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Cambodia: The Pursuit of Sustainable Economic Development

Genuine Savings 1970-2019

by

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Abstract This thesis estimates Genuine Savings for Cambodia during 1970-2019 following Blum, Ducoing, and McLaughlin (2017). By including additional components, the estimates of the World Bank are enhanced. The results suggest that Cambodia has followed an unsustainable development path until the turn of the millennium, but it has evolved positively over the last two decades. However, to foster this sustainable path, Cambodia needs to take action against exhaustive natural resource exploitation and increasing pollution. If Cambodia manages to control these internal factors while building up a more diversified economy, Cambodia should evolve economically sustainable in the future years.

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Glossary

AMR Adult Mortality Rate.

ANS Adjusted Net Savings.

ASEAN Association of Southeast Asian Nations.

C_{FC} Consumption of Fixed Capital.

CI Comprehensive Investment.

CMDG Cambodian Millennium Development Goal.

CMR Child Mortality Rate.

CO_2 Carbon Dioxide.

DI Domestic Investment.

DK Democratic Kampuchea.

EFA Education For All.

FDI Foreign Direct Investment.

GDP Gross Domestic Product.

GER Gross Enrolment Ratio.

GHG Green House Gases.

GI Green Investment.

GS Genuine Savings.

II Inclusive Investment.

KHR Khmer Riel.

KR Khmer Rouge.

KRR Khmer Rouge Regime.

LMB Lower Mekong Bassin.

MDB Maddison Database.

MoAFF Ministry of Agriculture, Forest and Fisheries.

MoEF Ministry of Economy and Finance.

MoEM Ministry of Energy and Mining.

MoEYS Ministry of Education, Youth and Sports.

NIS National Institute of Statistics.

NNS Net National Savings.

NO_x Nitrogen Oxides.

NPV Net Present Value.

PED Particulate Emission Damage.

PRK People's Republic of Kampuchea.

PWT Penn World Table.

SO_2 Sulfur Dioxide.

TB Trade Balance.

TFP Total Factor Productivity.

UN United Nations.

USD United States Dollar.

WB World Bank.

WDI World Development Indicator.

WTO World Trade Organization.

WWII World War II.

1 Introduction

Over the last few decades, sustainable economic development has become the focus of attention. “Sustained, inclusive, and sustainable economic growth” (United Nations, 2020) shall be promoted in order to enable and sustain the future well-being of a country’s economy. The concept of wealth accounting has shifted the focus away from pure output and income indicators towards the inclusion of broader measures (Hamilton, 1994). Hence, Genuine Savings (GS) has emerged as a commonly used indicator of sustainable development over the long run (Blum, Ducoing, & McLaughlin, 2017; Greasley, Hanley, Kunnas, McLaughlin, Oxley, & Warde, 2014; Hamilton, 1994; Hamilton & Clemens, 1999; Hanley, Dupuy, & McLaughlin, 2015; Pezzey, 2004).

GS[1] addresses shortcomings of conventional metrics of economic development. It considers broader measures of investments and savings, such as natural resource depletion, human capital accumulation, and polluting emissions (Blum, Ducoing, & McLaughlin, 2017; Stiglitz, Sen, & Fitoussi, 2009). As the World Bank (WB) states: “Natural and human capital are assets upon which the productivity and therefore the well-being of a nation rest” (Bolt, Matete, & Clemens, 2002). By including natural, social, physical, human, and institutional capital, GS measures year-on-year changes within the total wealth, and negative performance is generally interpreted as an unsustainable economic development path (Hamilton & Clemens, 1999; World Bank, 2006).

The WB has been publishing Adjusted Net Savings (ANS) on national level in their World Development Indicator (WDI) for the majority of the countries, starting as of 1970 (World Bank, 1997, 2011, 2015). These studies follow early publications by Pearce and Atkinson (1993) and Hamilton (1994), however, comprising calculations on a broader scale, both region- and time-wise, are not available yet. For the majority of the countries presented by the WB, ANS estimates are not available before the 1990s (World Bank, 2020a). Individual researches have focused on particular countries covering different time periods, e.g. Greasley et al. (2014) for the UK 1765-2000, Lindmark and Acar (2013) for Sweden 1850-2000, and Blum, Ducoing, and McLaughlin (2017) for Latin American countries starting 1900, just to name a few. However, their approaches vary slightly, and for comparisons, the respective component definitions have to be carefully distinguished. Region-wise, the focus of past calculations lays on Western Europe (Ferreira & Moro, 2011; Lindmark & Acar, 2013; Pezzey, Hanley, Turner, & Tinch, 2006), Latin America (Blum, Ducoing, & McLaughlin, 2017; Rubio, 2004; Vincent, 2001), Oceania (Greasley, McLaughlin, Hanley, & Oxley, 2017; Qasim, Oxley, & McLaughlin, 2020) and Sub-Saharan Africa (Hamilton & Clemens, 1999). Southeast Asia, in particular, has only barely be touched upon in the past despite one calculation for Malaysia by Othman, Falatehan, and Jafari (2012), who re-calculate the same time-span as provided by the WB (1990-2008). This paper aims to close this gap a little further and to contribute to the literature on GS for Southeast Asia.

[1] Also referred to as Adjusted Net Savings or Comprehensive Investment

The main goal of this thesis is to calculate GS for the Kingdom of Cambodia over the period 1970-2019. The Kingdom of Cambodia (hereafter Cambodia) looks at an eventful history stretching back until the 9^{th} century. Being governed by the French as part of their protectorate for almost a century (1863-1953) shaped Cambodia's economy and society. Attempts to re-establish the Kingdom of Cambodia flourished in the beginning but were thrown over in the 1970s. The extended Vietnam War, a civil war, and the destructive regime of the Khmer Rouge (KR), Democratic Kampuchea (DK), disrupted the country's social and economic situation harshly during this decade. Its aftermath was still visible during the 1980s, and only as of the 1990s, Cambodia seemed to slowly recover from the shocks of the preceding events. Still today, Cambodia is one of the poorest countries in Southeast Asia, illiteracy rates are still high, and its industry is mostly underdeveloped. However, the country bears a lot of improvement opportunities in many ways. Despite increasing attention to educational expenditure, Cambodia's educational system can still be advanced to a great degree. The country's natural resources yield a lot of potentials as well. Fisheries, forestry, and mining experience different levels of exploitation, but the overall trend is increasing. The country's pollution levels are rising over the last decades. The inclusion of all those enumerated factors into an economic status assessment can help to estimate Cambodia's genuine level of sustainable economic performance - from the past until today.

The key contributions of this thesis are threefold. The first is to estimate GS for a longer period than the current calculation by the WB reaching back to 1970. Second, this work aims to improve the WB's approach by including an additional crucial factor in Cambodia's economy: Fishery. The third intention is to provide a dataset as complete as possible for the 20^{th} century to enable and simplify future extensions of this work. Initially, the present research aimed to cover the time 1950-2019. Due to data constraints, this was not possible to achieve. However, future research can build on this first historical analysis and further extend it.

This work is structured as follows: Section 2 begins with the conducted literature review with a focus on the theoretical framework and previous research relevant to the research topic. Section 3 provides a presentation of Cambodia's development over time. Different focuses are on its history, economic and demographic development, educational system, and natural resource exploitation. This section shall help to put the conducted research into the relevant country perspective. Section 4 elaborates the methodology which this research follows. Next, Section 5 describes the main variables of the calculation, the data required for the analysis, and its sources. Section 6 presents the results of this work, and Section 7 the corresponding discussion, including significance, relevance, and limitations to the results. Finally, Section 8 concludes this Master's thesis.

2 Literature Review

2.1 Theoretical Framework

GS has emerged as a leading measure of the sustainability of economic development. Also referred to as ANS, Inclusive Investment (II) or Comprehensive Investment (CI) it measures year-on-year changes in a nations's total wealth. GS firmly focuses on wealth accounting (Hamilton & Hepburn, 2014), and addresses shortcomings of conventional metrics of economic performance, e.g. the classic Gross Domestic Product (GDP), by incorporating broader measures of investments and savings (Blum, Ducoing, & McLaughlin, 2017; Hamilton & Hepburn, 2014; Stiglitz, Sen, & Fitoussi, 2009). GS can be defined as the "traditional net savings less the value of resource depletion and environmental degradation plus the value of the investment in human capital" (Hamilton & Clemens, 1999, p.333). The term "genuine" was coined by Hamilton (1994) emphasizing that GS does not only include produced but all forms of capital: physical, institutional, human, natural, and social capital. Natural capital comprises both renewable and non-renewable resources whose values are priced by the market in many cases (e.g. timber, coal, minerals, etc.) (Hanley, Dupuy, & McLaughlin, 2015). When including environmental and natural resource aspects in traditional savings measures, GS turns negative for many countries (Hamilton & Clemens, 1999), signaling an unsustainable development. However, Bolt, Matete, and Clemens (2002) highlight the importance of including both natural and human capital in order to measure the "genuine" value of a country's performance. They point to both factors as being essential for the well-being and productivity of a country. Furthermore, they elaborate that spending on education can be seen as *investment* into future well-being and productivity, as it increases the value of human capital. On the contrary, depletion of natural resources is considered a *disinvestment* as it decreases the stock value of this asset.

The idea of GS derives from the "Green" National Accounts literature (Hamilton, 1994; Reppetto, Magrath, Wells, Beer, & Rossini, 1989; Weitzman, 1976). Hamilton (1994) elaborates that including both marketed and non-marketed natural resources in "Green" National Accounts provides the opportunity to consider the environment in the mainstream of the economic discourse. He continues that instead of purely measuring productivity, the inclusion of the level of environmental services could become an integral part of this new welfare. He concludes that based on a country's "genuine" level of both domestic and foreign saving, it can directly be measured whether income can be sustained in the future or not. By combining standard national accounting with published estimates of depletion and degradation, Pearce and Atkinson (1993) firstly applied this "greener" accounting method. They define an economy as acting sustainably if it saves more than the aggregated depreciation of capital, both natural and man-made.

Through calculating GS, the resource dependency of a country can be further tested. Following the "Resource Curse Hypothesis" (Atkinson & Hamilton, 2003;

Mikesell, 1997; Papyrakis & Gerlagh, 2004; Sachs & Warner, 1995; Van der Ploeg, 2011) resource-rich countries often grow slower than resource-poor ones. That implies that resource abundance is often negatively correlated with economic growth. Indeed, the poorest performers in terms of GS are the regions with the largest natural resource extraction rates (Neumayer, 2003). Thanks to further detailed GS calculations, resource dependency can be more precisely defined, and the hypothesis of Sachs and Warner (1995) retested (Hamilton & Clemens, 1999).

GS bases on the assumption of "weak sustainability" (Gutés, 1996). This assumption deals with the question of how to combine different forms of capital to produce a stream of well-being and to maintain a functioning economy-environment system (Hanley, Dupuy, & McLaughlin, 2015). Sustainable development can be defined as a situation where well-being is not declining but preferably increasing over time (Dasgupta, 2001; Pearce, Barbier, & Markandya, 1989). Supplementary, Arrow, Dasgupta, Goulder, Mumford, and Oleson (2013) define sustainable development as an economic development where intergenerational well-being (defined as "present value of discounted utility from consumption" (Greasley et al., 2017, p.2)) does not decline. This bases on Solow (1986) who mentions the requirement of each generation to pass on an undiminished stock of total capital requiring at least stable (or increasing) consumption and intergenerational fairness over time. The view that this intergenerational rule allows for declines in one asset, as long as it is offset by increases in another (as in the work of Pearce and Atkinson (1993)), moves away from a very strict strong sustainability perspective (Hanley, Dupuy, & McLaughlin, 2015). Furthermore, "weak sustainability assumes that all forms of capital – produced, natural, human, and social capital – are perfectly substitutable, and can be measured and aggregated using a given numeraire" (Greasley et al., 2017, p.1). Therefore, it can be said that the GS metric derives from the "weak sustainability" model as it measures the real value of changes in all instruments of wealth/capital stocks, but it also allows for reductions in e.g. natural capital to be offset by investments into produced or human capital (Hanley, Dupuy, & McLaughlin, 2015).

Another rule underlying GS is the "Hartwick Rule". It roots back to the work of the neoclassical economists John M. Hartwick (1977) and Robert M. Solow (1974). Both were concerned about how to model a development path of an economy that exploits non-renewable resources but does not decline in social welfare and well-being. The so-called "Hartwick Rule" states that income from the usage of non-renewable resources should be re-invested in renewable ones to maintain the total wealth and to achieve non-declining well-being over time (Qasim, Oxley, & McLaughlin, 2020). The originally neoclassical models were extended during the 1970s to account for the depletion of non-renewable natural capital as a production factor (Dasgupta & Heal, 1974; Hartwick, 1977; Solow, 1974) creating the notion of "weak sustainability", as discussed above. This new model accounts for the ideal usage of income produced from non-renewable resource extraction to establish a rule on how much of it can be consumed and how much of it should be re-invested in all forms of capital for future consumption (Qasim, Oxley, & McLaughlin, 2020).

Technological progress influences future consumption and can therefore be argued to be included in the calculation of GS. Pezzey (2004) refers to it as the "value of time passing" which potentially increases future consumption possibilities. Pemberton and Ulph (2001), Pezzey et al. (2006), and Arrow et al. (2013) highlight the need to include changes in technology when measuring a nation's capital stock. Weitzman (1997, 1999) suggests including a proxy for the accumulation of technology as well, as incorporating Total Factor Productivity (TFP) can make a "sizeable adjustment" to the sustainability indicator used. TFP growth implies that even if the capital stock remains constant over time, the output can increase thanks to more efficient usage of resources (Comin, 2010). Omitting technological growth would understate changes in capital and misstate the degree of sustainability a country experiences (Blum, Ducoing, & McLaughlin, 2017; Greasley et al., 2017).

Incorporating technological change into the GS calculation can be challenging when it comes to measuring technology. For example patents, R&D, and TFP are all indicators of this field, however, incorporating some of them in monetary units is empirically difficult (Hanley, Dupuy, & McLaughlin, 2015). One approach to incorporate technological change is by adding the TFP growth rate to the wealth per capita growth rate (as pursued by Arrow et al. (2013)). Another way of including this factor can be through the Net Present Value (NPV) of the contribution of TFP to future GDP growth (as pursued by Blum, Ducoing, and McLaughlin (2017), Greasley et al. (2014), Mota and Domingos (2013), Pezzey et al. (2006)). In this work, the methodology of Blum, Ducoing, and McLaughlin (2017) will be followed by incorporating the NPV of TFP growth in the calculation of GS, with the exact procedure presented in Section 4.2.

It needs to be mentioned, that the inclusion of TFP bears the risk of double-counting. TFP relates to institutions, social capital, intangible assets, and innovativeness which might include effects equally associated with technology as well as human capital. Baier, Dwyer Jr., and Tamura (2006) calculate that incorporating measures for human capital reduces the residual and Manuelli and Seshadri (2014) argue accordingly that better measurements for human capital quality and quantity can further reduce TFP. Consequently, there is a chance of a slight overestimation of total capital formation (Blum, Ducoing, & McLaughlin, 2017).

Besides technological, also population growth can play a role in the estimation of GS. When the population of a country grows, this can have two effects: First, the accumulation of human capital increases, and second, the existing amount of capital stock is split across more people (Hanley, Dupuy, & McLaughlin, 2015). The latter is also referred to as the "wealth-dilution effect" (Hanley, Dupuy, & McLaughlin, 2015, p.99). Later research is dedicated to the effects of population growth altering empirical GS estimates (Arrow, Dasgupta, & Mäler, 2003; Asheim, 2007; Dasgupta, 2001; Dasgupta & Mäler, 2001; Hamilton, 2002) indicating that they should account for this "capital-widening effect" (Ferreira, Hamilton, & Vincent, 2008, p.3). Dasgupta (2003) shows, for a small set of developing countries, that the population growth effect can be large enough to flip GS estimates from positive to negative. However, Ferreira, Hamilton, and Vincent (2008) test the relationship between current savings and changes in future consumption empirically in a broader context, including 64 developing countries, and find that population-related adjustments improve the results only minor. They admit that the adjustment of GS by a wealth-dilution effect is theoretically justified and that it has potentially large impacts on its estimations. However, they conclude that before including population growth effects to improve the predictive power of GS, the focus should rather lay on improving estimates of capital stocks for the basic underlying calculation.

General evidence seems to support GS as a good forward-looking sustainability indicator for future consumption. Ferreira and Vincent (2005) were the first to test this relation empirically, later pursued even further (Ferreira, Hamilton, & Vincent, 2008), followed by the World Bank (2006). All find a positive correlation between the present value of future changes in consumption and GS (Blum, Ducoing, & McLaughlin, 2017). However, the tests of Ferreira, Hamilton, and Vincent (2008) and World Bank (2006) neither include pollutant damages nor education expenditure. Greasley et al. (2014) and Hanley, Oxley, Greasley, McLaughlin, and Blum (2016) extend those tests for the UK, the US, and Germany, covering a period of up to 250 years.[2] They consider the already earlier mentioned "value of time passing" by incorporating technological change. They find evidence confirming that present GS can predict future consumption quite well. The predictive power improves by including e.g. TFP, as otherwise future consumption growth is greatly understated (Greasley et al., 2017). Also, Hanley, Dupuy, and McLaughlin (2015) and Blum, Ducoing, and McLaughlin (2017) are in favor of the inclusion of human capital and TFP growth as it supports probable sustainability in the long run and improves the predictive power of the indicator itself. According to Hamilton and Hartwick (2005), positive GS are a sign of rising future consumption, but only as long as those savings are not "too high" meaning as long as GS grows at a slower rate than the real interest rate (Hanley, Dupuy, & McLaughlin, 2015). Furthermore, Hamilton and Withagen (2007) then show that a negative GS value implies declining well-being in the future. However, the predictive power of GS depends heavily on both the choice of time horizon as well as the discount rate used to test (Greasley et al., 2014; Hanley et al., 2016). In sum, short-term tests (e.g. 5, 10, or 20 years) perform poorly, but long-term tests (e.g. 50 or 100 years) perform well and even better when adjusted for technological progress (Hanley, Dupuy, & McLaughlin, 2015). In conclusion, for testing the predictive power of GS, longer-term horizons are highly recommended.

The validity of the GS indicator of sustainability has been questioned, too. Vincent (2001) questions if "Greener National Accounts methods" truly provide a better indicator of long-term economic possibilities than others. Ferreira and Vincent (2005) scrutinize the basic underlying assumptions in the construction of GS in the WB's calculation estimates missing the consideration of freshwater, agricultural land, and fisheries. Dietz and Neumayer (2006) criticize that the general calculation of GS assumes a constant population that might be able to hold in the long run, but not in the short run, especially not for developing countries. Dasgupta (2001) shares this view. Both also focus on the lack of inclusion of technological process, a point which was already mentioned earlier and will be formally addressed for this work in Section 4.2. Pillarisetti (2005) calls GS "conceptually and empirically imperfect" (Pillarisetti, 2005, p.599) as his research suggests, that GS is overlooking key global externalities and the destruction of global assets by advanced economies. He advocates for looking at natural capital independently from physical and human capital and that environmental sustainability is a topic that should be discussed from a global perspective. Further limitations to the specific method used in this work will be discussed in Section 4.3.

[2] 250 years for the UK, 130 for the US, and 150 for Germany

2.2 Previous Research

The first calculations of GS base on the early works of Pearce and Atkinson (1993) and Hamilton (1994). Initiatives by the World Bank (1997, 2006) and the United Nations (1993) were encouraged by the fact that despite being resource-rich, many developing countries lack sustained economic growth. Their projects aimed for a more comprehensive accounting of national wealth. Under the name ANS, the WB firstly published cross-country estimates in their WDI as of 1999 (World Bank, 1997). Their method bases on a series of publications by Hamilton (1994, 1996) and Hamilton and Clemens (1999), as published in Bolt, Matete, and Clemens (2002). Their calculations are annually updated (World Bank, 2006, 2011).

Besides cross-country, also country specific analyses have been published so far. Hamilton and Clemens (1999) calculate estimates for developing countries focusing on Sub-Saharan Africa for the period 1970-1993. Both, Hanley, Moffatt, Faichney, and Wilson (1999) and Pezzey et al. (2006) determine GS for Scotland covering together the period 1980-1999. Following a similar logic, Pezzey et al. (2006) and Mota, Domingos, and Martins (2010) measure GS for Portugal for recent decades (1990-2005). Ferreira and Moro (2011) cover Ireland (1995-2005). Vincent (2001) compiles GS for 13 Latin American countries (mainland South America except French Guinea plus Mexico).

Besides the short-term, also some long-run analyses are available already. Rubio (2004) constructs figures for Venezuela and Mexico starting in the 1930s and 1980s, respectively. Blum, Ducoing, and McLaughlin (2017) enhance the earlier presented work of Vincent (2001) with a focus on Latin America (Argentina, Brazil, Chile, Colombia, and Mexico) constructing GS back to 1900. They also provide metrics for Western Europe (1900-2000). Reaching even further back until 1765, Greasley et al. (2014) calculate well-being measures of consumption and real wages per capita in the UK for 1765-2000. As already touched upon in the preceding section, they confirm GS as a valuable forward-looking indicator for periods of up to 100 years. Furthermore, Hanley et al. (2016) present figures for Germany (1850-2000) and the US (1869-2000). Lindmark and Acar (2013) specifically concentrate on Sweden, 1850-2000. Looking at Oceania, Greasley et al. (2017) provide results for Australia stretching back to 1861, and Qasim, Oxley, and McLaughlin (2020) enhance the World Bank's calculation for New Zealand looking back until 1950.

The region of Southeast Asia has not been covered very broadly yet. Othman, Falatehan, and Jafari (2012) construct GS for Malaysia 1990-2008 matching the calculation of the WB. Their results show positive GS, however, with a declining ratio to GDP indicating a declining capacity of Malaysia's economy to sustain the level of national capital for future well-being and productivity. They mention South Korea and Indonesia for an international comparison but do not include any further analysis.

2.2.1 Genuine Savings calculated for Cambodia

GS has been calculated partially for Cambodia already. The WB publishes ANS in the already earlier mentioned WDI, and calculations for Cambodia are included for the period from 1995 until 2018 (World Bank, 2021a). The WB defines ANS as Net National Savings (NNS) plus current governmental expenditure on education minus energy, mineral and forest depletion as well as carbon dioxide and emissions damage (Bolt, Matete, & Clemens, 2002). WB estimates do not include fishery as another aspect of natural resource depletion. However, this aspect is considered in the presented calculation. For some countries, this aspect might be minor indeed and does not alter the results significantly. But in the case of Cambodia, this sector plays a crucial role contributing more than 12% of its GDP in 2001, for example (Zurbrügg, 2004).

2.2.2 Gaps in Existing Literature

As presented above, GS calculations are not broadly available yet. There are still a lot of gaps when it comes to both country and time coverage. The WB presents estimates for almost two-thirds of the world, and their last comprehensive update in 2018 included calculations for 125 out of 195 countries (World Bank, 2020a). However, the time covered is limited with only part of the countries starting 1990 (96), which are then adding up during the 1990s and 2000s. Several authors have either re-calculated similar time-spans or extended the WB's calculation historically for specific countries, as mentioned above. It should be noted that the choice of methods, benchmarks, deflators, and exchange rates vary across the different works, hence, comparing results has to be done with caution (Hanley et al., 1999). Western Europe, North and South America, and parts of Oceania have been mainly discussed in the literature. On the contrary, Africa and Southeast Asia have been displayed only very little so far, regarding both a country- and a time-wise extension to the WB's calculation. In fact, for no country in Southeast Asia, historical calculations of GS reaching back more than 30 years have been made yet. This research contributes to a relatively small but growing literature about Southeast Asia by providing the first historical GS analysis of Cambodia.

3 Cambodia: Country Profile

This section gives an overview of Cambodia focusing on several different aspects. Firstly, a short outline of the country's history is presented. Secondly, as the DK marks a dramatic yet significant part in Cambodia's history, a separate section is dedicated to it. Thirdly, economic and demographic factors are discussed. And lastly, as they are crucial components of GS, both, Human Capital and Natural Resources such as forestry, fishing and mining are touched upon afterward.

3.1 History

Cambodia has an eventful history stretching back to the Khmer Empire in the early 9^{th} century.[3] Its contemporary history starts in 1863, when French authorities concluded a protectorate treaty with Cambodia and therewith acquired the country as part of their "l'Union indochinoise" (Deroche, 2018). For almost a century, French ruling shaped Cambodia's economy and society "to modernize, develop, instruct, and civilize" (Said, 1994, p.269). The French were interested in cheap labor, plantations, and profits, and this led, combined with a lot of heavy basalt-soil land which is not suitable for rice- but for rubber-cultivation, to the so-called "rubber-boom" (Slocomb, 2010, p.53) in the 1920s. French companies developed countless rubber plantations all over the country and exported the highest quality products into the whole world (Slocomb, 2010). By the 1950s, the only capitalized sector was the rubber sector, the majority of the population lived in rural and impoverished conditions, and education was not very vastly spread among the Cambodians (Slocomb, 2010). In 1953, Cambodia officially gained independence, and a monarchy under the lead of King Norodom Sihanouk was established. He pursued an ambitious plan to revive the country's educational system which had been disregarded in the century before. He managed to improve the educational system by building new schools and universities, institutions which the French had prohibited (Dy, 2004; Tan, 2007). Schools reached urban and also rural areas and universities were installed in Phnom Penh and several other cities (Dy, 2004). As of 1965, the extended Vietnam War stretched out to Cambodia bringing along US bombings across the Cambodian territory. The bombing situation escalated in 1969 when the US started to systematically carpet bomb Vietnam and its neighbor country (Owen & Kiernan, 2007). Additionally, a coup d'état led by General Lon Nol in 1970 brought the country into a civil war that lasted until 1975. The war brought a deep social, educational, and economic crisis with it (Chandler, 1996). In 1975, the KR, led by Pol Pot took over power in Cambodia and established DK, also referred to as the Khmer Rouge Regime (KRR). Its repercussions are discussed in the next section. The KR were defeated in 1979, and a new political system, the People's Republic of Kampuchea

[3]Further information on the history of Cambodia can be found in the work of David Chandler (1996). Margaret Slocomb (2010) focuses on Cambodia's economic history during the 20^{th} century.

