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Quantitative Analysis

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Research Notes in Economics & Statistics

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- It turns out that rating adjustments have been worse than what economic fundamentals justify for some countries and also more frequently altered, questioning the long-term properties of sovereign ratings.
- The results support the view that rating changes during the Asian crisis have been pro-cyclical rather than counter-cyclical. Omitted variables, such as soundness of banking sector, social and political factors, can be one reason for this misalignment but cannot explain all.

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Sovereign credit ratings

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Quantitative Analysis

Abstract

This paper describes sovereign credit ratings in emerging markets both for a specific year and over time, using quantitative explanatory variables. It turns out that rating adjustments have been worse than what economic fundamentals justify for some countries and also more frequently altered, questioning the long-term properties of sovereign ratings. The results support the view that rating changes during the Asian crisis have been pro-cyclical rather than counter-cyclical. Omitted variables, such as soundness of banking sector, social and political factors, can be one reason for this misalignment but cannot explain all.

Keywords. Dynamic model, panel data, sovereign credit ratings, emerging markets.

JEL Classification Codes. C23, C51, G23

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1. Introduction

Sovereign credit ratings are not "country ratings" but address the credit risk of national governments, not the specific default risk of other issuers, see Beers and Cavanaugh (1998). The Standard & Poor's rating categories are an assessment of the "economy's growth prospects, the government's fiscal flexibility, the government's debt burden, monetary stance, balance of payments flexibility, external debt burden" as well as the government's political risk, see Chambers (1999). Hence, sovereign country ratings are based on a number of macroeconomic fundamental factors as well as some qualitative variables. If this is the case it should be possible to understand the rationale for a specific rating and when it is due for a change by monitoring these factors.

The influence of sovereign credit ratings does, however, stretch beyond government securities as sovereign ratings usually serve as a ceiling for private sector ratings. During the past few years sovereign credit ratings have become increasingly influential, receiving extensive news coverage and affecting both investments and interest-rate spreads, see e.g. Ramcharran (1999). Meanwhile the rating agencies have come under severe criticism for the timing of their downgrades, that is, when a country receives a lower score than it used to have, see for example Larrain *et al.* (1997). The disadvantage of late downgrades is, except for giving late notice to the clients of the rating institute, that they will exacerbate the already negative sentiment for an economy in trouble. An early downgrade on the other hand, taking place before the full-fledged crisis, could dampen the capital inflows and smooth the downturn, see e.g. Reisen and von Maltzan (1999). There are however great risks with early downgrades. Sovereign credit ratings are long-term ratings and the rating agencies are afraid of acting on short-term fluctuations. Due to the strong market impact of rating changes there is a risk that an early downgrade could push a country over the edge into a crisis, while under normal circumstances, i.e. no downgrade, the economy would be able to get back on track. So the accurate timing of a downgrade is important.

The objective of this paper is twofold: The first is to find out to what extent macroeconomic fundamentals can explain the actual rating category for one point in time. The second is to describe the development of the rating categories over time. Hence, two separate models will be constructed: one static and one dynamic. Sovereign credit ratings also consist of a qualitative assessment for each country, which is formed at the time of the rating release. This information is not available and it is not possible to create such a series afterwards, since knowing the answer to all historical uncertainties would only render a biased series. Instead, the econometric methods applied have to take account of the fact that not all variables are included in the estimation. The study will only consider emerging markets.

The result of the first model (static) shows that a small number of macroeconomic variables can explain a major part of the rating categories. The random effects are also important for the good fit as

they capture the country-specific heterogeneity, which is a result of the omitted qualitative variables. It turns out that the influence of certain variables has increased during the sample: interest rate spreads and short-term debt to reserves. These variables are not significant when estimated and evaluated for the full sample but significant when evaluated for a short sample 1998-1999, i.e. after the East Asian crises. Rating adjustments have also been more frequent than what the model suggests, questioning the capability of sovereign credit ratings to be as long-term, forward-looking assessments as they claim to be, see Chambers (1999).

The second model (dynamic) is specified to describe rating changes over time. It performs even better than the static model with higher explanatory power and also better-behaved residuals. The most influential variable is the lagged rating category but the majority of the other variables, transformed into annual changes, are also highly significant. As for the static model the short-term debt to reserves variable is only significant for the very short sample 1998-1999. The result shows that the choice of variables considered when evaluating a country can differ over time as we update our knowledge of what can drive a financial crisis.

The actual rating categories are also compared to a continuous crisis definition, in order to find out whether the rating changes are pro-cyclical or counter-cyclical. That is, whether ratings are worsened when the economy is turning down (pro-cyclical) or if the countries are downgraded ahead of the downturn. This analysis is performed for the 1997 East Asian crisis. Ideally a rating change should occur before a crisis, since that would signal that the situation in the economy is not as good as it used to be, depressing investor sentiment. If the crisis is less severe, not influencing fundamentals, the rating should remain the same unless the long-term outlook has changed. The results in this paper show that rating changes are pro-cyclical; increasing in good times and decreasing in the midst of the crisis. The result can be influenced by the fact that we are using annual observations, but that does not explain all.

The outline of the paper is as follows: in the next section, Section 2, a few results from previous studies will be reviewed. It continues by presenting the choice of indicators that will be included in the specifications. Section 3 is devoted to a discussion on methodological issues starting by discussing the transformation of the rating categories into numerical values and also the choice of estimation methods. The data together with the results of the estimated models can be found in Section 4. Section 5 contains our conclusions.

2. Background

In this section a few studies on sovereign credit ratings will be reviewed and followed by a presentation of the explanatory variables that will be included in this study.

2.1 Previous studies

In a seminal paper Cantor and Packer (1996) make a quantitative assessment of sovereign credit ratings assigned by Moody's Investor Service and Standard & Poor's for a single year: 1995. They find

that a small number of quantitative variables, to a large extent (R^2=92%), are able explain the rating categories. The study is performed for a group of industrial countries and emerging markets. The included criteria are: per capita income, GDP growth, inflation, fiscal balance, external balance, external debt, economic development and default history, all measured as four-year averages. Despite the success in describing ratings in 1995, later studies have found that their results are not robust over time and especially not for the rating changes during the East Asian crisis in 1997/98. This makes sense since the origin of that crisis was different compared to previous ones. It also gave rise to new criteria such as short-term debt, etc.

Ferri *et al*. (1999) claim that the rating agencies aggravated the East Asian crisis by downgrading them more than the deterioration in the economic fundamentals would justify. The economic fundamentals included in their specification are the same as in the Cantor and Packer (1996) study together with short-term debt to reserves since that has been put forward as an influential factor in the East Asian crisis and has since been included in the rating agencies' evaluation (Chambers, 2001). Ferri *et al*. (1999) conclude that the downgrades increased the cost of borrowing capital abroad and shrank the supply of international credit. They also find that rating adjustments are pro-cyclical rather than counter-cyclical.

