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Gaëtan Le Quang

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**“Taking Diversity into Account”:
the Diversity of Financial Institutions and Accounting Regulation**

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Gaëtan Le Quang



UMR 7235

Université de Paris Ouest Nanterre La Défense
(bâtiment G)
200, Avenue de la République
92001 NANTERRE CEDEX

Tél et Fax : 33.(0)1.40.97.59.07
Email : nasam.zaroualete@u-paris10.fr



"Taking Diversity into Account": the Diversity of Financial Institutions and Accounting Regulation

Gaëtan Le Quang*

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Abstract : The global financial crisis and what followed point out at least two major failures of the financial system: its inability to contain liquidity risk and its inability to fund long term investments. We think that these two problems come from the setting up of rules and practices that tend to homogenize market participants' incentives and behaviors. Fair value accounting is one element of this set of practices and rules. If the rationale behind fair value accounting – that is enhancing transparency in order to limit unreported losses and manipulations – can justify its use in the case of short-term financial institutions (meaning institutions whose time horizon is short because of the maturity of their liabilities) that constantly face the risk of a sudden liquidity need, it seems totally irrelevant when it comes to long-term financial institutions that will not face liquidity needs before ten or twenty years. In this perspective, we develop a model that shows that an accounting regulation that takes the diversity of financial institutions into account offers better results both in terms of liquidity and in terms of efficiency than a regulation that ignores this diversity.

Résumé : La crise financière contemporaine a mis en évidence la difficulté qu'ont les marchés financiers à faire face au risque de liquidité et à assurer le financement de l'investissement à long-terme. Nous pensons que ces deux problèmes peuvent être expliqués par un même phénomène qui est la mise en place d'un ensemble de règles et de pratiques qui ont pour conséquence d'homogénéiser les incitations, et donc les comportements, des intervenants sur les marchés financiers. La comptabilité à la juste valeur fait

*EconomiX (UMR7235), GATE-LSE (UMR5824) and Université Paris-Nanterre, 200 Avenue de la République, 92001 Nanterre cedex, France. E-mail: glequang@u-paris10.fr

partie de cet ensemble de règles et de pratiques. Si la comptabilité à la juste valeur semble présenter certains avantages lorsqu'elle est utilisée par des institutions dont l'horizon temporel est court, elle ne semble pas appropriée à des institutions financières de long-terme. Dans cette perspective, nous développons un modèle qui met en évidence qu'il est préférable d'adapter les normes comptables à la diversité des institutions financières en les distinguant notamment selon la maturité de leur passif.

Keywords : Fair value; Banks; Insurers; Diversity

JEL codes : G21, G22, M41

Introduction

The global financial crisis and what followed point out at least two major failures of the financial system: its inability to contain liquidity risk and its inability to fund long-term investments. According to Persaud [20], these two problems can be linked to the same cause: the setting up of rules and practices that incentivize all financial institutions to behave the same way. Fair value accounting belongs to this set of rules and practices. The main issue concerning fair value accounting is that it gives all financial institutions incentives to focus on short-term volatility whereas some of them are naturally engaged in long-term strategies. This is for instance the case for young pension funds or life insurers whose liabilities' maturities are generally long. In this respect, the diversity of financial institutions appears both as a condition of financial stability – since all market participants are not incentivized to behave the same way, they will not decide to sell at the same time, which prevents asset prices from falling all of a sudden – and as a condition for long-term investments to be funded – because some financial institutions have the natural ability to handle long-term assets exhibiting high liquidity risk. Consequently, financial regulation would be better off taking this diversity into account. We develop a model that shows that, as compared to an accounting regulation that resorts to a one-size-fits-all approach, a regulation that takes the diversity of financial institutions into account offers better results both in terms of liquidity and in terms of efficiency.

Since the global financial crisis, accounting issues, particularly those related to fair value accounting¹, have become more and more popular among economists. Yet, those

¹The first occurrence of the phrase "fair value" is to be found in the 1975 U.S. standard FAS 12. More precisely, FAS 13, which was published in 1976, defines fair value as "[the] normal selling price, reflecting

issues are not new and date back at least to the 1930s according to Laux and Leuz [16]. The idea that financial reporting has to be as transparent as possible has progressively taken shape through the development of fair value accounting, particularly since the 1970s. In the case of the United States, Heaton *et al.* [15] indeed show that, from the 1970s, both an extension and a precision of fair value accounting rules have been observed. As for Europe, the adoption of the 2005 IFRS, and the interactions between these accounting standards and capital requirements², give fair value accounting a central position in the financial sector. Yet, if fair value accounting does have some advantages – for instance it gives less room for manipulations than historical cost accounting, as pointed out by Laux and Leuz [16] – it seems to have some harmful effects when it comes to financial stability. In particular, Allen and Carletti [1] demonstrate that when markets are imperfect and illiquid, historical cost accounting is a better option for both banks and insurers. Plantin *et al.* [22] point out that fair value accounting is a bad option for institutions that manage long-lived, illiquid and senior assets. Bignon *et al.* [5] show that fair value accounting strongly enhances asset prices volatility. Jaggi *et al.* [14] prove that fair value accounting is strongly procyclical in so far as it contributes to momentum.³ Plantin and Tirole [23] demonstrate that, in the case of laissez-faire, market participants tend to overuse mark-to-market accounting which has deleterious effects in terms of liquidity.

Some empirical works have tried to estimate the impact of fair value accounting on the quality of the information displayed in financial reports. For instance, Bernard *et al.* [4] compare Danish banks, which are subjected to fair value accounting rules, to American banks, which were subjected to historical cost accounting rules over the period. Using time series econometrics from 1976 to 1989, they show that fair value accounting offers a more relevant information than historical cost accounting but induces an increased volatility. Barth *et al.* [3] also show that, for a sample of 136 American banks, fair value accounting increases the relevance of financial information. Studying the impact of fair value accounting rules (SFAS 107) on American banks' financial reporting over the period 1992-1993, both Eccher *et al.* [11] and Nelson [19] cannot find any significative result concerning the superiority in terms of information quality of fair value accounting over

any volume or trade discounts that may be applicable". As for Europe, the first accounting standard to mention fair value was IAS 32, which was issued in 1995. The definition currently used in the European Union is that of 2011 IFRS 13.

²Capital requirements in both Basel 3 and Solvency 2 are calculated using fair value accounting.

³Momentum refers to the empirically observed tendency for rising asset prices to keep on rising and for decreasing asset prices to keep on decreasing.

historical cost accounting. Using a large sample of American firms between 1998 and 2010, Blankespoor *et al.* [6] show that fair value accounting increases the quality of the information carried by banks' leverage ratio in terms of credit risk. Concerning Europe, Capkun *et al.* [9], using a sample of 1722 European firms, show that the IFRS offer a better financial information than local accounting rules. Concerning the use of fair value accounting rules by insurers, Ellul *et al.* [12] show that, in the case of the U.S. insurance industry, insurers that are subjected to mark-to-market accounting rules tend to be more prudent in their portfolio allocations than those subjected to historical cost accounting.

