

Angus Deaton and consumption in Scotland

Hervey Gibson

This article started as a personal *festskrift* celebrating Scotland's latest Economics Nobel Prize winner. It aimed to outline his work and then apply some of his methods to data that is used to monitor the Scottish economy.

However the data turns out to hide a hornets' nest. The hornets have to be dealt with if Scottish Ministers and Parliament are not to be stung when they start to use their new powers under the Scotland Act to manage the economy.



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Angus Deaton, from Bowden in the Scottish Borders, won the 2015 Nobel Prize in Economic Science. On 10 December 2016 in the Stockholm Concert Hall, he stooped from his almost-two-metres height to accept the medal and diploma from the King of Sweden. The Nobel Committee's celebratory poster (pictured above) shows this friendly giant, the second Scottish Nobel Economics laureate after Jim Mirrlees, peering through a microscope at the world. Dressed in tartan suit (which may be apocryphal), but with a characteristic bow tie, Deaton was seen to be analysing people's consumption, poverty and welfare.

In this article we look at Deaton's early career, then seek to apply his Nobel Prize methods to inspect the available data on Scottish consumption and to estimate the economic model which was his first major contribution to applied economics.

1. Early career

Growing up in Roxburghshire as the son of a night-school-educated water engineer, Angus started on his academic path by gaining competitive admission to two elite educational institutions. He was one of only two Foundation (free) Scholars admitted in 1959 to Edinburgh's Fettes College. Fettes is now, and

probably was then, the most expensive and, in exam terms, most successful of Scotland's private schools. He distinguished himself on the rugby pitch and in chairing discussion groups, and the one-on-one teaching at Fettes taught him to write with clarity and wit. He gained access to further essay-based one-to-one teaching by winning an Exhibition at Fitzwilliam College Cambridge. The Exhibition was to read mathematics, but the man from Melrose is happy for it to be described as a 'football scholarship' – Fitz's first XV was in need of second-row forwards.

However Cambridge rugby could be ugly, and the maths (perhaps conceptually elegant) was tough and poorly taught. As an alternative to rustication (being thrown out) Deaton switched to economics for Part II of his BA and MA, before going to London to work for the Bank of England.

After a short time at the Bank, Angus returned to Cambridge, to take a D Phil, in due course becoming part of the Cambridge Growth Project. From the mid-1960s the aim of this group of around eight researchers was *'to study quantitatively in as great detail as possible the present structure and future prospects of the British economy and the possibility of influencing these prospects through economic policy.'* (This is much the same goal as the Fraser of Allander Institute has pursued for Scotland since its creation in 1975.)

Richard Stone, the Project founder, had switched from law as an undergraduate before working with Keynes in the wartime Treasury. Deaton describes him as his mentor, and Stone described them as being 'on the same side of the movement'. Stone also won a Nobel Economics Prize in 1984 for developing the social accounting methods on which the UN System of National Accounts was based. From those same methods the Growth Project's computable model, embodying the team's research, was constructed.

The second Director of the Project, Terry Barker (schooled at Edinburgh's Watson's) also switched into economics from another discipline, going to the Project after an accounting MA from Edinburgh. Barker contributed as coordinating lead author to the UN's International Panel on Climate Change, which was awarded the Nobel Peace Prize in 2007. His work for the prize was focused on the economics of greenhouse gas mitigation. The energy-economy-environment '3-E' models he helped introduce to Europe and the world began with the Growth Project model.

The part of the model that Deaton was detailed to study was consumption, where he had to follow path-breaking work 15 years earlier by Stone himself, updated and developed by earlier CGP members. He began with a paper analysing UK consumer spending 1900-1970, and in the mid-1970s produced about a dozen papers, touching also on finance and on the computing and estimation aspects of the time.

Cambridge is famously stingy with its Professorships, and quite stingy with its money. In economics this was sometimes presented as a deliberate (and very successful) strategy to generate a diaspora, so in 1976 Deaton went off to become Professor of Econometrics at the University of Bristol. This was where he produced his seminal work, discussed at greater length below, and where he developed contacts and collaborations, especially across the Atlantic.

