Rating philosophies: some clarifications

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Abstract

In this paper I try to give answers to some of the questions and problems that arise in relation to point in time (PIT) and through the cycle (TTC) rating philosophies. One of the most confusing of these is the definition of the two approaches that, as I argue, should be based on the scope of information behind the systems. Through a simple model I demonstrate that the results of quantitative analyses can be very sensitive to the definitions and, additionally, the stress concept applied. I analyze the role played by the rating philosophies in capital requirements calculations and stress tests, and touch on their implications on the pro-cyclicality of credit risk capital regulation.

Keywords: Basel II, credit risk regulation, rating philosophy, PIT, TTC, stress test

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I. Introduction

With the recent introduction of advanced methods in credit risk regulation (Basel [2005], CRD [2006]) the two approaches for the incorporation of macroeconomic effects in credit assessments came to the fore. One takes the actual state of the economy fully into account – this is the Point-in-Time (PIT) approach; the other looks over a whole economic cycle – hence it's called Through-the-Cycle (TTC) (of course, these designations are not meant to be exact definitions, only to give the main idea behind the approaches; the definitions are subject to discussion in subsection I.3). These two approaches come with several questions from the side of regulators, banks, as well as, policymakers.

In this paper I try to give answers to some of these questions, which are presented (with references to the existing literature) in this Section. In Section II I present and discuss an existing formal model aimed at the assessment of the effect of the choice of approach on the dynamics of portfolio default probabilities and capital requirements. I show that this model applies some disputable assumptions that are, in turn, of large influence of the conclusions derived from it. By means of a very simple alternative I demonstrate the importance of underlying assumptions when dealing with the issue. In Section IV I discuss several important practical questions, while Section V concludes.

I.1 The definition of PIT/TTC

One of the most important controversies in the literature relates to the definition of one of the two approaches. While a commonly accepted definition of PIT systems seems to exist ('In a point-in-time process, an internal rating reflects an assessment of the borrower's current condition and/or most likely future condition over the course of the chosen time horizon', BIS [2000]), the definition of TTC is at best ambiguous, and generally, in my view, even wrong.

In the literature, TTC definitions usually refer to the *stressed nature* of the resulting PD estimates (which might originate from BIS [2000], p. 21, and Basel [2005], paragraph 415.). This assumption of a one-to-one correspondence between philosophies and the stressed/unstressed nature of PDs (stressed PD belongs to the TTC approach, while unstressed PD belongs to the PIT approach) underlies, for example, Heitfield [2005] who shows that (in his model) the unstressed PD of a PIT bucket and the stressed PD of a TTC bucket are constant over time and the stressed PD of a PIT bucket and the unstressed PD of a TTC bucket changes over time. The same definition can be found, for example, in Vallés [2006], page 5 and is implicit in FSA [2003], paragraph 3.247.

This way of defining TTC is somewhat strange, if only since the definition of a PIT system refers to the *information* that is used by the system (and not to the stressed/unstressed conditions). A more natural definition of the TTC should also be based on the information used: such systems (in their perfectly clear form) should not include information on systemic factors.[1] *In this paper I argue that the definition of TTC should refer to the information included in the calculations and not to stress conditions; such a definition would not be incompatible with Basel [2005], paragraph 415.* Apart form the inconsistency in the widespread TTC-definition I try to show in this paper that it is also quite unpractical and makes the analysis of actual differences in rating philosophies more difficult; the alternative definition of TTC (referring to the information used) underlies some formal analysis in Section III.

[1] It is a question which variables should be regarded as systemic ones; for example, GDP, inflation should probably belong here. Another approach is to create common factors from single macro variables such as in Amato and Luisi [2006].

At the same time, the scope of information underlying the approaches is not always understood in the same way. On the one hand – as even the name of the approach implies – TTC systems are supposed to be based on obligor-specific – as opposed to systemic – information: a TTC rating system 'uses static and dynamic obligor characteristics but tends not to adjust ratings in response to changes in macroeconomic conditions' (Heitfield [2005]). On the other, Yoneyama [2005] defines a PIT rating as a rating where 'risks are evaluated based on the current condition of a firm regardless of the phase of the business cycle at the time of evaluation', while a TTC rating is a rating where 'risks are taken into account on the assumption a firm is experiencing the bottom of the business cycle and is under stress'; still, he correctly demonstrates the dynamics of PIT and TTC systems.[2] According to Vallés [2006], 'A TTC score should take into consideration specific obligor characteristics plus macroeconomic conditions, but a PIT score would be based mainly on current information on obligors'.[3] Moreover, while Tasche [2006] defines PIT and TTC in line with what I argue for in this paper, he seems to come to an opposite conclusion as either this paper or Heitfield [2005] – see Section III – with respect to the dynamics of the systems under the two approaches: in a TTC rating philosophy 'rating grades are assumed to express the same degree of creditworthiness at any time and economic downturns are only reflected by a shift of the score distribution towards the worst scores', while in a PIT rating philosophy 'the same rating grade can reflect different degrees of creditworthiness, depending on the state of the economy'.[4]

