

EABER WORKING PAPER SERIES

PAPER NO. 103

PROSPERITY, SUSTAINABILITY AND THE MEASUREMENT OF WEALTH

PAPER PREPARED FOR THE “PROSPERITY IN ASIA: THE INTERGENERATIONAL DIMENSIONS”
CONFERENCE, THE AUSTRALIAN NATIONAL UNIVERSITY, 16-17 APRIL 2015.

KEVIN MUMFORD

PURDUE UNIVERSITY
MUMFORD@PURDUE.EDU

JEL CODES: E01, E22

EABER SECRETARIAT
CRAWFORD SCHOOL OF ECONOMICS AND GOVERNMENT
ANU COLLEGE OF ASIA AND THE PACIFIC
THE AUSTRALIAN NATIONAL UNIVERSITY
CANBERRA ACT 0200 AUSTRALIA

Prosperity, Sustainability and the Measurement of Wealth

Kevin J. Mumford
Purdue University
April 2015

Prepared for the conference “Promoting Future Economic Prosperity in the Asian Region,” sponsored by the East Asian Bureau of Economic Research, Australian National University, April 16-17, 2015.

Author’s e-mail: mumford@purdue.edu

I am grateful to Peter Drysdale who suggested that I write this paper. My thinking on this subject has benefited greatly from conversations and collaboration with Kenneth Arrow, Partha Dasgupta, Anantha Duraiappah, Larry Goulder, Jeremy Lauer, and Pablo Muñoz.

I. Measuring Prosperity

When economists study economic growth, the focus is usually on income. The most common measure of income for an entire country is gross domestic product (GDP), a measure of the value of all market goods and services produced in the country in a year. International standards for how GDP is to be calculated have been developed, refined, and are widely accepted. Ignoring the distributional considerations, dividing GDP by the number of people in the country is a great starting point for measuring prosperity. It is certainly true that cross-country differences in GDP per capita are reflected in the average material living standards. However, as shown in Figure 1, this measure of aggregate production does not always move in step with measures of household consumption.

Household gross disposable income is a very attractive measure of the material living-standards of the citizens of a country. This is the sum of wages, interest and other financial returns, property income, net financial transfers, the value of government-provided services such as healthcare and education, and other goods and services provided by non-profit institutions, less taxes of all kinds paid to the government. Again, ignoring the distributional considerations, household income per capita measures how much the average household can consume. Household income measures prosperity to the extent that prosperity depends on market goods and services along with government- and non-profit-provided services.

This focus on goods and services when trying to measure prosperity may seem restrictive. What about family, friendships, safety, meaningful work, recreation, etc.? Surely these are important sources of happiness and are not generally a simple good or service that can be purchased. However, they all depend on goods and services. For example, educational services

help us to find meaningful work, develop friendships, and become the kind of person we want to be.

The justification for the attention economists place on measuring the consumption of goods and services (including those non-market goods and services provided by the environment, government, and non-profit organizations) is that they produce human well-being. So, why not dispense with all the counting and valuation and just directly measure happiness? An obvious place to start is with happiness surveys. My view is that this is probably a dead end. Happiness surveys essentially ask people to report their happiness by selecting one of a few ordered categories such as “very happy,” “somewhat happy,” etc. One can assign numerical values to these categories and then report how the average level of happiness in a country changes over time or in response to a certain policy. But, Bond and Lang (2014) show that it not possible to rank the overall happiness of two groups from a survey of this type without imposing some dubious assumptions. What this means is that a happiness survey which shows that a higher fraction of people report being “very happy” in country A than in county B does not necessarily imply that people are happier on average in country A than in country B.

