designed and implemented at the national level. Therefore we follow the Pezzey and Burke (2014) paradigm and aggregate national measures of GS to construct aggregate "global" indicators of sustainability and incorporate global externalities, mainly CO_2 emissions, in this calculation but we also present national indicators, excluding the global pollutants, so that comparison can be made both between countries and with components of the global estimate.

[1] A similar approach is also adopted by the Arrow et al. (2012)/UNU-IHDP. (2014, 2012), who also focus on measuring wealth and changes in wealth as a measure of sustainability.

[2] The World Bank has annually updated estimates and the most recent estimates covered 159, 152 and 131 countries in 2011, 2012, 2013: Data taken from http://data.worldbank.org/topic/environment [accessed 7 March 2016].

This paper follows the framework of Hamilton and Clemens (1999) and World Bank (2006, 2011) to extend estimates of GS back to the start of the 20th century. We track the evolution of fixed capital formation, natural resource use and educational expenditure across a number of countries in Western Europe, the Americas and the Antipodes. In addition, we have also included a value of technological progress, or what Pezzey (2004) refers to as the "value of time passing" which increases the future consumption possibilities of a country. We do this by incorporating country specific estimates of Total Factor Productivity (TFP)'s contribution to sustainable development, because as Weitzman (1997, 1999) illustrates, incorporating TFP can make "a sizeable adjustment" to the sustainability indicator proposed. Effectively what TFP growth implies is that even if capital stocks remain constant over time, output can increase due to efficiency gains.

The literature on GS relates to two major themes in the economic history literature namely capital formation and growth accounting. The focus on capital as a basis for sustainability harks back to an old literature (e.g. Rostow (1960)) on the importance of capital in the industrial revolution.[3] Statements about the centrality of capital led to a research agenda involving the construction of historical capital stock estimates for developed countries (e.g. Feinstein and Pollard (1988)), these pioneering studies for the basis of this undertaking. Also relevant to this project is the work of Angus Maddison (2001) who constructed historical Gross Domestic Product (GDP) estimates for many countries since the 1800s (again building on the national account estimates by Feinstein (1972)and others). Maddison's main objective was to construct comparable historical GDP estimates to chart the path of economic growth and development over time (Bolt and van Zanden, 2014). Although the GS approach outlined in this chapter shares similar roots with this growth literature, the emphasis is on welfare rather than outright growth and the emphasis on broader measures of saving are what distinguish GS from the wider growth literature (Ferreira et al., 2008); this is where our historical contribution lies.

Following the trajectory of GS during this period allows us to re-investigate the eventful economic history of the 20th century from the vantage of sustainability. The panel of countries we use to study this period in history includes leading Western economies such as the United States, Germany, Great Britain, Australia and France, and set of Latin American resource-dependent economies such as Brazil, Chile, Colombia and Mexico. In addition, Argentina serves as the counterpart of these resource-extracting countries, whereas Switzerland allows assessing the experiences of a Small Open Economy in the midst of European turmoil. The initial period of our study is the heyday of the first era of globalisation, with free capital and labour movements and a drive towards freer trade. The First World War was a major dislocation to the international economy and this is a period in which many of our countries experience negative GS. The inter-war period

[3]Rostow's preconditions was "a rise in the rate of productive investment from, say, 5 per cent or less to over 10 per cent of national income (or net national product)" and that this definition "is also designed to rule out from the take-off the quite substantial economic progress which can occur in an economy before a truly self-reinforcing growth process gets under way (emphasis added)." Also, see Arndt (1987, pp54-60) for a discussion on the importance of capital formation in early development theory.

witnessed the Great Depression and the re-introduction of trade barriers. The Second World War was another shock to the international economy. In the post-WWII period we see a gradual return to freer trade and integration in commodity markets. The period from 1970-2000 is also the backdrop of the 'curse of natural resources' whereby Sachs and Warner (2001); Sachs (1999) found a negative correlation between the share of primary exports in GDP and future GDP growth; countries in Latin America were seen as the prime exemplars of this (Sachs, 1999).

The economic development of Latin America has been a recurrent topic in twentieth century economic history, especially in the debate about divergence and convergence (Bértola and Ocampo, 2012). At the outset of the twentieth century Argentina and Chile had GDP per capita levels comparable to some European states, such as France or Germany, yet by the end of the millenium there was significant divergence (Bolt and van Zanden, 2014). There are several reasons behind divergence in the inter-war period (1918-38); however, recent studies point out the extenuation of an economic model based on natural resources exports and lack of productive diversification (Tafunell and Ducoing, 2015). In the post WWII period there is still debate surrounding the effects of Import Substitution Industrialization (ISI). The strong growth performance of larger countries, such as Mexico or Brazil, which stood in contrast to the poorer growth rates exhibited by the southern cone region (Argentina, Chile and Uruguay), opened a discussion on the gains and losses of this economic policy (Gómez-Galvarriato and J.G., 2009), and the timing of the divergence between Latin America and the developed world Prados de la Escosura (2009). In direct relation to this debate and the aim of this chapter, natural resource prices have played a key role in Latin American development. Latin American economic thought after the Second World War was strongly influence by the Prebisch-Singer hypothesis (secular deterioration in primary commodity prices relative to manufactured goods). The current extenuation of the so-called "supercycle" has increased worries about the region's economic future.

Our headline results (table 1 & figure 1) show that, in general, the aggregate global GS measure was positive. We find that all countries were on a positive development path in terms of physical capital accumulation. When more comprehensive savings indicators are used, we find that natural resource depletion lowers saving rates in resource abundant economies considerably, and results in negative saving rates in some Latin American countries. We find that the accumulation of intangible assets plays an increasingly important role, especially for leading Western economies during the second half of the twentieth century. The share of intangible assets has constantly increased ever since, constituting the most important single contributing factor to wealth accumulation in the majority of countries in our panel by the end of the twentieth century.

2 Genuine Savings as indicator of sustainability

The economics of Sustainable Development (SD) is traditionally based on capabilities-based or outcome-based definitions of what constitutes SD. The capabilities-based approach views a sustainable development path of an economy as one where the (per capita) real values of changes in capital stocks are non-negative (i.e. constant or increasing). Whereas the means-based approach views a sustainable development path as one where utility or consumption per capita is non-declining (Hanley et al., 2015). Furthermore, what constitutes sustainable development also depends on how one perceives total capital, one version being that SD requires non-declining total wealth (weak sustainability) and another where SD requires non-declining natural capital (strong sustainability). The first approach assumes perfect substitutability between different types of capital and that natural capital can be valued using monetary values. Whereas the latter approach sees natural capital as having critical thresholds and that a decrease in a physical unit of natural capital cannot be replaced by an increase in the quantity of other forms of capital. As the degree of substitutability is difficult to establish empirically (i.e. Markandya and Pedroso-Galinato (2007)), how one chooses to approach sustainable development, from a weak or strong perspective, is a matter of preference based on values. Moreover, this dichotomy is in some respects a false because if a country fails a weak sustainability test it will in all likelihood also fail a strong test as well.

Using the definition of sustainable development from the Brundtland Report,[4] the weak approach to sustainability links future well-being with changes in wealth (or capital stocks) (Pearce, 2002). The theoretical underpinnings of the neoclassical approach to weak sustainability are now well established.[5] The underlying logic is that future consumption can be seen as a form of interest on past wealth accumulation, since the productive basis, i.e. labour, physical and intangible capital, are the productive forces used to generate income. The GS approach to sustainability rests firmly on the so-called Hartwick Rule (Hartwick, 1977), as this shows how consumption can be constant over time by re-investing rents from natural resource extraction into other forms of capital (i.e. man-made or human). One of the attractions of the GS is that, under certain assumptions, it can be used to assess both the capabilities-based and the outcome-based approaches to Sustainable Development (Hanley et al., 2015). Another attraction is that it is firmly grounded in the system of national accounts (SNA) framework and can be used to measure and compare countries in a consistent manner.

Over the past 25 years there have been a series of GS estimates for a host of countries. The time period covered by most estimates range from the 1970s to the present (Hamilton and Clemens, 1999; World Bank,

[4]Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of ‘needs’, in particular the essential needs of the world’s poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organisations on the environment’s ability to meet present and future needs’ (World Commission on Environment and Development, 1987, p.43).

[5]See Hanley et al. (2015) for a comprehensive review.

2011), although a number of studies have calculated GS for shorter (Pezzey et al., 2006; Mota and Domingos, 2013; Ferreira and Vincent, 2005; Pezzey and Burke, 2014; Ferreira and Moro, 2011) and longer horizons (Greasley et al., 2016; Lindmark and Acar, 2013; Greasley et al., 2014; Hanley et al., 2016; Rubio, 2004). Studies have tended to trade off scale and scope, with studies focusing on individual countries being richer in data quality but not directly comparable with other country-specific studies. Definitions of metrics have also varied with 'green' and 'genuine' savings measures commonly constructed and used interchangeably.[6]

Technological change has been an important concept in the theoretical literature (e.g. (Weitzman, 1997; Pemberton and Ulph, 2001), but there are a number of challenges incorporating a measure of technological change into empirical studies.[7] A number of studies have attempted to address this and have have used TFP growth as an indicator of technological progress and incorporated this into the genuine savings framework through the net present value of TFP's contribution to future GDP growth (Pezzey et al., 2006; Mota and Domingos, 2013; Greasley et al., 2014).

There have been a number of empirical tests of the theoretical properties of GS and its link with future consumption and in general the evidence tends to be supportive of the predictive power of GS. For example, Ferreira and Vincent (2005), Ferreira et al. (2008) and World Bank (2006) find a positive correlation between GS and the present value of future changes in consumption.[8] Similarly, using the same testing structure, there is also evidence of a longer-run relationship between GS and future changes in well-being (real wages & consumption per capita), although here the results suggest that the choice of time horizon and discount rate has the greatest effect on the estimated parameters (Greasley et al., 2014; Hanley et al., 2016).

Another issue with current empirical indicators is the treatment of international trade flows. For example, countries heavily reliant on the export of natural resources can be deemed to have negative genuine savings whilst countries importing the said natural resources will have positive genuine savings as they are not consuming their "national" natural capital. Atkinson et al. (2012) explore this importing/exporting of sustainability using input-output models to assess the trade flows of countries, they find a clear trend of countries production of natural resources (i.e. extraction) being much less than their consumption. Moreover, changing trade patterns in recent years have seen a shift in manufacturing from developed to developing countries and this is reflected in a shift in emissions, for example European CO_2 emission reductions were as much a result of structural changes as they were due to environmental policy (Emission Trading Scheme). [9] In a sense, this links back to the literature on the "pollution haven hypothesis", i.e. tightening environmental regulation or changes in preferences for environmental goods can lead to an outsourcing of pollution to other areas with lower environmental regulatory standards or preferences. These are issues of extreme relevance

[6]See Hanley et al. (2015) for a review of the empirical literature.

[7]Such as how to measure technology, i.e. R&D, patents, energy intensity, total factor productivity.

[8]Although, Ferreira & Vincent found that education spending was a poor proxy for human capital formation and did not substantially improve the performance of the indicator.