Interestingly, rating agencies are also concerned with the definitional issue: while they are commonly said to apply a more TTC-like approach (see, for example, Rösch [2004]), I found no sign that in their ratings they embed assumptions on stressed economic conditions (S&P [2005]). This, again, is contradictory and could be resolved by using a definition that is based on the scope of information behind the systems.[5]

I.2 The correlation between non-systemic and systemic variables

The distinctive feature of TTC systems is usually mentioned to be that such systems exclude macro effects by incorporating a whole cycle (into the rating, parameter estimation, etc.).[6] Little attention seems to be devoted to the possibility that non-macro (obligor-, sector-specific) variables correlate with the cycle (macro-variables) thus even a system claimed to be 'fully TTC' is still a hybrid one (mixing PIT and TTC features).
It is not easy to explore the correlation between the 'systemic factor' and non-macro variables. One possibility may be to approximate the systemic factor with the GDP and to examine the correlation between the GDP and non-macro variables. Another one is to

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[2] p. 11

[3] p. 5

[4] p. 23 and 8, respectively

[5] It has to be noted that those who regard TTC as stressed and those who claim rating-agencies close(r) to TTC seem to be different, by and large – I found one reference where rating agencies are claimed to be TTC *and* to base their ratings on stress conditions, see Treacy and Carey [1998], p. 3. This supports the idea in Rösch [2004] that 'a definition of a Trough the Cycle Rating is not as clear-cut' [as the definition of PIT].

[6] It is important to mention Löffler [2006] where there are not only cycles and obligor specific variation behind the dynamics of the system, but also trends. Strictly speaking, TTC is concerned with cycles. This issue is closely related to whether the economy is cyclical or 'random walk'-like, see footnote 20. Since taking through this division of macro-variables in the definition of TTC would exceed the present scope, for now I only note that 1. PIT definition is not concerned with the issue and 2. this question points to an even higher possible distortion in the TTC-assessment of actual credit risk when there are trends.

search for cyclical components in non-macro variables. Doing it any ways, the analysis carries a lot of difficulty, takes a lot of time and requires a lot of assumptions.
An alternative way of analyzing the correlation between the systemic factor and the non-macro variables might be to examine whether capital requirements of more TTC-like banks contain strong cyclical components. The idea behind is that if banks calculate the amount of capital to be held based on non-macro variables the required capital should show similar cyclicality then the non-macro variables themselves, if there is correlation between the macro and the non-macro variables.
Similarly, one could take rating agency ratings and examine how these relate to systemic variables. The rationale behind is that rating agencies try, more or less, to look through the cycle and if their ratings still co-move with systemic variables then the non-systemic variables they use for the rating can also be expected to correlate with the systemic variables. One indirect indication that such co-movement may not be present is provided by Rösch [2004]. Here it is shown that fitting the Basel model extended with macro variables to the PD of rating agency rating grades one gets significant coefficients for the macro variables; this shows that macro variables help to explain the timely evolution of PDs of grades which is a feature of (more) TTC (-like) systems. Another, also indirect, sign of the small correlation of macro and non-macro variables can be found in Löffler [2006], where it is shown that cyclical movements have little role in explaining ratings (p. 19, p35.). To conclude, there does not seem to be definite evidence on the exact size of the correlation between macro and non-macro variables (probably being dependant on many factors, e.g. the sector), though it seems to be low.

I.3 Stress concepts in the regulation

As will be discussed in more detail below, stressed conditions appear in two respects in the new credit risk regulation (Basel [2005], CRD [2006]). First, the capital requirement is itself based on a stress scenario in the IRB model. This scenario is applied to the model behind the regulation. The purpose is to require banks to hold capital that covers even their large, low-probability losses – the theoretical minimum coverage of losses by own funds is 99.9 percent.
Reference to stressed economic conditions also appears in the requirement to carry out stress tests.[7] Such tests are not directly and automatically related to the actual capital requirement; their purpose is rather to assess the effect of hypothetical changes in certain conditions to, for example, the quality of their portfolios and their losses. These tests are not based on the Basel model, at all, so these two stress concepts are quite different.

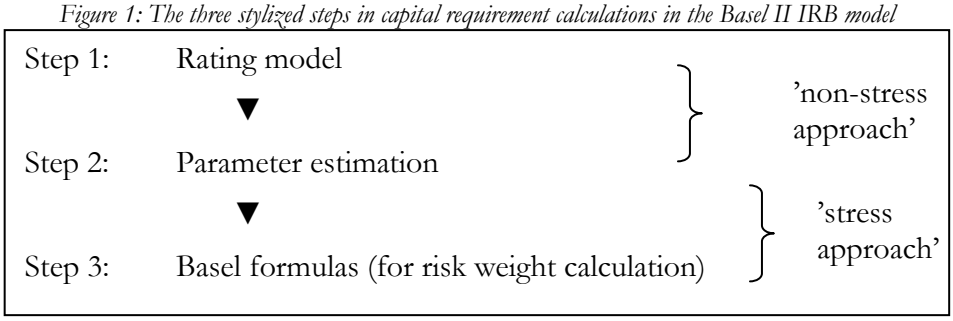
II. The present regime

II.1 What the new regime contains: from scoring to the risk weight

For the purposes of the discussion I divide the risk weight calculation into three levels, rating model – parameters – Basel formulas (risk weight calculation, in general):

[7] See, for example Basel [2005], paragraphs 434-437.

