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Full Length Research Paper

Inclusion of small-scale energy users in liberalized energy markets

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Climate change dramatically impacts the structure of energy business by adding renewables. In traditional energy networks, the balance between the demand for- and the offer of- power is managed by increasing the amount of commodity or by shedding loads. Customer-centered grid brings new paradigm about changing the economic behavior of small- and medium- scaled energy users instead of varying the amounts of commodity that is called flexibility. Flexible cooperative behavior of many actors participating in liberalized intraday market reduces pollutants because it optimizes renewable energy. However, it has implications on power markets in terms of prices and has technology implications nation-wide. This article discusses a generational change that moves decision making from few control rooms to the democratic neighborhood of the web. The objective is to present a changed socio-economic context and attract the attention of researcher to new challenges. The main result is a dynamic equilibrium that exists between the reward offered by the utilities to their customers and the advantage obtained by the utilities from such a flexible behavior. The article main conclusion is on the role of new market product called demand-side flexibility in the transformation of power markets towards ecological sustainability.

Key words: Demand-side flexibility, energy market, intraday trading.

INTRODUCTION

Climate change is a relatively new reality that impacts the structure of fossil and nuclear- based energy businesses. It has several adverse effects, including poverty (Houghton et al. 1995); but can also lead to prosperity in a sustainable way (World Bank 2016). More than 89% of observational studies have shown significant changes in physical and business systems consistently based on response to warming (Parry 2007); it is an activity that generates new jobs and values.

To reduce CO₂ and particulate matter pollutants, energy business adopted environmental-friendly power plants from Renewable Energy Sources (RES). The RES production has several peculiarities requiring attention because it is poorly predictable, weather-dependent, and has low-inertia. Because of the laws of physics, electricity distribution networks impose strict balance between the electric power being offered and the electric power being demanded at each instant over time.

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African countries form the electricity-poor region in the world where millions lack access to electricity and millions more are connected to an unreliable grid in terms of energy service needs. The International Energy Agency (IEA) forecasts the total demand for electricity in Africa to increase at an average rate of 4% a year through 2040. This includes self-generation from diesel generators being operated daily for some few hours. To meet the said demand, the region has to significantly expand its generation capacity, to upgrade the power grid, and consider the flexibility. Therefore, Africa is burdened with a complex and persistent electricity gap, of which the self-generation modality presents an interesting challenge because of the social aspects.

Big population of small-scale energy producers operates daily diffused self-generation from their own micro-plants, but they are not directly included in liberalized energy markets. In power market terms, the amount of commodity being offered and traded should be always equated in real time by the corresponding amount of demand in terms of both the energy and the rate of energy.

In traditional electricity distribution grid, the balance between the demand for- and the offer of- power was easily managed by increasing the amount of commodity or by shedding the amount of loads because of high inertia. In both inertia-less RES and self-generation scenario, there could be no sufficient time to take economic decisions in order to safeguard the stability of the supply in the case of unexpected production drop-outs.

An alternative solution is required to balance between the time-varying offer and the demand. A large population can decide to become more flexible when demanding resources. This can improve balancing of energy distribution networks. Because of the universality, this approach has an advantage to be transferable between different domains and geographic areas. For example, it can be used to optimize the limited resources of water, oil, or any other kind of energy-containing substance.

Demand side flexibility

Instead of *varying the quantity* of a commodity being offered on the market at a given time, an attempt to *piloting the dynamics* of the demand for power was recently proposed in the context of Transactive Energy Control (TEC) framework defined as a system of economic and control mechanisms that allow the dynamic balance of supply and demand across the entire electrical infrastructure using value as a key operational parameter. This new concept is currently known as the *flexibility of demand* for power associated with the key concept of value (CEER, 2016).

By definition, the Demand-Side Flexibility (DSF) is a *capacity to change* energy usage process by end-use

customers (including different types of energy users, residential or non-residential ones) from their “normal” or current consumption patterns in response to market signals, such as time-variable electricity prices or other incentive payments, or in response to acceptance of the consumer's bid, alone or through aggregation, to sell demand reduction/increase at a price in electricity markets or for internal portfolio optimization (Allcott, 2011).

Legacy associates generically the *demand* with the *value* ($\text{Value} = f(\text{Demand})$), without specifying the *structure of Quantities Demanded* (QD). New multi-scale interpretation associates the *Change in Demand* (CiD) with the *Value being Modulated* (VbM) through one or more economic signals $\text{Value} = g(\text{Signal}_i, \text{ChangeInDemand})$. On an individual level (Eurelectric, 2014), flexibility is the *modification of prosumption patterns* in reaction to an external signal in order to provide an ancillary service within any multi-energy system.

In this interpretation, the flexibility becomes measurable through the parameters such as the Amount of Demand (AoD) being modulated, the Duration of Flexibility (DoF), the Pattern of Demand (PoD) being modulated, the Rates of Change (RoC) in the pattern, the Response Time (RT) or the latency of the action, and the geo-location of the node. New realized demand pattern comes from the input PoD after the action RoC is expected to last (DoF-RT) in time.

On an aggregated level, the DSF can be materialized by collective cooperative behaviour of a group of people that decide to change their demand-response behaviour in order to achieve the shared prosperity in terms of sustainable use of energy-containing commodities. The aforementioned transformation represents a societal challenge. The exemplified pattern of demand (Figure 1) partly annotated as being flexible and/or non-flexible indicates a flexibility potential.

DSF value

The DSF appears to be a good that is very similar to the additional generation capacity, but it is CO₂ and particulate matter emission-less. The DSF is an energy-equivalent being collectively produced by certain group of people that are immediately expended by the totality of consumers, so it is an extremely short-living good. However, the DSF is supposed to be known in advance, so it appears predictable.

Therefore, the DSF should have a market price similar to- or higher than- the price of energy offered by power plants that use peak generators only. For example, ten percent DSF being effectively realized on a real intraday market during an over-crowded time slot between 9:00 and 11:00 AM has a specific size (10% of the traded volume) and a specific price (averaged spot price during

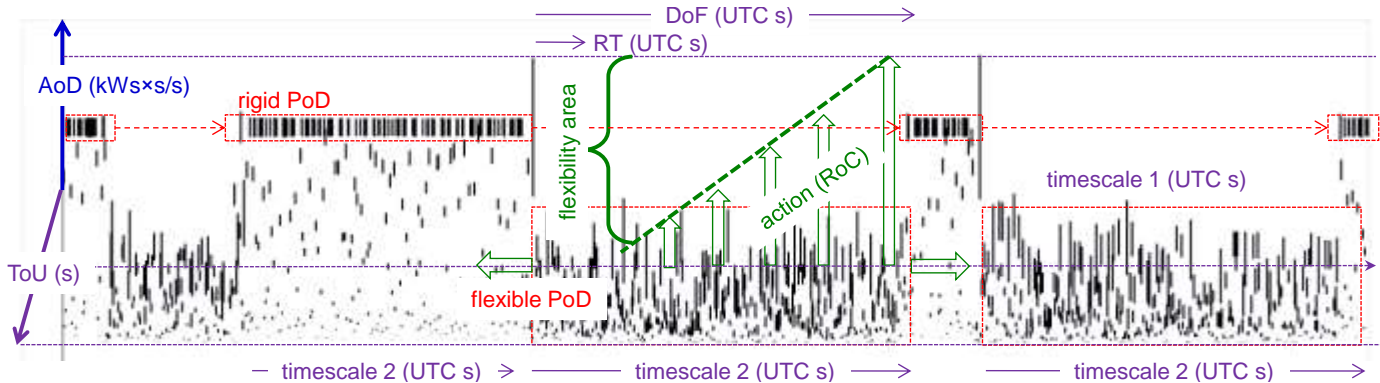


Figure 1. The pattern of demand of industrial customer annotated as being locally flexible.

the today's time slot 9.00 to 10.00 AM). However, the DSF is not a tangible asset that belongs to certain well-known energy producer, but a virtual product that depends on the collective behavior of many actors.

