Sustainability and Intergenerational Imbalances in a Comprehensive Balance Sheet Structure

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ABSTRACT

The comprehensive balance sheet is an extension of the traditional national balance sheet and shows the net present value of all assets and liabilities of current and future generations. Assets include current and future labour income (human capital), natural and produced capital and net foreign assets, while the liabilities consist of estimated future private and public consumption. A negative balance for the nation implies that the planned use of resources exceeds that which is actually available, and, hence, indicates that economic behaviour is unsustainable in its broadest sense. The framework also allows us to consider the issue of intergenerational equity from the perspective of whether people currently alive are consuming too much of the natural capital stock to leave bequests for their descendents. The framework is illustrated by means of application to the United Kingdom.

Introduction

In response to the recent financial crisis and recession it has been suggested that the British economy needs to rebalance away from a consumption-led economy to one in which a higher proportion of income is devoted to investment. Relative to the situation before the crisis, this requires some combination of higher domestic capital formation and a lower external deficit or even a move into external surplus. But of course the issue is much more general. At present statisticians do not provide indicators of whether economic behaviour is sustainable in its broadest sense. In this paper, using the UK as an example, we explore how far this rebalancing might eventually need to go, by establishing what sort of consumption pattern is consistent with the intertemporal budget constraint faced both by current adults and by future generations. This enables us both to derive estimates for intergenerational transfers and to establish what is sustainable for the economy. The exercise can be seen as an extension of generational accounting (Auerbach and Kotlikoff, 1987) to the economy as a whole. It is an empirical one and is thus dependent on assumptions which are made about the rate of return and the underlying growth rate of labour productivity. However the framework we set out is general and can be used to explore the implications of different values of these parameters as well as different assumptions about the underlying behaviour of people as both consumers and as suppliers of labour.

The intertemporal budget constraint implies no more than that the planned total use of resources over the indefinite future, i.e. the present discounted value of current and future consumption should not exceed the value of those resources, i.e. the sum of the present discounted value of current and future labour income and the value of existing capital, with the latter including both produced capital such as buildings and plant and machinery and naturally-occurring capital such as land. An informative analysis of the balance between resources and planned consumption should also indicate how those are allocated between current adults and future generations. The point, of course, is that intertemporal balance can always be delivered by limiting the consumption possibilities of future generations. But one can question whether this should be done in a way that people currently alive might regard as unfair had they rather than their descendents been treated in this way. Setting out the issue in terms of a comprehensive balance sheet as we propose here, shows these issues clearly.

In most economies resources are transferred both from current to future generations through mechanisms such as bequests and from future generations to earlier ones through mechanisms such as the national debt and pay as you go benefits. The use of the natural capital stock by people currently alive, although not a transfer from future generations, does have the effect of depriving them of resources available to those currently alive and should therefore also be indicated in any intertemporal analysis.

There is an obvious connection between what we attempt here and existing work on sustainability. A number of authors e.g. Hartwick (1977), Atkinson and Pearce (1993) and Arrow *et al* (2010) have addressed the issue in flow terms . If wealth *per capita* broadly defined, is rising, then Arrow *et al.* argue that the economy is developing on a sustainable path. Declining wealth means that consumption is too high and thus is not sustainable. Both these analyses and our own allow for the possibility that it may be sensible, nevertheless, to exploit particular types of exhaustible resources. Most notably, economies evolving in a sustainable way will tend to replace naturally-occurring exhaustible resources with produced capital in the manner suggested by Hartwick (1977). But an approach based on flows does not provide a timely warning about the consequences of some expected future changes, such as the ageing of a population bulge or a projected increase in life expectancy.

We begin by setting out our extended national balance sheet. We then discuss its compilation and present numerical estimates for the United Kingdom. We follow this with estimates which show that combination of working longer and saving more can help to deliver intertemporal balance.

A General Balance Sheet Structure

The framework we have in mind can be presented in table 1. Here we show assets, measured at market prices for those assets for which markets exist, and as the capitalised value of future income streams for those assets such as human capital which lead to income but which are not traded in capitalised form. As with the more conventional income-outlay accounts, we show transfers between the different sectors; where different sectors represent different generations these are represented by bequests rather than the more conventional transfer payments. In the framework set out below we distinguish

current adults from future adults, but a more detailed generational decomposition is, of course, possible in principle. Our present framework identifies naturally occurring assets only insofar as they are marketeable although it is possible to extend the framework to show collectively-owned non-marketed environmental assets as well. But a key point of the system is that it enables us to deduce what sort of pattern of generational transfers might be implied by consumption and labour supply plans.

