Accounting, Finance & Governance Review

The Journal of the Irish Accounting and Finance Association

THE IRISH ACCOUNTING AND FINANCE ASSOCIATION

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INVESTMENT HORIZONS, TIME DIVERSIFICATION AND SUSTAINABLE WITHDRAWAL RATES FOR A RETIREMENT INVESTMENT IN UK MARKETS

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ABSTRACT

We examine the sustainability of wealth and associated risks faced by a retiree in the drawdown phase of retirement. Risks are assessed using a range of commonly recommended withdrawal rates, and applied to common investment strategies in the UK markets. We consider the issue of time diversification of risk, in the context of expected retirement horizons. Our results demonstrate that after allowing for compounding effects and for regular investment withdrawals, the risk of financial ruin increases with the length of the retirement horizon, contrary to the premise of time diversification of risk.

INTRODUCTION

Market fluctuations and regulatory changes regarding pension investments have, in recent years, impacted on the potential experience of pensioners who expect to require a regular income. The issue of sustainable spending rates for retirees has taken on an added importance since the global financial crisis, due to the substantial losses that pension funds suffered during 2007–2008, and the mixed performance of markets and funds in the post-crash period. The importance of sustainable spending rates is also underscored by increasing longevity. For example, average life expectancy at birth in the United Kingdom (UK) continues to increase, reaching

79.5 years for males and 83.2 for females in 2012–2014.[1] Life expectancy at age 65 has also reached 18.8 years for males and 21.2 years for females. Given the importance that retirement asset pools will play in the life of those who will live longer, and the possibility that the savings pool available to a retiree at the point of retirement may be lower than anticipated due to poor market conditions, it is important that the manner in which savings pools are utilised is carefully examined. Commentators charge that too little concern is paid by the financial planning industry to the concept of sustainable spending. For instance, Arnott (2004, p. 6) states 'Our industry pays scant attention to the concept of sustainable spending, which is key to effective strategic planning for corporate pensions, public pensions, foundations, and endowments – even for individuals.'

In our paper, we consider the situation of a new retiree who at the time of retirement needs to plan for monthly withdrawals from their savings pot for living expenses, while ensuring that portfolio value is maintained at a level sufficient to support the withdrawal stream for the rest of their life. If the withdrawal rate is too high the retiree faces the prospect of running down the savings pool prematurely, resulting in financial ruin. If the withdrawal rate is too low, the retiree is deprived of a better standard of living.

If future investment returns are known with certainty, the solution to the determination of sustainable withdrawal rates is a present value computation, dependent on assumptions regarding lifespan following retirement. But there is uncertainty in expected investment returns and an unknown lifespan, so it is necessary to balance the amount of withdrawal with the risk of exhausting available capital. There are other contexts where the same computational principles apply. For example, the trustees of an endowment such as a scholarship fund need to determine the maximum sustainable scholarships that can be offered while maintaining desired safety levels in portfolio value. Financial institutions such as insurance companies also face a similar question in pricing annuity products.

Making longer-term projections of global economic conditions or of market performance is a hazardous guess at best, given the prevailing economic uncertainties. In an environment where no one can make clear predictions about future market performance, perhaps a sensible approach to take in retirement financial planning is to base future market expectations on the past experiences and performance of markets, with some added sensitivity analyses for estimating risk. The financial experiment conducted in this paper follows this approach, where future projections are made by replicating past market performances in a bootstrap simulation framework, for the purpose of formulating sustainable withdrawal rates and estimating risks associated with those outcomes, as measured by probabilities of financial ruin and of wealth shortfall.

We also specifically address the issue of time diversification of risk in relation to retirement planning horizons. The conventional wisdom of time diversification would suggest that a retiree with a long investment horizon would have lower investment risk, but at shorter horizons, risk levels would increase. We examine this issue in the context of the retiree who makes monthly withdrawals for consumption over their retirement life, and who views risk in terms of two alternative measures: the probability of facing financial ruin and the probability of facing a

shortfall in wealth. We examine the variation of these risks as the investment horizon shortens.

Risk outcomes are examined for a range of hypothetical investment strategies, consisting of investments in pure UK asset classes such as all equities (ALL), all bonds (BOND), an equally weighted equity/bond portfolio (SHBD), and a glide path of an equally weighted equity/bond portfolio increasing in its bond exposure as the retirement horizon decreases (GLIDE). Simulations are carried out for a range of withdrawal rates commonly adopted in the finance industry. We concentrate on the UK market, as it offers a full range of suitable investments.

In the next section, we review relevant literature and the methodologies we use in the paper. The sample data and main results are described in further sections, and a final section summarises and concludes.

LITERATURE AND METHODOLOGY

Researchers in the financial planning industry have been using data-centric approaches to estimate a maximum sustainable withdrawal rate that will allow a retirement asset pool to fund a full retirement period. An early study that has significantly influenced industry practice is Bengen (1994). In this study, 65 years of United States (US) equity market data between 1926 and 1991 were analysed to search for the highest withdrawal rate that would sustain an equally weighted portfolio of stocks and bonds over a 30-year retirement horizon. Based on his results, Bengen (1994) prescribes a 4 per cent withdrawal rate. This rule has come to be known as the '4 per cent rule' and investment advisors in the US, the UK, and other developed markets widely follow the policy of recommending a withdrawal rate of 4–6 per cent for retirement portfolios. The spending rate is increased each year by the rate of inflation in order to maintain a constant level of consumption over a retirement horizon, usually assumed at thirty years.

Other studies examine variations on this basic theme. Pye (2000) utilised a bootstrap simulation because it provides a framework for mimicking investors who make sustainable withdrawals. Investment choices can be evaluated over time, without needing to make any further assumptions about risk preferences. Hickman et al. (2001) examine the interplay between horizon and risk/return performance for various asset classes. Using analytical techniques, Milevsky and Robinson (2005) identify the withdrawal rate, the asset allocation decision, and investor mortality, as impacting on the likelihood of financial ruin. Basu, Byrne and Drew (2011) examine the accumulation phase of retirement planning, and the benefits or otherwise of asset allocation changes from a pure glide path that is commonly adopted by life-cycle or target-date retirement funds. The focus of many of these studies has been on investors and markets based in the US. It is surprising that the issue of sustainability in retirement planning in the UK and Ireland has received relatively limited attention.

The issue of time diversification is also relevant. Commonly cited in practitioner literature, the notion is that periods of above-average returns will offset periods of below-average returns, over a sufficiently long time horizon (Kritzman, 1994).

Assuming that asset returns are independent from one year to the next, the standard deviation of annualised return will diminish with time. The distribution of annualised returns will consequently converge as the investment horizon increases. A criticism of the analogy is that successive annual returns will be compounded into a total multi-year return, rather than being simply averaged. The risk should therefore be greater the longer an asset is held. This increased risk will, however, be offset by higher returns over a longer horizon, so it is unclear as to whether an extended investment horizon will be beneficial to investors. Samuelson (1969) formalises this point, as he demonstrates that although the annualised dispersion of returns converges towards expected return as the time horizon extends, the dispersion of terminal wealth also diverges from expected values. This result implies that although an investor is less likely to lose money over a long horizon than over a short horizon, the magnitude of potential loss increases with the duration of the investment horizon. Our paper offers a further contribution to this debate, as we consider this issue within the context of investment funds that are subject to regular withdrawals. We will examine this issue by considering both the risks associated with a diminishing retirement horizon, and the risks associated with an increased amount of periodic withdrawals. We apply a bootstrap simulation approach to investigate risk exposures and wealth-loss probabilities in retirement portfolios. We describe our bootstrap simulation approach in the following sub-section.

Bootstrap Methodology
The bootstrap re-sampling technique is widely used in finance to expand data size when the number of observations is relatively small. The span of available UK historical equity index return data and bond return data is quite limited. When historical experience needs to be replicated into the future, the available dataset can be extended by randomly re-sampling the data with replacement. The regenerated dataset can provide a sufficient number of independent samples needed to generate long series of return paths and a distribution of end-of-period wealth outcomes.[2] Because re-sampling is done with replacement, a particular data point from the original dataset can appear multiple times in a given bootstrap sample. The probability distribution of future outcomes must represent past data. To compute bootstrap samples, we start with the set of monthly return observations in the data series and repeatedly draw random observations with replacement until the required number of observations is drawn for a single complete run of wealth path computations. This results in one bootstrap sample. By repeating this process 500 times, we obtain 500 sample runs with randomly selected starting observations for the investment returns. The computational results from the 500 samples provide a frequency distribution of values from which probabilities of outcomes can be computed.

For illustrative purposes, we assume a retiree is 60 years of age on retirement, with a savings pool of £100, and plans for a retirement period of up to 30 years, potentially taking them to a maximum lifespan of 90 years. Over a 30-year period the retiree will make 360 monthly withdrawals. For shorter horizons of 10 and 20 years, we allow for 120 and 240 monthly withdrawals respectively. Wealth paths are simulated for withdrawal rates of 4 per cent, 5 per cent and 6 per cent per year on

the initial wealth. Investment returns are continuously compounded, and they are stated in nominal terms, which would incorporate inflation effects. To convert the withdrawals also to nominal terms, we raise the monthly withdrawal rate by the monthly inflation rate, based on an annual inflation rate of 3 per cent. We believe that this is a reasonable estimate for the future UK inflation rate.

The model is calibrated as follows. Investment portfolio values at the beginning and the end of month t respectively are V_t and V_{t+1}. Portfolio return for the month is R_t, consisting of the capital gains and other cash returns such as dividends, assuming monthly compounding. The withdrawal, W_t, is assumed to be made at the end of each month. Value of the investment portfolio at the end of month t therefore depends on:

$$V_{t+1} = V_t(1+R_t)-W_t \tag{1}$$

The value of an investment portfolio consisting of shares and bonds (SHBD) invested in the proportion λ in equity and $1-\lambda$ in debt is:

$$V_{t+1} = V_t[1+\lambda R_{St}+(1-\lambda)R_{Bt}]-W_t \tag{2}$$

The withdrawal amount is increased at the rate of monthly inflation 0.0025, so as to maintain a constant level of real consumption. R_{St} and R_{Bt} represent monthly return on the equity (ALL) and bond (BOND) investments respectively.

Our investigation of risk exposures and probabilities of financial ruin is based on the distributional return and risk properties of UK equities and bonds. We maintain the same assumptions of an initial savings pool of £100 and retirement periods of ten, twenty and thirty years. Results are computed for the ALL, BOND, SHBD and GLIDE strategies. We report mean and standard deviation of end-of-period wealth values and minimum values. We also compute probabilities of financial shortfall (i.e. wealth falling below the initial investment value of £100) and of financial ruin (i.e. wealth falling below zero, or fund exhaustion). The coefficient of variation in end-of-period wealth values is also reported, as it offers an indication of risk/return relationships.

DATA

In our study, we use index measures covering the equity market and the government debt market. Other major investment classes in the UK have not been included, as regular monthly indices of performance are not available over a sufficiently long historical time period. The FTSE All Share Index is selected to represent the equity market, as it is the longest available data series. It covers approximately 98 per cent of total market capitalisation.[3] When estimating returns on the FTSE All Share Index, we use total return values, as they include an adjustment for reinvested dividends. Twenty-year-long bond yield data provide the base from which we estimate return on bonds.[4] In order to compute returns, we estimate the bond price at the start of each month, using yield curve data. Allowing the bond term to

reduce by one month, we estimate an end-of-month value, using the yield on that date. Return is then calculated as the change in bond value over the month, plus accrued interest, divided by the start-of-month value. Every measure of monthly bond return comes from repeating this procedure. To facilitate these calculations, an assumption regarding the level of bond coupon payment is needed. A reasonable estimate is that each coupon payment is equal to the average of yield values over the previous three years.[5]

Monthly equity index values and long bond yields are both available from January 1965. We therefore compute monthly returns for each series from January 1965 to December 2014. This is a relatively long data series, covering a number of periods of both recession and growth, so we believe that it offers an appropriate dataset from which to analyse future sustainable withdrawal rates.

RESULTS

Summary Statistics
In Table 1, we report summary data for monthly return on the equity (ALL) and the bond (BOND) asset classes. We present the mean values, standard deviations, skewness and kurtosis. As expected, an investment in BOND provides lower average monthly returns and a lower standard deviation, indicating lower risk exposure. We also note considerably higher levels of positive skewness in BOND returns.

TABLE 1: SUMMARY RESULTS – SAMPLE DATA FROM JANUARY 1965 TO DECEMBER 2014 (NUMBER OF OBSERVATIONS = 598)

Return Series	Mean	Std. Dev.	Skewness	Kurtosis
ALL	0.0096	0.0543	0.1126	8.3748
BOND	0.0079	0.0269	0.5888	1.3151

Notation:
ALL   FTSE All Share index monthly return
BOND   Government Bond index monthly return

Bootstrap Results
In Tables 2 and 3, we identify apparent time diversification benefits. In Table 2, we report holding period returns and risks of each asset class. Returns are from re-sampling with the bootstrapping technique. In the re-sampling procedure, they are drawn independently to compute monthly return, and these returns are summed up to give the holding period return. We therefore do not allow for the impact of compounding on holding period return. This is repeated 500 times and the mean, standard deviation and coefficient of variation (CV)[6] of the 500 holding periods are reported. We show both total horizon returns and annualised returns.

We find that both total horizon return and standard deviation of return increase over longer holding periods. This is unsurprising. An examination of annualised values provides a more informative comparison. Annualised return increases slightly with increases in the holding period, but standard deviations decline monotonically

**TABLE 2: RETURNS AND RISKS AT DIFFERENT HOLDING PERIODS
(BASED ON 500 BOOTSTRAPPED SAMPLES)**

		10 Years	20 Years	30 Years
Total horizon return				
ALL	Mean	1.190	2.334	3.990
	Std. dev.	0.591	0.748	0.726
	CV	0.497	0.320	0.182
BOND	Mean	0.980	1.898	3.235
	Std. dev.	0.354	0.456	0.443
	CV	0.361	0.240	0.137
Annualised return				
ALL	Mean	0.119	0.131	0.133
	Std. dev.	0.059	0.042	0.024
	CV	0.497	0.321	0.180
BOND	Mean	0.098	0.106	0.107
	Std. dev.	0.035	0.025	0.014
	CV	0.361	0.236	0.131

Notation:
ALL   FTSE All Share index monthly return
BOND   Government Bond index monthly return

as the holding period lengthens. Coefficients of variation also decline as holding periods extend. This is evident if either total horizon returns or annualised returns are considered. These are the apparent benefits of time diversification, previously reported in Alles and Murray (2009). They are evident for both asset classes. They are the result of the mitigating impact of above and below average monthly returns on each other, giving the appearance of reduced risk.

In Table 3, we explore the distribution of wealth outcomes from an investment in each asset class, across a range of holding periods. We assume an investment of £100 in each asset class and we compare the characteristics of the distribution of end-of-period wealth, and how the distribution of end-of-period wealth changes for holding periods of ten, twenty and thirty years. To compute end-of-period wealth from an investment of £100 in an asset class we sum monthly returns obtained with the re-sampling methodology for the number of periods required for each holding period and we add the original investment. It should again be noted that we do not allow for the impact of compounding when estimating end-of-period wealth. We confirm that equities offer greater wealth potential than bonds. Expected value following a ten-year investment in equities is £222, while bonds provide £201. We note a relatively small increase in standard deviations of end-of-period wealth values as holding periods extend from ten to twenty years, followed by a small reduction if holding periods extend further to thirty years. Coefficients of variation therefore decline, again indicating the apparent benefits of time diversification.

TABLE 3: STATISTICS OF END-OF-HOLDING-PERIOD WEALTH DISTRIBUTIONS

	10 Years	20 Years	30 Years
ALL			
Mean	222	335	504
Std. dev.	60	79	69
CV	0.27	0.24	0.14
Median	226	339	500
Minimum	96	120	343
01-%ile	102	169	367
10-%ile	140	225	413
90-%ile	302	434	597
99-%ile	343	486	707
BOND			
Mean	201	288	425
Std. dev.	36	47	45
CV	0.18	0.16	0.11
Median	208	296	431
Minimum	95	142	293
01-%ile	122	168	314
10-%ile	150	221	364
90-%ile	244	342	478
99-%ile	262	367	498

Notation:
ALL   FTSE All Share index monthly return
BOND   Government Bond index monthly return

End-of-Retirement-Horizon Wealth and Probabilities of Wealth Loss
In Table 4 we identify wealth outcomes after a ten-year, a twenty-year and a thirty-year horizon for the retired investor with an initial investment fund of £100, based on the monthly withdrawal and the reinvestment and compounding process shown in Equations (1) and (2). We assess the impact of annual withdrawal rates of 3 per cent, 4 per cent, 5 per cent and 6 per cent at monthly intervals. For purposes of comparison we also examine the impact of no withdrawals, as this will correspond to the holding period outcomes in Table 3. We report the mean and standard deviation of end-of-horizon wealth, the coefficient of variation, minimum end-of-period wealth, the probabilities of financial ruin and the probabilities of financial shortfall for the all equity (ALL), all bond (BOND), balanced equity/bond (SHBD), and glide path (GLIDE) strategies.

For all investment strategies, regardless of horizon, mean end-of-horizon wealth typically declines as the withdrawal rate is increased. If we consider a twenty-year investment in ALL, mean end-of-horizon wealth reduces from £756 to £584 as annual withdrawal rates increase from 3 per cent to 6 per cent. Minimum values also decline from -£19 to -£399. The probability of financial shortfall (PS) increases

TABLE 4: STATISTICS ON END-OF-RETIREMENT-HORIZON WEALTH DISTRIBUTION AND PROBABILITIES OF WEALTH LOSS

W/D	10-Year Horizon						20-Year Horizon						30-Year Horizon					
	Mean	SD	CV	Min	PS	PR	Mean	SD	CV	Min	PS	PR	Mean	SD	CV	Min	PS	PR
Panel A: ALL																		
0%	308	211	0.69	26	0.06	0	954	975	1.02	44	0.01	0	3165	3988	1.26	13	0	0
3%	266	180	0.67	21	0.11	0	756	821	1.08	-19	0.06	0	2249	2745	1.22	-55	0.04	0.01
4%	232	187	0.80	7	0.22	0	764	879	1.15	-1	0.11	0	2181	3809	1.74	-376	0.09	0.04
5%	216	161	0.74	4	0.22	0	585	754	1.28	-77	0.17	0.04	1852	3796	2.04	-990	0.17	0.08
6%	203	165	0.81	-1	0.29	0	584	1054	1.80	-399	0.25	0.09	1498	2713	1.81	-727	0.21	0.12
Panel B: BOND																		
0%	146	82	0.12	103	0	0	219	39	0.17	120	0	0	326	75	0.22	177	0	0
3%	110	16	0.15	62	0.27	0	127	31	0.24	53	0.18	0	156	49	0.31	46	0.11	0
4%	100	16	0.15	63	0.52	0	97	27	0.27	35	0.58	0	98	44	0.45	8.4	0.55	0
5%	88	14	0.16	53	0.81	0	67	25	0.38	10	0.89	0	42	37	0.88	-58	0.93	0.12
6%	75	14	0.19	41	0.95	0	36	22	0.61	-18	0.99	0.02	-15	36	-2.37	-87	0.99	0.71
Panel C: SHBD																		
0%	209	68	0.32	68	0.02	0	466	208	0.44	92	0	0	1014	661	0.65	141	0	0
3%	174	62	0.35	44	0.09	0	320	185	0.58	33	0.03	0	638	489	0.76	1.69	0.01	0
4%	158	60	0.38	34	0.12	0	266	160	0.60	42	0.08	0	545	425	0.78	-23	0.05	0
5%	141	59	0.42	36	0.26	0	222	159	0.71	0.46	0.19	0.02	397	381	0.96	-146	0.17	0.04
6%	124	54	0.43	25	0.36	0	180	137	0.76	-40	0.30	0.03	282	303	1.07	-213	0.28	0.13

(Continue)

TABLE 4: (CONTINUED)

Panel D: GLIDE

W/D	10-Year Horizon						20-Year Horizon						30-Year Horizon					
	Mean	SD	CV	Min	PS	PR	Mean	SD	CV	Min	PS	PR	Mean	SD	CV	Min	PS	PR
0%	210	64	0.30	90	0.01	0	389	146	0.37	120	0	0	710	348	0.49	201	0	0
3%	163	56	0.34	66	0.08	0	277	136	0.49	46	0.04	0	450	251	0.55	12	0.02	0
4%	148	52	0.35	40	0.17	0	241	137	0.56	35	0.09	0	361	227	0.62	-8.2	0.06	0
5%	136	51	0.37	42	0.23	0	193	111	0.57	5.9	0.18	0	284	233	0.82	-64	0.19	0.03
6%	119	45	0.38	25	0.38	0	147	108	0.73	-46	0.38	0.03	187	217	1.16	-231	0.41	0.16

Notation:

ALL	FTSE All Share index monthly return
BOND	Government Bond index monthly return
SHBD	Portfolio of ALL and BOND
GLIDE	Glide path portfolio of ALL and BOND
W/D	Annual percentage withdrawal rate from savings pool
Mean	Mean end-of-period wealth value
SD	Standard deviation of end-of-period wealth values
CV	Coefficient of variation in end-of-period wealth values (i.e. SD/Mean)
Min	Minimum end-of-period wealth value
PS	Probability of savings pool value falling below £100
PR	Probability of running down the savings pool prior to retirement span, i.e. of financial ruin

from 0.06 to 0.25, and the probability of financial ruin (PR) increases from 0 to 0.09. For all strategies and all horizons, an increase in withdrawal rates does increase the risk of wealth loss. We note that coefficients of variation (CV) remain relatively unchanged as withdrawal rates increase. This implies relatively little material alteration in relationships between reward and standard deviation of expected end-of-horizon wealth.