Without some revolutionary advance in how we directly measure well-being, we are resigned to inferring well-being from measures of the quantity and social value of each good and service. Quantities can often be objectively known, but it is often impossible to directly observe the social value of a particular good. Even with fantastic quantity data, as in Chen and Graedel (2015), there is no way to aggregate the various goods and services into a single measure that we can use to represent well-being without first estimating the social value for each good and service. In a competitive market, for a good or service with no externalities, the relative price will

reflect the relative social value. However, there are deviations either because there is no market for the good or because consumption or production imposes costs or benefits on others. This means that some social prices will have to be imputed. This is not ideal, as imputation often introduces large uncertainties into the calculations. My view is that the best solution to this difficulty is transparency in what social values are applied. One can also recalculate the measure using alternative social values for those goods or services where there is greatest uncertainty.

Well-being is a function of the consumption of goods and services, where consumption is comprehensively defined to include market, government, environmental, health, and other non-market goods and services. Services are more difficult to measure than goods, particularly government, health, and environmental services. GDP does a good job measuring market goods and services. Household gross disposable income includes output-based measures of healthcare, education, and other government-provided services. The methods are imperfect, but including these services is certainly a step in the right direction. A truly comprehensive measure would include additional services, even those that are difficult to value or even to define.

Ignoring distributional considerations and population growth, the well-being of a country in period t is defined as $U(C_t)$. A country with a high level of consumption, C_t , is said to be prosperous while a country with a low level of consumption is said to be poor. For any given level of well-being, there are different combinations of goods and services that when aggregated, map to the same value of C_t and thus the same value of $U(C_t)$. This implies that there are trade-offs between the various goods and services. For example, consumption of a sufficient quantity of additional goods and services can compensate for the loss of environmental services due to pollution. Of course, the amount of other goods and services required to compensate depends

on the social values. We must be careful in assigning these social values as they may differ across countries.

II. Sustainability

Growth in a comprehensive measure of consumption means that people are better off, but it does not mean that people will continue to enjoy the higher standard of living in the future. Sustainability means that comprehensive consumption can be at least as high in the future as it is now. Income growth, or equivalently showing that $C_t \geq C_{t-1}$, does not mean that consumption growth can continue into the future. A formal model will help. Following Dasgupta and Mäler (2000), I define intergenerational well-being at period t as the discounted sum of the flow of well-being into the infinite future

$$V_t = U(C_t) + (1-\delta)U(C_{t+1}) + (1-\delta)^2 U(C_{t+2}) + \dots = \sum_{s=0}^{\infty} (1-\delta)^s U(C_{t+s}) \quad (1)$$

where δ is the discount rate. Intergenerational well-being represents well-being of people today, tomorrow, and on to future generations.

We could attempt to forecast it, but we can't know what future consumption will be. Therefore, the term V_t is a more of a conceptual object than something that we have any hope of directly measuring. It is not surprising then that governments, development agencies, and most economists focus on income growth when discussing sustainability. This is a mistake. Though income growth is likely correlated with intergenerational well-being, they are not the same thing. It is easy to come up with stories that would imply significant deviations.

For example, consider a simple economy with a single consumption good. Each period the agent can choose what quantity of the good to consume and what quantity to invest. Investing the good transforms it into capital that is used to produce the consumption good in the next period. Capital is assumed to depreciate, so without future investment the productive capacity will decline. With standard utility and production functions and a reasonable depreciation rate, an optimal growth path may exist which allows well-being to increase indefinitely. On this optimal growth path, income growth and intergenerational well-being increase together proportionally. But, what if the agent is not on an optimal growth path? Consumption today can increase by decreasing investment, essentially eating the capital stock. Consumption increases, but intergenerational well-being declines.

Sustainable development is not the same thing as optimal growth. As defined in Arrow et al. (2012), the economic development of a country over a period of time (say year t to year $t+s$) was sustainable if $V_{t+s} \geq V_t$. The country may be investing less than would be optimal given the social discount rate, the utility function, and production function. All that is required for development to be sustainable is that intergenerational well-being is not declining.

We may not be able to directly measure intergenerational well-being, but we can measure the productive base which is used to produce the goods and services that determine current well-being. Figure 2 presents a graphical representation of the relationship between the productive base (capital of various forms), GDP, and well-being. Note that there are many goods and services which are not counted in GDP but which nevertheless provide well-being. Dasgupta and Mäler (2000) showed that potential intergenerational well-being increases if and only if the productive base increase. This is very important, because it implies that the question of

sustainable development over a period of time is simply asking if the productive base is at least as large at the end of the period as it was at the beginning. A growing productive base does not ensure that well-being will increase, but it imply that the country has the potential to produce more goods and services.