(PRK) was established. However, political unrest continued until the signing of the Paris Peace Accords and the following free elections in 1993 organized by the United Nations (UN) (Tan, 2007). In this vein, Norodom Sihanouk was restored as King of Cambodia heading a multiparty democracy led by a constitutional monarchy (Kam, 2016). In order to regain its full status within the UN (which Cambodia had entered in 1955), Cambodia joined the regional trading bloc Association of Southeast Asian Nations (ASEAN) in 2000 and was admitted to the World Trade Organization (WTO) in 2004 (Slocomb, 2010). Despite political gains, Cambodia's economy remains vulnerable to occasional internal political turmoils and external shocks. Moreover, poverty levels are still high, as well as frustration over entrenched official corruption. Big parts of the country's budget consist of Foreign Direct Investment (FDI), and the future growth of its economy depends on two volatile sectors: foreign tourism and garment manufacturing for export trade (Slocomb, 2010).

3.2 Democratic Kampuchea 1975-1979

Supported by the Communist regime of North Vietnam, the KR came to power in 1975. The damage of the ongoing US bombings and the additional repercussions of the extended Vietnam War fuelled the anti-American propaganda from which the KR benefitted (Owen & Kiernan, 2007). Under the leadership of Pol Pot, the so-called KRR sought to rapidly revolutionize the country's economic system, and within the four years of their lead, markets, money, formal education, private property, and freedom of movement were abolished (Chandler, 1996). Already weeks after their takeover, the KR organized a massive evacuation of the main cities moving the Cambodian people to the countryside (Slocomb, 2010). Their economic priority was the transformation of Cambodian agriculture, particularly rice production (Chandler, 1996). Disregarding qualifications, the entire population was distributed into pre-defined zones and faced with "ever increasing levels of rice production" goals (Chandler, 1996, p.214). However, missing experiences in agricultural activities, and partially unsuitable soil quality, prevented the ambitious economic four-year plan to be achieved (Slocomb, 2010). Working conditions were severe, and food scarcities arose, many people died of over-working and starvation (Chandler, 1996).

Additionally, the time of DK led to the massive extinction of human capital. The KR fought intellectualism, ignored (technological) progress, and rebuilt an almost medieval agricultural society, in which libraries and temples, anything considered "Western" was declared enemy and got destroyed (Kiernan, 2002). Items such as eyeglasses were seen as a sign of intellectualism, and persons wearing glasses and their families were consequently executed (Bergin, 2009). Tuol Sleng, a former school in the middle of Phnom Penh, was turned into a concentration camp, and "the Killing Fields" right outside the capital became the symbols of the Cambodian genocide. The KR took around two million lives (Tyner, 2017), exact statistics are not available (Slocomb, 2010). Hard work, starvation, and executions decimated the Cambodian population with the most educated among them (Ayres, 2000a; Dy & Chhinh, 2009; Heuveline & Poch, 2007; Tan, 2007). In 1979, the KR were defeated by Vietnamese troops, but memories, damages, and effects of the DK era left the Cambodian population deeply shattered (Chandler, 1996).

3.3 Socio-Economic Development

Cambodia's population started to significantly increase only in the second half of the 20^{th} century. It is estimated that in 1800 only around 2 million inhabitants were living on the territory defined as Cambodia today, and by 1900, this figure was reported to be 2.9 million (United Nations, 2019). Until 1950 it increased to 4.4 million, picked up momentum after independence in 1953, and elevated to a preliminary peak of 7.5 million people in 1974 (Chandler, 1996). Suffering from the political circumstances presented earlier, Cambodia's population dropped to (maximal) 6.6 million in 1980, from which it significantly recovered to 16.7 million in 2020 (United Nations, 2019, Figure 1). Although Cambodia's population has increased over the past five decades, this trend occurred at a decreasing rate. Figure A.1, Appendix A, depicts that while the bottom of Cambodia's population growth was hit in 1979 at -3.1%, it jumped back up to 3.7% in 1983 before it settled around 1.5% during the 2010s. However, this trend is predicted to further decline, and according to the United Nations (2019), Cambodia's population growth will turn negative in 2070.

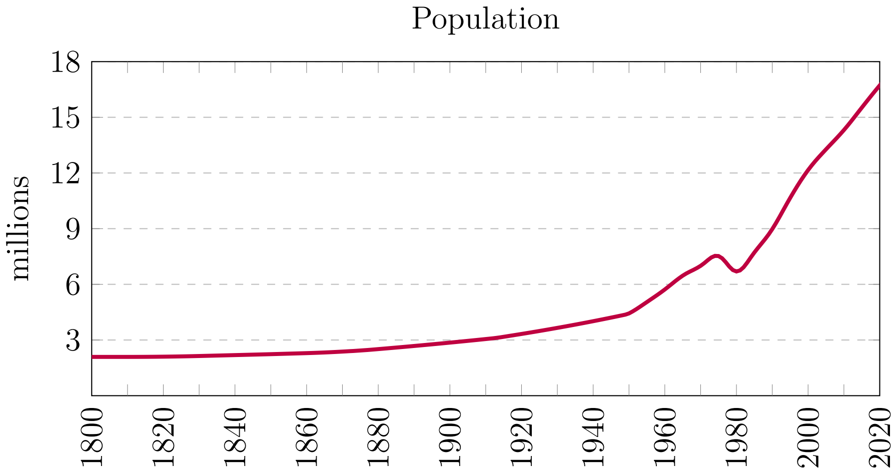

Figure 1: Population development Cambodia 1800-2020 (Gapminder, 2018; United Nations, 2019)

Economically, Cambodia evolved only modestly during the second half of the 20^{th} century. After gaining independence, absolute GDP per capita increased barely, and the country suffered from the extended Vietnam War with US bombings from 1965 until 1973 (Owen & Kiernan, 2007). From 1975 until 1979, the KR turned the country into an agricultural state to disconnect from the globalizing world around it. This resulted in an almost complete industrial dismantling and run-down of the economic system as it was known before (Chandler, 1996; Vickery, 1984, 1986). Consequently, Cambodia's economy struggled until the late 1990s, and only after 1999, it recovered visibly, at least in terms of GDP per capita (Bolt, Inklaar, de Jong, & van Zanden, 2018, Figure 2).

To evaluate the standard of living of a country, not only economic but also bio-demographic factors such as mortality, life expectancy, and overall well-being can be considered. Life expectancy at birth (e_0) is calculated as the average number of years that a person can expect to live under the assumption that age-specific mortality

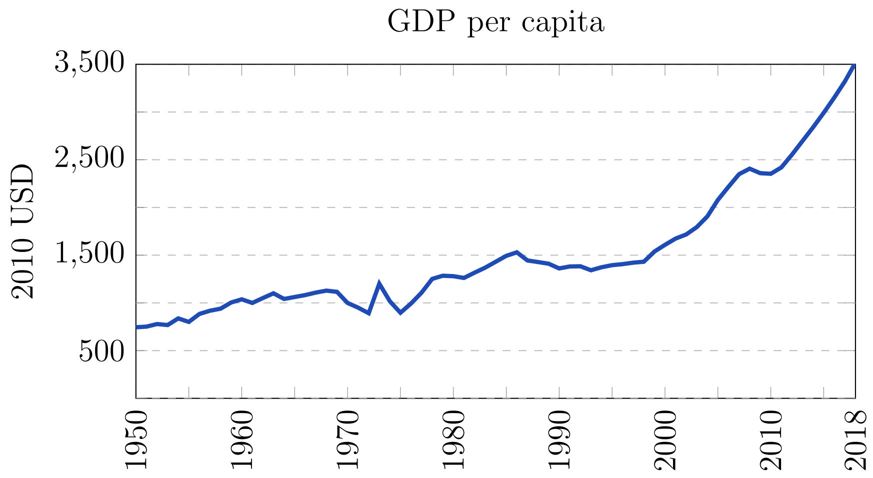

Figure 2: GDP per capita Cambodia 1950-2018 (Bolt, Inklaar, de Jong, & van Zanden, 2018)

levels remain constant (OECD, 2020). In Cambodia, life expectancy rose until 1969 before it showed an enormous drop during the 1970s fuelled by first, the continuing bombings over Cambodia, and second the systematic executions organized by the KR. This dramatic cut was followed by a rapid recovery after 1979, as presented in Figure 3. Since the late-1980s, women experience an average life expectancy of 55 years, and men 50 years. In 2018, this level increased to 72 years for women and 67 years for men, almost constantly preserving the prevailing gender gap of five years over time (United Nations, 2019).

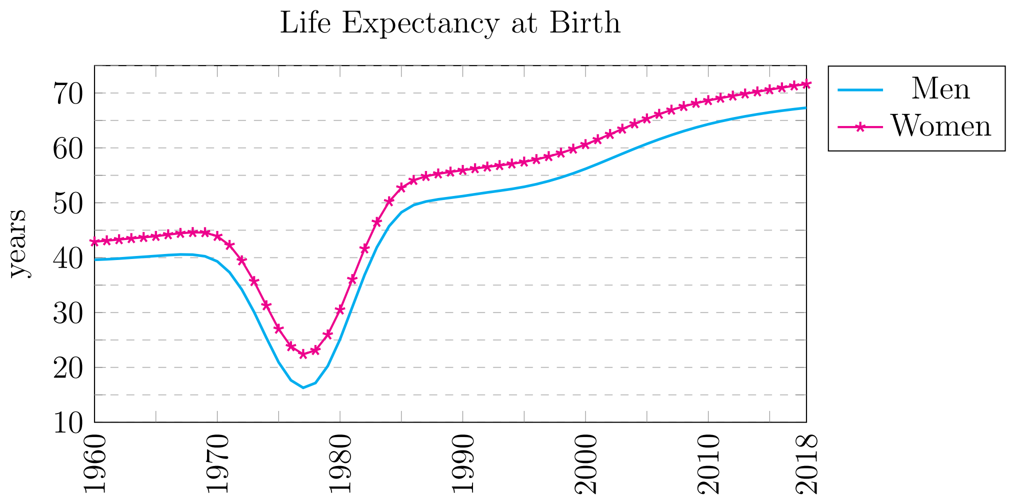

Figure 3: Life expectancy at birth Cambodia 1950-2018 by gender (United Nations, 2019)

Mortality Rates indicate how high the probability of dying for a specific age group is. They can be seen as the counterpart to life expectancy measuring the impact of all factors influencing death. The Adult Mortality Rate (AMR) comprises the probability of dying for people between ages 15 and 60, depicted in Figure 4. Already during the 1960s, this probability to die between 15 and 60 years old was high at around 55% for men and slightly below 50% for women. During the war-time years of the 1970s, AMR rose again and in 1977, it reached an all-time high at 92% for men and 80% for women. Similar to the development in life expectancy, this trend recovered to below 40% for both genders in the 1990s reaching a level of 13% for women in 2018, but still a higher level for men at almost 20% (United Nations, 2019; University of California, 2020). Not only for adults but also for children the risk of dying was affected during the political crisis in the 1970s. The Child Mortality Rate (CMR), defined as children born alive dying before their fifth birthday (to be found in Figure A.2, Appendix A) came down to 18% in 1970 before it drastically rose up to 42% in 1979. After 1980, it followed the continuous downwards trend of before 1970 and finally reached 2.8% in 2018 (United Nations, 2019).

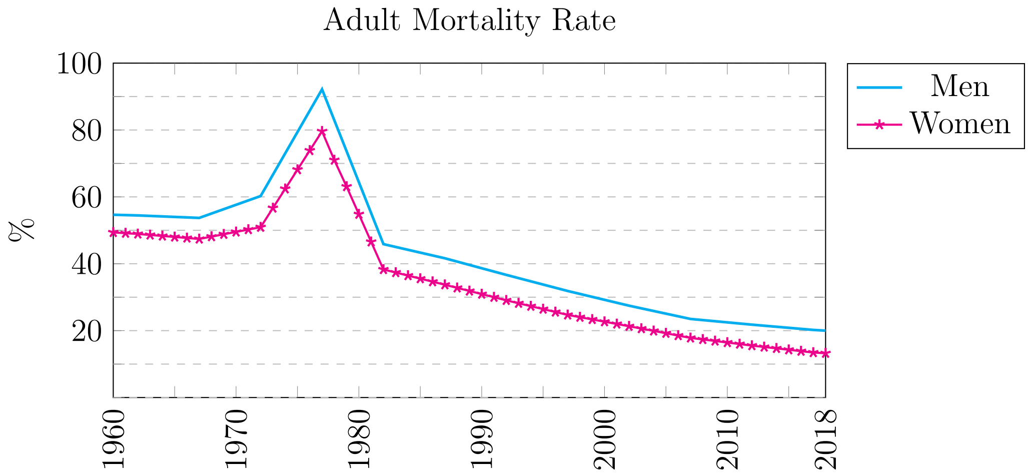

Figure 4: Adult Mortality Rate Cambodia 1960-2018 by gender (United Nations, 2019; University of California, 2020)

3.4 Education

After independence, Cambodia's education system could be thoroughly established. As mentioned earlier, during the colonial period, the French protectorate prohibited the spread of schooling institutions, including tertiary education. Under the lead of King Norodom Sihanouk, this changed. In 1955, there were ten high schools in Cambodia, and by 1968 this number had increased to 200 (Slocomb, 2010). Universities were established as well, first in Phnom Penh and then in other main cities, so that by 1968 there were nine across the whole country, compared to zero in 1955 (Dy, 2004; Slocomb, 2010). School Enrolments increased as well, reporting 1 million primary school enrolments, and 100,000 high school enrolments in 1968 (Slocomb, 2010, see Table 1).

During the wartime period of 1970-1975, some provincial universities and public instruction institutions had to shut down. However, education under the new regime remained as important as under the old one (Slocomb, 2010). General Lon Nol founded the *Neo-Khmerism*, a blend of political notions and religious values aiming to encourage a nationalistic spirit among the young (Slocomb, 2010). Neo-Khmerism consisted of three core elements which were civics education, Khmer as the language of instruction, and the mobilization of students to take direct action against the enemy (). However, the refugee situation as a consequence of the war heavily affected the educational infrastructure. During the academic year 1970-71, 40% of the primary school pupils were refugees, whose impoverished and malnourished state prevented effective learning with additionally, teaching materials being scarce (Ayres, 2000b).

Table 1: Education Indicators

Education Indicator	1955	1968	2006
Primary School Enrolments	300,000	1,000,000	2,582,250
High School Enrolments	5,000	100,000	824,833
Universities	0	9	45
High Schools	10	200	1,581

Sources: Slocomb (2010, p.91), Sheldon (2021), UNESCO (2008)

In 1962, more than half of the Cambodian population over the age of 10 could neither read nor write, with a clear imbalance between men (30% illiterate) and women (80% illiterate) (Slocomb, 2010). Only 2% of the Cambodian population received a primary school certificate, and barely 300 graduated from upper secondary school (Prud'homme, 1969). Towards the end of the 1960s, the development of schoolings and literacy campaigns tried to raise those numbers but without much success. The school curriculum was only poorly adapted to the current needs of development, pupils were prepared for bureaucracy tasks and "technicians, accountants, engineers, economists and entrepreneurs who play an important role in economic development [were] not very numerous in Cambodia" (Prud'homme, 1969, p.300).

In contrast to the previous two regimes who appreciated and encouraged education, the DK neglected it. "Cambodia had a rapidly expanding education system before Pol Pot's Year Zero", as Duggan (1996, p.361) phrases it. As of 1975, children aged over 5 were taught only basic literacy and numeracy, but in areas with very bad living conditions, not even those basic schooling institutions were built up (Ayres, 2000b; Vickery, 1984). The stated policy under the KR was it "to eradicate illiteracy", however, schooling was conducted in "factories and cooperatives" and was supposed to stay close to the "realities of an agricultural state" (Vickery, 1984, p.183). Furthermore, it was especially the educated population who suffered under the KRR. People were not primarily killed for being educated, but words, actions, or look (according to the KR, glasses were a clear indicator of intellectualism) were often interpreted as boastings of education, and people showing those signs were executed for those reasons (Vickery, 1984). To protect themselves from future revenge, whole families were extinguished (Vickery, 1984). In this way, around 67% of primary and secondary school pupils, 96% of the students, and 75% of the teaching staff died or fled between 1975 and 1979 (ADB, 1996; Benveniste, Marshall, & Araujo, 2008).

After the abolishment of the DK, it took not long to recover from the preceding shock, and the PRK prioritized formal education which commenced almost immediately in 1979 (Vickery, 1986). The school curriculum was re-defined focusing now on "political consciousness, revolutionary morality, and basic knowledge for competency in modern labor skills, production, agriculture, artisanry, and industry appropriate for the real situation of the Kampuchean revolution" (Heng, 1986, p.55). In the 1980s, the PRK accomplished to reconstruct the educational system of Cambodia and by 1988, the majority of the school-aged children had access to primary schooling, and 25% of its population "was involved somehow in the educational system" (Curtis, 1990). The Gross Enrolment Ratio (GER), defined as the total enrolment, regardless of age, as a share of the respective school-aged group, jumped up after 1979 to a level of 211% in 1983 for primary school enrolment (visible in Figure A.3, Appendix A). Due to the inclusion of potentially over- and under-aged students deriving from grade repetition and early or late school entrance, GER can exceed a level of 100% (World Bank, 2020b). The PRK's administration aimed to provide children with a minimum of five years of education, but without school enforcement (yet). Subsequently, the GER for secondary school enrolment stayed much behind (Figure A.3, Appendix A). Moreover, educational standards remained low, teaching material supplies were short, and there were high discrepancies between urban and rural areas (Slocomb, 2010). In Phnom Penh, over 90% of the school-aged children were enrolled during the 1990s, whereas in rural areas this figure dropped to 50-60% (Curtis, 1990), retaining illiteracy as the norm in the countryside.

Due to the stressed educational system, the Cambodian government initiated change during the 1990s. In 1991, it committed to achieving Education For All (EFA) by providing free primary and secondary education in Cambodia based on nine years of schooling (Tan, 2007). Inefficiencies, such as high repetition rates and relatively high costs of maintenance compared to a relatively low GDP forced this decision (Slocomb, 2010). Gender inequalities in school enrolment rates were also still high during the late 1990s, with girls being far less enrolled than boys in primary schools (World Bank, 2020b, Figure A.4, Appendix A). Only after 2003 this rate at least assimilated and reached a level above 90%. In 2005, the Ministry of Education, Youth and Sports (MoEYS) published its third *Education Strategic Plan 2006-2010* with the goals to ensure equitable access to education, increase efficiency and quality of educational services and promote capacity building and institutional development for further decentralization (MoEYS, 2005). The MoEYS's goal was and still is today to solve the problems of prevailing high drop-out and repetition and low enrolment rates.

The difficult position of teachers additionally impedes improvements in the educational sector. Teachers earn only very little in Cambodia, often not enough to cover their daily needs and take care of their families (Tan, 2007). Therefore, they seek additional income which they get from common practices in Cambodia: Teachers regularly do not cover the whole syllabus in class but offer the rest in privately-paid extra-lessons, which students have to attend if they want to pass their exams (Tan, 2007). As this increases education costs for the families, many students cannot participate and subsequently fail, poor teaching qualities lead to poor learning outcomes (Tan, 2007). In 2005, the primary school completion rate reached only 46.8%, although the total enrolment rate was at a stark level of 95.1% (MoEYS, 2005). Upon request, schools seem to have "no problems" despite increasing drop-out rates suggesting that preventing this rate to rise is not actively pursued by both, management and teaching style of the schools (Ovington, Geeves, Horie, & Sokhak, 2003). This inadequate behavior further fuels mistrust in the discretion and professional ability of the teaching staff (Kim & Rouse, 2011) and deepens the vicious cycle as it further demotivates the teachers: "Not respecting teachers for their classroom role does not help raise their motivation" (Kim & Rouse, 2011, p.426).

The main challenges of modernizing education in Cambodia but also its solutions seem clear today. Access, financing, quality, governance, and management are the main obstacles (Chealy, 2009). “There is an immediate need to better educate more people to promote more efficient and superior cadres to build up a stronger nation with economic self-sustainability” (Sovachana, 2012). Moreover, education shall further support the development of morality and critical thinking despite pure memorization on which current teaching and assessment methods are mainly focused on (Velasco, 2004). A genuine understanding shall be encouraged other than learning rote material by heart (Chealy, 2009). The measures to tackle the obstacles to a modern education system seem to be identified as well: decentralization of management, clustering of schools, financial aid to families in need, and an adequate salary for teachers (MoEYS, 2005). Cambodia has realized, that “political will is the key ingredient in educational reform” (Dy & Chhinh, 2009, p.128).

3.5 Natural Resource Exploitation

Fishery

Fish plays a major role in Cambodian cuisine. Rice is the overall food staple, but fish of all kinds, fresh, dried, or as a fermented paste, provides the main protein source in the Khmer diet (Slocomb, 2010), with a minimum of 80% (Golub & Varma, 2014; Nam, 2008). Each year, every Cambodian consumes an average of 60-75.6 kg of fish (Ahmed, Navy, Vuthy, & Tiongco, 1998). Family or subsistence fishing plays a major role in Cambodia and the majority of the fresh-water catch is consumed locally. During 1953-1969, only 10% of the captured fish were exported, mainly in the dried or salted form (Slocomb, 2010). The isolation of the DK benefitted both forests and fisheries to restock naturally (Slocomb, 2010). In 2008, fishery alone accounted for 12% of the country’s GDP being ahead of rice production, which reported a 10% contribution (Nam, 2008; Zurbrügg, 2004). Still today, the majority of the captured fish remains in the country as exporting fish adds almost no value in the Cambodian fish market (Mille, Hap, & Loeng, 2016). Aquaculture represents only a minor share in overall fishery production but increased from 3% in 1984-1986 to 8% in 1992-1994 (Zurbrügg, 2004), and 15% in 2008 (Nam, 2008).

The fish sector provides all kinds of employment. Over 6 million people are involved in fishing or fishing-related activities, almost 40% of the population in 2014 (Golub & Varma, 2014). Being fully, partly, or seasonally employed, 10.5% of the population count as full-time fishers, 35% part-time (Nam, 2008). Cambodian fishing can be divided into three scales of small-, medium- and large-scale fishing. The majority of the in fishery employed population, ca. 87% are operating as small-scale fishers, and only 4% do this on a large-scale (Nam, 2011). Besides that, family and subsistence fishing is very common in Cambodia, officially reported figures are missing, but they are roughly counted into the small-scale fishing part (Nam, 2011). Historical statistics on fishing in Cambodia are almost inexistent besides information on management rather than tons captured (Van Zalinge, Thouk, Tana, & Deap, 2000). Several sources on fish ton amount captured contradict themselves, and only as of 1999, the Ministry of Agriculture, Forest and Fisheries (MoAFF) began to officially record fishery statistics at all (Tana & Todd, 2002), encouraged by international development agencies (Zurbrügg, 2004). According to most recent estimates, capture and aquaculture fisheries in Cambodia produce around 527,000 tons of fish with a value of 1.2-1.6 billion United States Dollar (USD) per year (Food and Agriculture Organisation of the UN, 2011; Nam, 2008).

Besides the amount of fish, also the diversity of species in Cambodia is significant. Inland fishery in Cambodia is highly productive due to the annual flooding of the Tonle Sap River and Lake, which expands up to 5 times its regular size during the rainy season (Asian Development Bank, 2005). Those wetlands and flooded areas provide a fertile spawning area for at least 200 species, including the endangered giant catfish (Asian Development Bank, 2005; Mensher, 2006). In Cambodia's Mekong River, over 500 species of fish can be found, and the whole Lower Mekong Bassin (LMB) encompasses at least 1,200 (Nam, 2008). However, Cambodia's fisheries are in an alarming state suffering from over-fishing due to increases in population, the number of fishermen, and more efficient and effective fishing gear such as electro-shockers and very fine meshed-nets (Nam, 2008). Illegal large-scale fishing techniques decrease the numbers of valuable species (Slocomb, 2010), e.g. of the Siamese mud carps (Mille, Hap, & Loeng, 2016), which is just one example of the extensive over-exploitation of Cambodia's fisheries (Nam, 2011). Between 10-20% of all fish species in Cambodia are considered locally endangered, which, if current fishery practices continue, will lead to irreparably damages (Zurbrügg, 2004).

Forestry

Forests count as Cambodia's most important and most significant resources (Kim, Phat, Koike, & Hayashi, 2005). Unfortunately, due to the civil war and different political regimes throughout the 20^{th} century, Cambodia's forestry suffered a lot and decreased from a land cover of 73% during the 1950s and 1960s to 60% in 1997 (Kim et al., 2005). Cambodia's deforestation rate was the worst among all Southeast Asian countries between 1990 and 2015, with an average rate of -0.79% per year (Tsujino, Kajisa, & Yumoto, 2019). In 2010, the Cambodian Millennium Development Goal (CMDG) was set to strive for maintaining Cambodia's forest cover at 60% (Forestry Administration, 2010).