[9]e.g. see Koch et al. (2014).

for the current paper, whilst we do not have the data to observe trade patterns over time or CO_2 flows, by scaling up to a "global" level we can attempt to reduce some of the limitations that these trade flows may induce in our estimates.

3 Data and methodology

We have largely followed the World Bank (2011, 2006) methodology, as stated by Bolt et al. (2002), for calculating GS to calculate a range of increasingly-comprehensive measures of year-on-year changes in total capital for Germany over time. We construct the following indicators to display and distinguish several degrees of sustainability:

- Net Investment = net fixed produced capital formation and overseas investment
- Green Investment = Net + Δ natural capital
- Genuine Savings = Green Investment + education expenditure
- GSTFP = GS + Net Present Value of TFP
- GScarbon = GS - carbon emissions
- GSTFPcarbon = GSTFP - carbon emissions

To allow comparability across space and time, all units have been deflated using national GDP deflators and have been converted into purchasing power adjusted international dollars following Maddison (2001), expressed as Geary-Khamis dollars ($) in the figures below.[10]

An important component of GS is net investment, including overseas investment, which reflects changes in a country's physical assets.[11] In a previous study of Latin American 'Green' investment over the period 1973-1986, Vincent (2001) lamented the quality of conventional measures of reproducible capital in Latin American countries. In order to overcome this concern, we make use of new capital stock estimates for Latin American Tafunell and Ducoing (2015).

To account for the depletion of natural (renewable and non-renewable) resources we subtracted the rent from the depletion of natural resources, using gross revenues minus average costs of depletion, from net investment.[12] For European countries, the bulk of gross revenues from resource extraction originate from the

[10] See data appendix for a full list of data sources by country.

[11] These data were readily available for various countries, but for some countries we estimated net investment using gross investment and consumption of fixed capital, or simply annual depreciation of assets (see appendix for a detailed list of sources used).

[12] We used the market value of extracted renewables and non-renewable resources as well as the extracted quantities to compute the gross revenues. The average extraction costs were estimated using labour requirement and the average wage of labourers. Similarly, estimates of the value of the change in timber stocks by country was based on changes in area covered with forests, the average quantity of timber per m^3 and the market value of timber. For more recent periods the FAO (2010) provides estimates on the cubic quantities of timber on a given surface area; it is likely that applying this methodology on historical periods overestimates historical forest stocks since we implicitly assume than the high modern tree planting density has existed throughout the period under observation.

extraction of coal, and for more recent times from oil and natural gas (Great Britain). We also considered other resources, but the quantities by and large are negligible compared with the accumulation of other assets. For the US and Australia, two resource abundant developed nations, we included data on coal, oil and gas as well as metal and mineral ores, as well as changes in forestry. For Latin American countries, resources considered include metal and mineral ores and fossil fuels. Important sources of natural capital depletion are petroleum (Argentina, Colombia, Mexico), gold (Brazil, Colombia), silver (Colombia), coal (Brazil) and copper (Chile).

Education expenditure is used to proxy the accumulation of human capital to obtain a more inclusive measure of a country's assets. Admittedly there are limitations to this approach as it is known that education does not perfectly equate with human capital, however, alternatives measurements of human capital stocks, such as discounted life-time earnings, are not available for all countries over the whole of our sample. Furthermore, an additional limitation of this approach is that education expenditure as a proxy for human capital accumulation makes no allowances for appreciation of (e.g. on-the-job training & experience) and depreciation (aging & mortality) of human capital. Moreover, this approach does not account for international migration whereby migrant recipients benefit from the human-capital embodied in immigrants and developing countries may experience losses in human capital through emigration.

We added a proxy for the accumulation of technology to take into account intangible assets as suggested by Weitzman (1997).Weitzman suggests that this adjustment may be in the region of 40 per cent of Net National Product. Thus, omitting a technological progress measure would mis-state the degree of sustainability of an economy. In relation to technological progress, although many of the general purpose technologies were invented in the late nineteenth century (telephone, electricity, combustion engine), it was not until the twentieth century that they were adopted en masse and in many cases this meant the use of new natural resources that had been overlooked in the past (oil and natural gas for example) but in turn this lead to more efficient use of resources (e.g. improvements in fuel efficiency) e.g. see Gordon (2016). Therefore, we have incorporated the effects of exogenous technological progress in our measure of GS by including the present value of TFP growth. We calculate TFP assuming a standard Cobb-Douglas production function with capital and labour measured in man-hours.

$$\mathrm{Y} = \mathrm{AL}^{(\alpha)}\ \mathrm{K}^{1-\alpha}$$

Where Y equals income, L is labour (measured in man hours) and K is the capital stock. A denotes TFP which is estimated as a residual from this calculation. Trend TFP was used to estimate the value of exogenous technological progress. Following Pezzey et al. (2006) and Greasley et al. (2014) we calculate the present value of future changes in trend TFP over a 20 year time horizon. This is done to capture the uncertainty over the duration of the value of technological progress.[13] TFP is a central piece of the puzzle to assess

[13] Arrow et al. (2012, table 3) incorate a measure of TFP but do so by adding the current TFP growth rate to the per capita growth rate of Total (Comprehensive) Wealth. However, this approach only adds 1 year and does not take account of the value of time as an

sustainable development; this metric, however, is somewhat in conflict with other components of GS. TFP is related to innovativeness, intangible assets, institutions and social capital, and as a consequence the incorporation of TFP brings the risk of 'double-counting' the effects equally associated with technology and human capital. Baier et al. (2006) find that incorporating a measure of human capital reduces the size of the residual; Similarly, Manuelli and Seshadri (2014) argue that better measurements of human capital quantity and quality can further reduce TFP. There is therefore reason to believe that the overlap between human capital accumulation and the value of technology accumulation leads to a slight overestimation of total capital formation. Data limitations and availability prevent us from fully disentangling human capital and technology. We therefore opt to incorporate an unadjusted TFP series in our estimates, however, in the results section we illustrate the effect of TFP appended to Green investment to avoid the possibility of double counting as education expenditure is included in GS.

Lastly, we incorporate a range of prices related to damages from carbon dioxide emission in our global estimates. Carbon dioxide is a greenhouse gas (GHG) with lifetime of up to 200 years in the atmosphere and accounts for 75 per cent of global warming potential Stern (2007, table 8.1). The crucial factor is that it is a stock pollutant in that the annual emissions add to the existing concentration in the atmosphere and each unit of emissions increases the marginal damage cost of the pollutant in the future (Kunnas et al., 2014). To account for CO_2 in our sustainability indicator we used the total amount of carbon dioxide emitted and estimates of the social costs of carbon derived from the wider literature. There are a range of price estimates that we have incorporated, such as the constant $20 tonne carbon cost of the World Bank metric, $29 t/c from Tol (2012), $110 t/c from the Stern Review (Stern, 2007). However, the results presented below purposely utilise the more recent estimates of the social cost of carbon by Pezzey and Burke (2014). The first price, $131 t/c, estimated from a DICE model recalibrated to assume that it is economically optimal to control emissions such that warming may be limited to an agreed target of 2°C and a significantly higher price of $1455 t/c which assumes that no controls of CO2 emissions are implemented. We choose to highlight these contrasting prices as our study shares similarities with Pezzey and Burke (2014) in that we also attempt to determine if the world is on a "global" sustainability path. These prices are discounted over time as suggested by Tol (2012) and as illustrated by (Kunnas et al., 2014).[14]

A limitation of the construction of GS as outlined above is that it only covers quantifiable indicators that can be approximately expressed in monetary units. Thus GS overlooks non-market environmental goods and services and as a result the GS metric excludes developments in other pollutants such SO2 and NOx, and developments in biodiversity and ecosystem services. Historical estimates of SO2 and biodiversity

uncontrolled capital stock. The choice of 20 years follows Pezzey et al. (2006) and Greasley et al. (2014). Using the case of Argentina as an example, where the present value of TFP is 10.12 per cent over 20 years, if a shorter hoirzon (10 years) is used this is reduced to 8.45 per cent of GDP and if a longer horizon (30 years) is used this increases to 15.87 per cent of GDP. Therefore, by chosing a 20-year horizon we err on the side of underestimation of the value of technological progress.

[14]For a more comprehensive overview of data sources used see the data appendix as well as Blum et al. (2013), Camacho (2014), Greasley et al. (2014), Greasley et al. (2016), Höfeler (2014), Klenk (2013) and Mennig (2015).

are available but these indicators are difficult to incorporate in an augmented long-run GS metric until a compromise estimate of their economic value over time is obtained. The absence of monetary evaluations of these phenomena, however, cannot hide the fact that economic growth seems to adversely affect biodiversity and levels of pollution. The global output of SO2 increased throughout the twentieth century, with the major share of SO2 being emitted in North America, followed by Western Europe. Total global SO2 emissions rapidly rose after World War Two, and peaked around 1980. During the late twentieth century, mainly environmental regulation combined with fuel-saving technologies and a transition away from fuels with a high-sulphur content helped to lower global SO2 output (Stern and Kaufmann, 1996). Losses in biodiversity are largely the result of changes in land use; the increasing demand for grazing and cropland has encouraged deforestation which in turn resulted in losses in biodiversity. Estimates on the development of biodiversity suggests that Latin America and the US, and the majority of the world's countries experienced losses in biodiversity whereas some countries in Western Europe saw stagnating or even increases in biodiversity.[15] Any future evaluation of the costs of biodiversity loss and SO2 emissions will lower any sustainability indicator (see Goldewijk (2014) for an overview).

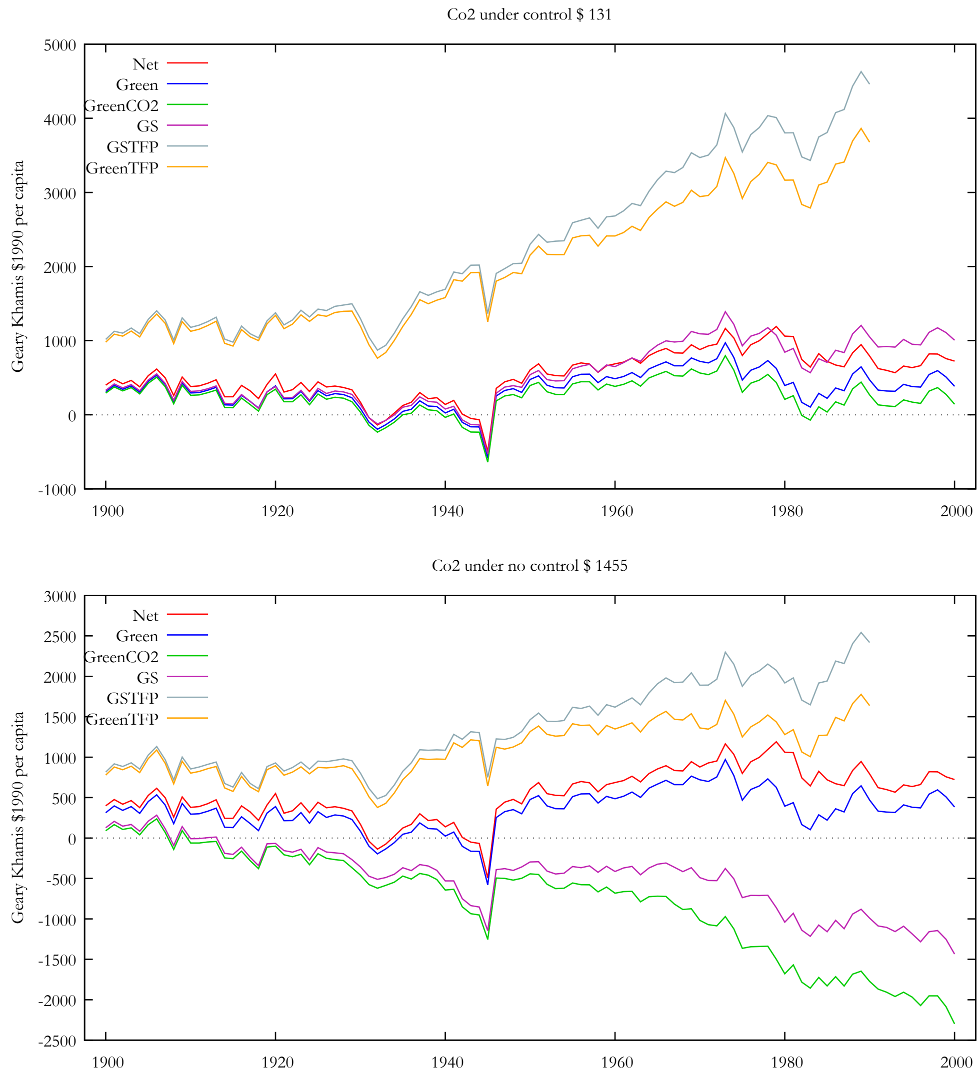
4 Trends in Genuine Savings through 20th Century