Given a fixed withdrawal rate, longer investment horizons are generally associated with an increase in mean end-of-period wealth. We note however that standard deviations in expected wealth outcomes increase to a considerably greater extent. CVs therefore also increase with investment horizons. This increase is most pronounced in ALL. For example, at a 4 per cent annual withdrawal, CV increases from 0.80 to 1.74 as the investment horizon extends from ten to thirty years. For all asset classes, regardless of withdrawal rate, CVs increase as holding periods extend. We therefore find no evidence of time diversification benefits, contrary to expectations of the practitioner literature. In contrast, we identify increased risk exposures. We note a similar relationship between length of investment horizon and the relative price of risk if there are no withdrawals (zero withdrawal rates). There is no evidence of time diversification benefits when we assume that returns are reinvested. Compounding will magnify the scale of end-of-period wealth, but variability of wealth outcomes, as indicated by standard deviation, is magnified to a considerably greater extent. Extended time horizons are therefore associated with increased risks to the investor, when risk is measured by a standard deviation of wealth outcomes.

There are, however, further subtle changes in risk exposures as time horizons increase, when risk is measured in terms of potential wealth loss. Probabilities of financial ruin do increase, but probabilities of financial shortfall reduce. With the exception of BOND, we typically find this trend for all investment strategies. For example, with an SHBD strategy and a 6 per cent annual withdrawal rate, the probability of financial shortfall reduces from 0.36 to 0.28 as the investment horizon expands from ten years to thirty years, whereas probability of ruin increases from 0 to 0.13. We therefore identify a form of time diversification benefit, as longer investment horizons are associated with a reduced likelihood that fund value will fall below initial nominal value. The distribution of expected outcomes is such that although the increase in standard deviations is relatively greater than that for expected mean values, the proportion of expected outcomes falling below £100 tends to fall as longer horizons are considered. We examine this issue further in subsequent analyses.

Assuming that life expectancy following retirement is ten years, probability of ruin is 0 for all strategies. Probabilities of financial shortfall are significant however, particularly at high withdrawal rates. Zero likelihood of financial ruin is an attractive outcome, but average UK longevity indicates that most retirees must allow for a considerably longer lifespan. Assuming a twenty-year lifespan, a 6 per cent annual withdrawal rate exposes the retiree to a risk of financial ruin of 0.09 in ALL, whereas BOND exposes the retiree to a 0.02 probability of financial ruin. All strategies that include bonds offer the retiree a greatly reduced exposure to the risk of fund exhaustion, as likelihood of ruin is 0.03 for the SHBD and GLIDE strategies. Probabilities of financial ruin are therefore significantly high for retirees who do not include bonds as part of their investment portfolio.

Assuming a thirty-year horizon, and a 6 per cent annual withdrawal, ALL offers the lowest probability of financial shortfall (0.21), while BOND has the highest, at a 0.99 probability. The retired investor is likely to prefer either a mixed SHBD or a GLIDE strategy to the BOND strategy, as it offers moderate PS risk exposures, even when high annual withdrawals are required.
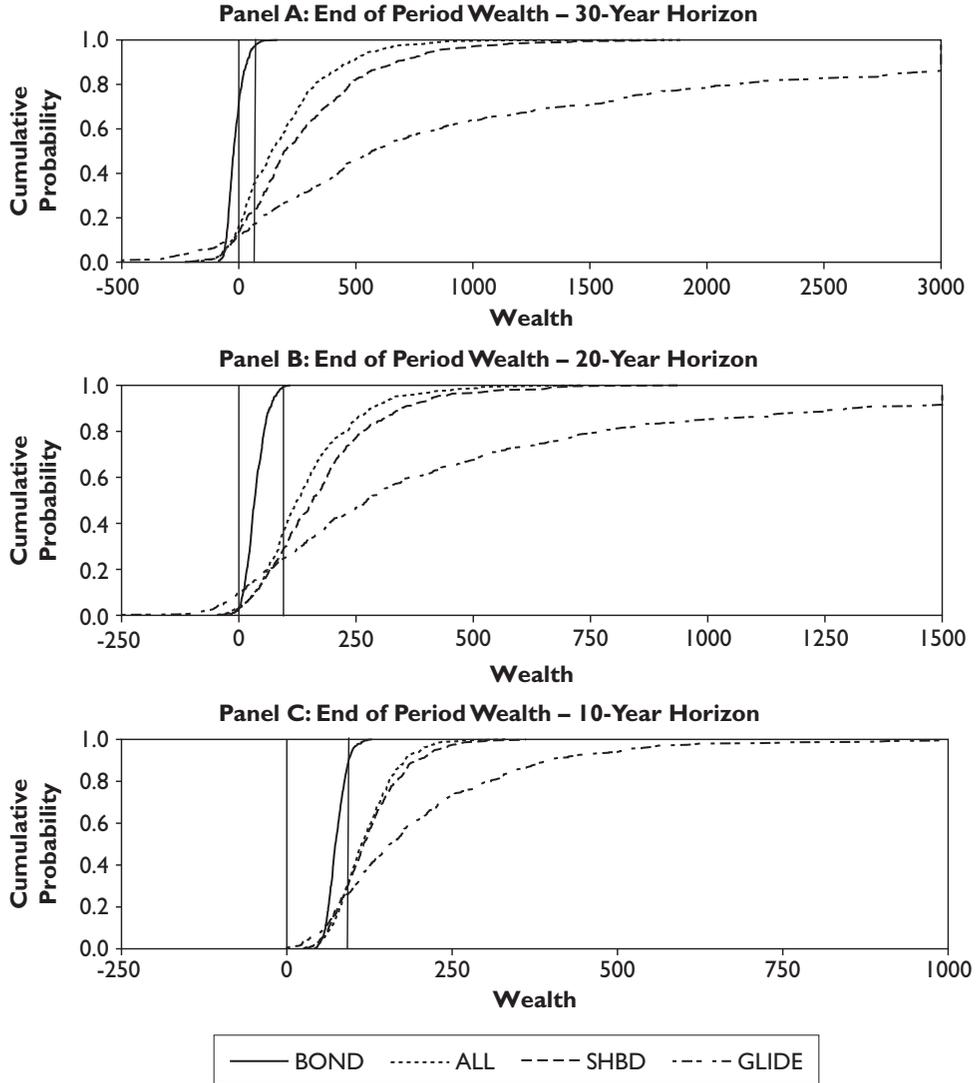
At shorter retirement horizons, an investment in equity becomes a more attractive proposition. If we consider standard deviations or coefficients of variation, it is clear that equity is the most risky investment, but it does offer greater potential capital growth, while limiting probabilities of financial ruin to reasonably acceptable levels. Average life expectancy at retirement is now such that long horizons are likely. Risk to terminal wealth increases with a longer investment horizon, contrary to the common expectation that a longer horizon will confer time diversification benefits.

Cumulative Probability Distributions and End-of-Retirement-Horizon Wealth
In order to provide further insight into the relative performance of each strategy, we plot cumulative probability distributions of end-of-horizon wealth. In Figure 1, we compare strategies over different time horizons. We assume an annual 6 per cent withdrawal. Panels A, B and C respectively illustrate outcomes for thirty-year, twenty-year and ten-year horizons. Cumulative probability at a given wealth level represents the probability of achieving that level or less. This is indicated on the vertical axis. The horizontal axis shows each end-of-period value. Vertical lines identify fund values of £0 and £100, indicating financial ruin and financial shortfall. For example, Panel A indicates that with a thirty-year horizon investment in ALL, the cumulative probability that end value will be £100 or less is 0.21. The probability that value will be more than £100 therefore is 0.79. In contrast, with a BOND investment strategy over thirty years, there is a 0.99 cumulative probability that horizon value will be £100 or less, and therefore only a 0.01 probability it will be more than £100. For any desired wealth outcome, an investment strategy which lies below all others will provide superior performance. Therefore, if an investor wishes to avoid financial shortfall, and a minimum £100 end value is required, equity investment offers best performance, as indicated by a lower cumulative probability than all other strategies. As shown in Panel A, an equity investment actually dominates all strategies if any wealth value exceeding zero is desired. Note that scale values on the horizontal axis differ in each panel, as the range in end-of-period wealth values expands considerably over the longer investment horizons.

In Panel A, at the thirty-year horizon, the longer left tail of the ALL curve indicates that the likelihood of large wealth losses, signified by negative end-of-period wealth values, is more likely if an ALL investment strategy has been employed. Alternatively, if a retired investor is primarily concerned with upside potential, equity becomes the most attractive investment strategy, as this strategy dominates for most wealth outcomes, as the ALL curve lies below all others. Much of the BOND investment curve lies to the left of a zero end-of-period wealth value. This is because if annual withdrawals of 6 per cent are required, a Bond investment may not generate sufficient annual returns to meet this requirement. If this occurs, fund value will reduce, and may fall to zero or lower. The probability of fund exhaustion (zero wealth level) therefore is highest for BOND. Probability of shortfall also

FIGURE 1: CUMULATIVE PROBABILITY DISTRIBUTIONS AND END-OF-PERIOD WEALTH – COMPARISON OF INVESTMENT HORIZONS

Panel A: End of Period Wealth – 30-Year Horizon

Panel B: End of Period Wealth – 20-Year Horizon

Panel C: End of Period Wealth – 10-Year Horizon

BOND ·········· ALL − − − − SHBD ·−·−·− GLIDE

is extremely high. The retiree may consider that one of the mixed investment strategies offers a more attractive prospective outcome. As indicated in Panel A, only a small proportion of either the SHBD or the GLIDE portfolios fall to the left of a zero wealth outcome. In both cases, the probabilities of ruin and of shortfall are at relatively low levels. They also offer relatively good prospects of strong end-of-period wealth. The SHBD strategy curve tends to dominate, as it typically is below the GLIDE curve; this is because a significant investment in shares is maintained throughout, thus maintaining exposure to potentially greater returns. In Panels B and C, a shift of the BOND curve to the right indicates a reduction in the probability of financial ruin, but the probability of shortfall still remains high.

FIGURE 2: CUMULATIVE PROBABILITY DISTRIBUTIONS AND END-OF-PERIOD WEALTH – COMPARISON OF INVESTMENT HORIZONS

Panel A: End of Period Wealth – BOND

Panel B: End of Period Wealth – ALL

Panel C: End of Period Wealth – SHBD

Panel D: End of Period Wealth – GLIDE

— 30-Year Horizon   ⋯⋯ 20-Year Horizon   – – – 10-Year Horizon
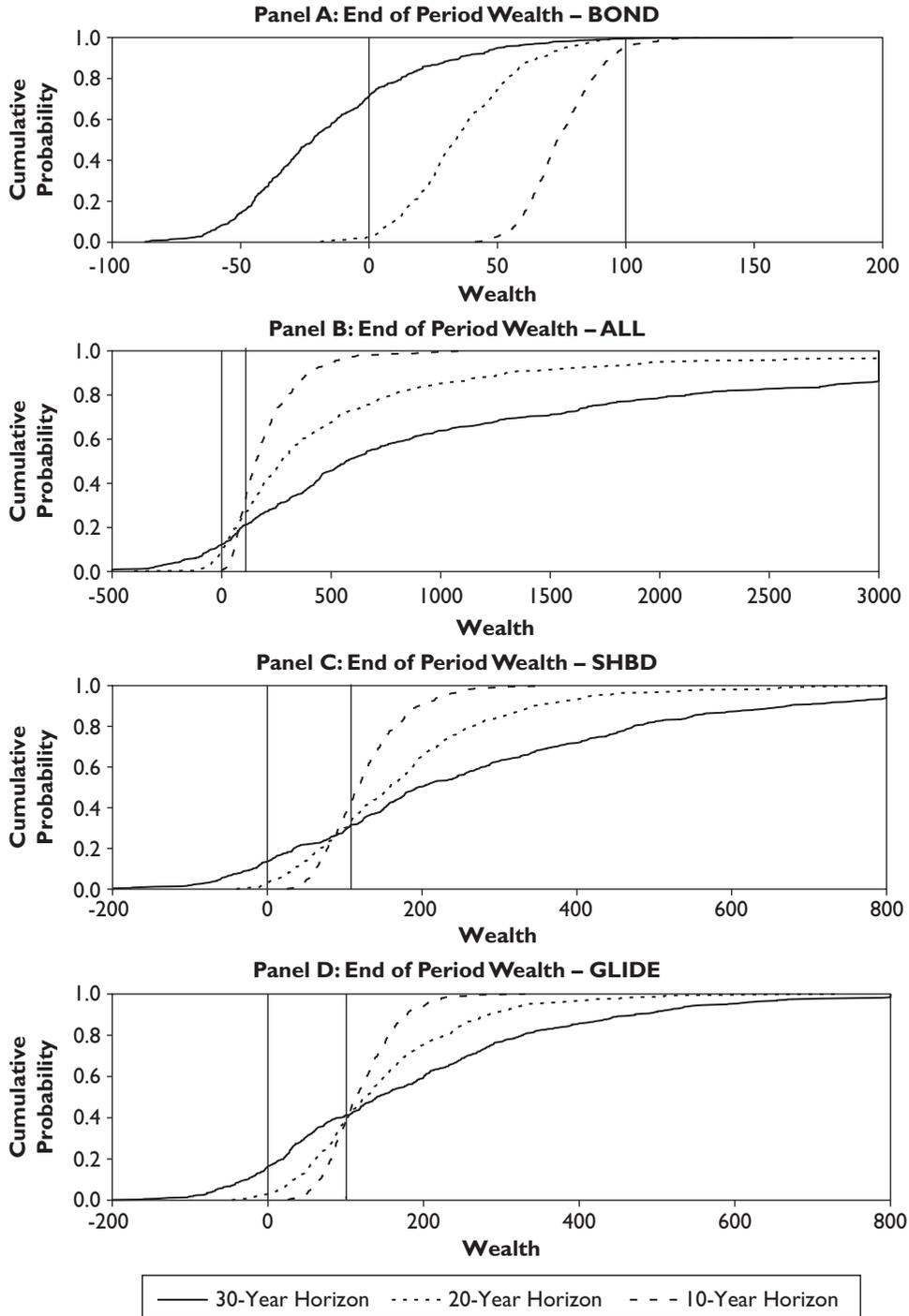
In Figure 2 we consider the different strategies in separate panels, and examine the impact of a change in the time horizon on end-of-period wealth, and on the likelihood that this value will reach certain minimum investor expectations. As in Figure 1, scale values on the horizontal axes differ for each investment strategy. In the previous section, we noted longer investment horizons are associated with an increased probability of financial ruin. This trend occurs with all investment strategies. In contrast, we also find that probability of financial shortfall typically declines as time horizons increase. Diagrams for all investment strategies demonstrate changes in risk exposure as retirement horizons extend. In Panel B, we consider ALL as an example. Assuming a ten-year retirement horizon, we observe that there is practically no possibility of financial ruin, but that risk of a shortfall in wealth is approximately 30 per cent. At a twenty-year horizon we note that the risk of financial ruin has increased to slightly below 10 per cent. In contrast, the risk of shortfall has declined to 25 per cent. Dominance of the twenty-year horizon curve over the ten-year curve accentuates for higher levels of end-of-period wealth. For example, the probability that fund value will equal £200 or less at a ten-year horizon is approximately 60 per cent, whereas at a twenty-year horizon it is approximately 40 per cent. At a thirty-year horizon, the risk of financial ruin increases further to approximately 12 per cent, but the risk of a financial shortfall declines again, compared to twenty-year horizon outcome, falling to approximately 21 per cent. This demonstrates that when investing in equities at longer retirement horizons there is an increased risk of suffering extreme losses, but the likelihood of suffering a moderate loss of wealth is reduced. Charts indicating the impact of increasing time horizons on the other investment strategies demonstrate similar changes in risk exposure, although the extent of change tends to be reduced for retirees who have invested greater proportions of their fund in bonds. The GLIDE strategy in Panel D provides a clear example of the presence and absence of time diversification of risk at different wealth levels. For wealth levels of £100 and above, the thirty-year horizon curve dominates the twenty-year and ten-year curves, indicating clear time diversification benefits at those wealth levels. But this benefit pattern is totally reversed for wealth levels of £100 and less, with the ten-year curve dominating the twenty-year curve and the twenty-year curve dominating the thirty-year curve. Panel A is an exception, as in the case of a BOND strategy, the shorter horizon curves always dominate longer horizons. As previously noted, this is because annual withdrawals of 6 per cent probably will exceed returns to a BOND investment, gradually reducing fund value as time horizons extend.

A generally accepted practitioner notion of time diversification is that investment risk diminishes with length of the investment horizon. Our results, however, demonstrate that the concept of risk reduction as horizons change has to be viewed in relation to the magnitude of wealth loss.

CONCLUSIONS

In this paper we examine the risks in retirement finance within the UK context of a retiree who has invested a savings pool in the UK equity and bond markets, and who

makes periodic withdrawals for sustenance during the drawdown phase of retirement. Risks are assessed for a range of withdrawal rates, and in terms of several alternative risk measures, and their variations are examined as investment horizons change. We utilised this setting to assess the premise of time diversification of risk in the context of periodic investment withdrawals and the presence of investment compounding effects. It is arguable that our choice of dataset will impact on our conclusions. Any time diversification benefit may be conditional on the level and timing of a major event within an investment time horizon. We draw our data from a fifty-year period that includes the recent global financial crisis, which clearly was a major market correction. Our bootstrap methodology however provides 500 sample runs with randomly selected starting observations for investment returns. This event will therefore appear at different stages in these sample runs, and will be absent from a significant proportion of them. Our computed results from these sample runs provide a distribution of probable outcomes that reflect the likelihood of a future calamitous event, assuming that the previous fifty-year experience is representative of likely future outcomes. We believe this is not an unreasonable assumption.

Our results demonstrate that extreme losses (equivalent to financial ruin) are greater with longer horizons, indicating no benefits of time diversification. But the risk of exposure to moderate losses (equivalent to financial shortfall) does become lower at longer investment horizons. This is consistent with the notion of time diversification benefits. The presence or absence of a time diversification benefit therefore is seen to be conditional on the level and extent of wealth loss. Considering that the average recent retiree can now expect a lifespan of twenty years, or possibly more, they should be aware there is a (small) possibility of financial ruin if higher withdrawal rates are required. We expect that the risk of financial shortfall, although clearly undesirable, will be of secondary importance.