In this example, the incentive-driven collective behavior of energy-efficiency oriented users materializes the desired amount of DSF. Thus, the DSF belongs to the community of energy users and it can be traded by someone on behalf of them. Most likely, the price of the DSF is cleared by utility. Moreover, the incentive (reward) that can be offered to end users cannot exceed the variable cost of energy production by peak generators. For this reason, the determination of the market price of DSF is not a trivial task.

METHODOLOGY

The research investigates the enabling role of the DSF in the TEC and how to spread its use at a scale (Figure 2).

This issue appears important because it indicates sustainable way to contain steadily growing demand for newly generated energy amounts by shaping intelligently the patterns of demand – instead of or in addition to the amounts of demand - based on the mutual knowledge about the time-varying changes in the capacity/availability of the energy resource.

The outcome appears highly impacting because only in Sub-Saharan Africa populated by 1 billion of people ca, more than 600 million people lack stable access to networked electricity. Given the estimate of the demand growing rate of 4% a year through 2040 and given the limited investments in infrastructure, the DSF behavior can ameliorate the current electricity access rates of about 20% destined to deteriorate without (policy) interventions (Avila et al., 2017).

The research outcome allows the preserving of the average energy consumption in any - the sub-Saharan, Asian, and others – geographic area by differently apportioning the available richness over time instead of insisting on the amounts and/or different redistribution over population. To real numbers, the International Energy Agency report (IEA) indicated 16.8% of self-generation in Sub-Saharan Africa (71 TWh of self-generation out of 423 TWh in total in 2010s. It is the estimate of the population that can get direct benefit from the DSF in the exemplified geographic area because this population already owns small-scale generation plants and uses them for self-consumption. The DSF can convert the

standalone capacity in the networked demand-response action optimally distributed over time.

This article started from the specialized literature review in order to establish the availability of components dealing with the DSF. The most difficult and less researched issues appear to be the analytic measurement of the population that originates the DSF and the real-time measurement of the change in demand figures they originate.

In order to acquire information about the shapes of demand-response, the observational study was considered. In the known state of the art, demand-oriented energy meters are not deployed to small-scale actors. Researchers explored the Event-Driven Meters being deployed by the PowerIntellimeter project to several users in Northern Italy because it allowed the QD.

In the examples, authors used anonymized time series of *real life data* from some industrial and residential users. Newly acquired individual and aggregated groups data emerged as a possibility to define new metrics and to build useful indicators. Given the experimental data, business analytics were derived by using state of the art statistical, descriptive, and sensitivity analysis tools.

Measuring the DSF

Since the amount of demand (expressed in kWh) alone is not sufficient to know the rates of work, the pre-requisite for DSF estimation is the analytical acquisition of the *structure* of the PoD (expressed in triplets (kW□h), (kW□h/s), and (s⁻¹)) from real life by measurements (Figure 3).

The Customer Baseline (CBL) is a sequence of QD (expressed in kWh/s) effectively expended during well-defined ToU (expressed in s_{use}) at certain well-specified RoW (expressed in (kWh)/s) by certain customer or a group of customers. The structured PoD is exemplified on the ad-hoc developed visual form (Figure 1) by plotting the diagonals $A_j C_i$ from the Figure 3 appearing in the form of vertical strobes $\sqrt{AoD^2 + ToU^2}$ [expressed in digital units $((kWh)^2 + (s)^2)^{0.5}$]. They are sequenced in non-uniform frequency domain after time wrapping factors $||t_i - t_{i-1}||^{-1} : 1^{-1}$ in order to make ad-hoc timers appear virtually as unitary ones¹. After this definition, the realized DSF is a difference between two time series namely the CBL_j in the baseline scenario hypothesis and the CBL_k after the signal being issued and considered by customer(s).

¹ For the sake of simplicity, in this work authors omits lengthy and complex discussion about semantic and physical meaning of this artificial digital construct drawing from the combined use of transforms.

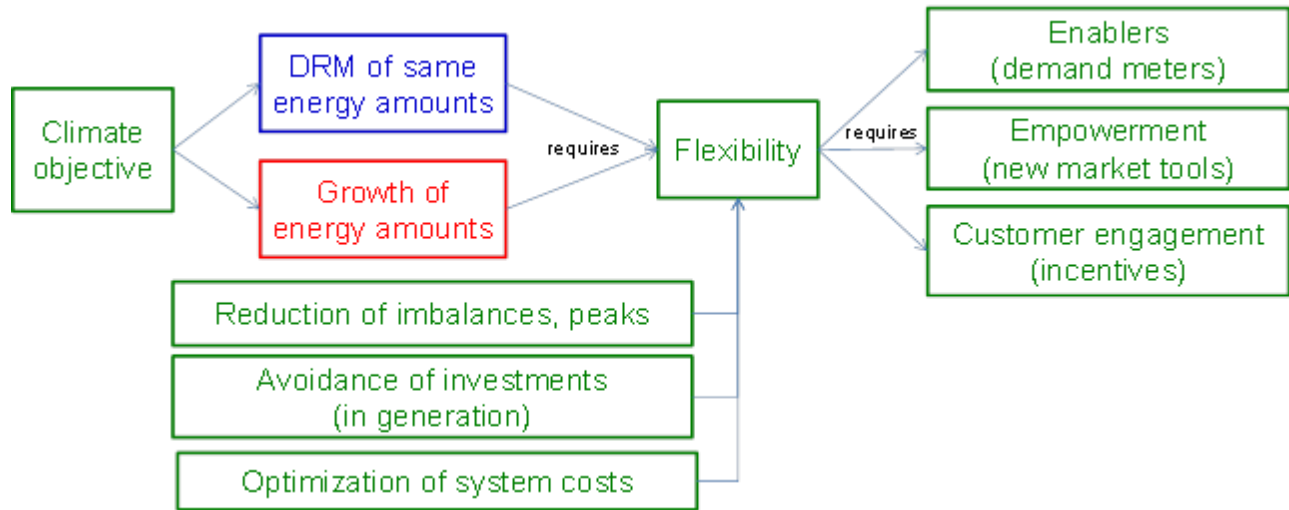


Figure 2. The role of the demand flexibility in achieving the climate objectives by containing the energy amounts being expended over time.

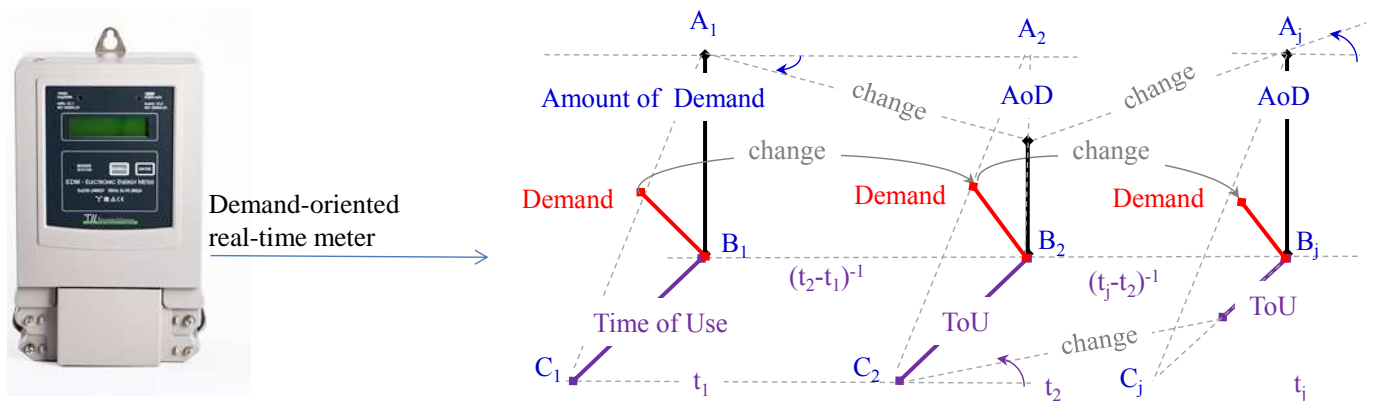


Figure 3. Demand-oriented real-time meter supplies the structure of the quantities demanded.