Figure 1: The three stylized steps in capital requirement calculations in the Basel II IRB model



Throughout the paper under parameter estimation my major concern will be the PD parameter. By 'Basel formulas' I especially refer to the formula for capital requirement calculation, and even more to a part of it that is concerned with the calculation of a high percentile of the loss distribution (for a description and an explanation of the formulas, see e.g. BIS [2005a]).[8]

On the right-hand side of Figure 1 I denoted when we (explicitly or implicitly) use 'normal' or 'non-stress' assumptions and when stress assumptions. It is important to note that the Basel formula implies a stress scenario and this stress scenario in Step 3 is applied in the risk weight calculation irrespective of whether the rating system of a bank is PIT-, or TTC-like. The actual form of the Basel formulas (a single systemic factor and perfect granularity, see Gordy [2003], Bank and Lawrenz [2003]) makes the formulation of the stress scenario straightforward: setting a percentile of the systemic factor provides for the desired percentile of the portfolio loss. The stress concept built into the Basel framework is very simple. Nonetheless, its purpose is to express regulatory preferences in a simple way so that capital requirement calculations can be based on relatively simple formulas.

II.2 What are rating philosophies concerned with?

In the discussion of the two philosophies it is an unclear point what the subject of the two philosophies is. Is it the rating system (Step 1 in Figure 1)?; the parameters (Step 2)?; and/or something else (e.g. Step 3)? Let's start with the rating system. Exposures of a bank are put into rating grades in a rating system based on their (perceived) riskiness. The Basel Framework (Basel [2005]) gives little guidance as to how rating grades have to be formed (for example, 'Perceived and measured risk must increase as credit quality declines from one grade to the next', see paragraph 397.). As to the *assignment* of exposures to grades the Framework allows both statistical (and other quantitative) methods and non-quantitative methods ('human judgment'). Probably it is correct to say that most banks use some kind of statistical procedures for most of their retail and corporate exposures, at least as a good basis for the final rating.[9] In this case, typically, the bank collects historical observations, selects appropriate explanatory variables and estimates the model. The output of the model then is a score that reflects the riskiness of

[8] Although my focus is on the high percentile of the loss distribution the risk-weight formula contains expected loss (EL), as well. Strictly speaking the capital required is the high percentile loss *minus* EL, the latter being supposed to be covered by provisions. However, if EL>provisions, deduction from the capital has to be made (see CRD [2006], Art. 57 (q), and Annex VII. Part 1, paragraph 36.). This implies that if PD increases the increase in the high percentile of the loss distribution might approximate the increase in capital requirement quite closely if provisions are around EL (calculated with the PD before the increase). This results in a close link between PD dynamics and capital requirement dynamics, which is important when interpreting the results in Section III and Section IV.

[9] Even in the lack of such formal models decisions might be based on considerations similar to those underlying such formal models.

the exposure (the client). Macro-effects can enter this procedure two different ways: 1. the bank uses macro-variables as explanatory variables; 2. even if the bank does not use macro-variables the observed defaults will contain the effects of these variables, as well. This latter effect is more prevalent if the bank uses default events from different years for the same estimation (in the sense that macro-effects blur the relationship between non-macro variables and default indicators more).
This discussion shows that – using the definition of PIT and TTC referring exclusively to the information content used under the respective approach – *raising the issue of rating philosophies is very straightforward at the level of rating models.* A clearly TTC model, for example, would require that a, banks don't use macro-variables as explanatory variables; b, macro and non-macro variables be non-correlated; c, for the estimation, banks use defaults from one given year (e.g. the year of the latest observations). However, banks are interested in the accurate default probabilities and some authors mention that banks' systems are indeed more PIT-like then TTC-like . The need for a more TTC-like system is usually derived from the regulatory side and not from the banks' side – however, neither the Basel accord, nor the European Capital Requirements Directive (CRD [2006]) contains such provisions![10]

What both regulatory documents contain is that 'PD estimates must be a long-run average of one-year default rates for borrowers in the grade'.[11] Those who argue that 'Basel is more TTC-like' may think partly of this provision. But it has to be seen clearly that the rating system (model) and the parameters that feed into the risk weight formula are not related directly. A rating system is used to classify the exposure or, to put it differently, to assign them to grades. Parameter estimation, in turn and in general, does not have a direct relation to the model, and its purpose is to assign risk parameters to grades.[12] There is an indirect relationship, however: parameters are estimated from data based on the categorization (grades) that in turn is strongly related to the model. If all the relevant factors are in the model – that is, we have a perfect PIT model – then the PD of a grade will be stable over time (see the discussion in the next part). If we have such a stable data history then the PD estimate to be used in the risk weight formula ('long run average of one-year default rates') will also be around this value correctly reflecting the true PIT probability of default. On the other hand, if one or more important factors are missing from the rating model (in a TTC model these are macro-factors), the PD of a grade will change over time because the omitted factors will not trigger a change in the rating, only in the probability of default. In such a case the historical PD of a grade will change over time and the dynamics of the PD of a grade will depend on how the long run average is estimated: the shorter the time horizon of the estimation sample is, the more the estimate varies over time. As we can see, *we can only have a TTC estimated PD parameter if we have a TTC rating system and we use a long enough sample period.*

A third major component of the risk weight calculation is the risk weight function. Is it PIT or TTC? While this function is just a simple formula to turn (the expected) PDs into the 99.9th percentile (stressed) PD[13], the philosophy behind the parameters has an

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[10] In Section IV. I conclude that this preference of regulators/policymakers towards TTC may be underpinned decisively by pro-cyclicality arguments.