Trends in "Global" GS per capita are presented in figure 1 whilst Table 1 presents mean results as a as a share of GDP. The aforementioned debate on national versus global measures of sustainability has been addressed by estimating a comprehensive measure which incorporates all the countries in this study (Pezzey and Burke, 2014). In the "Global GS" indicator we also take account of the CO2 prices outlined by Pezzey and Burke (2014). These CO2 prices are particularly higher than other estimates in the literature (e.g. Tol (2012) and thus adds a significant negative premium on fossil fuel based growth, especially the significantly higher 'business as usual' price. As a counterpoint to these results, a CO_2 of \$20 t/c or \$29 t/c has a trivial impact on our metrics and result in metrics that are effectively no different from the "Green" metric presented below.

The full panel of countries account for approximately half of the world's GDP by 1950 (Maddison, 2001), and allow us to throw a glance at the degree of weak sustainability over the period of observation. The global GS figure reflects naturally a mix of country-specific experiences. For example, while some belligerents experienced negative saving rates during the First World War, other countries were largely unaffected by it. As a result, global GS during the First World War does not suggest a deterioration of global wealth accumulation. Conversely, negative effects associated with the Great Depression and the Second World

[15]Stock valuations of global ecosystem services are most notable at the end of our period of study, such as Costanza et al. (1997), who estimated the global value of the entire biosphere to be between \$16-54 trillion, and Costanza et al. (2014), who updated the Costanza et al. (1997) figures from 1997-2011. However, these stock valuations do not enable us to value changes in ecosystem services in the years preceding 1997. Furthermore, there have been increasing uses of revealed and stated preference methods to value changes in environmental goods and services. However, these studies have not been applied consistently over time and benefit transfers may not be applicable spatially or temporally for all countries in our study.

Figure 1: Global estimations on Net Investment, Green Investment, GS and GSTFP per capita. GK$ 1990. Co2 Estimations with prices under control ($131 in 2005) and no control ($1455 in2005)



Sources: Own estimations-Data appendix table 3 and table 4

War are clearly visible in the global GS figure; these two periods were the only episodes in the twentieth century when the world experienced substantial losses of wealth. In the aftermath of the Second World War, global GS recovered quickly, rising to unprecedented levels in the 1970s. Starting with the economic depression in the 1980s, GS decreased to somewhat lower levels, but remained to be consistently high in historical perspective. Although towards the end of our sample represents a declining share of global GDP (40 per cent by 1990) and thus weakens the global representativeness of our findings.

Table 1: Global Net Investment, Green, Genuine Savings and GSTFP as share of the GDP

		CO2 Prices under control US$131 (2005)				CO2 Prices under no control US$1455 (2005)			
Net Investment	***Green***	***GreenCo2***	***GS***	***GSTFP***	***GreenTFP***	***GreenCo2***	***GS***	***GSTFP***	***GreenTFP***
%	%	%	%	%	%	%	%	%	%
7,39	4,97	3,74	6,88	33,01	30,08	-8,61	-5,47	20,80	17,86
1900-1946									
		CO2 Prices under control US$131 (2005)				CO2 Prices under no control US$1455 (2005)			
Net Investment	***Green***	***GreenCo2***	***GS***	***GSTFP***	***GreenTFP***	***GreenCo2***	***GS***	***GSTFP***	***GreenTFP***
%	%	%	%	%	%	%	%	%	%
7,47	4,97	3,94	5,69	32,93	31,19	-6,50	-4,75	22,50	20,75
1946-2000									
		CO2 Prices under control US$131 (2005)				CO2 Prices under no control US$1455 (2005)			
Net Investment	***Green***	***GreenCo2***	***GS***	***GSTFP***	***GreenTFP***	***GreenCo2***	***GS***	***GSTFP***	***GreenTFP***
%	%	%	%	%	%	%	%	%	%
7,33	4,96	3,58	7,88	33,09	28,94	-10,38	-6,08	19,05	14,91

Sources: Own estimations in based to the Appendix

In a counterfactual study of how much countries would be wealthier in terms of fixed capital if they followed the Hartwick Rule and reinvested in fixed capital, Hamilton et al. (2006) illustrate the possibility of unbounded and rising consumptionif a GS rate of at least 5 per cent of GDP was maintained over time. Hamilton et al. (2006)'s finding provides us with a yardstick with which to assess the performance of our global metric from a sustainability perspective in terms of its capacity for raising consumption over future generations. For our 'global' indicator, Table 1 shows that net investment is overwhelmingly positive which indicates that rents were reinvested in the productive capacities. However, in terms of Green investment, this is considerably lower and over the whole century this is below the 5% prescribed threshold outlined by Hamilton et al. (2006). When CO_2 damages are accounted for this suggests a worse performance and although this metric is not negative, CO_2 damages are large and rising over the 20th century and are likely to increase in the future. Our GS indicator, which includes education expenditure, returns our sustainability indicator towards a sustainability path and GSTFP even more so. The message appears to be clear, the 20th century shows that overall the Hartwick Rule was followed but worries about the legacy of CO_2 emissions are clearly evident. CO_2 damages clearly indicate a path towards lower "green savings". Yet, taking a sanguine view, if we continue to adopt technological solutions we may continue on a sustainable development path.

The data presented in Table 2 and Figures 2, 3 and 4 illustrate the patterns of our respective countries, although we have opted to exclude CO_2 from these metrics. Net investment in our panel of Western countries was generally positive, ranging from approximately five per cent in Great Britain, between seven and ten per cent in the United States, Australia, France, and Germany, to approximately 14 per cent in Switzerland. Resource depletion played a modest role among these countries, with Australia and the US depleting natural resources in the amount of 3.4 and 2.7 per cent of GDP, respectively. British and Germany depletion levels were between one and two per cent of GDP, while French depletion totals 0.6 per cent of GDP. Switzerland, a country almost without any significant natural resources, accumulated natural capital due to the absence of depletion of fossil fuels and minerals and afforestation. Our panel of Western countries was relatively homogenous in terms of education expenditure; figures range from 2.2 to 3.7 per cent of GDP.

However, by far the largest single contributor to wealth accumulation was through the value of technological progress. Technology is broadly defined, including human capital, social capital, but also the quality of formal and informal institutions; it is proxied as total factor productivity and it captures productive factors that are not included in physical capital and labour inputs. Our augmented GS indicator, which is inspired by Weitzman (1997), includes the accumulation of physical capital, pollution, resource depletion as well as the present value of future changes in technology. Our results suggest that technology is an important intangible asset, contributing 17 and 18 per cent of GDP to national savings in France and Australia, respectively, 23 and 25 per cent in Great Britain and the US, respectively, 28 per cent in Switzerland and 38 per cent in Germany.

The development of GS in the panel of Western countries mirrors the political and social history during this period (figure 2). Important events influencing economic development include the two World Wars, the Great Depression during the interwar years, and the depression during the early 1980s. These events are clearly visible in the data, but the magnitude of the associated economic effects suggest that these shocks were experienced differently across these six Western countries. War economies during the First World War resulted in negative GS in Great Britain, France, Australia and Germany, while GS in the United States remained almost unaffected. Similarly, Great Britain, the United States, France and in particular Germany experienced negative GS rates during the Second World War. These effects mirror the extraordinary war effort and the absence of any long-run development strategy; the consequences of the Second World War was most devastating in Germany, which suffered heavily due to dismantlement and destruction of capital, but other European warring parties were also seriously affected. Conversely, Australia during the Second World War, and neutral Switzerland throughout this troubled period benefitted from the turmoil in terms of GS. A somewhat atypical pattern is visible in the Swiss GS series. While the two World Wars and the Great Depression slowed wealth accumulation down considerably in many countries, Switzerland experienced large savings during these period. It is important to highlight Switzerland's role as a safe haven of capital, and the limited possibilities of import and domestic consumption during these periods.

Western countries in this panel developed rapidly during the post-war Golden Age, both in terms of economic growth but also in terms of GS. Between 1950 and 1970, GS in the United States and Great Britain almost doubled, French and German GS almost tripled, and Swiss GS more than quadrupled. The exception to this rule is Australia, where GS were constantly positive, but by and large stagnated during this period. Only during the 1970s and early 1980s, Australia experienced increases in GS. The global recession of the early 1980s is also visible in the development of GS; Great Britain and the United States experienced the largest decline in GS during this period.

In figure 2 we present the augmented GS estimate, which captures changes in the value of technology in an economy in addition to conventional GS. During the first half of the 20th century, we find that a large share of wealth is generated through the accumulation of technology, not through conventional GS. The upper trend in each country diagram reports the level of Genuine Savings including the present value of future changes in technology. This development is reinforced during the second half of the 20th century, when technology becomes a large contributor to wealth accumulation. In the United States, Great Britain and Germany, technology becomes the largest single contributor to wealth accumulation during this period. By 1950, augmented GS in these three countries is three to four times larger than the conventional GS metric. In France and Australia, technology also plays an important role with respect to wealth accumulation, but levels of GS and augmented GS are evidently lower than in the US, Great Britain and Germany. Switzerland, again, shows some atypical patterns regarding the role of accumulation of intangible assets. Swiss GS and augmented GS increased rapidly during the 20th century, but this increase seems to be the result of physical capital accumulation; the present value of future changes in technology appears to remain almost constant across time.