The valuation of DSF can be done either explicitly or implicitly. Since DSF appears explicitly on the market, it can be sold as a product/service on a power market. Therefore, it requires a specific control that traces the CBLs and other parameters used in the Demand-Response Management (DRM) actions.

The DSF is produced by a well-defined group of actors that makes certain percentage x of the total population of energy users y . For each member of the DSF-making group x_i , the CBL is analytically measured by using the real-time demand-oriented EDM metering device (Simonov et al., 2017) that produces the quantities demanded. More precisely, the input data include the amounts of energy, the time of use of energy, the demand factors, and similar values. Given the CBL ordered in natural time, the Load Duration Curve (LDC) is being produced by computations of true levels of load and re-ordering of newly established data. As an effect, the $DSF=CBL_k-CBL_j$ becomes measurable at multi-levels, for an individual customer x and/or for any individual group G_y of y customers being scaled from $y < N$ up to the entire portfolio G_N that counts N customers, but also for any arbitrary composition $\{G_i \oplus \dots \oplus G_j \oplus \dots\}$ that combines said groups of DSF-makers.

Additionally, since the DSF is also associated with the duration of action, the multi-scale timing should be adopted (viola time arrows on Figure 1) for measuring the DSF resulting from single incentive or from a series of incentive. Therefore, the ensemble of flexibility-making actors populates the sample space modeled after the N-T-cube with the effective dimensions drawing from the size of portfolio N (expressed in scalars) and the upper bound of the duration [expressed in seconds of natural time] of flexibility action T gauged to *timers* (expressed as a partition of time-arrow).

The information contained in the CBLs is consumed by Business Analytics (BA) in order to realize the decision variables that will be used to support automated decisions to trade the DSF or not to trade. A kind of composite indicator is required to realize the decision-making values associated with the DSF as a market good. Here, the DSF-index receives time series of numeric estimates of the structure of QD expressed in kW/s and the estimate of risk/uncertainty associated with the crowd behavior.

To complete the model, new index of responsiveness is being computed as a percentage change in one variable (the Change In Value, CIV) with respect to the percentage change in another

variable (the Change in Risk, CIR). The DSF operation appears useful until this index $\varepsilon_{civ|cir}=(\Delta CIV/CIV)/(\Delta CIR/CIR)$ remains greater than 1, for example, in all cases when the added values appears higher compared to the increase in risks.

On the other hand, the DSF is implicit because it does not need such a process. In effect, the DSF is produced by x , but it is never sold by an individual to anyone. The DSF remains for the benefit of the universality of final consumers y and for the corresponding retailer or for the Balance Responsible Party (BRP) as an optimization of its sourcing costs or imbalances (CEER, 2016).

In this assumption, the DSF value is already embedded - as part of - in any Intraday amount $AoE(t_k)$ and it can be expressed as a percentage and as a set of percentage changes. The DSF tool extracts and makes explicit the flexibility. By assuming that the value for the day j is $DSF(t_j)$, the DSF can be recursively evolved after the formula $DSF(t_j)=DSF(t_{j-1})+\Delta DSF(t_j)$, where the delta term is driven by the ratio between the $AoE(t_k)$ and the $AoE(t_{k-1})$. More accurate description of the process requires deeper discussion in a separate work.

Using the DSF

In power systems, the capacity to generate new energy is used at different rates of time by throttling between the levels of power. By fixing the total daily amount of energy expressed either in kWh or in monetary units, its distribution over time in storage-less system varies because of time-varying demand and physical laws imposed to consume the total of energy produced exactly in the same timescale.

As such, the daily amount of capacity can be decomposed in the daily amount of demand plus the corresponding amount of reserves/inertia. Currently, the ratio between the capacity and the reserves is computed empirically based on the past statistical estimates. When the power system is running at the highest capacity, or it is inertia-less, the DSF becomes a tool that can govern the security of supply. For this reason it is important to estimate the extent of flexibility/elasticity in the network.

Being flexible with how and when end-users consume and how small-scale plants produce energy means increasing the certainty that the power generated and delivered matches the amount being used at exactly the same time. The DSF as a service provider to power system appears on the power market after when modifying generation and/or consumption patterns in reaction to an external signal, for example a change in price, becomes measurable (Ilic et al., 2013). Once the DSF is quantified, it can be expended. In the Customer-Centered Smart Grid (CCSG) new paradigm called flexibility appears. It is about changing economic behavior of small- and medium- scaled energy users instead of varying the amounts of commodity. This behavioral aspect cannot be ignored because the cooperative behavior of many such actors participating in liberalized intraday market can mitigate poorly predictable energy production from renewable sources. It has several implications on power markets in terms prices. At the same time, new scenario has multiple implications on the technology side of country-wide critical infrastructure such as Smart Grid (Karnouskos, 2011).

In the past, investments were concentrated on large scale generators and their running. In new scenario, the investments come to smaller decentralized PV-, Wind-, and Bio- plants. New data-driven cooperative modality requires different ICT equipment and complex software (Lamparter et al., 2010). It moves to the software markets and markets of internet-enabled services. It enables a generational change that moves decision making from few control rooms to the democratic neighborhood of the web. In the African context with limited availability of resources and limited interconnectivity, this concept could offer additional benefits at different scales, for example at the microgrid level.

In the example from the Sub-Saharan Africa past, an individual

is running its own nano-generator in order to compensate chronic unavailability of the commodity from the distribution grid. Alternatively, several individuals – a group of x – decide running higher-scaled generators in shifts lasting up to $24/x$ h each. Since the individual demand levels are not constant in time but the production rate of generators is constant, the cost of the expended fuel between members of the group was compensated mutually (choice 1). However, the changes in amount of expended energy can be measured and the demand-oriented billing (choice 2) can be introduced. The cost repartitioning after metering figures can bring benefit because of the possibility to run shorter or longer shifts (choice 3) or because of the opportunity to sell extra energy to the external network (choice 4). At this point the market-based choice 4 can be exploited through the DSF.

Market competition and security of supply

Market competition is a balance in the supply of wholesale electricity, including generation and demand response, where there is an ideal harmony between provider profits and consumer savings. The current generation of market management systems has made significant technological strides to facilitate various market rules and designs towards competition. The aggregation of this functionality has helped ensure sufficient amount of transmission capacity in the market, as well as the elasticity of demand with respect to price. For energy trading to be realized, the necessary tools as well as timely information exchange between all stakeholders need to be provided. Part of it is also the actual smart metering that is, the high granularity of metering data acquisition. Through better resolution of the production and consumption (prosumption) data and effective analysis, any market participant is able to monitor and even predict his energy behavior. Data-driven real time smart meter technology, as well as the necessary energy services, prosumers will be able to offer and purchase electricity. Going back to the example, self-generation is a tool to mitigate a-posteriori chronic unavailability of the commodity from distribution network. The DSF can mitigate exactly the same issue based on the information about programmable unavailability (by shifting in time the demand) and/or about programmed availability (by deciding flexible and better elastic shares in the prosperity) of the commodity (Suvak, 2010). It becomes clear why the DSF can be used to adapt urban environments to climate change (Carter et al., 2015).

RESULTS AND DISCUSSION

It was found that the DSF is a new product enabled by Digital Energy Technology (DET) because it exploits the convergence of technologies, policies, and financial drivers in an active liberalized market as analyzed in Lim et al. (2014). The DSF operations are based on the anticipatory information about the amount/percentage of the limited resource/commodity that is-, can be-, or will be- unavailable to meet the demand. Researchers adhere to more specific definition of the Transactive Energy (TE) as a software-based grid management of grid reliability and resilience driven through a kind of incentives. In this conceptualization, artificial intelligence software applications use economic signals and timely operational information to value the DSF as an indicator used to manage production and consumption of energy.

Researchers defined the *measurable indicators* of DSF

by using real time demand-oriented energy measurement tools (Simonov et al., 2017). Researchers found that the known state of the art lacks tools including small-scale energy producers in the intraday markets (Liu et al., 2017), which is a major obstacle in any geographic context.