In short, following both the theoretical and the empirical literature, it seems that:

- fair value accounting is sometimes good for banks because it enhances the quality of the information displayed in financial reports, but it is sometimes not because it is procyclical and it increases volatility.
- fair value is always a bad option for insurers.

The main purpose of this paper is to study the impact of accounting regulation on the behavior of financial institutions. More precisely, we intend to compare an accounting regulation that resort to a full fair value approach – meaning that all financial institutions are subjected to fair value accounting while valuing their assets – to a regulation that makes a distinction between financial institutions on the basis of their nature – that is the structure of their liabilities. In the latter case, financial institutions that are naturally turned toward long-term issues because of what they do – such as a young pension fund or a life insurer – are subjected to historical cost accounting while institutions exhibiting shorter term preference – such as a bank – resort to fair value accounting. We resort to a theoretical framework that is very close to that developed by Plantin *et al.* [22]. In this respect, we make great use of the global game technique that was first introduced by Carlsson and Van Damme [8], and that has then been applied to many economic issues by Morris and Shin (see for instance [17] and [18]). Since our main purpose is to study the impact of the diversity of market participants on financial stability and on economic efficiency, we resort to a special kind of global game, namely a game with heterogeneous players. Sakovisc and Steiner [24] elaborate a methodology to solve this kind of game when there are several heterogeneous groups of players. Yet, since we are only interested in the case where two heterogeneous groups of players interact – i.e. long-term and short-term financial institutions – we do not need to resort to the Sakovisc

and Steiner framework. We instead use the methodology developed by Corsetti *et al.* [10] and Bannier [2] to study the impact of a large trader on the probability of success of a speculative attack on a currency. In both cases, when the actions of players are asymmetric, the authors consider the limiting case where the noise associated with the signal that is granted to each player vanishes to find the *ex ante* unique equilibrium. As previously said, the main result of Plantin *et al.* [22] is that fair value accounting is a bad option for banks holding long-lived, illiquid and senior assets. Using the same framework, but allowing heterogeneity among players, we depart slightly from this result and we show that, in some cases, the main criticisms attached to fair value accounting can be avoided by taking the diversity of financial institutions into account. We show that when banks (short-term financial institutions) are subjected to fair value accounting rules while insurers (long-term financial institutions) resort to historical cost accounting, the negative impact of fair value both on liquidity and on investment funding can sometimes be neutralized, due to the presence of long-term investors. The idea behind this result is easily understandable. When they are subjected to historical cost accounting, long-term investors do not need to take short-term volatility into consideration. Therefore they are not incentivized to sell when banks do and can hold long-term assets to maturity. Consequently, asset prices do not fall all of a sudden and long-term investments can be funded.

The model is presented in the next section and our main results are presented in sections 2 and 3. Section 4 concludes.

1 Model

We present here the general framework of our model. As mentioned before, the framework is very close to that developed by Plantin *et al.* [22], except we allow heterogeneity among financial institutions (FIs). We take two types of FIs into account: "short-term" institutions (in proportion $1 - k$) and "long-term" institutions (in proportion k). We implicitly suppose that the difference between these institutions lies in the structure of their liabilities, which translated into a difference in terms of time preference (the below-defined parameter ρ). More precisely, we make the assumption that "long-term" FIs have a funding structure that relies strongly on long-term instruments (as a young pension fund

or a life insurer for instance), whereas "short-term" FIs rely much more on short-term or very-short term instruments (as is the case for a bank). Consequently, "short-term" FIs can possibly face short-term liquidity needs and prefer short-term assets with low liquidity risk. On the contrary, "long-term" FIs do not normally bother to care about liquidity risk given the very nature of their liabilities. Yet, we consider that because of the use of the same kind of risk management models and the necessity to fulfill similar capital requirements⁴, all FIs hold the same portfolio.

There are 3 dates: $t = 0, 1, 2$. As we have just mentioned, all FIs hold a similar portfolio that yields v at an uncertain date: it yields in $t = 1$ with a probability $1 - d$ and it yields in $t = 2$ with a probability d . The initial value of the portfolio is denoted v_0 and is assumed to be exogenous. Each FI can either hold its portfolio until it pays or sell it to a special purpose vehicle between $t = 0$ and $t = 1$. We make the assumption that the portfolio is made of an asset that is not traded in an active market (such as loans or securitized loans). In consequence, there is no market price for this asset, and FIs need to resort to an intern model to price their portfolio:

$$p(v) = \delta v - \gamma s \tag{1}$$

where δ is a positive constant that can be interpreted as the liquidity risk associated with the asset, γ is a positive constant that captures market liquidity (the larger γ is, the least the market liquid is), s is the proportion of FIs that have sold their portfolio. We suppose that if a FI wants to sell its portfolio, it faces a price $p = \delta v - \frac{\gamma}{2}s$ (i.e. the position of a FI in the sellers' line follows a uniform law on $[0, s]$). If a FI does not sell its portfolio, it records its earnings on its balance sheet according to the accounting rule that has been chosen. Each FI seeks to maximise its $t = 1$ value.

1.1 Same Regulation for All Financial Institutions

We suppose here that all FIs resort to the same accounting rule, that is fair value accounting. As previously mentioned, each FI can either sell its portfolio or hold it to maturity.

⁴Even if capital requirements are not designed the same way in Basel 3 and in Solvency 2 the very logic that underlies these regulations is the same: estimating the risk associated to assets using a model mainly focused on short-term volatility and elaborating capital requirements accordingly. For further comments on Solvency 2 see Persaud ([20] and more specifically [21]).

