Session Number: 2A
Session Title: Improvements to the SNA
Paper Number: 1
Session Organizer: Barbara Fraumeni
Discussant: Paul McCarthy

Paper Prepared for the 28th General Conference of
The International Association for Research in Income and Wealth
Cork, Ireland, August 22 – 28, 2004

Linking income to ownership of assets

Anne Harrison

For additional information please contact:

Anne Harrison, (anne.harrison@oecd.org) OECD, 2 rue André Pascal, 75775 Paris Cedex 16

This paper is placed on the following websites: www.iariw.org
www.econ.nyu.edu/iariw
www.cso.ie

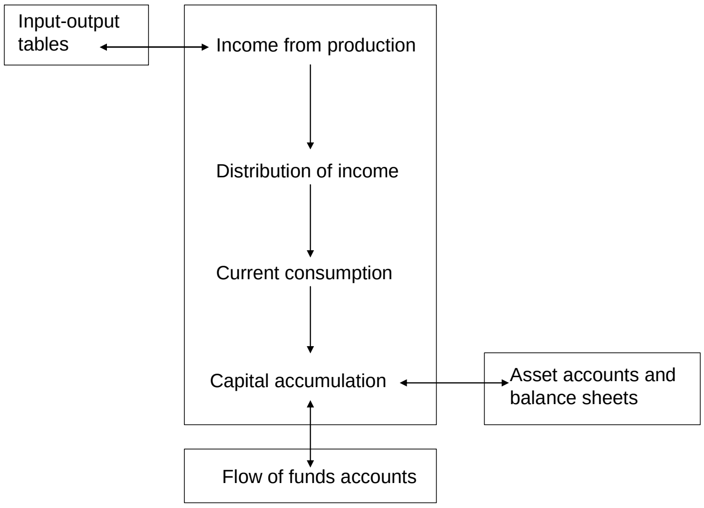
Linking income to ownership of assets

Anne Harrison[1]

Introduction

The 1993 SNA contains a number of distinct sets of accounts. Running through six chapters is the description of the sequence of accounts whereby income is generated, distributed and redistributed and then used either for current consumption or accumulated as some form of capital. Another chapter is devoted to an elaboration of the production process in the form of input-output tables. Two chapters show how capital formation can be linked to balance sheets in a set of accumulation accounts. The chapter on the financial account also describes a matrix of the flow of funds. The articulation between these accounts can be viewed schematically as in figure 1.

Figure 1: The main accounts of the 1993 SNA



At the time the 1993 SNA was completed, the links back from capital accumulation to the processes of production and income distribution were not elaborated in accounting terms though in economic terms the links were implicit. In many of the fora where discussion have been taking place leading up to the review of the SNA, these links have been explored in some detail and can now be made explicit. The aim of this paper is to bring these ideas together to make a

[1] This paper is incomplete is two senses. One is that not all assets are covered, in particular inventories, those currently called “intangible non-produced non-financial assets” and securities. Secondly, many of the discussions concerning the review of the SNA are still ongoing and thus final decisions on many of the questions raised are yet to be made. I hope to update the paper when these conclusions are reached. Meantime I must make clear the contribution many of those involved in the review have made to my thinking, wittingly or otherwise, and though they are too numerous to enumerate individually, offer my thanks to them.

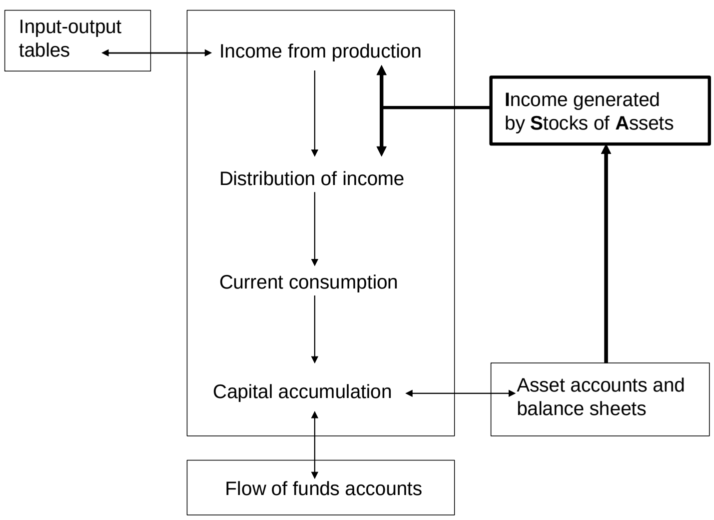
comprehensive set of accounts showing the feedbacks from the bottom right of figure 1 to the first two elements of the sequence of accounts as shown in figure 2. These accounts we call Income generated by Stocks of Assets (ISA) accounts.

In particular the following processes are examined.

> The link between the use of fixed assets in production and the income arising in the production account as elaborated by the Canberra groups on capital stock and non-financial assets;
>
> The extension of this to the approach to the income arising from the use of natural assets in production as elaborated by the London group in developing the 2003 version of the SEEA;
>
> The process of redistribution of income which arises when an asset is leased to another unit for use in production (which is also under consideration by the Canberra II Group);
>
> The link between financial assets and the generation of income by financial institutions as developed by the EDGs on financial services and insurance;
>
> The link between property income and the accrual of pension entitlement as elaborated in the EDG on pension funds.
>
> In addition, the Canberra II Group is considering the question of how far intangible assets can and should be identified when there is a future income stream arising from current production even though no physical product may embody this benefit.