We note that an extended investment horizon is associated with increasing risk exposures for all investment strategies, contrary to the common expectation that an extended investment horizon will confer time diversification benefits, and therefore reduced risk exposures. Regardless of expected withdrawal rates, an expanded investment horizon is associated with increased distributions in expected wealth outcomes when the impact of compounding is included. We find that equity investments warrant consideration, although probabilities of financial ruin become considerably greater, given withdrawal rates in excess of 4 per cent and a reasonably long retirement horizon. An implication of this finding is that a risk-averse retiree should therefore select either a mixed portfolio of shares and bonds (SHBD), or a glide path investment from shares to bonds (GLIDE). With greater life expectancy at retirement, our results imply that the average retiree will include fixed income investments as part of their portfolio. Assuming that higher withdrawal rates are required, they will not impact on overall risk exposure, as indicated by the coefficient of variation, but they do have a material impact on the risk of financial ruin if an equity-only strategy (ALL) is implemented.

The investor with a relatively short time horizon provides an interesting exception. If a lifespan of ten years or less is expected, the probability of financial ruin is zero, regardless of withdrawal rate or investment strategy. An equity portfolio will

offer the greatest potential upside. Assuming that a relatively high withdrawal rate also is required, the probability of financial shortfall also is minimal if there is an equity-only strategy. This surprising finding is contrary to the standard advice, as it implies that bonds are not required to manage risk exposure over a shorter horizon. We expect it is highly unlikely that a retiree will experience severe losses over a ten-year horizon.

Our results show that the ruin probabilities of the bootstrapping approach are relatively high. This may be due to the fact that the bootstrap simulation could reproduce a negative skewness that is observed in the actual return distributions. In that respect, the more recent relatively poor market experience is well represented. Whether this experience will persist in the future is a matter of conjecture. Retirement planners using these techniques should be cognisant of these assumptions. Negative skewness has however been a persistent feature of US equity returns, even if the period before 1950 is considered, so there is a reasonable expectation it will impact on future equity returns in many markets. This again implies that risk-averse retirees should hold a mixed investment portfolio.

This study has not taken into consideration taxes and transaction costs such as investment expenses and their effects on the sustainable withdrawal rates. Extensions of this analysis can include these factors, and also consider the inclusion of other asset classes and further investment/withdrawal strategies. This will become possible as extended datasets for other asset types and for separate sectors of the equity markets become available.

We also note the unexpected outcome that an extended investment horizon is associated with increasing risk exposures. The finding is contrary to the common expectation that an extended investment horizon will confer time diversification benefits, and therefore reduced risk exposures. Regardless of expected withdrawal rates, an expanded investment horizon is associated with increased distributions in expected wealth outcomes, when the impact of compounding is included. We believe it is likely that this outcome will be repeated under most future circumstances, although not all.

ENDNOTES

[1] See Office for National Statistics (2015), Statistical Bulletin, 'Life Expectancy at Birth and at Age 65, by Local Areas in England and Wales, 2012–2014', www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsand marriages/lifeexpectancies/bulletins/lifeexpectancyatbirthandatage65bylocalareasinenglandandwales/ 2015-11-04.

[2] A detailed description of the bootstrap re-sampling technique can be found in Efron (1979).

[3] This data were supplied by Thomson Datastream.

[4] The source for the long bond yield series is the Bank of England.

[5] With thanks to Shane Whelan for this suggestion. Full details regarding the estimation of monthly returns from long bond yield data are available from the authors.

[6] Coefficient of variation is defined as the standard deviation divided by the mean.

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ARTICULATED ACCOUNTING: ACCRUALS, CASH FLOW AND THE DOUBLE-ENTRY CONSTRAINT ON EARNINGS

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ABSTRACT

Motivated by comments by the FASB, IASB and CFA Institute on the need for greater articulation in financial reporting, this paper explores a model design for explicitly articulated financial statement variables. The estimation of articulated earnings components described in this paper uses a system of structural regressions, where the framework of simultaneous linear equations allows for the most basic property of accounting – double entry – to be incorporated within the model as a constraint that recognizes the zero-sum articulation of financial statement variables.

INTRODUCTION

In principle, financial statements should articulate, and the underlying double-entry logic should hold across the different statements that are prepared. For example, at a basic level, sales revenues in the income statement and cash collections from customers in the cash flow statement should reconcile with the movement in trade receivables in the balance sheet after allowing for write-downs. However, detailed articulations of this kind appear to be opaque to investors for most line items other than shareholders' equity (Moehrle et al., 2010; Casey et al., 2016). Indeed, representatives of the Chartered Financial Analysts' Institute, in their proposals for a comprehensive business reporting model, have commented that, for most

companies, it is difficult for even the most skilled analyst to create a reliable direct method cash flow statement from existing reported data, and that even to approximate such a statement is time-consuming (CFA Institute, 2005). The real challenge, however, is not the great effort required but rather the fact that the articulation between the balance sheet and the income statement is almost always obscured, with most companies providing insufficient information to permit a skilled analyst to clearly identify the entries affecting accounts receivable in order to determine cash inflows from sales. Along similar lines, the International Accounting Standards Board stresses in its 2008 discussion paper on financial statement presentation (issued jointly with the Financial Accounting Standards Board) that entities need to disaggregate cash receipts and payments in a manner that helps users to better understand how those cash flows relate to information presented in the income statement and balance sheet (International Accounting Standards Board, 2008).

The present study reconciles a simplified and articulated cash flow statement with all line items in the income statement and the opening and closing balance sheets, and then estimates components of future earnings consistent with the accounting identities that govern financial statement articulation. The statistical model uses a system of structural regressions with a framework of simultaneous linear equations that allows for the most basic property of accounting – double-entry bookkeeping – to be incorporated as a constraint within the model. Although research into the estimation of earnings from other financial statement information continues unabated (e.g. Sloan, 1996; Barth et al., 1999; Barth, Cram and Nelson, 2001; Dechow, Richardson and Sloan, 2008; Cheng and Hollie, 2008; Dechow, Ge and Schrand, 2010; Lev, Li and Sougiannis, 2010; Arthur, Cheng and Czernkowski, 2010), the application of a suitably constrained model to capture full accounting identities in the earnings relation is relatively new (Christodoulou and McLeay, 2014). This study introduces a constraint on two components that comprise earnings and proposes a joint estimation that is based on the accounting identities governing each of these two components.

The explanatory variables are the balance sheet changes that make up the total accrual and the movements in shareholders' equity, and related cash flow items from an articulated cash flow statement. The paper is concerned primarily with the development of the accounting-based model, and the exploratory results demonstrate how the double-entry constraint yields results that are interpretable within the context of a full set of articulated financial statements.

THE DETERMINISTIC CHARACTER OF ACCOUNTING VARIABLES

As mentioned above, although the estimation of earnings from cash flow data is discussed comprehensively in published work to date, the statistical models applied in such studies do not consider the full set of financial statement variables that record the calculation and distribution of cash flow and earnings, nor the articulation between these variables. This section sets out the background to the present study and considers the concept of financial statement articulation and the implications for the accounting variables involved.

An early attempt to explore financial statement articulation was published by Charnes, Cooper and Ijiri (1963). Their method introduces the notion of constraints that articulate accounting variables using the core duality specification of debit and credit, illustrated for a small set of accounting variables. This is the same notion of articulation across financial statements that is employed in this study, and as outlined in the work of Mann (1984): a case study that demonstrates how the full set of accounting identities govern the basic financial statements. Mann's concern is primarily with the linkages between the beginning and ending balance sheets, the income statement and the cash flow statement, but his case study nevertheless reflects the key ideas on the implications of double entry to be found in the influential theoretical works discussed in Charnes et al. (1963), and which continue to be debated by Ijiri and his followers (see, for example, Demski et al., 2006).

Whilst Charnes et al. (1963) only briefly examine the possible relations between mathematics and double entry, Ellerman (1985) formalises the conventional accounting equation with respect to the duality principle, whereby the construction of positive and negative integers as ordered pairs corresponds to the debits and credits of double-entry bookkeeping in T-accounts. An important issue concerns the way in which such accounting numbers are appropriately signed, which is operationalised in Arya et al. (2000) by embedding the double-entry accounting structure in a matrix representing all of the firm's transactions, where debits to any account are denoted by +1, and credits are denoted by –1. We adopt this convention in the analysis reported in this paper.

Demski et al. (2006) point out that the duality of accounting variables not only records 'what' has happened but also 'why' it happened; that is, put simply, the record of what has taken place in the firm (a *Dr* or *Cr* entry) has its mirror reflection in why these things have occurred (the offsetting *Cr* or *Dr* entry). They develop this thinking into two key rules concerning the articulation of financial statements, which are the principles on which we also build in this paper:

Rule 1: Beginning balances + increases = decreases + ending balances

Rule 2: A change in an account cannot occur without causing a corresponding change in another account

Note that the value of any one of the accounting variables can be deduced using Rule 1 if the values of the other variables are already known. Indeed, the inference need not stop here. Having calculated a variable by deduction, this makes it possible for the inferential process to continue to other variables, with a domino-like effect resulting from the combination of Rules 1 and 2. For example, if the beginning and ending inventory is known, then as soon as an entry for the transfer out to cost of goods sold is recorded the purchases of inventory can be deduced using Rule 1. When the purchase is entered on the debit side of the inventory account, the same amount will be entered on the credit side of accounts payable, in accordance with Rule 2, thereby creating a chain reaction. It is this deterministic character of double-entry bookkeeping that underlies the model-building in the current paper, by constraining the estimation to reflect the relationship between accounting variables that is encapsulated in the two rules in Demski et al. (2006).

ARTICULATED ACCOUNTING

As indicated above, the approach taken in this study is to draw together into one model all accounting variables reported as financial statement line items in the opening and closing balance sheets, the income statement, and, by a process of deduction, a reconciling cash flow statement. Below, we explain the process of imposing signs onto the accounting variables employed, the articulation between these variables, the arrangement of the underlying accounting identities into structural equations linking explanatory variables and response variables, the generalised modelling framework that is involved, and the constraints that are imposed.

In order to operationalise the consequences of double entry among financial statement variables, appropriate signs are imposed on the variables, as mentioned, based on whether they arise from debit or credit entries in accounting journals: assets (debit balances) are presented as positives, and liabilities (credit balances) as negatives. Therefore an increase in assets takes the positive sign, and an increase in liabilities (and in equities) takes the negative, and vice versa for decreases. The result of imposing signs on balance sheet changes in this way leads to the zero summation of all balance sheet changes. Following the same logic, we also impose appropriate signs on the income statement variables and cash flow statement variables. For instance, credit entries recorded as sales (SAL) take the negative sign, and debit entries recorded as customer receipts (REC) take the positive sign. Likewise, debit entries recorded as cost of goods sold (CGS) take the positive sign, and credit entries recorded as supplier payments (PAY) take the negative sign. Again, the summation of all accounting variables is equal to zero in both the income statement and cash flow statement, and it follows that the summation of the full set of accounting variables is equal to zero.[1]

Table 1 provides a summary of all financial statement variables employed in this study, together with their three-letter variable names, specifying whether they are sums of positive (Dr) or negative (Cr) entries. The first two columns summarise the balance sheet changes and the income statement, and the last column contains the derived cash flow statement, which is computed by deduction from the appropriate line items in the other two statements.[2]

The Balance Sheet Identity

To begin with, it is worth considering the most basic accounting identity governing the duality of accounts, where total assets must equal the sum of total liabilities and total equities. This can be rearranged as the following zero-sum identity:

$$\text{Total Assets} - \text{Total Liabilities} - \text{Total Equities} \equiv 0 \tag{1.1}$$

Equation 1.1 makes explicit the convention adopted in this study, where all assets are positively signed and all liabilities and equities negatively signed. By allowing for short-term and long-term components of both total assets and total liabilities, the accounting identity may then be extended as:

TABLE 1: SIGN ALLOCATION TO FINANCIAL STATEMENT VARIABLES

Balance Sheet			Income Statement			Cash Flow Statement		
Assets (+), Liabilities (−)			Expenses (+), Revenues (−)			Receipts (+), Payments (−)		
Cash and short-term investments	CSI	+	Sales	SAL	−	Customer receipts	REC	+
Accounts receivable	ARE	+	Cost of goods sold	CGS	+	Supplier payments	PAY	−
Inventory	INV	+	Selling and administrative expenses	SAE	+	Other operating cash flow	OOC	−/+
Prepaid expenses	PRE	+	Other operating expenses	OOE	+	Exceptional cash flow	ECF	−/+
Other current assets	OCA	+	Extraordinary credits	ECR	−	Tax payments	TXP	−/+
Property, plant and equipment	PPE	+	Extraordinary charges	ECH	+	Capital expenditure [net of disposals]	CED	−/+
Long-term receivables	LTR	+	Other (income)/expenses	OIE	−/+			
Other investments	OIN	+	Income taxes	ITX	+	Debt issues [net of repayments]	DIR	+/−
Other long-term assets	OLA	+	Depreciation and amortization	DDA	+	Net dividend [net of capital contribution]	NDC	−/+
Accounts payable	APA	−	Interest expense on debt	IED	+			
Short-term debt	STD	−	Interest income	IIN	−			
Accrued payroll	ACP	−	Minority interest in earnings	MIE	+			
Income tax payable	ITP	−	Net income: profit (loss)	INC	+/−			
Other current liabilities	OCL	−						
Long-term debt	LTD	−						
Provision for risks and charges	PRC	−						
Deferred income	DIN	−						
Deferred tax	DTX	−						
Other long-term liabilities	OLL	−						
Shareholders' equity	SEQ	−						
Preferred stock	PST	−						
Minority interest	MIN	−						
Dividend payable	DPA	−						

Current Assets + Long-term Assets − Current Liabilities −
    Long-term Liabilities − Total Equities ≡ 0   (1.2)

By extending Equation 1.2 further to incorporate all of the line items in the balance sheet, as presented in Table 1, the accounting identity can be fully specified as: [3]

$CSI + ARE + INV + PRE + OCA + PPE + LTR + OIN + OLA − APA$
    $− STD − ACP − ITP − OCL − LTD − PRC − DIN − DTX − OLL − SEQ$
    $− PST − MIN − DPA ≡ 0$ (1.3)

Again, the double-entry articulation constraint on the full set of variables is implicit in Equation 1.3, given that the sum of these variables must equal zero.

The Income Statement
We use a simple subdivision of the income statement, whereby net income is equal to operating income before depreciation *plus* other revenues and expenses. Operating income before depreciation (OID) is computed as:

$$OID ≡ SAL − CGS − SAE − OOE$$ (2.1)

and other revenues and expenses (ORE) as:

$$ORE ≡ ECR − ECH + OIE − ITX − DDA − IED + IIN − MIE$$ (2.2)

As $OID + ORE$ is equal to net income (INC), it follows that the full identity for net income may be written as:

$SAL − CGS − SAE − OOE + ECR − ECH + OIE − ITX$
    $− DDA − IED + IIN − MIE ≡ INC$ (2.3)

We then rearrange the income statement as a zero-sum identity, consistent with the sign convention adopted in this paper, as set out in Table 1, whereby net income (INC) takes a positive sign when a profit or a negative sign when a loss:

$− SAL + CGS + SAE + OOE − ECR + ECH − OIE + ITX + DDA$
    $+ IED − IIN + MIE + INC ≡ 0$ (2.4)

The Cash Flow Statement
As mentioned in the Introduction, we calculate the articulated values in the cash flow statement directly from the reported values in the balance sheets and income statement, with embedded sign as shown in Table 1. Specifically, receipts in the cash flow statement take the positive sign and payments take the negative sign, revenues in the income statement take the negative sign and expenses the positive sign, and, from the opening and closing balance sheet, increases (decreases) in asset accounts take the positive (negative) sign, whilst increases (decreases) in liability and equity accounts take the negative (positive) sign. Taking this approach,

we provide a demonstration below of the articulating condition for each of the eight cash flow statement line items listed in Table 1.

Customer Receipts
By articulating the change in accounts receivable (ΔARE) and customer receipts (REC) with sales (SAL), then the related zero-sum identity is expressed as follows:[4]

$$\Delta ARE - SAL + REC \equiv 0 \tag{3.1}$$

Supplier Payments
In the same way as the change in accounts receivable plus sales articulates with customer receipts, as shown above, then supplier payments (PAY) are derived from changes in accounts payable (ΔAPA) and purchases (PUR). The latter is computed as cost of goods sold (CGS) plus selling and administrative expenses (SAE), adjusted for changes in inventory (ΔINV) and changes in accrued payroll (ΔACP). In this case, the related zero-sum identity is the following:

$$\Delta INV - \Delta APA - \Delta ACP + CGS + SAE - PAY \equiv 0 \tag{3.2}$$

Other Operating Cash Flow
In addition to customer receipts and supplier payments, other operating cash flow (OOC) is computed from the changes in other current liabilities (ΔOCL), other current assets (ΔOCA), prepaid expenses (ΔPRE) and deferred income (ΔDIN), along with the related income statement item, other operating expenses (OOE). Based on the data analysed later in the paper, our default assumption is that other operating cash flow (OOC) is more likely to comprise net cash payments (–) than net cash receipts (+). Hence, the third cash flow statement zero-sum identity will be given as:

$$\Delta OCA + \Delta PRE - \Delta OCL - \Delta DIN + OOE - OOC \equiv 0 \tag{3.3}$$

Exceptional Cash Flow
Exceptional cash flow (ECF) is more likely to comprise net cash payments than net cash receipts and thus takes the negative sign by default. ECF is articulated with changes in other long-term assets (ΔOLA), other long-term liabilities (ΔOLL) and provision for risks and charges (ΔPRC), together with the income statement entries for extraordinary credits (ECR), extraordinary charges (ECH) and other (income)/expenses (OIE).[5] The zero-sum identity is given by:

$$\Delta OLA - \Delta OLL - \Delta PRC - ECR + ECH - OIE - ECF \equiv 0 \tag{3.4}$$

Tax Payments
The variables from which the cash flow statement item tax payments (TXP) is calculated are the changes in deferred tax (ΔDTX) and income tax payable (ΔITP), in addition to the related income statement entry for income taxes (ITX):

$$-\Delta DTX - \Delta ITP + ITX - TXP \equiv 0 \tag{3.5}$$

Capital Expenditure

The next variable in the summarised cash flow statement is capital expenditure (*CED*), which is net of asset disposals. *CED* is derived from the balance sheet changes in property, plant and equipment (ΔPPE), long-term receivables (ΔLTR) and other investments (ΔOIN), adding back the income statement charge for depreciation and amortization (*DDA*), as follows:

$$\Delta PPE + \Delta LTR + \Delta OIN + DDA - CED \equiv 0 \qquad (3.6)$$

Debt Issues

The cash flow statement variable debt issues (*DIR*) is net of debt repayments, and also offsets related short-term investment flows. *DIR* is calculated from the balance sheet changes in short-term debt (ΔSTD), long-term debt (ΔLTD) and cash and short-term investments (ΔCSI), together with interest expense on debt (*IED*) and interest income (*IIN*) from the income statement:

$$\Delta CSI - \Delta STD - \Delta LTD + IED - IIN + DIR \equiv 0 \qquad (3.7)$$

Net Dividend

The last variable in the cash flow statement is net dividend (*NDC*), which is stated net of any capital contribution. *NDC* is derived from the balance sheet changes in shareholders' equity (ΔSEQ), preferred stock (ΔPST) and minority interest (ΔMIN), together with the net profit (loss), i.e. net income (*INC*), as well as the minority interest in earnings (*MIE*) from the income statement:

$$- \Delta SEQ - \Delta PST - \Delta MIN - \Delta DPA + INC + MIE + NDC \equiv 0 \qquad (3.8)$$

We are now able to complete the full articulation between all variables, which is based on the financial statement information for United States (US) companies stored in the Worldscope database. The comprehensive reconciliation is presented in Table 2, for the average firm-year 1995–2009, i.e. as the mean of 18,949 firm-year observations for each variable. The double-entry condition is evident in the zero sum for each single line item across financial statements, and for each separate financial statement, and for the table as a whole.