Researchers projects that the DSF will cause a *societal change* because it materializes a kind of collectively-owned (social) energy. In the past, energy was seen as a *commodity being distributed* over distribution network. The DSF-based approach uses the information and *knowledge being shared* in order to sensitize people about the change in amount of prosperity that needs to be apportioned in optimal, fair, or other required fashion.

From the small-scale plant owner's viewpoint, the DSF is a knowledge-based *enabling tool* that includes them in the market. From the ecology-friendly consumer's viewpoint, the DSF is a *driver* of the behavioral change that keeps sustainable the exploitation of natural energy-containing resources by humans. From the societal viewpoint, the DSF is a *democracy and policy tool* that elastically re-shapes the energy markets in a hybrid way.

Researchers found that in the context of very different developing countries (World Bank, 2011), the DSF framework could be particularly beneficial to manage *fair access* to energy because of raising awareness and informing about energy needs, variations in demand figures, and ways to share the resource in knowledge-grounded fashion.

Finally, the authors found applicable the Global Sensitivity Analysis (GSA) with respective sensitivity indices to behavioral tracking of certain group of flexibility-makers with respect to the action realized by other group(s). However, this investigation has to continue in future work in order to express compositions of flexibility actions in nested- or differently organized models.

Conclusion

The authors discussed a new environmental-friendly energy product/service called DSF. In the past, investments were concentrated on large scale generators and their running in order to obtain *scalable amounts* (of energy).

In newer scenarios, the investments come to smaller decentralized PV-, Wind-, and Bio- plants in order to emerge *locally flowing QDs*. However, no investments at all in generators (Figure 2) are needed to *differently concentrate* the flows in after the flexibility. Instead, the investment goes to the cyber (information, software) assets. By introducing the DSF in power networks, new demand measurement and verification tools are required in order to determine the previous CBL, the new CBL, the effective amount of the DSF that can be used, and the correct price associated with the DSF. For this reason, the use of the DSF implies new data-driven cooperation

between many users that should be supported by new ICT equipment and sophisticated software products. Therefore, it evolves software markets and enriches markets of internet-enabled services by introducing new high-tech products and services.

The advent of the flexible behavior on energy markets depends on the investment made in the knowledge sharing infrastructure (DSF Framework) that allows knowledge-based decisions, in the tools for inclusion as market participants (Participatory Framework) that allows operations, and in mentality changing practice (Framework of Operations) that scales up the size of the group of DSF-makers.

CONFLICTS OF INTERESTS

The authors have not declared any conflicts of interest

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Full Length Research Paper

Fair value accounting and earnings quality (EQ) in banking sector: Evidence from Europe

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This research investigates the influence of fair value accounting (FVA) on earnings quality (EQ) in European banking sector over the 2007 to 2016 period. As financial reporting system of banks is particularly exposed to FVA, we assume that FVA may produce significant effects on EQ for European banks. It can be expected that financial instruments' prices are not available in illiquid markets, so Fair Values are estimated by applying valuation models. The application of valuation models (that is, market to model) in estimating Fair Value gives managers the opportunity to manipulate values, and thus could bring through lower quality of earnings. This study develops a multidimensional concept of EQ, and measures it using a set of attributes as persistence, predictability, variability, and earnings smoothing. The findings suggest that European banks with large Fair Value reporting in financial statements have higher rank of aggregate EQ.

Key words: Banks, earnings quality (EQ), fair value accounting, European banking sector, regression analysis.

INTRODUCTION

Earnings deliver valuable information from firms to stakeholders, and are very significant in decision-making of investors (Schipper and Vincent, 2003; Francis et al., 2004; Francis et al., 2006). As earnings are widely measured in many circumstances, their quality has drawn the interest of scholars, standard setters, and professionals. Every business entity is judged by its earnings as one of the most important parameter to measure the financial performance of the organization. Also in the context of banks, the quality of earnings is an important benchmark to determine the ability to earn consistently in the future and to maintain quality, sustainability and growth in performance. Hence,

earnings and especially the quality of earnings are investigated in the perspective of sustainability, competitiveness and healthy growth in banking sector (Gadhia, 2015).

Dechow et al. (2010) outlined that high quality reported earnings reveal present operating profitability, express upcoming performance and exactly represent the inherent value of the firm. Several empirical studies also showed that poor earnings quality (EQ) could increase information risks and eventually the cost of equity (Francis et al., 2004). With the adoption of International Accounting Standards (IAS)/International Financial Reporting Standards (IFRS), EQ has drawn keen

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attention from stakeholders since fair value accounting (FVA) may deteriorate EQ according to prior evidence in literature. The move from the traditional Historical cost-based accounting model to a Fair Value (market value)-based accounting model has significant consequences for the role and properties of financial reporting. When investigating the effectiveness of Fair Value, it is important to analyze how it achieves the overall target of financial reporting that is to supply decision-useful information to investors, creditors and other stakeholders (IASB, 2010).

Based on this overall objective, accounting has to provide valuation-relevant information as accounting information has one role: informativeness. Ronen and Yaari (2008) emphasized that informative purpose arises from investors' request of information to forecast future earnings and cash flows. According to Kirschenheiter and Melumad (2004), high quality earnings are more useful as they better signify the future performance of the company. Revsine et al. (1999), instead, argued that earnings are of higher quality if they are maintainable. How a FVA approach is expected to influence EQ, and what EQ will appear within such a model is certainly a remarkable issue (DeFond, 2010).

According to prior studies (Francis et al., 2004; Dechow et al., 2010), this study inspects the impact of FVA on four most usually applied measures of EQ: persistence; predictability, variability and smoothness. Furthermore, to moderate the possible implications of valuation mistakes and omitted variables, an aggregate EQ measure is fashioned by means of the earnings attributes specified previously.

Findings show that earnings under a FVA-based accounting system have higher aggregate quality ranks for banks in European countries. Specifically, we discover primary evidence that Fair Value gains (losses) through profit or loss (FVTPL) and through other comprehensive income (FVTOCI) are positively associated with banks' aggregate EQ. Though, the impact of net gains (losses) reported at Fair Value through banks' income statement on EQ variation is less statistically significant.

The likely involvement of this study to current literature can be found by various means. First, no prior studies assessed the impact of FVA on EQ in European banking sector. Second, this is the first study examining a wide variety of earnings attributes in addition to an aggregate EQ measure in such a context. Previous studies have mostly examined individual EQ measures or a subgroup of EQ measures to demonstrate their hypotheses. Our research advances a multidimensional concept of EQ based on four earnings attributes.

LITERATURE REVIEW

Numerous prior studies addressed the assessment of EQ in financial reporting. For instance, several empirical

studies inspected EQ variations over time and their determinants; others quantified the impacts of particular changes in corporate governance requirements, enforcement systems and accounting standards within or across countries. Many studies attempted to investigate the effects of IAS/IFRSs adoption as it is conceptually perceived to improve the proxies of accounting quality (Pascan, 2015).

However, there is a large debate about relative benefits of accounting under IAS/IFRSs era, and prior literature verified conflicting effects of IAS/IFRSs adoption on EQ. That is, several studies documented accounting quality improvements of voluntary IAS/IFRSs adoption (Gassen et al., 2006) but there are some papers that found no evidence on favorable effects of IAS/IFRSs in this regard (Sodan, 2015). Under both US GAAPs and IAS/IFRSs, the word "Fair Value" usually states for the current market value (that is, the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date) when available, and it encompasses an estimated value when the existing one is not directly recognizable because the market for an asset or a liability is illiquid (IASB, 2008).

FAS 157 - Fair Value Measurements and IFRS 13 - Fair Value Measurement provide a precise description of Fair Value and detailed disclosure requests for its use within IFRSs. To improve reliability and comparability in Fair Value measurements, both the IFRS 13 and the FAS 157 comprise a Fair Value hierarchy based on a three-tiered valuation process. Precisely, three steps of Fair Value measurement are established: Level 1 is used when the present price in a liquid market for just the same instrument can be achieved (that is, mark to market); Level 2 is related to the current price in a liquid market for a similar instrument, which must be applied to evaluate the Fair Value of the instrument to be measured (that is, mark to matrix); Level 3 needs to apply valuation models (that is, mark to model).