Just as consumption is defined comprehensively to include all non-market goods and services that provide well-being, the productive base must be equally comprehensive and include all forms of capital that provide these goods and services. Several authors including World Bank (2011), Arrow et al. (2012), and UNEP/UNU-IHDP (2014) have attempted to measure all these forms of capital and the social values that allow them to be aggregated into a single measure of wealth, referred to as inclusive wealth or comprehensive wealth.

III. Warren Buffett Analogy

That wealth is the key to evaluating if economic development over a period of time is sustainable would not come as a surprise to Warren Buffett. Many consider him to be the most successful investor of our time. Not only because his net worth is currently \$45 billion, but because he started out in 1950 with only \$100,000 (in 2015 dollars) and repeatedly invested in business which grew rapidly in value. How did Buffett evaluate which businesses he thought would produce the highest profits in the future?

Suppose that when evaluating a company, Buffet only has access to the income statements which provide the annual revenues and expenses. He would know how much money the company made in each period from sales and he would know how much the company paid out in expenses for wages, materials, and purchasing assets. The bottom of the income statement

for each period reports the difference between the total revenue and expenditure, the company's profits or bottom line. Companies that have experienced growth in profits may be those that will also experience future growth. It would be simple for Buffet to rank all the companies by their profit growth and then only invest in those with the highest growth rates. However, this was not his investment strategy.

The concern is that there is no way to differentiate two companies with the same profit growth rates if one is investing heavily in future income-producing ventures while the other is selling off its assets. The income statements alone would not provide any distinction. So, Buffet also studies the company's balance sheet that displays the value of all assets and liabilities in each period. He invests in companies that have increased in net worth by investing in new assets that have a strong potential to produce future profit, even if current profit is low. Future profits come from current investments or as Buffett explains, "Someone's sitting in the shade today because someone planted a tree a long time ago" (Kilpatrick, 1992).

The analogy to sustainable development is that there is too much emphasis on GDP and other measures of national income and not enough emphasis on national wealth. Adjustments to GDP, like Green GDP, or combining a set of social indicators and GDP with arbitrarily chosen weights, like the Human Development Index, are still primarily measures of the current flow of well-being rather than being measures of the stock of capital assets that make up the productive base. Without measuring how the comprehensive wealth of a country changes over time, we cannot evaluate if the economic development is sustainable.

IV. Empirical Methodology

Measuring comprehensive wealth is conceptually simple, though in practice there are large obstacles. I will note some of these obstacles with the intent to spark interest in addressing them. During the development of GDP, there were large obstacles that were addressed by collecting new data and applying new methods. Conceptually, all goods and services flow from capital stocks. Denote each capital stock as K_{it} where i indicates the specific type of capital, whether human, natural, manufactured, or health.

Each individual type of capital has an associated social value denoted by P_{it} . For assets with no externalities that are sold in a competitive market, the market price is probably a very good approximation of the social value. One of the major obstacles to national wealth accounting is estimating social prices for assets where there is no market price or where there are significant externalities.

With prices and quantities, wealth is defined as:

$$W_t = \sum_i P_{it} K_{it} . \quad (2)$$

It is important to note that current prices should always be used as they reflect the current social values. This means that wealth in the previous period is defined as

$$W_{t-1} = \sum_i P_{it} K_{it-1} . \quad (3)$$

Ideally, we would use an average of future prices rather than the current prices because the future prices reflect the social tradeoffs that future generations will face. However, for most assets, there is no way for us to know what the future prices will be, hence my recommendation to use only current prices. Referring again to proposition proved by Dasgupta

and Mäler (2000), the economic development from period $t-1$ to period t was sustainable if and only if $W_t \geq W_{t-1}$.