Restating Income as Cash Flows and Accruals

The main variables of interest are operating income before depreciation (*OID*) and other revenues and expenses (*ORE*), which are jointly estimated from their prior year cash flow components together with related accruals in the form of asset and liability changes. *OID* is computed as sales (*SAL*) *less* cost of goods sold (*CGS*), selling and administrative expenses (*SAE*) and other operating expenses (*OOE*), all of which are included in the accounting identities in Equations 3.1, 3.2 and 3.3. Thus, by substitution of the balancing items from each of these identities into Equation 2.1, we may rewrite *OID* to obtain the following cash flow and accrual representation:

$$OID \equiv (\Delta ARE + REC) + (\Delta INV - \Delta APA - \Delta ACP - PAY)$$
$$+ (\Delta OCA + \Delta PRE - \Delta OCL - \Delta DIN - OOC) \qquad (4.1)$$

TABLE 2: ARTICULATION OF FINANCIAL STATEMENTS (US$000S)

Operating Accruals		$000s	Operating Income Before Depreciation		$000s	Operating Cash Flow		$000s	Sum
Δ Accounts receivable	ΔARE	7,982	Sales	SAL	−535,680	Customer receipts	REC	527,698	0
Δ Payables net of inventory		−471	Purchases		452,114	Supplier payments	PAY	−451,643	0
Δ Inventory	ΔINV	5,001	Cost of goods sold	CGS	339,169				
Δ Accounts payable	ΔAPA	−4,026	Selling and administrative expenses	SAE	112,945				
Δ Accrued payroll	ΔACP	−1,446							
Δ Other items		−4,409	Other operating expenses	OOE	6,775	Other operating cash flow	OOC	−2,366	0
Δ Other current assets	ΔOCA	2,586							
Δ Prepaid expenses	ΔPRE	313							
Δ Other current liabilities	ΔOCL	−6,197							
Δ Deferred income	ΔDIN	−1,111							

Non-Operating Accruals		$000s	Other Revenues and Expenses		$000s	Non-Operating Cash Flow		$000s	Sum
Δ Other non-current items		13,332	Non-operating (income)/expenses		11,112	Exceptional cash flow	ECF	−24,444	0
Δ Other long-term assets	ΔOLA	17,677	Extraordinary credits	ECR	−906				
Δ Other long-term liabilities	ΔOLL	−2,101	Extraordinary charges	ECH	14,385				
Δ Provision for risks and charges	ΔPRC	−2,244	Other (income)/expenses	OIE	−2,367				
Δ Tax deferrals and accruals		−304	Income taxes	ITX	15,458	Tax payments	TXP	−15,154	0
Δ Deferred tax	ΔDTX	−185							

(*Continued*)

TABLE 2: (CONTINUED)

Non-Operating Accruals		$000s	Other Revenues and Expenses		$000s	Non-Operating Cash Flow		$000s	Sum
Δ Income tax payable	ΔITP	–119							
Δ Long-term assets		15,510	Depreciation and amortization	DDA	22,598	Capital expenditure [net of disposals]	CED	–38,108	0
Δ Property, plant and equipment	ΔPPE	13,324							
Δ Long-term receivables	ΔLTR	46							
Δ Other investments	ΔOIN	2,140							
Δ Financial items		–9,476	Net interest		4,519	Debt issues [net of repayments]	DIR	4,957	0
Δ Cash and short-term investments	ΔCSI	8,899	Interest expense on debt	IED	7,341				
Δ Short-term debt	ΔSTD	–2,415	Interest income	IIN	–2,822				
Δ Long-term debt	ΔLTD	–15,960							
Δ Equities		–22,164	Income including minority interests		23,104	Net dividend [net of capital contribution]	NDC	–940	0
Δ Shareholders' equity	ΔSEQ	–60,681	Net income: profit (loss)	INC	22,757				
Δ Preferred stock	ΔPST	38,951	Minority interest in earnings	MIE	347				
Δ Minority interest	ΔMIN	–389							
Δ Dividend payable	ΔDPA	–45							
Sum of variable means		*0*		*0*				*0*	

Note: The source of all balance sheet and income statement data is Worldscope. Table 2 reports the firm-year average for each financial statement line item, for the estimation sample described in Table 3. The final row confirms that the variable means sum to zero; the sign allocation is described in Table 1. The final column shows the zero-sum articulation of balance sheet changes, related income statement line items, and, by deduction, cash flow statement line items.

Similarly, by substituting the balancing items from Equations 3.4–3.7 into Equation 2.2, together with the equity identity in Equation 3.8 (which is adjusted for *INC* in order to specify the minority interest in earnings), we obtain the following cash flow and accrual representation of *ORE*:

$$ORE \equiv (\Delta OLA - \Delta OLL + \Delta PRC - ECF) - (\Delta DTX + \Delta ITP + TXP)$$
$$+ (\Delta PPE + \Delta LTR + \Delta OIN - CED) + (\Delta CSI - \Delta STD - \Delta LTD + DIR)$$
$$- (\Delta SEQ + \Delta PST + \Delta MIN + \Delta DPA - NDC + INC) \tag{4.2}$$

A STRUCTURAL MODEL WITH DOUBLE-ENTRY ARTICULATION CONSTRAINT

To account for the structured information set that has been assembled, a generalised system is employed for explaining earnings using prior cash flows and accruals, based on lagged values of the accounting identities for operating income before depreciation and other revenues and expenses, as derived in Equations 4.1 and 4.2, with the deterministic relationships of accounting articulation arising from double entry introduced into the system as a constraint.

The response variables are drawn from the financial statements of each firm *i* in year *t*, and the explanatory variables are lagged variables from the prior year's financial statements. The double-entry articulation constraint is applied to the parameters on these lagged accounting variables, so that the coefficients add up to zero, and the accounting outputs therefore obey the same rules as the accounting inputs. The autoregression process that is assumed here is restrictive, but it serves two purposes. First, the data that we model are drawn from financial statements that systematically contrast the current period with prior-period comparatives, including explicit reconciliations of movements from one financial position to the next. Second, the earnings-based research that motivates this paper, as cited in the Introduction above, mainly involves one-period estimating models. Hence the joint autoregression of order one in *OID* and *ORE* used as the base model here, adapted for the double-entry articulation constraint suggested in the econometric analysis of Christodoulou (2015), and presented (in summary form) in Equation (5) below:

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} OID_{it} \\ ORE_{it} \\ 0 \end{bmatrix} = \begin{bmatrix} \beta_{\Delta ARE} & \cdots & \beta_{OOC} & 0 & \cdots & 0 \\ 0 & \cdots & 0 & \beta_{\Delta OLA} & \cdots & \beta_{NDC} \\ \beta_{\Delta ARE} & \cdots & \beta_{OOC} & \beta_{\Delta OLA} & \cdots & \beta_{NDC} \end{bmatrix} \begin{bmatrix} \Delta ARE_{it-1} \\ \vdots \\ OOC_{it-1} \\ \Delta OLA_{it-1} \\ \vdots \\ NDC_{it-1} \end{bmatrix} + \begin{bmatrix} \gamma_{10} & \gamma_{1j} \\ -\gamma_{20} & -\gamma_{2j} \\ 0 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ J_{it} \end{bmatrix} + \begin{bmatrix} u_{1it} \\ u_{2it} \\ 0 \end{bmatrix}$$
$$\tag{5}$$

Specifically, the first row of the above matrix represents a regression of operating income before depreciation (OID_{it}) on lagged values of the eleven cash flow and accrual variables in Equation 4.1, from the change in accounts receivable (ΔARE_{it-1}) through to other operating cash flow (OOC_{it-1}). The regression in the second row

is on lagged values of the twenty cash flow and accrual variables in Equation 4.2, from the change in other long-term assets ($\Delta OLA_{it\text{-}1}$) through to the net dividend ($NDC_{it\text{-}1}$), excluding the balancing income statement variable (INC) in Equation 4.2. The structural coefficients allow for the inclusion of model intercepts γ_{10} and γ_{20}, together with industry binary indicators for sector $j = 1$ to J. The intercept and industry coefficients are the same across the two equations, but with opposite sign. The final equation provides the double-entry articulation constraint, that the sum of the thirty-one response coefficients is zero, such that the estimated marginal contributions obey the laws of double entry where the sum of debit entries equals the sum of related credit entries.

Each one of OID_{it} or ORE_{it} is a valid least squares equation (regression) on its own, and can be estimated separately as an appropriately identified and constrained regression; however, using the structural model with two joint equations, as presented above, it is unrealistic to expect that the equation errors (u_{1it} and u_{2it}) would be uncorrelated, particularly when the explanatory variables for both equations are linked through a zero-sum identity, as is the case in the sample estimations on which we report below.

SAMPLE SELECTION AND DATA

Sample Selection

The initial usable sample, referred to in Table 3, is 24,025 firm-year observations, which includes all firm-year panels between 1995 and 2009, and excludes firm years where there are missing values for either the dependent or independent variables. A sample of US listed firms is employed in order to make use of the high level of disaggregation in income statement and balance sheet data in available databases.

The first step in preparing this form of dataset, given the observations that are downloaded, is to ensure that the balance sheet balances and that the income statement adds up correctly. This involves imposing signs onto the variables, as described above, based on their accounting formulation (Dr or Cr). Interestingly, we find in some cases that the summation is close to zero, but not precisely equal to zero (between +$10 and −$10). Observations for which the sum of the balance sheet or income statement is not between +$10 and −$10 (3,302 observations) are taken out of the usable sample, but any small remaining discrepancies are rounded into the cash flow statement derivations. Note that whilst such errors may be due to mistaken transcription by the data provider, and similar processing errors, the most common cause is the lack of disaggregation in source financial statements, which can leave some lower-level cells empty in the database. Hribar and Collins (2002) make reference to the same issue when they note how measurement errors can arise during the computation of additional variables.

A further 748 observations are dropped because they have inconsistent signs, e.g. zero or negative sales ($SAL \leq 0$); a list of the rational signs required of all variables is presented in Panel B of Table 3.

The final step identifies those observations in the sample that unnecessarily distort the estimation, using the same criteria regarding studentized residuals as

TABLE 3: CONSTRUCTION OF THE ESTIMATION SAMPLE

Panel A: Outliers, Infrequent Observations and Inconsistent Signs

Initial usable sample	24,025
Firm-years where financial statement identities do not hold	−3,302
Inconsistent signs (see Panel B)	−748
Number of outliers in first estimates of *OID*	−547
Number of outliers in first estimates of *ORE*	−479
Estimation sample, 1995–2009	*18,949*

Panel B: Rational Signs for the Usable Sample

$SAL \leq 0^*$	$PRE \geq 0$	$ACP \leq 0$	$LTD \leq 0$
$CGS \geq 0$	$OCA \geq 0$	$ITP \leq 0$	$PRC \leq 0$
$SAE \geq 0$	$LTR \geq 0$	$DPA \leq 0$	$DIN \leq 0$
$CSI \geq 0$	$OIN \geq 0$	$OCL \leq 0$	$OLL \leq 0$
$ARE \geq 0$	$PPE \geq 0$	$STD \leq 0$	$MIN \leq 0$
$INV \geq 0$	$OLA \geq 0$	$APA \leq 0$	$PST \leq 0$

*The sales variable was further restricted to $SAL \geq \$1m$, in order to remove the smallest firms from the sample, following Lev et al. (2010).

Panel C: Industry Distribution

Sector	Number of Observations
Basic materials	659
Consumer goods	2,568
Consumer services	2,712
Health care	2,969
Industrials	4,792
Oil and gas	782
Technology	4,467
Total	*18,949*

employed by Kim and Kross (2005) in their estimation of the earnings and cash flow relationship in the US, leaving an estimation sample of 18,949 firm-years.

Note that financial institutions and utility companies were dropped from the usable sample before the above procedures were carried out, with the observations in the estimation sample relating to firms from seven broad industries, as shown in Panel C of Table 3.

For each variable, the mean values before deflation (for the estimation sample of lagged values) are given in Table 2 above. For example, the firm-year average increase in accounts receivable (ΔARE) is $7.982m, the average sales (*SAL*) is $535.680m, and these two variables articulate with the average cash inflow in the form of customer receipts (*REC*) of $527.698. The operating costs (*CGS* + *SAE* + *OOE*) sum to $458.889m ($339.169m + $112.945m + $6.775m), which, when deducted

from sales of $535.680m, results in operating income before depreciation (*OID*) of $76.791m for the average firm-year. The second component of net earnings is other revenues and expenses (*ORE*), which amounts to a $54.034m excess of expenses over revenues for the average firm-year. It follows that net income (*INC*) is equal to $22.757m on average.

RESULTS

This section describes the model estimation. Note that the articulation of parameter estimates in accordance with accounting identities lowers the log likelihood to 36,223 for the constrained joint estimation of *OID* and *ORE*, from 38,951 for the seemingly unrelated regression when unconstrained, and from 16,581 and 22,350 for the two separate ordinary least squares estimations of *OID* and *ORE*. The Akaike information criterion also provides a suitable likelihood-based measure of the relative goodness of fit, confirming the change in model fit attributable to fitting the articulation condition (see Table 4, Panel A). A likelihood-ratio test of the null hypothesis that the parameter vector satisfies the constraint, based on a comparison of the unrestricted and the restricted models, confirms that the procedure adopted here is a significant component of the model.

In Panel B of Table 4 we tabulate the findings. For convenience, the mean lagged value of each explanatory variable is given in the first column of tabulated data, which are the same figures as those shown in the articulation demonstration in Table 2. The deflator used for this table is the sum of the absolute value of all input variables, which is a superior generator of uniformly distributed predictors. This use of an aggregated deflator is based on the transactions-based approach suggested in Christodoulou and McLeay (2009).

The first set of financial statement line items (the first two rows) in Panel B of Table 4 shows the effect of the explanatory variables *REC* and Δ*ARE* when estimating operating income. As can be seen, the coefficients on *REC* (customer receipts) and Δ*ARE* (the change in accounts receivable) are 0.7289 and 0.5256 respectively, indicating that, for a $1 increase in cash receipts from customers (i.e. a marginal unit cash sale), *OID* will increase by 72.9 cents; however, for a $1 increase in accounts receivable (i.e. a marginal unit credit sale), *OID* will increase by only 52.6 cents, suggesting that *REC* contributes more than Δ*ARE* to the prediction of future changes in *OID*. Furthermore, to evaluate the predictive ability of cash flows versus accruals, we should consider not only the marginal contributions to income measured by the estimated coefficients, but also the precision implied by the standard errors (*REC* 0.0035; Δ*ARE* 0.0108). It can be seen that not only is the coefficient of *REC* larger than the coefficient of Δ*ARE*, its standard error is about *one-third* the standard error of Δ*ARE*, implying much greater precision in estimation for the cash flow variable *REC* than the accrual variable Δ*ARE*.

The outcome described above can also be observed in the second group of line items in Panel B of Table 4 (rows 3 to 6). The cash flow variable, *PAY*, adds to the joint estimation of future *OID* both with greater marginal contribution and with greater accuracy than the articulated accrual variables Δ*INV*, Δ*APA* and Δ*ACP*,

TABLE 4: ESTIMATION RESULTS WITH DOUBLE-ENTRY ARTICULATION CONSTRAINT
Panel A: Goodness of Fit

	Ordinary Least Squares		Unconstrained Model	Constrained Model
	OID	ORE	OID + ORE = INC	
Log likelihood	16,581	22,350	38,951	36,223
Akaike information criterion	−33,125	−44,647	−77,811	−72,358
Breusch–Pagan statistic			37.61	217.73
Residual correlation			−0.0446	−0.1072
Likelihood ratio test			Chi 5455.2, $p < 0.0001$	

Panel B: Estimation Results

		Means		OLS	Coefficients		Linear Prediction
		Raw ($000s)	Deflated		Zero-Sum Constraint	Standard Error	
Operating Income before Depreciation							
1. Customer receipts	REC	527,698	1.2316	0.7764	0.7289	0.0035	0.8977
Δ Accounts receivable	ΔARE	7,982	0.0159	0.6788	0.5256	0.0108	0.0084
2. Supplier payments	PAY	−451,643	−1.1598	0.7719	0.7238	0.0036	−0.8395
Δ Inventory	ΔINV	5,001	0.0094	0.6223	0.4934	0.0133	0.0046
Δ Accounts payable	ΔAPA	−4,026	−0.0077	0.5717	0.3747	0.0153	−0.0029
Δ Accrued payroll	ΔACP	−1,446	−0.0029	0.4728	−0.2965	0.0400	0.0008
3. Other operating cash flow	OOC	−2,366	−0.0101	0.7477	0.5695	0.0089	−0.0058
Δ Other current assets	ΔOCA	2,586	0.0028	0.6107	0.0623	0.0242	0.0002
Δ Prepaid expenses	ΔPRE	313	0.0005	0.4534	−1.2798	0.0570	−0.0006
Δ Other current liabilities	ΔOCL	−6,197	−0.0078	0.5850	0.2833	0.0144	−0.0022
Δ Deferred income	ΔDIN	−1,111	−0.0018	0.7225	0.2094	0.0293	−0.0004
	OID	76,791					
Other Revenues and Expenses							
4. Exceptional cash flow	ECF	−24,444	−0.0341	0.1051	0.0303	0.0062	−0.0010
Δ Other long-term assets	ΔOLA	17,677	0.0167	−0.0383	−0.2550	0.0076	−0.0043

(Continued)

TABLE 4: Panel B: (CONTINUED)

		Means (Raw) $000s	(Deflated)	OLS	Coefficients Zero-Sum Constraint	Standard Error	Linear Prediction
Δ Other long-term liabilities	ΔOLL	-2,101	-0.0012	0.0922	-0.2205	0.0139	0.0003
Δ Provision for risks and charges	ΔPRC	-2,244	-0.0010	-0.0145	-0.8263	0.0158	0.0008
5. Tax payments	TXP	-15,154	-0.0227	0.4165	0.2215	0.0229	-0.0050
Δ Deferred tax	ΔDTX	-185	-0.0002	0.1087	-0.3517	0.0394	0.0001
Δ Income tax payable	ΔITP	-119	-0.0005	0.3891	-0.3905	0.0392	0.0002
6. Capital expenditure [net of disposals]	CED	-38,108	-0.0664	0.8066	0.4648	0.0151	-0.0309
Δ Property, plant and equipment	ΔPPE	13,324	0.0170	0.7155	0.1739	0.0162	0.0030
Δ Long-term receivables	ΔLTR	46	-0.0004	0.8085	0.2235	0.0205	-0.0001
Δ Other investments	ΔOIN	2,140	0.0022	0.7909	0.2403	0.0188	0.0005
7. Debt issues [net of repayments]	DIR	4,957	-0.0065	0.6003	0.1001	0.0168	-0.0007
Δ Cash and short-term investments	ΔCSI	8,899	0.0119	0.6051	-0.0684	0.0169	-0.0008
Δ Short-term debt	ΔSTD	-2,415	-0.0027	0.6052	-0.0665	0.0176	0.0002
Δ Long-term debt	ΔLTD	-15,960	-0.0115	0.5880	-0.0893	0.0172	0.0010
	ORE	-54,034					
8. Net dividend [net of capital contribution]	NDC	-940	0.0681	0.0099	-0.0388	0.0034	-0.0026
Δ Shareholders' equity	ΔSEQ	-60,681	-0.9219	0.0028	-0.2071	0.0054	0.1909
Δ Preferred stock	ΔPST	38,951	0.8835	0.0028	-0.2071	0.0054	-0.1830
Δ Minority interest	ΔMIN	-389	-0.0004	0.0514	-0.4771	0.0309	0.0002
Δ Dividend payable	ΔDPA	-45	0.0000	0.0272	-0.6507	0.0350	0.0000
	INC	22,757					
Sum of fixed effects							-0.0505
Totals		0	0.0000	13.6862	0.0000	n/a	0.0214

Note: The average operating income before depreciation (OID_t $76.791m, OID_{t+1} $83.600m) and the average other revenues and expenses (ORE_t $-54.034m, ORE_{t+1} $-55.501m, which include the minority interest in earnings) sum to the average net income (INC_t $22.757m, INC_{t+1} $28.099m). The clean surplus equilibrium for the average firm in period t, which includes current net income ($22.757m), is shown in the last section of Table 2. The linear predictor for the average firm is given in the last column of Table 4, Panel B, summing to the deflated INC for period t+1 (0.0214).

having the largest coefficient (0.7238) and the smallest standard error (0.0036). On the face of it, it may be inferred from the coefficient on PAY that a \$1 increase in cash payments to suppliers and employees (i.e. the marginal cash cost of goods sold) will lead to a decrease in OID of 72.4 cents. In this context, however, it is important to note that the mean deflated customer receipt equals 1.2316 whilst the mean deflated supplier payment is –1.1598, and hence the relative contributions to the linear predictor of earnings are 0.8977 from REC (1.2316 × 0.7289) and –0.8395 from PAY (–1.1598 × 0.7238). To interpret the accrual-based coefficients (ΔINV 0.4934; ΔAPA 0.3747; ΔACP –0.2965), we must recognise that overheads are absorbed first into inventory values, and these inventories are then released into cost of sales, so a full analysis in this respect will require a more extensive structural model. Interestingly, however, the average firm appears to more than cover the financing of its inventory changes (\$5,001m) with accounts payable and accrued payroll (\$4.026m + \$1.446m = \$5.472m), and the weighted contribution of these three variables to the linear prediction of future earnings is positive overall (0.0046 – 0.0029 + 0.0008 = 0.0025). Again, as was the case above for cash receipts from customers, the low standard error suggests that cash payments to suppliers have greater forecasting precision than the associated accrual variables.