The contents of this paper draw heavily on the discussions and papers of all these groups and acknowledgement is due to all those who have participated in them. However, not all the groups have yet completed their work and there are places where I feel there may be a lack of consistency across the various topics. Thus, the synthesis presented here is my own and it is should be recognised as one individual's view and not a consensus opinion.

Figure 2 Providing the links from holding of assets to income



Income generated by fixed assets

In the 1993 SNA, gross operating surplus is described as being that part of value added which is due to the use of capital in production but it is calculated as a residual in the production account and linked to the value of assets used in production only after the event (if at all). The decline in the value of the asset is used as the consumption of fixed capital to derive net operating surplus from a given figure for gross operating surplus but this depends on the change in the value of an asset not its value in absolute terms. The work of the two Canberra Groups has served to refine this interpretation by showing how the idea of capital services can be incorporated into the production account without any fundamental change, or even necessarily any numerical revision, to the value of consumption of fixed capital, but with beneficial consequences for both data quality and analytical interpretation.

This is not the place to give a full description of the capital service approach to measuring capital stock but some summary is useful. A fixed asset can be seen as a stream of services to be rendered over a period of time. In order to find the value of the asset, it is necessary to postulate the profile of the services to be rendered, the length of time over which they are rendered and a discount rate which applies, at the moment the value is calculated, to all future income. The value of the asset is then estimated as the net present value of the future income stream. In a perfectly functioning market, this value should be equal to the market value of the asset. In a less than perfect market (which is the usual case with second hand assets), this may be the only way to estimate a value of the asset, a fact recognised by the SNA which suggests net present value as a second best approach when market values are not available or reliable.

The value of the asset declines over a year by the amount of capital services rendered in the year but this decline is partly offset by an increase in value due to the fact that future income is now one year nearer in time and thus is discounted one fewer times. The value of the capital services rendered can be equated with the economic rent of the asset and the increase in value due to the advance of time as the return to capital. Further, these two elements can be equated in part or in whole with gross operating surplus and net operating surplus. Whichever names they are given, the arithmetic sum (that is the excess of the decline over the increase) is equivalent to consumption of fixed capital. It can be shown that for any decline in the price of an asset over time, which is the usual starting point for the calculation of capital stock via a perpetual inventory model, there is one and only one capital service profile, so the swap from perpetual inventory model to a capital service model for determining the value of capital stock will not result in different values if the matching profiles are used (and vice versa).

At this point we can replace the (partial) identity that

> Capital stock at the beginning of the period
> *Less* consumption of fixed capital
> *Equals* capital stock at the end of the period

by one which reads

> Capital stock at the beginning of the period

Less capital services rendered
Plus return to capital
Equals capital stock at the end of the period

Further we can relate the second line to gross operating surplus and the third to net operating surplus. But this identity would hold completely only in a world where there were no other changes, including no changes in prices, in the period in question. Of more immediate concern, though, is how should we take account of changes in the two parameters necessary to calculate the value of an asset other than the profile of the services or prices of the asset over time. These parameters are the discount rate to be applied and the life length of the asset.

Changes in interest/discount rate

One consequence of accepting that the market value of an asset should be equal to the net present value of the future income stream is to recognise that changes in the discount rate will change the value of the asset. If the discount rate falls, the discount applied to future earnings is lower and so the sum of these is higher. It seems clear, initially, that in national account terms, we would view this once and for all change in the value of an asset as a holding gain. (In practice, since we have to abstract from changes in value caused by general inflation, we may not notice that part of the holding gain is strictly due to a change in the discount rate but let us assume for the moment that it is separately identified.) However, in the period that remains of the asset's life, the asset must still decline in value to zero. The cumulated decline, which we equate with consumption of fixed capital and deduct from gross operating surplus, must therefore be large enough to account for the holding gain as well as the value of the asset immediately before the rise in the discount rate. This leaves us with an inconsistency. We exclude the increase in value from income when it occurs but we subsequently deduct the value of this increase from income in later years.

There are four possible courses of action. The first is to follow the steps indicated above, to treat the initial change in value of the asset as a holding gain (or loss) but allow the writing off of this to affect net operating surplus over the rest of the asset's life (or until the next change in the discount rate). This asymmetry is not appealing in theory though in practice it may be disguised through inclusion with allowances for other holding gains and losses caused by general inflation. Over the long term NDP will be understated as the result of a fall in the discount rate and overstated after a rise.

A second possibility is to assume that the discount rate does not change through the life of the asset. Whatever rate was chosen when the asset was acquired is the one to be used for the whole of its life. In this way there will be neither change in the value of the asset in response to a change in discount rate not any change to be accounted for in later years. This is simple in accounting terms (and may be in effect what happens at present when using a PIM) but does it make economic sense? To suppose that changes in interest rate have no effect on the value of assets, and decisions about how to use them, seems unhelpful from an analytical point of view when interest rates (and thus discount rates) are being deliberately changed with a view to changing behaviour. It also presents a problem when an asset is transferred to a new owner and we have to use not the discount rate facing the new owner at the time he acquires the asset but the rate that applied to the original owner when the asset was new.

The third possibility is to allow a holding gain (or loss) to be recorded when the discount rate falls (rises) but to exclude the writing off of this from subsequent calculations of consumption of fixed capital. But these changes in value must be recorded somewhere. One possibility seems to be to use the other changes in asset account but what has caused this change in value? In the years after the initial change in the discount rate, the extra change in the value of the asset is not due to a change in discount rate, nor a change in general inflation, nor can it be regarded as a volume change. Assigning these entries to the other change in assets account is thus to revert to using it as a "catch-all" account, which might be renamed as the CTWETDWI account[2].