Table 1: A Schematic Balance Sheet designed to Show Intergenerational Transfers

		Current Adults	Future Adults	Government	Nation	Rest of World
Factors of Production	Natural Capital	CKC		GKC	KC	
	Produced Capital	CKP		GKP	KP	
	Human Capital	CKH	FKH		KH	
Transfers	Taxes etc	CT	FT	T	0	
	Consumption Transfer	CGC	FGC	GC	0	
	Bequests	CL	FL		0	
	Net Financial assets	CFA		GFA	FA	–FA
Consumption	Private	CC	FC		C	
	Public	CGC	FGC		GC	
Net Exports						FX
Inter-temporal Surplus		SC	SF	SG	S	SX

In this table we show first the factors of production, natural capital, produced capital and human capital. Much the most important measured component of the natural capital stock is land although we also include, as far as possible, naturally occurring resources in private ownership. Conventional capital can and does belong either to other current adults or to the government. The nation's holding of such assets is the sum of the holdings of current adults and those of the government.

Human capital, by contrast, can belong only to people and is the capitalised value of current and future labour income before deduction of taxes such as income tax and employers' and employees' national insurance contributions. The value of the national stock of human capital is therefore simply the sum of that attributed to current and future adults.

We show four types of capitalised transfer. These summarise movements of resources between the three domestic sectors; there may also be small flows to the rest of the world but for reasons of simplicity these are assumed to be zero.

The first transfer is the capitalised value of taxes and social security benefits. These represent negative assets of current and future adults and a positive asset of the government because the total value of taxes that people pay on average exceeds the value of the transfers that they receive. The second transfer is introduced so that we can show public consumption in the sectors which enjoy the benefits of that consumption. Thus the government is assumed to transfer the discounted value of consumption to either current or future adults because these, rather than the government itself, benefit from that consumption. Finally bequests are a negative contribution to the resources of people currently alive and a positive contribution for future adults. It is assumed that people do not leave bequests to the government and it is also assumed that none are paid to, or received from the rest of the world. Net financial assets are measured in their conventional way. These belong to current adults, to the government or to the rest of the world. The nation's holding of net financial assets is the sum of that of current adults and of the government, while the holdings of the nation and the rest of the world must sum to zero.

The sum of the different types of capital and capitalised transfers represents the resources available for expenditure, either on private or public consumption. In these calculations we measure private consumption net of indirect taxes, treating the latter like direct taxes as a transfer payment. The excess of resources over the capitalised value of private consumption indicates the intertemporal surplus of each of the domestic sectors. The nation as a whole has to provide net exports equal in present discounted value to the financial claims of the rest of the world. But, as the column showing the nation's resources and their uses indicates, for any given value of the intertemporal surplus high net liabilities to the rest of the world imply high net exports and low discounted consumption in order to satisfy the external intertemporal budget constraint. Thus the intuition that external debts must depress future consumption is fully recognised in the table.

The last row of the table shows the intertemporal surplus of each sector. A positive value indicates that expected resources exceed expected uses while a negative value indicates the opposite and thus suggests that the sector is in an unsustainable position. It should be noted that, as the table is set out

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national unsustainability can arise because of the behaviour of any one of the domestic sectors. Equally of course, the nation's finances could be perfectly sustainable if unsustainable government behaviour were offset by adequate intertemporal surpluses of current and or future adults.

Compilation

Human capital, consumption and taxes & transfers

The construction of the balance sheet requires age profiles for labour income, consumption and taxes & transfer payments. For labour income and consumption we wish to separate the cohort and time effects from the underlying behaviour, while for the taxes & transfers we need to represent the current policy. The consumption and labour income profiles first require panels by age to be created from the Living Cost & Food Survey (LCF), then Deaton's method is applied to give an Age, Time & Cohort model which can be used to give age profiles for the net present value calculations. Information on taxes & transfers by age and sex is taken from the profiles constructed for the production of generational accounts by McCarthy, Sefton and Weale (2011).

The income and consumption panels are compiled from raw data variables from the LCF survey from 2002 to 2010. Income by age can be directly estimated, while consumption is recorded at the level of household; hence, we run regressions of household consumption on individuals' ages to obtain the panel.

The Age, Time & Cohort model for labour income of someone age j at time t $(Y_{j,t})$ takes the following form:

$$lnY_{j,t} = \theta_j + \emptyset_t + \varphi_{t-j} + \varepsilon_{tj}$$

where θ_j represents an age effect, $\emptyset_t$ a time effect, φ_{t-j} a cohort effect and ε_{tj} is a residual term. The parameters are estimated by means of a regression with dummy variables, and consumption is similarly analysed. Profiles for future years are then calculated by combining cohort effects and age effects to

create estimated income by age $\widetilde{\alpha_{jt}}$ for the current and future generations. Cohort effects for future generations must be estimated using the cohort effects estimated for the current generations. Interestingly, the mean growth rate of the consumption cohort effect is 1.25% p.a. while that of the labour income cohort effect is 1.56% p.a. - the next section discusses the implications of fixing these growth rates to be equal and allowing them to differ. These profiles are then multiplied through by population figures projections and discounted using the assumed rate of return of 4.4% p.a. This rate of discount is just below what was observed for the UK economy over the period for the period 1989-2006. The NPV of the current generation's human capital is:

$$HK = \sum_{t=2010}^{2061} \sum_{j=20}^{70} \left[\widetilde{\alpha_{jt}} * \left(\frac{1}{r} \right)^{t-2010} * N_{j,t} \right]$$

where $N_{j,t}$ is the population aged j at time t, which is calculated from current ONS population data and mortality assumptions to exclude migration. The future generation's NPV is calculated in a similar manner with the sum to infinity truncated at 500 years.