At Level 3, estimations embrace valuation techniques (that is, discounted cash flow model, income approach, etc.) that rely upon internal information and assumptions. In this respect, an additional result of the information delivered by Fair Value measurement is the subjective estimate that certainly occurs in valuating assets or liabilities for which inputs are unobservable. This discretionary appears through managerial decision, application of earmarked information, and the inherent uncertainty about the reliability of the expectations assumed in the estimation (Power, 2010). In Level 3 estimate of discretionary fair value implies probable adjustments of the earnings since assumptions need inputs (that is, cash flow or income predictions) that are themselves exposed to valuation error.

Chen et al. (2010) emphasized the more biased nature of Level 3 as Fair Value measurement may be exposed to manipulation in inactive markets whereas quoted

market prices are not available (Dechow et al. 2010). Fair Value evaluations possibly lead to more information asymmetry and therefore to more valuation errors, even without the intended misrepresentation of managers. In this regard, the opponents of fair value accounting (FVA) disapprove its reliability, particularly in using valuation models (mark to model) that are prejudiced by viewpoints and estimations arising from management.

Although the use of FVA looks credibly rational in well operating markets, the reliability, relevance and integrity of this approach decrease when markets do not run. In these circumstances, Fair Values is likely to be measured through valuation techniques which allow earnings management and could result in lower quality of reported earnings. Valuation of Fair Value (mark to model) opens doors for the application of management judgment and intended prejudice which can reduce the quality of financial reporting (Nissim, 2003; Hitz, 2007; Ryan, 2008; Chen et al., 2010).

Opponents of FVA claim that sometimes fair value measurements don't reflect probable cash flows and underlying economic conditions as the measures comprise "noise" attributed to market sensitivity instead of to economic fundamentals. Then, in illiquid financial markets the procedure of market prices to measure assets and liabilities may not be useful since in these circumstances prices are not related to the correctly discounted value of expected cash flows. Existing research also demonstrated that Fair value estimations are less significant when they are based on unreliable observable inputs (Nelson, 1996; Simko, 1999; Song et al., 2010). Besides, value relevance of FVA is not constant across time, specifically it decreases during periods of economic turmoil owing to information risk and superior illiquidity (Hung, 2000; Allen and Carletti, 2008).

On the contrary, prior literature has advanced some reasons why IAS/IFRSs could improve accounting quality (Barth et al., 2008; Daske et al., 2008; Liu et al., 2011; Bartov et al., 2005). The majority of previous studies on FVA investigated effectiveness of fair value information for investors in capital markets and in this regard proponents of FVA argued that market prices offer the most significant and appropriate measures of assets and liabilities (Barth, 1994; Barth and Clinch, 1998; Ryan 2008).

Empirical evidence mostly advises that the application of FVA has really improved level of informativeness of the accounts, and researchers mostly agreed that FVA delivers valuable information concerning the volumes, timing and uncertainty of future cash flows (Landsman, 2007; Hitz, 2007; Barth, 2008).

An essential statement in value relevance literature is that FVA is able to predict cash flows in future realizations (that is, fair value estimations signify the present value of predictable future cash flows). Therefore, usefulness of FVA can be directly studied by its predictive aptitude in assessing forthcoming cash

flows and earnings. As fair value valuations are consistent measures of assets' values, adjustments in fair values (that is, unrealized Fair Values gains and losses) should involve future performance variations (Barth, 2000).

Since the financial reporting system of banks is particularly exposed to FVA, a number of studies investigated predictive ability of FVA in the banking sector performance. Specifically, balance sheet of bank contains predominantly financial instruments which are mostly recognized at fair value. For example, within the performance literature on banking industry, Hill (2009) argued that amplified exposure to FVA in financial reporting improves the capacity of earnings to forecast cash flows.

However, Hill (2009) also underlined that these empirical findings concerning prognostic aptitude of fair value could not be generalised because variations in fair values reported in net income or in other comprehensive income could be temporary within more volatile market conditions, and could not amplify earnings capacity to expect future operating performance (Dhaliwal et al., 1999; Jones and Smith, 2011) in a particular circumstance. In this regard, previous empirical studies linked high ranks of earnings volatility with FVA (Bernard et al., 1995; Barth et al., 1995; Barth (2004); Hodder et al., 2006; Plantin et al., 2008; Magnan, 2009; Solé et al., 2009; Sun et al., 2011).

Barth (2004) pointed out that financial statement volatility itself is not a signal of defective financial reporting. It is apparent that estimation error volatility outcomes from defective measurements, since future cash flows are uncertain. Estimation error volatility tends to be lesser if fair value is measured using the prices that the active markets provide (mark to market). On the contrary, estimation error tends to be larger when prices are not available in active markets and Fair Value is based on valuation models and subjective estimations.

We assume that the use of FVA may have significant effects on EQ for European banks since large portion of financial instruments are reported at fair value in banks' balance sheets. Even though managers could behave opportunistically in situations with weak shareholders protection (Hung, 2000), we argue that they are more likely to use discretionary power in order to deliver reserved information to stakeholders and subsequently to increase EQ.

To summarize, when examining prior research concerning the relationship between the use of FVA and EQ measures, conclusions can be resulting as follows. First, there are varied and unreliable evidences from prior studies. Second, existing literature examined EQ applying single earnings attributes or a subgroup of earnings attributes. Third, most of previous researches on this issue are implemented in countries such as US, United Kingdom or Australia and there is usually an absence of investigation about the impact of FVA on EQ

in European banking sector (Sodan, 2015).

We test whether the higher exposure to FVA is related with the quality of reported earnings in European banking sector. We expect FVA to influence EQ but we do not expect a direction of the relationship. Hence, the study hypothesis is stated as follows:

H1: Fair value accounting (FVA) affects banks' EQ

METHODOLOGY

This section illustrates the collection of data, the description and the measurement of the variables and the research method applied to test the relationship between the use of FVA and EQ. The study investigates the hypothesis that high proportion of Fair Value gains and losses through net income and other comprehensive income influences the level of aggregate EQ.

Sample

We examined an unbalanced panel dataset of 5,030 commercial European banks, generating 50,300 observations over a 10-year period from 2007 to 2016. Within sample selection any active bank which operated in an European country and had complete, consistent and accessible dataset for each of the years of the time period chosen for the analysis was selected. Banks had to meet the following characteristics to be comprised in the sample, given the period of investigation. First, banks had to operate in the European Union banking sector, according to the analysis of the European Central Bank (ECB) as at 31st December 2016. Second, each bank included in the sample must have available data obtained from the annual balance sheets and income statements collected from the BvD Orbis Bank Focus database for all the years between 2007 and 2016. As our study regards European banks, we excluded non-banking credit institutions, securities houses and European Central Bank (ECB). Cross-sectional and time series data taken from BvD Orbis Bank Focus have been scrutinized using a panel data multiple regression. BvD Orbis Bank Focus database supplies annual financial information for banks in 180 countries all over the world and thus it is believed the most comprehensive database for research in banking.

MEASUREMENT OF EQ

EQ is challenging to define and, although there are no definitive criteria to evaluate it, there are many factors that can be considered in assessing the quality of earnings. Prior literature classified some attributes of reported income that are commonly appreciated as required characteristics of reported earnings (Francis et al., 2004; Barton et al., 2010). Pratt (2010) describes EQ as "the extent to which net income reported on the income statement differs from true earnings".