'An almost ideal model'

One of those contacts was John Muellbauer, who shortly thereafter had returned to the UK to Birkbeck College, London. While at Bristol, in 1980 Deaton and Muellbauer wrote an article rated among the most influential ever in economics. *An almost ideal demand system* (Deaton & Muellbauer, 1980) was ranked in the top 20 papers ever published in the *American Economic Review*, which is the top-rated journal in the profession. A textbook, *Economics and consumer behaviour* (Deaton & Muellbauer, 1980) followed shortly afterwards, and set the model in its intellectual context.

Essentially the book argues from fundamental economic welfare axioms to a set of equations that is easy to use, does not ride roughshod over theory and logic, and tends to produce results that are either 'as expected', or interestingly at variance.

The basic structure of Almost Ideal Demand Systems (AIDS) is to divide consumption into a number of categories. There is one equation for each category, focusing on the 'budget share', the proportion of total spending that it absorbs. This share is explained in terms of the overall volume of expenditure, and the price of each category. From a purely practical viewpoint, these equations have many advantages over other formulations.

They are **easy to estimate** – both the fitting and a fair amount of testing can be performed with very basic software. The results in this paper were all obtained within Excel – the diagnostic statistics and tests are not the most elegant, but they are adequate.

They are **consistent with theory**. Deaton and Muellbauer go to great lengths to show how their model structures are consistent with realistic and simple assumptions about individual behaviour, and consistent with the motives behind it, which can be expressed in formal economic terms.

Their algebraic structure or functional form gives them **good long-run behaviour**, increasing the chances they will produce sensible results if the variables (explanatory or objective) move outside the historically observed range¹. For example, consumption of a good reacts absolutely and proportionally more strongly to price shifts when it absorbs a larger share of the household budget: we care more about prices when we are spending a lot of money on a good or service.

They are **easy to elaborate**, for example to cover data difficulties, or to add extra variables – for example I have used the age and fuel-efficiency of cars when investigating petrol demand, and weather variables when looking at tourism.

¹ *In the long run, choosing an appropriate and well-behaved functional form for a model is usually more important than estimating coefficients. The main coefficients normally take care of themselves. The fitted curve will go through the centre-of-gravity of the data, unless there is good reason otherwise. (Whether it should or not is an important thing to consider in specifying/selecting the data). The 'slope' (local first differential) of the main explanatory variable is also likely to closely reflect the data. Beyond this, you are lucky if you have data of a quality and in sufficient quantity to be very discriminatory when it comes to higher-order effects.*

2. Scottish consumption; the data, what do Scots consume and how do we know?

Some applied economists work from the theory to the data, and others from the data to the theory. Although Angus is ambidextrous in this respect, we start with the data. In a reflective piece that provided lots of information for this article (Deaton, 2013) he comments that ‘Economists spend a lot less time with the creators and producers of data than once was the case, to the detriment of both groups; economists often do not understand the data they work with, and the evolution of national income accounting practice has taken place without much input from users’².

Although this may contain more than a grain of truth in the UK, this is less the case in Scotland, where since the late 1990s the situation has been getting progressively better. Before 1997 there was less regular statistical information about the Scottish economy than was published *in English* about the Icelandic economy. Devolution and the advent of the internet seem to have changed all that. Scottish national accounts statisticians now work physically in the same Office as the Government’s Chief Economic Advisor and his economists, and collaborate on many informal joint teams. Their engagement with outside users in the Economic Statistics Consulting Group, the Input Output Expert Users Group, and the Oil and Gas Statistics Group eclipses that of the much larger Office for National Statistics (and the Fraser of Allander Institute is notable amongst those outside users).

But Scottish resources are still very limited, and Scotland relies heavily on raw data collected and processed by ONS.

The data we need to estimate Deaton and Muellbauer’s AIDS model is a time series of household budgets. This we have, in the Scottish National Accounts Project, covering twelve items.

2.1 How the Scottish Government estimates the value of consumption

Scottish data on consumption is produced by the Scottish Government primarily using data from the ONS Living Costs and Food Survey (LCF) and the quarterly publication *Consumer Trends*.

Now formally part of the Integrated Household Survey, LCF is the current embodiment of the Family Expenditure Survey that started in 1957. It is a survey conducted continuously throughout the year with an annual sample size across the UK of 6,000, so there are slightly fewer than 500 households in Scotland. The survey reports on the consumption of over 70 items. In the UK National Accounts its results are balanced with other information to generate a time series of *Consumer Trends*, showing the value and volume for the UK on a quarterly basis.