The fourth alternative is more radical. That would be to say that changes in value due to changes in the discount rate, unlike changes in value due to changes in absolute or relative prices, are not to be treated as holding gains and losses but as income. This would restore the value of NDP to its correct value over the long term, would not require any entries in the other changes in assets account and would have an increase (decrease) in the value of an asset, as incorporated into the balance sheet value, fully accounted for via consumption of fixed capital so that over the whole life of the asset the sum of consumption of fixed capital would be equal to the initial purchase price plus and changes in value due to changes in the discount rate. The cost of achieving these consequences is that of redefining holding gains and losses, a possibility that many will find undesirable.

Changes in life length

An entrepreneur has a degree of latitude about how intensively an asset will be used. The more intensive, the shorter the life length; the less intensive the longer. This decision can be varied during the life of the asset also. Assuming the total amount of capital services is given, lengthening the life length will lessen the net present value of the asset because future services will be more discounted than earlier. Similarly, shortening the life of the asset will increase the value because there will be less discounting than previously. However, lengthening the life of an asset not only reduces the net present value of the asset at any point in time but also increases the net operating surplus over a period of time since the cumulated value of the net operating surplus is equal to the difference between the sum of the values of capital services rendered, not discounted, and the net present value of these, that is the current value of the asset at any point in time.

Just as changes in the discount rate may not always be incorporated into the value of capital stocks used by national accountants, so the implications for the value of the stock of capital, or the income it gives rise to, of any changes in life length of the asset may also be overlooked.

Linking changes in discount rate and life length?

In general, national accountants seldom change the calculations for consumption of fixed capital for changes in the discount rate during the life of the asset. This could be justified if an increase in the discount rate, say, was accompanied by a corresponding change in the life of the asset so that the combined effect did not alter the profile of the decline in value of the asset. Intuitively

---

[2] Can't think what else to do with it account.

one might expect an increase in the discount rate to be accompanied by an extension of the life length, but independently both of these would lower the value of the asset. If the life length is estimated endogenously on the basis of a change in discount rate, it seems, somewhat surprisingly, that there is no automatic effect on the life length[3]. This is turn suggests that in principle, when a change in discount rate occurs, the values for consumption of fixed capital should be recomputed.

Other changes in assets

Apart from these two parameters of the way in which the net present value of an asset may be calculated, there are other factors which may cause a change in value. These are changes in the relative or absolute price levels in the economy and non-economic events such as natural disasters or political seizure. These items also need to be recorded in the other changes in assets account if the end of year stock value is to be reconciled with the start of year figure.

An account for the income generated by the stock of fixed assets

Taking all these factors into consideration means we can draw up an asset account for fixed assets with indications of where the various contributions to the change in value feature in the other accounts of the system. Such an account is shown in Figure 3.

Figure 3: Income generated by the stock of fixed assets

	Generation of income account	Other changes in volme of assets account	Revaluation account	Fixed asset
Opening balance sheet				x
Gross operating surplus	g			
Of which:				
Realisation of capital services	a			- a
Return to capital	-b			b
Net operating surplus	n=g-a+b			
Changes in volume of the asset		c		c
Changes in the value of the asset			d	d
From changes in discount rate			d1	d1
From changes in life length			d2	d2
From general inflation			d3	d3
Closing balance sheet of the asset owner				y = x-a+b+c+d

Special cases for fixed assets

There is nothing in the description above of the measurement of fixed assets and their ability to generate income which is dependent on any physical characteristics of the asset. Exactly the same treatment can be applied to intangibles as to goods. The only difference may be that while goods suffer physical deterioration, intangibles, which are typically based on embodied knowledge, reach the end of their useful life because they become intellectually obsolete. This may happen

---

[3] The content of this short paragraph was the subject of discussion with Erwin Diewert. I am grateful to him for the formal derivation of the assertion in this sentence. The proof is included as an annex to the paper.

because new developments provide newer and more effective knowledge-based products or because the copyright protection which applied when the product was new expires. An exception is the case of partially complete service deliverables such as a travel agencies services or consultancy reports but these should be treated as inventories of work in progress.

Nor is there anything in the general discussion on fixed assets which is dependent on the type of production in which the asset is used, specifically whether that production is market or non-market. Prior to the 1993 revision of the SNA, there was discussion about whether an opportunity cost of capital should be included in the output of non-market services when this is measured as the sum of costs. The proposal now is subtlety different. It is the recognition that even assets used in non-market production benefit from an increase in value from one year to the next because the future income streams they generate become closer. Accepting that this return to capital is a form of income to be included as net operating surplus ensures consistency with similar assets used in market production, or indeed with similar assets used in non-market production where output can be valued by using a market equivalent rather than the sum of costs.

A third area where the view of the link between asset value and income can be useful for the national accounts is in the area of owner occupied housing. In principle equivalent market rentals should be used but often the rental market is so shallow, or even non-existent, that this is not possible. Deriving the capital services coming from a house and adding reasonable regular maintenance costs provides an alternative way of estimating the rentals of owner occupied housing which may be more comparable across the regions of a country, over time and across countries.