There is no requirement that the composition of consumption stay the same in future periods. This means that sustainable development does not imply everyone will consume at least as much of every good or service as they do now. Similarly, sustainable development does not imply that every form of capital must be sustained. A country that reduces one form of capital and increases another form of capital has experienced sustainable growth if the social value of the capital gain is larger than the social value of the capital loss.

There are several potential pitfalls in national wealth accounting that are beneficial to discuss before discussing the empirical evidence for several Asian countries:

1. For mineral and energy resources which are extracted from the ground, reported changes in the proven reserves are not the same as changes in the amount of that asset owned by the country. For example, proven oil reserves have increased every year for the past 30. This is not because nature is producing oil faster than we can extract it. It is because we are inventing technologies for finding and extracting the oil faster than we extract it. So, rather than use the proven reserves as reported in earlier years, take the current proven reserves and add the extraction estimates for each intervening year.
2. Carbon emissions are a global public bad which implies that all countries are affected when any country emits. Therefore, a country's natural capital declines by the social cost of a ton of emissions multiplied by total global emissions, not the country's own emissions.

3. Produced capital can be located in one country, but owned by the citizens of another country. This future returns from the capital asset flow to the owner. Therefore, produced capital should be allocated to the country with ownership rights.
4. Wealth should be reported in per-capita terms for comparability across countries. Note that the proposition that potential intergenerational well-being increases if and only if wealth increases is not necessarily true if the population changes in size. Dasgupta (2001) and Arrow et al. (2003) identify conditions under which this proposition holds.
5. Each of the current attempts to measure inclusive wealth is missing a large number of capital assets. In addition, there is a question as to how much of some assets to count. Therefore, I suggest focusing attention on the change in the value of wealth per capita over a relatively short time period (say, five years) rather than focusing on the actual wealth per capita values in each year or percentage changes. The percentage changes will be sensitive to the base value, while the changes themselves will not.
6. There is no requirement that inclusive wealth analysis be performed at the national level. If the data is available, wealth can be calculated for states or provinces using the same methods. For example, Mumford (2012) calculates inclusive wealth for each state in the United States.

V. Empirical Evidence of Sustainable Development in Asia

In this section, I present inclusive wealth measures for several Asian countries. Note first that while countries collect large quantities of data to produce GDP statistics, they collect relatively little wealth-related data. Table 1 presents reports the 5-year change in three types of capital, produced, natural (forests, minerals, energy) and human (education) in per capita terms. The 5-year change in GDP per capita is also reported for comparison.

Table 1 makes it clear that GDP growth does not necessarily indicate growth in wealth. For example, Cambodia has experienced GDP growth in each of the four time periods considered and yet has experienced declines in inclusive wealth in all four time periods. There are several other examples, including Australia, Indonesia, Malaysia, Papua New Guinea, the Philippines, and Thailand, where growth in wealth and growth in GDP have different signs in at least one 5-year period.

That said, GDP per capita growth and wealth per capita growth are highly correlated. For example, from 2005 to 2010, those countries with the largest GDP per capita growth, Australia, China, Malaysia, New Zealand, South Korea, and Singapore, also tend to have the largest growth in wealth per capita.

Across most Asian countries, natural capital has experienced large decreases while produced and human capital have experienced large increases. An exception is South Korea where natural capital is actually increasing, driven by renewable natural resources including forests. Those countries with a decline of inclusive wealth per capita in some time period were simply extracting more from the environment than they were investing in education, roads, housing, production facilities, and equipment, etc. For some countries, including China and

India, the annual reduction in natural capital is declining over time. In other countries, including Australia, the decline in natural capital is accelerating.

VI. Conclusion

National wealth accounting enables the evaluation of whether economic development is sustainable. The methods for calculating comprehensive or inclusive wealth do not require assumptions about optimality, nor do they require forecasts of future quantities. The methods do require high-quality quantity and price data for a wide variety of capital assets.