In tracking the value of Scottish consumption, the approach of Scottish Government statisticians for the quarterly Scottish National Accounts is to take the ‘Scottish’ proportion for each of these 70 items’ figures. The Scottish proportions reported in the latest LCF range from 17.4 per cent of all the preserved fruit bought by UK consumers to 1.2 per cent of the ‘mixed mode’ travel tickets. Thus their figures are essentially a reweighted version of ONS’s consumer expenditure figures for the UK. When it is grouped

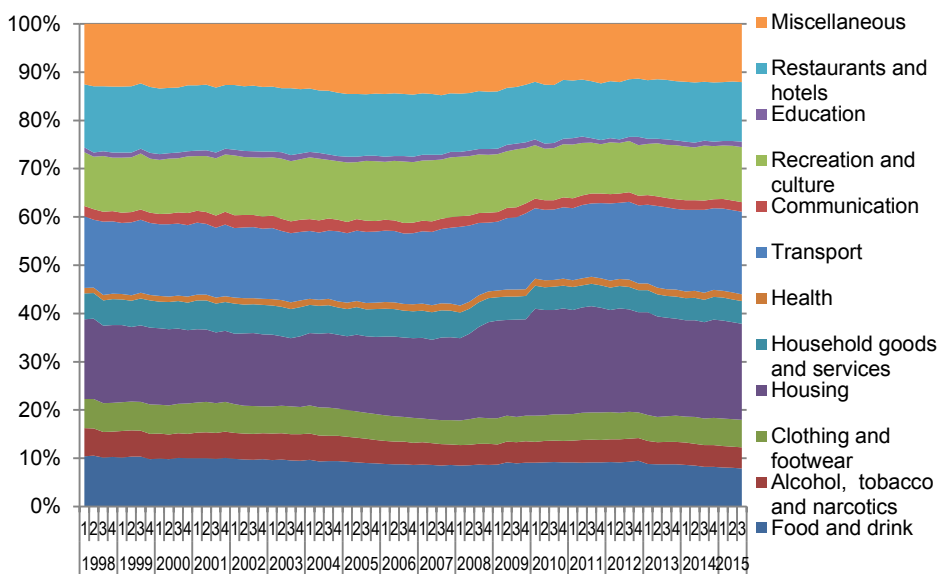
² I have edited out the adjective ‘academic’ from Deaton’s description of users.

into twelve categories according to purpose, Scottish Expenditure as a proportion of the UK ranges from 10-11 per cent for restaurants and hotels to 4-5 per cent for education. The higher figure for the former group represents a Scottish penchant for pubs and carry-outs, and the lower figure for the education comes from differences in University fees and financing.

2.2 What this indicates about shares of Scottish household budgets

When the budget shares are plotted over 18 years, the picture is one of relative stability, except for a large increase in the housing component from early 2008 to early 2010 where the share of Scottish consumers' expenditure on housing went up from 17 per cent to 22 per cent.

Figure 1 Composition of household consumption in SNAP



Source: Scottish National Accounts (20160210)Ref:F:\Data\SGDP\SNAP\Tables at 20160210.xlsm

However, given that the volume of housing consumed cannot have changed very much over such a short period the answer must lie in the cost of housing. Sure enough, the price deflators in the Consumer Trends reference tables on the ONS website show an increase of 19.3 per cent in the rentals paid by tenants and 27.5 per cent in the rentals that owner occupiers are 'deemed' to have paid themselves as property owners. This brings us on to the next set of data required to estimate the Almost Ideal Demand System, prices.

2.3 Data on prices

There is in effect no data available on Scottish prices. ONS collects data on a UK-wide basis, and only publishes prices for regions and countries every six years, in order to comply with EU directives. Data was published for 2004 and 2010, and they indicated that the overall price level was very uniform across the UK. However, more detailed data, which may have shown more variation, was not reported.