Another potential insight into the role of assets in generating income comes in the case of unincorporated enterprises. Here the 1993 SNA states that it is impossible to satisfactorily separate the contribution of labour and capital to value added and these are combined in a single entry called “mixed income”. While this is realistic in terms of practical statistical observation, it is a complication for productivity studies. Having an “of which” component of mixed income which represents the estimated capital services provided by the fixed assets used leaves an implicit contribution of labour also. While there may be other factors to be taken into account (the case of land is discussed below) this route may make the division of mixed income into a labour and capital component more tractable.

Income from natural resources

Natural resources including land, mineral deposits, natural forests and wild fish stocks all contribute to production. With the exception of land, the other resources have traditionally been regarded as free gifts of nature and for that reason no estimates of depletion of resources is made in the accounts. Even without making such an adjustment, though, it is clear that free or not, these resources contribute to the profitability of an enterprise and to gross operating surplus. In this case economic rent is usually described as resource rent but part of gross operating surplus will be attributable to this and as in the case of a fixed asset, some part of the decline in value of the resource will be offset by a return to the resource. It is thus straightforward to amend figure 3 to represent the case of a natural resource[4]. This is shown in Figure 4.

Figure 4: Income generated by natural resources

	Generation of income account	Other changes in volme of assets account	Revaluation account	Natural resource
Opening balance sheet				x
Gross operating surplus	g			
Of which:				
Realisation of capital services	a			- a
Return to capital	-b			b
Changes in volume of the asset		c		c
Discoveries and re-evaluation		c1		
Other changes in volum		c2		
Changes in the value of the asset			d	d
From changes in discount rate			d1	d1
From changes in life length			d2	d2
From general inflation			d3	d3
Closing balance sheet of the asset owner				y = x-a+b+c+d

Here the entry for net operating surplus has been removed (but could be included as a memorandum item or in a satellite account). Further, the entry for other changes shows explicitly the impact of new discoveries and re-evaluations.

Own account rent

Even for countries not endowed with natural resources such as minerals and forests, the contribution of land to operating surplus, especially in farming and perhaps especially in developing countries, gives a valuable extra insight into the basic features of the economy.

Income from an operational lease of a fixed asset

It is common in most economies for some assets to be put at the disposal of another unit by their legal owner. For fixed assets, this takes the form of either operational or financial leasing. In the case of operational leasing, the owner of the asset, the lessor, has a productive activity which involves maintaining the assets in question and being prepared to make them available to others, often for short periods and often on short notice. The lessee might not be a production unit but could be a final consumer, as in the case of hire cars. However, to simplify the exposition, we will assume that the lessee is also a producer for he moment.

To the information in Figure 3, we add column's for the owner's and user's production account. In order to be clear what is happening, we also add two rows in italics which show the effective transfer of the asset other user at the beginning of the period and the return to the owner at the end

---

[4] An extensive discussion on this application of capital service theory to the valuation and accounting for natural resources is to be found in chapter 7 of Integrated Environmental and Economic Accounts 2003, (SEEA2003).

of the period. These are not accounting entries but serve only to highlight the relationship between the other entries in the table.

The user has full use of the asset for the period of the lease. During this time, a certain amount of capital services, a in this example, is used and a certain amount of return to capital is generated, b in this example. These entries are caused by the user but affect the owner and so appear in his production account. The amount of the rental paid by the user is e. If e is exactly equal to a-b, then the user is paying exactly what he would pay if he bought the entire asset for himself. If e exceeds a-b, then the owner is making more operating surplus from hiring out the asset than he could make by undertaking the same activity as the user with the same fixed asset. If e is less than a-b, then the user is at an advantage relative to owning the asset outright.

If the user wished to use the asset for only a short period, he may be prepared to pay a premium for its use, since he would avoid costs in the rest of the year. The owner will accept a short lease if he believes there will be enough short leases in the course of the year, each operating at a premium, to at least cover the decline in the value of the asset.

The main purpose of figure 5 is to show explicitly the flows associated with a fixed asset which is leased to a user other than the owner. However, for some purposes, when some units in an industry own their own assets and some rent them, it may be useful in an ancillary table to reconstruct a notional account for the renters where the value of the rentals is translated into approximate figures of operating surplus in order to look a the role of capital, whether owned or leased, as a whole.

Figure 5: Income from an operational lease of a fixed asset

	Owner's production account	User's production account	Owner's generation of income account	Other changes in volme of assets account	Revaluation account	Fixed asset - user	Fixed asset - owner
Opening balance sheet							x
Effective transfer of the asset						*x*	*-x*
Lessee/user's intermediate consumption		-e					
Lessor/owner's output	e						
Gross operating surplus			g				
Of which:							
Realisation of capital services			a				- a
Return to capital			-b				b
Net operating surplus			n=g-a+b				
Effective return of the asset						*-(x-a+b)*	*x-a+b*
Changes in volume of the asset				c			c
Changes in the value of the asset					d		d
From changes in discount rate					d1		d1
From changes in life length					d2		d2
From general inflation					d3		d3
Closing balance sheet of the asset owner							y = x-a+b+c+d

Income from a financial lease of a fixed asset

In the case of a financial lease, the owner of the asset in question has no productive activity associated with the asset. Instead it is assumed that the owner extends a loan to the user with which the owner assumes ownership of the asset. In this case, unlike the case of an operational lease, there is an actual, recorded, transfer of the asset from the legal owner to the user.[5]

Entries for the supply of capital services and the return to the fixed capital appear in the user's generation of income account. In addition, there will be an entry of interest paid in the distribution of primary income account and a repayment of part of the loan in the financial account. If we assume that the discount rate used to calculate the value of the asset corresponds to the rate of interest charged on the loan (and in this case it is difficult to see how any other rate could be justified) then the amount of interest should match the return to capital and the repayment of the loan the consumption of fixed capital of the asset.