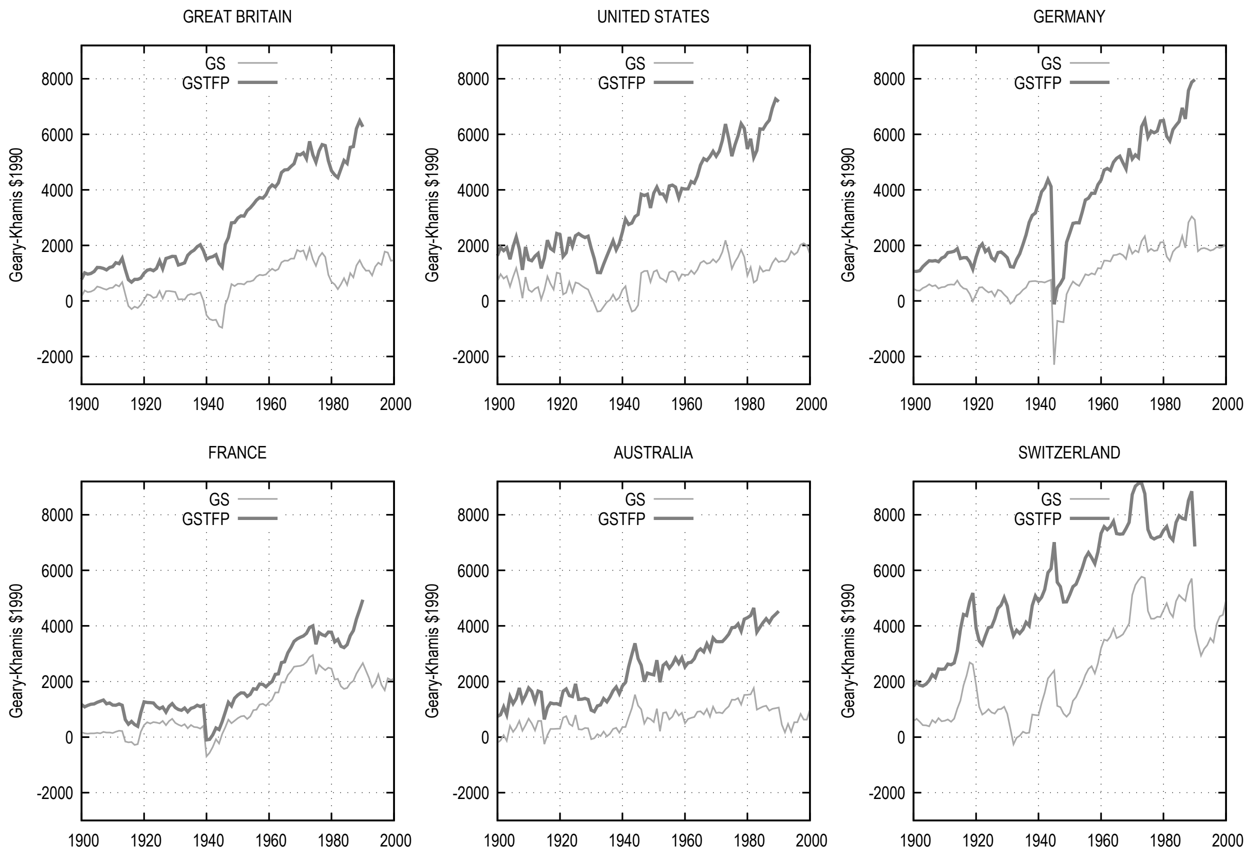
Results for Latin America suggest that net investment during the twentieth century was somewhat lower compared with Western countries' wealth accumulation. However, net investment was considerable in Brazil, Colombia and Mexico, almost reaching Western levels (table 2). Whereas net investment in Argentina and Chile was relatively low in comparison, but positive on average. The most striking difference between Latin American countries and the set of Western countries is the generally low levels of augmented saving measures. If resource depletion is incorporated in the green investment indicator, savings are substantially lower, and reach negative values for Chile and Mexico. Similarly, Brazilian and Colombian investment figures drop from eleven and nine per cent to approximately 4 per cent each when resource depletion is considered. In Chile, depletion can be mainly attributed to copper ore and saltpetre depletion, while Colombia and Mexico have been producers of petroleum. Resource depletion is partly outweighed by investment in education; the value of education expenditure ranges between under 0.5 per cent of GDP (Argentina) to up to 1.7 per cert (Brazil). Moreover, with lower TFP growth, technological progress accounts

Table 2: Net Investment, Green, Genuine Savings and GSTFP as share of GDP

1900 - 2000				
	Net Investment	***Green***	***GS***	***GSTFP***
	%	%	%	%
Britain	4,63	2,80	5,49	28,58
Germany	9,41	8,09	11,34	49,57
US	7,07	4,42	8,11	32,62
Australia	7,68	4,33	6,55	24,69
France	8,93	8,38	11,76	29,07
Switzerland	14,07	14,39	17,53	45,40
Argentina	3,73	3,20	3,54	13,67
Brazil	11,10	3,88	5,71	27,29
Chile	2,06	-5,64	-3,75	1,82
Colombia	8,73	3,61	4,69	6,98
Mexico	8,58	-1,40	-0,30	7,24
1900-1946				
	Net Investment	***Green***	***GS***	***GSTFP***
	%	%	%	%
Britain	2,64	0,86	2,42	20,80
Germany	9,47	8,01	10,12	49,25
US	9,30	6,27	8,29	38,02
Australia	7,59	4,59	5,51	25,09
France	5,16	4,69	6,26	35,54
Switzerland	11,47	11,80	13,90	54,29
Argentina	3,56	3,40	3,59	16,58
Brazil	12,96	3,29	4,20	14,17
Chile	3,85	-1,67	-0,64	3,14
Colombia	1,48	-3,38	-3,05	-0,69
Mexico	2,42	-11,42	-10,93	-5,85
1900-1946				
	Net Investment	***Green***	***GS***	***GSTFP***
	%	%	%	%
Britain	6,29	4,43	8,07	35,08
Germany	9,35	8,16	12,36	49,83
US	5,21	2,88	7,96	34,36
Australia	7,75	4,11	7,42	24,35
France	12,09	11,47	16,35	23,66
Switzerland	16,24	16,56	20,57	37,95
Argentina	3,87	3,02	3,50	11,24
Brazil	9,59	4,43	7,05	38,53
Chile	0,56	-8,96	-6,36	0,72
Colombia	14,80	9,45	11,17	13,40
Mexico	13,73	6,97	8,60	18,20

Source: Own estimations and Data Appendix

Figure 2: Genuine Savings and augmented Genuine Savings with TFP per capita.
Developed Countries 1900 - 2000, Geary -Khamis $ 1990



Source, Appendix

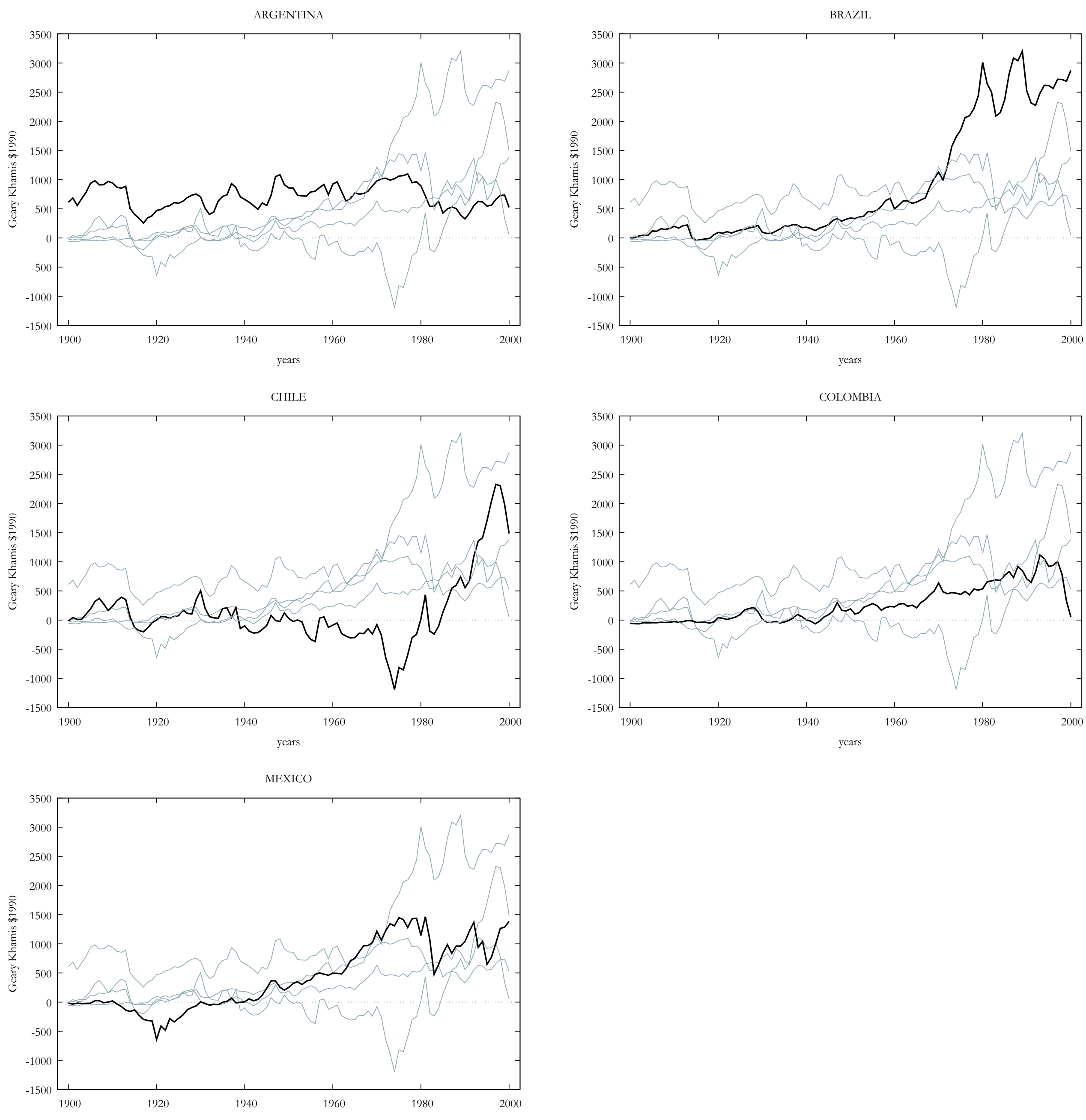
for only 2 per cent of GDP in Colombia, between 10 and 20 per cent in Argentina and Brazil, approximately five-seven per cent of GDP in Chile and Mexico.

Figure 4 allows a closer look at the development of investment in Latin America, including the effects of social turmoil and somewhat higher investment rates in the second half of 20th century. We cannot identify a clear trend in the development of GS during the first half of the 20th century; in fact, we by and large observe long periods of stagnation, which were interrupted by the First World War, the Second World War and to a lesser extend by the Great Depression. Latin American economies, however, were generally less affected by these events compared with some Western countries. The Mexican Revolution resulted in highly negative GS during the Revolution, 1910 to 1920, and its aftermath. Mexican GS turned positive only during the Second World War. The second half of the 20th century generally brought somewhat higher GS, and some Latin American economies experienced a sustained increase in savings. Decisive events in this period include capital flight after 1970, and the Chilean depression after 1972, which were related to socialist reforms. Chilean GS recovered slowly, only reaching positive saving rates in the early 1980s. The global

Figure 3: Genuine Savings TFP augmented in GK $1990 per capita. Developed countries 1900 - 1990

Source, Appendix

Figure 4: Genuine Savings TFP augmented in GK $1990 per capita. Latin American countries 1900 - 1990



Source, Appendix

recession of the early 1980s, and especially the depression of Asian economies in the late 1990s, affected Latin America, leading to plummeting investment.