Rather than replacing GDP, or household income measures, national wealth accounting serves as a complement. Flow variables, like GDP, are directly related to current well-being. Stock variables, like inclusive wealth, are instead related to potential intergenerational well-being. An increase in inclusive wealth implies that future citizens will inherit a larger productive base and will therefore be able to enjoy higher levels of well-being. However, this is only a statement about the potential intergenerational well-being, not a claim that well-being will definitely be higher.

My view is that national wealth accounting should be added to the national income accounting departments in each country. Regularly produced national wealth statistics would provide another metric to measure country performance. It would reduce the obsession in some countries with GDP growth statistics and would place additional focus on the importance of environmental and educational investment.

References

- Arrow, Kenneth J., Partha Dasgupta, and Karl- Göran Mäler (2003), "The Genuine Savings Criterion and the Value of Population", *Economic Theory*, 21(2), 217-225.
- Arrow, Kenneth J., Partha Dasgupta, Lawrence H. Goulder, Kevin J. Mumford, and Kirsten Oleson (2012) "Sustainability and the Measurement of Wealth" *Environment and Development Economics* 17:3, 317-353.
- Bond, Timothy N. and Kevin Lang (2014) "The Sad Truth About Happiness Scales," mimeo.
- Chen, Wei-Qiang and T. E. Graedel (2015) "In-Use Product Stocks Link Manufactured Capital to Natural Capital," forthcoming in PNAS.
- Dasgupta, P. (2001), *Human Well-Being and the Natural Environment* (Oxford University Press, Oxford). 2nd Ed. 2004.
- Dasgupta, Partha and Karl- Göran Mäler (2000) "Net National Product, Wealth, and Social Well-Being," *Environment and Development Economics*, 5(1), 69-93.
- Kilpatrick, Andrew (1992) *Warren Buffett: The Good Guy of Wall Street*, Donald I. Fine, Inc, p. 288
- Mumford, Kevin J. (2012) "Measuring Inclusive Wealth at the State Level in the United States" in UNU-IHDP and UNEP (2012) *Inclusive Wealth Report 2012*, Cambridge: Cambridge University Press, pp 69-86.
- UNU-IHDP and UNEP (2012) *Inclusive Wealth Report 2012: Measuring Progress Towards Sustainability*. Cambridge: Cambridge University Press.
- UNU-IHDP and UNEP (2014) *Inclusive Wealth Report 2014: Measuring Progress Towards Sustainability*. Cambridge: Cambridge University Press.
- World Bank (2011) *The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium* (Washington, DC: World Bank).