Although the ONS, and the UK Statistics Authority, recognise that there is a demand for more frequent regional price indicators, ONS has little appetite for what it sees as an expensive task. Sir Charles

Bean, former Deputy Governor of the Bank of England, is currently leading a review of UK economic statistics. But with a great deal else on the agenda it is unlikely that the Bean Report will prioritise regional prices. The last Bank-inspired review of economic statistics, the Allsopp Report in (2004), did. At the time of Allsopp's publication, ONS expressed an intention to implement most of its recommendations, but since then the ONS has retrenched – or been obliged to retrench – from the great majority, including the analysis and publication of regional prices.

So, in the absence of accurate Scottish price data, if we wish to analyse Scottish consumption we are obliged to use UK-level price indices.

But the UK data has major issues estimating the price of the largest single component of consumption, housing. Two different methods applied by ONS yield diametrically opposing views of the past decade. A third, suggested by Eurostat, gives an entirely different (and much more extreme) picture. And a fourth, more flexibly applying similar principles, gives yet another view.

Part of the problem lies with the structure of the housing market. In the UK as a whole, 17 per cent or a sixth of all housing (23 per cent in Scotland) is rented from social landlords, and a sixth (15 per cent in Scotland) from private landlords. There are quite significant surveying difficulties measuring the 'price' that should be applied to the private renting category, and this is done differently in each of England, Scotland, Wales and Northern Ireland; and in England and Wales it's about to be changed.

But in most of the housing market there isn't really a price at all. Across the UK, a third of houses are owned outright by their occupiers, and a third are being bought with a mortgage (62 per cent for these two groups together in Scotland). For these a 'price' of owner occupation, 'imputed rent', is calculated. This is a sum which home-owners are deemed to pay to themselves. Although not part of 'consumer spending' in the common sense of the term, it has to be included so that the choices of owner-occupiers and tenants are as comparable as possible. It is also required by international accounting standards, to make different countries more comparable.

In short, the figures went haywire in late 2009 and at the beginning of 2010. Over these two years there was a 19.3 per cent increase in 'actual rents', which are composed of private sector and social housing rents across Great Britain. Such a large increase in an economy sliding into depression is surprising. In the published data we cannot peel the social and private elements apart, but if this increase really happened, it may have been a consequence of structural shifts affecting landlords in the buy-to-rent market, and of the finance provided for that market as financial institutions crashed.

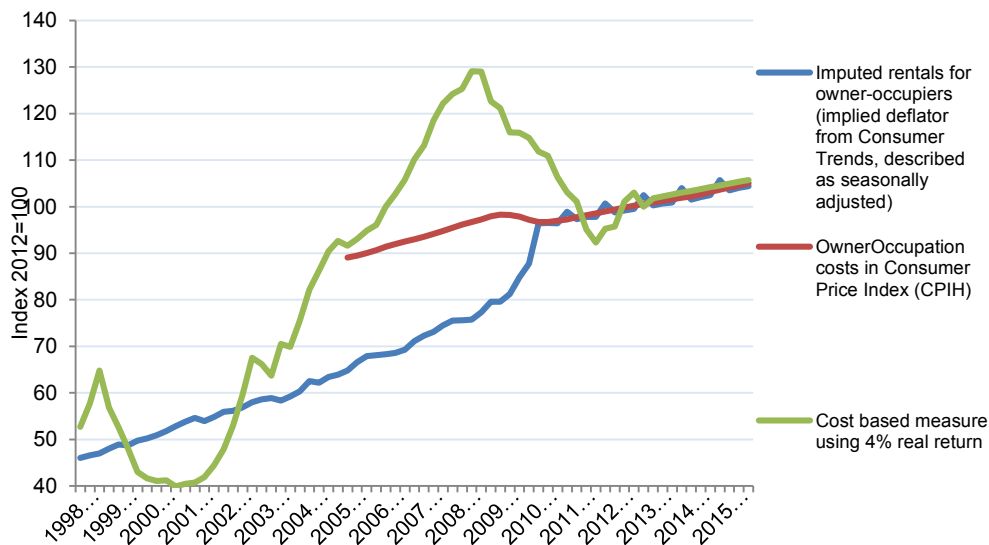
Whatever the problems that arose in assessing private rents, they were multiplied by five in UK calculations and by more than six in Scotland as private rents are used to stand in for imputed rents. ONS uses a 'proxy' model which aims to estimate imputed rent on the basis of actual private sector rents. This model generated an increase of 27.4 per cent in imputed rentals. The model decided that we were all spending much more money on consuming housing, and it was this that generated the step up in housing's budget share.