Mora (2001), on the other hand, suggests that the spreads already increased before the rating change and, hence, that sovereign ratings lag the interest rate spreads, instead of the other way around. She observes that the cost of capital already was high when the downgrades finally occurred but agrees with Ferri *et al*. (1999) that they are pro-cyclical. The bi-causal relationship between interest rate spreads and sovereign ratings is supported by Larrain *et al.* (1997) and Reisen and von Maltzan (1999) who test Granger causality and find a bi-directional causality. They believe that rating changes intensify the boom-bust cycles and support the doubts that rating announcements lead the market.

Monfort and Mulder (2000) explain Standard & Poor's and Moody's ratings changes for both a specific year and over time. They include several explanatory variables: in levels as well as in first differences. They also allow for several lags using a panel data model with a common intercept. The advantage in this study is that they allow for a dynamic specification but the disadvantage is of course difficulties with degrees of freedom when allowing for long lags and many explanatory variables as time series are short. Also, by using a common intercept they do not account for omitted qualitative factors in their econometric specification, which also could be a disadvantage. The paper concludes that rating agencies act pro-cyclically to crisis indicators and that parameters are not stable over time.

There appears to be a consensus that rating agencies are lagging rather than leading economic crises. But these results are based on static models that do not include the latest available rating observation as one of the explanatory variables, which might not be optimal. The dynamic model, see Monfort and Mulder (2000), does not allow for country heterogeneity in that they use a common intercept for all

countries. In this paper I will distinguish between the dynamic and the static specification. Both will, however, allow for country-specific omitted variables.

2.2 Explanatory variables

This study includes the same quantitative indicators as the ones chosen by Cantor and Packer (1996). They proved to be successful in previous studies explaining rating categories (see Section 2.1). The indicators are: *per capita income*: Mirroring the potential tax base in a country and the ability of the government to repay its debt. *GDP growth*: Where a higher growth rate would make the debt easier to service. *Inflation*: Portraying structural problems in government finance, printing money instead of raising taxes to cover its expenses. *Fiscal balance*: Government lacks ability or willingness to tax its citizens, also absorbs private savings. *External balance*: A deficit forces the government to rely on funds from abroad. *External debt to exports/GDP*: If the debt grows faster than exports (or GDP) the risk of default increases.

After the East Asian crisis other explanatory variables were put forward: *Short-term currency debt to foreign reserves*: To measure the liquidity conditions in a country, see Ferri *et al*. (1999). *Export growth:* Where higher export earnings makes the debt default less likely. *Interest rate spreads*: Where increasing spreads mirror the investors' increased risk premium, suggesting debt default being more likely, Mora (2001). The latter suggesting that spreads cause ratings instead of the other way around.

3. Methodology

This section starts by describing how the rating categories are transformed into numerical values and continues by reviewing the econometric methods available for the study. Note that qualitative variables, such as political uncertainty or political issues will not be considered, as discussed in the introduction. This does not imply that they are superfluous in describing the actual ratings but rather that no objective series exist describing such issues, which is why qualitative variables are excluded altogether in this paper.

3.1 Transforming rating categories

The rating categories themselves do not correspond to a particular number and have to be transformed into some numerical value before the econometric analysis can begin. As long as the ordinal nature of data is reflected in the numerical values a BB+, for example, could be any number. Quantifying the rating categories there is a choice between doing a linear transformation, which is most common, see e.g. Cantor and Packer (1996), or a nonlinear one, see e.g. Reisen and von Maltzan (1999). While a linear transformation assumes the distance between the rating categories to be identical, a nonlinear transformation makes them different depending on whether the rating moves from a BB+ to a BB. If a logistic function is applied, the transformation function will be "S-shaped", suggesting that the rating steps in the middle of the span are "larger" than the ones in the tails. Considering that a rating change from investment to speculative grade can increase the difficulties for

a country on the international debt markets it is possible that the distance between the steps are uneven. On the other hand, except for that example, it seems highly unlikely that there is a difference between the categories. Ferri *et al.* (1999) make both a linear and a nonlinear transformation but the conclusions from the models are similar. Moreover, no such difference is said to exist according to Standard & Poor's, see Beers and Cavanaugh (1998), and a linear transformation will be used. The transformation table can be found in Appendix A.

3.2 Methodological issues

The complex nature of ratings observations: discrete, bounded and ordinal also put certain restrictions on the econometric methods applicable. An ordered regression model would appear to be the optimal choice since it is especially designed to deal with bounded, discrete, ordinal data, see e.g. Greene (1993). But this method cannot account for the unobserved country heterogeneity due to the absent qualitative assessment, which is why a different methodology has to be applied. A probit and/or logit model is often applied, see e.g Ferri *et al.* (1999), Mora (2001). This is probably because of the bounded dependent variable. However, the transformation to numerical values left us with sixteen categories, which is quite a lot for a discrete variable; therefore no special treatment should be required for the data's discrete or bounded features, increasing the number of models available. A panel data model is of course the preferred choice because of the few observations and the many countries. By assuming that the omitted variables are country dependent and time independent a fixed-effect panel data model would be appropriate for the estimations. But the fixed-effect model is "expensive" in terms of degrees of freedom which is why it is vital to test whether it significantly improves the explanatory power of the model compared to the common intercept approach. An F-test is calculated to compare the explanatory power of the two models where the null hypothesis is that the two models are equal. For details on this test, see Hsiao (1986). A random effect model could also be considered if the effects are uncorrelated with the explanatory variables. This is unlikely when considering country ratings and omitted qualitative variables, since that would require that they are uncorrelated with the quantitative variables, hence no correlation between i.e. quality of financial system and bank lending. A Hausman test will be performed to choose between specifications. The test is designed to test for orthogonality between the random effects and the regressors, see Greene (1993) using a Chi-square distribution. When there is a significant difference between the two models the regressors are correlated with the random effects and, in that case, a fixed-effect model is estimated.

To achieve the first goal of the paper, describing the actual ratings at a certain point in time, a cross-section study would be sufficient. But given that we not are interested in a particular year a static panel data model is preferred since that will increase the number of observations. In order to attain the second goal of the paper, describing rating changes over time, a dynamic panel data model is estimated. But when a panel data model includes lagged dependent explanatory variables, standard estimation procedures leads to estimators which are often seriously biased in small samples. Kiviet (1995) explores the performance of a series of estimation methods for dynamic panel data models

with a Monte Carlo study. According to this study a model with a high coefficient on the lagged dependent variable and only six observations in the time dimension the OLS estimator is the most efficient. The coefficients of the OLS estimator are biased upwards (positively) but not significantly according to Kiviet (1995). Moreover, for this sample size and the high magnitude of the estimated coefficient of the lagged dependent variable the OLS estimator outperforms the GMM, the Anderson-Hsiao, the instrumental variable and the least square dummy variable according to the root mean squared errors for the estimated coefficients, which is why the former is selected.