[11] Basel [2005], paragraph 447; for retail exposures and some other exposure classes the rules may differ. The CRD contains similar provisions, see CRD [2006] Annex VII, part 4, paragraph 59.

[12] The regulation refers to the possibility of the direct usage of model outputs in the parameter estimation, see Basel [2005] paragraph 462 point 3, CRD [2006] Annex VII, part 4, paragraph 30.

[13] See Varsanyi [2006]

important effect on the resulting risk weight and also on the pro-cyclicality of rating systems. I will analyze this effect later in the paper, for now I only conclude with that *the stressed nature of the Basel formula does not make the Basel regulation TTC.*

III. Models

The model in Heitfield [2005] is a good point to start the formal analysis of rating philosophies with. The reason for it is that it is simple and straightforward, and since it is accessible in different publications (in BIS [2005b], for example) it can be assumed to be widespread and well-known; moreover, I failed to find any other articles that analyze the issue in a similarly compact and focused way. So in what follows I first present his model briefly. I show its more or less apparent features and explore its implicit assumptions; most importantly, I show that the model is based on a rather specific stress concept and that his results much depend on this concept. Finally, I analyze rating system dynamics with a different definition of TTC systems that I think is more consistent with the definition of PIT systems and is based on the information used in the rating model. All in all, I argue that the definition of the TTC approach (grade) and the stress concept applied are very marked features of Heitfield's model, while can be subject to debate as shown in this section.[14]

III.1 Heitfield's model

Heitfield [2005] sets up a model to present the two rating philosophies and their implications for stressed and unstressed default probabilities on a grade level. His model departs from generality with some specific features that should be highlighted since these affect the results substantially. His model is of the form (using his notation):

$$\begin{aligned} Z_{i,t+1} &= \alpha + \beta_w W_i + \beta_X X_{it} + \beta_Y Y_t + U_{i,t+1} \\ U_{i,t+1} &= \omega V_{t+1} + \sqrt{1-\omega^2}\, E_{i,t+1} \end{aligned} \qquad (1)$$

Z is a measure of the distance to default of obligor i, with a default threshold of zero. W and X are obligor-specific explanatory variables, the latter being time-dependant (the former not); Y is a common (systemic) factor. U is a composite shock where V is a common shock and E is an obligor-specific shock. Because of the lagged explanatory variables (1) can be regarded as a forecast of the distant to default (DD) indicator in time period t.[15]

Heitfield defines a PIT rating grade as such that all obligors in that grade share the same unstressed PD:

$$\Gamma_t^{PIT} = \{i \mid \alpha + \beta_w W_i + \beta_X X_{it} + \beta_Y Y_t = -\gamma_{PIT}\}, \qquad (2)$$

where $-\gamma$ is the expected value of the distance to default indicator and is common across obligors in the grade. If, for example, the expected value of the indicator is -3, default occurs if the shock variable, U in (1), takes on a value less then +3. Consequently, the

[14] While he states that '…the objective here is to demonstrate how the characteristics of rating systems and pooled PDs interact. For this reason, wherever necessary, the model sacrifies realism in favour of expositional simplicity' (p. 21), his assumptions on the form of the model have a decisive effect on his conclusions.

[15] It is worth mentioning that this setup is quite different from that of the model behind Basel II regulation, where all variables are synchronous (no lagged explanatory variables). In that model the purpose is to 'explain' (rather then forecast) the distance to default indicator.

(unstressed) default probability in the grade is given by $\Phi(\gamma_{PIT})$, where Φ denotes the cumulative normal distribution function. The stressed PD is given by (Heitfield [2005], p. 24):

$$PPD_{PIT}^{S} = \Phi\left(\frac{\beta_Y y_t + \gamma_{PIT} - \psi}{\sqrt{1-\omega^2}}\right), \tag{3}$$

where *PPD* stands for 'pooled PD', i.e. PD that is expected to be observed in a grade and $\psi = \beta_Y y_t + \omega V_{t+1}$ is a constant representing the stress scenario. As can be seen, the stressed PD of a PIT grade decreases as the *observed* macro factor decreases (worsens). This is because the stress scenario is defined with reference to both the observable *and the unobservable* macro-factors and the worsening of the observable macro-factor is offset by the unobservable factor plus, at the grade-level, offset 'again' by the non-macro factor.