The cumulated value of the consumption of fixed capital over the life of the asset is equal in value to the initial value of the asset. If this is the value of the loan to acquire the asset, and the loan is repaid by instalments equal to the consumption of fixed capital, then the loan will be exactly paid off a the end of the asset's life. But only if there is no change in interest rate. We saw earlier that, when the value of an asset is calculated using net present value techniques involving a discount factor, a change in the interest rate changes the value of the asset. However, the value of the loan is nominal and not affected by interest rates. We thus have a further complexity to add to those listed in the section above on the impacts of changes in the interest/discount rate. If the discount rate falls, the value of the asset increases and the cumulated value of the consumption of fixed capital will exceed the initial value by the extent of any holding gain. Thereafter we loose the tidy link between consumption of fixed capital and repayment of capital and return to capital and interest payments on the loan. As before, we can avoid this situation by performing the calculations as if interest rates had not changed but , again as before, we must ask whether this careful expunging of the impact of interest rate changes is helpful to the users of the accounts.

Figure 6: Income from a financial lease of a fixed asset

	Generation of income account	Distribution of primary income account	Capital account	Financial account	Other changes in volme of assets account	Revaluation account	User's balance sheet	Owner's balance sheet
Opening balance sheet (asset)								x
Acquisition of the fixed asset			x				x	-x
Incurrence of a financial loan				-x			-x	x
Gross operating surplus	g							
Of which:								
Realisation of capital services	a						- a	
Return to capital	-b						b	
Net operating surplus	n=g-a+b							
Interest on loan		-b						
Repayment of capital				a-b			a-b	a-b
Changes in volume of the asset					c		c	
Changes in the value of the asset						d	d	
Closing balance sheet - asset							x-a+b+c+d	
Closing balance sheet - loan							-(x-a+b)	x-a+b

[5] In practice, the assumption of ownership by the legal owner may not be recorded in the SNA but only a purchase of the asset by the user.

Income from leasing natural resources

There are some interesting features of leases of natural assets which mean that they are not quite like operational or financial leases. As with a financial lease, the capital services and the return to capital accrue to the exploiter and not the owner of the asset. Like an operational lease, ownership of the asset remains with the legal owner.

There are two sorts of leases on natural resources. Land is characteristic of the first sort. Typically the landlord grants a tenant the right to use the land exclusively for a fixed period of time[6]. The land may be used for farming or may underlie a building. If the lease runs for n years, then the income stream coming from the land for years 1 to n accrue to the tenant. The income from years n+1 to infinity accrue to the landlord. One obvious way to deal with this is to split the value of the asset, with the tenant holding that part which relates to the first n years and the landlord holding the remainder. If there is land rent payable each year, then this should be deducted from the income stream used to calculate the net present value of the tenant's asset and should be added to the income stream for the landlord. The use of capital services will show only in the production account of the tenant but the return to capital will be split between the two owners since at the end of the first year, the future income for both has become one year nearer. Changes in volume and price of the asset also need to allocated between the lease period and later and attributed to the tenant and landlord respectively. This scenario can be shown fairly simply in figure 7 but it is not uncontentious[7].

Figure 7: income from a lease on a natural asset

	User's generation of income account	User's distribution of primary income account	Ower's distribution of primary income account	Other changes in volme of assets account	Revaluation account	Natural resource - user	Natural resource-owner
Opening balance sheet							x
Effective transfer of the asset						x1	x2=x -x1
Gross operating surplus	g						
Of which:							
Realisation of capital services	a					-a	
Return to capital	-b1		b2			b1	b2
Land rent/royalties		-e	e				
Changes in volume of the asset				c		c1	c2
Changes in the value of the asset					d	d1	d2
Closing balance sheet of						x1-a+b1+c1+d1	x2+b2+c2+d2

One alternative is that instead of paying a land rent every year, the tenant may pay a single sum up front when he takes over the use of the land. This is especially common for land under buildings in some countries. The tenant usually acts as if he owned the land and may be liable for restrictions on its use as if indeed he did. This possibility could be accommodated in Figure 7 just by removing the line for land rent/royalties.

---

6 In my view a landlord who allows a caravan to park for a few days at a caravan site or a motor scramble to take place on a fixed day is engaged in operating leasing and the payments should be regarded as rentals and service outputs. But this is not the source of most income from land and is not further discussed here.

7 Note there is no provision for the entry of b2 in the accounts at present, that is a return to capital not being used in production. In Figure 7 it is placed in the distribution of primary income account as a marker only.

The second sort of lease on a natural resource is where one party is licensed to extract the natural resource. This sort of lease is significantly different from the land lease because the resource in question will not be returned to the owner at the end of the period, or at least not in exactly the same state. In the case of minerals, there will be no return in future; in the case of forests or fish stocks there may be a stock of plants or animals at the end of the lease but these may not have exactly the same demographic or other characteristics as at the beginning of the lease. There may be a one off payment for this right up front but more usually the proceeds from the extraction will be split between the owner and the extractor. In this profit sharing venture, the owner, often government, is a sleeping partner but one with the ultimate control over the resource in question.