4. Results

The study is performed for 38 emerging markets covering data from 1990 to 1999. The countries included are: Argentina, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Dominican Republic, Egypt, El Salvador, Estonia, Hungary, Indonesia, India, Israel, Jordan, Kazakhstan, Korea, Latvia, Lithuania, Malaysia, Mexico, Pakistan, Panama, Peru, Philippines, Poland, Romania, Russia, Slovakia, South Africa, Thailand, Tunisia, Turkey, Uruguay, and Venezuela. The choice of which countries to include is based on data availability and not on any other criteria. Standard & Poor's ratings are used for the left-hand side while World Development Indicators from the World Bank are applied for the explanatory variables, see Appendix B. As data are annual the number of observations is small and fluctuations within the year will be missed. Also, when a rating change occurs during a year the rating observation in the study equals the annual average.

Three separate models will be estimated for both the static and the dynamic specification. The first model, "model 1", uses the same explanatory variables as Cantor and Packer (1996) did except for the dummy variables. The second model, "model 2", adds some variables that have been suggested in later studies, and the third model, "model 3", will include all variables that proved to be influential in the previous two models, being the preferred choice. This model will be the one interpreted when presenting the results and implications of the models.

4.1 The static model: constituents of sovereign credit ratings

In this specification the aim is to describe the actual rating in a particular year, rather than rating changes over time. One of the major difficulties in doing this is to decide on how many years of the explanatory variables that should be considered in the present rating. That is, are the ratings based on an average of several years of observations or is it only the latest observation that matters? According to the rating agencies the ratings are forward-looking, long-term evaluations that see through cyclical behaviour in economic, political, credit and commodity factors, which is why four-year (or longer) averages should be preferable. There is no obvious answer to that question and both scenarios have been applied: Cantor and Packer (1996) using four-year averages while Ferri *et al.* (1999) and Mora (2001) consider solitary years. In order to find out which scenario is preferable both specifications have been estimated for this study[1]. The explanatory power is slightly higher for the model using four-

[1] Results are not presented here but can be given upon request.

year averages but there are no conspicuous differences between the two considering variables included or their signs, so single-year observations are chosen because of a scarcity of data.

The first model consists of the explanatory variables of the Cantor and Packer (1996) model except for the dummy variables "Indicator for economic development" and "Indicator for default history", which are excluded. As mentioned above and in the introduction many qualitative aspects that affect the ratings are disregarded and instead of including dummies for a few of these features a panel data model with fixed or random effects will be applied. Hence, dummy variables are avoided altogether. As the aim is to describe sovereign ratings in general rather than focusing on a particular year, the full sample is used for the estimations. A random effect model is specified, the modelling procedure is described in Section 3, and the results are presented in the first column of Table 1 (p. 17): "S-model 1". The adjusted R^2 is high and equals 86% with a standard error barely exceeding one notch. This result is largely due to the random effects that mirror country-specific information not captured by the explanatory variables, and could be factors we had to disregard because of data difficulties. The current account enters significantly but with an unexpected negative sign. This is a common result, see e.g. Mora (2001), and the reasoning is usually that some countries can "afford" a negative current account being generally well managed and in an overall good shape. However, looking at the data, there is a strong and clear negative correlation between rating downgrades and an improved current account for a majority of the Asian countries from 1996 - 97 and onwards. The econometric model captures this and interprets it as if a negative current account itself would improve the rating. In the Cantor and Packer (1996) study CA/GDP did not enter significantly. Except for that the indicators enter with the expected signs and all are significant on a 10% significance level.

In the second model more explanatory variables are allowed in order to find out if they can improve the understanding of sovereign credit ratings. The variables are: debt to exports, export growth, short-term debt to reserves and LIBOR interest rate spreads. All have been suggested in previous studies, see e.g. Ferri ***et al.*** (1999)[2] and Standard & Poor's, Chambers (1999). Due to a high correlation between the debt variable and the debt to export variable, the debt variable was excluded in this set-up. The results of this model can be found in the second column in Table 1 (p. 17): "S-model 2". None of the new variables enter significantly except for the debt to export variable. Moreover the explanatory power of the model is not improved. This is puzzling given that short-term debt to reserves was an important indicator for the East Asian crisis and other studies have shown its importance using different sample. Cutting out the sample, allowing for only 1998 - 1999: "S-model 2a" in Table 1, short-term debt to reserves does enter with the right sign and is significant. The spread is also close to entering significantly. However, when euro spreads are used, for a much smaller sample, they do enter significantly[3]. The major problem when including spreads is the short series available since they have to be transformed into annual numbers. The explanatory power of the model should not be taken too seriously: it is only due to the short sample.

[2] Euro spreads were initially included but they only cover a few countries and are only available for a short time span, which is why LIBOR spreads are applied. Slight improvement.

The conclusion is that both spreads and short-term debt to reserves are important factors in sovereign country ratings and are therefore included in the final model specification. The result of this model can be found in the last column: "S-model 3", in Table 1. The current account still enters with a negative sign but is not significant. All other variables enter with the expected sign but not all of them enter significantly.

As can be seen from the model evaluation below each model in Table 1, the Durbin Watson statistic of first order serial correlation indicates a misspecified model. This can be due to omitted variables or nonlinearity, for example. The result makes sense in that it seems highly unlikely that the country analysts at Standard & Poor's update sovereign credit ratings without looking at last period's rating category, especially given the long-term aspects of ratings. Hence, a dynamic model where the latest available rating observation is included is more plausible and this will be explored in the next section, 4.2. But given that most studies which aim at exploring sovereign credit ratings use a static approach, it is included here for comparability.

The residuals are plotted in Figure 1 (p. 19) sorted by country (alphabetically) and over time. The residuals are generally in the neighbourhood of within 1 notch. However, there are some extreme events where the model over- or underestimates the rating categories. In the former part of Figure 1 the conspicuous positive biases are due to Indonesia 1994 - 1997, where the model constantly under-predicts the actual ratings, indicating that the country is overrated with respect to fundamentals. The large negative residuals that follow immediately after that also refers to Indonesia, but for 1998 – 2000. The errors amount to at least four notches, and it appears as even though the model suggested a downgrade it cannot capture the magnitude of it. In the middle of Figure 1 there is another conspicuous negative peak that is due to the Korea downgrade in 1998 and a little later there is another one, which refers to the Philippines, 1998. Also for these countries the model suggests a downgrade but does not capture the magnitude of it.

The fitted values of "S-model 3", the preferred model specification, are plotted against the actual rating numbers in Figure 3 (p. 19). If the model could predict the rating categories perfectly, the observations would be a thin diagonal line. The "thicker" the line, the worse the mistakes. Generally they are in the neighbourhood of this line but it is not perfect. The largest discrepancies refers to Korea 1998, point (15,19) and Indonesia 1998, point (10,15).