On the other hand, in a TTC rating grade – by definition – obligors share the same stressed PD. Moreover, the same model as in the PIT case, (1), is used, so the information used is the same in the two approaches. That is, a TTC grade is defined as:

$$\Gamma_t^{TTC} = \left\{ i \,|\, \frac{\alpha + \beta_w W_i + \beta_X X_{it} + \psi}{\sqrt{1-\omega^2}} = -\gamma_{TTC} \right\}. \tag{4}$$

As can be seen, the definition does not directly refer to the information used.[16] However, Heitfield shows that the distribution of obligor specific-characteristics tends not to change over time (p. 23) – so that, at the end, we have a property that we expect TTC systems indeed to have: not to adjust rating as a response to changes in the common factor(s).[17] The unstressed PD in a TTC grade is given by (Heitfield [2005], p. 25):

$$PPD_{TTC}^{U} = \Phi\left(-\beta_Y y_t + \sqrt{1-\omega^2}\,\gamma_{TTC} + \psi\right) \tag{5}$$

The unstressed PD decreases as y_t, the actual condition of the economy, improves, because – as opposed to PIT buckets – in TTC buckets there is no systematic worsening ('offsetting', as referred to in the PIT case) of non-macro factors following an improvement of actual economic conditions. Observe, that in this model a TTC system is also pro-cyclical: while bucketing is carried out based on stressed PDs, which are stable over time, both the unstressed PD and the 'observed' PD (not reported here, see Heitfield [2005], p. 26) are negative functions of y_t.[18]

To conclude this section I note that – as was previously shown – unstressed PDs can be used in the capital requirement calculation, while stressed PDs are useful in the stress test prescribed by the regulation independently from the capital requirement calculation.

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[16] In fact, the appearance of ψ in (3) (and not in (2)) is a difference, but ψ embodies no 'real' information, only stress hypothesis. This issue will be analyzed later.

[17] In Heitfield's work this non-responsiveness is due to the common stressed PD of obligors in a grade, but non-responsiveness can be consistent with common unstressed PD, as well, in a different setup, see below.

[18] Though in Heitfield [2005] the longer the time horizon used for default probability estimation the less effect y_t has on the results. This is in line with arguments on the importance of the length of the sample period below.

III.2 Restrictions on the generality of the model

Assuming we are in time t V_{t+1} is not an unobservable factor (as Heitfield states, p. 22) in the sense that even with perfect knowledge of the current state in time t it would be impossible to know this variable. It can rather be regarded (for simplicity) as a shock to Y_t in time t+1. This way, getting to know V_{t+1} in time t+1 is equivalent to becoming able to update the forecast of the DD indicator for the *same time period* (t+1) – in fact, by this time we already know whether the obligor in question defaulted or not. However, being in time t, should we stress the *current* conditions?
On the other hand, if we are in time t-n (n positive constant) should we stress *both* time t and time t+1 conditions?
A better view of Heitfield's approach seems to be that it is forward looking two periods ahead (at least…), that is, when the stress scenario is applied we are in period t-1.[19] This way, *the model embeds a 'multi-period' stress test. As such, it contains rather specific assumptions, which questions the general validity of the conclusions.* In the stress scenario it is assumed that in the next period economic conditions worsen and/or in the subsequent period there is a negative macro-shock. The effect of these adverse movements taken together is fixed, but the worse the assumed conditions in the next period are, the lower the PD in a PIT grade is (TTC grades have constant stressed PDs in Heitfield's model). At the end, we have a stress-assessment for the end of the *second period from now*, that can be compared to a one-year horizon that has to be applied when calculating the capital requirement.

This discussion also highlights the feature of the model that in applying the stress scenario it really matters how one divides the stress shock between Y_t and V_{t+1}. The higher the part allocated to Y_t is, the smaller the difference between the stressed and unstressed PDs of grades corresponding to the PIT and TTC approaches are. This follows easily from (3) and (5). For example, (3) can be rewritten as:

$$PPD_{PIT}^{S} = \Phi\left(\frac{\beta_Y y_t + \gamma_{PIT} - \psi}{\sqrt{1-\omega^2}}\right) = \Phi\left(\frac{\beta_Y y_t + \gamma_{PIT} - \beta_Y y_t - \omega V_{t+1}}{\sqrt{1-\omega^2}}\right) = \Phi\left(\frac{\gamma_{PIT} - \omega V_{t+1,y}}{\sqrt{1-\omega^2}}\right)$$

where the 'y' subscript of V in the last expression refers to the fact, that it is determined by y (given ψ).