Penman (2003) specifies that EQ depends upon the quality of expected earnings in addition to present reported earnings. Schipper and Vincent (2003) delineate EQ as "the extent to which reported earnings faithfully represent Hicksian income", which consists of "the change in net economic assets other than from

transactions with owners". A consequence of the difficulty to give a unique definition of EQ is the multiplicity of measures that have been used in literature to approach EQ. In literature, it's difficult to find either an agreed significance of the concept or a commonly unanimous methodology to assess it (Schipper and Vincent, 2003). For example, according to Dechow and Schrand (2004), "a high-quality earnings number is the one that accurately reflects the company's current operating performance" and it is a useful summary measure for assessing firm value. EQ is a multidimensional and contextual concept lacking of a shared explanation and depending on each user's perspective. Hence, EQ is difficult to quantify and current empirical studies evaluate it by taking into account a single attribute of earnings or various earnings characteristics related to EQ (Francis et al., 2004; Dechow et al., 2010; Gaio, 2010; Kousenidis et al., 2013).

This study considers EQ as a multidimensional concept using four accounting-based earnings qualities that do not rely on market insights (Leuz et al., 2003; Francis et al., 2004; Burgstahler et al., 2006; Gaio, 2010; Kousenidis et al., 2013). Considering the accounting-based characteristics, time-series qualities of earnings express the spreading of profits over time and the statistical properties of the procedure that produces earnings (Schipper and Vincent, 2003). Precisely, we contemplate the subsequent four individual selected earnings attributes: persistence, predictability, variability and smoothness. In addition, we clarify how prior studies have described each attribute as desirable and then we consider an aggregate EQ measure based on Gaio (2010) methodology.

Earnings persistence is regarded as a desired earnings attribute and typically represents the capacity of present recognized earnings to be maintained in the future (Francis et al., 2004). Persistence accounts earnings sustainability and it is related with constancy and return of earnings over time (Schipper and Vincent, 2003). Persistence is a measure of earnings information quality, and it is calculated as the slope coefficient of the regression function of a period's earnings per share (EPS) compared to the preceding period's EPS (Francis et al., 2005; Mehri et al., 2011).

A value of the slope coefficient nearer to 1 indicates high earnings persistence while a value closer to 0 stands for a low persistence of earnings. Oei et al. (2008) replicated the Francis et al. (2005) approach modifying it by changing EPS with the ratio of earnings before interest and after tax to total assets. According to Lipe (1990) and other researchers (Francis et al., 2004; Dichev and Tang, 2009; Cascino et al., 2010; Gaio, 2010). In this study, Kousenidis et al. (2013), earnings persistence is calculated as the slope coefficient estimated from autoregressive models of earnings.

$$X_{j,t} = \phi_{0,j} + \phi_{1,j} X_{j,t-1} + v_{j,t} \quad (1)$$

where $X_{j,t}$ and $X_{j,t-1}$ are firm i 's earnings in year t and $t-1$, respectively, and coefficient $\phi_{1,j}$ captures firm j 's persistence of earnings.

$$PERS = \phi_{1,j}$$

Persistent earnings are regarded as higher-quality earnings. Values of $\phi_{1,j}$ close to 1 suggest highly persistent earnings, while values of $\phi_{1,j}$ close to 0 denote highly transitory earnings.

Earnings predictability measures the ability of earnings to be expected. Following previous research of Lipe (1990), Francis et al. (2004), Cascino et al. (2010), Gaio (2010) and Kousenidis et al. (2013), we identify earnings predictability with the adjustment of earnings shocks, where higher variance indicates lower predictability. We apply the square root of the error adjustment from equation (1).

$$PRED = \sqrt{\sigma^2(v_{j,t})}$$

Large (small) values of predictability (PRED) entail less (more) predictable earnings and lower (higher) EQ. More predictable earnings are assumed higher quality earnings.

Earnings variability is another earnings attribute that indicates the time-series property of earnings. It is calculated as the standard deviation of earnings.

$$VAR = \sigma(X_{j,t})$$

where $X_{j,t}$ is firm j 's earnings in year t .

According to prior research (Francis et al., 2004; Francis and Wang, 2008; Dichev and Tang, 2009), higher (lower) values imply higher (lower) ranks of earnings variability, which are assumed as lower (higher) EQ. It is supposed that less volatile earnings are more persistent and predictable.

Earnings smoothing is a manipulative technique to decrease normal earnings variability that is often connected with risk. In this viewpoint, smoother earnings represent lower EQ (Dechow and Skinner, 2000; Zeghal et al., 2012). Earnings smoothing is generally calculated as the ratio of earnings variability to cash flow variability (Leuz et al., 2003).

Researchers who used this measure of earnings smoothing are Francis et al. (2004), Burgstahler et al. (2006), Van Tendeloo and Vanstraelen (2008), Cascino et al. (2010), Gaio (2010) and Kousenidis et al. (2013). In line with prior literature (Leuz, 2003; Francis et al., 2004; Hodder et al., 2006; Gaio, 2010), we measure earnings smoothing as the ratio of earnings variability to operating

cash flow variability as follows:

$$SMOOTH = \frac{\sigma(X_{j,t})}{\sigma(CFO_{j,t})}$$

where $X_{j,t}$ is firm j 's earnings in year t and $CFO_{j,t}$ is the cash flow from operations in year t .

High (low) values show low (high) variability in cash flows than in earnings and, consequently, a low (high) degree of artificial earnings smoothing. High values of SMOOTH suggest low quality of earnings. Table 1, Panel A sum up the description and the calculation of the attributes individually. According prior studies (Leuz et al., 2003; Gaio, 2010), we construct an aggregate EQ measure. High ranks of SMOOTH imply a high value of EQ; hence, high degree of the aggregate index of EQ indicates high EQ.

Fair value accounting (FVA)

Exposure to FVA is computed by income statement approach (Hodder et al., 2006; Bratten et al., 2012). We accept that banks report a large amount of financial instruments (assets and liabilities) that are recognized at fair value according to IAS 39 - Financial Instruments: Recognition and Measurement (IFRS 9 - Financial Instruments will be effective for annual periods beginning on or after 1 January 2018). Hence, reported net gains (losses) at FVTPL and at FVTOCI are applied to measure the extent of fair values recognized in banks' income statements. We match two different measures of reported income (that is, net income and other comprehensive income) and we focus on the impact of both fair value gains (losses) through net income (that is, profit and loss - FVTPL), and fair value gains (losses) at FVTOCI on EQ.

If assets are recognized at fair value in subsequent recognition, gains and losses are either reported completely in profit and loss or in other comprehensive income. The FVTOCI classification is required for certain debt instruments assets unless the fair value option is adopted. The statement of comprehensive income aggregates net income (profit and loss) and other comprehensive income which comprises mostly fair value adjustments that are not permitted to be included in profit and loss statement. Comprehensive income is the sum of net income and other comprehensive income, which includes items that are not recognized in income statement because they have not been realized. Thus, relative amount of FVTPL is designed as the ratio of FVTPL and net income (NI) for every bank:

$$ext(FVTPL_{j,t}) = \frac{FVTPL_{j,t}}{NI_{j,t}}$$

Table 1. Variables definitions.

Panel A: EQ measures		
Earnings attributes	Description	Measurement
Persistence	Stability of earnings	Slope coefficient estimated from a first order autoregressive model (eq. 1) for annual earnings $PERS = \phi_{1,j}$
Predictability	Ability of earnings to be predicted	Square root of the error variance of eq. (1) $PRED = \sqrt{\sigma^2(v_{j,t})}$
Variability	Real volatility of earnings	Standard deviation of earnings $VAR = \sigma(X_{j,t})$
Smoothing	Intentional reduction in earnings variability	Standard deviation of earnings divided by the standard deviation of cash flows $SMOOTH = \frac{\sigma(X_{j,t})}{\sigma(CFO_{j,t})}$
Panel B: Measures of FVA and control variables		
ext(FVTPL)	Extent of Fair Value gains (losses) through net income	FVNI divided by comprehensive income (CI) $ext(FVTPL_{j,t}) = \frac{FVTPL_{j,t}}{NI_{j,t}}$
ext(FVTOCI)	Extent of Fair Value gains (losses) through other comprehensive income	FVOCI divided by comprehensive income (CI) $ext(FVTOCI_{j,t}) = \frac{FVTOCI_{j,t}}{CI_{j,t}}$
SIZE	Bank size	Logarithm of total assets
LEV	Leverage	Total liabilities divided by total assets

The amount of fair value gains (losses) through FVTOCI for banks included in the sample is calculated as the ratio of FVTOCI and comprehensive income (CI) as the sum of the value of net income (NI) and other comprehensive income (OCI):

$$ext(FVTOCI_{j,t}) = \frac{FVTOCI_{j,t}}{CI_{j,t}}$$

Finally, control variables have been included in the regression model to lessen the noise in

quantifying the influence of accounting changes on EQ (Francis et al., 2004; Ball and Shivakumar, 2005; Goncharov and Hodgson, 2008; Gaio, 2010). Based on prior EQ studies, we include in the model size and leverage as control variables (Francis et al., 2004; Burgstahler et al., 2006; Cascino et al., 2010; Gaio, 2010).