Figure 1: Change in GDP and Household Gross Disposable Income

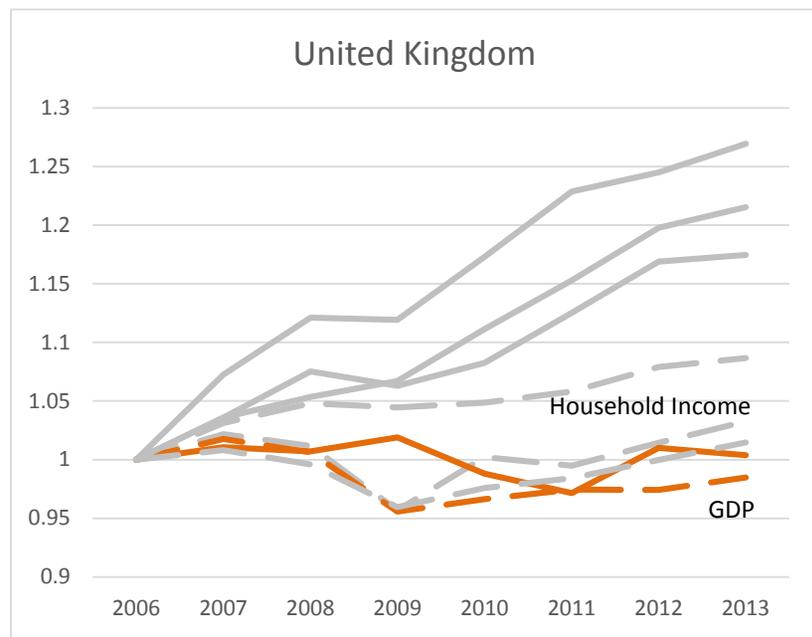
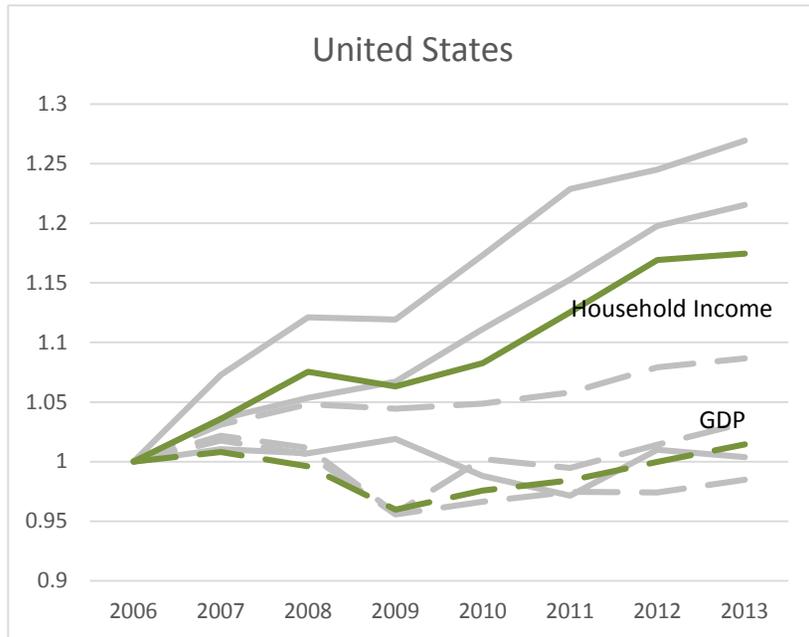
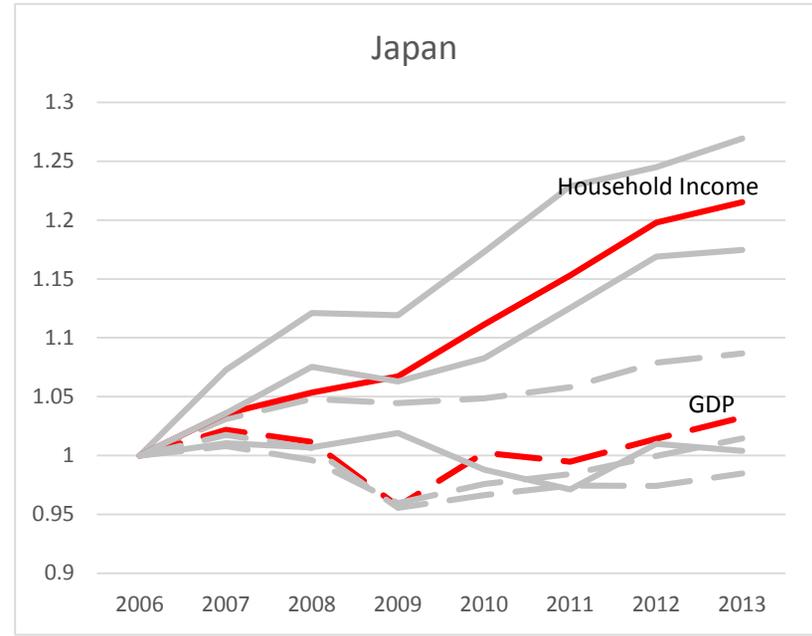
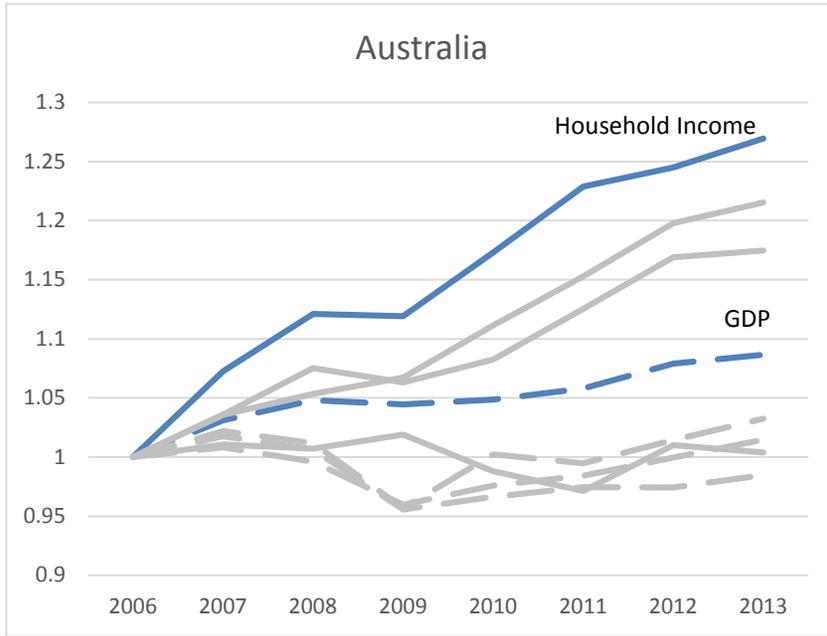