Many commentators are uneasy with splitting the value of the asset between the extractor and the owner. However, some would allocate the whole value to the extractor and some the whole value to the owner. In either case, showing how extraction affects the remaining wealth of the two parties is not obvious. An alternative which formally avoids splitting the same asset may be to designate an extraction licence as an asset distinct from the resource itself. The value would still be determined by the net present value of the income stream the licence was expected to bring to the licence-holder and this amount would be deducted from the value of the resource to the owner. In practical terms, the effect of this would still be as in figure 7.

What emerges from this is that we may need to specify a third kind of lease, a resource lease, which is distinct from both operational and financial leases and, possibly, make a distinction between a resource lease where the resource is ultimately returned to the owner and an extraction license when it is not.

Income from financial assets

Financial assets are different from non-financial assets in one crucial respect. Since they are always denominated in monetary terms, there is no need to approximate their value by means of a net present value calculation. This does not means that they do not obey the same principles, however. A financial asset of 100 retains this value in perpetuity (in nominal terms). At the end of a year, interest would have increased its value to (1+r)100 but today’s value of that amount is still 100 because the increment coming from postponing use of the asset is exactly offset by the discount necessary to reach a present day valuation. Further, as with fixed assets, the increment in value in an asset which comes about because the future income stream to which it refers is one period closer should also be deemed to be income.

Only two types of financial assets are discussed at present, deposits and loans and households net equity in pension funds.

Deposits and loans

The 1993 SNA states that property income received from the investment of own funds should be excluded from the calculation of FISIM. This has sometimes been taken to imply that no service charge arises in respect of lending own funds. The example in figure 8 is intended to show this need not be the case.

In this example a bank receives a deposit of z and makes a loan of y which is larger than z by an amount x. This amount, x, is therefore the bank’s own funds lent to the borrower. The interest rate charged to the depositor is r+s1, that to the depositor is r-s2. By decomposing the amounts payable to and receivable from the bank into a 'pure' interest element and the service component, we see that the amount of property income earned on own funds, rx is exactly equal to the difference between the interest payable by the borrower less than payable to the depositor. This amount, though, is not part of the service charge received by the bank, s1.y+s2.z. Indeed the borrower is indifferent whether he borrows intermediated funds or own funds and will pay the same interest rate and the same service charge on both.

On all funds, therefore, whether intermediated or "own" a partition of apparent interest is made so that only that part which would correspond to an appropriate discount factor is recorded as interest with the rest showing as a service charge. In the case of deposits and loans, the amounts owed to the bank by the borrower and to the and by the bank at the end of the year are less then the discounted value at the start of the year but this is entirely due to the service charge payable to the bank.

Figure 8: Income generated by deposits and loans

	Borrower	Depositor	Bank
Opening balance sheet		z	x
Deposit made at bank		-z	z
Loan made by bank	y		-y
Interest rates on loans and deposits	(r+s1)	(r-s2)	
Service charge payable to bank	-s1.y	-s2.z	s1.y+s2.z
Interest payable to (-) receivable from (+) bank	-r.y	r.z	r(y-z)

Households net equity in pension funds

The mechanics of the way in which the reserves in a pension fund are built up are well known. The employer makes a contribution which is routed via the employee who may add to this contribution. In addition, there is property income attributed to the employee by the pension fund managing the fund on his behalf. These flows are shown schematically in figure 9. What is of interest here is what they represent and how they should be calculated.

The contribution of both the employer and employee in the year, c+d in this example, represents the addition to the future pension entitlement of another year's service. The augmentation of the fund from the investment income attributed to the employee, b, represents the increase in value of the entitlement previously accrued because his pension date is one year nearer. Looked at in this way a number of issues arise. If the fund is a defined benefit type, the value of his entitlement is calculated using a net present value applied to the percentage of his salary earned to date, the gap between now and expected retirement and his expected longevity. In this case, the amount of augmentation is pre-determined and is not affected by the source of the funds used for the augmentation. In such a scheme, the investment income of the fund may be quite volatile from year to year. In years of high investment income the fund will be able to create unusually high reserves which it will call on in less good years to supplement its investment returns to meet its pension commitments. To the beneficiary of the pension scheme it does not matter how the fund finds the money, simply that it does so. Thus the stricture that the augmentation should exclude holding gains in investment income is mis-conceived. It confuses the nature of income for the pension fund with the nature of the payment due to the employee. It is possible to imagine a case where a retail enterprise pays income tax from the holding gains made on inventories, but we would not exclude this amount from taxes due and paid because of the source of the funds to meet them.

Note that the amount due for the augmentation of the value of the pension for previous year's service to an employee with an unfunded scheme should clearly be set to be the full value of he increase in the pension entitlement. We are thus in the anomalous situation if the SNA is changed to include liabilities for unfunded schemes without changing the basis of the allocation of property income, then an employee belonging to an unfunded scheme may have a greater notional increase in pension than someone with a more secure pension belonging to a funded scheme.

What of the employee with a defined contribution scheme? Here we have a problem of symmetry between employees with different sorts of pension schemes and possibly between those with the same type of schemes but different management approaches. An employee with a pension invested entirely in government bonds will appear to be better off than someone whose pension funds are invested in equities in a year when the stock market does well. (He may actually do better in a year when the stock market performs poorly.) But in fact pension funds, like many other securities, operate with a smoothing mechanism for distributing investment income and it is not clear that it is helpful for the SNA to step into the allocation and decide to remove holding gains as and when they occur.