III.2.1 An alternative stress scenario in PIT systems

To explore Heitfield's model further, I modify the stress scenario applied to refer only to V_{t+1} in (1). Its easiest interpretation is that this way I assume that we are in time t and the stress test is carried out to examine the dynamics of the system over the coming year. Unstressed PDs of a PIT grade will of course not change; the calculation of stressed PDs can be shown to have the form:

$$PPD_{PIT}^{S} = \Phi\left(\frac{\gamma_{PIT} - \omega V_{t+1}}{\sqrt{1-\omega^2}}\right),$$

which, apparently, is also the same as in the original model. However, there is an important difference: while here the stress condition can be expressed as $\psi = \omega V_{t+1}$, in the original model it is $\psi = \beta_Y y_t + \omega V_{t+1}$, and the two equals only if y_t is zero. A deterioration of Y_t (observed, actual economic conditions in the modified model) will lead to a decrease in the stressed PD of PIT grades in the original model, whereas in the

[19] In this case we also have to use forecasts of the other variables rather than observed values.

modified model there will be no increase, since obligors will be downgraded as a result of the worsening of economic conditions. It turns out that we can make the two models equivalent (so that the stressed PD in the modified model increases as Y_t improves), by a simple assumption that gives a different view of the original model: in the modified model we have to use a variable shock, not a constant one, a shock that depends on the current state of the economy, i.e. $\psi = \psi(Y_t) = \omega V_{t+1,y}$. Thus, *in Heitfield's model the better the actual condition of the economy, the higher the shock applied. Another phrasing of this conclusion is that in the model the better the actual condition of the economy is, the longer is the time horizon applied in the stress test.*[20] If we apply a constant shock in the modified model, the stressed PD of a PIT-grade is constant, such as the unstressed PD.

The cause of the difference between the modified model and Heitfield's original model can be seen as a lack of information updating in the original model. Namely, while he formulates a stress scenario in terms of time t and t+1 economic conditions ($\psi = \beta_Y y_t + \omega V_{t+1}$), when describing the dynamics of PDs he links these dynamics to changes in y_t; that is, in the stress scenario he conditions on information before time t (and in this case y_t can be regarded as *assumed* changes in economic conditions) and he does not update the stress test as the time t information on y_t arrives.

III.3 Dynamics under the alternative TTC-definition

In this section I analyze the TTC-case using a different TTC-definition. I modify the above model and write it in a general form:

$$Z_{i,t+1} = f\left(W_i, X_{it}, Y_t, V_t, E_{i,t+1}\right)$$

This model contains the same explanatory variables, except for V, the idiosyncratic systemic shock in the original model that now represents every omitted, lagged (time t) factor (not only the systemic one).[21]

For us, the dynamics of TTC-grade PDs under a new definition is of interest now. In Heitfield [2005], as well as in other sources, the definition of TTC is directly linked to a stressed economic situation.[22] Here, I redefine TTC as a system where the bank bases its (*unstressed*) rating only on non-systemic information, thus the model becomes:

$$\begin{aligned} Z_{i,t} &= \alpha + \beta_w W_i + \beta_X X_{it} + U_{i,t} \\ U_{i,t} &= g\left(V_t, E_{i,t}\right) \end{aligned}, \qquad (7)$$

i.e. the set of 'observable' macro factors (Y) is empty.[23] It can be seen that – since the rating by this model does not consider macro-factors – a change in the condition of the economy will not change the rating, only the actual number of defaults in a grade. We are

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[20] This implies that he is thinking in terms of 'perfect' cycles (e.g. sinusoids, the bottom of which is, by his definition, the stress state). At the other extreme, one can regard the system as 'random walk'-like (see Taylor [2003], p. 6); the truth must lie between these two extremes. Interestingly, those who argue in favor of TTC, do it from pro-cyclicality considerations which does not require any assumptions about the evolution of the economy – it only requires some kind of 'averaging' in the calculations.

[21] In fact, as regards the dynamics of grade PDs, this latter assumption only matters when there is correlation between the systemic factor and the non-systemic ones.

[22] See, for example, BIS [2000], p. 21.

[23] Of course, 'observable' should not be understood literally; it rather refers to the fact that bank omit these variables from the model – just as if these were unobserved.

in the same situation as in Heitfield's model: as economic conditions improve, unstressed PD of a TTC-grade will decrease.
However, this will also apply to any shock situation with respect to V, which is contrary to what happens in Heitfield's model, where the stressed PD of a TTC-grade is constant (*by definition*). It is also true that in this simple model there will actually be no difference between a PIT and a TTC bucket, since the only difference between the two systems is that there is a systemic factor in the PIT and since its coefficient is kept constant across obligors in a grade disregarding it will make no changes to the buckets. This is why the model demonstrates the trade-off between the volatility of grade PDs (TTC) and the systematic movement of obligors across buckets (PIT) very clearly.

IV. Implications and practical concerns

IV. 1 A visit at stress testing: the purpose of stressed PD calculation

As I argued above, part of the subject of the discussion on rating philosophies – assuming that it is not to question the Basel formulas – is how parameters are/should be estimated, i.e. it is concerned with the second step in Figure 1. These parameters are, in turn, put into the stress-model (the Basel formulas) in Step 3. It follows, that we should estimate '*unstressed*' parameters and we should not care – at least as long as risk weight calculations are concerned – about stressed parameters; the stress scenario is provided by the Basel formulas.
Indeed, since – at least, as long as statistical models are concerned – rating models are based on historical observations (that can be assumed to contain very scarce data on stress situations) and these models are used for determining rating scales to which exposures are subsequently assigned *it is very difficult to imagine any actual systems where the grades are based on similar stressed* (as opposed to unstressed) *PD of obligors. This is another argument against defining TTC models with reference to stress conditions.*