A "long-term" FI (hereafter FI_{LT}) holds its portfolio to maturity if its expected value in $t = 1$ (i.e. $(1 - d)v + d(\delta v - \gamma s)$) is larger than its estimated market price (i.e. $\delta v - \frac{\gamma s}{2}$):

$$(1 - d)v + d(\delta v - \gamma s) > \delta v - \frac{\gamma s}{2} \leftrightarrow (1 - d)(1 - \delta)v > \gamma s(d - \frac{1}{2}) \quad (2)$$

Similarly, a "short-term" FI (hereafter FI_{ST}) holds its portfolio to maturity if its expected value in $t = 1$ (i.e. $(1 - d)v + \rho d(\delta v - \gamma s)$) is larger than its estimated market price (i.e. $\delta v - \frac{\gamma s}{2}$):

$$(1 - d)v + \rho d(\delta v - \gamma s) > \delta v - \frac{\gamma s}{2} \leftrightarrow (1 - d - \delta + \rho d\delta)v > \gamma s(\rho d - \frac{1}{2}) \quad (3)$$

The parameter $\rho \in]0, 1]$ captures the difference in time preference between FI_{ST} and FI_{LT} . The table presented in the Appendix (see **4.2.**) provides some insights on the impact of parameters' values on the behavior of financial institutions. From now on, we focus on situations where $\rho d > \frac{1}{2}$, $d > \frac{1}{2}$ and $\delta < \frac{1-d}{1-\rho d}$. The first two assumptions mean that the asset is rather long-lived. The last one states that δ is a decreasing function in d . Indeed, if we think of d as the duration of the asset and of δ as a parameter that captures the liquidity risk associated with this asset, the fact that $\delta < \frac{1-d}{1-\rho d}$ does make sense economically speaking – since long-term assets are normally more subject to liquidity risk than short-term assets. Therefore, it makes sense to think of δ as a decreasing function in d and to assume that $\delta < \frac{1-d}{1-\rho d}$.

According to (2), when $v > \frac{\gamma(d-\frac{1}{2})}{(1-d)(1-\delta)}$, a FI_{LT} always holds its portfolio to maturity no matter what others do. Similarly, because of (3), when $v > \frac{\gamma(\rho d-\frac{1}{2})}{(1-d-\delta+\rho d\delta)}$ a FI_{ST} always holds its portfolio to maturity. Conversely, if $v < 0$, all FIs sell their portfolio. When $v \in [0, \min\{\frac{\gamma(d-\frac{1}{2})}{(1-d)(1-\delta)}, \frac{\gamma(\rho d-\frac{1}{2})}{(1-d-\delta+\rho d\delta)}\}]$, there are two equilibria: one where all FIs sell their portfolio and one where they all hold it. In this case, the impossibility to select *ex ante* the equilibrium that will be reached *ex post* is the consequence of the strategic complementarities that exist between players.

In order to overcome the multiple equilibria problem, we use the global game technique as notably developed by Morris and Shin (see for instance [17] or [18]). The idea is that FIs do not observe the true value of v but are instead granted a noisy signal of it. This assumption offers at least two advantages: it makes it possible to find the *ex ante* unique equilibrium and it releases the strong assumption according to which v is

common knowledge. We suppose that each FI receives a private signal of v such that: $x_i = v + \varepsilon_i \eta$ where $\varepsilon_i \hookrightarrow U([-1/2, 1/2])$ and $\eta > 0$. If i and j are two different FIs, we make the assumption that $E(\varepsilon_i \varepsilon_j) = 0$ (i.e. ε_i and ε_j are independent). The distribution of x_i is common knowledge but its realization is not.

We define $v_{LT}^* = \gamma s(v_{LT}^*) \frac{d - \frac{1}{2}}{(1-d)(1-\delta)}$ the threshold value of v for FIs_{LT}, meaning the value of v from which a FI_{LT} decides to hold its portfolio to maturity rather than selling it. Similarly, $v_{ST}^* = \gamma s(v_{ST}^*) \frac{\rho d - \frac{1}{2}}{(1-d-\delta+\rho d\delta)}$ is the threshold value of v for FIs_{ST}. $s(v_{LT}^*)$ (resp. $s(v_{ST}^*)$) is the proportion of FIs that sell their portfolio when $v = v_{LT}^*$ (resp. $v = v_{ST}^*$).

LEMMA 1: *in the limiting case where $\eta \rightarrow 0$, there exists a unique threshold value of v , denoted v^* , such that when $v < v^*$ all FIs sell their portfolio and when $v > v^*$ they all decide to hold it to maturity.*

Let us prove LEMMA 1. We focus on FIs_{LT} (the reasoning is the same for FIs_{ST}). We suppose that each FI resorts to a threshold strategy, meaning that a FI_{LT} "i" sells its portfolio when $x_i < x_{LT}^*$ and that a FI_{ST} "j" sells its portfolio when $x_j < x_{ST}^*$. Consequently, the proportion of FIs that sell their portfolio when $v = v_{LT}^*$ is given by:

$$\begin{aligned} s(v_{LT}^*) &= k \Pr(x_i < x_{LT}^* | v_{LT}^*) + (1-k) \Pr(x_j < x_{ST}^* | v_{LT}^*) \\ &= k \Pr\left(\frac{x_i - v_{LT}^*}{\eta} < \frac{x_{LT}^* - v_{LT}^*}{\eta}\right) + (1-k) \Pr\left(\frac{x_j - v_{LT}^*}{\eta} < \frac{x_{ST}^* - v_{LT}^*}{\eta}\right) \end{aligned} \quad (4)$$

We know that $\Pr\left(\frac{x_i - v_{LT}^*}{\eta} < \frac{x_{LT}^* - v_{LT}^*}{\eta}\right) = \frac{1}{2}$ because x_i is centered on v so when $v = v_{LT}^*$, the probability of observing a signal below x_{LT}^* is the same as the probability of observing a signal above x_{LT}^* .

$$\text{In addition, } \Pr\left(\frac{x_j - v_{LT}^*}{\eta} < \frac{x_{ST}^* - v_{LT}^*}{\eta}\right) = \begin{cases} 1 & \text{if } \frac{x_{ST}^* - v_{LT}^*}{\eta} \geq \frac{1}{2} \\ \frac{x_{ST}^* - v_{LT}^*}{\eta} + \frac{1}{2} & \text{if } -\frac{1}{2} < \frac{x_{ST}^* - v_{LT}^*}{\eta} < \frac{1}{2} \\ 0 & \text{if } \frac{x_{ST}^* - v_{LT}^*}{\eta} \leq -\frac{1}{2} \end{cases}$$

We focus on situations where $-\frac{1}{2} < \frac{x_{ST}^* - v_{LT}^*}{\eta} < \frac{1}{2}$. When $v = v_{LT}^*$, the proportion of FIs that decide to sell their portfolio is therefore given by:

$$s(v_{LT}^*) = \frac{k}{2} + (1-k) \left(\frac{x_{ST}^* - v_{LT}^*}{\eta} + \frac{1}{2} \right) \quad (5)$$

The threshold value of v for FIs_{LT} can consequently be rewritten as follows:

$$v_{LT}^* = \gamma \left[\frac{k}{2} + (1-k) \left(\frac{x_{ST}^* - v_{LT}^*}{\eta} + \frac{1}{2} \right) \right] \frac{d - \frac{1}{2}}{(1-d)(1-\delta)} \quad (6)$$