Figure 9: Income generated by a pension fund

	Employer	Employee	Pension fund
Start year value of fund			x
Investment income of the fund			a
Attributed to employee			b
Employer's contribution	-c	c	
Employee's combined contribution to the fund			c+d
End year value of fund			x+b+c+d
Retained by pension fund			a-b

This raises a much more general question. The SNA is clear that holding gains are not production and so, in measuring output and intermediate consumption we rightly go to some pains to ensure that there are no holding gains and losses included from goods produced or purchased in a previous period. Nor would it make sense to include gains on the value of fixed assets in the value of output of the enterprises using these assets (including owner occupied housing). But perhaps the situation for financial institutions is different. It is their business to obtain the best return to the capital entrusted to them by clients. If they make a considerable improvement in the value of a deposit by investing in securities or equities rather than in lending at a rather low interest rate, shouldn't the depositor be at least as well off, preferably better off, than in the more conservative case? And shouldn't the financial institution also generate more production?

The case of pension funds is a nice one to consider because is possible to see quickly what the returns from investment "should" represent. But there is a much more general question. While continuing to exclude holding gains and losses from measures of production, are we quite sure we also wish to continue to exclude them from all measure of property income? It is true that by including them, the output of financial institutions would change because we use property income as a device to find a proxy measurement for them. But perhaps the version including holding gains and losses would be a better proxy. If we included some holding gains which were not exactly balanced by holding losses, we might have to contemplate breaking the absolute identity between GDP measured from the three sides and say that in fact we have a measure of production, of income and expenditure which we can perfectly reconcile but which are not absolutely equal because of different measurement conventions. Is this truly inconceivable?

Conclusions

The aim of this paper is two-fold. One objective is to make clearer to novice national accountants and to users of the accounts the links between the assets of the SNA and the income flows they generate and other flows they attract. The second is to explore the implications of viewing the income flows as comprising two elements, a service flow and a return to capital. This view casts light on some of the longstanding and thorny dilemmas of the accounts. Should there be a return to the assets of non-market producers in the system? How can we hope to separate the contribution of capital from the contribution of labour in an unincorporated enterprise? How should we value and account for the contribution of natural resources to the economy? At the same time some other problems emerge. How should the SNA measure the effects of changes in interest rates on the valuation of assets? If the economic benefits from an asset are shared by two units, how should this be reflected via the ownership of the asset into the measure of wealth of the two units? Should the sources of funds affect how their deployment is recorded? These questions are still under discussion in the various fora considering the changes to be made in the SNA in the course of the current review and could prove some of the most significant and challenging.

A Note on the Effects of a Real Interest Rate Increase on Asset Lives

Erwin Diewert,
Department of Economics,
University of British Columbia,
Vancouver, Canada, V6T 1Z1.
Email: diewert@econ.ubc.ca

August 9, 2004.

Anne Harrison in an email raised the issue of whether an increase in the real interest rate would increase or decrease asset lives. The answer to this question requires that we have a model where the length of life that an asset is used is *endogenously* determined by the model.[8] In this note, we consider two models and attempt to answer Harrison's question. In Model 1, which assumes constant real revenues for the asset and geometric real growth rates for complementary inputs, the answer is no. In Model 2, which assumes constant real gross revenues and a profile of increasing maintenance expenditures, the answer is also no. However, other endogenous asset life models may well give a different answer to the question.

Model 1: Geometrically Increasing Complementary Asset Expenditures

Let R^t be the gross revenue that can be attributed to the use of an asset in period t and let C^t be the corresponding period t costs that are complementary to the use of the asset or required in order to maintain it in working condition. If the interest rate that the user of the capital faces is r (constant over time for simplicity), then the asset value from the perspective of period 0 if it is used t periods is A(t) defined as follows:

$$(1)\ A(t) \equiv R^0 + R^1/(1+r) + R^2/(1+r)^2 + \ldots + R^{t-1}/(1+r)^{t-1} - [C^0 + C^1/(1+r) + C^2/(1+r)^2 + \ldots + C^{t-1}/(1+r)^{t-1}].$$

In order to further simplify the model, we assume that $r > 0$ is a real interest rate and gross revenues are constant in real terms over all periods but that costs accelerate over time at the (real) rate of cost inflation, $i > 0$, so that

$$(2)\ R^t = R^0\,; \qquad t = 1,2, \ldots$$
$$(3)\ C^t = C^0(1+i)^t\,; \qquad t = 1,2, \ldots$$

where

$$(4)\ 0 < C^0 < R^0 \text{ and } 0 < i \text{ and } 0 < r.$$

Under these assumptions, A(t) becomes:

$$(5)\ A(t) = R^0 - C^0 + (1+r)^{-1}[R^0 - (1+i)C^0] + (1+r)^{-2}[R^0 - (1+i)^2C^0] + \ldots + (1+r)^{-(t-1)}[R^0 - (1+i)^{t-1}C^0]\,.$$

Define g(t) as follows:

$$(6)\ g(t) \equiv [R^0 - (1+i)^{t-1}C^0]\,; \qquad t = 1,2,\ldots\,.$$

[8] For examples of endogenous life models, see Diewert's (2001) linearly increasing maintenance expenditures model or Harper's (2002) generalized Solow vintage model.

Note that $g(1) = R^0 - C^0$ is positive and that g(t) monotonically decreases as t increases, becoming negative eventually, since i is assumed to be positive. The beginning of period 0 asset value, A^0, can be defined as the maximum A(t) where t ranges over all positive integers; i.e.,

(7) $A^0(r,i) \equiv \max_t \{A(t): t = 1,2,\ldots\}$.