With regard to the third set of line items, whilst it is evident that the other operating cash flow variable (OOC) contributes more than the accrual variables ΔOCA, ΔOCL and ΔDIN in explaining future OID, a change in prepaid expenses (ΔPRE) has a substantial counter-effect (–1.2798). However, the volume of prepayments is low overall (\$0.313m), and inaccuracy in estimation is high (the standard error is 0.0570). The key result is that OOC has a lower standard error (0.0089) by comparison with prepaid expenses and the other related accruals, again implying much greater precision in prediction for the cash flow variable.

In summary, regarding the estimation of future OID, using a structural model that includes a double-entry articulation constraint on the simultaneous equations employed, the cash flow variables (REC, PAY and OOC) tend to have a higher marginal impact than most of the accrual variables, especially when the weighted contribution to linear prediction is considered. Moreover, the cash flow variables have the smallest standard errors amongst all of the predictor variables, providing evidence of their greater precision in forecasting.

The second part of Panel B in Table 4 describes the joint linear estimation of other revenues and expenses (ORE). Reflecting the key finding reported above, the standard error on each of the cash flow variables (ECF, TXP, CED, DIR and NDC) is smaller than the related accrual-based changes in assets and liabilities. The greatest marginal contribution to future ORE results from the high estimated coefficient on capital expenditure, CED (0.4648). With regard to debt issues and changes in cash and investments, there is no evidence to discriminate between the impacts on ORE prediction. Overall, for the net dividend flows and equity changes, the coefficients show little predictive power, apart from a direct substitution effect arising from the increase in equity and the decrease in preferred stock for the average firm.

Overall, the findings indicate the superiority of operating cash flow variables over related accrual variables in the estimation of future earnings, with the most pervasive finding being that all cash flow variables – operating and non-operating,

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TABLE 5: ESTIMATION RESULTS WITH DOUBLE-ENTRY ARTICULATION CONSTRAINT – BY INDUSTRY

		Basic Material	Consumer Goods	Consumer Services	Health Care	Oil and Gas	Technology	Industrial
Operating Income before Depreciation								
1. Customer receipts	REC	0.7819***	0.8076***	0.7507***	0.7580***	0.7379***	0.7228***	0.6985***
Δ Accounts receivable	ΔARE	0.6680***	0.8548***	0.5877***	0.5573***	0.5599***	0.4241***	0.5422***
2. Supplier payments	PAY	0.7528***	0.8067***	0.7531***	0.7562***	0.7364***	0.7190***	0.6967***
Δ Inventory	ΔINV	0.5006***	0.5093***	0.5542***	0.5457***	0.5676***	0.4767***	0.4537***
Δ Accounts payable	ΔAPA	0.5797***	0.6548***	0.4586***	0.4296***	0.4197***	0.4084***	0.3201***
Δ Accrued payroll	ΔACP	-0.2727**	-0.0681	0.9497***	-0.6490***	0.0827	-0.6551***	0.0179
3. Other operating cash flow	OOC	0.5223***	0.1924*	0.6888***	0.6798***	0.6521***	0.6558***	0.0359
Δ Other current assets	ΔOCA	-0.1532*	-0.5458***	0.2192	0.3121***	0.3261***	0.2654***	-0.4223***
Δ Prepaid expenses	ΔPRE	-1.5534***	-1.7435***	-0.062	-0.8467***	-1.7099***	-0.5241***	-1.1663***
Δ Other current liabilities	ΔOCL	0.2599***	0.2614**	0.6363***	0.2644***	0.3631***	0.3956***	-0.2014***
Δ Deferred income	ΔDIN	0.4302***	-0.7040***	0.3808	0.3718***	-0.2328*	0.1954***	-0.3973***
Other Revenues and Expenses								
4. Exceptional cash flow	ECF	0.0658***	-0.0003	0.0581**	-0.0134	0.0512***	0.0328*	0.0392***
Δ Other long-term assets	ΔOLA	-0.1204***	-0.3563***	-0.1901***	-0.1678***	-0.2297***	-0.3287***	-0.2008***
Δ Other long-term liabilities	ΔOLL	-0.0417	-0.2380***	-0.0894	-0.2455***	-0.2191***	-0.2926***	-0.0731**
Δ Provision for risks and charges	ΔPRC	-2.7654***	-0.7190***	-1.2383***	-0.3047***	-0.4689***	-1.3560***	-0.5762***
5. Tax payments	TXP	0.3346***	0.3056***	0.3052***	0.4273***	0.1979***	0.2422***	0.2260***
Δ Deferred tax	ΔDTX	-0.2786***	-0.186	0.0998	-0.1560***	-0.2888***	-0.3691***	-0.2128***
Δ Income tax payable	ΔITP	-0.3483**	0.2434	0.1678	-0.0259	-0.2914***	-0.4542***	-0.074

(Continued)

TABLE 5: (CONTINUED)

		Basic Material	Consumer Goods	Consumer Services	Health Care	Oil and Gas	Technology	Industrial
6. Capital expenditure [net of disposals]	CED	0.4877***	0.4676***	0.8314***	0.3774***	0.4076***	0.6570***	0.5542***
Δ Property, plant and equipment	ΔPPE	0.2924***	0.2187**	0.6108***	0.1387***	0.1241***	0.3755***	0.2629***
Δ Long-term receivables	ΔLTR	0.3048***	0.3126**	0.6527***	0.2326***	0.2496***	0.3912***	0.023
Δ Other investments	ΔOIN	0.3611***	0.3443***	0.7920***	0.2710***	0.2429***	0.3010***	0.4200***
7. Debt issues [net of repayments]	DIR	0.3970***	0.3814***	0.2159*	0.0711	0.0853**	0.1896***	0.2027***
Δ Cash and short-term investments	ΔCSI	0.3262***	0.1876**	0.0883	–0.037	–0.0690*	–0.0089	0.0994***
Δ Short-term debt	ΔSTD	0.3348***	0.2087***	0.1638	0.0154	–0.0638*	–0.0459	0.0601
Δ Long-term debt	ΔLTD	0.2954***	0.1587**	0.1063	–0.0451	–0.0899***	–0.0805*	0.1054***
8. Net dividend [net of capital contribution]	NDC	0.0221***	–0.0502***	–0.0284**	–0.0272***	–0.0531***	–0.0619***	–0.0519***
Δ Shareholders' equity	ΔSEQ	–0.0783***	–0.2529***	–0.1431***	–0.1270***	–0.2039***	–0.2873***	–0.1534***
Δ Preferred stock	ΔPST	–0.0783***	–0.3875***	–0.1789***	–0.1151***	–0.2604***	–0.3195***	–0.1559***
Δ Minority interest	ΔMIN	–0.1125*	–0.2461***	–0.0674	–0.9779***	–0.5043***	–1.3058***	–0.3458***
Δ Dividend payable	ΔDPA	–1.9145***	–1.4179***	–8.0737***	–2.4701***	–1.1191***	–0.3627***	–0.7266***
Observations		*659*	*2568*	*2712*	*2969*	*782*	*4467*	*4792*

Note: The table does not report *t*-statistics; *p*-values less than 0.001 (***), 0.01 (**) and 0.1 (*) are indicated accordingly.

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employed in the estimations of both *OID* and *ORE* – display lower standard errors in prediction by comparison with accruals.

The methodological rigour introduced by the articulation constraint is shown in the totals given in the last row of Table 4, Panel B. Consistent with accounting practice, the sum of appropriately signed balance sheet changes, and the cash flow statement line items obtained by deduction, is shown to be zero for the average firm in the sample. Second, the sum of unconstrained parameter estimates is shown to be non-zero, whereas the sum of constrained parameter estimates is zero, reflecting our underlying argument that, when forecasting accounting numbers, the accounting identities involved should govern the marginal changes that are predicted. Finally, the last row of the final column provides confirmation that the components of the linear predictor, as reported here, sum to the expected value of future scaled income ($INC_{t+1} = 0.0214$).

Estimation by Industry

As a further check on the results, the seemingly unrelated regressions were estimated again within each industry. As shown in Table 5, the results are relatively robust. For instance, in the estimation of future *OID*, *REC* has a larger significant coefficient than ΔARE across all industries except consumer goods, and *PAY* is always larger than the corresponding accruals. Some inconsistency exists in the third line item, but overall the cash flow variables are marginally superior (as judged by larger significant coefficients) to the accrual variables in explaining future cash flows.

In the estimation of future *ORE*, the predominance of investing cash flow on capital expenditure (*CED*) is consistent across all industries, whilst, as is the case for the pooled sample, there is no evidence across industries to discriminate between the impacts on *ORE* prediction with regard to debt issues and changes in cash and other financial investments, nor with regard to net dividend flows and equity changes.

Analysis by industry, despite involving much smaller numbers of observations, demonstrates the consistency of the main results.

CONCLUSION

The articulation of financial statements is an inherent outcome of the double-entry system; each transaction recorded in accounting books must be reflected both as a debit and a credit, whether the transaction arises from a cash payment or receipt, or from an accrual that is based on expected payments and receipts. One property of such a system is that it is possible to generate articulated cash flow statement variables from (a) revenues and expenses in the income statement, and (b) changes in the relevant line items in the balance sheet, as demonstrated in this paper. Based on this framework, we expected that a model that employs all available variables in accordance with their governing accounting identities, with appropriate identification, would be preferable to other models that do not consider the double-entry equilibrium. Based on Christodoulou (2015), we also argue that a marginal adjustment to any one accounting input must result in an equal adjustment across all other related variables, comprising all debit entries and their offsetting credit entries, thus

summing to zero within the system as a whole. The constraint in the third row of Equation 5, where we require all coefficients estimated by a regression that employs the full set of articulated accounting variables to sum to zero, implements this central argument in this paper.

The standard regression model would assume that the equations in the first two rows of Equation 5 (describing the two components of earnings) are unrelated, and consequently that the equation residuals are uncorrelated. The appropriately constrained structural model assumes that the two linear earning predictors are simultaneous equations, related through their correlated residuals, and that the accounting relations between the predictor variables can be imposed as a constraint based on the double-entry system, as mentioned. The results reveal that, in estimating *OID* in particular, the cash flow variables tend to have larger coefficients, and smaller standard errors than the accruals variables. In particular, lower standard errors suggest the greater precision of cash flow variables in predicting future earnings.

Our findings are important for standard setters, investors and business managers. As set out in the *Statement of Financial Accounting Standards No. 1*, a primary objective of financial reporting is to provide information useful to decision-makers. Estimating future earnings is a complex task confronting not only equity investors but also creditors and others, and estimates and projections are the primary means by which managers convey credible forward-looking proprietary information to investors. Accrual and cash flow accounting information is highly relevant to such estimations; thus the research results presented in this paper provide useful guidance for those who regulate accounting on the basis that estimating future earnings is a key objective.

Finally, the results of this study show that, even when articulation between financial statements is lacking, thus preventing investors from properly appreciating the links between a firm's balance sheet, income statement and cash flow statement, an appropriately constrained structural model may still enable us to reach unbiased estimates of future earnings. This paper outlines an important issue, with a view to persuading both the FASB and IASB to improve their framework so that investors will be able to better understand the *articulation between financial statements*, and enable analysts to make unbiased and articulated estimations of the future performance of a company.

ENDNOTES

1   A similar approach is adopted in a recent article by Casey et al. (2016).

2   In practice, when non-operating events such as acquisitions, disposals and accounting changes take place, articulation breaks down (see Hribar and Collins, 2002). However, as the main focus here concerns model development for a complete set of financial statement items, we avoid reported cash flow data and generate articulated cash flows instead. Clearly, further empirical application of the model will take into consideration the full reconciliation with reported cash flow data.

3   For definitions of all three-letter abbreviations used in equations, see the variable descriptors set out for financial statements in Tables 1 and 2.

4   A key assumption here is that long-term receivables (LTR) and other long-term assets (OLA) do not include balances arising from trading, relating to sales (SAL). As this paper is concerned with demonstrating an already extensive model, the need to disaggregate other items potentially related to sales should be considered in empirical applications. The same applies to Equation 3.2, and the possible need to allow for any other long-term liabilities (OLL) that may relate to cost of goods sold (CGS).

5   The variable other (income)/expenses (OIE) in Equation 3.4 includes a number of other Worldscope income statement line items that are present in the database but are reported infrequently, i.e. pre-tax equity interest earnings, equity interest earnings, discontinued operations, extraordinary items and gain or loss on sale of assets, and after tax other income/expense. Likewise, the variable other investments (OIN) in Equation 3.6 comprises another infrequent Worldscope line item, investment in unconsolidated subsidiaries, and another balance sheet variable in Equation 3.6, shareholders' equity (SEQ), includes the final infrequent Worldscope item, non-equity reserves.

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WHY CASH-BASED BUDGETING STILL PREVAILS IN AN ERA OF ACCRUAL-BASED REPORTING IN THE PUBLIC SECTOR

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ABSTRACT

This paper discusses the phenomenon that governments in many Western countries have transferred their cash-based systems into accrual-based systems for reporting purposes during the last decades, while still retaining cash-based budgeting systems. The main question we want to answer is whether there are more substantial reasons why governments prefer cash above accruals for budgeting. Our paper is the result of a comprehensive literature review. At first glance, combining accruals for both budgeting and reporting seems to be preferable above combining cash for budgeting and accruals for reporting: there is consistency between the budgeting and reporting logic, and accrual information is richer than cash information. However, we are in favour of a more nuanced perspective. The combination of cash for budgeting and accruals for reporting can be defended through the lens of a fundamental budgeting logic that identifies all expenditures and revenues expected for the budget year and sees the comparison between cash-based appropriations and actual cash outflows as an easy and straightforward control mode. Moreover, this combination aligns with the dominance of budgeting over reporting and the limited accounting expertise of many accounting information users (for example, public sector managers and especially politicians). We argue that the ultimate transfer from cash to accruals in budgeting needs to be based on a solid assessment of its added value to these users, and not due to pressures of accounting experts.

INTRODUCTION

In line with broader public management reforms, governments of various countries around the world (particularly in Europe) have, over the last few decades, changed their accounting systems from a traditional cash mode to accrual-based systems. These reforms were often in accordance with the harmonisation of private sector accounting standards (for example, towards International Financial Reporting Standards – IFRS) and gained support from the emergence of International Public Sector Accounting Standards (IPSAS). As a consequence, a number of countries now use accrual systems and generate the usual financial reporting documents (such as income statements and balance sheets) as a basis for reporting. However, when taking a closer look at these reforms, the observer will discover that many of these countries have not changed their budgeting systems (and still maintain such systems on the basis of cash). Such a cash budgeting and accrual reporting (CB&AR) mode appears somewhat contradictory and inconsistent from a financial management perspective. Our aim, and the corresponding research question therefore, is to investigate the rationale behind the lack of alignment of the two systems. What were the reasons and arguments of the respective governments to follow this mode? Is it only a matter of time before countries will move to accrual budgeting, or are more fundamental reasons at stake? Moreover, we want to discuss and critically assess the various arguments in favour of and against the cash budgeting mode (and correspondingly in favour of and against the accrual budgeting mode).

This paper is predominantly based on a review of the public sector management literature with cash-based and accrual-based budgeting as main search terms. Given that this theme has gained attention in the academic and practice-oriented literature quite recently, our search for publications was mainly focused on the last fifteen years. Google Scholar was used for a first identification of relevant academic papers. After reading the selected papers and assessing their potential appropriateness for our research project, complementary papers were identified through the so-called snowball method (identification of additional papers based on the references of the originally selected papers). In order to acknowledge that sources other than academic journals might be important outlets for publications on the theme at hand, we included edited books, papers from practice-oriented journals and reports published by consultancy firms in our database of publications. All publications were read and critically assessed in the light of the above indicated research question. In addition, we contacted the authors of recently published studies on those countries that have adopted cash for budgeting and accruals for reporting, for clarification of, among other things, the possible reasons for adopting such a budgeting and reporting mode.

This paper is structured as follows: in the next section we present a general empirical picture of countries following various budgeting and reporting modes. Here we describe some particularities of six European countries (Belgium, Denmark, Greece, France, Portugal and Spain) using the CB&AR mode. This is followed by an explanation of the differences between accrual and cash budgeting and an illustration of particular circumstances in public sector organisations (PSOs) which may lead to differences between the two budgeting modes. In the penultimate section

we discuss and assess various arguments pro and contra cash/accrual budgeting which we found in our literature review. In the final section we discuss our findings and draw some conclusions.

THE EMPIRICAL PICTURE: CASH BUDGETING IN AN ERA OF ACCRUAL ACCOUNTING

This section reports the extent to which governments in various groups of countries have adopted accrual-based accounting for reporting, while continuing to use a cash-based budgeting system. The reviewed studies mainly differ regarding the specific group of countries they address: worldwide (PricewaterhouseCoopers, 2015), Organisation for Economic Co-operation and Development (OECD) countries (Moretti, 2016), or a group of fourteen European countries (Brusca et al., 2015a).[1] In addition, an older OECD study is included (Blöndal, 2004), so that some developments can be tracked over time. Except for the study by Brusca et al. (2015a), which examines various governmental levels – central, intermediate and local – the other studies are all concerned with central government.

Combining either cash or accruals with budgeting and financial reporting gives rise to four possible combinations:

- Cash for budgeting and reporting (CB&CR)

- Cash for budgeting and accruals for reporting (CB&AR)

- Accruals for budgeting and cash for reporting (AB&CR)

- Accruals for budgeting and reporting (AB&AR)

However, because the third combination – accruals for budgeting and cash for reporting – never occurs, three combinations remain, and these combinations are shown in Table 1 for each of the above studies. When comparing the different modes, we should be aware that budgeting is a process with several stages, covering an ex-ante view (i.e. budget formulation and decision for the coming year) as well as an ex-post view (budgetary accounting for controlling budget execution during and after the respective budget year to identify differences between actual and planned appropriations). To some extent, financial accounting, which usually is ex-post-focused, can also have an ex-ante perspective, for instance, with regard to financial forecasting of future expenses or revenues.