Firm size (SIZE) is often chosen as a control variable in empirical research because it is associated with the amount of cash flow and accruals, which are intrinsically related to EQ. The coefficient of the variable SIZE is estimated to be positive (Francis et al., 2004; Gaio, 2010). The

variable size (SIZE) is calculated as the logarithm of total assets (Francis et al., 2004; Cascino et al., 2010; Gaio, 2010).

Leverage (LEV) is the second control variable. Leverage stands for the trade-off between tax benefits and bankruptcy costs. Particularly, the amount of leverage reveals the firm's possible risk affecting the firm's reporting and accrual accounting policies. The coefficient of the variable LEV is estimated to be positive (Francis et al., 2004; Gaio, 2010). The variable leverage (LEV) is calculated as the ratio of total liability to total assets (Francis et al., 2004; Cascino et al., 2010;

Gaio, 2010). Table 1, panel B illustrates the definition and the construction of the explanatory variables.

Regression model

With the aim of investigating the impact of FVA on EQ, the cross-section and time series data have been scrutinized using a panel data OLS-regression model. As in many prior studies, we adopted both a descriptive analysis and a regression one to explore the combined effects of FVTPL and FVTOCI on aggregate EQ (AEQ) for selected banks.

According to Gaio (2010) research methodology, we computed EQ measures for the period 2007 to 2016 for banks separately and we created an aggregate EQ measure on firm level to moderate the possible consequences of valuation errors and omitted variables bias. To calculate the aggregate EQ measure (AEQ), we constructed the AEQ variable by averaging the single EQ measures. In the first step, we calculated EQ for each bank through four specific measures: persistence, predictability, variability and smoothness. Secondly, we built the AEQ measure for each bank by averaging the ranks of the four individual quality measures.

To check the hypothesis of this research, we applied a linear regression model by including the panel data of European banks in the period 2007-2016. We selected panel data because they paved way for the variations of the cross-sectional units over time. Hence, a multivariate analysis is designed by means of an ordinary least square (OLS)-regression model. We applied a pooled least squares (OLS) method as the dataset signals that European banks react to cyclical economic trends likewise. OLS-regression model is the most reliable regression method due to its overall approach to minimize biases and alterations (Koutsoyiannis, 2003; Greene, 2004). To inspect the impact of FVA on European banks' EQ, a linear regression model is constructed as follows:

$$EQ_{i,t} = \delta_0 + \alpha_1 ext(FVTPL)_{i,t} + \alpha_2 ext(FVTOCI)_{i,t} + \alpha_3 SIZE_{i,t} + \alpha_4 LEV_{i,t} + \varepsilon_{i,t}$$

where $EQ_{i,t}$ is the aggregate EQ ranking computed as the average value across the four different measures; i refers to an individual bank; t refers to year; δ_0 constitutes the fixed effect; $ext(FVTPL)_{i,t}$ is the extent of Fair Value gains (losses) through net income; $ext(FVTOCI)_{i,t}$ is the extent of Fair Value gains (losses) through other comprehensive income; SIZE is the natural logarithm of total assets; LEV is Leverage (total liabilities divided by total assets); $\varepsilon_{i,t}$ is a normally distributed random variable disturbance term (error term).

The model is projected using the OLS method to a

fixed effects model. To moderate the effect of error terms that are related across firms and time, we used the standard errors clustered by firm and year and we included year-fixed effects following Petersen (2009). We eliminated the firm-level heterogeneity through the calculation of the mean deviation data. We applied White's (1980) transformation to test cross-sectional heteroscedasticity of the variables and we used White's adjustment to test the standard errors verified for all coefficients. We included two control variables (size and leverage) that we adopted fixed when we examined the influence of unrealized Fair value gains (losses) on EQ.

Moreover, contrasting to prior literature, greater consideration was reserved to the control of cross-sectional and time-series dependence in regression models. The choice of a fixed effects model instead of a random effects one has been tested with Hausman test (Baltagi, 2001).

We also applied the Breusch-Pagan test to verify the residual heteroscedasticity. Assumed the dynamic feature of our model, least squares estimation methods produce biased and inconsistent valuations. Thus, we used techniques for dynamic panel valuation dealing with the biases of our estimations. An additional challenge regarding the measurement of EQ concerns the endogeneity problem which is controlled by employing the system GMM estimator. Descriptive statistics, correlation matrix and multivariate regression findings are presented in Tables 2, 3 and 4, respectively.

Descriptive statistics

In the initial step of this empirical research, a descriptive analysis is performed. Table 2 summarizes descriptive statistics for dependent and independent variables included in the regression model for the pooled sample of banks. Panel A reports the individual EQ measures and the index of AEQ. Persistence (PERS) has a mean (median) value of 0.079 (0.043), Predictability (PRED) has a mean (median) value of 0.042 (0.028), Variability (VAR) reports a mean (median) value of 0.051 (0.033) and Smoothing (SMOOTH) has a mean (median) value of 0.595 (0.592).

Panel B lists the explanatory variables (measures of FVA) and the control variables. The mean of FVTPL is 0.175 which is lower than the proportion of banks' Fair Value through other comprehensive income (FVTOCI) (0.426). However, median values are significantly low-grade (0.081 and 0.407) showing that most of the banks have recognized a small percentage of FVTPL and FVTOCI. EQ considers persistence, predictability, variability and smoothness.

Table 1 shows the variables definitions. We check the presence of an econometric problem of dataset included in the multivariate statistical analysis through the correlation matrix (Table 3), which contains pair wise correlations among the variables comprised in the

Table 2. Descriptive statistics.

Panel A: EQ measures	PERS	PRED	VAR	SMOOTH	EQ
Mean	0.079	0.042	0.051	0.595	0.494
Median	0.043	0.028	0.033	0.592	0.502
Q1	-0.632	0.005	0.017	0.127	0.315
Q3	0.878	0.083	0.120	1.000	0.677
Std Dev	0.548	0.043	0.049	0.429	0.217

Panel B: Measures of FVA and control variable	ext(FVTPL)	ext(FVTOCI)	SIZE	LEV	-
Mean	0.175	0.126	3.302	2.035	-
Median	0.085	0.007	3.268	0.817	-
Std Dev	0.025	0.221	0.673	3.582	-

Table 3. Correlation coefficients of the OLS regression variables.

Variable	EQ	ext(FVTPL)	ext(FVTOCI)	SIZE	LEV
EQ	1.0000	0.1395	-0.6632	0.0187	0.4415
ext(FVTPL)	-	1.0000	-0.0872	-0.0215	0.0564
ext(FVTOCI)	-	-	1.0000	-0.0280	0.0557
SIZE	-	-	-	1.0000	-0.1488
LEV	-	-	-	-	1.0000

Table 4. Regression analysis.

Variable	Coefficient	Std. Error	t-ratio	p-value
Dependent variable: EQ				
Const	233.5140	0.34963	4.3989	0.0078
ext(FVTPL)	87.30902	0.01994	1.5089	0.0082**
ext(FVTOCI)	241.9954	0.00536	5.4124	0.0036***
SIZE	0.083400	0.04072	0.1675	0.8056
LEV	-249.9677	0.38567	-2.3275	0.0072
R-squared	0.572016	Log-likelihood	-156.3845	-
F-statistic	10.47502	Schwarz criterion	377.3868	-
S.E. of regression	0.542326	Akaike criterion	344.7079	-
Adjusted R-squared	0.747154	Hannan-Quinn	357.5461	-
P-value(F)	1.17e-12	Durbin-Watson	1.928564	-

***, ** and * indicate significance at the level of 0.01, 0.05 and 0.10 respectively; p-values are two-tailed.

regression analysis. By examining individual correlations between independent and dependent variables, the coefficients indicate that a multivariate regression analysis can be applied.