Let t* be the unique positive integer such that:

(8) $g(t^*) \geq 0$ but $g(t^*+1) < 0$.

Using (5) and (6), it can be seen that this t* solves the integer programming problem (7) so that the asset value A^0 is equal to:

(9) $A^0 \equiv A^0(r,i) = A(t^*)$

where A(t) is defined by (5) and t* is defined by (8). Note that if we increase the real interest rate r, then g(t) defined by (6) does not change and hence t* does not change as r changes. Thus *in this model, an increase in the real interest rate does not lead to a change in the length of time that the asset is used*.

By examining (5) for t = t* and noting that each term in square brackets is nonnegative and independent of r, it can be seen that *as the real interest rate increases, the asset value will decrease*; i.e., we have:

(10) $A^0(r',i) < A^0(r,i)$ for all $r' > r$.

Now consider the case where i increases to i′ (but i′ is still less than r). In this case, g(t*) defined by (6) when t = t* will decrease and if the increase in i′ is big enough, g(t*) will become negative. Hence *as the inflation rate for complementary inputs increases, the optimal length of life t* will decrease* (or at least not increase). It can also be seen that *as the inflation rate for complementary inputs increases, the asset value will decrease*; i.e., we have:

(10) $A^0(r,i') < A^0(r,i)$ for all $i' > i$.

All four of the above comparative statics results are intuitively plausible, except perhaps for the first result, that asserts that a change in the real interest rate will *not* affect the asset life.

Model 2: Time Increasing Complementary Asset Expenditures

As in the previous model, we assume that r > 0 is the real interest rate and gross revenues are constant in real terms over all periods so that assumption (2) holds. However, we now assume that complementary costs are equal to a nonnegative fixed cost, $C^0 \geq 0$, that is constant over time but that costs accelerate over time according to the general function M(t), so that period t complementary costs, C^t, are given by:

(11) $C^t = C^0 + M(t)$; $t = 0,1,2, \ldots$

where M(t) is a monotonically increasing function in t that in addition, satisfies the following conditions:

(12) M(0) = 0 and M(t) tends to plus infinity as t tends to plus infinity.

Thus in plain language, we are simply assuming that complementary costs increase over time. We assume that:

(13) $0 \leq C^0 < R^0$ and $0 < r$.

Under these assumptions, the asset value if it is used t periods, A(t) defined by (5), becomes:

$$A(t) = R^0 - C^0 + (1+r)^{-1}[R^0 - C^0 - M(1)] + (1+r)^{-2}[R^0 - C^0 - M(2)] + \ldots + (1+r)^{-(t-1)}[R^0 - C^0 - M(t-1)]. \quad (14)$$

Define h(t) as follows:

$$h(t) \equiv [R^0 - C^0 - M(t-1)] ; \qquad t = 1,2,\ldots . \quad (15)$$

Note that $h(1) = R^0 - C^0$ is positive and that h(t) monotonically decreases as t increases, becoming negative eventually under our monotonicity assumptions on M(t). The beginning of period 0 asset value, A^0, can be defined by (7), where A(t) is now defined by (13).

Let t* be the unique positive integer such that:

(16) $h(t^*) \geq 0$ but $h(t^*+1) < 0$.

Using (14) and (15), it can be seen that this t* solves the integer programming problem (7) so that the optimal asset value A^0 is again defined by (9).

The properties of Model 2 with respect to the real interest rate r are exactly the same as the properties of Model 1 above: if we increase the real interest rate r, then h(t) defined by (15) does not change and hence t* does not change as r changes. Thus *in this model, an increase in the real interest rate does not lead to a change in the length of time that the asset is used*.

By examining (14) for t = t* and noting that each term in square brackets is nonnegative and independent of r, it can be seen that *as the real interest rate increases, the asset value will decrease*; i.e., we have:

(17) $A^0(r',i) < A^0(r,i)$ for all $r' > r$.

Now consider the case where the marginal complementary cost functions shift upwards[9] to M*(t) so that

(18) $M^*(t) > M(t)$; $t = 1,2, \ldots$.

Let A(t) be defined by (14) and h(t) by (15), except that the functions M*(t) replace the functions M(t) for t = 1,2, … . As usual, we define the optimal asset value by solving the integer programming problem (7) with our new definitions for the functions A(t). It can be seen that the new t* defined by (16) will always be equal to or less than our previous t* under our new assumptions. Hence *as the costs for complementary inputs increase, the optimal length of life t* will decrease* (or at least not increase). It can also be seen that *as the costs for complementary inputs increase, the asset value will decrease*.

[9] It can be seen that Model 1 is a special case of Model 2.

Conclusion

For the two classes of endogenous life of asset models that we have considered, a change in the real interest rate did not change the optimal asset life. Furthermore, an increase in the real interest rate led to a decrease in the asset value in both models. However, an increase in the profile of intertemporal complementary costs will lead to a shortened asset life and a decreased asset value.

References

Diewert, W. E. (2001), "Measuring the Price and Quantity of Capital Services under Alternative Assumptions", paper presented at the Second Annual Joint NBER and CRIW Measurement Workshop, Cambridge Massachusetts, July 27, 2001.

Harper, M. J. (2002), "Technology and the Theory of Vintage Aggregation", paper presented at the Third Annual Joint NBER and CRIW Measurement Workshop, Cambridge Massachusetts, July 30, 2002.