Following the same approach, we got the threshold value of v for FIs_{ST}:

$$v_{ST}^* = \gamma \left[\frac{1-k}{2} + k \left(\frac{x_{LT}^* - v_{ST}^*}{\eta} + \frac{1}{2} \right) \right] \frac{\rho d - \frac{1}{2}}{1-d-\delta+\delta\rho d} \quad (7)$$

The previous two equations can be rewritten as follows:

$$x_{LT}^* = \left[1 + \frac{\eta(1-d-\delta+\rho d\delta)}{k\gamma(\rho d - \frac{1}{2})} \right] v_{ST}^* - \frac{\eta}{2k} \quad (8)$$

and

$$x_{ST}^* = \left[1 + \frac{\eta(1-d)(1-\delta)}{\gamma(1-k)(d - \frac{1}{2})} \right] v_{LT}^* - \frac{\eta}{2(1-k)} \quad (9)$$

As such, the system cannot be solved properly. Therefore, we focus on the limiting case where $\eta \rightarrow 0$. Doing so, we follow the same strategy as that proposed by Corsetti *et al.* [10] and Banner [2]. In this case, we have $x_{LT}^* \rightarrow v_{LT}^*$ and $x_{ST}^* \rightarrow v_{ST}^*$ and we can show that $v_{LT}^* = v_{ST}^* = v^* = \frac{\gamma(\rho d - \frac{1}{2})(d - \frac{1}{2})}{2[(1-k)(d - \frac{1}{2})(1-d-\delta+\rho d\delta) + k(1-d)(1-\delta)(\rho d - \frac{1}{2})]}$ ⁵

□

1.2 Taking Diversity into Account

We suppose here that all FIs do not resort to the same accounting rule. Depending on its nature, a FI either resorts to fair value accounting or to historical cost accounting. Precisely, we suppose that FIs_{LT} resort to historical cost accounting whereas FIs_{ST} resort to fair value accounting.

A FI_{ST} holds its portfolio to maturity if its expected value in $t = 1$ (i.e. $(1-d)v + \rho d(\delta v - \gamma s)$) is larger than its estimated market price (i.e. $\delta v - \frac{\gamma s}{2}$):

$$(1-d-\delta+\rho d\delta)v > \gamma s(\rho d - \frac{1}{2}) \quad (10)$$

A FI_{LT} holds its portfolio to maturity if its expected value in $t = 1$ (i.e. $(1-d)v + dv_0$)

⁵In the case of homogeneous players (i.e. when $\rho = 1$), we find $v^* = \frac{\gamma(d - \frac{1}{2})}{2(1-d)(1-\delta)}$, which is the same threshold as that found by Plantin *et al.* [22].

is larger than its estimated market price (i.e. $\delta v - \frac{\gamma^s}{2}$):

$$\frac{\gamma^s}{2} + dv_0 > (d + \delta - 1)v \quad (11)$$

No matter what other FIs do, a FI_{LT} decides to hold its portfolio to maturity if $v < \frac{dv_0}{d+\delta-1}$ and to sell it if $v > \frac{\frac{\gamma}{2}+dv_0}{d+\delta-1}$. When $v \in \left[\frac{dv_0}{d+\delta-1}; \frac{\frac{\gamma}{2}+dv_0}{d+\delta-1}\right]$, a FI_{LT} sells its portfolio with a probability $\frac{2}{\gamma}[(d + \delta - 1)v - dv_0]$. The proportion of FIs_{LT} that sell their portfolio as a function of v is therefore given by:

$$s_{LT}(v) = \begin{cases} 0 & \text{if } v < \frac{dv_0}{d+\delta-1} \\ \frac{2}{\gamma}((d + \delta - 1)v - dv_0) & \text{if } \frac{dv_0}{d+\delta-1} \leq v \leq \frac{\frac{\gamma}{2}+dv_0}{d+\delta-1} \\ 1 & \text{if } \frac{\frac{\gamma}{2}+dv_0}{d+\delta-1} < v \end{cases}$$

LEMMA 2: *there is a unique threshold value of v , denoted v_2^* , such that when $v < v_2^*$, all FIs_{ST} sell their portfolio and when $v > v_2^*$ they all decide to hold it to maturity.*

Let us prove LEMMA 2. As previously, we make the assumption that FIs do not observe the true value of v but are instead granted a noisy signal such as a FI indexed i receives a signal $x_i = v + \eta\varepsilon_i$ where $\varepsilon_i \hookrightarrow U\left(-\frac{1}{2}, \frac{1}{2}\right]$ and $\eta > 0$. This assumption does not modify what we have just said concerning FIs_{LT} as shown in Plantin *et al.* [22].

The threshold value of v for FIs_{ST} is given by:

$$v_2^* = \gamma s(v_2^*) \frac{\rho d - \frac{1}{2}}{1 - d - \delta + \rho \delta d} = \gamma \left[\frac{1 - k}{2} + k s_{LT}(v_2^*) \right] \frac{\rho d - \frac{1}{2}}{1 - d - \delta + \rho \delta d} \quad (12)$$

When the market is not too illiquid⁶ (i.e when $\gamma < \frac{1-d-\delta+\rho\delta d}{\rho d - \frac{1}{2}} \frac{dv_0}{d+\delta-1}$) and, since $\gamma\left(\frac{1-k}{2} + k s_{LT}(v_2^*)\right) \frac{\rho d - \frac{1}{2}}{1 - d - \delta + \rho \delta d} \leq \gamma \frac{\rho d - \frac{1}{2}}{1 - d - \delta + \rho \delta d}$, we have $v_2^* < \frac{dv_0}{d+\delta-1}$. Therefore, $s_{LT}(v_2^*) = 0$, meaning that the proportion of FIs_{LT} that decide to sell their portfolio when $v = v_2^*$ is equal to 0.

Finally, the threshold value of v for FIs_{ST} can be rewritten as follows:

$$v_2^* = \gamma \left(\frac{1 - k}{2} \right) \frac{\rho d - \frac{1}{2}}{1 - d - \delta + \rho \delta d} \quad (13)$$

⁶A standard result in the literature that studies the impact of fair value accounting on financial institutions is that it has deleterious effects on financial stability when markets are illiquid (see for instance Allen and Carletti [1] or Plantin *et al.* [22]). Our model also exhibits this feature since both $\frac{\partial v^*}{\partial \gamma}$ and $\frac{\partial v_2^*}{\partial \gamma}$ are positive. Consequently, when we focus on cases where γ is not too large, we study a situation that is particularly favorable to fair value (i.e. to case 1).