Some of the "badly behaving" countries from each of Asia, Latin America and Eastern Europe are discussed at some length in the following. Generally the estimated static model detects the overrated Asian countries in the middle of the 1990s with one or two notches, with the results for Korea displayed in Figure 3 (p. 19). The country was upgraded in 1994 but this was not because of an improvement in the macroeconomic fundamentals, which is why the rating of the model does not

[3] Results are not presented here but can be provided on request.

change. Both the actual rating as well as the model estimates decreased during 1997, the model smoothly and the rating institute sharply. In 1998 there is a discrepancy of four notches between the two. In 1999 the model rating deteriorates further while Standard & Poor's (S&P) update the country, making the difference smaller, one notch, the model still having the positive view. After that both the S&P and model estimates improved the view on Korea. Hence, it appears as if S&P overreacted in its rating adjustments. Also, the adjustments are too frequent to be interpreted as a long-term country assessment, which is said to be the objective according to S&P, see e.g. Chambers (2001). The development in Thailand is quite different, see Figure 4 (p. 19) where the model results in a higher rating than S&P at the beginning of the sample. However, the model's good opinion of Thailand deteriorates from 1991 onwards. The two are equal in 1994 where S&P upgrades Thailand further while the model suggests a further decline. In 1996 the divergence amounts to two notches, S&P taking the positive view, and in 1998 it is one notch, the model being the positive part. Again in Figure 5 (p. 20) the rating history for Indonesia is displayed. The S&P has a more optimistic view on the country until 1997/98 when it turns more negative compared to the model estimates. In 2000 the model supports a higher rating than S&P but this might be the result of omitted qualitative factors given that the political situation within the country is quite turbulent. Hence, it appears as if the estimated model is less volatile than the actual rating, which usually is the case for modelled series compared to real. However, the discrepancies are large and quite frequent, questioning the validity of S&P ratings being the long-term, forward-looking estimates they claim to be.

In Argentina the model initially over-predicts the rating, which might be due to the late effect of the Mexican crisis 1994, Figure 6 (p. 20). But for 1999 and 2000 the model is suggesting that the country is overrated since the discrepancy between the two exceeds one notch. In Russia, Figure 7 (p. 20), the rating decreased five notches between 1997 and 1999, when it reached its minimum. The fundamentals suggested that the country was overrated in 1997, and underrated in 1999 compared to the model estimates. However, for 2000 both are in the same neighbourhood. The results of the Czech Republic can be found in Figure 8. The actual rating and the model estimate are generally quite close. The exception is in 1995 where the model suggests that it is undervalued at 1.5 notches. In 1996 the model estimates were stable while the country got an upgrade, suggesting that the model has some predictive power.

Generally it appears as if the Cantor and Packer (1996) indicators still hold in that they are able to explain a major part of the sovereign credit ratings. It also turns out that the model improves further when the "new" variables, whose importance was obvious during the East Asian crisis (1997), are included. Also, the random effects are vital for the good performance of the model allowing for country heterogeneity. Furthermore, the model appears to be more forward-looking than S&P for this short sample.

4.2 The dynamic model: development of sovereign credit ratings

When discussing changes or developments in sovereign credit ratings the latest available rating for a specific country is usually an important factor. Disregarding the time-series structure of the data might not be optimal when choosing the econometric method, in particular since there is a lot of information captured in the last period rating. Moreover, ratings are long-term assessments and do not change between the years on a regular basis. Unfortunately the sovereign credit ratings for emerging markets are a rather new phenomenon and, as mentioned in Section 3, the time series are generally short. However, cross-sections are large and the total number of observations adequate.

In this set-up it is assumed that all information is efficiently used in the last year country rating assessment, which is why lags of the dependent variables should be superfluous in the model[4]. Rating changes should therefore only occur when there has been a change in the explanatory variables. Hence, all indicators enter contemporaneously in first differences (annual changes). The modelling procedure is the same as for the static model, see Section 4.1, where the first model includes the indicators suggested by Cantor and Packer (1996), except for the dummies. A random effect model is estimated and the results can be found in Table 2 (p. 18), first column: "D-model 1". As expected the most important variable in this specification is last year's rating category, which enters with a high coefficient (0.92) and significantly. The inclusion of the lagged rating variables also makes the random effects less influential, since a majority of the country specific features are captured in the old rating. Annual changes in current account to GDP enter with a negative sign and is significant on 10%, a discussion on the negative sign of this coefficient can be found in Section 4.1. Annual changes in external debt, fiscal balance and annual growth in GDP do not enter significantly while rate of change of inflation and annual growth in GDP per capita enters significantly and with the expected signs. The explanatory power is higher and the model is better behaved than the static model as there is no error autocorrelation.

In the second model, "D-model 2" in Table 2, more explanatory variables are included. These are the variables that are said to be more influential after the East Asian Crisis. And indeed, none of them enter significantly unless the sample is cut to only include 1998 - 1999. For this sample the annual growth in short-term debt to reserves turns significant. The change in spreads does not enter significantly, which is different from the results of "S-model 2a" in Table 1 as well as the results in Mora (2001). However, none of these models are dynamic.

In the final and preferred specification, "D-model 3", the annual change in interest rate spreads and export growth are excluded together with growth in the external debt, since they have not entered significantly in any of the previous specifications.

[4] This is unfortunately not the case. A few of the dependent variables enter significantly when last year rating is included in the specification. Results are not shown here. However, previous changes in these variables have not been powerful enough to create a rating change earlier which should affect how well reflected they are in the ratings.

The residuals are displayed in Figure 9 (p. 21) and the three of the major peaks that is conspicuous in the static model are distinct here as well, they are Indonesia, Korea and the Philippines 1998. This implies that the model does not get the magnitude of the rating changes, just like the static model. The plot of rating forecasts by the dynamic model compared to the actual ratings look better than for the static model, see Figure 10 (p. 21), as it is slimmer. The observations are closer together compared to the observation in Figure 2, and the spread is not as big as it was for the others specification.

For a closer look at the ratings and the dynamic model estimates for a few countries see Figures 11 – 12 (p. 21): Argentina and Venezuela in Latin America; Figures 13 – 14 (p. 22) show Czech Republic and Hungary in Eastern Europe and Figures 15 – 16 (p. 22) Korea and Thailand in Asia. In Argentina the model suggests an upgrade in 1996 and an upgrade did occur in 1997. The same thing happened in 1997 when the model once again suggested an upgrade, which took place in 1998. However, in 1998 the model suggested that a downturn was imminent implying an overrating in 1999. A downgrade came about in 2000. Hence, for this case the model performs very well and also supports the idea that rating agencies are slow in changing the ratings as they do not want to act on short-term fluctuations. In Venezuela, displayed in Figure 12 and chosen because of its long time series, the rating and the model are usually quite close. The model is more volatile than the rating, which is expected since ratings are long-term and are meant to see through business cycles. The largest discrepancy was in 1997, exceeding one notch, the model having the positive outlook. However, Venezuela got upgraded and the difference is less than half a notch after that.