The stress concept appears both in the revised Basel Accord and in the CRD also from a different perspective: the regulation requires banks to carry out stress test.[24] This stress test is not related directly to either the Basel model or the estimated parameters that are used by the model. One purpose of this stress test is to evaluate to what extent ratings would worsen in downturn economic conditions. For this purpose banks can use their rating models and in this case we can make use of the discussion and the results above that correspond to the dynamics of grade PDs under the PIT and TTC approaches.
One of the conclusions of the above analysis is that the stress concept has to be chosen very carefully. It is very important here, too; now I discuss the case of a PIT system. If we apply Heitfield's model, with his constant shock stress scenario (that was shown to be equivalent to a modified model in Section III.2.1 with a variable shock), we have that under stress if the economy is going down a PIT PD will fall. It should have the interpretation that if we compare two stress tests carried out in consecutive periods and if, from the first period to the second, the observed economic conditions worsened the stress PD of a given grade decreases. This may mislead, by indicating that the quality of the portfolio improved, those who interpret the result of the stress test without knowing the underlying assumptions. In fact, as economic conditions worsen obligors will move to worse, higher risk grades – offsetting, more or less the parallel decrease of stressed PD of grades. Conversely, the alternative model would clearly indicate that in a stress

[24] Basel [2005], paragraphs 434-437, CRD [2006], Annex VII, part 4, 1.8

situation if economic conditions worsen the migration of obligors to worse quality grades will result in even higher potential loss and capital requirement.

IV.2 Sensitive elements of the TTC approach

There are several obstacles to creating a clear TTC system. One can be the correlation between non-systemic and systemic variables: in this case excluding systemic variables from the assessment of credit quality does not mean that the *effect* of such variables is also excluded.

Another reason may relate to the cycles. I emphasize that this is not necessarily a problem, since neither the excluding of macro factors from the rating model, nor the usage of as long time series as possible to the estimation of the parameters requires reference to cycles. Why TTC became the subject of widespread discussion is, in my view, its less pro-'cyclical' nature, but *the cycle referred to here doesn't assume very regular or 'perfect' cycles, just changes in the economic conditions*. Still, the question is important, as is highlighted by the difference in the stress concept in Heitfield's model and in my alternative (see Section III), for example, where the difference could be claimed to be due to different views on the systemic factor: the former model seemed to be based on a systemic factor that evolves according to a 'perfect cycle', while in the alternative model it was more like a random walk. In the former approach a big problem is the measurement of cycles: 'The phases of the latest cycle will probably be longer or shorter, steeper or less severe, than just repetitions of earlier cycles' and 'Indeed, at any given point, it is difficult to know the stage in the cycle of the general economy, or a given industrial sector' (S&P [2005], p. 34 and p. 35, respectively).

Moreover, trends and cycles can be assumed to coexist and while from the pro-cyclicality point of view the two have similar implications, the TTC approach seems to be concerned only with the latter ones. Thus, even the proposed reference to (the omission of) macro variables in the definition of TTC has some conceptual problems, see footnotes 6 and 20.

IV.3 Pro-cyclicality of the Basel model

In this section I put together the results obtained so far to argue that a TTC-model can lead to similar pro-cyclicality then a PIT system. In Section II I showed that the rating philosophy behind capital requirement calculations depends on two factors: the scope of information used in the model (whether there are macro variables or not) and the way parameters are estimated (the length of the estimation sample). In Section III I examined (based on Heitfield [2005]) the dynamics of grade PDs under the two rating philosophies. Capital requirements were not the subject of that analysis; in the spirit of Figure 1 it was only concerned with Step 1 and Step 2 and not with Step 3.

However, the analysis of pro-cyclicality requires that we link the dynamics of rating systems to capital requirement calculations. The pro-cyclicality of rating systems has two sources. First, in 'bad times' the number of defaults increase and the losses can lead to a decreased capital, which, in turn, may lead to a contraction of the supply of credit. Second, in 'bad times' the non-defaulting obligors may be downgraded leading to a higher capital requirement – this has the same effect as and adds to the decrease of capital.

The difference between the two rating philosophies is related to the second source of pro-cyclicality. In a PIT rating system the expected PD of a grade will be constant and pro-cyclicality is caused by the flow of obligors across grades; for example, as a result of worsening economic conditions obligors will tend to move to more risky grades with a higher capital requirement. In a TTC system the issue is somewhat more complicated. While systematic flow of obligors is not expected as a result of changing economic

conditions, if the parameters are estimated within a relatively short time-frame, there will be variability in the estimates and the estimates will correlate with economic conditions (if, for example, the economy is going down, the PD of grades will increase). However, *an increasing (as a result of economic downturn) PD parameter will lead to an increase in the capital requirement for exposures in a given grade.*

Thus, we can conclude that from the point of view of the logic of both rating philosophies it is important to base the estimation of the PD parameter on as a long sample as possible (of course, together with other considerations: for example, old data may not be that meaningful). This issue can be highly relevant now, as institutions that have recently built out their IRB systems may not have long enough data series.