Systematic deforestation in Cambodia began only in the second half of the 20^{th} century. Although the French Protectorate felled thousands of hectares in 1924 to make way for rubber plantations, its Forestry Service was committed to good stewardship of the forests, leaving more than 167 forestry reserves by independence in 1953 (Slocomb, 2010). By 1970 this had changed as the forestry production had already climbed to an annual contribution of 3.7% to GDP. Besides timber, forest products include e.g. charcoal, firewood, honey, bamboo, and cardamoms (Slocomb, 2010). In the 1970s, Cambodia's forestry suffered from the extended Vietnam war through bombings and defoliation, which destroyed hundreds of thousands of hectares of wildlife sanctuaries, watershed forests, and rubber plantations east of the Mekong River (Kim et al., 2005). It is assumed that during the DK, forestry as well as fishery (as mentioned earlier) recovered significantly, as they benefitted from the isolation of the system. However, official prove is impossible to find as no records for the time 1975-1979 exist (Kim et al., 2005; Slocomb, 2010).

During the PRK, timber production increased again. Commercial logging became operational in 1982, and additionally, in the final years of the PRK, Cambodia's rich tropical forests started to decrease severely due to logging bans in neighboring countries, e.g. Thailand, and increasing world demand for timber (Slocomb, 2010). This activity peaked in 1995 when forest exploitation accounted for 43% of Cambodia's export earnings (Le Billon, 2000). Illegal logging and overexploitation of Cambodian forests continued until the late 1990s causing deforestation and forest degradation (Kim et al., 2005). After 1998, the Cambodian government tried to control illegal forestry activities and the massive logging of luxury woods (Kim et al., 2005). However, from 2002 until 2016, deforestation accelerated again, caused by high international demands. This currently causes decreasing timber resources, decreasing biodiversity, and a loss of non-timber forest products (Tsujino, Kajisa, & Yumoto, 2019).

The critical situation of Cambodia's forests has been realized by the country's government. In 2010, Cambodia's government initiated a *National Forest Program 2010-2029* (Royal Government of Cambodia, 2010). It acknowledged the severe situation and the need to conserve forest resources and biodiversity. Its goal was and still is to take strong political actions to reduce small- and large-scale deforestation and promote adequate rehabilitation of the degraded land areas. However, if the country's forest cover shall remain at a minimum level of 60%, even stronger measures are required to conserve the country's forests and enable sustainable forest management (Forestry Administration, 2010; Tsujino, Kajisa, & Yumoto, 2019).

Mining and Energy

The depletion of mineral resources does not play a significant role in Cambodia's economy today. The mineral industry in Cambodia is not very well developed, and extraction of resources does not occur at an industrial scale (US Geological Survey, 2018). In 2015, the production focused on cement, gravel, sand, laterite, and stone, mainly for domestic consumption (US Geological Survey, 2018). The Ministry of Energy and Mining (MoEM) promulgated a *Law on Management and Exploitation of Mineral Resources* in 2001 to attract both domestic and foreign mining companies to invest in mineral exploitation in Cambodia (Vichett, 2013). However, until today only a few projects have been realized (US Geological Survey, 2018; Vichett, 2013; Wu, 2007).

There are potentially promising resources to be mined in Cambodia. Until today, the country's mineral sources are largely unexplored but e.g. ruby, sapphire, and zircon were identified in the northwestern province of Battambang, and manganese, phosphate, and salt in the center of the country (Wu, 2007). Additionally, Cambodia's geological environment yields the potential to host e.g. bauxite, copper, gold, granite, limestone, tin, and zinc resources (Wu, 2007). However, the precise potential and the extent of those minerals are still unclear due to the lack of geological surveys (US Geological Survey, 2018).

Natural energy resources were not present until recently. In 2015, Cambodia imported petroleum at a value of 1 billion USD representing 8.5% of the country's total import value (US Geological Survey, 2018). However, an estimated amount of ca. 30 million barrels of oil have been found offshore, which could be recovered over nine years (Open Development Cambodia, 2019). But only in 2017 agreements were signed, and an offshore oil platform was set up accordingly with the plan to start operating in 2020/2021 (Open Development Cambodia, 2019).

4 Methodology

4.1 Genuine Savings

To calculate GS of Cambodia for the time 1970-2019, the methodology of Blum, Ducoing, and McLaughlin (2017) will be followed. They in turn base their calculation on World Bank (2006, 2011), which is explicitly documented by Bolt, Matete, and Clemens (2002). The estimation covers year-on-year changes in total capital formation. As the WB, they define increasingly comprehensive indicators to measure different levels of sustainability. The following list depicts the indicators which are part of the process (Blum, Ducoing, & McLaughlin, 2017, p.97):

- Net Investment = Net Fixed Produced Capital Formation + Overseas Investment
- Green Investment = Net + △ Natural Capital
- **Genuine Savings = Green Investment + Education Expenditure**
- GSTFP = GS + Net Present Value of TFP
- GScarbon = GS - Carbon Emissions
- GSTFPcarbon = GSTFP - Carbon Emissions

To ensure comparability across time and space, Blum, Ducoing, and McLaughlin (2017) deflate all units by national GDP Deflators and convert them into purchasing power adjusted international dollars following Maddison (2001). However, as the scope of this work focuses on GS of one country solely, only comparability across time is required. Hence, several exchange rates (Piastre to USD, French Franc to USD, and Khmer Riel (KHR) to USD) are considered as well as the USD Deflator to report all figures in constant 2010 USD.[4] The first indicator, Net Investment, also NNS, calculates a country's physical assets. Both Domestic Investment (DI) and Net FDI are included in the calculation. The second step, Green Investment (GI), accounts for the depletion of natural resources, renewable and non-renewable. Their gross revenues minus the average costs of depletion are subtracted from NNS. As already presented in Section 3, the depletion of natural resources occurs only very minor in Cambodia (yet), so this part of the calculation is expected to be small in monetary terms. As a third calculation step, GS is retrieved by adding governmental expenditure on education to GI as a proxy for the accumulation of human capital. This approach has its limitations as the level of human capital can arguably be equaled with governmental spending on it. However, alternative measurements of human capital stocks are difficult to find. This limitation will be discussed more in-depth in Section 4.3. As presented in Section 2, the inclusion of technological change

[4]Following the project by Ducoing (2019), in which this work's results will be incorporated.

is recommended to come closer to a "genuine" savings level of a country. Therefore, in a fourth step, the NPV of TFP growth is added to GS. The exact method is described below. Finally, in steps five and six, prices related to carbon dioxide emissions are deducted from GS and GSTFP, respectively. In Section 5, a more detailed overview and description of all variables used are presented. Additionally, the specific data sources are explained along with the caveats faced during research.

4.2 Total Factor Productivity

Excluding technological change when calculating GS can lead to a misstatement of the degree of an economy's sustainability (Section 2). Blum, Ducoing, and McLaughlin (2017) include this exogenous technological progress in the form of NPV of TFP growth in their augmented GS calculation. "TFP is a central piece of the puzzle to assess sustainable development" (Blum, Ducoing, & McLaughlin, 2017, p.98). Again, following the approach by Blum, Ducoing, and McLaughlin (2017), TFP is calculated by assuming a standard Cobb-Douglas production function incorporating capital and labour measured in man-hours:

$$Y = A * L^{\alpha} * K^{(1-\alpha)} \tag{1}$$

The components are as follows: Y equals income, A stands for TFP (which is calculated as residual), L represents labor (measured in man-hours), and K denotes the capital stock. The contribution share of labor, α, is assumed to be 63.3%, and the respective residual capital share 36.7% (Blum, Ducoing, & McLaughlin, 2017). To reduce volatility, a Kalman Filter is applied to the TFP growth series and the NPV is calculated over 20 years. Data limitations and lacking availability prevented the fully disentangling of technology and human capital effects. Therefore, an unadjusted TFP series is considered in the estimates. Furthermore, to avoid the risk of "double-counting" and overestimating total capital formation, the unadjusted TFP series will be added to GI, as in GS education expenditure is included.

4.3 Limitations

The approach applied in this work (Section 4.1) has its limitations. First, it only considers quantifiable indicators that can be expressed in monetary units. Therefore it overlooks non-market environmental goods and services. Second, the effect of other pollutants, such as Nitrogen Oxides (NO_x) and Sulfur Dioxide (SO_2) are not considered. Third, developments in biodiversity and ecosystem services are excluded. Losses in biodiversity mainly derive from changes in land use, e.g. deforestation. The ignorance of both biodiversity and pollution levels influences the results, as economic growth seems to adversely affect both components (Blum, Ducoing, & McLaughlin, 2017). Based on Goldewijk (2014), Blum, Ducoing, and McLaughlin (2017, p.100) assume that "any future evaluation of the costs of biodiversity loss and SO_2 emissions will lower any sustainability indicator".

5 Data and Variable Definitions

This section presents an overview of the process of data collection and the state of data for each component. The aim was to obtain a long-term annual series for NNS, governmental expenditure on education, natural resources rents, exchange rates, TFP, GDP, and population figures. Altogether, this data is the base for calculating GS as presented in the foregoing Section 4.

To retrieve the data needed to calculate GS for Cambodia, both, domestic and international sources were consulted. As a first step, national institutions, such as the National Institute of Statistics (NIS) and the Ministry of Economy and Finance (MoEF) were approached. Unfortunately, the focus of their publications lays on rather recent than historical information. Data dating back to before 1993 was barely found, sometimes not earlier than 2005. The same challenge applied for more specific questions for which the MoEM and MoEYS were contacted. Therefore, in a second step, sources such as the WB and UN were considered. Relevant data on Cambodia could also be found in e.g. the Penn World Table (PWT), the Maddison Database (MDB), and several articles, as presented in the following.

When deciding on data sources, two principles were applied: First, if possible the selection of too many sources was avoided to minimize confusion through potential variation. Second, sources that provided a long and continuous series were preferably chosen in order to reduce the use of interpolation for missing observations. For some variables, e.g. natural resource rents, GDP, and population figures, the required information was fairly easily accessible. However, information on NNS, government expenditure on education, fishery activities, and exchange rates were more difficult to retrieve and partially required interpolation. TFP was calculated separately, as well as the GDP and USD deflators. The final dataset in 2010 USD is depicted in Table B.1, Appendix B.

Net National Savings

NNS are calculated by taking DI of a country plus FDI minus the Consumption of Fixed Capital (C_{FC}). Finding DI in Cambodia was the main challenge during this work. Only for some recent years, Statistical Yearbooks provide those figures officially (National Institute of Statistics, 2021). However, the United Nations (2020) provides information on DI for Cambodia 1970-2019 in their *National Accounts - Analysis of Main Aggregates (AMA)*. For consistency, the latter source was chosen. The second component, FDI, includes both, investment flows into and out of the country. Information on this indicator could be found in the WB's WDI (World Bank, 2021d). The third part, C_{FC}, was retrieved from the sub-file *Capital detail* to the PWT 10.0 published by Feenstra, Inklaar, and Timmer (2015).[5] As a final step, Cambodia's Trade Balance (TB) was included in further calculation to consider additional capital flows. TB information were also derived from a sub-file to the

[5]After some clarification with the owners of the platform on currency and unit, both information were missing, unfortunately, their information could be further processed.

PWT 10.0 called *NA data* (Feenstra, Inklaar, & Timmer, 2015). For comparing the final results with the ANS calculated by the WB, TB is excluded as it showed a higher correlation index.

Education Expenditure

The governmental expenditure on education serves as a rough indicator for the accumulation of human capital. For recent years (1970-1974 and 1998-2018), the World Bank (2020a) provides information. For very early years, some Statistical Yearbooks of Indochina, conducted by the French as documentation of their colony, could be found which provided information for the years 1918-1922, 1931, 1935, 1937, and 1940 (Gouvernement Général de l'Indochine, 1927, 1931, 1937, 1939, 1942). Gaps were filled with linear interpolation. To retrieve figures until 1954, the last year in which the French officially resided in Cambodia (Slocomb, 2010), the average growth rate of the last 15 years coming up to 1940 was applied to the range 1941-1954. To find data points for further gaps in the following years was very difficult, but some assumptions in the literature helped: According to Chandler (1996), between 1955 and 1970 under the lead of Prince Sihanouk, a minimum of 20% of government expenditure was put on education. Vickery (1984) states, that the KR solely installed basic primary education, not reaching further than basic literacy and numeracy, and that across some areas no education took place at all. And following Slocomb (2010), after 1979 expenditure on education jumped up again to an assumed level as before the DK. Therefore, the following assumptions were made: For the missing years 1975-1979, a symbolic value of zero was placed into the dataset. For the period 1980-1994, no official source was found, not even on the governmental budget. However, the share of education expenditure to GDP was almost constant during the first half of the 1990s (averaging 1.15% from 1990-1995) (World Bank, 2020b). Therefore, the share of the year 1990 (1.25%) was applied backward.

Natural Resources

The depletion of natural resources (both renewable and non-renewable) is considered in the calculation of GS as the total rents on resources harvested and extracted. Non-renewable resources are split into mineral and energy resources. Following the logic of Blum, Ducoing, and McLaughlin (2017), renewable resources included are fishery and forestry.

Minerals and Energy

The WB provides a series about Mineral and Energy resource depletion in its WDI for Cambodia 1970-2018 (World Bank, 2021b). Figures for Energy equal zero throughout this period except for 2017. As already mentioned in Section 3.5, oil reserves have been found in Cambodia, however, recovery is planned to start after 2021 only (Open Development Cambodia, 2019). The US Geological Survey (2018) documents that Cambodia mainly produces laterite, gravel, cement, crushed stones, and sand. The natural occurrence of mineral resources in Cambodia is only minor and its exploitation is still rare and underdeveloped: The MoEM states, that Cambodia has resources of inter alia iron ore, sapphire, tin, and zinc, however, due to the lack of geological surveys, its potential and extent are still unknown (US Geological

Survey, 2018). Furthermore, in 2016, the MoEM published, that steel, gold, lime- and gemstone licenses were issued to exploit those resources, but this would happen "in the future" (Ministry of Mines and Energy, 2016) only. Consequently, the data provided by World Bank (2021b) was assumed to be complete and included in the subsequent GS calculation. As the figures equal zero almost throughout the period, the same number was also assumed for the last missing year 2019.

Fishery

As mentioned in Section 3.5, fishery represents an important part of Cambodia's economy. To calculate the contribution of fishery to the depletion of natural resources, the most crucial information is the amount of fish captured. Included in this number is the volume of fish catches landed by a country for all industrial, commercial, recreational, and substantial purposes (World Bank, 2021c). As fish farming implies an artificial stock of fish, it is not included in the calculation following the definition of the International Monetary Fund (2017) in their *Guide to analyze Natural Resources in National Accounts*. For a historical overview about the amount of fish captured, Slocomb (2010) provides extensive information for the time 1863 until 1969, and 1979. For the 1970s no record could be found. However, Slocomb (2010) states that "from a conservationist perspective, [Cambodia's forests and fisheries] benefitted from the isolation of the DK regime" (Slocomb, 2010, p.209). After 1975, the fisheries restocked naturally and as there were fishery productions still active during the DK (Slocomb, 2010), the preceding amount of fish (120,000 tons) was assumed to be continued for this period. For the subsequent years of 1980-2002, Baran (2005) provides yearly figures on the amount of fish captured. Lastly, for the time 2003-2015, the series on *Capture fisheries production* by the World Bank (2021c) was taken. The average price of a ton of fish was selectively found in Baran (2005) (who presents information by the MoAFF), Nam (2008), and Mille, Hap, and Loeng (2016). Gaps were linearly interpolated. To calculate the total rents, costs of fishery in the form of compensation to in fishery employed people has to be deducted. Information on in fishery employed people and their compensation for the time 1993-2005 was found in the Statistical Yearbook of Cambodia 2006 (National Institute of Statistics, 2021). Important to note when looking at the figures for employment in fishery: The National Institute of Statistics (2021) officially reports child labor figures (1,7 million in 2006) for Agriculture, Forestry and Hunting. This figure is not considered in the present calculation as the allocation to the different sectors was impossible to disentangle. Furthermore, children would not be paid an equal amount of salary as they would not be officially employed. For historical data, the share of in fishery employed people in 1993 (13,8%) was estimated to be constant and applied retrospectively. The number of in fishery employed people is very likely understating the real number of in fishery active people like a lot of private fishing for both, work and subsistence is present in Cambodia still today (Baran, 2005; Slocomb, 2010).

Forestry

As part of the GS calculation, forests offer natural resources of timber. Required information for this part of the calculation is the woodland area of a country and its development over time (if it is increasing in times of forestation or decreasing in times of de-forestation), the forest volume, and the price for which the depleted timber was sold. Detailed information on the woodland area of Cambodia 1960-2016 can be found in the work of Tsujino, Kajisa, and Yumoto (2019). Their assumptions are based on information by the Department of Forestry and Wildlife (2002), the Forestry Administration (2004, 2011), the Ministry of Environment, Kingdom of Cambodia (2018), and Royaume du Cambodge (1965). They close gaps in the dataset with linear interpolation. Their approach could be reconstructed and therefore it was considered in the present calculation. The period of the 1950s had to be calculated separately. Tsujino, Kajisa, and Yumoto (2019) state that "the current deforestation and forest degradation was initiated around 1970 [and that] in the 1960s, the forest was relatively undisturbed than in later periods" (Tsujino, Kajisa, & Yumoto, 2019, p.375). Only as of 1967, with the start of the (extended) Vietnam War, the woodland area of Cambodia began to suffer (Tsujino, Kajisa, & Yumoto, 2019). Based on that information, the same amount of woodland area was assumed for the 1950s as for the first half of the 1960s (13,277,000 hectares). Tsujino, Kajisa, and Yumoto (2019) provide figures until 2016. Therefore, for 2017 and 2018, information from the WDI was taken (World Bank, 2021e). For 2019, a constant evolution from the preceding year of -1.84% was applied. Cambodia's forest volume is calculated to be 40 cubic meters per hectare as stated by the Food and Agriculture Organisation of the UN (2000). Lastly, information on international timber prices was taken from Blum, Ducoing, and McLaughlin (2017).

Carbon Dioxide Emissions

To account for pollution, carbon dioxide emissions are considered in the GS calculation. Carbon Dioxide (CO_2), a greenhouse gas, has a lifetime of up to 200 years in the atmosphere and can be accounted for almost 75% of the global warming potential (Stern, 2007). It is a stock pollutant that adds to the existing concentration in the atmosphere, and each unit makes the marginal damage costs of future pollutants increase (Kunnas, McLaughlin, Hanley, Greasley, Oxley, & Warde, 2014). In the calculation, the total amount of CO_2 emitted is taken into account. Data on CO_2 emission from 1960-2019 are provided by the Global Carbon Atlas (2021). The figures for Cambodia are not very high, especially not in the 1960s to the 1980s. Only in 1990, the emissions started to increase. It can be assumed that the trend in the 1960s was initiated during the 1950s. Therefore, the linear trend from 1960 to 1968 was taken to linearly extrapolate Carbon dioxide emissions for 1950-1959. To weigh the emitted tons of CO_2, estimates of the social costs of carbon are considered. In particular, more recent estimates by Pezzey and Burke (2014) are used, which contain two different price assumptions. The first one is a price of 131$ per ton of CO_2, assuming control over CO_2 limiting global warming to 2°C. The second is a significantly higher price of 1,455$ assuming no controls of CO_2 being implemented. As suggested by Tol (2012), those prices are discounted over time.

TFP

TFP, the relation of economy-wide total in- and outputs (labour and capital) is calculated following the logic of Blum, Ducoing, and McLaughlin (2017, Section 4.2, Equation 1). Data required are capital stock and total labor hours worked. The PWT 10.0 (Feenstra, Inklaar, & Timmer, 2015) provides information on capital stock 1970-2019, number of persons engaged in employment 1970-2019, and average annual hours worked by persons engaged for 1993-2019. The only assumption which had to be made was working hours for the missing years 1970-1992. As the number of hours was constant throughout the provided period and especially during the 1990s, the same amount of hours worked in 1993 was considered for 1970-1992 (2,190 hours worked per person). To calculate the NPV of TFP growth, a Kalman Filter was applied to smoothen volatility, and an interest rate of 1.22% (Trading Economics, 2021) was taken to discount the values over 20 years.

GDP

Information on GDP is required for the final comparison of results. Again, the United Nations (2020) provide figures in their *National Accounts - Analysis of Main Aggregates (AMA)* for 1970-2019. For this calculation, their data was considered. However, if GS for Cambodia will be further extended in the future, the calculation by Bolt and van Zanden (2020) suggests itself as it stretches back until 1950.

Population

The UN provides population figures for Cambodia starting 1950 on a yearly basis in their World Population Prospects 2019 (United Nations, 2019). To retrieve data from before 1950, 5-yearly information was found in Slocomb (2010) starting in 1900. Both sources deviated only slightly for the exact year of 1950 and the time-series of the United Nations (2019) was taken for this calculation. Again, for any future further-stretching back calculus, the information by Slocomb (2010) can help.

Exchange Rate KHR to USD, USD Deflator

To calculate GS, exchange rates are required when information can only be found in specific currency units. As part of their colonial administration, France introduced the Piastre as currency in Indochina (Slocomb, 2010). When introduced, the Piastre was linked to 5.37 silver Francs, replaced by the gold bullion standard in 1930 equaling one Piastre to ten Franc (Matsuoka, 1942). With the end of World War II (WWII), the exchange rate was lifted to 17 Piastre equaling one French Franc which was taken back to 10 on May 11^{th}, 1953 in the course of Cambodia's independence process (Gignoux, 1953). The introduction of Cambodia's currency, the KHR took place at par with the Piastre. Early exchange rates from the French Franc to the USD were found in Bassino and Nakagawa (1999) and from the Piastre to the USD in the Statistical Yearbook of 1954 by the United Nations (1954). A long-term series about the exchange from KHR to USD is presented in the PWT (Feenstra, Inklaar, & Timmer, 2015). Finally, a USD Deflator was considered to convert current USD to constant 2010 USD (Webster, 2021), the unit in which GS in the Ducoing (2019) project is reported.

Earlier Calculations

As mentioned in Section 2.2.1, ANS has been calculated by the WB presented in the WDI for the time from 1995 until 2018 (World Bank, 2021a). The results of the WB were retrieved in order to enable a comparison to the outcome of this very study.

6 Results

This section presents the results of the analysis. The presentation of the results is clustered in accordance with the estimation steps presented in Section 4. First, the main results, NNS, GI and GS are presented. Second, the effects of including Carbon Dioxide Emissions are depicted. Third, TFP effects are shown. Fourth, the present results are compared to the ANS published by the WB.

6.1 Net National Savings, Green Investment, and Genuine Savings

The trend for NNS, GI, and GS for Cambodia in the period 1970-2019 is presented in Figure 5. To account for the "wealth-dilution effect" as mentioned in Section 2, the results are reported in per capita 2010 USD. All indicators show negative figures until 1992. At the start of the observation period, NNS report -75 USD and remains negative until the 1990s. The main driver is C_{FC}, which exceeds both, DI and FDI until 1991. The negative export balance throughout the observed time span only amplifies the weak results. A more detailed overview about the components of NNS is presented in Figure C.1, Appendix C. In 1992, NNS turns positive for the first time, fluctuates slightly around 0 until 1999 and achieves a level of 144 USD in 2008 where it stagnates for the following years. In 2012 it continues its progressive path and reaches 401 USD per capita in 2019.

When accounting for the depletion of natural resources, the trend for GI shows (even more) negative numbers as Cambodia extracts natural resources. A presentation of the exact split between forestry, fishery, mining, and energy contribution can be found in Figure C.3, Appendix C. GI starts at a level of -80 USD per capita in 1970. During the 1970s and 1980s, forestry is the only natural resource mathematically considered in this estimation. Afforestation during 1998-2001 led to positive resource rents for that period which result in GI slightly exceeding NNS. Fishery rents equal 0 until 1992, at least as part of this calculation. Data limitations forced this assumption, although it very likely heavily understates the natural resource depletion of fisheries. Despite being volatile, the overall trend in fishery rents increases until 2019. As mentioned in various places of this work already, mining and energy resource depletion does not contribute to the natural resource depletion, as defined here, in Cambodia for the time 1970-2019. Due to stark forest depletion after 2010, GI shows remarkable discrepancies to NNS as of 2010. In 2011, GI reports a level of 94 USD compared to 153 USD of NNS. In 2019, GI attains a level of 355 USD, further preserving the gap to NNS.

Lastly, by adding governmental expenditure on education, GS are retrieved. Therewith, GS always slightly exceeds GI, except for the time 1975-1979, when education expenditure equals zero (as explained in Section 5 and depicted in Figure C.4, Appendix C). In 1970, GS is at a level of -47 USD per capita. It turns positive

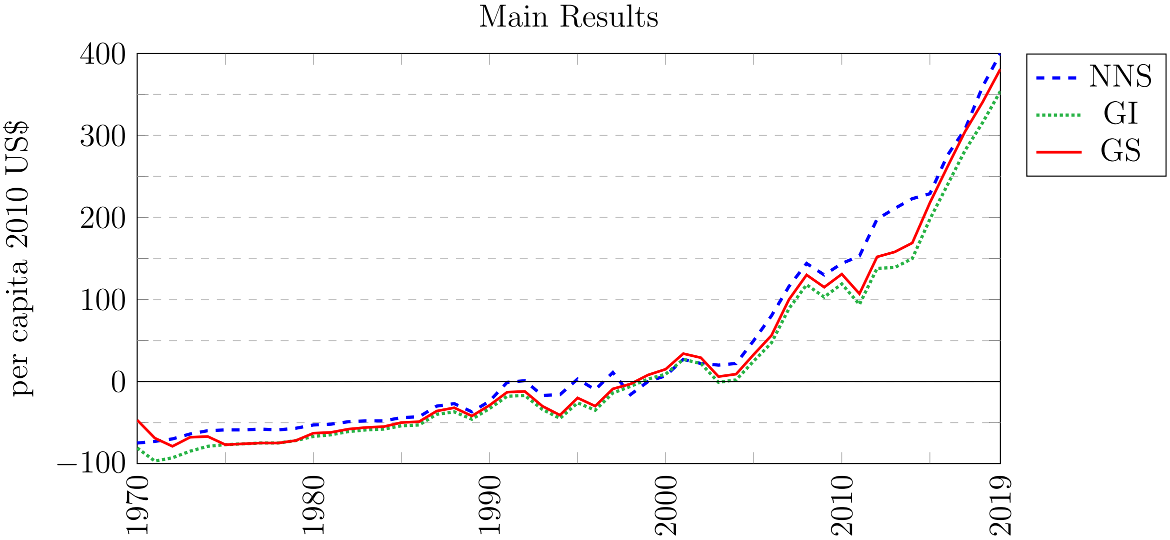

Figure 5: Results: NNS, GI, and GS Cambodia 1970-2019

in 1999 with a slight relapse in 2003, and a fluctuation around 130 USD during the 2010s. However, after 2011 GS for Cambodia is constantly increasing marking 381 USD in 2019. Figure C.2, Appendix C, expands the view of Figure 5 by additionally showing GDP per capita for the respective period. As per definition, GDP exceeds GS, which is visible for the Cambodian case. GDP per capita starts at 617 USD in 1970, falls below 400 USD during the 1980s and 1990s but goes back up as of 1999 ending at 1,402 USD in 2019. Although its level is significantly higher, all indicators follow a very similar trend throughout 1970-2019. Furthermore, Figure 6 depicts the main results as a share of GDP. Logically, the same trend as in Figure 5 can be observed in terms of algebraic signs. However, it should be mentioned that for the period estimated (1970-2019), all indicators, NNS, GI, and GS do not exceed the 30% ratio to GDP, to a both positive and negative extend. In 2019, NNS reports 28.6%, GI 25.3%, and GS 27.2%. The estimation results for both, GI and GS are to be found in Table B.2, Appendix B.