The model performs well in explaining the rating adjustments for the Czech Republic, see Figure 13, but is lagging rather than leading the actual rating changes except in 1997. However, discrepancies are small, less than one notch. Looking at Hungary, Figure 14, the model follows the rating closely, indicating that the opinion of Standard & Poor's and the econometric model agree.

In Korea, Figure 15, the model shadows the rating, as the high coefficient of the lagged rating makes any over- or underrating (compared to macroeconomic fundamentals) feed into the model forecast. However, the model captures the downgrade in 1998 but, as noted before, the rating minimum is not met by the model. Instead it is flattened out, suggesting that the downgrading was too sharp. Korea got upgraded in 1999 and again in 2000, again supporting that the rating downgrade was too harsh. In Thailand, Figure 16, the model estimates also lag the rating. The model does suggest a slower downgrade than what really occurred but both are equal in 1999, suggesting that the rating institute was forward-looking.

In this section a dynamic model has been estimated to explain sovereign rating developments over time. This model is better specified than the static one as it has a higher explanatory power and also no error autocorrelation. As for the static model the dynamic model manages to capture the downgrades but underestimates the magnitude of them, at least for the East Asian countries in

1997/98. There is also support for the view that rating adjustments are late, rather than forward-looking, using Argentina as an example. However, whether rating adjustments are early or late when it really matters, i.e. in crisis times, will be further explored in the next section.

4.3 Are ratings forward-looking?

As stated earlier, credit ratings are long-term assessments based on economic fundamentals. This implies that they should react before a crisis or when the effect of the crisis influences the fundamentals. Also, because of the ratings' forward-looking properties countries should be downgraded ahead of a crisis if the crisis is so severe that it will affect the macroeconomic fundamentals. To evaluate whether this holds the ratings are plotted against a continuous crisis index consisting of high, out-of-the-ordinary exchange-rate and interest-rate events, see Eliasson and Kreuter (2001) for a complete description. The crisis measure is generated by a maximum value of exchange rate returns, interest rate increases or a high level of the latter. The index is created on a monthly basis but transformed into annual data using the mean of the year, just like the S&P ratings. Figures 17 – 20 (p. 23) depict Indonesia, Korea, Malaysia and Thailand respectively. The dashed line indicates the crisis index and the solid line the S&P rating category.

For both Indonesia and Korea, Figures 17 and 18 respectively, the crisis indicator is rising while the ratings are falling, hence, the S&P is acting in the midst of the crisis downgrading the two. In Malaysia and Thailand, see Figures 19 and 20, the rating and the crisis indicator increase simultaneously up to 1997, when both variables begin to decrease. In this case it appears as if the downgrade is taking place when the worst of the crisis is over. This result can be due to the transformation of the crisis index since the peaks are smoothed. However, the results support the view that ratings are pro-cyclical rather than counter-cyclical, see Ferri et al. (1999). In all cases above, the crisis index is increasing or has begun to fall when the downgrade occurs.

5. Conclusions

In this paper S&P sovereign credit ratings have been described in both a static and a dynamic framework using solely macroeconomic indicators as explanatory variables. No qualitative variables are included as there are no objective time series fully capturing the socio-political situation in the countries, which is why a random-effect panel data model is applied as it allows for country-specific omitted variables. It turns out that a few variables can explain a major part of the constituents as well as the development in the rating categories. The results show that the actual rating adjustments have been more volatile than economic fundamentals would justify. Moreover, the rating adjustments appears to be pro-cyclical rather than counter-cyclical compared to both a crisis index as well as to the economic fundamentals.

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Appendix A

The linear transformation of the rating categories into Arabic numbers are displayed below.

	Ratings	Numerical value
Investment-Grade Ratings		
Highest quality	AAA	25
High quality	AA+	24
	AA	23
	AA-	22
Strong payment capacity	A+	21
	A	20
	A-	19
Adequate payment capacity	BBB+	18
	BBB	17
	BBB-	16
Speculative-Grade Ratings		
Likely to fulfil obligations Ongoing uncertainties	BB+	15
	BB	14
	BB-	13
High risk obligations	B+	12
	B	11
	B-	10
	CCC+	9
	CCC	8
	CCC-	7
	CC+	6
	CC	5
	CC-	4
	C+	3
	C	2
	C-	1

Appendix B

Countries included

The ratings data are from Standard & Poor's covering the period 1990 – 2000. The countries are chosen due to the length of their rating series, rather than anything else. The countries included in the estimations are: Argentina (ARG), Brazil (BRA), Chile (CHL), China (CHN), Colombia (COL), Croatia (HRV), Czech Republic (CZE), Egypt (EGY), Estonia (EST), Hungary (HUN), Indonesia (IDN), India (IND), Israel (ISR), Jordan (JOR), Kazakhstan (KAZ), Korea (KOR), Latvia (LVA), Lithuania (LTU), Malaysia (MYS), Mexico (MEX), Pakistan (PAK), Peru (PER), Philippines (PHL), Poland (POL), Romania (ROM), Russia (RUS), Slovakia (SVK), Thailand (THA), Turkey (TUR), Taiwan (TWN), Uruguay (URY), and Venezuela (VEN).

Data source: World Development Indicators 2001, World Bank

Current account balance (% of GDP) (BN.CAB.XOKA.GD.ZS)
External debt, total (DOD, current US$) (DT.DOD.DECT.CD)
Exports of goods and services (current US$) (NE.EXP.GNFS.CD)
GDP per capita (constant 1995 US$) (NY.GDP.PCAP.KD)
GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)
Inflation, consumer prices (annual %) (FP.CPI.TOTL.ZG)
Short-term debt (% of total external debt) (DT.DOD.DSTC.ZS)
Net international reserves (excludes gold, current US$) (FI.RES.XGLD.CD)
Overall budget deficit, including grants (% of GDP) (GB.BAL.OVRL.GD.ZS)
Total debt service (% of exports of goods and services) (DT.TDS.DECT.EX.ZS)
Exports of goods and services (annual % growth) (NE.EXP.GNFS.KD.ZG)
Interest rate spread (lending rate minus LIBOR) (FR.INR.LNLB)