The variables' independence (that is, the lack of multi collinearity problems) that may modify the findings was verified. To examine the EQ determinants, we carry out a univariate analysis. First, we estimate the Pearson and Spearman correlations to analyze the relationships between AEQ and the explanatory variables. The

following Table specifies the correlation coefficients of the variables used in the regression model.

Table 3 displays that the correlation between the bank specific variables is satisfactory signifying that multi collinearity criticalities do not subsist and endorsing that the model utilized is sound and reliable (Kennedy, 2008). The correlation between each of the variables is low and the supreme degree of it is very acceptable. The highest value of the correlations is 0.4415 between LEV and AEQ. The correlations between the independent

variables (FVTPL and FVTOCI) and the control variables do not exceed an absolute value of 0.0564.

Hence, the results demonstrate that no collinearity problem exists between the independent variables since multi collinearity is a problem when the correlation exceeds 0.80 (Kennedy, 2008). Therefore, the coefficients demonstrate that a multivariate analysis can be applied. The regression results are displayed in Table 4. To save space, the full regression findings concerning each measure of EQ (which comprise both time and bank-specific fixed effects) are not described here.

In line with the study specified hypothesis, we found a relationship between AEQ and fair value measures. The preliminary results suggest that higher exposure to FVA is positively correlated to higher quality of reported earnings in European banks. FVTPL and FVTOCI have a positive impact on EQ. R-square of 0.572016 indicates that the estimated model is overall statistically significant. The coefficient of ext(FVTPL) is positive and statistically significant (coefficient = 87.30902, p-value = 0.0082), suggesting that European banks with more FVTPL result in a major level of AEQ measure.

Similar results can be found for Fair Value gains (losses) reported through FVTOCI. Estimated coefficient of ext(FVTOCI) is also positive and statistically significant (coefficient = 241.9954, p-value = 0.0036), showing that European banks with large percentage of FVTOCI have higher level of AEQ measure.

The empirical analysis confirms different estimation results. In particular, the R-square specifies how fair value gains (losses) influence AEQ and the adjusted R-squared states for the reliability of additional predictor variables with statistical shrinkage. The range between R-square and adjusted R-squared (that is, shrinkage degree) is not elevated, revealing an adequate degree of correlation between independent and dependent variables. The value of F-statistic is significant attesting the validity and the reliability of the model applied in the research.

The explanatory power of the model is soundly high as 75% of the variation of the dependent variable AEQ depends on the independent variables (the value of the R-squared adjusted is 0.747154). The EQ index is positively associated with FVTPL. Consistent with H1, the coefficient of the variable ext(FVTPL) is positive and significant at 0.05 level. Thus, the application of FVTPL increases EQ by 0.0082. The coefficient (0.0036) of FVTOCI is more significant (at the level of 0.01), but it slightly decreases in magnitude. Although the FVTOCI has the significant predictable positive sign in the model, its impact on EQ is weaker than the influence of FVTPL. Hence, the overall results show that FVA influences positively AEQ.

Regarding the association between IAS/IFRSs' adoption and EQ, the findings confirm that the application of fair value increases EQ. The movement from HCA towards FVA is appraised to result in more relevant,

timely, credible and transparent financial statements. The application of Fair Value enhances the relevance of the reported numbers because it reflects current value and has more economical meaning than HCA. Accordingly, proponents of FVA suggested several benefits resulting from its application. First, FVA well reports the bank's exposure towards risk, especially in unstable circumstances (Hodder et al., 2006; Blankespoor et al., 2010).

Thus, market values develop effectiveness and guides toward an early revealing of bankrupt banks. Second, income smoothing and earnings management can be realized under HCA (for example, if economic results deteriorate, management can edit reported income by selling revalued assets) while under FVA the opportunity of income smoothing is reduced since Fair Value gains and losses from subsequent valuations are reflected in the income statement when they are generated.

On the contrary, opponents of FVA argue that it grows the volatility of bank's earnings and it decreases their predictability although this additional volatility doesn't appear to have been returned in bank share prices (Barth et al., 1995; Nelson, 1996; Eccher et al., 1996). Second, the valuation transparency in performance assessment may be uncertain in illiquid markets or when valuation techniques are applied in a particular financial report (Allen and Carletti, 2008). Third, FVA may conduct to undue leverage in booms and write-downs in busts, hence causing procyclicality (Laux and Leuz, 2009; 2010).

Conclusions

This study investigates the influence of FVA on EQ in European banking sector over the 2007 to 2016 period. Following prior literature, we assert that there is a gap of research concerning the impact of FVA on EQ in European banking sector.

Furthermore, most prior research examined the effects of FVA on a single earnings attribute or a subset of properties of earnings but it derived mixed and unreliable evidence. We suppose that the application of FVA may originate significant effects on EQ in European banking sector. Many empirical results from prior studies largely reinforce our hypothesis.

However, our findings demonstrate that earnings under Fair value-based reporting model have higher aggregate quality ranks for European banks. Specifically, we find primary evidence that net gains (losses) reported at Fair Value through banks' income statement (FVTPL) and through other comprehensive income (FVTOCI) are positively associated to banks' aggregate EQ. Moreover, findings show that the extent of Fair Value recognized through other comprehensive income (FVTOCI) is less significant in implying positive variation of EQ extents. Regarding the relation between IAS/IFRSs and FVA, we note that the design of IFRS 9 improves accounting

quality and favours capital market participants and other stakeholders in decision-making process.

This research accepts the concept of EQ as a multidimensional measure and deepens the issue of EQ in European banking sector. First, we construct a multidimensional measure of EQ through four earnings attributes: persistence, predictability, variability and earnings smoothing. This study calculates EQ proxy based on reported earnings attributes; on the contrary, prior literature on the subject of FVA founded the construction of the EQ proxy on looking back adjusted income analyses or simulation procedures. Second, we analyze the role of specific accounting measurements (that is, FVTPL and FVTOCI) in influencing EQ. This allows us to offer a more comprehensive portrait of the relationship between accounting variables and EQ in the European banking sector.

This study adds to the recent discussion about FVA and, particularly, proposes different conclusions in relation to those included in earlier studies, which usually associate lower ranks of EQ with FVA. Overall, our findings provide new evidence within the banking sector in Europe and advocate the relevance of examining a number of banks' specific accounting variables to assess the financial reporting quality of a bank. If EQ is a crucial variable employed by stakeholders to make economic decisions, it would be necessary to observe the influence of its possible determinants.

Higher quality disclosure supports investors to decide more efficiently and to reduce risk in capital allocation decisions. Our results can also assist bank managers in their decision-making and are beneficial to users of financial statements in evaluating EQ performs. Moreover, the findings may guide academics, standards setters and regulators to assess the quality of earnings in various industries other than banking industry. The empirical outcomes are robust to numerous adjustments of the model, i.e., changes of the sample composition and the extension of the time period. Nevertheless, our research has some limitations and concerns which open the way for future research.

Despite various sensitivity analyses, some questions about the "true" influence of FVA on EQ persist. Although consistent results support our prediction, these findings may potentially suffer from biases related with our intrinsic value estimation procedure. For instance, prior studies found that banks smooth earnings using discretionary loan loss provisions (Whalen, 1994; Collins et al., 1995; Beaver and Engel, 1996; Ahmed et al., 1999; Beatty et al., 2000) whereas, this research design does not consider any earnings management strategies. Since our conceptualization of earnings volatility considers reported earnings, it may be influenced by smoothing behavior. Finally, we accept earnings smoothing as a typical quality of earnings although some authors believe that earnings smoothing is also a measure of earnings management (Leuz et al., 2003).

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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