The number of countries following the AB&AR mode, at least at the central government level, varies between 18 and 36 per cent. In addition to Australia and New Zealand, and to a limited extent Canada, we find five countries using the AB&AR mode in Europe: Austria, Finland, Sweden, Switzerland and the United Kingdom (UK). The lowest percentage of the AB&AR mode (18 per cent) is noted in the worldwide study, while substantially higher percentages are recorded for OECD countries (32 per cent) and European countries (36 per cent). This suggests that accrual budgeting and reporting are far less adopted in poor than rich countries. In addition, the subsequent OECD studies indicate that accrual reporting has

TABLE 1: OVERVIEW OF STUDIES ON THE APPLICATION OF CASH OR ACCRUALS FOR BUDGETING AND REPORTING IN GOVERNMENTS

Study	Observation Period	Focus and Number of Countries	% of Countries Applying Cash for Budgeting and Reporting	% of Countries Applying Cash for Budgeting and Accruals for Reporting	% of Countries Applying Accruals for Budgeting and Reporting
PWC (2015)	2014–2015	120 countries worldwide (central government)	48%	34%	18%
Blöndal (2004)	2003	29 OECD countries (central government)	69%	10%	21%
Moretti (2016)	2015–2016	34 OECD countries (central government)	18%	50%	32%
Brusca et al. (2015b)	2014	14 European countries (central government)	28%	36%	36%
		11 European countries (local government)*	10%	45%	45%

*The number of countries for which usable local government information is available in the book is eleven, because in three countries (Denmark, Italy and UK) there are no consistent and homogeneous regulations concerning the type of accounting or budgeting concept at local level. Additionally, we are deviating with regard to two countries (Austria and Germany) from the classification of Brusca et al. (2015b). With reference to additional information, we have attributed these countries to the dominant category, i.e. the one to which the majority of local governments can be assigned (Austria to the CB&CR mode and Germany to the AB&AR mode).
Source: compiled by the authors.

increased substantially between 2003 and 2016. Table 1 further indicates that the number of countries in the CB&AR mode is substantial, varying (in central government) between 10 per cent (worldwide) and 50 per cent (OECD countries in 2016). The Brusca et al. (2015b) comparative study also reveals that this combination has an important role in European local government (45 per cent of the countries). Taking a worldwide view, the findings indicate that the combination of cash budgeting and reporting (CB&CR) is still the most often used mode (48 per cent of countries), with poorer countries particularly availing of this mode of operation.

Subsequently, we will further focus our analysis on the Brusca et al. (2015b) study for two reasons. First, in contrast to the other research, this study covers both central and local government. Second, this study provides considerable background information relating to each of the countries (for which separate studies were conducted – see Brusca et al., 2015a). This provides us with deeper insights into the way cash or accruals, or combinations of both, are applied. As such, it can also help to identify possible reasons for particular preferences (a key focus of this

paper). Our analysis is based on two sources: the already mentioned country studies in the Brusca et al. (2015a) book, and additional information provided by the authors of these studies upon our request. The latter information was aimed at clarifying certain specifics of the budgeting and reporting mode in each of the countries. Moreover, it allowed more informed insights relating to two issues: the reasons for adopting the CB&AR mode, and the match or lack of match between the structure of the cash-based budget (in terms of items or articles) and the structure of the accrual-based income statement.[2]

Although the Brusca et al. (2015b) study distinguishes between three levels of government – central, intermediate and local – we confine ourselves to central and local government, acknowledging that intermediate governments are difficult to compare (for example, states in the federal system of Germany and provinces in the unitary system of Netherlands). In addition to pure cash- or accrual-based systems, the Brusca et al. (2015b) study identifies modified cash and modified accrual systems being used. A modified cash system is primarily a cash system which includes some accrual elements, often commitments at the year-end (which will lead to cash outflows in the first months of the next year). A modified accrual system is merely an accrual system, but it may ignore, for example, the depreciation of particular fixed assets (for example, heritage and defence) or certain liabilities, such as pension obligations (see, for definitions: International Federation of Accountants, 2000; PricewaterhouseCoopers, 2015, p. 11).

If we combine cash and modified cash in one category, and also combine accrual and modified accrual in another category, Table 2 shows which European countries apply the budgeting and reporting modes under investigation (CB&CR, CB&AR and AB&AR). This table reveals some consistency in these modes across governmental layers, that is, central and local government in the same country using parallel modes. This is the case in Belgium, Denmark, France, Portugal and Spain for the CB&AR mode, as well as Finland, Sweden, Switzerland and the UK for the AB&AR mode. The other five countries, Austria, Germany, Greece, Italy and the Netherlands, are using partly or fully diverging modes for central and local government.

Given the focus of our research (why countries combine cash for budgeting and accruals for reporting), the following six countries, which use this mode, are investigated further: Belgium, Denmark, Greece (only local government), France, Portugal and Spain.[3] A further examination of these countries is possible because the Brusca et al. (2015a) book comprises country studies of all fourteen included countries. We will try to answer two questions:

- To what extent are the identified countries similar in public sector budgeting and reporting practices?
- What are the reasons standard setters and practitioners in these countries give for preferring a combination of cash-based budgeting and accrual-based reporting?

While each of the six identified countries combine cash-based budgeting and accrual-based reporting, there are also notable differences. First, in Belgium, Flemish local government combines cash and accrual budgeting (Christiaens and Neyt,

TABLE 2: CASH OR ACCRUALS FOR BUDGETING AND REPORTING IN GOVERNMENTS OF SELECTED EUROPEAN COUNTRIES

Government Level	Countries Applying Cash for Budgeting and Reporting	Countries Applying Cash for Budgeting and Accruals for Reporting	Countries Applying Accruals for Budgeting and Reporting	Countries with Heterogeneous or Ambiguous Accounting or Budgeting Modes
Central government	Germany, Greece, Netherlands*	Belgium, Denmark, France, Portugal, Spain	Austria, Finland, Sweden, Switzerland, UK	Italy**
Local government	Austria***	Belgium, France, Greece, Portugal, Spain	Finland, Germany, Netherlands, Sweden, Switzerland	Italy,** Denmark,**** UK*****

* Central government agencies in the Netherlands mostly apply accrual budgeting and accounting.

** In Italy, for both central and local government, reporting also contains elements of accrual accounting; so, the country seems to use a hybrid system of both cash and accrual elements (source: Manes Rossi, 2015, as well as additional information provided by this author).

*** In Austria, the majority of municipalities are still applying cash for budgeting and reporting, but some of them have moved to the AB&AR mode; in the next few years the rest of them will follow (source: Rauskala and Saliterer, 2015).

**** Danish local government uses also some cash elements in its reporting system and municipalities have the right to choose between cash and accrual modes for budgeting (source: Aggestam Pontoppidan, 2015, as well as additional information provided by this author).

***** There are no explicit legal prescriptions in the UK for a specific accounting and budgeting mode for local government.

Source: compiled by the authors.

2015), while governments in the other countries exclusively rely on cash or modified cash for their budgeting system. A recent study (Buylen and Christiaens, 2016) shows that cash-based issues (such as current expenditures by destination or capital expenditures by destination) are used to a larger extent than accrual elements (such as depreciation of assets) in Flemish local government. Second, in Denmark, municipalities have the option to choose between accrual and cash for budgeting (Aggestam Pontoppidan, 2015), while this is not the case in the other countries. Third, several countries seem to have what is referred to as 'integrated accounting systems', indicating that both cash information about budget appropriations and budget execution, as well as accrual information for the income statement and balance sheet, can be derived from the same system. This applies to Belgium for local government (Christiaens and Neyt, 2015), Spain (Brusca, Montesinos and Vela, 2015) and Portugal (Jorge, 2015). The provided information about the countries using the CB&AR mode clearly indicates that there is in general no match between the structure of the cash-based budget report and the accrual-based income statement. While the cash-based budget is structured according to functions (or programmes), the accrual-based income statement is structured according to line items (for example, total salary costs and total depreciation costs). This implies that under such a mode accrual-based information is not appropriate for controlling and for giving account

of the budget execution.[4] Fourth, Greece seems to have adopted accrual elements very recently (Cohen, 2015), largely due to pressures related to the financial crisis, while other countries have longer histories of reforms in which accrual accounting is core. Finally, some countries are inspired by IPSAS in their reforms (Belgium, France, Spain, Portugal), while others deliberately stick to their own history of national standard setting (Denmark), or are faced with such major shortcomings in their current accounting systems that IPSAS may be a step too far (Greece).

The country studies do not extensively provide arguments for the preferred combination of cash budgeting and accrual reporting. Rather than being the result of explicit and extensive debates, the decision for the CB&AR mode seems to be the outcome of implicit reasoning about the assumed information preferences of politicians and public sector managers. In this reasoning two arguments in favour of the CB&AR mode dominate: the mindset of these users of public sector budgets is cash-oriented and they lack the expertise for using accrual-based information. In addition, some more specific arguments were provided: accrual-based budgeting could be more risky; it is convenient to have two types of accounting systems serving different purposes; and the use of accrual information is poor (for more arguments relating to the CB&AR mode, see the later section which explores its pros and cons).

WHICH CIRCUMSTANCES IN A PSO LEAD TO DIFFERENCES BETWEEN CASH BUDGETING AND ACCRUAL BUDGETING?

For an appreciation of the competing arguments relating to cash-based budgeting and accrual-based budgeting, an exploration of the financial effects of their adoption by a public sector organisation (PSO) is important. First, a brief introduction of public sector budgeting is provided: according to Wildavsky (1984, p. 4), a budget is a monetary representation of the planned activities of a governmental organisation. In a more elaborate way, a budget can be defined as an overview of the activities, categorised according to functions, programmes and/or organisational units, of a governmental organisation over a certain future period, in the form of at least its financial aspects (both revenue and cost items), and often supplemented by other information about these activities, such as their goals or desirable impacts (see, for example, van Helden and Hodges, 2015, p. 111). Traditionally, budgeting has been the process through which governments decide how much to spend on which activity, limiting expenditures to the revenues available and preventing overspending. In a broader sense, budgeting has increasingly been expected to perform other roles and functions (for example, enforcing managerial responsibility, discharging a strengthened external accountability and supporting macroeconomic steering of the economy – see, for instance, Anessi Pessina et al., 2016, p. 492).

There are different variables which can be modified when composing a public budget: which aspects of government activities should the budget inform (for example, financial inputs, targets, outputs or outcomes)? How long is the planning period (one or more years)? What should the main criterion of structuring be (following the organisation or along programmes, products, etc.)? How detailed should the budget be (highly differentiated into thousands of items or more aggregated)? How

flexible is the process of budget execution (binding detailed appropriations or offering options for carrying over, etc.)? How does the process of budget formulation proceed (bottom-up versus top-down)? And finally, what is the accounting basis of the financial information used in the budget (cash or accrual)? Budgeting reforms usually deal with one or several of these variables. In this paper, we are primarily concerned with the last issue: the use of cash- or accrual-based financial information within the budgeting process.

Having described some essentials and characteristics of public budgets, we now explore the circumstances in PSOs under which CB (cash budgeting) leads to either quite similar or to substantially diverging financial outcomes than AB (accrual budgeting). The core difference between cash and accrual accounting and budgeting is as follows (van Helden and Hodges, 2015, pp. 46–47): a cash-based system registers cash outflows (payments) and cash inflows (receipts) when they occur, while under an accrual-based system, revenues and costs are recognised when they are earned and incurred respectively, not when cash is received or paid. This implies that in the accrual case the benefits of certain activities are matched with the resource consumption needed for these activities. Consequently, CB and AB may diverge with regard to resource creation (receipts vs revenues) as well with regard to resource consumption (expenditures vs expenses). At first we illustrate possible deviations of the discussed budgeting modes on the revenue side, and subsequently on the expenses side. It has to be acknowledged that CB and its related budgetary accounting is often much more than just a registration of intended cash inflows and outflows per budget article, because it distinguishes between three steps in registering transactions: a registration of the planned cash revenues and expenditures (appropriations), the commitments, and the actual receipts and expenditures at the time transactions occur (see, for instance, Christiaens and Neyt, 2015, p. 31).

Revenues

Important revenue categories of PSOs are taxes, service charges and transfers from other governmental layers (for example, from central to intermediate or local government).

Budgeted cash revenues are the expected receipts in a certain period, often a year. However, a part of these incoming cash flows relate to the previous year. In accrual terms, this part is recorded as accounts receivable at the year-beginning. In a similar vein, a part of the expected revenues of the current year will be received in the next year, which is recorded as accounts receivable at the year-end.

Now we can give the following definition:

Budgeted accrual revenues are budgeted cash revenues in the 'budget year' less the estimated accounts receivable at the year-beginning, plus the estimated accounts receivable at the year-end.

So, under what circumstances do accrual revenues diverge from cash revenues? When accounts receivable substantially decrease or increase over the year. This implies that for governments with well-organised and stable processes of income generation, CB and AB revenues are not expected to diverge much.[5] The latter conclusion cannot be drawn for expenditure/expenses, where the CB–AB differences are more fundamental, as will be shown now.

Expenditures/Expenses

Budgeted expenditures are the expected payments in a certain period, usually a year.

Budgeted expenses (this is an accrual term for consumption of resources) can be different from expenditures (equal to cash outflow). The three following factors are considered to be the main causes for differences between CB and AB, although, in practice, an array of other factors may also impact:[6]

- *Fixed assets*: under CB the payments for purchasing fixed assets (such as infrastructure assets for roads and bridges) are recorded, while under AB the depreciation of all assets in use is recorded, where depreciation is the loss in value during the year of use of the fixed assets. If the purchase pattern of fixed assets is irregular over the years (for example, through large purchases in one year, and no or minimal purchases in some subsequent years), CB and AB will lead to significantly different outcomes. AB will show a much more stable pattern of resource consumption over the years than CB. However, if investments are more even between years, capital expenditures (under CB) and expenses (under AB) can be relatively similar.

- *Provisions* are obligations for payments in the future which originate in a transaction in the current year, while the exact value of these obligations is uncertain and has to be estimated. An example relates to pension provisions where the PSO has to pay pensions to its employees retiring in the future. Under CB there are no provisions, and pension payments in the current year are booked as outgoing cash flows. In contrast, under AB the yearly estimated future obligation for paying pensions will be recorded as an expense, while the actual paid pensions in the current year are deducted from the provisions' account. So, if payments in the current year are quite similar to estimations of future payments related to the current year, CB and AB come to similar financial outcomes. However, if, for example, staff numbers have decreased substantially in the recent past, current payments will be higher than obligations for future payments, and CB and AB give rise to diverging outcomes. Moreover, if a PSO starts to include its future pension obligations as a provision under AB, it will need to pay its current pensioners and create a provision relating to future pensioners, an action that will result in an ongoing double burden.

- *Accounts payable* are debts originating in the current year (relating to resource consumption) which will lead to payments in subsequent years. An example is the production of certain services (like waste water treatment or museum exhibitions) which requires purchase of energy, for which payments are not chronologically corresponding to resource consumption in the production process. This leads to similar accrual corrections as for revenues: resource consumption under AB in a certain year is equal to budgeted payments for these resources in this year (this is the expenditure under CB) less estimated accounts payable at the year-beginning plus estimated accounts payable at the year-end. Consequently, if payables are relatively stable over time, CB and AB result in similar outcomes regarding the financials of resources consumed.[7]

All in all, a fundamental and material difference between CB and AB is the treatment of fixed assets. The other causes of differences – provisions and accounts payable – can also be influential, but probably their impact is often relatively less substantial, particularly if, in the case of pension provisions, staff numbers are stable over time.

After having pointed to the main causes of differences between CB and AB, it is worthwhile to realise that AB requires more additional administrative actions compared to CB. A few examples can illustrate this. First, some general purpose fixed assets, such as office assets, will lead to depreciation expenses which have to be attributed to all work spots and related budget articles. Second, accrued interest expenses have to be attributed based on the book values of the fixed assets of the budget articles. Finally, there are various options for using AB in a decentralised governmental organisation with, for instance, agencies: on the one hand, funding agencies' full costs (cash-in-hand), i.e. including depreciation, which means a loss of central control of investments, and on the other hand funding only agencies' cash elements (no-cash-in hand), and separate control of non-cash items (depreciation of investments), which implies that the cash system largely remains (see further Blöndal, 2004, pp. 107–110).

THE PROS AND CONS OF CASH BUDGETING AND ACCRUAL BUDGETING

After demonstrating that many governments combine cash for budgeting and accruals for reporting, and having explored the circumstances for such a combination, we now address the core of our paper. Here we critically assess the arguments for retaining a cash basis for budgeting against a transition to accruals for budgeting. Obviously, most of the pro arguments for CB are at the same time contra arguments for AB (and vice versa). To avoid duplication, we abstain from repeating arguments for one mode of budgeting which already have been presented with regard to the other mode. The arguments we are discussing here are principally focused on *budgeting*, although the quite narrow interrelations between budgeting and reporting (in our case, of accrual reporting) should not be ignored. The discussion is based on a comprehensive literature review.

Arguments in Favour of Cash Budgeting

At first we discuss several arguments found in the reviewed literature with regard to the relative preference of the CB mode compared with the AB mode, implicitly or explicitly in the framework of an existing accrual system. We do not refer to the fundamental debate about the general applicability of accrual accounting in the public sector which took place in the last decades (see, for example, Monsen and Näsi, 1998).

Money Is Core
The most striking, and also most often used, argument is that CB is a concept allowing easy and well-functioning planning and control of monetary spending of government. For centuries, governments used to formulate and execute a budget

covering all expenditures and all revenues expected for the budget year. Comparing cash-based appropriations with the actual cash outflow is easy and clear in this case (Robinson, 2009; Warren, 2015). In contrast, in the case of AB the control of spending by the Ministry of Finance (or another responsible ministry) would be more ambiguous because sector departments have more discretion to determine their expenses (for example, regarding to depreciation of assets). Therefore, the risk of overspending may be higher in the AB case than in the CB case (Blöndal, 2003). A related argument is that the CB concept is more clearly focused on the authorisation function of the budget: the legislation authorises the government to spend certain expenditures (Bergmann, 2009, p. 66).

Assessment
A clear and strict focus on monetary spending within the given framework of the budget is doubtless a central feature of a budget. In principle, an AB can also inform about cash-based items (see below for details). This is, however, contestable as the information quality very much depends on how cash-based information is structured in such an AB. For instance, does cash information follow the various line items of the budget or is it offered in an aggregated mode (for example, summarised operational cash flow and investment cash flow)? The AB can obviously have a higher risk of overspending because expense control may be less straightforward.

Consistency with Fiscal Policy
As the fiscal policy of a government is usually formulated according to cash terms (for example, with regard to national debt or future tax policy), it is obvious that a CB is more in line with such policies than an AB (Blöndal, 2004; Robinson, 2016). In recent times, international organisations like the International Monetary Fund (IMF), and also national governments, have developed new tools for increasing fiscal transparency. For example, long-term fiscal sustainability reports and medium-term expenditure frameworks which are cash-based and allow forecasting of the future financial development of the state have been utilised (Robinson, 2009, 2016). An argument against AB in this context is that such an approach may not be consistent with existing budget legislation and budget rules (which, for example, provide deficit limits) (Warren, 2015, p. 122). Changing such rules may be costly and time-consuming. Additionally, some critical observers are concerned that the move to accruals may shift the central budgetary focus from compliance to more general issues of performance (Carlin and Guthrie, 2003, p. 154).

Assessment
It is true that fiscal policies are to a large extent dealing with future monetary issues (like the taking on of debt or the raising of tax revenues). An AB is, at the first glance, less tailored to such issues. On the other hand, accrual data serve a medium-term and long-term perspective with respect to state finances, as they identify future challenges of financing re-investments in infrastructure or of paying pension benefits to civil servants. We also have to be aware that important macroeconomic statistical systems such as the European System of National and Regional Accounts (ESA) are composed on an accrual base, although such systems still have a strong focus on

important cash items (see below). All in all, the CB can be considered an appropriate information source about fiscal sustainability, meaning that government can repay its debts, operationalised by a sufficient low level of budget deficits. AB, including depreciation of fixed assets, cannot contribute to this goal. Alternatively, however, the net financial debt, which is defined as liabilities minus financial assets, can be used under AB as a ratio to assess the accomplishment of the fiscal policy goal of a PSO (Robinson, 2009).

Understandability and Complexity of Budgeting Concept
A widely used argument for CB is its comprehensibility, which is considered particularly relevant for politicians involved in the budgeting process. Cash as the 'language' of the CB seems to be a clear and unambiguous denominator, and politicians, as well as a range of other relevant stakeholders, can understand it and communicate about its attribution to certain government policies (Carlin and Guthrie, 2003, p. 157). In contrast, AB requires more sophisticated accounting and budgeting knowledge and skills, not only from politicians but also from public servants. There is evidence that elected politicians are not much interested in accruals (PricewaterhouseCoopers, 2015; Moretti, 2016). As a result, in the AB case budgetary power may shift from elected politicians to professionals and accounting experts, which may weaken the democratic control of government (Schick, 2007, p. 134). Furthermore, some observers indicate that AB may only work if the involved managers dispose of sufficient operative discretion to take decisions, for example with regard to valuation of assets or other accrual items within the process of budget formulation (Schick, 2007, p. 131). And finally, because of higher complexity of the AB, the whole budgeting process may be overloaded and a timely budget decision may be at risk (Warren, 2015, p. 121).