Figure 2 Use of Capital in Production

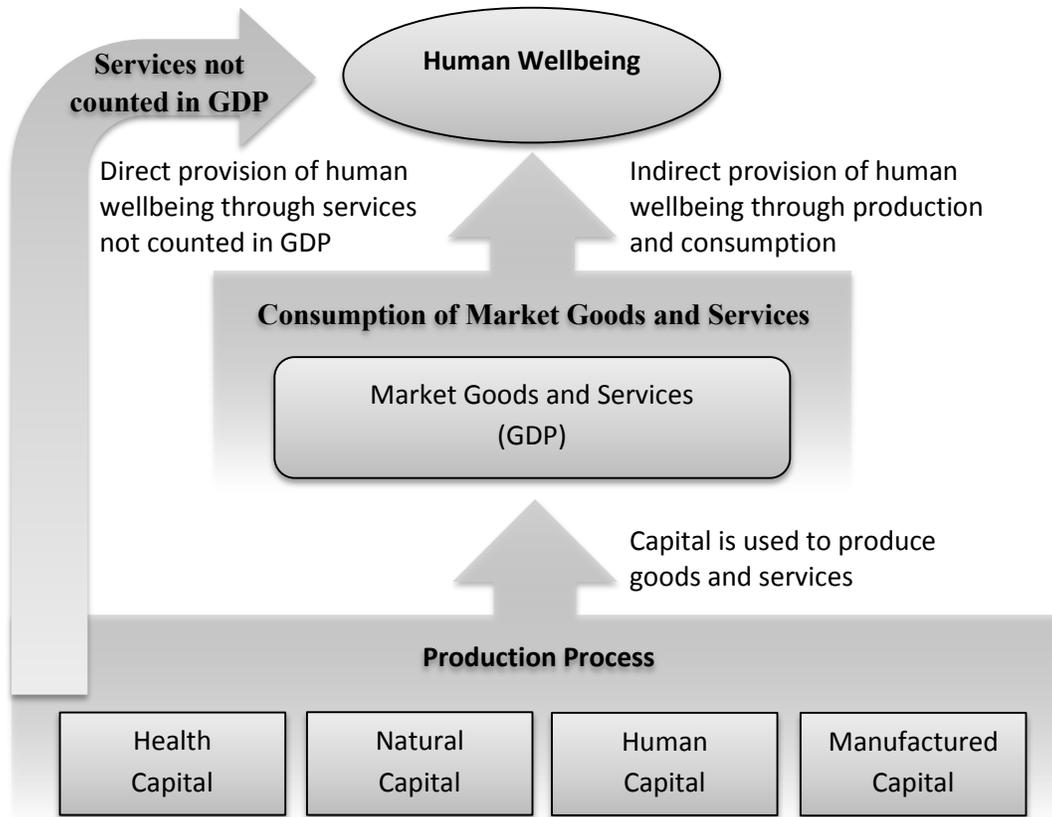


Table 1: Change in Inclusive Wealth and GDP per capita (2005 US\$)