□

When $v < v_2^*$, all FIs_{ST} sell their portfolio while all FIs_{LT} hold it to maturity and $s(v) = 1 - k$. When $v_2^* < v < \frac{dv_0}{d+\delta-1}$, all FIs hold their portfolio to maturity and, consequently, $s(v) = 0$. When $\frac{dv_0}{d+\delta-1} \leq v \leq \frac{\frac{\gamma}{2} + dv_0}{d+\delta-1}$, a proportion of $\frac{2k}{\gamma}[(d + \delta - 1)v - dv_0]$ of FIs_{LT} sell their portfolio and all FIs_{ST} hold it to maturity, therefore $s(v) = \frac{2k}{\gamma}[(d + \delta - 1)v - dv_0]$. Finally, when $\frac{\frac{\gamma}{2} + dv_0}{d+\delta-1} < v$, all FIs_{LT} sell their portfolio and all FIs_{ST} hold it to maturity, therefore $s(v) = k$.

2 Accounting Regulation, Liquidity and Efficiency

We now want to compare the two cases. We are particularly interested in the impact of accounting regulation on both liquidity and efficiency. To do so, we first determine asset price in both cases and then define the loss in terms of efficiency.

2.1 Price

Asset price has been defined as $p(v) = \delta v - \frac{\gamma}{2}s(v)$. The following two tables summarize this price in all situations.

	$s(v)$	$p(v)$
$v < v^*$	1	$\delta v - \frac{\gamma}{2}$
$v^* < v$	0	δv

Table 1: Asset price in the first case

	$s(v)$	$p(v)$
$v < v_2^*$	$1 - k$	$\delta v - \frac{\gamma}{2}(1 - k)$
$v_2^* < v < \frac{dv_0}{d+\delta-1}$	0	δv
$\frac{dv_0}{d+\delta-1} < v < \frac{dv_0 + \frac{\gamma}{2}}{d+\delta-1}$	$\frac{2k}{\gamma} [(d + \delta - 1)v - dv_0]$	$\delta v - k [(d + \delta - 1)v - dv_0]$
$\frac{dv_0 + \frac{\gamma}{2}}{d+\delta-1} < v$	k	$\delta v - \frac{k\gamma}{2}$

Table 2: Asset price in the second case

PROPOSITION 1: *there is no liquidity crisis when different financial institutions are subjected to different accounting rules while such a crisis occurs when*

all FIs are subjected to fair value accounting when $v < v^$.*

The above proposition directly comes from the observation of Table 1 and Table 2. We call liquidity crisis a situation where all market participants want to sell their asset at the same time. Such a crisis occurs in the first case when $v < v^*$ since when $v \in]-\infty; v^*[$ we have $s(v) = 1$. On the contrary, in the second case, $s(v)$ is never equal to 1 meaning that there is no situation where all financial institutions are incentivized to sell at the same time. This explains why the price reaches a smaller minimum in the first case ($\delta v - \frac{\gamma}{2}$) than in the second case ($\delta v - k\frac{\gamma}{2}$ or $\delta v - (1 - k)\frac{\gamma}{2}$ depending on the value of k). The global financial crisis pointed out that sudden falls of asset prices play a major part in the transmission of the crisis through the financial sector. Indeed, the fall of asset prices lies in the center of the liquidity spirals as described by Brunnermeier and Pedersen [7]. In consequence, taking diversity into account when designing accounting regulation is a good option for liquidity and consequently for financial stability.

2.2 The Loss of Efficiency

We define the loss of efficiency as follows $L(v) = s(v)(v - p(v))$. The difference $v - p(v)$ gives us an idea of the loss due to ineffective sales at the aggregate level⁷. This loss can be interpreted as investments that cannot be funded anymore because of managers' choices to sell instead of holding their portfolio to maturity. The following tables summarize the loss of efficiency in the two cases as a function of v .

	$L(v)$
$v < v^*$	$(1 - \delta)v + \frac{\gamma}{2}$
$v^* < v$	0

Table 3: The loss of efficiency in the first case

⁷We always have $v - p(v) < 0$ since we made the assumption that $\delta < \frac{1-d}{1-\rho d}$.

	$L(v)$
$v < v_2^*$	$(1 - k)(1 - \delta)v + \frac{\gamma}{2}(1 - k)^2$
$v_2^* < v < \frac{dv_0}{d+\delta-1}$	0
$\frac{dv_0}{d+\delta-1} < v < \frac{dv_0 + \frac{\gamma}{2}}{d+\delta-1}$	$\frac{2k}{\gamma} [(1 - \delta + k(d + \delta - 1))v^2 - dv_0(1 - \delta - 2k(d + \delta - 1))v + k(dv_0)^2]$
$\frac{dv_0 + \frac{\gamma}{2}}{d+\delta-1} < v$	$k \left[(1 - \delta)v + k\frac{\gamma}{2} \right]$

Table 4: The loss of efficiency in the second case

PROPOSITION 2: *when all FIs are subjected to fair value accounting, the loss of efficiency grows as the number of FIs_{LT} grows (i.e. $\frac{\partial v^*}{\partial k} > 0$).*

Proof: See the Appendix (4.1.1).

This result is consistent with the idea that fair value accounting is not a good option for long-term FIs because of their time preference that directly comes from the very nature of what they do. This is something regulation has to take into account in order to solve the above-mentioned two problems: liquidity risk and poor long-term investments funding. Indeed, when the diversity of financial institutions is taken into consideration in the design of accounting regulation, the loss of efficiency is equal to 0 for $v \in]v_2^*; \frac{dv_0}{d+\delta-1}[$.

PROPOSITION 3: *since $v_2^* < v^*$, the regulation that consists in adapting accounting rules to the nature of financial institutions is a better option for assets that exhibit a fat-left tail than the full fair value approach.*

Proof: See the Appendix (4.1.2).

Figure 1 provides an illustration of the loss of efficiency in both cases for some values of the parameters ($d = 0.7$, $\delta = 0.6$, $\rho = 0.8$, $\gamma = 1.5$, $k = 0.5$ and $v_0 = 1$).