Assessment
This is a quite uncontestable argument. The CB is easy comprehensible and can be used by politicians and bureaucrats without deeper and more demanding accounting knowledge. Additionally, some other prerequisites of the accrual logics have to be taken into account. While balancing a CB is a clear fact (expected cash inflow against cash outflow), an accrual budget balance is a more complex and ambiguous issue: the AB not only has to cover all expenditures in the budget year but additionally also non-cash expenses like depreciation. This makes budget balancing not only more difficult to achieve but also less comprehensible. On the other hand, the relative simplicity of the CB mode should not hide the fact that the focus on cash transactions without recognising the activities 'behind' the cash flow can provide a partly inappropriate picture of resource creation or consumption (see further discussion below). Furthermore, decision makers are in the CB&AR case anyway, forced to become acquainted to some extent with accruals, although less with a view on the budget.

Risk of Budget Manipulation
Some experts consider a CB as less vulnerable to manipulation than an AB. In the latter case, governments or single departments have quite remarkable discretion as

to how to assess the future development of, for instance, the value of assets or interest rates (Government Accountability Office, 2000; Khan, 2013, p. 354).

Assessment
This judgement is quite contested, as opponents suggest even higher opportunities for manipulation in the case of CB, for example by pushing up or postponing payments (Diamond, 2002, pp. 6–7). All in all, we think that manipulation of budgets is always possible to some extent, irrespective of the application of CB or AB, even if such manipulation may be less easy to detect or to prevent in the case of AB.

Low Costs
Obviously, if a government decides for the CB&AR mode it has to reform the reporting system. However, it can continue to use the already existent CB. The total costs of system change, of qualifying involved staff and other stakeholders, and of operating the reporting and budgeting system will be lower if CB is maintained than if the budgeting system is also changed (Robinson, 2016, p. 36). Thus, from a value-for-money perspective it may be questioned if the additional costs of transforming the budgeting system – in the case of an already existing accrual reporting system – from CB to AB are justified. On the other hand, continuing CB while applying accrual reporting is also costly, because the government has to operate two parallel accounting systems: the accrual reporting and a cash-based budgetary reporting. However, the usefulness of budgeting change has to be judged also with regard to its expected benefits. Are the whole efforts worth it if the differences between both budget types are quite marginal? Schick (2007, p. 135) for instance refers to New Zealand's budget of 2004, where the difference between cash-based and accrual-based revenues was only about 0.8 per cent.

Assessment
The cost efficiency of the CB mode compared to the AB mode is debatable. There are certainly costs of the reform process which could be avoided when maintaining the CB mode. The bulk of these costs are, however, caused by transforming the reporting system (for example, with respect to the valuation of assets). Second, some additional costs of operating a more complex AB concept instead of a CB system can be expected. Such costs have to be offset against the costs of running two parallel accounting systems (see above). Finally, we doubt that the differences between CB and AB will always be as marginal as indicated in the New Zealand case above. We rather assume that the differences will be considerably higher at the expenditure/expenses side of the budget, because here depreciation and other expenses are in most cases quite different from the cash outflows related to them.

Arguments in Favour of Accrual Budgeting
In this subsection we present arguments favouring the AB mode in comparison to the CB mode, again assuming that this budgeting concept is incorporated in an accrual accounting system (see also Blöndal, 2004; Cortes, 2006).

Consistency of Budgeting and Reporting System

In the AB&AR mode both parts of the financial management system of a government are aligned with one another and follow the same accounting logic (Lüder, 1999). This makes comparisons between the budgeted and the realised figures easier and more plausible: having 'system consistency pays-off in the long run' (Bergmann, 2009, p. 66). The harmonisation and consistency of reporting and budgeting is seen as a benefit. In a recent survey of German public financial management experts in the context of the European Public Sector Accounting Standards (EPSAS) debate, the majority of respondents were clearly in favour of a parallel change of reporting and budgeting (Wüstemann, Wüstemann and Conrath-Hargreaves, 2016).

Assessment

From an accounting viewpoint this argument is certainly relevant. If a government has introduced accrual reporting, it is coherent to change the budgeting concept accordingly. However, this argument becomes less important when the structure of the cash budget does not resemble the structure of the accrual-based income statement, which is often the case. Then budget execution reports follow the structure of the cash budget. Evidently, reconciliation adaptations are needed at the end of the year for comparing the end-of-year budget execution report with the income statement.

Compatibility of AB with Current Macroeconomic Statistical Systems

The macroeconomic national accounts – for example, those stipulated for the member states of the European Union (EU) – are mostly based on modified accruals. This is the case with the EU Stability and Growth Pact (Khan, 2013, p. 349) and with the Government Finance Statistics (GFS) of the IMF (Schick, 2007, p. 133). A national budget following the accrual mode can therefore be easier and more consistently translated into the respective national fiscal statistics. Such a common database also improves the comparability of financial accounts of countries in Europe and in other parts of the world (which is also the aim of current homogenisation strategies in public sector accounting as discussed in the actual debate of EPSAS; see, for instance, Aggestam Pontoppidan and Brusca, 2016).

Assessment

Generally, this argument is plausible, although the data necessary for such statistical systems can also be provided separately. And the above discussion about the consistency of CB with fiscal issues has to be considered here as a counter argument.

AB Provides Comprehensive Information about Full Costs

The AB can facilitate the calculation of the full costs of government activities (for example, programmes or services), because not only cash-related transactions but also non-cash resource consumption (like depreciation of assets) is included (Blöndal, 2004). Some future obligations, like quasi-liabilities related to long-term public–private partnership contracts, are only recognised in the AB (Khan, 2013, p. 353). The medium-term, and to some extent long-term, perspective of the AB ensures more intergenerational equity, as we discussed above in the case of pension

provisions (Schick, 2007, p. 117). This may result in a strengthened accountability of the respective government, because budget managers are responsible for the total costs of their programmes and services (Warren, 2015, p. 117).

Not all future obligations are, however, covered by the AB. Certain long-term commitments like social insurance benefits are often not recognised in the AB, because their character as government obligation is debatable, a factor which reduces the significance of this type of budgeting (Government Accountability Office, 2007). Apart from this, the AB allows a broader view on resource allocation: this mode is not only focused on the creation and consumption of one single kind of resource (cash), but covers also other types of resources. Additionally, AB ensures a better control of the liabilities of PSOs, including contingent liabilities, such as provisions (Robinson, 2016, p. 37).

Assessment
The quality of accrual data is doubtless higher compared to cash data. As has been said, the picture of the financial situation is more complete and broader in the AB case than in the CB mode.

Risk of Budget Manipulation
In contrast to the above mentioned argument, several experts argue that the AB may be less affected by manipulation, because accrual systems usually follow commonly recognised international accounting (and budgeting) standards (like IPSAS) which limit manipulation opportunities (Diamond, 2002). Additionally, it is argued that manipulation opportunities are generally higher in the CB case as managers can easily anticipate or postpone cash-related decisions, for example, with regard to the procurement of assets (Warren, 2015, p. 125).

Assessment
This argument has already been assessed before (see above). It is a contested argument, because both systems, AB and CB, are vulnerable to data manipulation.

AB Usually Also Includes Cash Data
Proponents of the CB mode sometimes create the impression that there is an 'either/or' option (either only accrual data or only cash data). The reality is often different. Most practical cases of an AB show that such concepts do not only include accrual figures but also cash data, for instance in a cash flow forecast. There is clear evidence that AB concepts provide information about the resource consumption as well as about the cash inflow and outflow (for example, in the UK and in Austria: Marti, 2013, p. 35). Thus, deciding to use accrual budgeting does not mean cash-based information cannot be used or accessed. The CB/AB choice is instead the question of the more dominant perspective of budgetary decision-making: is it the accrual-based 'operations plan' (in the logic of an operations or income statement) or is it a 'payment plan' according to the logic of a cash flow statement? However, to answer this question is difficult, as it needs empirical evidence from the study of budgetary decision-making processes in governments having applied the AB concept. Such types of investigation are rarely available.

Assessment

This is certainly a plausible point. If the AB also provides important aspects of the monetary situation of government, there is little reason to argue against it. However, it is questionable which type of cash information is provided under AB. If reporting is not in line with the budget structure, then relevant information for budget control is not available.

Empirical Experiences with Accrual Budgeting

While there is extensive experience with cash budgeting by various governments over decades which is discussed at length in numerous critical reflections of this budgeting mode, the evidence of AB practices is relatively limited due to the quite recent implementation of this budgeting mode (see also the earlier section on the 'Empirical Picture'). Some observers find that, in general, the experiences with AB seem to provide only modest, and sometimes even disappointing, advantages. Because of the various prerequisites (well-trained staff, sufficient information technology support, etc.), the AB mode is considered to be appropriate only 'for the small cohort of best managed governments' (Schick, 2007, p. 137).

Problems are particularly identified with respect to non-cash transactions, such as depreciation and capital charges (Monteiro and Gomez, 2013, p. 106; Robinson, 2016, p. 38). Several researchers observe that after the formal introduction of AB the majority of involved government staff continue using cash data for decision making (Monteiro and Gomez, 2013, p. 108; Robinson, 2016, p. 37). Furthermore, even the practice of accrual reporting appears to be weakened if AB does not work as expected. This is perhaps unsurprising: budgeting, as the politically much more important financial management tool, determines to a great extent financial reporting. If it remains in a cash-based position, the adjacent reporting system will likely follow the same logic. Carlin and Guthrie (2003) draw conclusions from the Australian experience with AB: introducing AB is much more than a technical exercise, it must be seen in connection with broader public management reform concepts like the strengthening of market mechanisms and contracting out. In such cases, PSOs may embrace producing a full-cost budget, as they need sufficient resources for efficient in-house production or for contracting out its provision to external providers.

CONCLUSIONS AND DISCUSSION

The basic aim of this paper is to understand the rationale of reform decisions made by various governments with regard to their reporting and especially budgeting systems. From previous studies it appears that about one-third to half of governments in industrialised countries changed their reporting system during the last decades from traditional cash to accruals, while continuing to use cash budgeting. At least from an accounting perspective such inconsistency of financial management logics appears to be inappropriate, and it may be asked why governments decide to use such a combination of divergent concepts.

In our literature review we found various arguments in favour of and against the combination of cash budgeting and accrual reporting (which were discussed

and assessed in the previous section). Summarising the various arguments, we think that the following issues have been most influential on the decisions of governments to continue CB while moving to AR:

- Cash is perceived as a clear language and unambiguous denominator for the budget of a state or any PSO which is easy to understand and to communicate.

- Major actors have long experience in using CB. Various routines in the procedures of budget formulation, execution and control are well established and follow long-standing traditions.

- The interrelations of the annual CB with the medium- and long-term fiscal policy of the respective governments are perceived as being transparent and unambiguous.

- As accrual reporting is in use, the government gets a sufficient picture of the full resource consumption at least ex post, via the financial reporting. Thus, the CB&AR mode combines the cash-based spending focus with the resource-based reporting focus.

- Reformers are critical about the additional costs of a system change from cash to accrual budgeting and they believe that the change is not worth the effort.

In contrast to these points, the critical debate on the insufficiency of CB, and on the benefits of AB, has proved to be less relevant and influential. As a result, various governments have decided to stay with CB in their budgeting systems.

For the evaluation of the CB&AR mode, we consider the following aspects as relevant. At first it may be asked, how divergent are CB and AB in reality? Our review of the literature indicates that CB and AB are different, but their differences should not be exaggerated. In the case of labour-intensive activities, especially regarding policy making and policy oversight, expenditures (cash-based) are almost identical to expenses (accrual-based). However, when activities require substantial amounts of capital, as for public infrastructure or services delivery, CB and AB can lead to diverging outcomes, because of budgeting for capital investments and depreciation respectively. This also explains why in some countries, such as the Netherlands, CB is used for labour-intensive core government, while agencies, which often combine labour and capital resources, are applying AB (Budding and van Schaik, 2015). It may be, therefore, a pragmatic solution to request the AB mode only from PSOs with a strong and fluctuating non-cash resource consumption, and to allow other types of PSOs (and for the 'whole of government' finances) to stay with CB.

Second, we observe that, when governments are combining cash for budgeting with accruals for reporting, the two are not (or only to a limited extent) connected with each other. In a more general sense, budgetary documents are structured according to programmes, functions or organisational units, and the follow-up of those budgets in the budget execution reports is structured in the same way. In contrast, the financial reporting documents, especially the income statements, are structured along expense categories (for example, salaries and depreciation) and revenue categories (for example, taxes and grants). This means that budgeting and reporting documents are generally largely decoupled with regard to their internal

structures. Consequently, in both modes (CB and AB) there is the need for a separate budgetary reporting which follows the budget structure.

In this context we have to be aware that – as already indicated before – politicians are mainly interested in budgetary affairs including appropriations and comparing actual and budgeted appropriations. In contrast, accrual information in reports only receives little attention, irrespective of whether budgeting is cash- or accrual-based. However, evidently, one difference remains: the reconciliation between the end-of-year budget execution report and the income statement is straightforward and easily accomplishable under AB, while it requires various end-of-year adaptations under CB.

Third, in the debate about the pros and cons of accrual budgeting, it should also be recognised that AB requires a higher professionalisation of financial management staff, because it is based on a more advanced accounting system and such staff need considerable expertise. Moreover, layperson politicians, as important users of budget information, often lack the skills for proper interpretation of the more advanced accrual information because of issues such as depreciation, provisions and deferred transactions. Sufficient training is therefore an important prerequisite of introducing AB.

Fourth, there is evidence that the AB mode will only work if budget managers have sufficient discretion. In the relationship between the executive and the legislature, the former is mandated by the latter in the budgeting process to spend amounts of money according to budgeted totals per budget unit. The legislature is the budget authority and the executive is the budget receiver. This mandate is clear and quite unambiguous in the case of cash budgeting: cash payments per programme or function can be made by the executive up to the ceilings approved by the legislature. This mandate is, however, much more ambiguous under accrual budgeting (see, for example, Bergmann, 2009, p. 66). In this case, the spending ceiling gives the budget receiver more discretion in combining cash and non-cash elements (such as salaries and depreciation) according to its own judgement. The increase of discretion results in a transfer of accountability from the budget authority to the budget receiver. Consequently, the legislature has to show more trust in the judgmental abilities of the executive under AB than under CB – and this trust must be justified in practice. Put differently, AB implies broader spending mandates at the executive part than CB.

In a similar vein, AB requires broader spending mandates between core ministries (as budget authorities) and their agencies (as budget receivers) compared to CB. Blöndal (2004), for example, argues that two options for the funding of agencies are possible. One is the 'cash-in-hand' option, which is a funding of the agencies' full costs, including resources for depreciation. This may result in a loss of central control of investments. The other option is an exclusive funding of cash elements ('no-cash-in-hand') and a separate control of non-cash items (depreciation of investments), which implies a constrained autonomy for agencies and substantial central control, and actually means that the cash system (at least to some extent) remains. In a similar way, cumulative depreciations of agencies can be handled: either these agencies can be allowed to re-invest their accumulated depreciations (which means high agency autonomy and constrained central control) or agencies' investments require central guidance and approval (resulting in limited agency autonomy and

strong central control). Summing up, we conclude that the advantageousness of the AB mode is dependent on several contextual conditions of the respective public sector systems which have to be carefully examined before starting such reforms.

As a result of this debate we conclude that in most cases a stepwise adoption of accrual elements in the budget is recommended. The motto should be 'first things first and keep it simple' (see also Hyndman, 2016). For example, depreciation of business assets should be done before the more contested valuation and eventual depreciation of other types of assets (for example, community assets and heritage assets). Another option should be the implementation of AB in those governmental domains where its potential added value is the highest (possibly agencies first and core government not, or at a later stage). Evidently, a gradual and partial adoption of accrual elements in budgeting has implications for reconciliation with the accrual-based income statement at year-end (more adjustments are needed than in a fully accrual-based budget). These recommendations may be particularly important to less developed countries, which often suffer from a lack of quality regarding their accounting systems and accounting expertise (see also Diamond, 2002).

The theme of this paper was related to the reasons for preferring the cash versus the accrual mode of budgeting. Thus, the analytical focus was directed to the type of accounting material for budgeting purposes: should this material or data be based on cash flows or should it cover also non-cash data (as used by the accrual mode)? This issue is, however, only one perspective of budgeting reforms. As we indicated before, there are several variables which can (and should) be subject to public budgeting reforms. Possibly one of the most important issues to be addressed relates to the inclusion of information on targets, outputs and outcomes in the budget (performance budgeting; see Mauro, Cinquini and Grossi, 2016 for a literature review). Another improvement would be to expand the time frame of the budget, and move from an annual to a multi-annual budget, and to link it with medium-term expenditure frameworks. Other relevant issues to be considered relate to the possibility of increasing opportunities for a flexible budget execution: shifting among items; or carrying over of unspent appropriations; or the redirection of the process of budget formulation from the traditional bottom-up to a top-down perspective. These examples of budgetary reform issues illustrate the complexity of budget innovations and relativise the importance of the CB&AR mode.

A further reflection regards the stakeholder perspective on accounting information. Our user perspective was almost exclusively constrained to politicians and public sector managers. Given this perspective, we tried to assess the pros and cons of cash-based and accrual-based budgeting. However, additional stakeholders using accounting information in the public sector can be relevant. For example, creditors and credit agencies, or oversight bodies, may have a primary interest in accrual types of accounting information related to the financial health of a PSO, particularly with respect to ratios like equity over total liabilities, or the extent of financial surplus over costs. This implies that a PSO may need different accounting systems – cash- *and* accrual-based – serving different purposes and related stakeholders. This, however, does not undermine the importance of discussing the most relevant accounting basis for budgeting purposes – cash or accrual – for its main stakeholders (politicians and public sector managers).

A main issue for future research is how to explain the reasons why several sets of countries have adopted diverging budgeting and reporting modes. By taking Lüder's contingency framework of financial management reforms in the public sector as a starting point (see, for example, Lüder, 2002), several groups of variables are expected to be influential. These include different doctrines for ruling the public sector (such as New Public Management (NPM) versus Neo-Weberian thinking); certain reform drivers (for example, the ideas of specific professional groups like accountants and consultants); political promotors of reforms (like the Ministry of Finance, or the audit institution). In addition, political or financial scandals can be drivers for certain changes. Just listing these groups of variables is, however, insufficient. It will be challenging to relate different values of each of these variables to diverging budgeting and reporting modes. For example, it is possible that a strong NPM perspective, combined with influential professional bodies of accountants adhering to business accounting (such as in the UK), could be drivers for the AB&AR mode. However, where there is less pronounced embracing of NPM thinking, and stronger traditions of bureaucratic administration, such as in France, this could explain the adoption of a CB&AR mode. In addition, it can be expected that long-lasting traditions of cash-based governmental standards setting (as in German and Dutch central government), could be an obstacle for adopting accrual standards for budgeting and reporting.

In a nutshell, we would like to conclude our observations and reflections on the issue of why many governments opt for accrual accounting for reporting, but not for budgeting, and thus continue to use cash budgets. At first glance, this mode of financial management appears quite inconsistent and contradicting. However, from a more nuanced perspective, the combination of cash budgeting and accrual reporting can be seen as an acceptable compromise. It can be defended through the lens of a fundamental budgeting logic that identifies all expenditures and revenues expected for the budget year, and sees the comparison between cash-based appropriations and actual cash outflows as an easy and straightforward control mode. Moreover, this combination aligns with the dominance of budgeting over reporting and the limited accounting expertise of many accounting information users (often public sector managers and, especially, politicians). The ultimate transfer from cash to accruals in budgeting needs to be based on a solid assessment of its added value to these users, and not due to the pressures of accounting experts.