We need to ask ourselves what was happening to the value of the housing services that owner-occupiers were providing to themselves? Surely in fact the reverse was true; they were dropping like a stone. House prices were weak and falling, mortgage interest rates were almost halving. Even if you didn't have a mortgage, inflation and real investment returns had collapsed. So why should the return on housing investment go up?

And the numbers are dramatic. According to Registers of Scotland the average house price in Scotland fell from £158 700 in 2008 Q2 to £146 000 one year later. And the Bank of England says the mortgage rate fell from 7.7 per cent at the turn of 2008 to 4.0 at the turn of 2010. If, for the sake of drama, we apply the high rate to the high price and the low rate to the low price, then the cost of servicing a mortgage went down by 52 per cent! A more statistically fair approach based on quarterly averages give a drop of 47 per cent, which is barely less dramatic.

The European System of Accounts (ESA) does have a provision to take such factors into account. In its methodology, Eurostat prefers matching imputed rent to 'actual' rental markets. But, 'in the absence of a sufficiently large rental market', a cost-based method calculated from house prices to give a constant real rate of return can be used. This I did, using the Bank of England's 4 per cent the rate of return.

Figure 2: Measures of housing inflation for owner-occupiers (UK)



Source: see labels Ref: F:\Data\Prices\Consumer deflators \consumer deflators 2015Q3.xlsx

Even this is not the whole story. The ONS database for the Consumer Price Index including owner-occupation (CPIH) tells a completely different story from the 'price deflator' used in the national accounts and the Consumer Trends estimates. It *does* show a fall in owner-occupation costs, albeit a small one.

However, relief may be at hand. Last week ONS came to Edinburgh's Assembly Rooms to talk to users. I asked them to explain the mess that was owner occupiers' costs. It obviously hit a nerve. Several of them jumped up to say that it is being fixed, and all will be clear in the National Accounts 'Blue Book' to be published at the end of July 2016. But, no explanations were given.

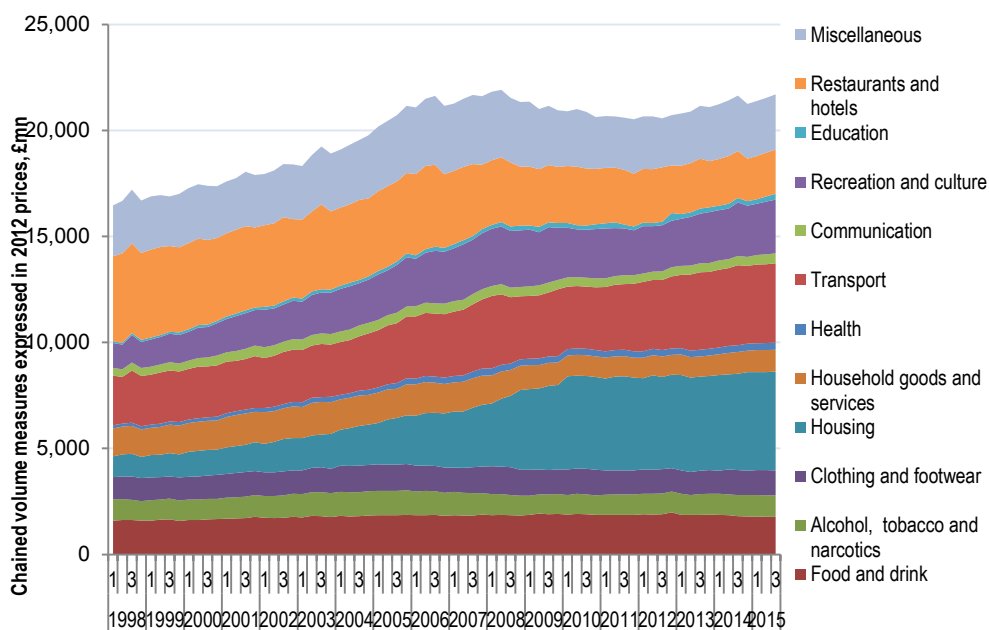
Meantime, what do we do? How do we analyse Scottish consumption when we can't trust the official price indices of the single largest item of household consumption, housing? For the final section of this paper I have constructed an index in the spirit of the Eurostat manual. However that manual was written after a period of stable real returns of the order of 3-5 per cent. Since then returns have slumped to and below zero for considerable periods, so I revalued the owner-occupied sector on the basis of actual prices times actual mortgage rates.