Table 1: Results of the static panel data model

Variables	S-model 1	S-model 2	S-model 2a	S-model 3
Current account to GDP $_{t-1}$	-0.065*** (0.024)	-0.069*** (0.026)	-0.077*** (0.026)	-0.019 (0.028)
External debt$_{t-1}$	-1.84 E-11*** (4.92 E-12)	----	---	-1.72 E-11*** (5.62 E-12)
Fiscal balance $_{t-1}$	0.086* (0.048)	0.13** (0.054)	0.0012* (0.066)	0.12** (0.051)
GDP per capita $_{t-1}$	0.00028* (0.000147)	-0.000079 (0.00013)	0.00032* (0.000142)	0.00026 (0.000165)
GDP annual growth$_{t-1}$	0.084*** (0.025)	0.064** (0.029)	-0.025 (0.036)	0.077*** (0.026)
Inflation$_{t-1}$	-0.0011* (0.00063)	-0.035* (0.010)	-0.028** (0.013)	-0.025** (0.00063)
External debt to export $_{t-1}$		-0.64** (0.27)	-0.59* (0.32)	---
Export growth$_{t-1}$		0.0078 (0.011)	0.014 (0.10)	---
Short-term debt to reserves$_{t-1}$		-0.00026 (0.0010)	-0.012*** (0.0022)	-0.00044 (0.00092)
Spread$_{t-1}$		0.013 (0.0092)	-0.028 (0.019)	-0.19 (0.013)
Intercept	15.07*** (0.64)	17.05*** (0.82)	16.31*** (0.83)	16.30*** (0.77)
	Random effects	Random effects	Random effects	Fixed effects
Total panel observations:	215	182	60	171
Observations:	11 [1990-2000]	11 [1990-2000]	2 [1998-1999]	11 [1990-2000]
Cross sections:	38	32	32	32
Adjusted-R^2:	0.86	0.86	0.99	0.87
Standard error:	1.09	1.03	0.24	1.00
Durbin Watson:	1.28	1.38	4.01	1.32
F-statistic fixed effects:	27.20***	23.22***	---	34.68***
Hausman-test random effects:	5.68	3.87	---	1.27

*Note: *, **, *** refers to 10%, 5%, 1% level of significance respectively.*

Table 2: Results of the dynamic panel data model

Variables	D-model 1	D-model 2	D-model 2a	D-model 3
Δ(Current account to GDP)$_t$	-0.061* (0.026)	-0.079*** (0.027)	-0.092** (0.040)	-0.071** (0.040)
Δ(External debt)$_t$	4.25 E-12 (1.02 E-11)	---	---	---
Δ(Fiscal balance)$_t$	-0.013 (0.044)	0.025 (0.048)	-0.019 (0.072)	-0.035 (0.045)
Δ(GDP per capita)$_t$	0.0028** (0.00058)	-0.0025*** (0.00054)	-0.0023*** (0.00071)	0.0021*** (0.00072)
Δ(GDP annual growth)$_t$	-0.026 (0.022)	-0.066** (0.025)	-0.062** (0.032)	-0.059** (0.027)
Δ(Inflation)$_t$	-0.020** (0.0067)	-0.040* (0.0090)	-0.052* (0.012)	-0.039*** (0.0087)
Δ(External debt to export)$_t$	---	-1.45*** (0.42)	-1.19** (0.58)	-1.64*** (0.42)
Δ(Export growth)$_t$	---	0.0012 (0.0076)	0.0035 (0.011)	---
Δ(Short-term debt/reserves)$_t$	---	0.00046 (0.00063)	0.0061* (0.0036)	0.00021 (0.00060)
Δ(Spread)$_t$	---	0.018 (0.015)	-0.030 (0.026)	---
Rating$_{t-1}$	0.92** (0.048)	-0.64** (0.27)	-0.93*** (0.076)	-0.96*** (0.045)
Intercept	0.79 (0.75)	1.19* (0.64)	0.64* (1.17)	0.34 (0.69)
	Random effects	Random effects	Random effects	Random effects
Total panel observations:	143	122	50	127
Observations:	9 [1991-1999]	9 [1991-1999]	2 [1998-1999]	9 [1990-1999]
Cross sections:	35	29	28	32
Adjusted-R^2:	0.93	0.92	0.95	0.94
Standard error:	0.81	0.78	0.57	0.77
Ljung- Box Q test: 1 lag	---	---	---	
2 lags	---	---	---	
3 lags	---	---	---	
4 lags	---	---	---	---
F-statistic fixed effects:	5.45**	4.36***	---	4.31***
Hausman-test random effects:	0.064	1.17	---	6.77

*Note: *, **, *** refers to 10%, 5%, 1% level of significance respectively.*

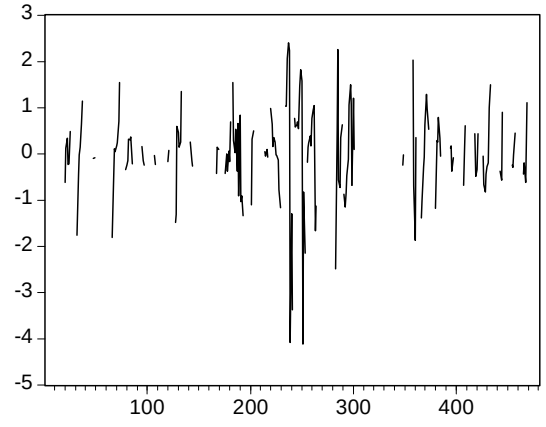

Figure 1: Residuals of the random effect static panel data model: S-model 3.

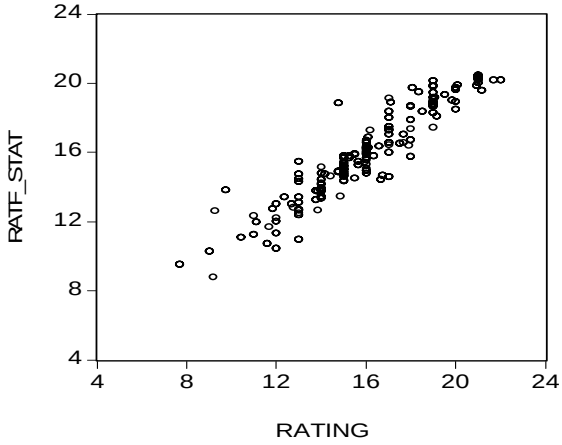

Figure 2: Plot of actual ratings vs. forecasts of the static panel data model: S-model 3.