Australia				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	7,912	13,209	18,583	22,404
Natural Capital	-11,663	-11,417	-12,548	-18,169
Human Capital	1,723	1,576	7,848	12,837
Inclusive Wealth	-2,028	3,367	13,883	17,073
GDP	2,923	4,315	3,839	1,788

Bangladesh				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	59	139	218	323
Natural Capital	-64	-35	-29	-17
Human Capital	104	296	194	171
Inclusive Wealth	98	401	382	477
GDP	27	49	69	114

Cambodia				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	-18	75	204	413
Natural Capital	-1,886	-1,175	-720	-571
Human Capital	163	196	191	123
Inclusive Wealth	-1,740	-905	-325	-35
GDP	36	69	147	144

China				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	626	1,128	1,921	3,704
Natural Capital	-450	-473	-453	-368
Human Capital	577	518	366	521
Inclusive Wealth	753	1,174	1,835	3,856
GDP	317	349	616	1,149

India				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	184	283	467	917
Natural Capital	-307	-252	-227	-197
Human Capital	65	312	246	201
Inclusive Wealth	-57	343	486	921
GDP	66	99	167	288

Table 1 (continued): Change in Inclusive Wealth and GDP per capita (2005 US\$)

Indonesia				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	728	638	460	811
Natural Capital	-1,576	-1,121	-843	-806
Human Capital	316	624	193	484
Inclusive Wealth	-532	142	-190	488
GDP	283	-34	195	315
Japan				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	19,844	15,503	10,272	6,716
Natural Capital	-82	-28	-123	-43
Human Capital	10,303	6,009	2,311	319
Inclusive Wealth	30,065	21,484	12,460	6,993
GDP	1,646	1,250	2,085	168
Malaysia				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	3,474	2,717	1,241	1,829
Natural Capital	-3,937	-3,493	-3,014	-2,314
Human Capital	4,183	2,223	791	2,546
Inclusive Wealth	3,720	1,447	-981	2,060
GDP	1,155	494	612	764
New Zealand				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	1,109	6,901	9,777	8,652
Natural Capital	-6,686	-1,854	-9,629	-1,896
Human Capital	3,963	3,411	9,126	2,336
Inclusive Wealth	-1,615	8,459	9,274	9,092
GDP	1,531	2,245	3,042	421
Papua New Guinea				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	-57	3	130	66
Natural Capital	-10,163	-9,086	-7,411	-6,085
Human Capital	84	32	29	99
Inclusive Wealth	-10,137	-9,051	-7,251	-5,921
GDP	222	-80	-15	138

Table 1 (continued): Change in Inclusive Wealth and GDP per capita (2005 US\$)

Phillippines				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	134	246	173	299
Natural Capital	-177	-134	-114	-71
Human Capital	183	372	14	414
Inclusive Wealth	139	484	73	641
GDP	-10	67	140	201

Singapore				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	10,749	17,637	10,278	8,818
Natural Capital	-1	-1	-1	-1
Human Capital	4,290	7,589	10,225	13,820
Inclusive Wealth	15,038	25,225	20,503	22,636
GDP	5,036	3,833	4,070	4,211

South Korea				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	13,448	13,373	13,302	12,828
Natural Capital	14	212	303	81
Human Capital	7,556	4,584	4,122	2,630
Inclusive Wealth	21,017	18,168	17,728	15,539
GDP	3,410	2,956	3,210	3,160

Thailand				
	1990 - 1995	1995 - 2000	2000 - 2005	2005 – 2010
Produced Capital	3,316	1,336	616	1,255
Natural Capital	-356	-518	-426	-288
Human Capital	6	340	743	988
Inclusive Wealth	2,966	1,158	934	1,953
GDP	696	-77	467	395

Source: Author's calculations and the Inclusive Wealth Report 2014