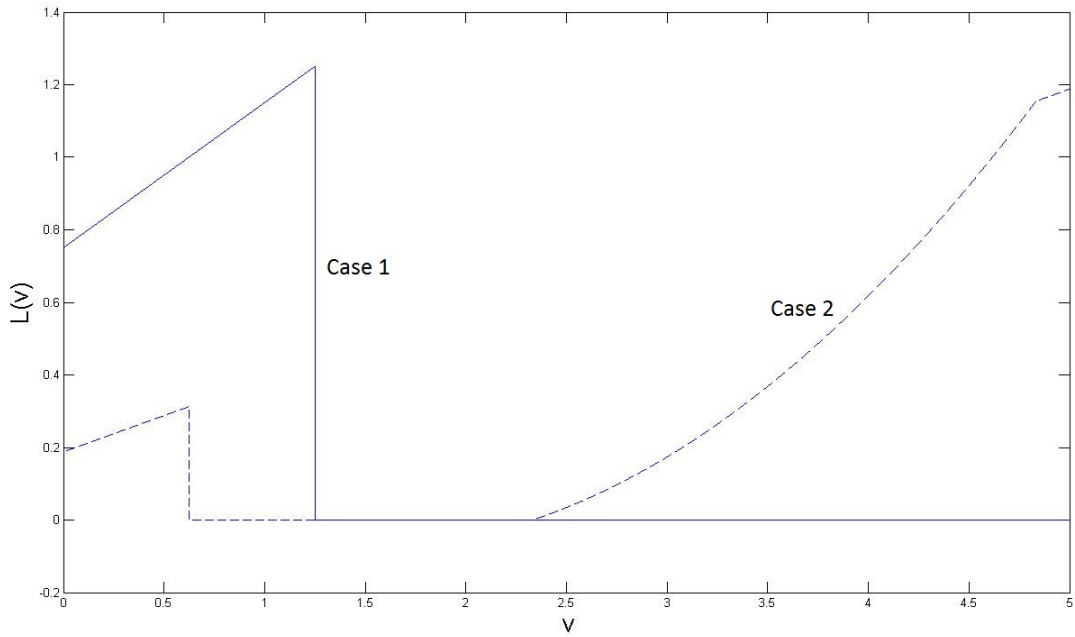


Figure 1: The loss of efficiency in cases 1 and 2

We see that when $v \in [0.63; 2.33]$ – meaning for all situations between a decrease of the return of the portfolio of 37% and an increase of this return of more than 100% – the loss in terms of efficiency is equal to zero in the second case. This interval covers a wider range of realistic situations than $[1.25, +\infty]$ (i.e. the interval where the loss in terms of efficiency is equal to zero in the first case). In conclusion, according to Figure 1, an accounting regulation that is designed according to the nature of FIs improves the ability of financial markets to fund investments. This result illustrates the intuition according to which, when accounting regulation treats financial institutions according to their nature, financial markets can more easily fulfill their goal – that is transferring money from those who have liquidity in excess to those who need liquidity to invest. In this respect, an accounting regulation that makes a distinction between financial institutions on the basis of their time horizon offers better results in terms of economic growth than a regulation that resorts to the one-size-fits-all approach.

3 Asset Duration and Market Liquidity

In this section, we study the impact of the duration of the asset and of market liquidity on both liquidity and efficiency in the two cases that have been presented in the first section.

3.1 Asset Duration

We study here the impact of the duration of the asset on our results. We interpret d as a measure of the duration of the asset.⁸ To do so, we first make the assumption that $\delta = \frac{1-d}{d}$, meaning that we suppose that δ is a decreasing function in d .⁹ This assumption summarizes the condition according to which we have $\delta < \frac{1-d}{1-\rho d}$ ¹⁰ and is meant to endogenize the link between d and δ . Indeed, while considering changes in the duration of the asset, we also have to take the impact of these changes on δ into account. We denote \tilde{v}^* (resp. \tilde{v}_2^*) the threshold value of v in the first (resp. second) case when $\delta = \frac{1-d}{d}$.

PROPOSITION 4: when d increases, it becomes even more preferable to make a distinction between FIs_{ST} and FIs_{LT} when elaborating accounting regulation. This is particularly the case when γ is sufficiently small.

Proof: See the Appendix (4.1.3).

In the first case, the impact of an increase of the duration of the asset is not ambiguous: when d increases, \tilde{v}^* increases. This means that when the duration of the asset increases, the range of situations where a liquidity crisis occurs widens and the loss of efficiency grows on average. On the contrary, the impact of an increase of the duration of the asset on financial stability and on economic efficiency is at first sight ambiguous in the second case. We indeed have $\frac{\partial \frac{d^2 v_0}{(1-d)^2}}{\partial d} > 0$ and $\frac{\partial \tilde{v}_2^*}{\partial d} > 0$, which means that the interval $[\tilde{v}_2^*; \frac{d^2 v_0}{(1-d)^2}]$ "moves rightward" when d increases. In other words, when d increases, the loss of efficiency becomes smaller if the asset pays a yield close to the upper bound of the interval while this loss becomes larger if the asset underperforms. The second case becomes therefore less favorable to fat-tail assets when d increases. Yet, for a sufficiently small value of γ , it

⁸Duration can be defined as the weighted average of the times until fixed cash flows of a financial asset are received. In our model, d is the probability that the asset pays in $t = 1$ so the bigger d is the longer the duration of the asset is.

⁹In 1.1 we gave a reason why, economically speaking, we can think of δ as a decreasing function in d .

¹⁰We indeed have $\frac{1-d}{d} < \frac{1-d}{1-\rho d}$ since $d > \frac{1}{2}$ and $\rho d > \frac{1}{2}$.

is possible to show that $\frac{\partial\left(\frac{d^2v_0}{(1-d)^2}-\tilde{v}_2^*\right)}{\partial d} > 0$, which means that when d increases the interval $[\tilde{v}_2^*; \frac{d^2v_0}{(1-d)^2}]$ widens and consequently the range of situations where the loss of efficiency is equal to zero in the second case widens. Finally, when the duration of the asset increases, it seems that it becomes even more preferable to choose an accounting regulation that makes a distinction between long and short-term institutions, especially when the market is not too illiquid. This result is particularly interesting since it is now a standard result in the literature that fair value is never a good option for financial institutions when markets are illiquid. We add to this result the idea that, even when markets are liquid, it is preferable not to opt for a full fair value approach but to design accounting rules regarding the nature of FIs.

3.2 Market Liquidity

We know that an increase of market illiquidity has a negative impact on both liquidity and efficiency when financial institutions are subjected to fair value accounting. Indeed, both $\frac{\partial v^*}{\partial \gamma}$ and $\frac{\partial v_2^*}{\partial \gamma}$ are positive. Yet, the impact of an increase of γ on the comparison between the two cases that have been presented in the previous section is not clear.

PROPOSITION 5: *when γ increases it becomes even more preferable to make a distinction between FIs_{LT} and FIs_{ST} when designing accounting regulation.*

Proof: Since we know that $v^* > v_2^*$ and since we have $\frac{\partial v^*}{\partial \gamma} = \frac{v^*}{\gamma}$ and $\frac{\partial v_2^*}{\partial \gamma} = \frac{v_2^*}{\gamma}$ we consequently have $\frac{\partial(v^*-v_2^*)}{\partial \gamma} > \frac{1}{\gamma}(v^* - v_2^*) > 0$

□

When γ increases, the loss of efficiency grows in both cases. Yet, according to PROPOSITION 5, it grows faster in the first case than in the second. This proposition indeed states that the range of situations where $s(v) = 0$ shrinks slower in the second case than in the first.