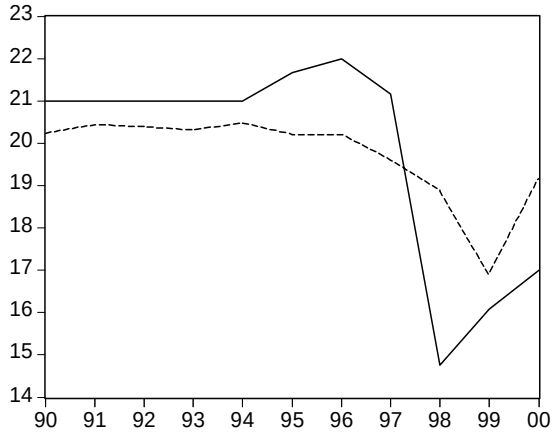

Figure 3: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Korea, 1990-2000**.**

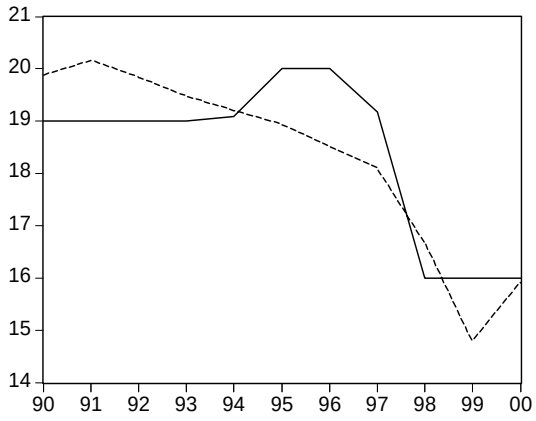

Figure 4: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Thailand, 1990-2000.

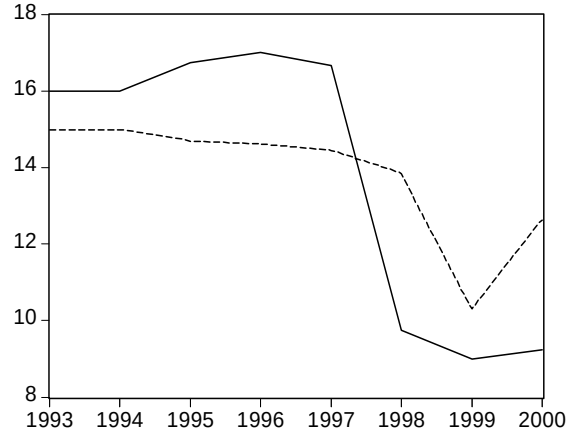

Figure 5: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Indonesia, 1993-2000.

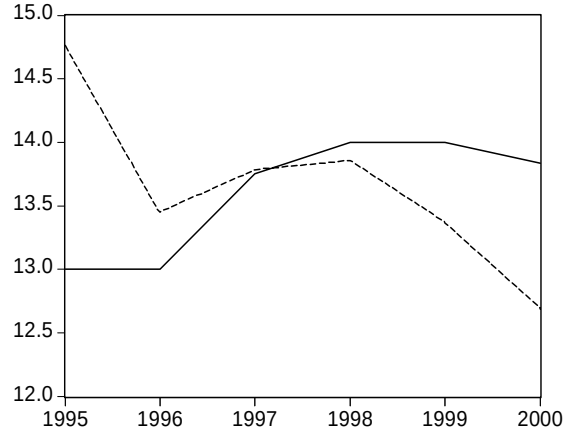

Figure 6: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Argentina, 1994-2000.

Figure 7: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Russia, 1993-2000.

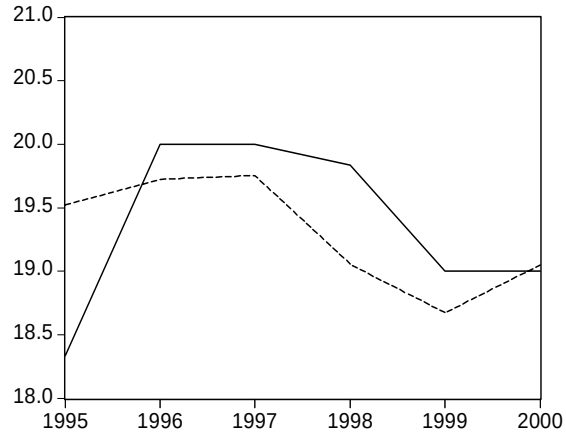

Figure 8: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Czech Republic, 1994-2000.

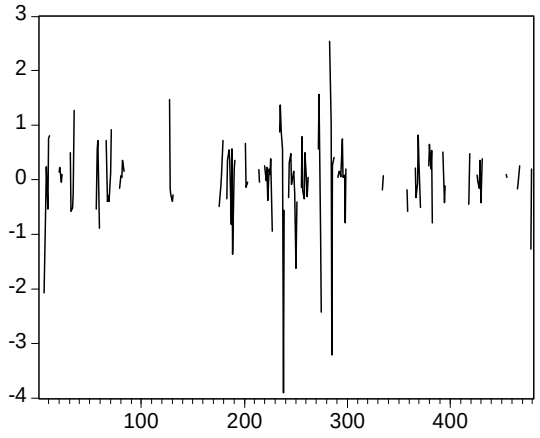

Figure 9: Residuals of the random effect dynamic panel data model: D-model 3.

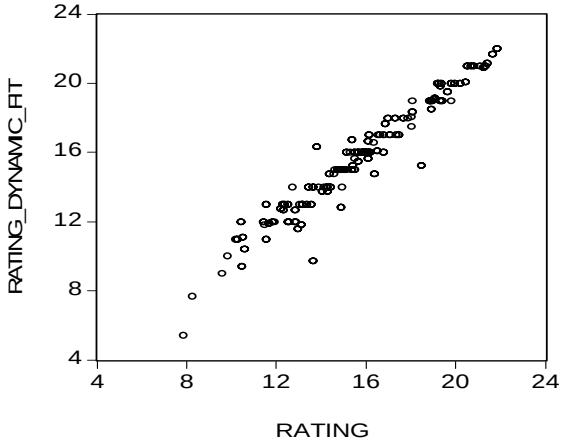

Figure 10: Plot of actual ratings vs. forecasts of the static panel data model: D-model 3.

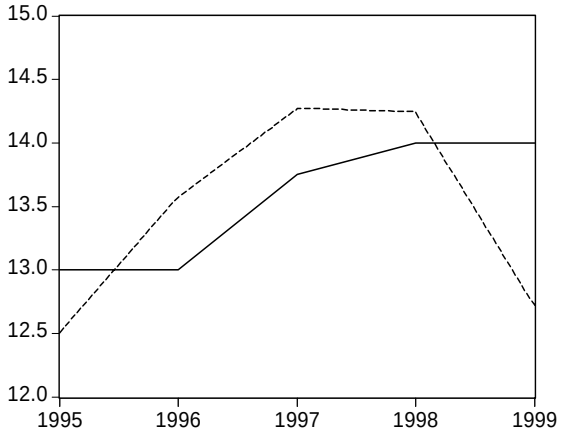

Figure 11: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Argentina, 1995-1999.