5 Conclusions

This study provides estimates of the development of a series of 'Global' and national savings metrics using a panel of eleven countries in the course of the twentieth century. We compare net investment, GS, and an augmented GS measure that considers the value of technology, to assess the degree of weak sustainability of these countries. We find that GS were mostly positive during this period and increased substantially during the second half of the twentieth century. The results for six Western countries in our panel - Australia, France, Germany, Great Britain, Switzerland, and the United States - suggest that the Western world experienced large accumulation of capital, and that a large share of this capital accumulation occurred due to intangible assets, such as technology. For Latin America, we find that physical capital accumulation was largely positive during the twentieth century. However, most Latin American countries in our panel experienced substantial depletion of natural resources, and this disinvestment reduces national savings considerably. The eventful history of the twentieth century left severe marks, which are reflected by investment and savings figures presented in this study. The First World War is the first of these events in the twentieth century; it resulted in plummeting savings rates among European warring parties. The Great Depression, which is considered one of the most severe depressions in history, had a similar impact among the affected countries. The most devastating effect, however, came about during the Second World War, when a great deal of economic resources were invested in the war effort, and long-run development strategies were largely absent. The second half of the twentieth century brought substantial increases in wealth accumulation, especially in Western countries, but also setbacks during the Oil Crisis in the 1970s and the global economic depression in the early 1980s. However, we find that the treatment of CO2 and how it is priced has an enormous impact on the sustainability signal (Pezzey and Burke (2014). The two prices shown, the high 'business as usual' and the lower 'control', highlight the messages embodied in their assumptions: if there are no attempts to control emissions into the future, then the twentieth century was a century built on unsustainable practices; if, however, the damaging potential of uncontrolled emissions are accepted and these emissions are optimally 'controlled', then the development seen in the twentieth century can be determined to have been on a sustainable path. Only time can tell. Why do these events matter? The results presented in this chapter have strong implications for the present and future economic development of the countries considered in this study. A number of studies argue that consumption is a function of (previous) capital accumulation, since the productive basis, i.e. labour, physical and intangible capital, are the productive forces used to generate income. The lessons from these studies are straightforward: current investment in physical capital, intangible assets such as human capital and technology may result in higher consumption, wages and well-being in the future. Likewise, erosion of the productive basis due to depreciation of assets, pollution and depletion of natural resources may limit, or even reduce, future well-being. The implications of this perspective for the 'global' economy are clear; in order to ensure future sustainability the Hartwick Rule ought to be followed and technological progress, i.e. an increasingly intelligent use of existing assets, can play an immense role in future sustainability, especially taking into account the future development of the new economic giants of twenty-first century (i.e. China and India).

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Appendix

Sources

Australia

The GS estimations for Australia: Greasley et al. (2016)

Great Britain and United States

Hanley et al. (2016)

France

Note that all statistics use for this study refer to 'European France', excluding Algeria and other (former) colonies. GDP and GDP deflator: Pre-1982 data on French GDP is available from Toutain (1987) and Flora et al. (1983). GDP levels for later periods are taken from official Statistical Yearbooks of the French National Institute of Statistics and Economic Studies (INSEE). Data for the period between 1914 and 1920 can be found in Hautcoeur (2005). For the period 1939 to 1945 data on French GDP is taken from Occhino, Oosterlinck and White (2006). A GDP deflator was constructed using data from Mitchell (2007), Lévy-Leboyer and Bourguignon (1985) and the INSEE. Net investment: net fixed capital formation and changes in inventories for the 19th and for the beginning of the 20th century is provided by Lévy-Leboyer and Bourguignon (1985). The gap between 1914 and 1945 was estimated using Markovitch (1966) who reports investment and destructions during the wars as well as investment in the inter-war period and Carré, Dubois and Malinvaud (1972). For the period 1945 to 2000 data on inventory changes and net fixed capital formation was taken from the INSEE, the World Bank (2014) and the United Nations UNSD (2014) investment statistics. Data on net overseas investment is provided by Banque de France (2014), which provides a section with historical time series going back to the 18th century. Private consumption was taken from Flora et al. (1983), the INSEE, Baudrillard (1996), Beaupré (2004) and Asselain (1984). Forestry: For the second half of the 19th century a complete time series of French forest stocks and the French timber market was not available. In France, forestry management only developed to a high standard at the end of the 19th century. Therefore, linear interpolation was used for the construction of the time series between 1850 and 1890 as there was only data available in five year intervals. Information on French forestry stocks were taken from Zon (1910) and Zon and Sparhawk (1923), Cinotti (1996), Koerner et al. (2000) and from the statistical database of the FAO (2014). Non-renewable resources: Detailed data on French mining activities, including the number of employees in the mining sector, extraction quantities and market prices, can be found in the yearly publications of the French mining sector called Les Annales des Mines, a series of which the first issue was published in 1794. Additional information are provided by the statistical yearbooks of the INSEE, especially by the issues called Annuaires Rétrospectifs, which include data going back until the 18th century, and by Mitchell (2007). To assess the costs of depletion the number of employees in the mining sector and their average wage were used. Data on the labour force is provided by Les Annales des Mines and the INSEE. Wages of mining workers are reported by the INSEE, Simiand (1907), Marchand and Thélot (1997) and Diebolt and Jaoul-Grammare (2008). Education expenditure is provided by Diebolt (1995, 2000).

For the post-1994 period World Bank (2014) data on education expenditure was used. Carbon emissions were taken from Andres et al. (1999) and Boden, Marland and Andres (1995). This data is available online on the website of the Carbon Dioxide Information Analysis Center, an organization within the United States Department of Energy, under http://cdiac.ornl.gov/CO2_Emission/timeseries/national. Total Factor Productivity: labour hours worked and real GDP is taken from Greasley and Madsen (2006). Information on capital stock can be found in Guerrero (2013). Factor shares used were from Greasley and Madsen (2006), capital share is 0.60 and labour 0.40. A Kalman filter of the TFP growth rate was estimated and this was forecast using an ARIMA (2,1). Discount rates: Data on historical interest rates and government bond yields were taken from Homer and Sylla (2005) and Banque de France (2014).

Germany

GDP and GDP deflator: Pre-1975 data on German national product is available from Flora et al. (1983) and Hoffmann et al. (1965). GDP levels for later periods are taken from German Statistical Yearbooks (1999, 2008). Missing periods 1914-1924 and 1940-1949 were estimated using Ritschl and Spoerer's (1997) GNP series. A GDP deflator was constructed using data from Hoffman et al (1965), Mitchell (2007) and the United Nations Statistical Division (2013). Net investment: Net investment from 1850-1959 is provided by Hoffmann et al. (1965). We estimated the gap during 1914-1924 using Kirner (1968) who reports investment in buildings, construction, and equipment by sector for the war and inter-war periods. The period 1939 to 1949 was estimated by using data on net capital stock provided by Krengel (1958). To estimate investment during 1960 to 1975 we used Flora et al.'s (1983) data on net capital formation. For the period 1976 to 2000 we use official World Bank (2010) and United Nations (2013) investment statistics to complete the series. Data on the change in overseas capital stock and advances is provided by Hoffmann et al. (1965). Gaps during war and inter-war periods were estimated using information on the balance of payments provided by the German central bank (Deutsche Bundesbank, 1998, 2005). Remaining missing values were estimated using trade balances as a proxy for capital flows (Deutsche Bundesbank, 1976; Flora et al., 1983; Hardach, 1973). Private Consumption is taken from Flora et al. (1983), German Statistical Office, downloadable under www.gesis.oreg/histat, Ritschl (2005), Abelshauser (1998), and Harrison (1988). Forestry: Zon (1910), Zon et al. (1923), Hoffmann et al. (1965), and Endres (1922). Non-renewable resources: Fischer (1989) and Fischer and Fehrenbach (1995) provide detailed data on German mining activities including the number of employees in mining, covering the period until the 1970s. Information on quantities and market prices by commodity on an annual basis are available. Additional information was collected from Mitchell (2007). Data provided by Fischer (1989) and Fischer and Fehrenbach (1995) are also available by German state, which allows subtracting contemporary contributions of the mining sector of Alsace-Lorraine between 1871 and 1918. Moreover, the statistical offices of the German Empire and the Federal Republic of Germany provide information on the 1914 to 1923 as well as the post-1962 periods, respectively (Bundesamt, 2013; Germany. Statistisches Reichsamt., 1925). To assess the costs of depletion the number of employees in mining and their average wage were used. Data on the labour force in mining is provided by Fischer (1989), Fischer and Fehrenbach (1995), and the German Statistical Office (2013). Wages of mining workers are reported by Hoffmann et al. (1965), Kuczynski (1947), Mitchell (2007), and official contemporary statistics (Germany. Statistisches Reichsamt., 1925). Expenditure on schooling: Data on education expenditure is provided by Hoffmann et al. (1965) and Diebolt (1997, 2000). For the post-1990 period we use World Bank data on education expenditure. Missing values for the periods 1922-24 and 1938-48 have to be estimated. For the former period, we assume that expenditures between 1921 and 1925 developed gradually and apply linear interpolation. For the latter period we use Flora (1983, p. 585) who reports that the number of pupils and students in Germany dropped by 16.3 per cent between 1936 and 1950 – this occurred most likely due to population losses after WWII. The corresponding drop in education expenditure was 16.5 per cent. We assume that the 1939 expenditure level was maintained until 1945, when the number of students plummeted. Therefore, we assume that the expenditure level between 1946 and 1948 was equal to the 1949 figure. Carbon emissions were taken from Andres et al. (1999) and Boden et al. (1995). TFP: Data on labour hours worked and real GDP is taken from Greasley and Madsen (2006). Information on capital stock for the period 1850 through 2000 is provided by Metz (2005). Missing values during and after WWII have been estimated on the basis of Krengel (1958). Factor shares used were from Greasley and Madsen (2006), capital share is 0.60 and labour 0.40. A Kalman filter of the TFP growth rate was estimated. Discount rates were taken from Homer and Sylla (2005) and Deutsche Bundesbank (2013)[2].