Thus we have *four* different bases on which to measure the cost of housing to consumers:

- The deflators implied by the UK national accounts, which show a steep rise through 2008 and 2009
- The indices collected for the consumer price index, which show a fall through 2009
- Two indices based on house prices and a return on the investment, which show very dramatic falls through 2008, extending in some formulations to 2011.

2.4 Published and calculated data on the volume of consumption

Figure 3: Volume growth in consumption in Scotland (1998-2015)



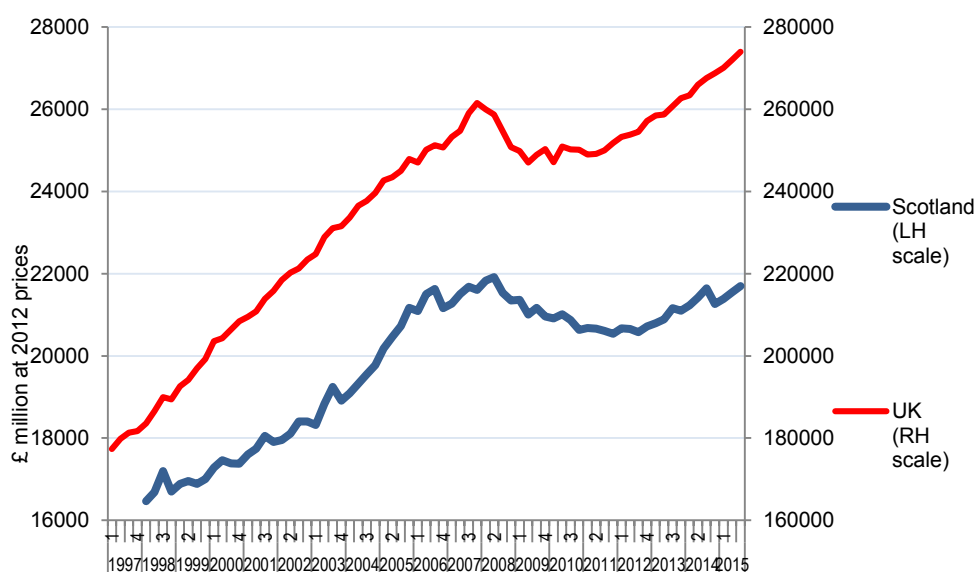
Source: Author's calculations F:\Data\SGDP\SNAP\Tables at 20160210.xlsm

The Scottish Government does not publish estimates of the volume of consumption. However, if we have price indices, we can easily make an estimate by deflating each of the twelve published consumption components. Given the dubious quality of the price indices this procedure is not ideal, but if the volume of housing services appears to evolve in an orderly way then the overall volume figure is likely to be reasonable.

The chart shows that there is no bizarre or erratic movement in any component. Nevertheless, the fact that housing provided two thirds of all consumption growth, expanding at 12 per cent per year for more than a decade, does not quieten suspicions. We should not put our scepticism away. It may well be that both UK and Scottish consumption growth have been overstated.

Since the mix of consumption is not too different in Scotland from the rest of the UK, the patterns of total consumption over time are broadly similar, but not identical. In 2008, Scotland apparently turned down into recession six months after the UK. In 2011 it turned up into recovery also six months later than the UK. But whereas the UK is now five per cent above its 2008 peak, Scotland is still one per cent below.

Figure 4: Consumer spending in real terms, Scotland and the UK 1997-2015



Source: UK: ONS Consumer Trends Scotland: Scottish Government SNAP deflated by ONS deflators Ref: F:\Data\SGDP\SNAP\Tables at 20160210.xlsm

However the taking of proportions to construct Scottish consumption may affect the last two years of this story. As outlined above, the shares are largely taken from the LCF. But because of the low sample size, LCF results for the countries and regions of the UK are published only in the form of three-year moving averages. As this article went to press in March 2016 the latest regional data (issued two months ago) related to three years centred around 2013. Being two-and-a-half years old, the weights are from the trough of the business cycle, and they show Scottish consumption equivalent to 8.2 per cent of the UK total. Similar figures were reported in the previous trough. However around the peak years of 2008 (and before that, in 1998) Scottish consumption was 8.5 per cent of the UK total, a much higher proportion. *If* it is currently running at about 8.5 per cent (and we won't know that until December 2017), then the recovery *will* have taken consumption past its previous peak, by about 3 per cent.