NPV figures for private sector consumption net of taxation, indirect taxes, direct taxes, transfer payments and public consumption are calculated in a largely analogous manner (using ages from 20 to 95); in the estimates we present below they are based on the UK generational accounts of McCarthy, Sefton and Weale (2011). Thus, while private consumption and labour income is based on the Age, Time & Cohort decomposition, public consumption and transfers are estimated making the assumption that current policy remains in force.

Produced and Natural Capital and Net Financial Claims

Figures for produced and natural capital and net financial claims are compiled from the national balance sheets produced by the Office for National Statistics.

Bequests and Net Exports

The estimate of the value of bequests by current adults is derived as a residual which has to be non-negative. If the calculation yields a negative number the value of bequests is set to zero and the overall balance is shown in the final row of the table. The figure for net exports is derived so as to balance the account for the rest of the world.

Estimates for the UK in 2010

We present here estimates of comprehensive balance sheets for the UK for 2010. The calculations presented below are on the assumption that employment patterns correspond to those observed in 2009 but that government's plans for public spending are implemented as they stood in January 2011. Table 2 shows estimates if we fix the growth rate of the consumption cohort effect to equal that of the growth rate of the labour income cohort effect (1.56% p.a.), while the generational accounts are also calculated using the same long-run growth rate. Looking at the position of current adults, we can see that, even if the natural capital stock is used entirely to fund their consumption, discounted expenditure still exceeds resources by a the sum of £945bn - about 5 per cent of their total assets. The shortfall faced by future generations is 10 per cent of their total assets, and overall discounted consumption of both current and future generations (Nation) exceeds resources by 9 per cent. The table demonstrates clearly that the public sector imbalance is only a small part of the total; consumption levels are incompatible with the labour supply patterns and associated labour income profiles if consumption grows at the same rate as income for future generations.

Table 2: Comprehensive Balance Sheet for the United Kingdom in 2010* (£bn at 2008 prices)

		Private Current Adults	Private Future Adults	Government	Nation	Rest of World
Assets						
Factors of Production	Land	2632		210	2842	
	Exhaustible resources (Oil&Gas)	141			141	
	Produced capital	2493		646	3140	
	Human capital	12096	12115	0	24211	
Transfers	Net consumption transfer from Government	6784	4225	-11008	0	
	Other net transfers from Government	-6131	-4261	10393		
	Net financial claims	825		-862	-37	37
	Bequests	0	0		0	
Liabilities						
Final Demand	Consumption Private	13002	9069		22071	
	Consumption Public	6784	4225		11008	
	Net Exports				0	37
Balance		-945	-1216	-621	-2783	0

*Land and produced capital are estimated using data up to 2009.

Closing the Gap

As noted above, the figures in table 2 are calculated assuming that the cohort effects driving consumption and labour income grow at the same rate (1.56% p.a.) . However the observed consumption cohort effects show growth of only 1.25% p.a. Were this trend to continue the discounted

sum of consumption by future adults would decline by £1029bn while that of current adults would not be affected – the figures already reflect their actual cohort consumption effects.

Separately, it is possible that the income profile may change as a consequence of changes to the state pension age. The State Pension age is planned to rise by up to three years for the current generation[1], and at the Budget the Chancellor announced that there will be "an automatic review of the state pension age to ensure it keeps pace with increases in longevity". Beyond the current announced legislation, this implies that the state pension age will rise by one year every six years and we used this metric to adjust the working lives of the future generation. We assume that the extra years of work extend the period which workers are at their peak earnings, and this, of course, may be an optimistic assumption. These steps increase discounted labour income by £588bn for those currently alive and by £943bn for the future adults. Thus both of these changes, taken together, would eliminate the shortfall shown in table 2; the current population would nevertheless run a deficit at the expense of the future generation.

Of course this says neither that the economy does have a saving problem, nor that there is nothing to worry about. It simply illustrates in a positive rather than normative sense, how one particular combination of working longer and saving more can deliver intertemporal balance.

Conclusions

We have demonstrated here how the extension of a traditional national balance sheet to show additionally the capitalised value of future labour income and transfer net receipts, together with the discounted value of future consumption makes it possible to investigate whether consumption and labour supply patterns are consistent with the intertemporal budget constraint. This provides a test of whether the patterns underlying these are sustainable. An application to the United Kingdom suggests that the nation may be broadly in balance, but that this is achieved at the expense of future generations.

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[1] Under current legislation, the State Pension age is planned to increase to: 66 between November 2018 and October 2020, 67 between 2034 and 2036 and 68 between 2044 and 2046. However, the government has announced that the increase to 67 will now take place between 2026 and 2028 and we use these dates for our calculations.

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