Switzerland

GDP: Halbeisen et al (2012), Wirtschaftsgeschichte der Schweiz im 20. Jahrhundert. Basel: Schwabe; HSSO: Historische Statistik der Schweiz Online (Historical Statistics of Switzerland online), Kammerer Patrick et al. (Hg.), www.fsw.uzh.ch/histstat/main.php.; Capital: Halbeisen et al. (2012); BFS Online: Swiss Statistics, Swiss Federal Statistical Office (BFS), www.bfs.admin.ch/; Kehoe and Ruhl (2003); Goldsmith (1981); Siegenthaler and Ritzmann-Blickenstorfer (1996); Education expenditure: BFS Online: Swiss Statistics, Swiss Federal Statistical Office (BFS), www.bfs.admin.ch/; HSSO: Historische Statistik der Schweiz Online (Historical Statistics of Switzerland online), Kammerer Patrick et al. (Hg.), www.fsw.uzh.ch/histstat/main.php; Forest: HSSO: Historische Statistik der Schweiz Online (Historical Statistics of Switzerland online), Kammerer Patrick et al. (Hg.), www.fsw.uzh.ch/histstat/main.php; Siegenthaler and Ritzmann-Blickenstorfer (1996); BFS Online: Swiss Statistics, Swiss Federal Statistical Office (BFS), www.bfs.admin.ch/; LFI Online: National forest inventory Switzerland LFI, http://www.lfi.ch/resultate/suche.php; Rieger (2007); Costs of production: BAFU (2010). Biodiversität und Holznutzung – Synergien und Grenzen. Federal Office for the Environments Switzerland (BAFU), April 2010; BAFU (2011). Jahrbuch Wald und Holz - Annuaire La forêt et le bois – Federal Office for the Environments Switzerland (BAFU); Strawe (1994); HSSO: Historische Statistik der Schweiz Online (Historical Statistics of Switzerland online), Kammerer Patrick et al. (Hg.), www.fsw.uzh.ch/histstat/main.php.; Degen (2012); BFS Online: Swiss Statistics, Swiss Federal Statistical Office (BFS), www.bfs.admin.ch/; Studer (2008); Fossil fuel: Marek (2008); Marek (1994); (Gisler, 2011); Gebhardt (1957); Bellwald (2013); BFS Online: Swiss Statistics, Swiss Federal Statistical Office (BFS), www.bfs.admin.ch/ Iron ore: Fehlmann H. & Durrer R. (1932); HSSO: Historische Statistik der Schweiz Online (Historical Statistics of Switzerland online), Kammerer Patrick et al. (Hg.), www.fsw.uzh.ch/histstat/main.php.; IEA online: International Energy Agency (IEA), http://www.iea.org/countries/membercountries/switzerland/; BFS Online: Swiss Statistics, Swiss Federal Statistical Office (BFS), www.bfs.admin.ch/; Kündig and Leuenberger (1997); Bärtschi, 2011; Gesis online, Historische Statistiken, Historical statistics (Histat): http://www.gesis.org/histat/; Population: BFS Online: Swiss Statistics, Swiss Federal Statistical Office (BFS), www.bfs.admin.ch/; HSSO: Historische Statistik der Schweiz Online (Historical Statistics of Switzerland online), Kammerer Patrick et al. (Hg.), www.fsw.uzh.ch/histstat/main.php.;

Discount rates: BFS Online: Swiss Statistics, Swiss Federal Statistical Office (BFS), www.bfs.admin.ch/; TFP: Halbeisen et al, (2012).

Latin America

GDP and GDP deflator: Argentina – From 1900-2000 the nominal GDP was derived from Della Paolera and Taylor (2003). GDP deflator is based on data from MoxLAD (2014) from 1900-1960 and on data from World Bank (2014b) for years thereafter. Brazil – Nominal GDP and GDP deflator were derived from the historical series from IBGE (2014). Chile – From 1900-1940 the nominal GDP in USD was calculated using Hofman (2000). From 1940-1995 the nominal GDP was taken from Braun-Llona et al. (2000) and from 1995-2010 from Banco Central de Chile (2014). The GDP deflator was derived from World Bank (2014b) from 1960-2010. Braun-Llona et al. (2000) reports a real GDP series from 1900-1995 in prices from 1995. Colombia – The nominal GDP was taken from GRECO (1999b) from 1905-1997 and from 1998-2010 from World Bank (2014b). For the years before 1905 the GDP was calculated using the growth rate reported by Hofman (2000). From 1900-1960 the GDP deflator was derived by using the variations given by GRECO (1999b), after 1960 is it taken from World Bank (2014b). Mexico – From 1900-1970 the nominal GDP was taken from INEGI (2009), following years are derived from World Bank (2014b). The GDP deflator was calculated using the GDP deflator reported by MoxLAD (2014). Consumer price index and inflation: Argentina, Brazil, Mexico – data were taken from Clio infra (2014). Chile – 1900-1995 from Braun-Llona et al. (2000); from 1995 and thereafter from Clio infra (2014). Colombia – 1900-1905 from Braun-Llona et al. (2000) and from 1905 to 1996 data is from GRECO (1999b). For the last years it was taken from World Bank (2014b). Exchange rates and changes in local currency units (LCU): Argentina – data from Della Paolera and Taylor (2003). The exchange rate from Nuevos Pesos to USD from 1916 until 1999 was taken from Della Paolera and Taylor (2003) and for later years from Clio infra (2014). Brazil – Changes in LCU were derived from MoxLAD (2014); the exchange rate from LCU to USD from IBGE (2014). Chile – Changes in LCU are reported by MoxLAD (2014). From 1900-1995 the exchange rate to USD is reported by Braun-Llona et al. (2000), while later years were taken from Banco Central de Chile (2014). Colombia – exchange rate from Pesos to USD was taken from GRECO (1999b) from 1905-1997; for the following years it is from CEPAL (2014). Mexico – Changes in LCU were taken from MoxLAD (2014); the exchange rate to USD was derived from INEGI (2009) until 2009, while later years are from CEPAL (2014). Investment and gross fixed capital formation (GFCF) – All countries – The series for GFCF after 1950 was taken from CEPAL (2009) and CEPAL (2014). These data was converted to real prices of 2010 and calculated for the years from 1900-1950 using the index reported by Tafunell (2011). Tafunell (2013) explains the method to build the GFCF data on non-residential construction and machinery and equipment. The article by Tafunell and Ducoing (2015) is an extension of the latter. Consumption of fixed capital – All countries – World Bank (2014b) reports information starting in 1970. For previous years data was estimated using the methodology reported by the World Bank in Bolt et al. (2002). Overseas investment – All countries – From 1900-1949 data is based on Taylor (1998). Argentina, Colombia, Mexico: From 1950-1969 data was taken from CEPAL (2009) and for later years from World Bank (2014b). Brazil, Chile: Data is taken from CEPAL (2014) from 1950-1974 and later from World Bank (2014b). Natural resources: Forestry – All countries – Annual change of forest area for the period of 1900-1985 was taken from Houghton et al. (1991). Forest area after 1990 was taken from the World Bank (2014b). Minerals & Energy - Argentina – Gold, silver: 1921-1944: Imperial Mineral Resources Bureau (various years); 1949-1954: Colonial Geological