ACKNOWLEDGEMENT

ENDNOTES

[1] Our empirical picture relies to a large extent on Brusca, Caperchione, Cohen and Manes Rossi (eds) (2015), *Public Sector Accounting and Auditing in Europe: The Challenge of Harmonization*, Basingstoke: Palgrave

Macmillan (quoted as Brusca et al., 2015a). This book offers an abundance of evidence on fourteen European countries; its last chapter (quoted as Brusca et al., 2015b) provides a comparative summary of these findings. We also refer to Jones et al. (2013) for a comparative study on budgeting and reporting practices in the central governments of France, Germany, the United Kingdom and the United States.

[2] We would like to show our gratitude to our colleagues Caroline Aggestam Pontoppidan (Denmark), Isabel Brusca (Spain), Johan Christiaens (Belgium), Sandra Cohen (Greece), Susana Jorge (Portugal) and Marine Portal (France). We also thank Francesca Manes Rossi for clarifying the complex budgeting and accounting mode in her country, Italy.

[3] Apart from these European countries, also the European Commission (EC) itself follows this mode; the EC applies accrual accounting (IPSAS) but uses a modified cash budgeting system (European Commission, 2014, p. 262).

[4] The only exception is Flemish local government where budget and income statement structures match and are thus comparable.

[5] We acknowledge that, in addition to regular revenues, also extraordinary revenues, such as the sale of assets, can be at stake.

[6] For example, loans and debts, interest payments versus accrued interest expenses, saved interest payments due to equity, pre-paid expenditures and pre-received income (see for some further explorations: Blöndal, 2004, pp. 107–116; Budding and van Schaik, 2015, pp. 146–152). In addition, the valuation of fixed assets, i.e. the preferences for either a historical or some kind of future value, is a contested issue, and also the question as to which assets have to be valued and depreciated, for instance economic versus community assets (van Helden and Hodges, 2015, Chapter 5).

[7] If the use of materials is at stake, somewhat similar registrations have to be made: the use of materials under accrual budgeting is related to the expected production activities; if the use is higher (lower) than the purchase of materials, this will be seen in a decrease (increase) in the stock of materials.

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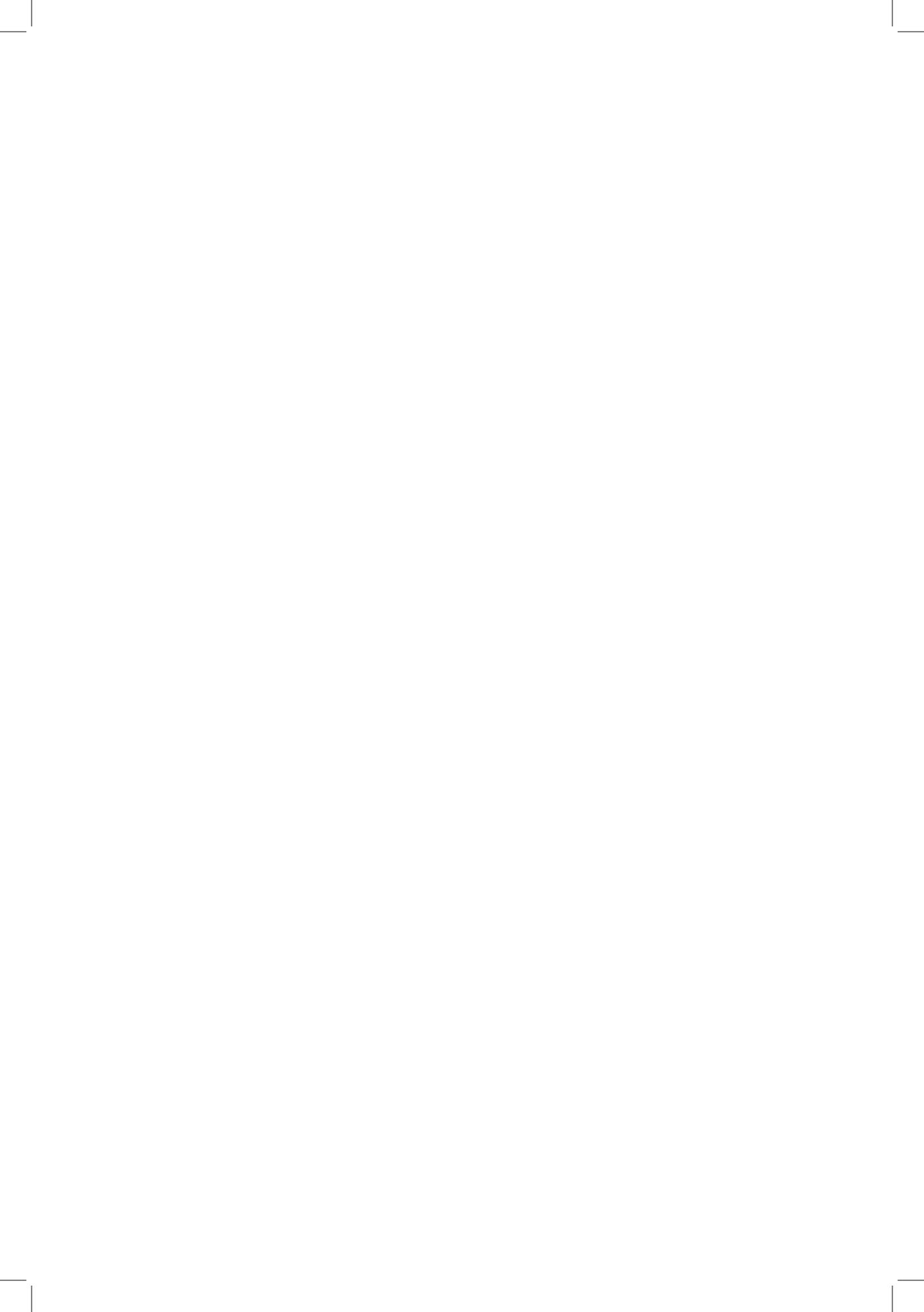
PAPERS PRESENTED AT THE TWENTY-NINTH ANNUAL CONFERENCE

The titles of papers presented at the twenty-ninth Annual Conference of the Irish Accounting and Finance Association (19–20 May 2016), Waterford Institute of Technology, were as follows:

Author(s)	Paper Title
Alhendi, A. and Rodgers, W.	The Effect of Social Capital on the Compliance with the Auditing Practices
Burke, R. and Demirag, I.	Managing Risk through the Special Purpose Vehicle in Irish Public–Private Partnerships
Campa, D. and Donnelly, R.	Loan Loss Provisions in Publicly Quoted European Banks and Auditor Independence
Cleary, P., Quinn, M. and Moreno, A.	Evidence of Socio-Emotional Wealth in the Chairman's Statement: A View of Two Family-Controlled Irish Breweries
Clerc-Renaud, S.	Regulating Remuneration in Financial Services: Lessons from Two Research Works for the European Commission on Insurance Intermediaries and Banks
Deeney, P., Cummins, M., Dowling, M. and Smeaton, A.F.	The Influence of Twitter Sentiment in the EU Emissions Trading Scheme
Doherty, O., O'Keeffe, C. and Forbes, W.	Social Learning and Informational Cascades in Financial Markets: Review and Synthesis
Doyle, E.	The Impact of Recession on Ethics in Tax Practice: A Qualitative Study
Edgar, V. and Beck, M.	The Role of the National Audit Office in Private Finance Initiative Endurance
Fargher, N., Zhang, J.Z. and Hou, W.	Do Banks Audited by Specialists Have Less Accruals and Real Activities Management? Evidence from Loan Loss Provisions and Repo Transactions
Garavan, C.	The Tax Exile Problem
Griffin, R., McCarthy, P. and O'Riordan, C.	The Real and Its Performances in Bankruptcy and Insolvency
Hannon, C. and Doyle, E.	Tax Evasion and Avoidance: A Study of Taxpayers' Perceptions

Author(s)	Paper Title
Heid, A.K. and Petry, H.M.	'By Words the Mind Is Winged': Centrality of Trustworthiness Demonstration in Accounting Narratives of Crisis Organisations
Killian, S. and O'Regan, P.	Expertise, Risk, Tax and Society
King, D.	Using Blended Learning and Mobile 'Apps' to Enhance the Engagement and Retention of First-Year Financial Accounting Students
Kirwan, C.E. and Brennan, N.M.	Accountability in the Boardroom: Reconceptualising Non-Executive Directors as Guardians of the Firm
Lenihan, O.	A Study of CEO Annual Incentive Plans: Performance Measures, Performance Targets and Performance Outcomes
Martyn, P., Sweeney, B. and Curtis, E.	Combining Predictable Goal Achievement and Creative Innovation at Middle Management Level and the Influence of the Beliefs System
Mattimoe, R. and Kenny, N.	Performance Measurement and Management in the Accounting Literature 2000–2010: An Evidence-Based Management Approach?
Maughan, R. and O'Dochartaigh, A.	Sustainability Accounting and Reporting for Origin Green: A National Sustainability Programme for the Irish Food and Drink Industry
McGeough, F.	Legitimising Governance Activities in Irish NPOs: The Annual Report as a Disclosure Tool
McGeough, F. and Beck, M.	Building Public Policy on Shifting Sands: The Case of NAMA
McNamara, A., O'Donohoe, S. and Murro, P.	An Analysis of the Lending Infrastructure and SME Credit Availability: A European Perspective
Merkl-Davies, D.M. and Brennan, N.M.	A Theoretical Framework of External Accounting Communication: Research Perspectives, Traditions and Theories
Molumby, J.	Evaluation of the Effectiveness of Accounting Information Systems in a Cloud-Based Environment
Murphy, A., O'Keeffe, C. and Forbes, W.	An Investigation into Momentum in the UK Stock Market: 1995–2015
Murphy, B. and Quinn, M.	The Emergence of Mandatory Continuing Professional Education at the Institute of Certified Public Accountants in Ireland
O'Brien, B. and Iannone, P.	Students' Experiences of Teaching at Secondary School and University: Sharing Responsibility for Classroom Engagement
O'Callaghan, L. and Dempsey, S.	The Requirements of Work Placement in an Accounting Programme from the Employers' Perspective
O'Callaghan, S., Ashton, J. and Hodgkinson, L.	Executive Compensation and Ownership Structure in Private Firms in the UK
Pasley, D., O'Donohoe, S. and O'Gorman, B.	Displacement of Private Finance by Government: An Examination of Irish Government Financial Support for Indigenous SMEs

Author(s)	Paper Title
Peltier-Rivest, D.	The Effectiveness of Reporting Mechanisms in the Battle Against Fraud
Quinn, M. and Gibney, D.	Accounting in the Early Days of the Irish Free State: The Accounting Practices of Bennett's of Ballinacurra
Ross, O., Langan, E. and Doyle, B.	Stay with the Programme: Describing the Evolving Retention Strategy of AIT's Faculty of Business and Hospitality
Sheppard, G. and Beck, M.	Policy Transfer and the Sustainability of Public–Private Partnership in Ireland: A Conceptual Analysis
Spencer, L. and O'Donohoe S.	SME Internationalisation and Its Financing: The Case of Ireland and Scotland
Sweeney, B., Bisbe, J. and Bedford, D.S.	How Performance Measurement Systems Help Firms Achieve Intended Ambidexterity: The Role of Cognitive Conflict
Tynan, A.	One Hundred Years of Irish Tax Policy Formulation
Vance-Lee, R. and Kelly, R.	Engagement Measurement in Irish HEIs
Ward, A. and Forker, J.	Female Leadership Selection in Community-Governed Financial Institutions: The Glass Cliff Phenomenon as an Effective Organisational Response to Institutional and Social Barriers
Whelan, G., Gleeson, E. and Lambert, J.	An Assessment of Asset and Liquidity Quality as Indicators of Performance in the European Banking Sector
Zavadska, M., Morales, L. and Coughlan, J.	Oil Prices Volatility During Turbulent Times

CHARTERED ACCOUNTANTS IRELAND EDUCATIONAL TRUST (CAIET)

RESEARCH AGENDA

2017

ABOUT CHARTERED ACCOUNTANTS IRELAND EDUCATIONAL TRUST (CAIET)

The principal objectives of the Chartered Accountants Ireland Educational Trust (CAIET) are to further and develop the science of accountancy in all of its branches and to promote educational facilities for the teaching of the science and practice of accountancy, auditing, finance and other related subjects.

The Trustees interpret the science of accounting as including audit and assurance, reporting to stakeholders, management information, taxation policy and procedures, governance, risk management, business and professional ethics, and business regulation. It would not normally include the separate sciences of economics, management theory, and business studies.

The policy of the Trustees is to act as a catalyst for activities in the sphere of accountancy education and research and to provide financial assistance where such activities would not otherwise be feasible. If the resources available prove inadequate for these needs the Trust may act as a vehicle for additional public fundraising.

The CAIET (henceforth 'the Trust') has identified broad research themes to stimulate applications for funding and they may come from the following areas:

- Audit and assurance

- Business ethics

- Business reporting

- Governance (both in businesses and in other organisational forms)

- Management accounting and financial management

- Methodologies of education and training

- Not-for-profit and public sector accounting, reporting and regulation (for example, state agencies, charities or credit unions)

In the past the Trust has funded projects such as:

- Implementation of accruals accounting in the Irish public sector

- XBRL development

- Delivery of accounting cases to large groups in an educational setting

- *Accounting, Finance and Governance Review* – the Trust has, since the inception of the Irish Accounting and Finance Association (IAFA) supported the publication of its official academic journal (at present entitled the *Accounting, Finance and Governance Review*)

Examples of topics of potential interest to the Trust include (but are not limited to):

- A comparison of principles vs rules approaches as a basis for financial reporting
- Changing needs, skill sets and techniques in the auditing profession
- The efficacy of differing methods of the teaching of accountancy (including the use of IT to support teaching and learning)
- Emerging reporting frameworks (for example, with respect to corporate social responsibility and sustainability)
- Changing regulatory structures in financial institutions in the wake of the financial crisis (for example in banks or credit unions)
- The impact of new public management (NPM) ideas on accounting, budgeting and performance measurement systems in the public sector
- Accounting, reporting and regulation requirements in the charity sector
- The influence of changed accounting requirements on pension schemes
- The effect of changed taxation policies on the economy

FUNDING POLICY

1. The Trust welcomes applications from the academic research community both within and outside the island of Ireland. It is particularly interested in applications based on professional, business and/or international collaboration.

2. Grants cover the direct expenditure attributable to the project (**Note:** College/university fees are not paid for, nor are projects funded that are part of a postgraduate programme). Following any decision by the Trust to approve funding, claims for reimbursement should be supported by vouched expenses or other appropriate evidence.

3. The Trust is not limited to supporting academic research only but is also available to those in practice or in any other form of activity that promotes the science of accounting and/or accountancy education.

4. It must be clearly acknowledged in each project that the Trust has supported it. The suggested form of wording to be used in such acknowledgement is:

   'This article/report/book is based on research carried out in collaboration with xxxx from xxxx and with financial support from the Chartered Accountants Ireland Educational Trust.'

5. Copies of the research outputs must be made available to the Trust and the Trust reserves the right to publish such outputs on its website or in its journal or any other Chartered Accountants Ireland publication. There is a requirement that among the research outputs from a funded project there should be one submission to the official academic journal of the IAFA, at present entitled the *Accounting, Finance and Governance Review* (this is a journal funded by the Trust), and a shorter, professionally focused paper submitted to *Accountancy Ireland*.

6. Projects which are unduly delayed may be reassessed by the Trustees. Grant recipients are required to provide written progress updates to the Trustees at least twice per annum (March and August).

REQUESTS FOR FUNDING

Each request for funding must include the following:

1. Research proposal to include the following:
   a. a summary of the project
   b. prior research that has been carried out by the applicant(s) or others in relation to the topic
   c. timeline for the project
   d. problem/hypothesis or question
   e. research methodology
   f. potential contribution to the science of accounting
   g. intended outputs
2. Completion of the attached application form
3. Curriculum vitae(s) of the applicant(s)

CHARTERED ACCOUNTANTS IRELAND EDUCATIONAL TRUST

Application Form for Research Funding

1. APPLICANT

Lead Applicant: _____

Name: _____

Title & Position Held: _____

Institution: _____

Address: _____

_____

_____

Tel: _____   Email: _____

If there is a co-applicant, please provide details:

Name: _____

Title & Position Held: _____

Institution: _____

Address: _____

_____

_____

Tel: _____   Email: _____

Note that detailed CV(s) of the applicant(s) should be appended to this application form

2. RESEARCH PROJECT

Title: _____

Brief Description of the Project:

A fuller description of the project should be appended to this document

3. FUNDING AMOUNT REQUESTED _____

Give an indication of a breakdown of the costs related to the project:

Staff	
Travel	
Other	
Total	

4. PROJECT MILESTONES

Detailed milestones* of the project, ensuing costs and estimated time to completion:

Milestone	Cost	Target milestone completion date
1.		
2.		
3.		
4.		
5. Copy of project sent to the Trust		

* Literature review, gathering information, analysis, etc.

5. OTHER FUNDING

Has application been made to any other funding body in respect of this project? If yes, please provide details:

6. PREVIOUS APPLICATIONS TO THE TRUST

Has the applicant being in receipt of funding from the Trust in the past and, if yes, for what project:

To qualify for Grant assistance the project must 'enhance the science of accountancy'. The Trustees interpret the science of accounting as including audit and assurance, reporting to stakeholders, management information, taxation policy and procedures, governance, risk management, business and professional ethics, and business regulation. It would not normally include the separate sciences of economics, management theory and business studies.

7. CAIET TERMS OF REFERENCE

Please briefly explain how this project will enhance the science of accountancy:

How will the project promote educational facilities for the teaching of accountancy, auditing, finance or other related subjects?

Date: _____

Completed applications should be sent to:

M. Murphy
CAIET Administrator
Chartered Accountants Ireland Educational Trust
Chartered Accountants House
47–49 Pearse Street
Dublin 2

Telephone: +353 (1) 637 7200
www.charteredaccountants.ie/caiet

NOTES FOR CONTRIBUTORS

1. Papers should be submitted electronically. Papers should not normally exceed 8,000 words.

2. There should be a separate file containing the title, author(s), affiliation(s) and one address to which correspondence regarding the paper (including proofs) should be sent. An abstract of not more than 100 words should be given at the beginning of the paper.

3. Citations in the text should be by author's name and year of publication, for example, Black (1972) or (Brown, 1972). In the case of citations of books or specific quotations, page numbers should be given, for example (White, 1992, pp. 10–11). Where more than one publication by the same author in a given year is cited, they should be distinguished by lowercase letters after the year, for example (Green, 1987a; Green, 1987b). Where there are more than two authors, all names should be given in the first citation with 'et al.' used subsequently.

4. References should be listed alphabetically at the end of the manuscript in the following style:

DeAngelo, L.E. (1981). Auditor Size and Audit Quality, *Journal of Accounting and Economics*, Vol. 3, No. 3, pp. 183–199.

European Commission (1996). *Green Paper on the Role, the Position and the Liability of the Statutory Auditor Within the European Union*, October, Brussels: European Commission.

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Fielding, N.G. and Fielding, J.L. (1986). *Linking Data: Qualitative Research Methods*, Beverly Hills, CA: Sage Publications.

Only works referred to in the text should be listed, and a general bibliography should not be included.

5. Essential notes should be included as endnotes rather than footnotes.

6. In initial submissions, tables and diagrams may be either included at the appropriate point in the text or after the references with their positions indicated in the text. Do not submit any separate Excel documents. Any exceptional costs of artwork for diagrams will be charged to authors.

7. Mathematics should be used only if they contribute to clarity or economy of presentation. The conclusions of mathematical papers or elements of papers should be made intelligible to readers who are not mathematicians.

8. Papers should not be submitted while under consideration by any other journal.

9. Papers are accepted for publication on the understanding that they are subject to editorial revision and have not previously been published.

10. In the preparation of papers, authors must observe copyright rules and practices.

11. Authors should correct proofs quickly and should not make revisions to proofs.

12. Authors submitting a paper do so on the understanding that, if it is accepted for publication, copyright of the paper is assigned to the publisher. The Irish Accounting and Finance Association, as publisher, will not impose restrictions on the author(s) regarding the use of material from the paper in other published works.