Conclusion

The global financial crisis has clearly brought out the devastating consequences of the inability of the financial system to handle liquidity shortages. We think that this inability

directly comes from the setting up of rules and practices that tend to homogenize incentives and consequently to homogenize behaviors in financial markets. Besides limiting the resilience of the financial system, this homogenization of behaviors has harmful consequences in terms of long-term investments funding in so far as no one wants to handle the liquidity risk associated with long-term assets.

Fair value accounting is one element of this set of practices and rules that tends to shorten market participants time horizon. If the rationale behind fair value accounting – that is enhancing transparency in order to limit unreported losses and manipulations – can justify its use in the case of short-term financial institutions that constantly face the risk of a sudden liquidity need, it is totally irrelevant when it comes to long-term financial institutions that will not face liquidity needs before ten or twenty years.

In this perspective, our model shows that an accounting regulation that takes the diversity of financial institutions into account offers better results both in terms of liquidity and in terms of efficiency than a regulation that ignores this diversity. More specifically, our model focuses on situations where the asset is rather long-lived (i.e. $d > \frac{1}{2}$)¹¹ and the market not too illiquid. In this particular case, which is favorable to fair value accounting since the negative effects associated with fair value are particularly strong when markets are illiquid, we indeed show that it is preferable to make a distinction between long-term and short-term financial institutions.

This is an argument in favor of an accounting regulation that focuses on the nature of institutions rather than on assets and liabilities taken separately. This may be one of the major problems with the way the IFRS are designed: instead of taking a balance sheet approach, they focus on what kind of assets and liabilities are to be found in the balance sheet. This leads to curious situations such as the fact that insurers are subjected to IFRS 4 Phase 1¹² when valuing their liabilities whereas they are subjected to IAS 39¹³ for their assets. In practice, in France for instance, this means that, most of the time, insurers value their liabilities using historical cost accounting while valuing their assets using fair value accounting.¹⁴ We think the IASB should take another approach than the

¹¹The investment to be fund is consequently a long-term investment.

¹²IFRS 4 Phase 1 "Insurance Contracts"

¹³IAS 39 "Financial Instruments"

¹⁴Even if IAS 39 makes it possible to classify assets as "held to maturity" (HTM) and use historical cost accounting to value these assets, very few insurers resort to this possibility in practice. The reason is that when an asset considered as HTM is sold before its term, all assets classified as HTM are immediately re-classified as "available for sale" and subjected to fair value accounting with values' fluctuations reported

Therefore:

$$\frac{\partial v^*}{\partial k} > 0 \leftrightarrow \delta < \frac{1-d}{1-\rho d} \frac{(1-\rho d)(\rho d-d)}{(1-d)(\rho d-\frac{1}{2})-(1-\rho d)(d-\frac{1}{2})}$$

Since $\rho d > \frac{1}{2}$, we know that $(\rho d - d)(1 - \rho d) - (1 - d)(\rho d - \frac{1}{2}) + (1 - \rho d)(d - \frac{1}{2}) = (\rho d - \frac{1}{2})(d - \rho d) > 0$, therefore $\frac{1-d}{1-\rho d} \left[\frac{(\rho d-d)(1-\rho d)}{(1-d)(\rho d-\frac{1}{2})-(1-\rho d)(d-\frac{1}{2})} \right] > \frac{1-d}{1-\rho d}$

We made the assumption that when $\rho d > \frac{1}{2}$ we always have $\frac{1-d}{1-\rho d} > \delta$, therefore when $\rho d > \frac{1}{2}$ we always have $\frac{\partial v^*}{\partial k} > 0$

4.1.2 Proof of Proposition 3

$$v_2^* < v^* \leftrightarrow \frac{(1-k)}{1-d-\delta+\rho d\delta} < \frac{(d-\frac{1}{2})}{(1-k)(d-\frac{1}{2})(1-d-\delta+\rho d\delta)+k(1-d)(1-\delta)(\rho d-\frac{1}{2})}$$

$$\leftrightarrow \delta < \frac{1-d}{1-\rho d} \left[\frac{(1-k)^2(d-\frac{1}{2})+k(1-k)(\rho d-\frac{1}{2})-(d-\frac{1}{2})}{(1-k)^2(d-\frac{1}{2})+\frac{k(1-k)(1-d)(\rho d-\frac{1}{2})}{1-\rho d}-(d-\frac{1}{2})} \right]$$

When $\rho d > \frac{1}{2}$, we always have $\frac{(1-k)^2(d-\frac{1}{2})+k(1-k)(\rho d-\frac{1}{2})-(d-\frac{1}{2})}{(1-k)^2(d-\frac{1}{2})+\frac{k(1-k)(1-d)(\rho d-\frac{1}{2})}{1-\rho d}-(d-\frac{1}{2})} > 1$

So, when $\rho d > \frac{1}{2}$ and $\frac{1-d}{1-\rho d} > \delta$, we always have $v_2^* < v^*$

4.1.3 Proof of Proposition 4

Proof that $\frac{\partial \tilde{v}^*}{\partial d} > 0$

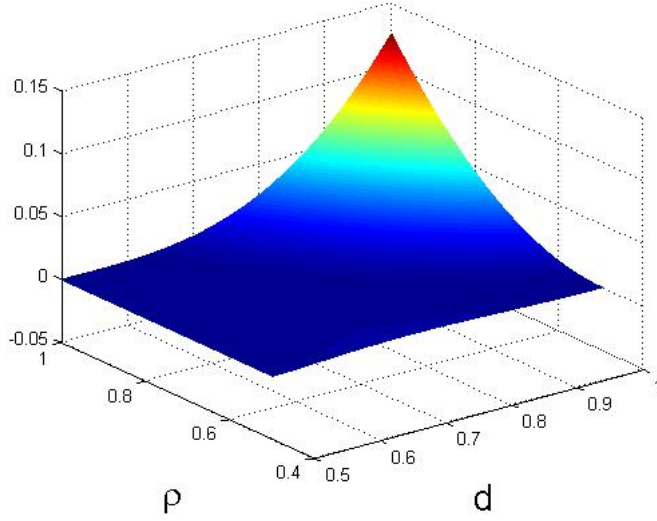
$$\frac{\partial \tilde{v}^*}{\partial d} = \frac{2\gamma[(1+\frac{\rho d-1}{d})(d-\frac{1}{2})(\rho d+\frac{1}{4}-\frac{1}{2}\rho-\frac{1}{2}d)-(1-d)(d-\frac{1}{2})^2(\rho d-\frac{1}{2})\frac{1}{d^2}+k((\rho d)^2-\rho^2d-\frac{3}{2}\rho d^2+\frac{3}{2}\rho d-\frac{3}{8}\rho-\frac{1}{2}d+\frac{1}{8}+\frac{1}{4}\rho^2+\frac{1}{2}d^2)]}{4(1-d)^2[(d-\frac{1}{2})(1+\frac{\rho d-1}{d})+k(\rho d-\frac{1}{2}\rho-d+\frac{1}{2})]^2}$$