IV.4 The Standardized Approach to capital requirements calculations

So far the analysis was concerned with the IRB approach to capital requirement calculation. In this section I discuss some consequence of the Standardized Approach on the pro-cyclicality of the regulation.

In the Standardized Approach an exposure is either not rated at all or rated by a rating agency. In the first case it has a fixed rating that does not react to any changes in macro- or non-macro variables. This is the least pro-cyclical component of the regulation – and, at the same time, the least risk-sensitive (thus can be expected to be the least accurate from an economic capital perspective).

As regards rating agency ratings, the key question is how these ratings are set and what factors are behind their dynamics. The answer to these questions is well documented; see for example S&P [2005], especially pages 33-35. While so far we saw two different, concurring motivations determining the form of models and the interpretation of ratings (accuracy versus dampening pro-cyclicality), involving rating agencies in the analysis seems to immediately rise a third aspect: 'Standard & Poor's credit ratings are meant to be forward-looking; that is, their time horizon extends as far as analytically foreseeable' and 'Accordingly, the anticipated ups and downs of business cycles…should be factored into the credit rating all along'. Though agencies can be supposed to be hardly concerned with pro-cyclicality, their ratings imply the dampening of such effects.

It is interesting to note that while rating agencies are thought to be more TTC-based, there approach is sensitive to certain conditions. One important example is found in S&P [2005], p. 34: 'Sensitivity to cyclical factors – and ratings stability – also varies considerably along the rating spectrum'. While for worse rated companies a 'cyclical downturn may involve the threat of default before the opportunity to participate in the upturn that may follow' and, consequently, in their case 'cyclical fluctuations will usually lead directly to rating changes', 'companies viewed as having strong fundamentals…are unlikely to see their ratings changed significantly due to factors deemed to be purely cyclical'. One can observe that the assumed correlation of credit quality with the systemic factor is inversely related to credit quality here then in the Basel model, where the higher the credit quality, the higher the correlation with the systemic factor. Another conclusion is that a rating agency's (at least, S&P's) rating is the 'more TTC', the better the quality of the obligor.

IV.5 More accuracy or less pro-cyclicality?

From equations (6) and (7) it can be inferred that a TTC system is a special case of a model where there is (are) omitted variable(s). The effect, in general, of excluding significant variables from a model is that the model becomes less accurate. This happens in the case of a TTC-model, as well: the more a system is TTC-like, the more it 'averages out' changes in macro-factors and the worse estimates/forecasts of the actual PD

parameter it can be expected to make use of in capital requirement calculations. This latter consequence leads to undercapitalization in certain times and to overcapitalization in others.[25]

Thus, the rating system should not be evaluated independently of the purpose of the regime it is a part of. *If* the purpose is very clearly defined to protect external liabilities of banks at the 99.9th percentile then the rating system should be such that it accurately measures (or, at least, tries to measure) the loss distribution over the required horizon, at all times. A PIT rating system that uses all relevant information is consistent with such a purpose. I think that banks' interest is to measure the riskiness of a client as accurately as possible, so they can be expected to use PIT systems. Any stimulation of banks to use TTC systems may result in the divergence of economic and regulatory models.

If the main purpose is something else (and, still, to protect *some* high percentile, but not always exactly the 99.9th), then a TTC regime can be justified; while I think the only reason why the 'TTC approach' has received so much attention is the issue of pro-cyclicality. This approach, being less pro-cyclical, supports more wide-spread interests and complies with the preferences of a 'social planner' (Kashyap and Stein [2004]). Similarly, Catarineu-Rabell et al. [2003] conclude that while from a bank's perspective pro-cyclical rating systems are the second best choice (the best one would be a counter-cyclical system, but this is not allowed by the regulation), from a broader, welfare perspective a-cyclical rating is the best.

Though with different considerations, Taylor [2003] also argues for more stable rules. He argues that economic capital is a buffer and (as long as cyclicality is recurring) it 'should be relatively stable with any short-term ups and downs in actual losses around' the 'mean value absorbed by capital'. That is, when the economy is going down, capital should be let to decrease (as a result of losses) and as economic conditions improve capital will come up again. To protect against small probability events with severe negative effects he proposes some early-warning mechanisms be built into such a system.

V. Conclusions

In this paper I analyzed the difference between and some implications of point in time and through the cycle rating philosophies. I pointed out several problems that can be observed in the current literature. I argue that the definitions are inconsistent and propose to base the TTC definition (as can be observed in the work of some authors) to the scope of information underlying ratings in the systems. I show that the present definition referring to stressed economic conditions raise several problems. Moreover, the literature seems to be somewhat heterogeneous about the meaning/content of certain notions. Another important question is how stress scenarios are defined and how conclusions are drawn form stress tests. I also claim that it is not as clear as some authors argue that the Basel regulation is in favor of the TTC approach. I also show that for a rating system to be TTC – which might be important from the perspective of a 'social planner' – it is necessary (and still not sufficient) to use long data series for parameter estimation – otherwise the system will behave similarly to a PIT system; and that this issue is especially relevant at these times when systems are newly introduced and banks usually get concession as to the length of the sample period.

[25] Assuming, somewhat restrictively, that banks always hold the minimum capital requirement that is calculated by these models.

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