Surveys (various years); 1955-1969: Institute of Geological Sciences (various years-a); 1970-1980: Institute of Geological Sciences (various years-b); 1981-1991: British Geological Survey (various years); 1992-2010: British Geological Survey (2014); Rothwell (1898) reports data for 1895-1897. Copper: 1913-1944: Imperial Mineral Resources Bureau (various years); 1960-1969: Institute of Geological Sciences (various years-a); 1970-1973: Institute of Geological Sciences (various years-b); 1974-2008: CEPAL (2014); 2009-2010: British Geological Survey (2014). Missing years were linearly interpolated. Coal: 1939-2002: Mitchell (1998); 2003-2008: CEPAL (2014); 2009-2010 were assumed to be constant as 2008. Iron ore: 1937-1989 Mitchell (1998), 1990-2010 World Steel Association (2014). Natural gas: 1929-1966: Mitchell (1998); 1970-1980: Institute of Geological Sciences (various years-b); 1981-1991: British Geological Survey (various years); 1992-2010: British Geological Survey (2014). Crude petroleum: 1915-2002 Mitchell (1998); 2003-2010: British Geological Survey (2014). Lead: 1920-2000: Mitchell (1998); 2001-2010: British Geological Survey (2014). Tin: 1923-1944: Imperial Mineral Resources Bureau (various years); 1944-54: Colonial Geological Surveys (various years); 1955-1970: Institute of Geological Sciences (various years-a); 1974-1995 CEPAL (2014), from 1996-2010 production was assumed to be constant as value of 1995. Zinc: 1939-1944: Imperial Mineral Resources Bureau (various years), 1945-1955: Institute of Geological Sciences (various years-a); 1956-2003: Mitchell (1998); 2004-2008: CEPAL (2014); 2009-2010: British Geological Survey (2014). Brazil – Gold: 1913-1944: Imperial Mineral Resources Bureau (various years), 1949-1954: Colonial Geological Surveys (various years); 1955-1969: Institute of Geological Sciences (various years-a); 1970-80: Institute of Geological Sciences (various years-b); 1981-91: British Geological Survey (various years); 1992-2010: British Geological Survey (2014); Rothwell (1898) reports data for 1895-1897. Silver: 1913-44: Imperial Mineral Resources Bureau (various years), 1949-54: Colonial Geological Surveys (various years); 1955-1969: Institute of Geological Sciences (various years-a); 1970-80: Institute of Geological Sciences (various years-b); 1981-91: British Geological Survey (various years); 1992-2010: British Geological Survey (2014). Copper: 1955-1960: Institute of Geological Sciences (various years-a); 1965: Instituto Brasileiro de Mineração (2013), 1974-2008 CEPAL (2014); 2009-2010: British Geological Survey (2014). Coal: 1913-2002: Mitchell (1998); 2003-2008: CEPAL (2014); 2009-2010 was assumed to be constant as value in 2008. Iron ore: 1923-1935: Imperial Mineral Resources Bureau (various years); 1936-92: Mitchell (1998), 1993-2008: CEPAL (2014); 2009-2010: British Geological Survey (2014). Natural gas: 1942-1966: Mitchell (1998), 1972-1980: Institute of Geological Sciences (various years-b); 1981-1991: British Geological Survey (various years); 1992-2010: British Geological Survey (2014). Crude petroleum: 1942-2002: Mitchell (1998); 2003-2010: British Geological Survey (2014). Lead: 1921-1944: Imperial Mineral Resources Bureau (various years); 1945-2003: Mitchell (1998); 2004-2010: British Geological Survey (2014). Tin: 1943-2002: Mitchell (1998); 2003-2008: CEPAL (2014); 2009-2010: British Geological Survey (2014). Zinc: 1965-2003: Mitchell (1998); 2003-2008: CEPAL (2014); 2009-2010: British Geological Survey (2014). Aluminium/ bauxite: 1953-1991: Mitchell (1998); 1992-2010: British Geological Survey (2014). Chile – Gold, silver: 1900-1995: Braun-Llona et al. (2000), 1996-2010: British Geological Survey (2014). Copper: 1900-1995: Braun-Llona et al. (2000); 1996-2008: CEPAL (2014); 2009-2010: British Geological Survey (2014). Coal: 1900-1990: Braun-Llona et al. (2000); 1991-2008: CEPAL (2014); 2009-2010 the production volume of 2008 was assumed. Iron ore: 1911-1998: Mitchell (1998); 1990-2007: CEPAL (2014); 2009-2010: British Geological Survey (2014). Natural gas: 1952-1966: Mitchell (1998); 1970-1980: Institute of Geological Sciences (various years-b); 1981-1991: British Geological Survey (various years); 1992-2010: British Geological Survey (2014). Crude petroleum: 1949-2002: Mitchell (1998); 2003-2010: British Geological Survey (2014). Lead: 1920-1944: Imperial Mineral Resources Bureau (various years), 1945-1954: Colonial Geological Surveys (various years); 1955-1969: Institute of Geological Sciences (various years-a); 1970-1980: Institute of Geological Sciences (various years-b); 1981-1991: British Geological Survey (various years); 1992-2010: British Geological Survey (2014). Zinc: 1926-33: Imperial Mineral Resources Bureau (various years); 1953-54: Colonial Geological Surveys (various years); 1955-1970: Institute of Geological Sciences (various years-a) missing years were assumed to be zero as production is already very low in the years before; 1974-2008: CEPAL (2014); 2009-2010: British Geological Survey (2014). Colombia - Gold, silver: 1913-1929: Imperial Mineral Resources Bureau (various years). 1931-2010: UMPME (2014). Copper: 1951-2010: UMPME (2014). Coal: 1926-32: Imperial Mineral Resources Bureau (various years); 1933-1949: Mitchell (1998); 1950-2010: Mineral Agency of Colombia. Iron ore: 1960-1998: Mitchell (1998); 1999-2010: British Geological Survey (2014). Natural gas: 1952-1966: Mitchell (1998); 1970-1980: Institute of Geological Sciences (various years-b); 1981-1991: British Geological Survey (various years): 1992-2010: British Geological Survey (2014). Crude petroleum: 1922-2005: Mitchell (1998); 2003-2010: British Geological Survey (2014). Lead: 1960-1985: Mitchell (1998); 1990-2010: Mosquera and Bautista (2005). Zinc: 1960-1970: Institute of Geological Sciences (various years-a). Mexico - Gold, silver: 1900-2008: INEGI (2009); 2009-2010: British Geological Survey (2014). Copper: 1900-1975: INEGI (2009); 1976-2003: Mitchell (1998); 2004-2007: CEPAL (2014); 2008-2010: British Geological Survey (2014). Coal: 1900-2008: INEGI (2009). Iron ore: 1900-2008: INEGI (2009); 2009-2010: British Geological Survey (2014). Natural gas: 1932-1966: Mitchell (1998); 1970-1980: Institute of Geological Sciences (various years-b); 1981-1991: British Geological Survey (various years); 1992-2010: British Geological Survey (2014). Crude petroleum: 1901-2007: INEGI (2009). Lead: 1900-2008: INEGI (2009); 2009-2010: British Geological Survey (2014). Tin: 1903-2008: INEGI (2009). Zinc: 1900-2008: INEGI (2009); 2009-2010: British Geological Survey (2014). Resource prices: Coal: 1900-1971: U.S. Bureau of Mines (2014); 1972-2010: U. S. Energy Information Administration (2012). Crude petroleum, lead, copper, silver, tin, zinc: 1900-2010: The price index was taken from MoxLAD (2014). Natural gas: 1922-2010: U.S. Energy Information Administration (2014). Iron ore: 1900-2010: U.S. Geological Survey (2014). Gold: 1908-2000: GRECO (1999a); 2001-2010: World Bank (2014a). Bauxite: 1900-2010: U.S. Geological Survey (2014). Labor costs were calculated by multiplying the economically active populations (EAP) in the extractive industry with the average real wage. Argentina - 1914-1990: EAP of the extractive industry was taken from Mitchell (1998), who reports data for the years 1914, 1947, 1960, 1970 and 1980. For 1980 and 1985 data from CEPAL (2014) and from 1990-2010 data from World Bank (2014b) was available for the total workforce. Brazil - From IBGE (1990) information about the EAP in extractive industry from 1900-1989 are available. From 1990-2010 data from the World Bank (2014b) about the total workforce was available. From 1990 to 1995 the percentage of occupied population in the extractive industry from the whole labor force was calculated. Chile - Braun-Llona et al. (2000) gives the number of people working in mining as well as percentages of people working in mining from the whole labor force from 1900-1995. From 1996 the total EAP was available from World Bank (2014b). Colombia - Mitchell (1998) reports the EAP in the extractive sector for 1938, 1951, 1964, 1973, 1992 and 2004. Data about the general workforce is available from GRECO (1999b) between 1925 and 1996 as well as between 1997 and 2010 from World Bank (2014b). Mexico - INEGI (2009) reports the EAP in the extractive and petroleum industry from 1900-1997 and from 1998-2004 the EAP in the extractive and petroleum sector. The discount rate for calculating the PV of future changes in real wages is based on each country's geometrical average of real GDP growth rate. Population: Argentina – From 1900-1996 the population was taken from Braun-Llona et al. (2000) and thereafter from INDEC (2014). Brazil - The whole series was taken from IBGE (2014). Chile – From 1900-1995 data was derived from Braun-Llona et al. (2000) and for years after 1996 from Banco Central de Chile (2014). Colombia – From 1905-1997 data was derived from GRECO (1999b), the following years were from DANE (2014). The first five years were calculated using the average growth rate between 1905 and 1915. Mexico – The whole series until 1995 was taken from Braun-Llona et al. (2000), the following years from World Bank (2014b). Education expenditure: Argentina – World Bank (2014b) and MoxLAD (2014). Brazil – From 1930-2004 data was calculated with information on education expenditure which is given as a percentage of GDP by Rodrigues M. (2007). From 2004-2010 data is reported by World Bank (2014b). Chile - Braun-Llona et al. (2000) report data for the period between 1900 to 1996. The data series was completed with World Bank (2014b). Colombia – Data from Helg (2001), DANE (1985), World Bank (2014b) and MoxLAD (2014). Mexico – From 1900-1966 data is derived from INEGI (2009) and from 1997-2014 from INEGI (2014). Carbon emissions: All countries – Data on emissions are reported by Boden et al. (2014). The prices for CO2 were calculated using the methodology presented by Tol (2012) who estimated a CO2 price of 29 USD per ton in 2015. The prices for other years are calculated by discounting it with a rate of 1.99 %. TFP: LA ASTORGA, P., BERGÉS, A. R., & FITZGERALD, V. (2011). PRODUCTIVITY GROWTH IN LATIN AMERICA OVER THE LONG RUN. Review of Income and Wealth, 57(2), 203–223. http://doi.org/10.1111/j.1475-4991.2011.00447.x Argentina – From 1900-1993 TFP growth is reported by Elias (1996) and from 1993-2010 from data estimated by Feenstra et al. (2013). Brazil, Chile – From 1900-1950 data was derived from Elias (1996). These growth rates were assumed to be constant for every decade. From 1950-2010 growth was calculated from the series estimated by Feenstra et al. (2013). Colombia – From 1900-1950 growth rates are reported by Astorga et al. (2003); thereafter we used a series provided by Feenstra et al. (2013). Mexico – From 1900-1950 growth rates are derived from Baier et al. (2006). From 1950-2010 the growth was calculated from the series estimated by Feenstra et al. (2013). The value of technology in the economy was calculated using the methodology in Pezzey et al. (2006).

Data

Table 3: World Aggregates 1900 - 2000 with CO_2 under control (US$131) : Net Investment, Green Investment, Green CO_2, Genuine Savings, Augmented GS and Green TFP. in GK $1990 per capita

	Net	Green	Green CO_2	GS	GSTFP	GreenTFP		Net	Green	Green CO_2	GS	GSTFP	GreenTFP
1900	398,73	312,29	292,34	329,11	1017,03	980,27	1951	687,03	524,93	436,97	596,08	2434,44	2275,33
1901	476,42	396,37	375,70	415,01	1126,27	1086,96	1952	549,68	397,34	310,04	472,79	2327,09	2164,34
1902	417,36	342,87	321,50	361,95	1101,10	1060,65	1953	528,35	363,64	274,53	455,42	2341,91	2161,02
1903	463,11	389,11	365,40	406,67	1169,82	1128,55	1954	523,21	360,91	272,54	458,88	2346,94	2160,60
1904	375,89	304,89	281,06	323,81	1093,34	1050,60	1955	668,95	512,49	416,25	619,85	2589,92	2386,32
1905	525,71	450,53	424,75	468,96	1286,50	1242,29	1956	699,27	546,38	445,27	654,81	2623,54	2414,01
1906	615,92	534,06	507,38	551,92	1402,13	1357,59	1957	682,83	547,47	446,06	679,86	2655,93	2422,13
1907	498,17	408,36	377,81	423,04	1278,04	1232,81	1958	571,81	432,91	334,03	575,73	2517,01	2275,31
1908	257,84	176,96	148,31	196,42	1007,43	959,31	1959	660,47	514,56	413,61	670,54	2670,12	2413,19
1909	509,24	428,27	397,95	448,79	1307,09	1256,25	1960	686,23	486,65	381,38	650,49	2682,41	2413,30
1910	379,52	294,53	262,52	314,52	1178,11	1126,10	1961	709,89	516,48	410,26	702,68	2750,77	2458,34
1911	388,68	299,31	266,74	321,61	1208,17	1153,31	1962	763,52	568,13	457,59	766,53	2851,18	2542,24
1912	424,67	331,52	297,26	350,90	1256,96	1203,32	1963	693,66	501,62	385,37	721,00	2822,00	2486,36
1913	472,21	370,34	333,16	388,84	1316,43	1260,75	1964	797,10	617,41	496,53	851,90	3016,14	2660,76
1914	243,02	133,06	98,91	155,04	1020,44	964,32	1965	854,50	667,64	542,74	939,17	3169,55	2773,11
1915	243,10	129,00	94,33	147,53	979,84	926,64	1966	894,25	713,24	584,00	997,50	3286,44	2872,93
1916	396,63	262,45	224,30	272,24	1196,59	1148,65	1967	835,65	659,60	526,56	981,58	3267,55	2812,53
1917	324,52	180,74	139,34	181,92	1094,51	1051,94	1968	830,66	661,09	521,94	991,02	3335,31	2866,22
1918	218,26	91,92	49,60	86,41	1037,80	1000,99	1969	944,19	765,52	617,93	1124,78	3535,92	3029,07
1919	407,67	308,39	270,53	310,24	1266,49	1226,78	1970	879,09	719,53	563,10	1091,37	3470,81	2942,54
1920	550,64	389,56	345,39	379,38	1375,16	1341,17	1971	928,64	699,44	540,01	1085,64	3503,69	2958,06
1921	306,35	214,18	176,22	227,72	1211,86	1160,36	1972	953,62	755,09	589,27	1149,62	3641,09	3080,74
1922	337,01	215,57	175,30	232,15	1279,68	1222,84	1973	1164,32	970,30	795,42	1390,72	4065,86	3470,56
1923	435,16	314,84	268,46	328,78	1408,95	1348,64	1974	1035,29	772,95	602,22	1220,62	3875,49	3257,08
1924	312,46	181,87	135,74	194,72	1319,13	1260,16	1975	799,05	468,14	303,12	930,17	3545,50	2918,45
1925	442,88	325,78	278,91	355,39	1424,74	1348,25	1976	943,74	601,01	425,84	1061,16	3780,99	3145,67
1926	374,70	254,44	208,93	286,53	1405,42	1327,83	1977	998,63	644,58	465,69	1097,40	3876,11	3244,40
1927	388,00	285,81	236,10	319,68	1462,97	1379,39	1978	1094,24	731,21	544,82	1175,01	4035,61	3405,42
1928	367,58	272,62	222,98	307,99	1480,85	1395,83	1979	1190,97	625,76	434,41	1072,63	4008,97	3370,75
1929	335,30	228,96	175,35	274,12	1498,07	1399,30	1980	1061,08	393,84	207,25	844,46	3803,03	3165,82
1930	169,31	82,85	33,99	135,58	1295,86	1194,27	1981	1055,91	436,63	255,99	894,71	3805,79	3167,07
1931	-38,60	-99,94	-142,79	-39,64	1046,76	943,62	1982	744,77	166,08	-9,36	632,93	3479,14	2836,85
1932	-138,38	-196,35	-234,54	-124,80	872,65	762,91	1983	643,59	103,14	-73,28	567,70	3430,62	2789,64
1933	-74,13	-134,61	-175,26	-77,07	937,91	839,72	1984	825,19	287,97	106,73	755,98	3748,43	3099,18
1934	21,50	-57,02	-101,10	-3,12	1100,63	1002,65	1985	719,94	221,26	36,65	706,99	3808,31	3137,97
1935	123,93	45,81	-0,68	102,18	1294,44	1191,58	1986	671,17	361,52	174,64	869,96	4077,22	3381,90
1936	168,95	72,90	20,54	126,65	1459,01	1352,91	1987	646,91	323,39	129,36	839,07	4119,36	3409,65
1937	299,91	187,71	131,40	240,34	1660,60	1551,66	1988	834,99	549,07	348,08	1089,92	4435,03	3693,19
1938	216,43	118,03	66,10	179,03	1609,91	1496,98	1989	946,55	645,86	439,39	1205,39	4629,74	3863,74
1939	229,54	110,94	54,75	167,99	1658,88	1545,64	1990	792,24	469,93	268,01	1049,87	4459,82	3677,96
1940	138,92	24,04	-36,02	76,16	1692,97	1580,79	1991	623,96	332,19	134,01	914,35		
1941	193,96	74,07	10,33	114,30	1926,26	1822,29	1992	599,00	320,41	119,88	921,89		
1942	7,36	-101,96	-169,35	-69,31	1902,79	1802,76	1993	567,01	316,08	111,14	913,30		
1943	-50,13	-163,27	-232,78	-132,95	2017,61	1917,78	1994	657,17	409,71	201,12	1016,45		
1944	-67,17	-164,55	-235,51	-135,64	2020,07	1920,21	1995	635,67	380,95	169,58	951,41		
1945	-495,42	-579,34	-640,11	-532,17	1364,65	1256,71	1996	662,06	373,26	153,08	942,80		
1946	356,15	252,81	185,49	289,63	1906,41	1802,27	1997	820,14	542,90	318,31	1110,82		
1947	443,73	326,74	252,37	372,62	1971,61	1851,36	1998	819,21	595,87	366,52	1174,11		
1948	477,83	351,38	272,89	392,41	2039,12	1919,60	1999	756,54	508,43	274,76	1108,51		
1949	423,49	300,77	228,88	369,21	2044,11	1903,78	2000	723,88	384,01	142,46	1005,70		
1950	603,74	476,18	393,43	540,96	2300,06	2152,53							