It is easy to show that $(\rho d)^2 - \rho^2 d - \frac{3}{2}\rho d^2 + \frac{3}{2}\rho d - \frac{3}{8}\rho - \frac{1}{2}d + \frac{1}{8} + \frac{1}{4}\rho^2 + \frac{1}{2}d^2 < 0$ when ρ and d are in $] \frac{1}{2}; 1[$

Consequently, if $g(d, \rho) = (1 + \frac{\rho d-1}{d})(d - \frac{1}{2})(\rho d + \frac{1}{4} - \frac{1}{2}\rho - \frac{1}{2}d) - (1 - d)(d - \frac{1}{2})^2(\rho d - \frac{1}{2})\frac{1}{d^2} + ((\rho d)^2 - \rho^2 d - \frac{3}{2}\rho d^2 + \frac{3}{2}\rho d - \frac{3}{8}\rho - \frac{1}{2}d + \frac{1}{8} + \frac{1}{4}\rho^2 + \frac{1}{2}d^2) > 0$ we also have $\frac{\partial \tilde{v}^*}{\partial d} > 0$

The following graph plots $g(d, \rho)$ for $\rho \in] \frac{1}{2}; 1[$ and $d \in] \frac{1}{2}; 1[$. We indeed have $g(d, \rho) \geq 0$ for these values of d and ρ

Finally, $\frac{\partial \tilde{v}^*}{\partial d} > 0$



Proof that $\frac{\partial\left(\frac{d^2v_0}{(1-d)^2}-\tilde{v}_2^*\right)}{\partial d} > 0$ **when** $\gamma < \frac{2dv_0(d+\rho d-1)^2}{\frac{1-k}{2}(1-d)((3\rho+2\rho^2-1)d^2-4\rho d+1)}$

On the one hand, we have $\frac{\partial\left(\frac{d^2v_0}{(1-d)^2}\right)}{\partial d} = \frac{2dv_0(1-d)^2-2(d-1)d^2v_0}{(1-d)^4} = \frac{2dv_0}{(1-d)^3} > 0$ since $d < 1$

On the other hand, we have $\frac{\partial\tilde{v}_2^*}{\partial d} = \gamma\left(\frac{1-k}{2}\right) \frac{\rho(1-d)\left(1+\frac{\rho d-1}{d}\right)+\left(1+\rho-\frac{1}{d^2}\right)\left(\rho d-\frac{1}{2}\right)}{\left[(1-d)\left(1+\frac{\rho d-1}{d}\right)\right]^2}$

We can show that $\frac{\partial\tilde{v}_2^*}{\partial d} > 0$ when $\rho \in]\frac{1}{2}; 1[$.

We are now interested in the sign of

$$\frac{\partial\left(\frac{d^2v_0}{(1-d)^2}-\tilde{v}_2^*\right)}{\partial d} = \frac{1}{d^2(1-d)^3\left(1+\frac{\rho d-1}{d}\right)^2} \left[2dv_0(d+\rho d-1)^2 - \gamma\frac{1-k}{2}(1-d)((3\rho+2\rho^2-1)d^2-4\rho d+1)\right]$$

Immediately, we have $\frac{\partial\left(\frac{d^2v_0}{(1-d)^2}-\tilde{v}_2^*\right)}{\partial d} > 0$ when $\gamma < \frac{2dv_0(d+\rho d-1)^2}{\frac{1-k}{2}(1-d)((3\rho+2\rho^2-1)d^2-4\rho d+1)}$

4.2 Parameters' values

	FI _{ST}			FI _{LT}				
	1	2	3	4	5	6	7	8
	$\rho d < \frac{1}{2}$	$\rho d < \frac{1}{2}$	$\rho d > \frac{1}{2}$	$\rho d > \frac{1}{2}$	$d > \frac{1}{2}$	$d > \frac{1}{2}$	$d < \frac{1}{2}$	$d < \frac{1}{2}$
	$\delta > \frac{1-d}{1-\rho d}$	$\delta < \frac{1-d}{1-\rho d}$	$\delta > \frac{1-d}{1-\rho d}$	$\delta < \frac{1-d}{1-\rho d}$	$\delta < 1$	$\delta > 1$	$\delta < 1$	$\delta > 1$
$v < 0$	Hold	Sell or hold	Sell or hold	Sell	Sell	Sell or hold	Sell or hold	Hold
$v \in [0; \frac{\gamma(\rho d - \frac{1}{2})}{(1-d-\delta+\rho d\delta)}]$	Sell or hold	Hold	Sell	Sell or hold	Sell or hold	Sell	Hold	Sell or hold
$v \in]\frac{\gamma(\rho d - \frac{1}{2})}{(1-d-\delta+\rho d\delta)}; \frac{\gamma(d - \frac{1}{2})}{(1-d)(1-\delta)}]$	Sell	Hold	Sell	Hold	Sell or hold	Sell	Hold	Sell or hold
$v > \frac{\gamma(d - \frac{1}{2})}{(1-d)(1-\delta)}$	Sell	Hold	Sell	Hold	Hold	Sell	Hold	Sell

- To draw the table we made the assumption that $\frac{\gamma(\rho d - \frac{1}{2})}{(1-d-\delta+\rho d\delta)} < \frac{\gamma(d - \frac{1}{2})}{(1-d)(1-\delta)}$ (the reverse assumption would not change anything to the below discussion).
- Cases 3 and 6 do not seem realistic in so far as we have a rather long-term asset (since $d > \frac{1}{2}$ and $\rho d > \frac{1}{2}$) that can be profitably sold in the short run (since $\delta > 1$ and $\delta > \frac{1-d}{1-\rho d}$). On the contrary, a long-term asset is associated to a liquidity risk, meaning that it is normally hard to sell in the short run. Therefore, we put aside these two cases.
- In cases 2 and 7, fair value accounting achieves the first-best in so far as FIs always hold their portfolio to maturity when $v > 0$. These two cases are consequently put aside.
- Cases 4 and 8 cannot be taken together since we cannot have at the same time $\delta > 1$ and $\delta < \frac{1-d}{1-\rho d}$.
- The only matches possible are consequently: case 1 with case 8, case 1 with case 5 and case 4 with case 5.
- We put aside cases 1 and 8 because we are particularly interested in situations where sales are ineffective at the aggregate level (i.e. $v > p(v)$) to study the impact of accounting regulation on economic efficiency. Finally, we focus on cases 4 and 5.

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