As well as possibly distorting the current view, the smoothing into a three-year average has a further disadvantage for modelling: in order to throw out the bathwater of spurious annual observations, ONS has also thrown out the baby, in terms of 'dynamic' information about year-to-year changes. So not only are the weights regrettably ancient, but three years of smoothing destroys the prospect of sensibly

analysing the short-term dynamics of spending. We are hopeful that when this drawback is brought to ONS' attention, the individual annual figures for the regional LCF will be released.

3. How do people choose what to consume?

The basic structure of the AIDS model for the twelve products and services reported in the Scottish National Accounts is estimated by regressing the budget share of each product on the logarithms of all twelve prices and on 'real' expenditure, where 'real' expenditure deflator is calculated with a slight (and simple) variation on a conventional price index:

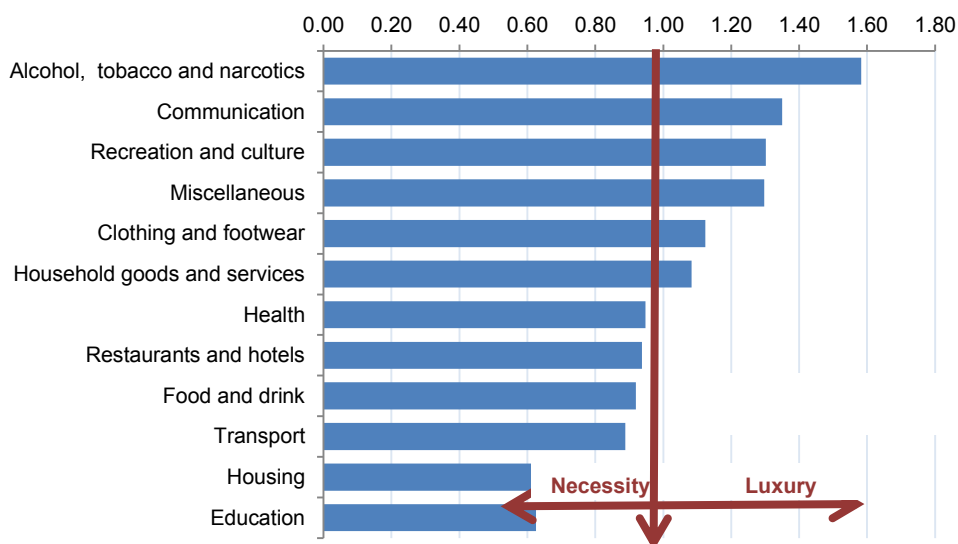
$$\omega_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(X/P) \quad i = 1,12, j = 1,12$$

When these twelve equations are estimated one at a time (that is, across all i) then the α_i automatically add to one, and the γ_i and the β_i to zero. To comply fully with the requirements of utility maximisation then the γ_{ij} should equal γ_{ji} , but this does not happen automatically.

I estimated these equations twice, first using the original data, and secondly with data recalibrated using the housing cost index instead of the troubled ONS deflator.

The estimates generate a coefficient on total expenditure volume, which is akin to an income elasticity, and a set of price reactions which can be summarised in an own-price elasticity.