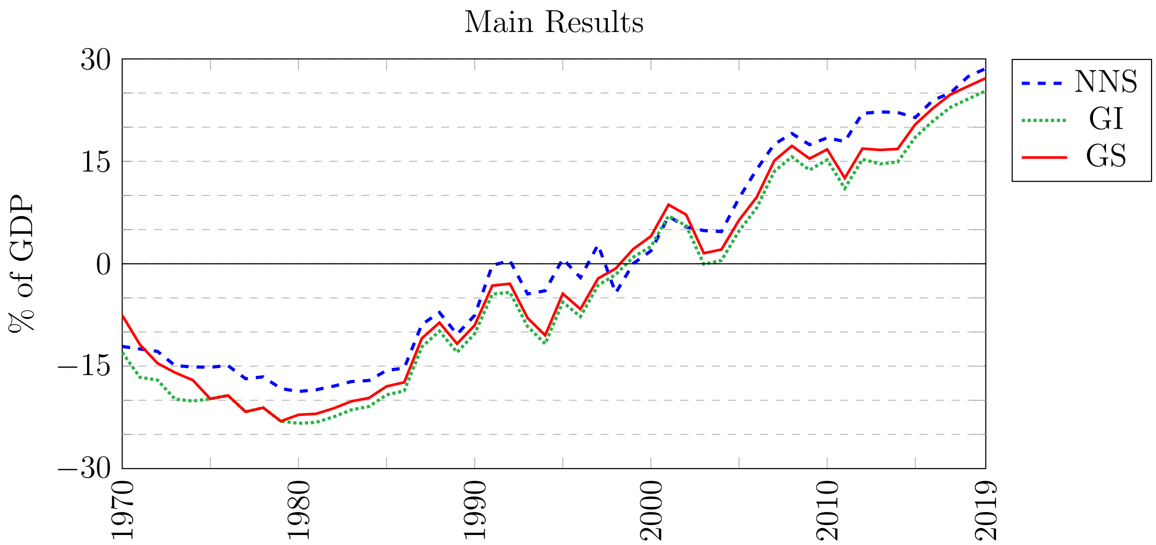

Figure 6: Results: NNS, GI, and GS Cambodia 1970-2019

6.2 Carbon Dioxide Emissions Effect

When accounting for pollution through subtracting priced Carbon Dioxide Emissions, the results depend on two factors: First, the amount of carbon dioxide emitted, and second, its price. Cambodia shows low levels of CO_2 emissions until 1989. Only as of 1990, its output slightly increases, and finally accelerates after 2010 with doubling its emissions within four years from 8,446 ktCO_2 in 2015 to 16,027 ktCO_2 in 2019 (Global Carbon Atlas, 2021, Figure C.5, Appendix C). As explained in Section 5, two different prices for a ton of CO_2 are considered in this calculation following Pezzey and Burke (2014): A fairly low price of 131 US$ and a higher price of 1,455 US$. The results from deducting the weighted CO_2 emissions from both, GI and GS, are depicted in Figure 7. The inclusion of pollution pulls the sustainability indicators down. Both, GI and GS perform weaker when accounting for CO_2. When priced with 131 US$ per ton CO_2, GS turns and remains positive as of 2005, GI only a year later in 2006. Both indicators remain positive until 2019, however, visibly below their level without accounting for CO_2 emissions (228 USD compared to 355 USD for GI, and 254 USD compared to 381 USD for GS). Higher pollution levels result in higher subtractions from the indicators, especially so for the heavier priced calculation. When the price for a ton of CO_2 is set at 1,455 US$, both GI and GS do not turn positive at all. In fact, the negative extend which they reach accelerates after the 2010s, when Cambodia's emission levels boomed. GI reports -1,060 USD, and GS -1,033 USD for the high priced CO_2 emissions scenario.

Figure C.6, Appendix C captures the changes through CO_2 emissions in percentage of GDP. In the relative series, the overall trend is similar to the absolute results, however, it is a lot more volatile. Following the 131 USD calculation, both GI and GS still show a positive share of GDP with 16.2% and 18.1% respectively. However, the extend which the higher priced calculation reaches heavily undergoes GDP with -75,6% for GI, and -73.7% for GS in 2019. The exact results for the CO_2 effect on both, GI and GS can be found in Table B.2, Appendix B.

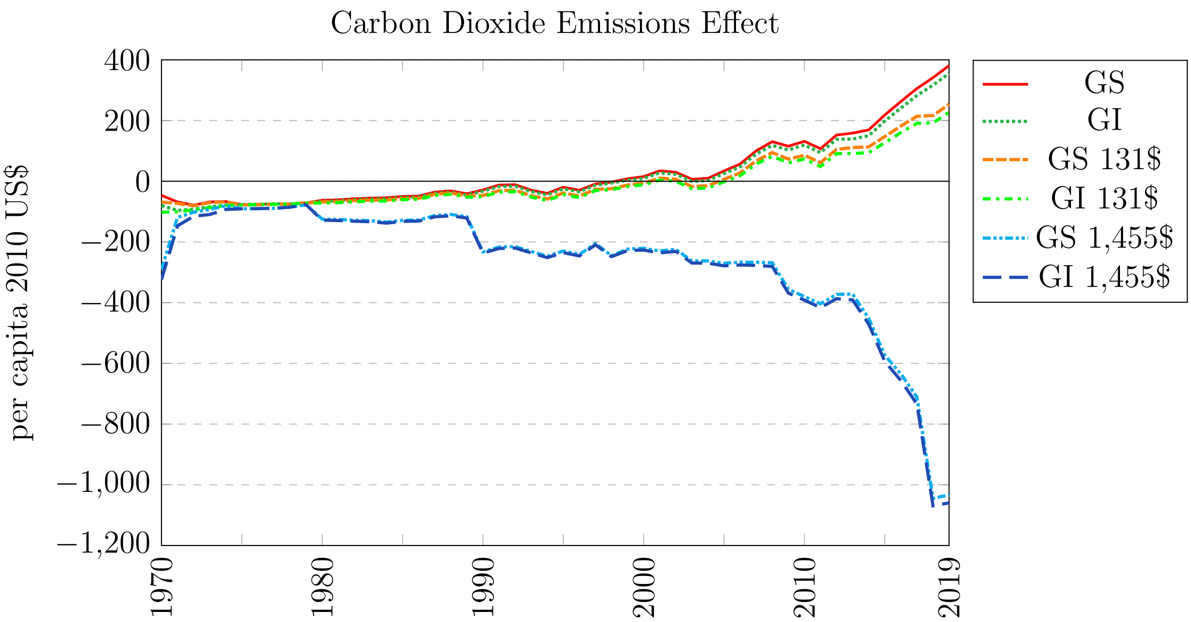

Figure 7: Results: Carbon Dioxide Emissions Effect on GI and GS

6.3 Total Factor Productivity Effect

Including technological change can avoid misstating a country's true level of sustainable performance. In this work, technological change is considered as NPV of TFP growth over 20 years. TFP is retrieved through a standard Cobb-Douglas production function defined in Equation 1, Section 4.2. In a second step, NPV is calculated by applying the filtered TFP growth rate to GDP and discounting the results with a 1.22% rate over 20 years. The calculated rates for TFP, TFP growth (unfiltered and filtered), and its NPV are graphically depicted in Figure C.7, Appendix C.

Cambodia's TFP decreases from a level of 36.6% in 1970 to 16.4% during the early 1980s. Afterward, it recovers only slightly, reaches a preliminary plateau in the late 1990s at 31.9%, struggles again during the early 2000s, and closes at a level of 48.4% in 2019. Accordingly, TFP growth remains negative until 1982, fluctuates around the turn of the millennium, and evolves positively until 2019. The NPV of the growth rate displays this development. Incorporating TFP into the GS measure emphasizes the overall trend. By adding NPV of TFP growth, GS for Cambodia remain negative until 1983 and only shortly in 1998. The augmented GS trend performs overall more positive reaching a high level of 92.8% in 1988, 92.4% in 1991, and 111.2% in 2007 benefitting from a rising TFP. Finally, GSTFP closes at a level of 110.0% in 2019 compared to 27.2% without technological change. The performance is depicted in Figure 8 as a share of GDP.

When TFP is incorporated in GS, effects related to both, human capital and technological change can potentially be double-counted as mentioned earlier in Section 2. Therefore, the effect of TFP on GI was calculated separately in a second series. This way, the effect of human capital accumulation as defined in this analysis was excluded, and double-counting was avoided. Hence, Figure 8 shows a second series of GI and GI augmented with TFP. The difference is only minor due to the missing education expenditure. This way, GITFP closes at 108.1% in 2019, slightly lower than GSTFP.

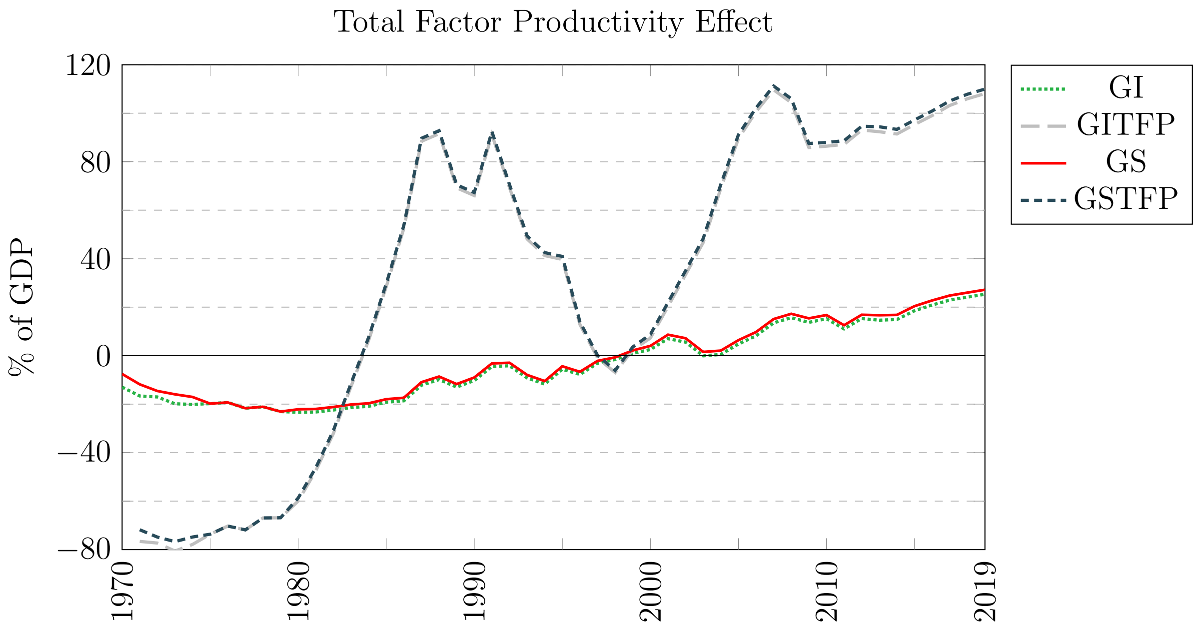

Figure 8: Results: TFP (NPV of TFP growth) Effect on GI and GS

In a final step of combining all results, both effects on GS, Carbon Dioxide Emissions, and TFP are considered together. Figure 9 presents the series of GS, GSTFP, and GSTFP-CO_2 as share of GDP. GSTFP-CO_2 was again calculated considering both prices of a ton CO_2. When picturing all indicators jointly, the overall relations become clear. First, GS for Cambodia is negative in relation to GDP until 1998. As of 1999, it turns positive with a more or less constant trend reaching 27.2% in 2019. Second, by adding NPV of TFP growth to the series, GSTFP improves significantly, turning positive already in 1984 and closing 2019 at a level of 110.0% of GDP. Third, when accounting for CO_2 emissions, GSTFP lowers its overall level but still reaches 100.9% in 2019 when a price of 131 US$ per ton of CO_2 is taken. For a ton price of 1,455 US$, GSTFP shows a very volatile performance throughout the study period. It reports a low level of 9.1% in 2019 suffering from the increasing CO_2 emissions in Cambodia. The results for all TFP calculation steps are presented in Table B.3, Appendix B.

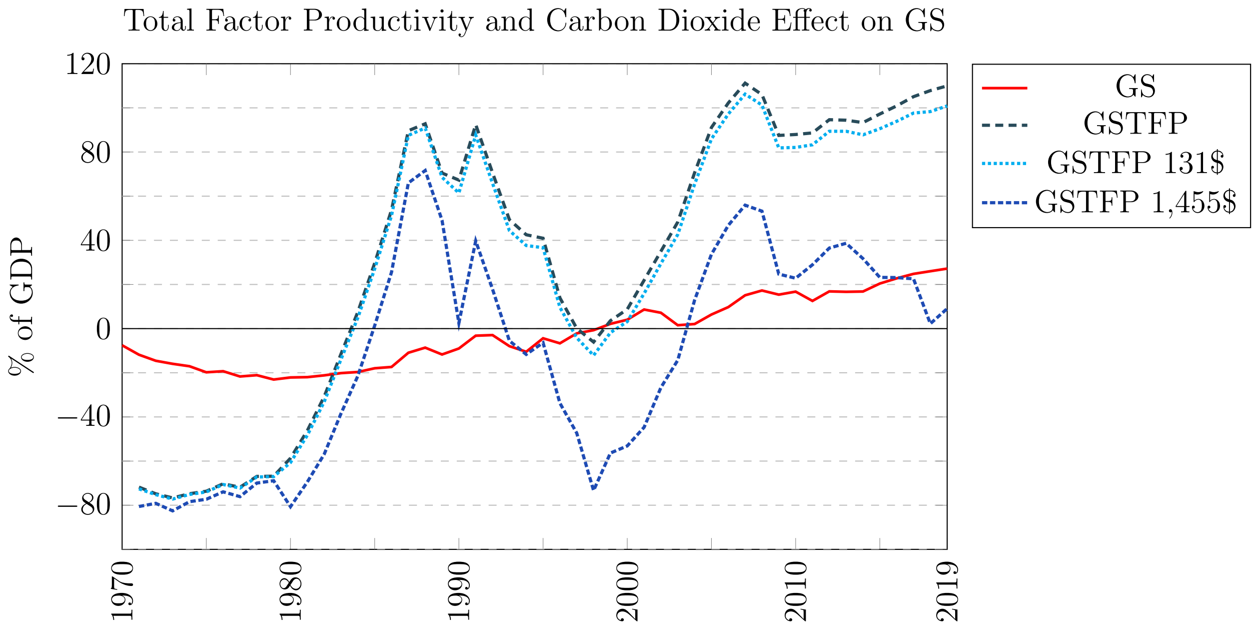

Figure 9: Results: TFP and CO_2 Effect on GS

Figure C.8, Appendix C shows a similar conclusion of the main results, but in per capita 2010 US$. For readability purposes, the calculation of 1,455 US$ is excluded in this view. Once again, the positive effect of TFP becomes visible as well as the negative effect through CO_2 emissions. In absolute terms, GS reaches 381 USD in 2019, and falls to 254 USD when pollution is included at a price of 131 USD per ton of CO_2. However, GS increases to 1,542 USD when technological change is added, and finally decreases again to 1,414 USD when pollution is additionally accounted for, again at a price of 131 USD.

6.4 Comparison to the World Bank's Adjusted Net Savings

In a final step, the GS results for Cambodia shall be compared to the ANS calculated by the WB. As a starting point, key statistics are briefly compared between this work's approach and the corresponding measures included in ANS. Table 2 demonstrates both similarities and differences between values and data sources considered. All indicators are reported as a share of nominal GDP. Additionally, the average value of GDP and population figures are shown. Overall, the data similarities between GS and ANS are high for forestry, mining and energy, and education expenditure. Information on mining and energy depletion and education expenditure partially was taken from the same source. Fishery rents are not included in the WB's statistics. Information on forestry was taken from different sources, and the here applied approach considers higher forestry rents than the WB. However, both approaches consider the same population figure, the common source is the United Nations (2019). NNS in the GS approach exceeds the figure of the WB when the TB is taken out, the same applies for Gross Capital Formation and C_{FC}. GDP also slightly differs, but this result is diluted by the fact that the WB only reports GDP figures for 1970-1974 and 1993-2019. If the GDP figures of this approach are considered for the same period, this gives an average of 8,949 million USD. In summary, key factors for discrepancies are different data sources and slight differences in estimation methods.

Table 2: Comparison of GS and WB's ANS Data Sources

Variable	Avg. share of nominal GDP between 1970-2019		
	WB's ANS	GS	comment on source
NNS w/o TB	7.72%	9.38%	different data sources
Gross Capital Formation	15.96%	18.46%	different data sources
Consumption of Fixed Capital	7.56%	9.08%	different data sources
Fishery	N/A	1.03%	different data sources
Forestry	2.08%	2.85%	different data sources
Mining & Energy	0.00%	0.00%	same data sources
Education Expenditure	1.99%	1.55%	same data sources
Mean of nominal GDP (mil.)	7,923	6,645	different data sources
Mean of population (mil.)	10.77	10.77	same data sources

The main conceptual differences between the WB's and the present approach are that here a longer time is covered (1970-2019 compared to 1995-2018) and that fishery as an additional aspect of natural resource depletion is included. Furthermore, afforestation is considered whereas the WB considers forest depletion rents, but no positive effects on GS in times of afforestation (relevant for Cambodia around the 2000s as presented in Figure C.3). Another difference exists regarding the consideration of pollution. The WB includes CO_2 emissions in its ANS. As the "global marginal social cost of a metric ton of carbon emitted" (Bolt, Matete, & Clemens, 2002, p.19) they take an estimated value from 1995 which is 20 US$ per ton of CO_2 (Bolt, Matete, & Clemens, 2002). As an additional dimension to ANS, they define Particulate Emission Damage (PED), which covers the "willingness to pay to avoid mortality and morbidity attributable to particulate emissions" (United Nations, 2021, p.276). Consequently, in order to compare the GS calculated in this work with the WB's ANS, the definition of the indicators to be compared has to be carefully distinguished.

First, a comparison of the results without any emission effects is presented. Figure 10 depicts GS, GS without fishery, ANS, and ANS excluding CO_2 damage in per capita 2010 USD. To compare the GS results with the WB's, the TB is taken out of the NNS calculation as this way, NNS of both approaches reported a higher relation index. Therefore, GS shown below report 400 USD in 2019 *excluding* TB in contrast to the earlier reported 381 USD *including* TB. Without fishery rents, GS increases to 420 USD in 2019 (again excluding TB). The two indicators most comparable as per definition in this graph are GS without fishing and ANS without CO_2 damage. ANS for Cambodia turn positive in 1999 and evolve positively with some ups and downs until 2018, reporting a level of 131 USD for that year. Without CO_2 effect, the trend shifts up to 154 USD per capita. When observing the overall development throughout 1995-2018, both indicators (GS without fishing and ANS without CO_2) follow a very close upwards pattern until 2008. After that, GS calculated in this work increases steeper than the WB's ANS and the gap widens further until 2019. Trend-wise, however, both indicators go in a similar direction.

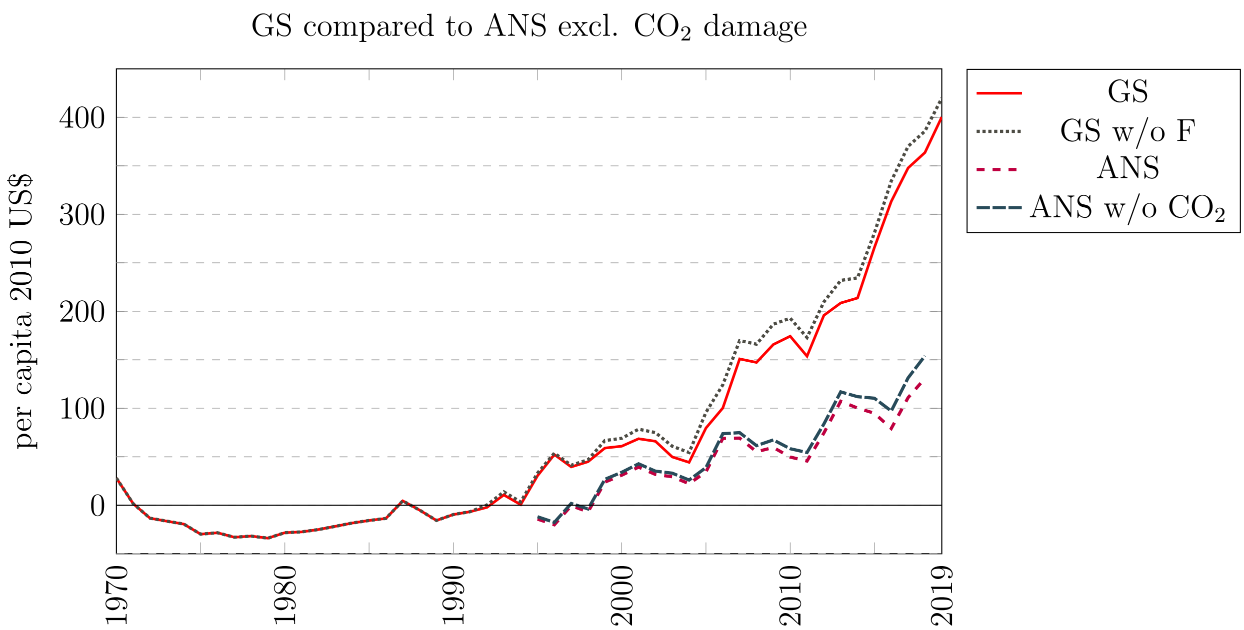

Figure 10: Results: GS and ANS excl. Emission Damages compared

Second, a comparison of the results including emission effects is shown below. Figure 11 presents GS (again without TB), GS without fishery weighted with the CO_2 price of 131 US$, ANS from the WB which includes CO_2 but excludes PED, and ANS including both, CO_2 and PED. The two most comparable indicators as per definition in this graph are GS without fishery weighted with 131 USD per ton of CO_2 and ANS. Both series almost meet in 2004 and follow a very close pattern again until 2008. Then, GS increase steeper than ANS, even considering the emissions effect. In 2018, GS without fishery reaches 261 USD and ANS only half its level at 131 USD. In general, when accounting for emissions damages in ANS, its overall trend remains the same, and its level seems to not change much. This reflects the humble assumption of the WB of a CO_2 ton price of 20 US$.

In extension to Figure 11 presented here, Figure C.9, Appendix C, includes GS figures for the CO_2 price of 1,455 US$ (with and without fishery). For readability reasons, those figures were excluded in the graph depicted in this section. The visualisation in Figure 11 resembles the results presented in Section 6.2. When including a CO_2 price of 1,455 US$, both GS and GS without fishery remain negative throughout the calculation period. The gap to ANS widens at an increasing rate over time which is mainly driven by the major difference in price assumptions made in this work and by the WB (1,455 US$ compared to 20 US$ per ton of CO_2). The estimation of this work and the WB's ANS figures are displayed in Table B.4, Appendix B.