Table 4: World Aggregates 1900 - 2000 with CO_2 no control (US$1455) : Net Investment, Green Investment, Green CO_2, Genuine Savings, Augmented GS and Green TFP. in GK $1990 per capita

	Net	Green	Green CO_2	GS	GSTFP	GreenTFP		Net	Green	Green CO_2	GS	GSTFP	GreenTFP
1900	398,73	312,29	90,74	127,51	815,44	778,67	1951	687,03	524,93	-451,99	-292,89	1 545,47	1 386,36
1901	476,42	396,37	166,76	206,06	917,33	878,02	1952	549,68	397,34	-572,32	-409,56	1 444,74	1 281,98
1902	417,36	342,87	105,43	145,88	885,04	844,59	1953	528,35	363,64	-626,10	-445,22	1 441,27	1 260,39
1903	463,11	389,11	125,77	167,04	930,19	888,92	1954	523,21	360,91	-620,63	-434,29	1 453,78	1 267,44
1904	375,89	304,89	40,27	83,01	852,55	809,80	1955	668,95	512,49	-556,42	-352,82	1 617,25	1 413,65
1905	525,71	450,53	164,20	208,42	1 025,95	981,74	1956	699,27	546,38	-576,63	-367,10	1 601,64	1 392,10
1906	615,92	534,06	237,69	282,23	1 132,44	1 087,90	1957	682,83	547,47	-578,94	-345,14	1 630,93	1 397,14
1907	498,17	408,36	69,06	114,30	969,30	924,07	1958	571,81	432,91	-665,34	-423,64	1 517,64	1 275,93
1908	257,84	176,96	-141,32	-93,20	717,81	669,69	1959	660,47	514,56	-606,61	-349,68	1 649,90	1 392,97
1909	509,24	428,27	91,49	142,33	1 000,63	949,79	1960	686,23	486,65	-682,63	-413,52	1 618,40	1 349,29
1910	379,52	294,53	-61,03	-9,03	854,56	802,55	1961	709,89	516,48	-663,37	-370,95	1 677,14	1 384,72
1911	388,68	299,31	-62,47	-7,60	878,96	824,10	1962	763,52	568,13	-659,63	-350,70	1 733,96	1 425,02
1912	424,67	331,52	-49,01	4,63	910,70	857,06	1963	693,66	501,62	-789,56	-453,92	1 647,07	1 311,44
1913	472,21	370,34	-42,59	13,10	940,68	885,00	1964	797,10	617,41	-725,15	-369,78	1 794,45	1 439,08
1914	243,02	133,06	-246,19	-190,07	675,34	619,22	1965	854,50	667,64	-719,69	-323,26	1 907,12	1 510,68
1915	243,10	129,00	-256,10	-202,89	629,42	576,21	1966	894,25	713,24	-722,25	-308,75	1 980,19	1 566,69
1916	396,63	262,45	-161,35	-113,41	810,94	763,00	1967	835,65	659,60	-818,02	-363,00	1 922,96	1 467,94
1917	324,52	180,74	-279,10	-236,52	676,07	633,50	1968	830,66	661,09	-884,47	-415,38	1 928,91	1 459,82
1918	218,26	91,92	-378,08	-341,27	610,11	573,30	1969	944,19	765,52	-873,77	-366,92	2 044,22	1 537,37
1919	407,67	308,39	-112,05	-72,34	883,91	844,20	1970	879,09	719,53	-1 017,92	-489,65	1 889,79	1 361,52
1920	550,64	389,56	-100,96	-66,97	928,81	894,82	1971	928,64	699,44	-1 071,35	-525,71	1 892,33	1 346,70
1921	306,35	214,18	-207,52	-156,01	828,13	776,62	1972	953,62	755,09	-1 086,73	-526,38	1 965,10	1 404,75
1922	337,01	215,57	-231,68	-174,84	872,69	815,85	1973	1 164,32	970,30	-972,05	-376,75	2 298,39	1 703,09
1923	435,16	314,84	-200,26	-139,95	940,23	879,91	1974	1 035,29	772,95	-1 123,41	-505,00	2 149,87	1 531,46
1924	312,46	181,87	-330,51	-271,53	852,89	793,91	1975	799,05	468,14	-1 364,67	-737,62	1 877,70	1 250,66
1925	442,88	325,78	-194,87	-118,38	950,96	874,48	1976	943,74	601,01	-1 344,60	-709,28	2 010,55	1 375,23
1926	374,70	254,44	-250,97	-173,37	945,52	867,92	1977	998,63	644,58	-1 342,32	-710,61	2 068,10	1 436,39
1927	388,00	285,81	-266,31	-182,73	960,56	876,98	1978	1 094,24	731,21	-1 339,00	-708,81	2 151,79	1 521,60
1928	367,58	272,62	-278,76	-193,74	979,11	894,10	1979	1 190,97	625,76	-1 499,63	-861,41	2 074,94	1 436,72
1929	335,30	228,96	-366,45	-267,69	956,26	857,50	1980	1 061,08	393,84	-1 678,58	-1 041,37	1 917,20	1 279,99
1930	169,31	82,85	-459,85	-358,26	802,02	700,43	1981	1 055,91	436,63	-1 569,67	-930,95	1 980,13	1 341,41
1931	-38,60	-99,94	-575,81	-472,67	613,73	510,59	1982	744,77	166,08	-1 782,50	-1 140,21	1 706,00	1 063,71
1932	-138,38	-196,35	-620,53	-510,79	486,67	376,93	1983	643,59	103,14	-1 856,32	-1 215,34	1 647,58	1 006,60
1933	-74,13	-134,61	-586,13	-487,93	527,05	428,86	1984	825,19	287,97	-1 724,98	-1 075,73	1 916,71	1 267,46
1934	21,50	-57,02	-546,64	-448,66	655,09	557,11	1985	719,94	221,26	-1 829,19	-1 158,85	1 942,48	1 272,13
1935	123,93	45,81	-470,51	-367,65	824,61	721,75	1986	671,17	361,52	-1 714,07	-1 018,74	2 188,52	1 493,19
1936	168,95	72,90	-508,59	-402,49	929,87	823,77	1987	646,91	323,39	-1 831,65	-1 121,95	2 158,34	1 448,63
1937	299,91	187,71	-437,69	-328,75	1 091,51	982,57	1988	834,99	549,07	-1 683,32	-941,48	2 403,63	1 661,79
1938	216,43	118,03	-458,70	-345,78	1 085,10	972,17	1989	946,55	645,86	-1 647,36	-881,36	2 542,99	1 776,99
1939	229,54	110,94	-513,20	-399,96	1 090,93	977,68	1990	792,24	469,93	-1 772,72	-990,86	2 419,09	1 637,23
1940	138,92	24,04	-643,09	-530,91	1 085,91	973,72	1991	623,96	332,19	-1 868,94	-1 088,60		
1941	193,96	74,07	-633,94	-529,97	1 281,99	1 178,02	1992	599,00	320,41	-1 906,86	-1 104,84		
1942	7,36	-101,96	-850,46	-750,43	1 221,68	1 121,64	1993	567,01	316,08	-1 960,12	-1 157,96		
1943	-50,13	-163,27	-935,37	-835,54	1 315,02	1 215,19	1994	657,17	409,71	-1 907,11	-1 091,78		
1944	-67,17	-164,55	-952,68	-852,81	1 302,90	1 203,04	1995	635,67	380,95	-1 966,79	-1 184,96		
1945	-495,42	-579,34	-1 254,32	-1 146,38	750,44	642,50	1996	662,06	373,26	-2 072,27	-1 282,54		
1946	356,15	252,81	-494,97	-390,83	1 225,95	1 121,81	1997	820,14	542,90	-1 951,60	-1 159,10		
1947	443,73	326,74	-499,29	-379,04	1 219,95	1 099,70	1998	819,21	595,87	-1 951,47	-1 143,88		
1948	477,83	351,38	-520,38	-400,86	1 245,85	1 126,33	1999	756,54	508,43	-2 086,88	-1 253,14		
1949	423,49	300,77	-497,73	-357,39	1 317,50	1 177,17	2000	723,88	384,01	-2 298,76	-1 435,52		
1950	603,74	476,18	-442,95	-295,41	1 463,69	1 316,15							