Figure 5: Total expenditure elasticities using ONS deflator



Source: Author's calculations Ref: F:\Data\Households\ModAIDSregs.xlsx\incelas

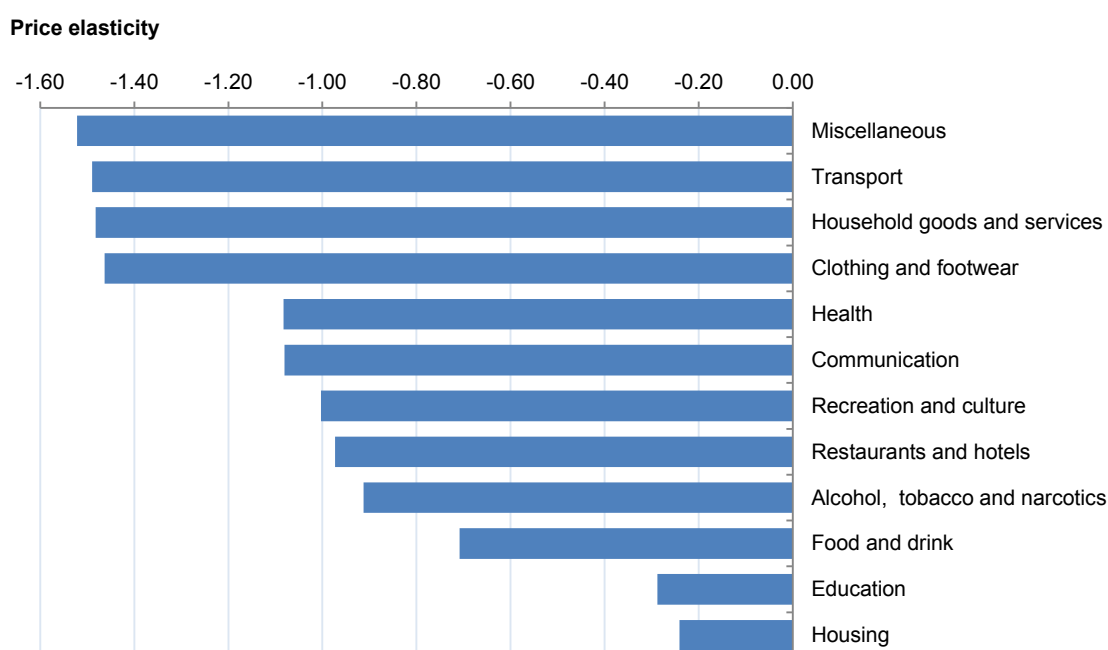
The two estimations produced fairly similar results for the 'income effect'. This is often seen as dividing consumption goods into 'luxuries', highly responsive to income, and necessities, where income has relatively little effect.

The results confirm a few prejudices: 'sin' (alcohol, tobacco and narcotics) and smartphones head the luxury categories, while learning and a roof over your head are necessities.

The coefficients on prices in the first estimation, using the ONS deflator for housing, were erratic and unrealistic. One had the wrong sign, and many others were excessively high, for example a negative price elasticity of -3 on food.

The second set of estimates produced plausible price elasticities. All variables had the expected sign and apparently sensible orders of magnitude.

Figure 6: Price elasticities using housing cost index



Source: Author's calculations Ref: F:\Data\Households\ModAIDSregs.xlsx\chart2

Statistics of fit in the second set were generally good, and the standard error of estimate typically only around two per cent. Autocorrelated errors were also not a great problem. The one respect in which the estimates do invite further exploration is in price homogeneity. As Deaton himself found, when prices are on the move, *even if they all move together*, patterns of consumption change.

1. Postscript and conclusion

From Bristol, Deaton's transatlantic contacts and collaborators eventually seduced Angus into American academia, not only through the pull they exerted, but by the contrast with ever tightening UK university resources in the 1980s under Thatcherism. Family ties may have played a part as well, Mary Ann his first wife being from the US.

Over this transition Deaton worked on developing models of consumption over time and then went on to look at growth and cycles in consumption decisions. He demonstrated how the pattern of consumption in a community or country over time bears little relation to the pattern within an individual's lifetime: there is no such thing as a 'representative consumer' and in fact individual consumption patterns diverge increasingly as people move through life.

When it comes to managing the economy through tax rates or spending, to any differences in the business cycle must be added differences in the life cycle. Scotland has a significantly older population than the UK as a whole, a different mix of income sources, and a different structure of household assets. Together these create a significant risk that UK management of consumer spending may not align to the pattern and structure of consumption in Scotland. In the past that management has been exercised predominantly by Westminster governments. And that will still be the case in future, Westminster has reserved the major powers on fiscal policy.

But for the first time the Scottish Parliament and Government will shortly begin to assume powers under the Scotland Act which could have a measurable impact on demand management *in Scotland*. However, it will be difficult to exercise these wisely with so little information on the most recent movement of the largest and most influential component of demand - consumption. Angus Deaton has given us some important tools to analyse consumption, but we need data from ONS to allow those tools to be used and to make them effective.

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