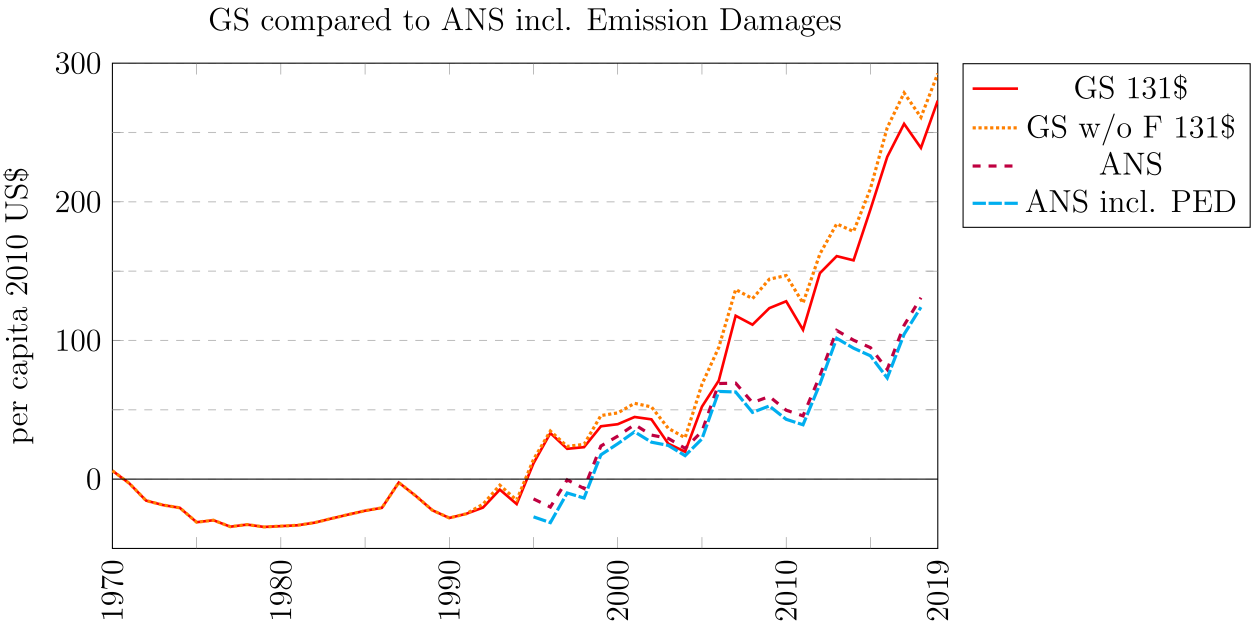

Figure 11: Results: GS and ANS incl. Emission Damages compared

7 Discussion of Results

7.1 Signification, Relevance, and Implications

The results presented in the foregoing section suggest that Cambodia's economy is operating on a sustainable development path today. Until 1999, Cambodia showed a negative trend in GS with a low point in 1979. Looking at a strongly increasing positive development after 2010 until 2019, the capacity of the Cambodian economy to sustain wealth accumulation seems to increase. This trend occurs despite accounting for a potential "wealth-dilution" effect, which suggests that the increasing population of Cambodia does not hamper the positive GS development per capita over time. Main drivers of Cambodia's GS evolution are the NNS components of DI and FDI, which are both significantly elevated during the 2010s. Also, the spending on education further accelerates, which lifts the overall GS accumulation. From its negative ratio to GDP of -23.1% in 1979, and 2.2% in 1999 to 27.2% in 2019, GS has clearly shown a positive development throughout the last four decades. When accounting for TFP, both GI and GS depict the challenging political circumstances during the 1970s. The impact of the industrial dismantling by the KR becomes graphically visible until the mid-1980s, but afterwards the trend recovers and benefits from an increasing TFP in Cambodia. GITFP and GSTFP reach remarkably high levels in 2019 of 108.1% and 110.0%, respectively. As all metrics show constantly increasing values since the 2000s, it stands to reason that this positive trend will further increase in the upcoming years.

However, with regard to future development, some significant trends have to be considered. First, concerning the educational sector. Although governmental expenses on education have advanced over the past two decades, its ongoing challenges mentioned in Section 3.4 still hamper sustainable development in human capital accumulation. Despite the key position teachers have to further pass on knowledge to their students, their jobs seem to have been sidelined in the discussion of how to improve education in Cambodia (Chansopheak, 2009; Kim & Rouse, 2011). Although teacher development has been identified as the most cost-effective intervention to reduce drop-out rates and to improve pupils' progression and achievement (Benveniste, Marshall, & Araujo, 2008), their personal development is still not in focus. The MoEYS has realized that the low salary levels contribute to the poor teaching quality and this, in turn, hampers the learning achievements of children. But even in their *Education Strategy Plan 2006-2010*, there were no specific actions included against this vicious cycle (MoEYS, 2005).

Second, CO_2 emissions in Cambodia increased tremendously over the past few years. Depending on the price considered per ton of CO_2 included in the GS calculation, Cambodia's development does not only heavily decrease, it even remains negative throughout the calculation period. If Cambodia does not control for its CO_2 emissions in the future, the price of it will inevitably be high, if not even further increase. Cambodia has to reduce its CO_2 emissions if it wants to have a chance to pursue a sustainable development path towards the future. Furthermore, the CO_2 price level as adjusting screw in this calculation has to be checked again if it applies to the Cambodian situation. Worst case, if emissions keep increasing, even the higher price of 1,455 USD per ton of CO_2 might be understating Cambodia's emission damages.

Third, natural resource exploitation in Cambodia seems not unsustainable - yet. The performances within all sectors, fishery, forestry, and mining, show warning signs towards the future. Fishery in Cambodia increases mainly due to an increasing population and more effective fishing gear. The latter causes 10% of all species in Cambodia to be locally endangered. Black fishing additionally threatens the country's fishing stock, and the MoAFF is not on top of detailed and exact fishing statistics. Several sources provide contradicting information, and there is no veritable status of Cambodia's fishing stock available. Cambodia's official fishery management policies are outdated and represent a further danger for the country's fish culture (Zurbrügg, 2004). One way out of this trap could be aquaculture. As per definition, aquaculture does not count towards natural resource depletion (International Monetary Fund, 2017). It stands for an alternative and sustainable source of fish, and its share within Cambodia's fishing sector has been increasing over the past years. Targeted support to local fish farmers could help to further foster this part of the sector, make fish farming a liveable income, and provide families with cheap fish. Even if fish farms would be set up at a large scale and private fishing would be allowed, this would already unburden the fish culture in the LMB.

Cambodia's forestries have increasingly suffered over the last two decades. Increasing demand for timber led to an unhealthy extraction of the country's forest resources. The decimation of trees along riverbanks causes siltation in Cambodia's countless waterways and lakes and, additionally, threatens the country's fish stock (Nam, 2008). Furthermore, if Cambodia manages to control for deforestation, it thereby reduces its CO_2 output as the decrease in forests was one of the main contributors for increasing emissions (Kim et al., 2005). As Thailand did in the late 1990s, Cambodia should now ban private logging and actively persecute illegal logging activities. To maintain its rich forests and effectively reduce CO_2 emissions the increasing deforestation in Cambodia has to be stopped.

The mining industry in Cambodia is not big yet, however, the government tries to push it in order to benefit from its mineral extractions. More and more mining licenses are provided to private entrepreneurs to attract foreign investors. There is a serious risk that mineral resource exploitation will be pushed to benefit from it financially but that it will be facilitated at the expense of natural sustainability. To make remittances, Cambodia's government might make choices that favor its short-term treasury over its long-term sustainability path. Where possible, those actions will have to be controlled for and reduced, even if this means that revenues are slightly lower for the moment but will pay off in the future.

Finally, Cambodia's economical setup is questionably (economically) sustainable. The two main sectors booming in Cambodia are long-distance tourism and the garment industry for export business (Slocomb, 2010). Both sectors can be highly vulnerable to external shocks. Conducting this Master's thesis in times of a pandemic, when long-distance travels are not to be planned, one might say that this is a luxury problem for potential in-coming tourists. However, this crisis is a fundamental existence-threatening problem for all Cambodians depending on tourism as a source of income. As long as it is unclear, when and how this business will be revived again, this part of Cambodia's economy is at a standstill. The garment industry poses another risk of uncertainty. In times of sustainable thinking and insourcing of production steps to avoid unnecessary emissions and to meet increasingly conscious customer needs, it is questionable if cheap and unsustainable garment productions will find sufficient demand in the future. The global crisis the world experiences right now makes the developed world scrutinize its actions once more. The question is if they can further afford the unsustainable production steps which are visible across so many sectors. One can argue, that the conscious decision to act sustainably can only be afforded by the rich, developed world. In any case, if more and more products will be required to meet certain sustainable production standards, developing countries like Cambodia will have to adapt if they want to remain in business. Not least because of their participation in international organizations, such as the UN, ASEAN, and WTO. Although having the status of a developing country, Cambodia has to fulfill certain standards in order to remain part of those organizations, which would mutually reinforce the country's economy. Unfortunately, Cambodia's activism does not only depend on willingness but also on financial possibilities. Only if foreign countries keep supporting Cambodia with FDI, the adjustment towards a sustainable path might become fostered in the future.

7.2 Further Improvements

The results of this work represent the first long-term analysis of GS for Cambodia. It is the second formal part of research after the ANS calculation provided by the WB. Besides extending the time coverage, the contribution of afforestation and fisheries to GS was considered. However, the endeavors in the field of GS remain in progress, and several topics could not be covered in this Master's thesis. In the following, potential improvements for future research are enumerated.

One of the major and, therefore, firstly mentioned areas of improvement is data constraints. As already touched upon in Section 5, reliable and comprising data sources were hard to find in preparation for this work. Official statistics provided by the NIS do not reach further back than the 1990s. Attempts to get in touch with the NIS, the MoEYS, and the MoAFF remained unanswered. Therefore, the majority of the data had to be taken from international sources provided by the UN, the WB, or within the PWT. To fill gaps in data series, various econometric methods had to be applied, mainly linear inter- and extrapolation. This procedure enabled a GS calculation throughout 1970-2019. However, it also bears a slight degree of ambiguity naturally deriving from estimating calculation components. Furthermore, the effects of e.g. fishing included in this calculation are certainly understated as no official records exist about both the absolute number of in fishery employed people and their total compensation.

The second set of limitations focuses on components included in this calculation. The accumulation of human capital is considered as the governmental expenditure on education. As already touched upon in Section 4.3, human capital accumulation can hardly be equaled with expenditure on education. Although this might be a crude measure, it is not uncommon to proceed that way. Other methods to account for human capital accumulation exist (see Le, Gibson, and Oxley (2003)), but these measures have not been extensively applied to Cambodian data yet. Therewith, future research could draw a more exact, although possibly more negative contribution picture on educational contribution to GS. Furthermore, and simultaneously another limitation, the unprecedented genocide in Cambodian history during the KRR could find an adequate representation in the calculation of Cambodia's GS. So far, the impact of the KR is only considered with a symbolic value of zero education expenditure. However, this ignores the killing of almost two million people and the associated destruction of human capital. Momentous events, such as famines or genocides do not find representation in the current definition of GS. This gap yields more potential for further research.

In the method applied, technological change in the form of the net present value of TFP was included. However, TFP as growth accounting residual can also be labeled as "measure of our ignorance" (Abramovitz, 1956), as it de facto calculates the part of efficiency, which cannot be explained by either capital or labor improvements. Future research could focus on how to include a more enhancing measure of technological progress into the calculation of GS. Incorporating alternative measures (eventually additionally to TFP), e.g. R&D expenditure, energy intensity, or patents could provide a more adequate estimation of a country's genuine technological progress (Hanley, Dupuy, & McLaughlin, 2015).

The third part of improvement potentials addresses shortcomings of the general setup of GS. As already mentioned earlier (Section 4.3), the only emission gas included in this calculation is CO_2. Including the costs of other Green House Gases (GHG), e.g. NO_x or methane, would more adequately represent a country's overall pollution damages. As CO_2 is the only commonly priced emission so far, this field would be important for future research. Moreover, additional natural factors could be included in future GS calculations. Examples are soil erosion, biodiversity, and freshwater quality and quantity. Another omitted asset not included in neither ANS nor GS calculation are diamonds (Hanley, Dupuy, & McLaughlin, 2015). In the case of Cambodia, this could also make a difference (see Section 3.5). Furthermore, health-related costs could be considered to evaluate the country's health system (Qasim, Oxley, & McLaughlin, 2020). Also, the quality of institutions is not commonly included in the calculation of sustainability indicators, but efficiency, corruption, and output levels could certainly shed further light on a country's development path.

In conclusion, it is difficult to predict how all the a.m. effects would alter the GS results of this work for Cambodia. In this thesis, a detailed framework of the GS approach is provided, a dataset as complete as possible for the 20^{th} and 21^{st} century, and results for Cambodia's GS following a given methodology. Future research will be able to build on this foundation, and by including the a.m. caveats, an even more detailed and accurate picture of Cambodia's path towards sustainability can be drawn.

8 Conclusion

GS has become an increasingly important measure for sustainable economic development. Even though the methodology of calculating GS leaves room for improvement, it already serves as a valuable indicator of a country's economic performance. Unlike e.g. GDP, the GS metric informs if an economy is moving towards sustainable economic development or not. It additionally serves as a good predictor of the future well-being of a country.

In this research, GS has been calculated for Cambodia over the period 1970-2019. Therewith, this work is the first long-term analysis for Cambodia extending the WB's present ANS calculation. Furthermore, fisheries are included in the present estimation, a crucial economic sector in Cambodia that has been overlooked in the past. Due to data constraints and methodology limitations, the results can be seen as the first analysis of Cambodia's genuine economic performance from the 1970s until today. There are many ideas on how to even further develop GS as a reliable and standardized measure of sustainable development. This work could be a starting point for future research.

Until 1999, GS in Cambodia was negative, but since then, a positive trend has emerged. Compared to the WB, the presented results are higher in recent years, but the overall trend pattern is similar. The results suggest that Cambodia is moving on a sustainable development path, at least since the turn of the millennium. Cambodia has suffered from various political systems, turmoils, and wars on its territory throughout the 1970s and 1980s. The extreme effects of these events, not to mention the massive genocide conducted by the KR, caused a delay in Cambodia's economic recovery.

For the future, Cambodia's positive development has to be evaluated with caution. Increasing governmental expenditure on education can only translate into higher human capital accumulation if teachers as principal actors of education are provided with more extensive education and compensation themselves. If their situation does not get more attention, inadequate teaching practices will continue, and drop-out levels will subsequently remain high. The depletion of Cambodia's natural resources has to be monitored urgently to prevent long-term damages to the country's fishery stocks, forestries, and mineral reserves. If the CO_2 emissions continue the trend of the last years, Cambodia's pollution damage will heavily increase and inevitably lower each sustainability indicator, and therewith GS. At the moment, Cambodia finds itself at a turning point where many adjustment screws can be actuated to create a healthy, sustainable economy. However, Cambodia's policymakers have to realize the future path-dependency of their decisions today. This can prevent that Cambodia adopts a course towards a short-term beneficial but costly and unsustainable long-term development path.

References

Abramovitz, Moses (1956). Resource and Output Trends in the United States since 1870, in: Abramovitz, Moses, ed. (1956) *Resource and Output Trends in the United States since 1870*, Cambridge, MA, USA: National Bureau of Economic Research, pp. 1–23 (cit. on p. 37)

ADB (1996). Cambodia: Education sector strategy study, Manila, Philippines: Asian Development Bank (cit. on p. 14)

Ahmed, Mahfuddin, Hap Navy, Ly Vuthy, and Marites Tiongco (1998). Socioeconomic Assessment of Freshwater Capture Fisheries in Cambodia: Report on a household survey, Phnom Penh, Cambodia: Mekong River Commission Secretariat (cit. on p. 16)

Arrow, Kenneth J, Partha Dasgupta, and Karl-Göran Mäler (2003). The Genuine Savings Criterion and the Value of Population, in: *Economic Theory*, vol. 21, no. 2-3, pp. 217–225 (cit. on p. 5)

Arrow, Kenneth J., Partha Dasgupta, Lawrence H. Goulder, Kevin J. Mumford, and Kirsten Oleson (2013). Sustainability and the Measurement of Wealth: Further reflections, in: *Environment and Development Economics*, vol. 18, no. 4, pp. 504–516 (cit. on pp. 4, 5)

Asheim, Geir B. (2007). Green National Accounting with a Changing Population, in: Asheim, Geir B., ed. (2007) *Justifying, Characterizing and Indicating Sustainability. Sustainability, Economics, and Natural Resources*, Dodrecht, The Netherlands: Springer, pp. 271–289 (cit. on p. 5)

Asian Development Bank (2005). The Tonle Sap Basin Strategy, Manila, Philippines: Asian Development Bank (cit. on p. 17)

Atkinson, Giles and Kirk Hamilton (2003). Savings, Growth and the Resource Curse Hypothesis, in: *World Development*, vol. 31, no. 11, pp. 1793–1807 (cit. on p. 3)

Ayres, David M (2000a). Tradition, Modernity, and the Development of Education in Cambodia, in: *Comparative Education Review*, vol. 44, no. 4, pp. 440–463 (cit. on p. 10)

Ayres, David M. (2000b). Anatomy of a Crisis: Education, development, and the state in Cambodia, 1953-1998, Honululu, Hawaii: University of Hawaii Press (cit. on p. 14)

Baier, Scott L., Gerald P. Dwyer Jr., and Robert Tamura (2006). How important are Capital and Total Factor Productivity for Economic Growth?, in: *Economic Inquiry*, vol. 44, no. 1, pp. 23–49 (cit. on p. 5)

Baran, Eric (2005). Cambodian Inland Fisheries: Facts, Figures and Context, Phnom Penh, Cambodia: WorldFish Center, Inland Fisheries Research, and Development Institute (cit. on p. 23)

Bassino, Jean-Pascal and Hironobu Nakagawa (1999). Exchange rates and exchange rate policies in Vietnam under French rule, 1878–1945, in: *Quantitative economic history of Vietnam*, (cit. on p. 25)

Benveniste, Luis, Jeffery Marshall, and M. Caridad Araujo (2008). Teaching in Cambodia. Working Paper no. 44850. Washington, DC, USA: The World Bank, Human Development Sector and Ministry of Education, Youth and Sport (cit. on pp. 14, 34)

Bergin, Sean (2009). The Khmer Rouge and the Cambodian Genocide, New York City, NY: Rosen Publishing Group (cit. on p. 10)

Blum, Matthias, Cristián Ducoing, and Eoin McLaughlin (2017). A Sustainable Country? Genuine savings in developing and developed countries, 1900-2000, in: Hamilton, Kirk and Cameron Hepburn, eds. (2017) *National Wealth: What is missing, why it matters*, Oxford: Oxford University Press (OUP), pp. 89–113 (cit. on pp. 1, 3, 5–7, 19, 20, 22, 24)

Bolt, Jutta, Robert Inklaar, Herman de Jong, and Jan Luiten van Zanden (2018). Maddison Project Database, version 2018. URL: `https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2018` (visited on 01/03/2021) (cit. on pp. 11, 12)

Bolt, Jutta and Jan Luiten van Zanden (2020). Maddison Project Database, version 2020. URL: `https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2020` (visited on 04/23/2021) (cit. on p. 25)

Bolt, Katharine, Mampite Matete, and Michael Clemens (2002). Manual for Calculating Adjusted Net Savings, in: *Environment Department, World Bank*, pp. 1–23 (cit. on pp. 1, 3, 7, 8, 19, 31)

Chandler, David (1996). A History of Cambodia, Boulder, CO, USA: Westview Press, Inc. (cit. on pp. 9–11, 22)

Chansopheak, Keng (2009). Basic Education in Cambodia: Quality and Equity, in: Hirosato, Yasushi and Yuto Kitamura, eds. (2009) *The Political Economy of Educational Reforms and Capacity Development in Southeast Asia*, Berlin, Germany: Springer, pp. 131–152 (cit. on p. 34)

Chealy, Chet (2009). Higher Education in Cambodia, in: Hirosato, Yasushi and Yuto Kitamura, eds. (2009) *The Political Economy of Educational Reforms and Capacity Development in Southeast Asia*, Berlin, Germany: Springer, pp. 153–165 (cit. on p. 16)

Comin, Diego (2010). Total Factor Productivity. In: *Economic Growth*. Ed. by Steven N. Durlauf and Lawrence E. Blume. The New Palgrave Economics Collection. London, UK: Palgrave Macmillan, pp. 260–263 (cit. on p. 5)

Curtis, Grant (1990). Cambodia: A country profile, Stockholm, Sweden: Swedish International Development Authority (cit. on p. 15)

Dasgupta, Partha (2001). Human Well-Being and the Natural Environment, Oxford, UK: Oxford University Press (cit. on pp. 4–6)

Dasgupta, Partha (2003). Population, Poverty, and the Human Environment, in: Mäler, Karl-Göran and Jeffrey R. Vincent, eds. (2003) *Handbook of Environmental Economics: Environmental Degradation and Institutional Responses*, Amsterdam, The Netherlands: Elsevier, pp. 191–247 (cit. on p. 5)

Dasgupta, Partha and Geoffrey Heal (1974). The Optimal Depletion of Exhaustible Resources, in: *The Review of Economic Studies*, vol. 41, no. -, pp. 3–28 (cit. on p. 4)

Dasgupta, Partha and Karl-Göran Mäler (2001). Wealth as a Criterion for Sustainable Development. Discussion Paper 139. Stockholm, Sweden: Beijer International Institute of Ecological Economics (cit. on p. 5)

Department of Forestry and Wildlife (2002). Cambodia: Forestry Statistics to 2002, Phnom Penh, Cambodia: Statistics Section, Planning, Accounting Office, Department of Forestry, and Wildlife (cit. on p. 24)

Deroche, Alexandre (2018). L'empire indochinois. Le gouvernement général de l'Indochine, de la création de l'Union indochinoise au rappel de Richaud (1887-1889), in: *Revue Historique de droit français et étranger (1922-)*, vol. 96, no. 3, pp. 524–526 (cit. on p. 9)

Dietz, Simon and Eric Neumayer (2006). A critical appraisal of Genuine Savings as an Indicator of Sustainability, in: Lawn, Philip A., ed. (2006) *Sustainable Development Indicators in Ecological Economics*, : Edward Elgar Publishing, Incorporated, pp. 117–135 (cit. on p. 6)

Ducoing, Cristián (2019). Genuine Savings as a measure of sustainable development. Towards a GDP replacement. URL: https://www.rj.se/en/anslag/2019/genuine-savings-as-a-measure-of-sustainable-development.-towards-a-gdp-replacement/ (visited on 05/22/2021) (cit. on pp. 19, 25)

Duggan, Stephen J (1996). Education, teacher training and prospects for economic recovery in Cambodia, in: *Comparative Education*, vol. 32, no. 3, pp. 361–376 (cit. on p. 14)

Dy, Sideth S. (2004). Strategies and Policies for Basic Education in Cambodia: Historical Perspectives., in: *International Education Journal*, vol. 5, no. 1, pp. 90–97 (cit. on pp. 9, 13)

Dy, Sideth S. and Sitha Chhinh (2009). Education Reform Context and Process in Cambodia, in: Hirosato, Yasushi and Yuto Kitamura, eds. (2009) *The Political Economy of Educational Reforms and Capacity Development in Southeast Asia*, Berlin, Germany: Springer, pp. 113–129 (cit. on pp. 10, 16)

Feenstra, Robert C., Robert Inklaar, and Marcel P. Timmer (2015). The Next Generation of the Penn World Table, in: *American Economic Review*, vol. 105, no. 10, pp. 3150–82 (cit. on pp. 21, 22, 24, 25)

Ferreira, Susana, Kirk Hamilton, and Jeffrey R. Vincent (2008). Comprehensive Wealth and Future Consumption: Accounting for population growth, in: *The World Bank Economic Review*, vol. 22, no. 2, pp. 233–248 (cit. on pp. 5, 6)

Ferreira, Susana and Mirko Moro (2011). Constructing Genuine Savings Indicators for Ireland, 1995–2005, in: *Journal of Environmental Management*, vol. 92, no. 3, pp. 542–553 (cit. on pp. 1, 7)

Ferreira, Susana and Jeffrey R. Vincent (2005). Genuine Savings: Leading indicator of sustainable development?, in: *Economic Development and Cultural Change*, vol. 53, no. 3, pp. 737–754 (cit. on pp. 5, 6)

Food and Agriculture Organisation of the UN (2000). Global Forest Resources Assessment. URL: http://www.fao.org/3/Y1997E/y1997e1u.htm#bm66 (visited on 04/24/2021) (cit. on p. 24)

Food and Agriculture Organisation of the UN (2011). Fishery and Aquaculture Profiles: National Fishery Sector Overview Cambodia. URL: http://www.fao.org/fishery/docs/DOCUMENT/fcp/en/FI_CP_KH.pdf (visited on 05/15/2021) (cit. on p. 17)

Forestry Administration (2004). Cambodia: Forestry Statistics 2004, Phnom Penh, Cambodia: Statistics Section, Planning and Accounting Financing Office, Forestry Administration (cit. on p. 24)

Forestry Administration (2010). Cambodia Forestry Outlook Study. Working Paper no. APFSOS II/ WP/ 2010/ 32. Phnom Penh, Cambodia: Food and Agriculture Organisation of the UN (cit. on pp. 17, 18)

Forestry Administration (2011). Cambodia Forest Cover 2010, Phnom Penh, Cambodia: Ministry of Agriculture, Forestry and Fishery (cit. on p. 24)

Gapminder (2018). GD003 Total Population. URL: https://www.gapminder.org/data/documentation/gd003/ (visited on 2018) (cit. on p. 11)

Gignoux, C.-J. (1953). L'affaire de la piastre, in: *Revue des Deux Mondes (1829-1971)*, vol. 1, no. 8, pp. 554–562 (cit. on p. 25)

Global Carbon Atlas (2021). URL: www.globalcarbonatlas.org (visited on 04/23/2021) (cit. on pp. 24, 28, 62)

Goldewijk, Kees Klein (2014). Environmental Quality Since 1820, in: Zanden, Jan Luiten van, Joerg Baten, Marco Mira, Auke Rijpman, Conal Smith, and Marcel Timmer, eds. (2014) *How was Life? Global Well-being since 1820*, Paris, France: OECD Publishing, pp. 179–198 (cit. on p. 20)

Golub, Stephen and Abir Varma (2014). Fishing Exports and Economic Development of Least Developed Countries: Bangladesh, Cambodia, Comoros, Sierra Leone and Uganda. Working Paper prepared for UNCTAD. Swarthmore, PA, USA: Swarthmore College (cit. on p. 16)

Gouvernement Général de l'Indochine (1927). Annuaire Statistique de l'Indochine - Premier Volume - Recueil de Statistiques relatives aux années 1918 à 1922, Hanoi, Vietnam: Imprimerie d'Extréme-Orient (cit. on p. 22)