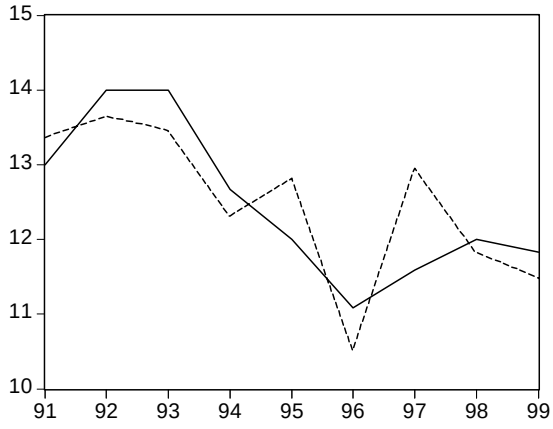

Figure 12: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Venezuela, 1991-1999.

Figure 13: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Czech Republic, 1995-1999.

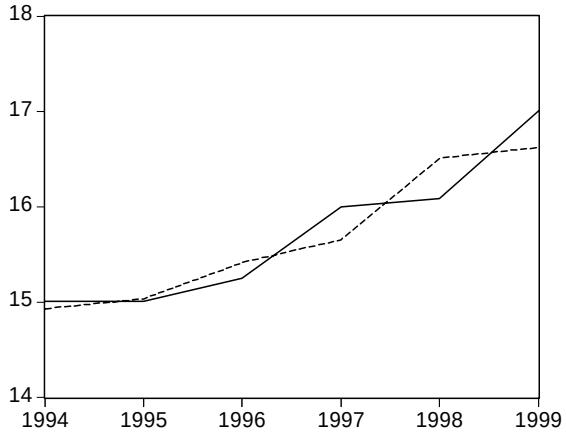

Figure 14: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Hungary, 1994-1999.

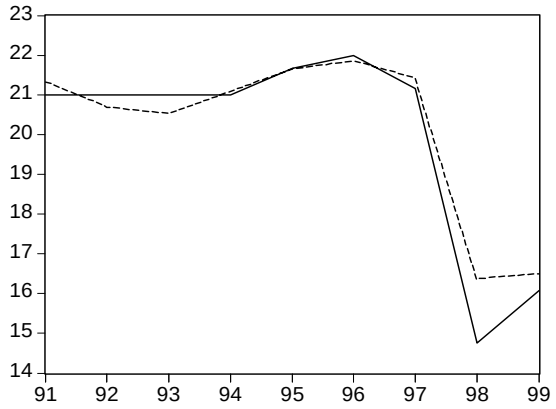

Figure 15: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Korea, 1991-1999.

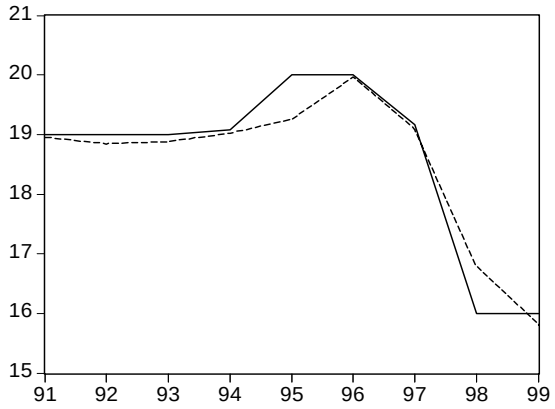

Figure 16: The observed ratings (solid line) and the estimated ratings for the static model (dashed) for Thailand, 1991-1999.

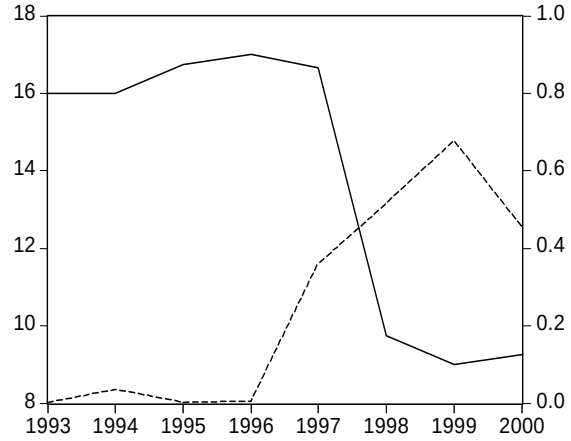

Figure 17: The observed rating (solid line) and the crisis indicator (dashed) for Indonesia, 1993-2000.

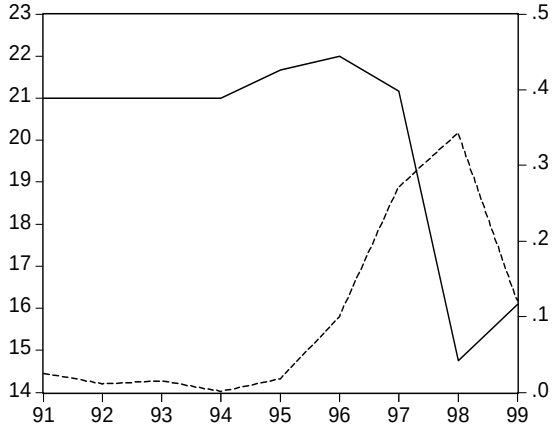

Figure 18: The observed rating (solid line) and the crisis indicator (dashed) for Korea, 1990-2000

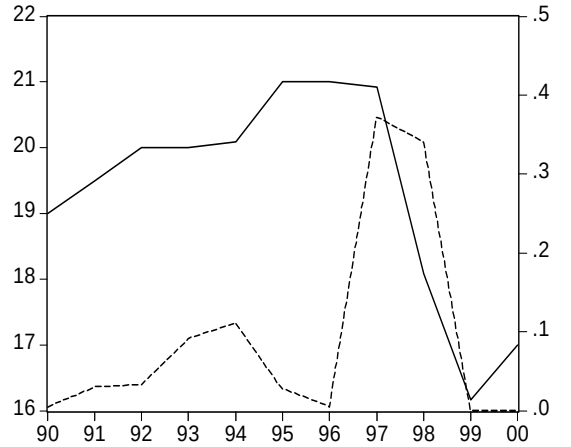

Figure 19: The observed rating (solid line) and the crisis indicator (dashed) for Malaysia, 1990-2000

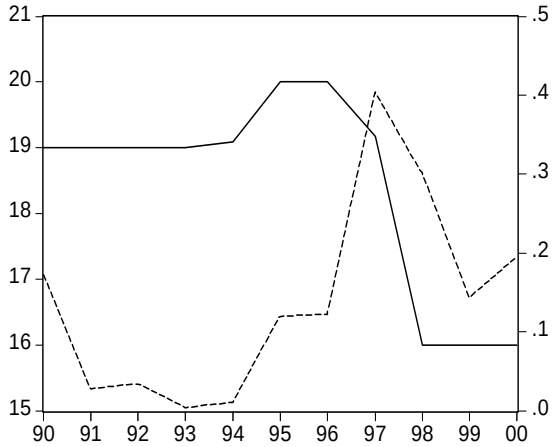

Figure 20: The observed rating (solid line) and the crisis indicator (dashed) for Thailand, 1990-2000

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