Gouvernement Général de l'Indochine (1931). Annuaire Statistique de l'Indochine - Troisième Volume 1930-1931, Hanoi, Vietnam: Imprimerie d'Extréme-Orient (cit. on p. 22)

Gouvernement Général de l'Indochine (1937). Annuaire Statistique de l'Indochine - Sixième Volume 1934 - 1935 - 1936, Hanoi, Vietnam: Imprimerie d'Extréme-Orient (cit. on p. 22)

Gouvernement Général de l'Indochine (1939). Annuaire Statistique de l'Indochine - Huitième Volume 1937 - 1938, Hanoi, Vietnam: Imprimerie d'Extréme-Orient (cit. on p. 22)

Gouvernement Général de l'Indochine (1942). Annuaire Statistique de l'Indochine - Neuvième Volume 1939 - 1940, Hanoi, Vietnam: Imprimerie d'Extréme-Orient (cit. on p. 22)

Greasley, David, Nick Hanley, Jan Kunnas, Eoin McLaughlin, Les Oxley, and Paul Warde (2014). Testing Genuine Savings as a forward-looking Indicator of future well-being over the (very) long-run, in: *Journal of Environmental Economics and Management*, vol. 67, no. 2, pp. 171–188 (cit. on pp. 1, 5–7)

Greasley, David, Eoin McLaughlin, Nick Hanley, and Les Oxley (2017). Australia: A land of missed opportunities?, in: *Environment and Development Economics*, vol. 22, no. 6, pp. 674–698 (cit. on pp. 1, 4–7)

Gutés, Maita Cabeza (1996). The Concept of weak Sustainability, in: *Ecological Economics*, vol. 17, no. 3, pp. 147–156 (cit. on p. 4)

Hamilton, Kirk (1994). Green adjustments to GDP, in: *Resources Policy*, vol. 20, no. 3, pp. 155–168 (cit. on pp. 1, 3, 7)

Hamilton, Kirk (1996). Pollution and Pollution Abatement in the National Accounts, in: *Review of Income and Wealth*, vol. 42, no. 1, pp. 13–33 (cit. on p. 7)

Hamilton, Kirk (2002). Sustaining Per Capita Welfare with Growing Population: Theory and measurement. Paper. Monterey, California: Second World Congress of Environmental and Resource Economists, pp. 27–30 (cit. on p. 5)

Hamilton, Kirk and Michael Clemens (1999). Genuine Savings Rates in Developing Countries, in: *The World Bank Economic Review*, vol. 13, no. 2, pp. 333–356 (cit. on pp. 1, 3, 4, 7)

Hamilton, Kirk and John M Hartwick (2005). Investing Exhaustible Resource Rents and the Path of Consumption, in: *Canadian Journal of Economics/Revue canadienne d'économique*, vol. 38, no. 2, pp. 615–621 (cit. on p. 6)

Hamilton, Kirk and Cameron Hepburn (2014). Wealth, in: *Oxford Review of Economic Policy*, vol. 30, no. 1, pp. 1–20 (cit. on p. 3)

Hamilton, Kirk and Cees Withagen (2007). Savings Growth and the Path of Utility, in: *Canadian Journal of Economics/Revue canadienne d'économique*, vol. 40, no. 2, pp. 703–713 (cit. on p. 6)

Hanley, Nick, Louis Dupuy, and Eoin McLaughlin (2015). Genuine Savings and Sustainability, in: *Journal of Economic Surveys*, vol. 29, no. 4, pp. 779–806 (cit. on pp. 1, 3–6, 37)

Hanley, Nick, Ian Moffatt, Robin Faichney, and Mike Wilson (1999). Measuring Sustainability: A time series of alternative indicators for Scotland, in: *Ecological Economics*, vol. 28, no. 1, pp. 55–73 (cit. on pp. 7, 8)

Hanley, Nick, Les Oxley, David Greasley, Eoin McLaughlin, and Matthias Blum (2016). Empirical Testing of Genuine Savings as an Indicator of Weak Sustainability: A three-country analysis of long-run trends, in: *Environmental and Resource Economics*, vol. 63, no. 2, pp. 313–338 (cit. on pp. 6, 7)

Hartwick, John M. (1977). Intergenerational Equity and the Investing of Rents from Exhaustible Resources, in: *The American Economic Review*, vol. 67, no. 5, pp. 972–974 (cit. on p. 4)

Heng, Samrin (Nov. 1986). Decree-Law Concerning the System of General Education. Decree 30 Kr. Phnom Penh, Cambodia: ANC People's Republic of Kampuchea (cit. on p. 14)

Heuveline, Patrick and Bunnak Poch (2007). The Phoenix Population: Demographic crisis and rebound in Cambodia, in: *Demography*, vol. 44, no. 2, pp. 405–426 (cit. on p. 10)

International Monetary Fund (2017). Guide to Analyze Natural Resources in National Accounts. URL: `https://www.imf.org/external/pubs/ft/qna/pdf/na.pdf` (visited on 05/04/2021) (cit. on pp. 23, 35)

Kam, Stefanie (2016). Cambodia, in: Gunaratna, Rohan and Stefanie Kam, eds. (2016) *Handbook of Terrorism in the Asia-Pacific*, Singapore: World Scientific, pp. 127–139 (cit. on p. 10)

Kiernan, Ben (2002). The Pol Pot Regime: Race, power, and genocide in cambodia under the Khmer Rouge, 1975-79, New Haven, CT: Yale University Press (cit. on p. 10)

Kim, Chae-Young and Martyn Rouse (2011). Reviewing the Role of Teachers in Achieving Education for All in Cambodia, in: *Prospects*, vol. 41, no. 3, p. 415 (cit. on pp. 15, 34)

Kim, Sophanarith, Nophea Kim Phat, Masao Koike, and Hiromichi Hayashi (2005). Causes of Historical Deforestation and Forest Degradation in Cambodia, in: *Journal of Forest Planning*, vol. 11, no. 1, pp. 23–31 (cit. on pp. 17, 18, 35)

Kunnas, Jan, Eoin McLaughlin, Nick Hanley, David Greasley, Les Oxley, and Paul Warde (2014). Counting Carbon: Historic emissions from fossil fuels, long-run measures of sustainable development and carbon debt, in: *Scandinavian Economic History Review*, vol. 62, no. 3, pp. 243–265 (cit. on p. 24)

Le, Trinh, John Gibson, and Les Oxley (2003). Cost-and Income-based Measures of Human Capital, in: *Journal of Economic Surveys*, vol. 17, no. 3, pp. 271–307 (cit. on p. 37)

Le Billon, Philippe (2000). The Political Ecology of Transition in Cambodia 1989-1999: War, peace and forest exploitation, in: *Development and Change*, vol. 31, no. 4, pp. 785–805 (cit. on p. 18)

Lindmark, Magnus and Sevil Acar (2013). Sustainability in the Making? A historical estimate of Swedish sustainable and unsustainable development 1850–2000, in: *Ecological Economics*, vol. 86, no. -, pp. 176–187 (cit. on pp. 1, 7)

Maddison, Angus (2001). The World Economy: A millennial perspective, Paris, France: OECD Publishing (cit. on p. 19)

Manuelli, Rodolfo E. and Ananth Seshadri (2014). Human Capital and the Wealth of Nations, in: *American Economic Review*, vol. 104, no. 9, pp. 2736–62 (cit. on p. 5)

Matsuoka, Koji (1942). The Currency System in French Indochina, in: *The Kyoto University Economic Review*, vol. 17, no. 2, pp. 44–63 (cit. on p. 25)

Mensher, Ian J. (2006). The Tonle Sap: Reconsideration of the laws governing Cambodia's most important fishery, in: *Pacific Rim Law & Policy Journal Association*, vol. 15, no. 3, pp. 797–825 (cit. on p. 17)

Mikesell, Raymond F. (1997). Explaining the Resource Curse, with Special Reference to Mineral-Exporting Countries, in: *Resources Policy*, vol. 23, no. 4, pp. 191–199 (cit. on p. 3)

Mille, Guillaume, Navy Hap, and Nob Loeng (2016). Economic Value of Fish in Cambodia and Value added along the Trade Chain, Phnom Penh, Cambodia: Inland Fisheries Research, Development Institute (Fisheries Administration), and WorldFish (cit. on pp. 16, 17, 23)

Ministry of Environment, Kingdom of Cambodia (2018). Cambodia Forest Cover 2016. URL: `https://redd.unfccc.int/uploads/54_3_%20cambodia_forest_cover_resource__2016_english.pdf` (visited on 04/24/2021) (cit. on p. 24)

Ministry of Mines and Energy (2016). General Department of Mineral Resources. URL: `http://www.mme.gov.kh/en/article/111/Results.html` (visited on 01/29/2016) (cit. on p. 23)

MoEYS (2005). Education Strategic Plan 2006-2010. Phnom Penh, Cambodia: Ministry of Education, Youth and Sport (cit. on pp. 15, 16, 34)

Mota, Rui Pedro and Tiago Domingos (2013). Assessment of the Theory of comprehensive National Accounting with Data for Portugal, in: *Ecological Economics*, vol. 95, no. -, pp. 188–196 (cit. on p. 5)

Mota, Rui Pedro, Tiago Domingos, and Victor Martins (2010). Analysis of Genuine Saving and Potential Green Net National Income: Portugal, 1990–2005, in: *Ecological Economics*, vol. 69, no. 10, pp. 1934–1942 (cit. on p. 7)

Nam, Dr. So (2008). Fisheries Resources in Cambodia - Current Status, Key Issues, Directions. Status Report. Phnom Penh, Cambodia: Inland Fisheries Research and Development Institute (IFReDI) (cit. on pp. 16, 17, 23, 35)

Nam, Dr. So (2011). Fisheries Management and Development in Tonle Sap Great Lake, Cambodia. Consultation Report. Wuhan, China: Fisheries Administration (cit. on pp. 16, 17)

National Institute of Statistics (2021). Cambodia Statistical Yearbook 2006. URL: https://www.nis.gov.kh/nis/yearbooks/Yearbook06.htm (visited on 04/26/2021) (cit. on pp. 21, 23)

Neumayer, Eric (2003). Weak versus Strong Sustainability: Exploring the limits of two opposing paradigms, Cheltenham, UK: Edward Elgar Publishing (cit. on p. 4)

OECD (2020). OECD Health Data 2007: Statistics and Indicators for 30 Countries, Data sources, definitions and methods. (Visited on 11/20/2020) (cit. on p. 12)

Open Development Cambodia (2019). Oil and Gas Resources. URL: https://opendevelopmentcambodia.net/topics/oil-and-gas-resources/ (visited on 05/16/2021) (cit. on pp. 18, 22)

Othman, Jamal, Roby Falatehan, and Yaghoob Jafari (2012). Genuine Savings for Malaysia: What does it tell? Working Paper 19(1). Faculty of Economics and Management, University Kebangsaan Malaysia, pp. 151–174 (cit. on pp. 1, 7)

Ovington, G., R. Geeves, Y. Horie, and H. Sokhak (2003). Schools of Hope: Community-focused partner- ships in recent conflict areas in Siem Reap, Cambodia. Phnom Penh, Cambodia: Save the Children Norway (cit. on p. 15)

Owen, Taylor and Ben Kiernan (2007). Bombs over Cambodia, in: *Third World Resurgence*, vol. 201, no. 41, (cit. on pp. 9–11)

Papyrakis, Elissaios and Reyer Gerlagh (2004). The Resource Curse Hypothesis and its Transmission Channels, in: *Journal of Comparative Economics*, vol. 32, no. 1, pp. 181–193 (cit. on p. 4)

Pearce, David W. and Giles D. Atkinson (1993). Capital Theory and the Measurement of Sustainable Development: An indicator of "weak" sustainability, in: *Ecological Economics*, vol. 8, no. 2, pp. 103–108 (cit. on pp. 1, 3, 4, 7)

Pearce, David W., Edward B. Barbier, and Anil Markandya (1989). Blueprint for a Green Economy, London, UK: Earthscan Publications Ltd. (cit. on p. 4)

Pemberton, Malcolm and David Ulph (2001). Measuring Income and Measuring Sustainability, in: *Scandinavian Journal of Economics*, vol. 103, no. 1, pp. 25–40 (cit. on p. 4)

Pezzey, John C.V. (2004). One-sided Sustainability Tests with Amenities, and Changes in Technology, Trade and Population, in: *Journal of Environmental Economics and Management*, vol. 48, no. 1, pp. 613–631 (cit. on pp. 1, 4)

Pezzey, John CV and Paul J Burke (2014). Towards a more Inclusive and Precautionary Indicator of Global Sustainability, in: *Ecological Economics*, vol. 106, no. -, pp. 141–154 (cit. on pp. 24, 28)

Pezzey, John CV, Nick Hanley, Karen Turner, and Dugald Tinch (2006). Comparing Augmented Sustainability Measures for Scotland: Is there a mismatch?, in: *Ecological Economics*, vol. 57, no. 1, pp. 60–74 (cit. on pp. 1, 4, 5, 7)

Pillarisetti, J. Ram (2005). The World Bank's 'Genuine Savings' Measure and Sustainability, in: *Ecological Economics*, vol. 55, no. 4, pp. 599–609 (cit. on p. 6)

Prud'homme, Remy (1969). l'Economie du Cambodge, Paris, France: Presses Universitaires de France (cit. on p. 14)

Qasim, Mubashir, Les Oxley, and Eoin McLaughlin (2020). Genuine Savings as a Test of New Zealand weak Sustainability, in: *Environment, Development and Sustainability*, vol. 22, no. 1, pp. 89–127 (cit. on pp. 1, 4, 7, 37)

Reppetto, Robert, William Magrath, Michael Wells, Christine Beer, and Fabrizio Rossini (1989). Wasting Assets: Natural resources in the national accounts, Washington, DC: World Resources Institute (cit. on p. 3)

Royal Government of Cambodia (2010). National Forest Programme 2010-2029, Phnom Penh, Cambodia: Ministry of Agriculture, Forestry and Fisheries (cit. on p. 18)

Royaume du Cambodge, Ministère du plan (1965). Annuaire Statistique de Cambodia 1965., Phnom Penh, Cambodia: Royaume du Cambodge, Ministère du plan (cit. on p. 24)

Rubio, Maria del Mar (2004). The Capital Gains from Trade are not enough: Evidence from the environmental accounts of Venezuela and Mexico, in: *Journal of Environmental Economics and Management*, vol. 48, no. 3, pp. 1175–1191 (cit. on pp. 1, 7)

Sachs, Jeffrey D. and Andrew M. Warner (1995). Natural Resource Abundance and Economic Growth. Working Paper 5398. Cambridge, Massachussetts: National Bureau of Economic Research (cit. on p. 4)

Said, Edward W. (1994). Culture and Imperialism, London, UK: Vintage (cit. on p. 9)

Sheldon, Anna Marie L. (2021). Cambodia. URL: `https://education.stateuniversity.com/pages/225/Cambodia.html` (visited on 05/15/2021) (cit. on p. 14)

Slocomb, Margaret (2010). An Economic History of Cambodia in the twentieth century, Singapore: National University of Singapore Press (cit. on pp. 9, 10, 13–17, 22, 23, 25, 35)

Solow, Robert M. (1974). Intergenerational Equity and Exhaustible Resources, in: *The Review of Economic Studies*, vol. 41, no. -, pp. 29–45 (cit. on p. 4)

Solow, Robert M. (1986). On the Intergenerational Allocation of Natural Resources, in: *The Scandinavian Journal of Economics*, vol. 88, no. 1, pp. 141–149 (cit. on p. 4)

Sovachana, Pou (2012). Progress and Challenges of Education in Cambodia Today, in: Pou Sothirak Geoff Wade, Mark Hong, ed. (2012) *Cambodia: Progress* *and Challenges since 1991*, Singapore: Institute of South-East Asian Studies, pp. 292–319 (cit. on p. 16)

Stern, Nicholas Herbert (2007). The Economics of Climate Change: The Stern review, Cambridge, UK: Cambridge University Press (cit. on p. 24)

Stiglitz, Joseph E, Amartya Sen, and Jean-Paul Fitoussi (2009). Report by the Commission on the Measurement of Economic Performance and Social Progress. Report -. Paris, France: CMEPSP (cit. on pp. 1, 3)

Tan, Charlene (2007). Education Reforms in Cambodia: Issues and concerns, in: *Educational Research for Policy and Practice*, vol. 6, no. 1, pp. 15–24 (cit. on pp. 9, 10, 15)

Tana, Touch Seang and Bruce H. Todd (2002). The Inland and Marine Fisheries Trade of Cambodia, Phnom Penh, Cambodia: Oxfam America (cit. on p. 16)

Tol, Richard S.J. (2012). On the Uncertainty about the Total Economic Impact of Climate Change, in: *Environmental and Resource Economics*, vol. 53, no. 1, pp. 97–116 (cit. on p. 24)

Trading Economics (2021). Cambodia Interest Rate. URL: `https://tradingeconomics.com/cambodia/interest-rate` (visited on 05/26/2021) (cit. on p. 25)

Tsujino, R, T Kajisa, and T Yumoto (2019). Causes and History of Forest Loss in Cambodia, in: *International Forestry Review*, vol. 21, no. 3, pp. 372–384 (cit. on pp. 17, 18, 24)

Tyner, James A. (2017). From Rice Fields to Killing Fields: Nature, life, and labor under the Khmer Rouge, Syracuse, NY: Syracuse University Press (cit. on p. 10)

UNESCO (2008). Secondary Information Regional Education Base: Cambodia, Bangkok, Thailand: UNESCO Bangkok (cit. on p. 14)

United Nations (1954). Statistical Yearbook 1954, New York City, NY, USA: Statistical Office of the United Nations (cit. on p. 25)

United Nations (1993). Integrated Environmental and Economic Accounting - Methods and Applications, in: *Journal of Official Statistics*, vol. 9, no. 1, p. 179 (cit. on p. 7)

United Nations (2019). World Population Prospects: The 2019 Revision. URL: `https://population.un.org/wpp/Download/Standard/Population/` (visited on 11/20/2020) (cit. on pp. 11–13, 25, 31, 51)

United Nations (2020). National Accounts - Analysis of Main Aggregates (AMA). URL: `https://unstats.un.org/unsd/snaama/` (visited on 04/27/2021) (cit. on pp. 1, 21, 25)

United Nations (2021). Adjusted Net Savings as a Percentage of Gross National Income. URL: `https://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/econ_development/adjusted_net_saving.pdf` (visited on 05/11/2021) (cit. on p. 31)

University of California (2020). University of California, Berkeley, and Max Planck Institute for Demographic Research. The Human Mortality Database. (Visited on 11/20/2020) (cit. on p. 13)

US Geological Survey (2018). 2015 Minerals Yearbook Cambodia, Washington, DC, USA: US Department of the Interior (cit. on pp. 18, 22)

Van der Ploeg, Frederick (2011). Natural Resources: Curse or blessing?, in: *Journal of Economic Literature*, vol. 49, no. 2, pp. 366–420 (cit. on p. 4)

Van Zalinge, Nicolaas, Nao Thouk, Touch Seang Tana, and L Deap (2000). Where there is Water, there is Fish? Cambodian fisheries issues in a Mekong River basin perspective, in: *ICLARM - Studies and Reviews*, vol. 1, no. 26, pp. 37–48 (cit. on p. 16)

Velasco, Esther (2004). Ensuring Gender Equity in Education for All: Is Cambodia on Track?, in: *Prospects: Quarterly Review of Comparative Education*, vol. 34, no. 1, pp. 37–51 (cit. on p. 16)

Vichett, Chrea (2013). Current Situation of Mining Industry in Cambodia, Phnom Penh, Cambodia: General Department of Mineral Resources in Cambodia (cit. on p. 18)

Vickery, Michael (1984). Cambodia: 1975-1982, Boston, MA, USA: South End Press Boston (cit. on pp. 11, 14, 22)

Vickery, Michael (1986). Kampuchea: Politics, economics and society, London, UK: Frances Pinter (cit. on pp. 11, 14)

Vincent, Jeffrey R. (Feb. 2001). Are Greener National Accounts better? Working Paper 63. Cambridge, Massachussetts: Harvard University (cit. on pp. 1, 6, 7)

Webster, Ian (2021). $100 in 1950 → 2010 — Inflation Calculator. URL: `https://www.in2013dollars.com/us/inflation/1950?endYear=2010&amount=100` (visited on 04/23/2021) (cit. on p. 25)

Weitzman, Martin L (1976). On the Welfare Significance of National Product in a Dynamic Economy, in: *The Quarterly Journal of Economics*, vol. 90, no. 1, pp. 156–162 (cit. on p. 3)

Weitzman, Martin L (1997). Sustainability and Technical Progress, in: *Scandinavian Journal of Economics*, vol. 99, no. 1, pp. 1–13 (cit. on p. 5)

Weitzman, Martin L (1999). Pricing the Limits to Growth from Minerals Depletion, in: *The Quarterly Journal of Economics*, vol. 114, no. 2, pp. 691–706 (cit. on p. 5)

World Bank (1997). Expanding the Measure of Wealth: Indicators of environmentally sustainable development, Washington, DC: World Bank (cit. on pp. 1, 7)

World Bank (2006). Where is the Wealth of Nations? Measuring capital for the 21st century, Washington, DC: World Bank Publications (cit. on pp. 1, 6, 7, 19)

World Bank (2011). The Changing Wealth of Nations: Measuring sustainable development in the new millenium, Washington, DC: World Bank Publications (cit. on pp. 1, 7, 19)

World Bank (2015). World Development Indicators 2015, Washington, DC: World Bank Publications (cit. on p. 1)

World Bank (2020a). World Development Indicators - Adjusted Net Savings. URL: https://databank.worldbank.org/source/adjusted-net-savings#%20 (visited on 04/26/2021) (cit. on pp. 1, 8, 22)

World Bank (2020b). World Development Indicators - Education Statistics. URL: https://datacatalog.worldbank.org/dataset/education-statistics (visited on 03/08/2021) (cit. on pp. 15, 22, 52)

World Bank (2021a). World Development Indicators - Economy. URL: https://datatopics.worldbank.org/world-development-indicators/themes/economy.html (visited on 01/05/2021) (cit. on pp. 8, 25)

World Bank (2021b). World Development Indicators - Environment. URL: https://datatopics.worldbank.org/world-development-indicators/themes/environment.html (visited on 01/05/2021) (cit. on pp. 22, 23)

World Bank (2021c). World Development Indicators - Fishery. URL: https://databank.worldbank.org/reports.aspx?source=2&series=ER.FSH.CAPT.MT&country=KHM# (visited on 04/26/2021) (cit. on p. 23)

World Bank (2021d). World Development Indicators - Foreign Direct Investment. URL: https://databank.worldbank.org/reports.aspx?source=2&series=BX.KLT.DINV.CD.WD&country=KHM# (visited on 04/27/2021) (cit. on p. 21)

World Bank (2021e). World Development Indicators - Forestry. URL: https://databank.worldbank.org/reports.aspx?source=2&series=AG.LND.FRST.ZS&country=KHM# (visited on 04/01/2021) (cit. on p. 24)

Wu, John C. (2007). The Mineral Industries of Cambodia and Laos, Washington, DC, USA: US Department of the Interior (cit. on p. 18)

Zurbrügg, Andreas (2004). Where There Is Water, There Is Fish: An analysis and critical assessment of Cambodia's Tonle Sap fisheries. Project Report ECON5197. Sydney, Australia: University of New South Wales (cit. on pp. 8, 16, 17, 35)

A Background Information

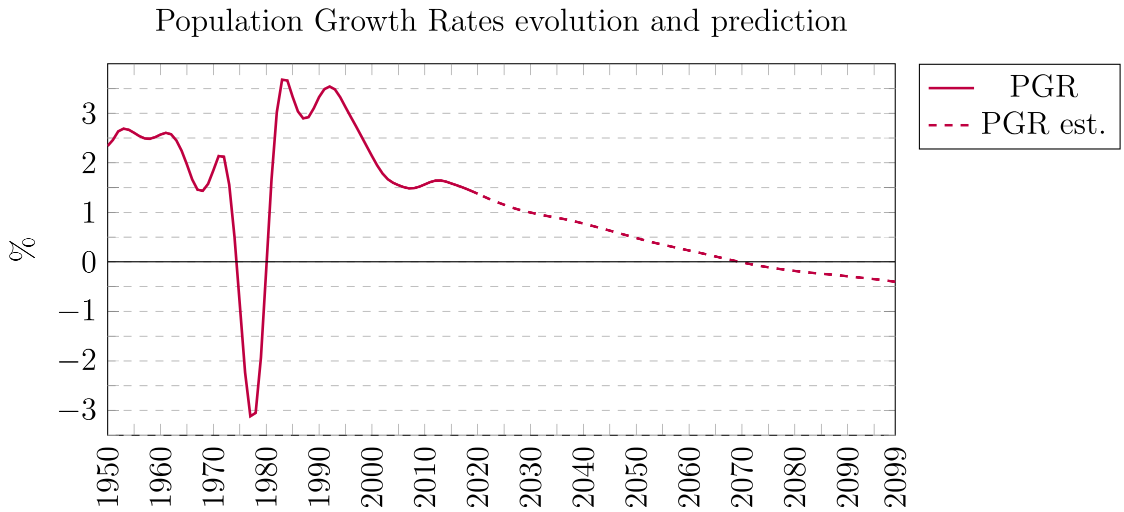

Figure A.1: Population evolution in Cambodia 1950-2099 (est.) (United Nations, 2019)

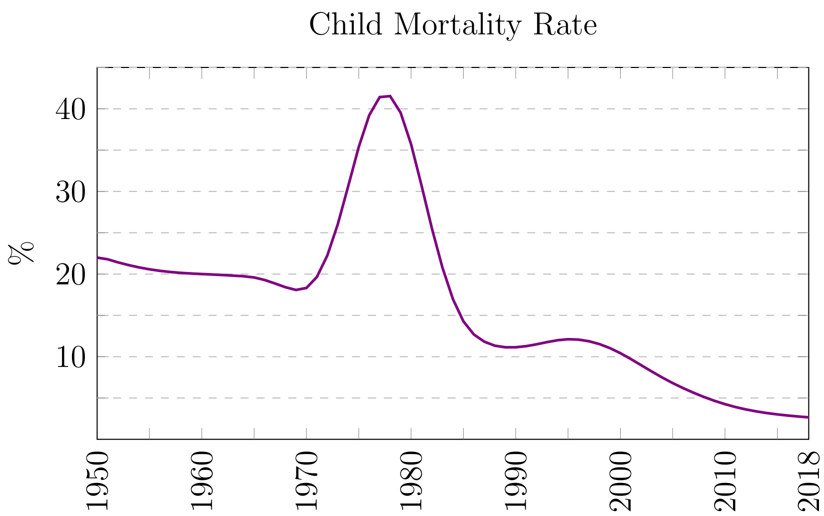

Figure A.2: Child Mortality Rate Cambodia 1950-2018 (United Nations, 2019)

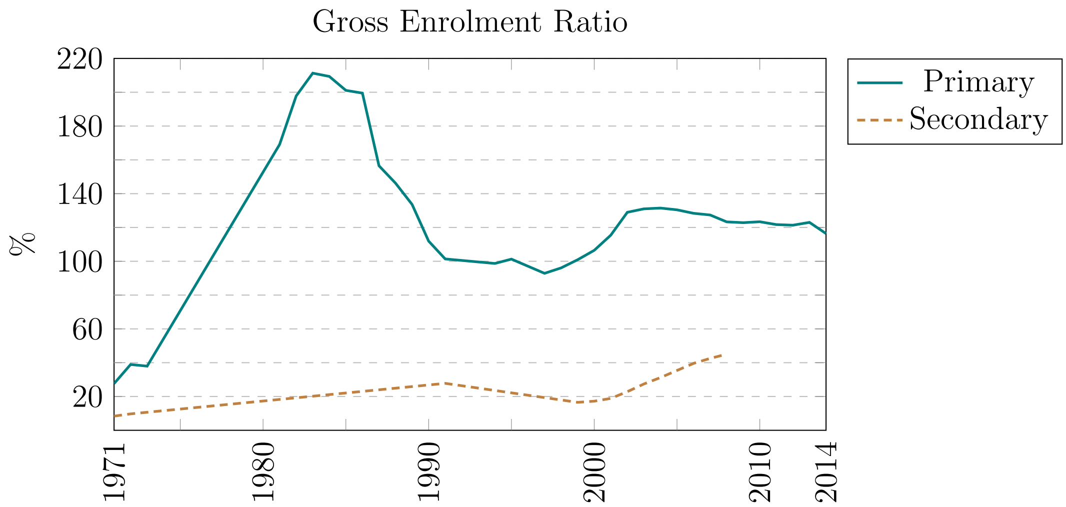

Figure A.3: Gross Enrolment Ratio in Primary and Secondary Education Cambodia 1971-2014 (World Bank, 2020b)

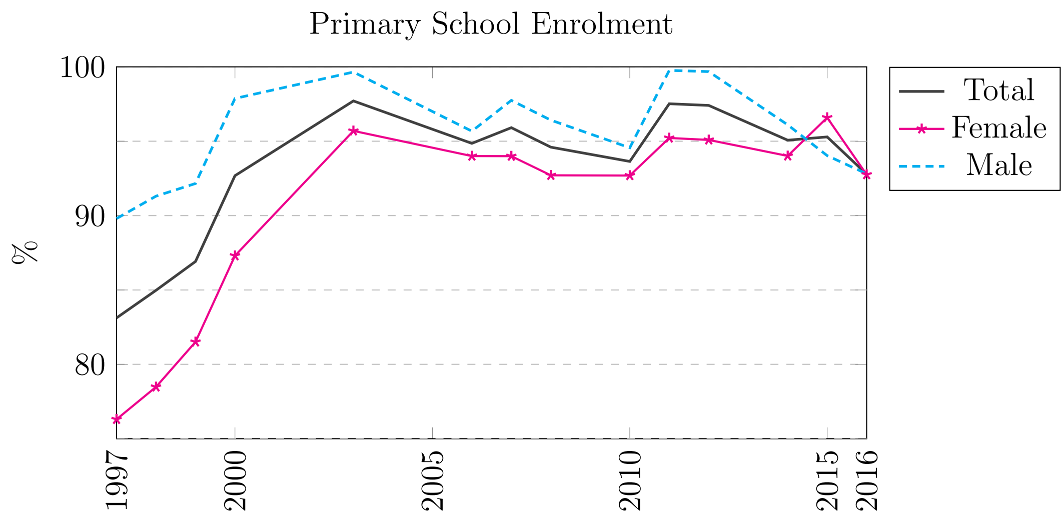

Figure A.4: Primary School Enrolment Cambodia 1997-2016 (World Bank, 2020b)

B Data and Results Tables

Table B.1: Data Set for Genuine Savings Calculation Cambodia 1970-2019

Year	**Net National Savings**		**Educ. Exp.**	**Resources Rents**			**CO_2**	**TFP**	**GDP**	**Population**
	excl. TB	**incl. TB**		**Fishery**	**Forestry**	**M & E**				
	2010 USD	2010 USD	2010 USD	2010 USD	2010 USD	2010 USD	$ktCO_2$	%	2010 USD	
1970	-1,079,482	-523,198,048	234,268,827	-	37,172,304	-	1,172	36.63	4,319,028,334	6,996,576
1971	-16,298,605	-515,387,548	198,428,543	-	171,154,183	-	249	34.46	4,128,512,320	7,139,640
1972	-29,267,593	-506,031,782	97,321,524	-	165,831,200	-	117	32.36	3,943,641,153	7,302,114
1973	-90,102,798	-474,042,422	123,754,783	-	156,120,358	-	128	25.73	3,176,174,020	7,449,233
1974	-89,327,543	-446,408,232	90,479,793	-	147,298,768	127,686	73	23.76	2,953,780,093	7,533,332
1975	-89,325,743	-441,931,007	-	-	134,978,238	8,098	73	23.47	2,916,197,563	7,524,457
1976	-82,375,451	-434,276,656	-	-	127,624,417	-	73	23.67	2,912,090,751	7,404,687
1977	-117,580,311	-416,969,813	-	-	119,832,163	-	72	20.51	2,476,051,640	7,196,042
1978	-110,048,387	-408,049,712	-	-	111,377,746	-	51	20.86	2,463,176,417	6,957,267
1979	-129,686,502	-381,563,237	-	-	100,025,187	-	29	18.02	2,088,051,039	6,770,393
1980	-125,019,754	-354,371,024	23,638,595	-	88,129,005	-	286	16.49	1,893,399,063	6,693,759
1981	-119,121,718	-346,884,067	23,464,006	-	89,684,554	27,339	300	16.40	1,879,414,903	6,749,849
1982	-112,166,549	-336,870,880	23,463,556	-	84,480,058	14,143	337	16.28	1,879,378,846	6,919,803
1983	-98,654,593	-340,962,977	24,665,943	-	81,850,655	8,705	366	16.89	1,975,687,414	7,170,004
1984	-83,883,625	-352,004,193	25,708,977	-	78,463,188	-	410	17.34	2,059,232,070	7,447,844
1985	-71,126,182	-335,594,069	26,814,479	-	76,913,057	2,337	418	17.81	2,147,780,366	7,714,894
1986	-61,608,696	-341,255,058	27,868,745	-	74,382,524	-	432	18.24	2,232,224,750	7,960,952
1987	91,302,895	-238,681,250	33,491,037	-	88,073,285	-	436	21.59	2,682,557,844	8,198,082
1988	3,721,014	-221,021,871	38,666,961	-	84,574,180	-	451	24.55	3,097,137,873	8,435,909
1989	-93,950,769	-316,440,172	38,238,760	-	80,686,495	-	451	23.94	3,062,839,966	8,691,331
1990	-44,990,380	-213,892,262	35,359,702	-	76,550,306	-	1,260	21.78	2,832,233,804	8,975,597
1991	45,204,118	-8,423,375	44,947,959	-	151,836,114	-	1,304	27.11	3,600,231,891	9,289,298
1992	105,217,893	17,107,692	46,445,835	23,332,824	149,218,732	-	1,348	27.50	3,720,208,476	9,623,899
1993	235,161,201	-162,344,506	45,849,669	32,022,173	143,114,724	-	1,385	26.50	3,672,456,903	9,970,727
1994	263,567,020	-155,904,528	49,167,694	28,742,776	277,360,641	-	1,467	27.78	3,938,223,361	10,317,901

Table B.1 continued from previous page

Year	Net National Savings		Educ. Exp.	Resources Rents			CO_2	TFP	GDP	Population
1995	565,385,408	34,230,873	59,120,159	29,342,953	271,392,098	-	1,540	31.97	4,735,393,746	10,656,145
1996	799,273,129	-99,022,533	53,005,522	16,318,732	261,981,164	-	1,597	31.83	4,873,153,022	10,982,919
1997	677,685,590	130,287,950	46,585,615	19,845,038	257,695,652	-	1,525	29.24	4,678,302,831	11,298,594
1998	371,130,988	-179,228,456	36,915,815	23,404,154	-136,269,534	-	1,935	24.87	4,187,416,052	11,600,510
1999	603,353,931	1,519,662	54,858,555	91,981,628	-134,857,404	-	1,894	25.82	4,598,186,926	11,886,464
2000	640,809,963	87,491,583	69,362,409	99,082,136	-128,989,169	-	1,975	24.75	4,643,079,093	12,155,241
2001	767,112,570	341,459,431	80,426,286	122,288,017	-125,420,296	-	2,250	23.96	4,914,601,035	12,405,411
2002	739,859,937	279,647,661	83,857,684	113,380,038	-123,468,227	-	2,206	24.00	5,200,854,019	12,637,719
2003	823,804,615	268,696,902	89,056,929	142,143,349	130,429,902	-	2,378	24.60	5,529,062,536	12,856,171
2004	740,181,258	290,342,749	98,483,876	132,224,129	128,391,957	-	2,444	26.47	6,162,155,220	13,066,475
2005	1,284,504,632	675,817,307	110,873,633	214,134,634	124,195,395	-	2,774	28.69	7,026,902,129	13,273,355
2006	1,670,754,080	1,086,295,806	123,513,807	322,958,909	120,323,388	-	2,997	30.41	7,868,281,380	13,477,705
2007	2,282,929,721	1,590,782,148	142,551,233	259,067,618	102,191,741	-	3,453	33.23	9,087,779,117	13,679,953
2008	2,234,741,485	2,000,481,687	169,494,218	260,997,223	98,435,445	-	3,805	36.15	10,486,942,795	13,883,835
2009	2,552,139,388	1,843,901,809	176,159,759	294,585,095	97,565,588	-	4,566	34.49	10,575,838,580	14,093,605
2010	2,685,354,469	2,073,992,236	172,432,893	265,583,875	97,375,600	-	5,031	34.55	11,242,278,819	14,312,205
2011	2,899,713,062	2,225,527,362	187,813,491	280,443,649	572,633,379	-	5,105	36.34	12,438,072,831	14,541,421
2012	3,582,717,303	2,939,619,632	208,347,401	204,788,565	692,411,558	-	5,334	37.93	13,347,909,098	14,780,454
2013	3,929,630,885	3,178,345,368	292,289,230	349,813,326	738,105,263	-	5,476	39.49	14,292,368,459	15,026,330
2014	4,086,670,521	3,408,811,544	292,196,182	317,560,818	797,382,702	-	6,516	40.56	15,387,316,625	15,274,506
2015	4,290,775,800	3,555,558,455	312,447,997	232,587,850	245,785,415	-	8,446	41.74	16,606,670,326	15,521,435
2016	5,151,749,916	4,353,826,896	342,162,825	331,881,601	222,954,963	-	9,724	43.04	18,188,771,668	15,766,290
2017	5,612,347,795	4,936,863,515	370,848,321	357,142,835	58,253,958	34,935	11,186	44.72	19,728,747,359	16,009,413
2018	6,214,091,776	5,849,961,913	398,662,880	359,037,636	344,103,704	-	15,479	46.48	21,329,594,274	16,249,795
2019	6,927,304,475	6,609,741,610	432,004,312	321,446,939	437,609,917	-	16,027	48.41	23,113,455,412	16,486,542

Table B.2: Results I: Green Investment, Genuine Savings, and CO_2 Effects

Year	Green Investment		Genuine Savings		Green Investment-CO_2				Genuine Savings-CO_2			
					131 USD		1,455 USD		131 USD		1,455 USD	
	2010 USD	%	2010 USD	%	2010 USD	%	2010 USD	%	2010 USD	%	2010 USD	%
1970	-560,370,351	-13.0	-326,101,524	-7.6	-713,941,651	-16.5	-2,266,066,851	-52.5	-479,672,824	-11.1	-2,031,798,024	-47.0
1971	-686,541,731	-16.6	-488,113,188	-11.8	-719,148,941	-17.4	-1,048,705,781	-25.4	-520,720,398	-12.6	-850,277,238	-20.6
1972	-671,862,982	-17.0	-574,541,458	-14.6	-687,195,222	-17.4	-842,156,182	-21.4	-589,873,698	-15.0	-744,834,658	-18.9
1973	-630,162,780	-19.8	-506,407,997	-15.9	-646,918,990	-20.4	-816,271,830	-25.7	-523,164,207	-16.5	-692,517,047	-21.8
1974	-593,834,686	-20.1	-503,354,894	-17.0	-603,407,118	-20.4	-700,154,446	-23.7	-512,927,326	-17.4	-609,674,654	-20.6
1975	-576,917,343	-19.8	-576,917,343	-19.8	-586,489,775	-20.1	-683,237,103	-23.4	-586,489,775	-20.1	-683,237,103	-23.4
1976	-561,901,073	-19.3	-561,901,073	-19.3	-571,434,467	-19.6	-667,787,243	-22.9	-571,434,467	-19.6	-667,787,243	-22.9
1977	-536,801,976	-21.7	-536,801,976	-21.7	-546,296,332	-22.1	-642,254,556	-25.9	-546,296,332	-22.1	-642,254,556	-25.9
1978	-519,427,457	-21.1	-519,427,457	-21.1	-526,126,666	-21.4	-593,834,702	-24.1	-526,126,666	-21.4	-593,834,702	-24.1
1979	-481,588,424	-23.1	-481,588,424	-23.1	-485,428,296	-23.2	-524,237,384	-25.1	-485,428,296	-23.2	-524,237,384	-25.1
1980	-442,500,029	-23.4	-418,861,434	-22.1	-479,938,519	-25.3	-858,324,479	-45.3	-456,299,924	-24.1	-834,685,884	-44.1
1981	-436,595,960	-23.2	-413,131,953	-22.0	-475,954,910	-25.3	-873,750,710	-46.5	-452,490,903	-24.1	-850,286,703	-45.2
1982	-421,365,081	-22.4	-397,901,525	-21.2	-465,523,871	-24.8	-911,831,031	-48.5	-442,060,315	-23.5	-888,367,475	-47.3
1983	-422,822,337	-21.4	-398,156,394	-20.2	-470,820,737	-23.8	-955,934,337	-48.4	-446,154,794	-22.6	-931,268,394	-47.1
1984	-430,467,380	-20.9	-404,758,404	-19.7	-484,225,850	-23.5	-1,027,555,730	-49.9	-458,516,874	-22.3	-1,001,846,754	-48.7
1985	-412,509,463	-19.2	-385,694,984	-18.0	-467,228,163	-21.8	-1,020,262,963	-47.5	-440,413,684	-20.5	-993,448,484	-46.3
1986	-415,637,581	-18.6	-387,768,836	-17.4	-472,275,431	-21.2	-1,044,706,831	-46.8	-444,406,686	-19.9	-1,016,838,086	-45.6
1987	-326,754,535	-12.2	-293,263,498	-10.9	-383,873,155	-14.3	-961,163,635	-35.8	-350,382,118	-13.1	-927,672,598	-34.6
1988	-305,596,051	-9.9	-266,929,091	-8.6	-364,633,821	-11.8	-961,320,901	-31.0	-325,966,861	-10.5	-922,653,941	-29.8
1989	-397,126,667	-13.0	-358,887,907	-11.7	-456,164,437	-14.9	-1,052,851,517	-34.4	-417,925,677	-13.6	-1,014,612,757	-33.1
1990	-290,442,568	-10.3	-255,082,866	-9.0	-455,554,968	-16.1	-2,124,324,568	-75.0	-420,195,266	-14.8	-2,088,964,866	-73.8
1991	-160,259,489	-4.5	-115,311,530	-3.2	-331,135,889	-9.2	-2,058,161,489	-57.2	-286,187,930	-7.9	-2,013,213,530	-55.9
1992	-155,443,864	-4.2	-108,998,029	-2.9	-332,084,264	-8.9	-2,117,365,864	-56.9	-285,638,429	-7.7	-2,070,920,029	-55.7
1993	-337,481,402	-9.2	-291,631,732	-7.9	-518,916,402	-14.1	-2,352,656,402	-64.1	-473,066,732	-12.9	-2,306,806,732	-62.8
1994	-462,007,944	-11.7	-412,840,250	-10.5	-654,198,044	-16.6	-2,596,638,444	-65.9	-605,030,350	-15.4	-2,547,470,750	-64.7

Table B.2 continued from previous page

Year	Green Investment		Genuine Savings		Green Investment-CO_2				Genuine Savings-CO_2			
1995	-266,504,179	-5.6	-207,384,020	-4.4	-468,283,479	-9.9	-2,507,640,679	-53.0	-409,163,320	-8.6	-2,448,520,520	-51.7
1996	-377,322,429	-7.7	-324,316,907	-6.7	-586,555,629	-12.0	-2,701,248,429	-55.4	-533,550,107	-10.9	-2,648,242,907	-54.3
1997	-147,252,740	-3.1	-100,667,125	-2.2	-347,040,840	-7.4	-2,366,273,240	-50.6	-300,455,225	-6.4	-2,319,687,625	-49.6
1998	-66,363,076	-1.6	-29,447,261	-0.7	-319,900,476	-7.6	-2,882,370,076	-68.8	-282,984,661	-6.8	-2,845,454,261	-68.0
1999	44,395,437	1.0	99,253,992	2.2	-203,757,863	-4.4	-2,711,811,063	-59.0	-148,899,308	-3.2	-2,656,952,508	-57.8
2000	117,398,616	2.5	186,761,026	4.0	-141,313,284	-3.0	-2,756,080,884	-59.4	-71,950,874	-1.5	-2,686,718,474	-57.9
2001	344,591,710	7.0	425,017,997	8.6	49,881,010	1.0	-2,928,721,790	-59.6	130,307,297	2.7	-2,848,295,503	-58.0
2002	289,735,849	5.6	373,593,533	7.2	789,149	0.0	-2,919,557,651	-56.1	84,646,833	1.6	-2,835,699,967	-54.5
2003	-3,876,350	-0.1	85,180,579	1.5	-315,381,250	-5.7	-3,463,720,850	-62.6	-226,324,321	-4.1	-3,374,663,921	-61.0
2004	29,726,663	0.5	128,210,539	2.1	-290,424,237	-4.7	-3,526,147,837	-57.2	-191,940,361	-3.1	-3,427,663,961	-55.6
2005	337,487,279	4.8	448,360,912	6.4	-25,854,321	-0.4	-3,698,100,721	-52.6	85,019,312	1.2	-3,587,227,088	-51.0
2006	643,013,508	8.2	766,527,316	9.7	250,380,308	3.2	-3,717,912,492	-47.3	373,894,116	4.8	-3,594,398,684	-45.7
2007	1,229,522,789	13.5	1,372,074,022	15.1	777,245,289	8.6	-3,793,864,711	-41.7	919,796,522	10.1	-3,651,313,478	-40.2
2008	1,641,049,019	15.6	1,810,543,237	17.3	1,142,594,019	10.9	-3,895,225,981	-37.1	1,312,088,237	12.5	-3,725,731,763	-35.5
2009	1,451,751,127	13.7	1,627,910,886	15.4	853,565,827	8.1	-5,192,215,373	-49.1	1,029,725,586	9.7	-5,016,055,614	-47.4
2010	1,711,032,761	15.2	1,883,465,654	16.8	1,052,037,261	9.4	-5,608,344,739	-49.9	1,224,470,154	10.9	-5,435,911,846	-48.4
2011	1,372,450,334	11.0	1,560,263,826	12.5	703,656,034	5.7	-6,055,761,166	-48.7	891,469,526	7.2	-5,867,947,674	-47.2
2012	2,042,419,508	15.3	2,250,766,909	16.9	1,343,731,008	10.1	-5,717,822,992	-42.8	1,552,078,409	11.6	-5,509,475,591	-41.3
2013	2,090,426,780	14.6	2,382,716,009	16.7	1,373,096,980	9.6	-5,876,862,220	-41.1	1,665,386,209	11.7	-5,584,572,991	-39.1
2014	2,293,868,025	14.9	2,586,064,206	16.8	1,440,219,625	9.4	-7,187,493,975	-46.7	1,732,415,806	11.3	-6,895,297,794	-44.8
2015	3,077,185,191	18.5	3,389,633,187	20.4	1,970,719,891	11.9	-9,212,181,309	-55.5	2,283,167,887	13.7	-8,899,733,313	-53.6
2016	3,798,990,332	20.9	4,141,153,157	22.8	2,525,146,332	13.9	-10,349,429,668	-56.9	2,867,309,157	15.8	-10,007,266,843	-55.0
2017	4,521,431,787	22.9	4,892,280,108	24.8	3,056,065,787	15.5	-11,754,198,213	-59.6	3,426,914,108	17.4	-11,383,349,892	-57.7
2018	5,146,820,572	24.1	5,545,483,452	26.0	3,119,071,572	14.6	-17,375,124,428	-81.5	3,517,734,452	16.5	-16,976,461,548	-79.6
2019	5,850,684,755	25.3	6,282,689,066	27.2	3,751,147,755	16.2	-17,468,600,245	-75.6	4,183,152,066	18.1	-17,036,595,934	-73.7

Table B.3: Results II: TFP Effects on GS, and GI as share of GDP

Year	NPV TFP	GSTFP	GSTFP-CO_2		GITFP
			131 USD	1,455 USD	
1971	-60.0	-71.8	-72.6	-80.6	-76.6
1972	-60.3	-74.8	-75.2	-79.1	-77.3
1973	-60.8	-76.7	-77.2	-82.6	-80.6
1974	-57.8	-74.8	-75.1	-78.4	-77.9
1975	-53.9	-73.7	-74.0	-77.3	-73.7
1976	-51.0	-70.3	-70.6	-73.9	-70.3
1977	-50.2	-71.9	-72.2	-76.1	-71.9
1978	-45.9	-66.9	-67.2	-70.0	-66.9
1979	-43.8	-66.9	-67.0	-68.9	-66.9
1980	-36.6	-58.7	-60.7	-80.7	-60.0
1981	-24.2	-46.2	-48.3	-69.5	-47.5
1982	-9.6	-30.8	-33.2	-56.9	-32.1
1983	8.7	-11.5	-13.9	-38.5	-12.7
1984	27.2	7.6	5.0	-21.4	6.3
1985	47.6	29.7	27.1	1.4	28.4
1986	71.1	53.7	51.2	25.6	52.5
1987	100.6	89.7	87.5	66.0	88.4
1988	101.4	92.8	90.9	71.6	91.5
1989	82.2	70.5	68.5	49.1	69.2
1990	76.3	67.3	61.5	2.5	66.0
1991	95.6	92.4	87.7	39.7	91.2
1992	73.5	70.6	65.8	17.8	69.3
1993	57.3	49.4	44.4	-5.5	48.1
1994	53.0	42.5	37.6	-11.7	41.3
1995	45.3	40.9	36.7	-6.4	39.7
1996	20.6	13.9	9.6	-33.8	12.8
1997	2.3	0.1	-4.2	-47.3	-0.9
1998	-5.4	-6.1	-12.1	-73.3	-7.0
1999	1.4	3.6	-1.8	-56.4	2.4
2000	4.7	8.7	3.2	-53.1	7.2
2001	13.3	21.9	15.9	-44.7	20.3
2002	27.8	35.0	29.5	-26.7	33.4
2003	46.7	48.3	42.6	-14.3	46.7
2004	68.5	70.6	65.4	12.9	69.0
2005	84.7	91.1	85.9	33.7	89.5
2006	92.5	102.2	97.2	46.8	100.6
2007	96.1	111.2	106.2	55.9	109.6
2008	88.7	106.0	101.3	53.2	104.4
2009	72.1	87.5	81.9	24.7	85.9
2010	71.2	87.9	82.1	22.8	86.4
2011	76.1	88.7	83.3	28.9	87.1
2012	77.8	94.6	89.4	36.5	93.1
2013	77.7	94.4	89.4	38.7	92.4
2014	76.5	93.3	87.8	31.7	91.4
2015	76.8	97.2	90.5	23.2	95.3
2016	78.1	100.9	93.9	23.1	99.0
2017	80.3	105.1	97.6	22.6	103.2
2018	81.8	107.8	98.3	2.2	106.0
2019	82.8	110.0	100.9	9.1	108.1

Table B.4: Results III: Comparison to the World Bank's Adjusted Net Savings

Year	GS w/o Fishery	ANS	GS w/o Fishery-CO_2		ANS	
		Excl. CO_2	131 USD	1,455 USD	Incl. CO2 excl. PED	Incl. CO2 & PED
	2010 USD	2010 USD	2010 USD	2010 USD	2010 USD	2010 USD
1970	196,017,042	-	42,445,742	- 1,509,679,458	-	-
1971	10,975,755	-	- 21,631,455	- 351,188,295	-	-
1972	- 97,777,269	-	- 113,109,509	- 268,070,469	-	-
1973	- 122,468,372	-	- 139,224,582	- 308,577,422	-	-
1974	- 146,274,204	-	- 155,846,636	- 252,593,964	-	-
1975	- 224,312,080	-	- 233,884,512	- 330,631,840	-	-
1976	- 209,999,868	-	- 219,533,262	- 315,886,038	-	-
1977	- 237,412,474	-	- 246,906,830	- 342,865,054	-	-
1978	- 221,426,132	-	- 228,125,341	- 295,833,377	-	-
1979	- 229,711,689	-	- 233,551,561	- 272,360,649	-	-
1980	- 189,510,164	-	- 226,948,654	- 605,334,614	-	-
1981	- 185,369,604	-	- 224,728,554	- 622,524,354	-	-
1982	- 173,197,195	-	- 217,355,985	- 663,663,145	-	-
1983	- 155,848,011	-	- 203,846,411	- 688,960,011	-	-
1984	- 136,637,835	-	- 190,396,305	- 733,726,185	-	-
1985	- 121,227,097	-	- 175,945,797	- 728,980,597	-	-
1986	- 108,122,474	-	- 164,760,324	- 737,191,724	-	-
1987	36,720,647	-	- 20,397,973	- 597,688,453	-	-
1988	- 42,186,206	-	- 101,223,976	- 697,911,056	-	-
1989	- 136,398,504	-	- 195,436,274	- 792,123,354	-	-
1990	- 86,180,984	-	- 251,293,384	- 1,920,062,984	-	-
1991	- 61,684,037	-	- 232,560,437	- 1,959,586,037	-	-
1992	2,444,996	-	- 174,195,404	- 1,959,477,004	-	-
1993	137,896,146	-	- 43,538,854	- 1,877,278,854	-	-
1994	35,374,074	-	- 156,816,026	- 2,099,256,426	-	-

Table B.4 continued from previous page

Year	GS w/o Fishery	ANS	GS w/o Fishery - CO_2		ANS	
1995	353,113,468	- 126,518,758	151,334,168	- 1,888,023,032	- 152,073,901	- 289,996,423
1996	590,297,487	- 194,095,320	381,064,287	- 1,733,628,513	- 221,234,111	- 344,664,875
1997	466,575,553	20,632,777	266,787,453	- 1,752,444,947	- 5,842,842	- 112,941,891
1998	544,316,338	- 44,178,887	290,778,938	- 2,271,690,662	- 78,574,698	- 158,367,808
1999	793,069,890	317,934,119	544,916,590	- 1,963,136,610	283,760,400	208,252,910
2000	839,161,541	413,103,011	580,449,641	- 2,034,317,959	376,809,291	310,271,070
2001	972,959,153	530,254,044	678,248,453	- 2,300,354,347	487,943,052	423,343,849
2002	947,185,848	444,090,018	658,239,148	- 2,262,107,652	401,344,348	336,741,762
2003	782,431,641	425,135,958	470,926,741	- 2,677,412,859	377,875,252	312,435,292
2004	710,273,177	339,708,574	390,122,277	- 2,845,601,323	289,669,429	221,193,432
2005	1,271,182,870	515,477,177	907,841,270	- 2,764,405,130	457,135,545	385,170,074
2006	1,673,944,499	994,111,007	1,281,311,299	- 2,686,981,501	929,308,069	852,415,723
2007	2,323,289,213	1,024,105,228	1,871,011,713	- 2,700,098,287	947,098,546	859,806,505
2008	2,305,800,258	853,441,341	1,807,345,258	- 3,230,474,742	765,846,308	668,229,347
2009	2,630,733,559	949,446,941	2,032,548,259	- 4,013,232,941	839,923,069	743,627,011
2010	2,760,411,762	834,362,041	2,101,416,262	- 4,558,965,738	711,383,482	617,333,286
2011	2,514,893,175	790,962,554	1,846,098,875	- 4,913,318,325	663,352,526	569,950,131
2012	3,098,653,146	1,238,185,376	2,399,964,646	- 4,661,589,354	1,100,962,107	1,013,175,321
2013	3,483,814,851	1,756,611,978	2,766,485,051	- 4,483,474,149	1,611,051,528	1,525,815,509
2014	3,581,484,001	1,710,093,677	2,727,835,601	- 5,899,877,999	1,530,719,434	1,442,537,138
2015	4,357,438,382	1,712,989,759	3,250,973,082	- 7,931,928,118	1,472,287,595	1,380,629,772
2016	5,270,957,778	1,532,190,372	3,997,113,778	- 8,877,462,222	1,247,620,375	1,150,335,867
2017	5,924,907,224	2,102,367,972	4,459,541,224	- 10,350,722,776	1,776,350,048	1,672,728,749
2018	6,268,650,952	2,502,771,854	4,240,901,952	- 16,253,294,048	2,126,579,250	2,015,186,093
2019	6,921,698,870	-	4,822,161,870	- 16,397,586,130	-	-

C Results

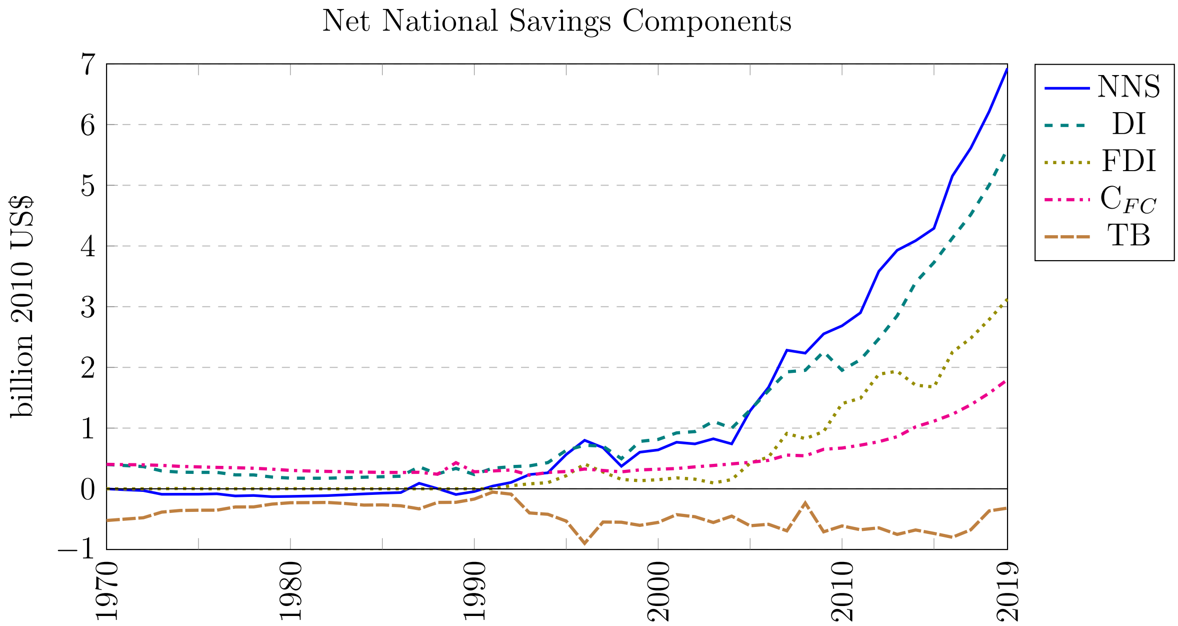

Figure C.1: NNS and its Components: DI, FDI, C_{FC}, and TB Cambodia 1970-2019 (various sources, Section 5)

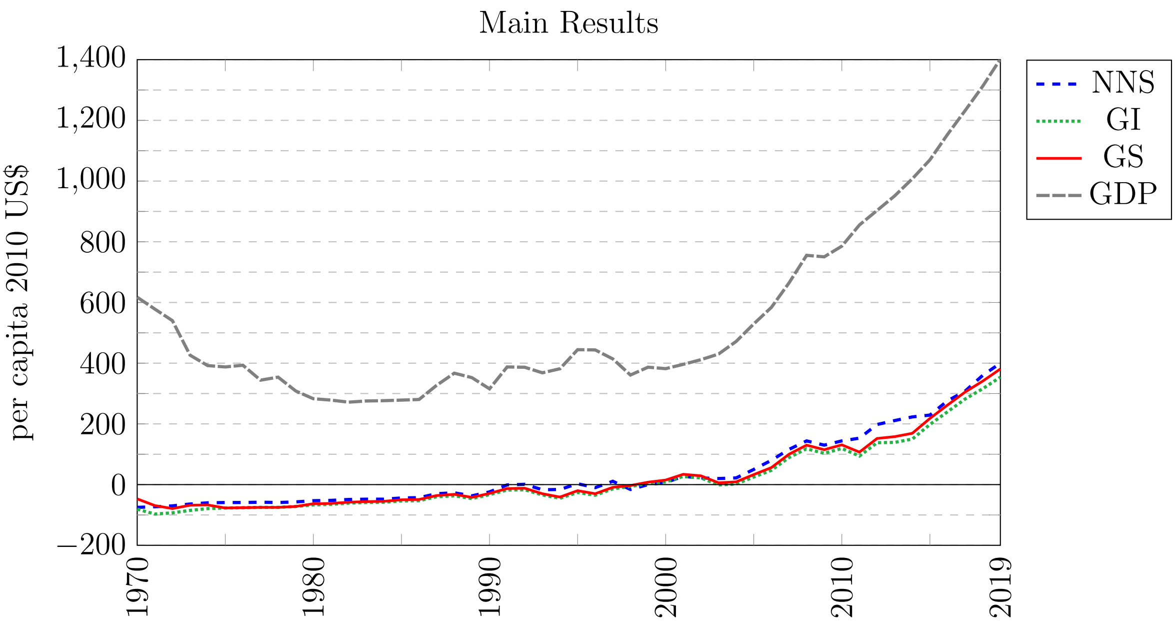

Figure C.2: Results: NNS, GI, GS, and GDP Cambodia 1970-2019

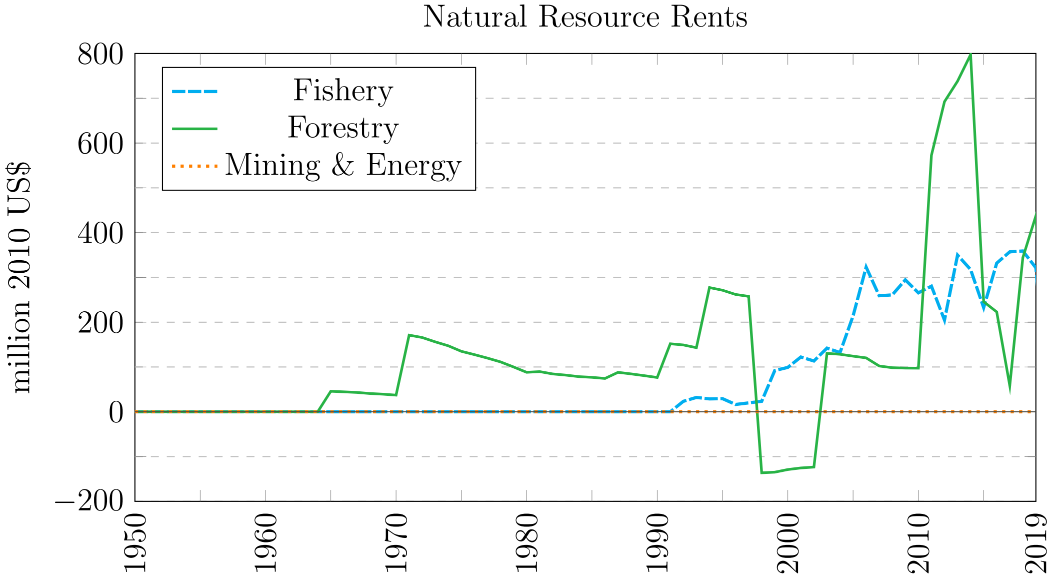

Figure C.3: Natural Resource Rents Cambodia 1950-2019 (various sources, Section 5)

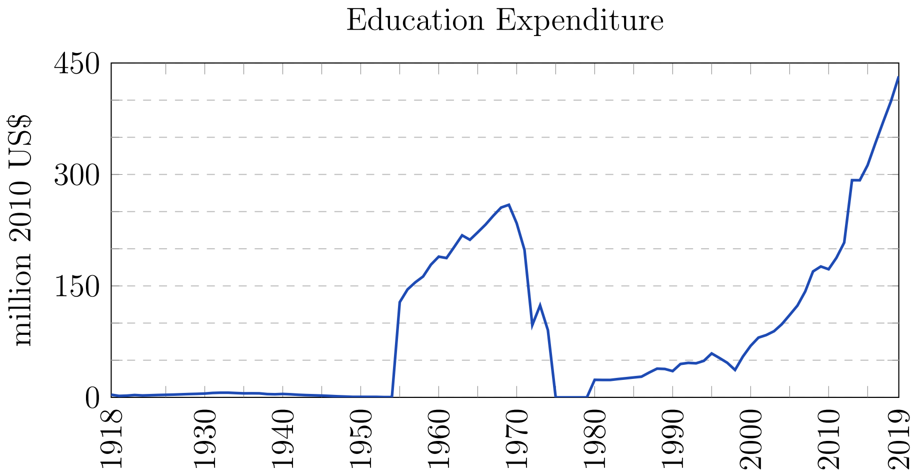

Figure C.4: Governmental Expenditure on Education Cambodia 1918-2019 (various sources, Section 5)

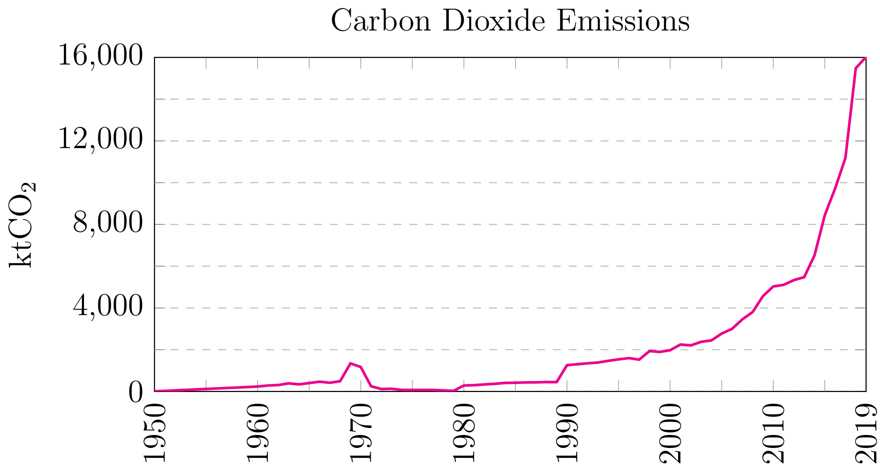

Figure C.5: Carbon Dioxide Emissions Cambodia 1950-2019 (Global Carbon Atlas, 2021)

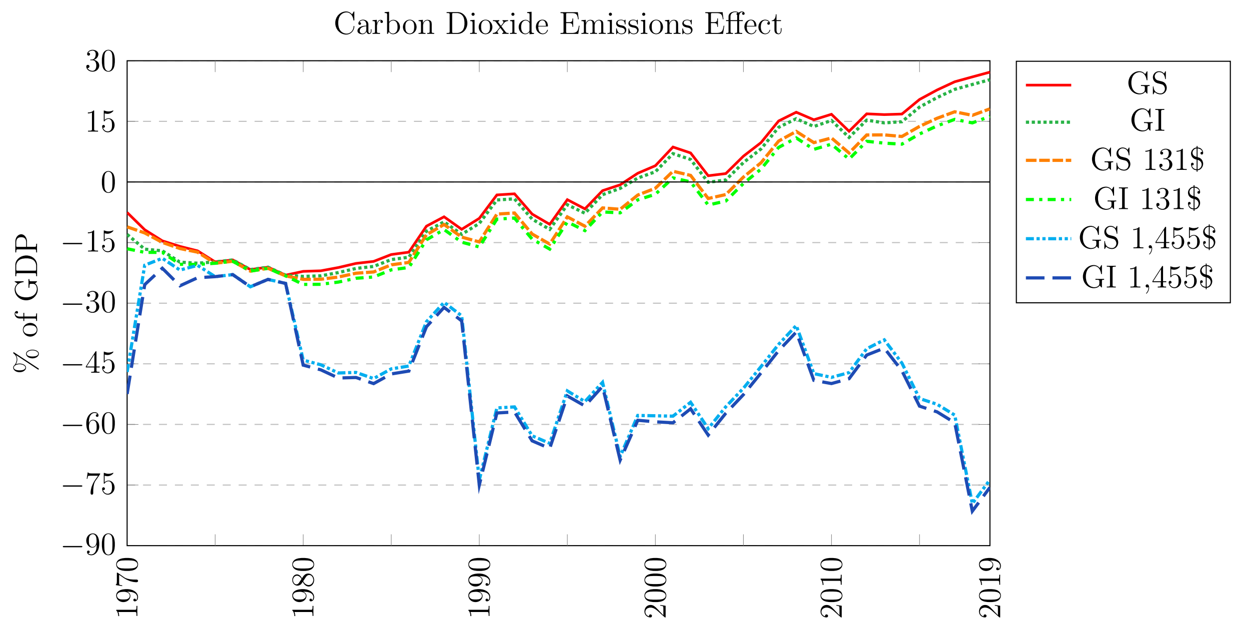

Figure C.6: Results: CO_2 Effects on GI and GS

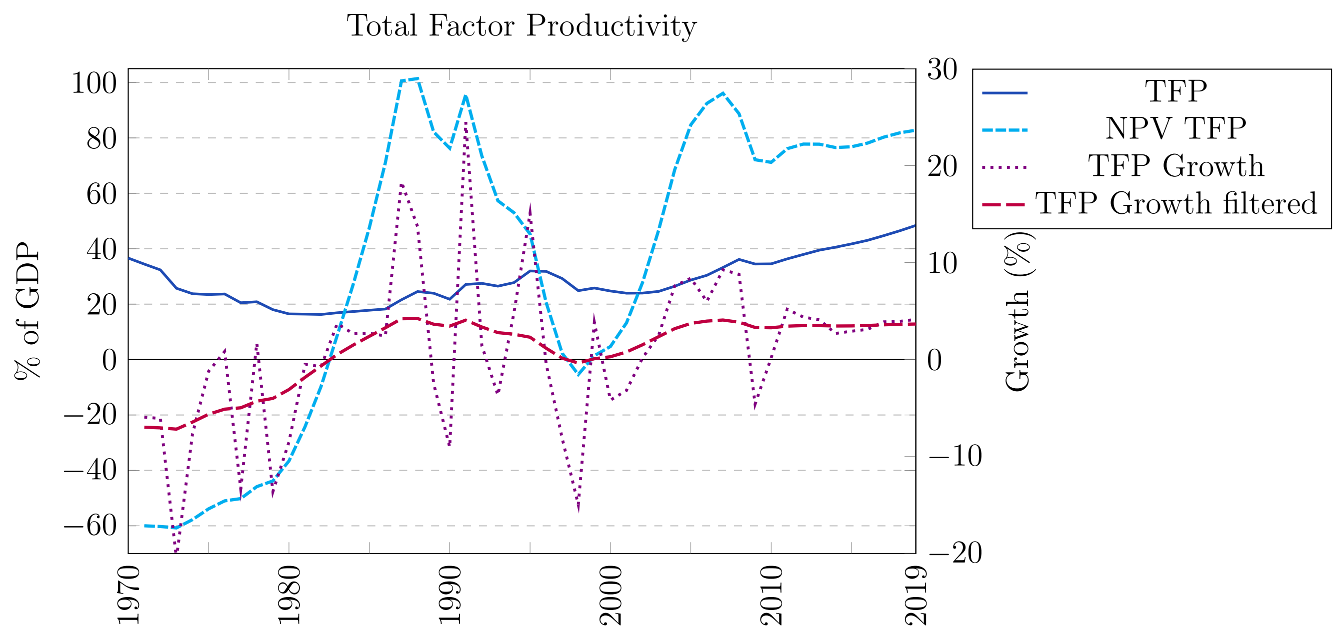

Figure C.7: Results: TFP, NPV of TFP Growth and TFP Growth Rates Cambodia 1970-2019

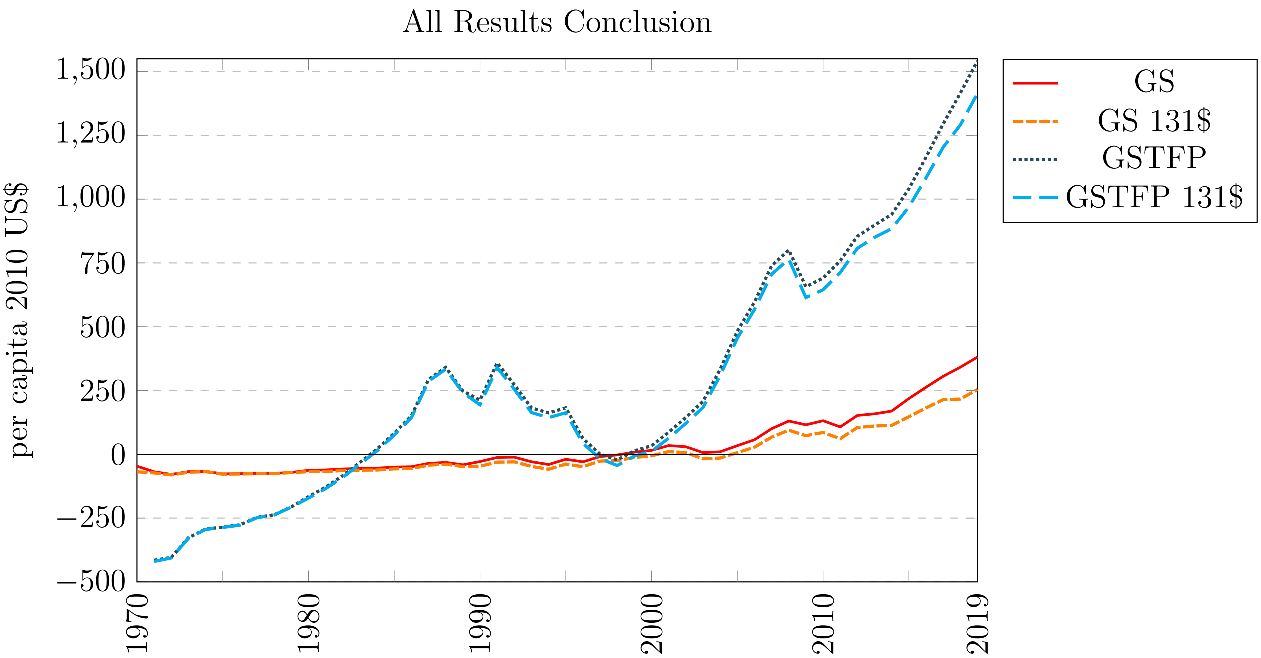

Figure C.8: Results Conclusion: GS, $GSCO_2$, GSTFP, and $GSTFPCO_2$ Cambodia 1970-2019

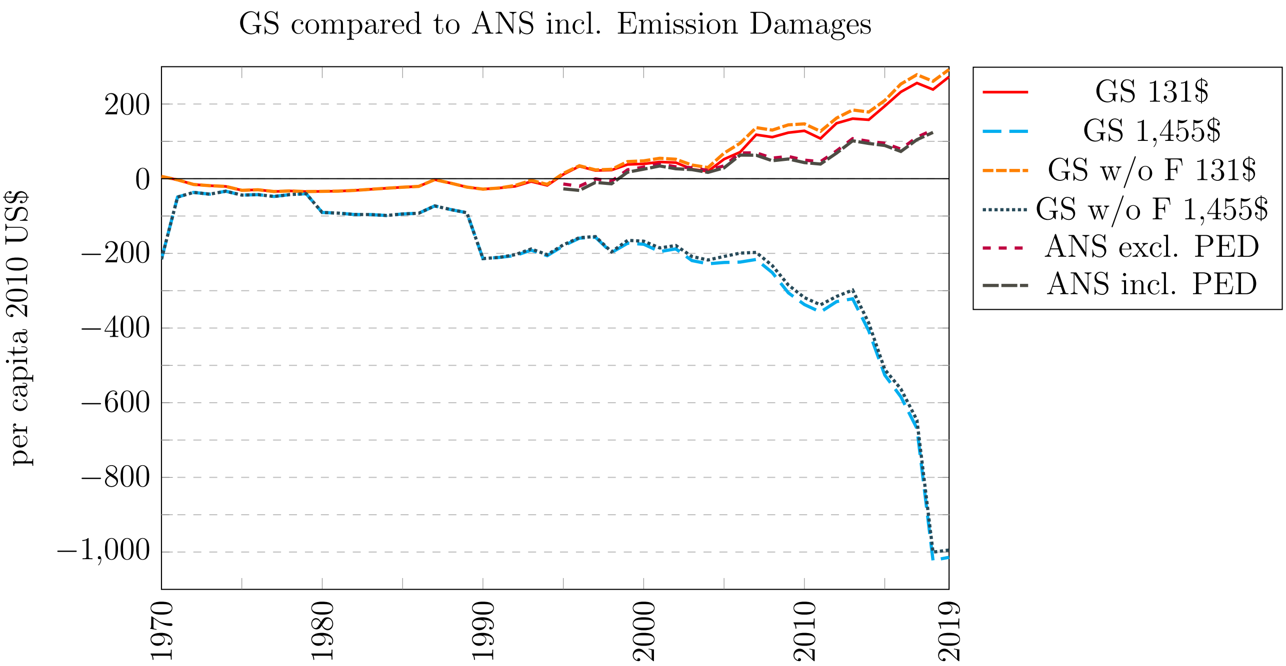

Figure C.9: Results: GS and ANS incl. Emission Damages compared - extended