# *Basel 2 in Emerging Countries: "The Case of two Eastern European Banks"*

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**For the readers notice: Bank names are hidden for confidentiality reasons.**

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***Abstract***

*The objective of my dissertation is to evaluate the change in the capital requirements of emerging country bank commercial portfolios after the implementation of the new Basel Accord. A detailed discussion of the possible impact of the proposed Basel 2 guidelines to emerging countries is followed by the calculation of capital requirements for credit and operational risks. To perform my simulation analysis I used data from two Eastern European banks and I find that the capital requirement for the commercial segment can go up to 16-17% for Bank P, and 11-12% for Bank K under the IRB-F approach. These results show that emerging country banks might reduce the commercial lending and increase the less risky assets in their portfolios to lessen the capital requirements.*

# 1. INTRODUCTION

Eligible provisions are taken by banks in order to cover the expected losses, whereas capital[1] acts as a buffer, which enables banks to survive when adverse events that lead to unexpected losses occur. In that sense determination of the minimum regulatory capital is a fundamental issue for banks and supervisors. In fact, capital standards were introduced as a self-controlling mechanism (banks would manage their portfolio through controlling the risk-weighted capital ratios) to complement the deposit insurance system that is a guarantee given by governments.

The global banking systems had lacked a mutually agreed (banks and supervisors) capital standard till the introduction of Basel 1 by the Basel Committee[2] that was an official start to reply to the concerns about bank capital at the time. Therefore, it has been considered to be the first evidence of global capital standards for internationally active banks to act as a cushion against their increasing risk profiles. Initially Basel 1 aimed to regulate the capital measurement and capital standards in the founder countries, but it was then implemented by over one hundred countries. Following its some of the important banking system ratios had changed substantially. For instance, the table below shows that Tier 1 and total capitalization ratios (both ratios calculated over risk-weighted assets) of banking systems worldwide had improved in the post Basel 1 era (following the implementation of the Accord) whereas ROE decreased worldwide on average after the implementation

[1] Economic capital is usually defined as the capital level that is required to cover the bank's losses with a certain probability or confidence level. Regulatory capital is the minimum capital required by the regulator. As noted by Allen (2006), "the two concepts reflect the needs of different primary stakeholders. For economic capital, the primary stakeholders are the bank's shareholders, and the objective is the maximization of (their) wealth. For regulatory capital, the primary stakeholders are the bank's (depositors), and the objective is to minimize the possibility of loss."

[2] The Basel Committee on Banking Supervision was founded by the central bank governors of the G10 countries and Luxembourg in 1975.

of the accord. Based on that, the total capital ratio rose from 14.45% to 15.37% while Tier 1 ratio increased by 2.71% in the post Basel 1 era. On the contrary, ROE reduced worldwide by almost 3.6% after Basel 1 (although there is no explicit impact of Basel 1 on ROEs).

**Table 1**

Pre and Post Basel banking system ratios globally (pre and post Basel periods separated by the Basel 1 implementation year between 1987 to 2000)

| (%) | Total Capital Ratio | | Tier 1 Ratio | | Return on Average Equity | |
|---|---|---|---|---|---|---|
| | Pre-Basel | Post-Basel | Pre-Basel | Post-Basel | Pre-Basel | Post-Basel |
| Africa | 15.35 | 22.36 | 11.93 | 12.48 | 18.95 | 18.86 |
| Asia | 11.13 | 12.10 | 7.62 | 8.67 | 7.19 | -4.57 |
| Europe | 16.14 | 16.38 | 9.78 | 11.76 | 13.85 | 10.26 |
| Middle East | 20.56 | 17.30 | 13.05 | 15.47 | 14.86 | 12.53 |
| US and Canada | 3.21 | 12.45 | 2.42 | 10.01 | 9.15 | 12.71 |
| Latin America & Caribbean | 13.67 | 18.03 | 11.27 | 12.50 | 14.62 | 7.39 |
| World average | 14.45 | 15.37 | 8.09 | 10.80 | 12.56 | 8.99 |
| Number of observations | 1182 | 4374 | 518 | 3098 | 4581 | 11400 |

*Source: Barajas, A., Chami, R., and Cosimano, T. (2005).*

Following the introduction of the Accord, many scholars, bankers and supervisors around the world contributed to the improvement of the capital standards regulation. In the late 90s the Basel Committee presented its first consultative paper which was followed by two others (CP2 and CP3) and finally, Basel 2 was proposed in June 2004 of which an updated version was published in June 2006.

## 1.1 Objective of this study

Basel 2 requires banks to hold the adequate amount of capital for the absorption of unexpected losses. Capital is very crucial during financial downturns as it might prevent bankruptcies as well as banking crises. In this sense, the adoption of the Accord is more

critical in emerging countries[3] where banking crises are known to be more costly than in developing countries. Caprio and Honohan (1999) show that in the 59 banking crises in emerging countries, the average cost to the economy was over 9 % of the GDP, whereas in 10 banking crises in developed countries the average cost was about 4% of the GDP. This cost can be exacerbated by a reduction in commercial lending causing a sharp decline in economic activity. Such an impact will be more detrimental in emerging countries where the capital markets are not as developed as in the developed ones. In the literature this decline in credit availability or a leftward shift in the credit supply curve is known as credit crunch. Below I explain two causes of credit crunch that are widely studied.

Following Basel 1, many scholars investigated the impact of it on bank lending[4]. Their purpose was to find whether Basel 1 constrained banks to reduce commercial lending (corporate and SME corporate asset classes are more risky than sovereign asset class in general) in order to meet the regulatory capital ratio *(the first possible cause of credit crunch)*. According to Basel 1, a bank that moves its asset holdings from commercial loans with a full 8% capital requirement to government securities with no capital requirement eases the associated regulatory burden. This gave banks, that were poorly capitalized, an incentive to increase the government securities in their portfolios. For

[3] There is not a unique list of emerging countries. According to Bloomberg page on emerging markets, the set includes any country with a nascent stock and bond markets, as well as small economies. On the other hand the World Bank definition of developing country is the one defined by a GDP per head of less than $9200 based on 1999 figures. In general, a common characteristic shared by the emerging countries is that they all possess an elevated degree of "macroeconomic weaknesses" that manifests itself into a high level of denominated "country risk" which is the additional return requested by an investor in order to put his money in these countries.

[4] Brinkmann and Horvitz (1995); Berger and Udell (1994); Peek and Rosengren (1995); Hancock and Wilcox (1994); Haubrich and Wachtel (1993); Rime (2000); Honda (2002); Ediz, Michael, and Perraudin (1998); Ito and Sasaki (1998); Chiuri, Ferri, and Majnoni (2002); Barajas, Chami, and Cosimano (2004) all investigated the reduction in corporate lending (credit crunch) after Basel 1 implementation.

instance, Furfine (2001) shows that in the U.S the share of commercial loans as a percent of total assets decreased to 16% in 1994 from 22.5% in 1988 (the year that corresponds to the proposal of Basel 1) while the share of U.S. government securities as a percentage of total assets increased sharply from 15% to 25% over the above period. On the other hand, Rime (2000) investigates the credit crunch in a non-recessionary period and do not find any decrease in the commercial lending following the Basel 1 implementation.

In the following years the Basel Committee published Basel 2 that would bring –if implemented- several implications one of which is the procyclicality *(the second possible cause of credit crunch)* that is realized due to external and internal ratings usage[5]. This impact becomes more intense during recessions when rating migrations occur more frequently due to banks downgrading client ratings that lead to an increase in risk weighted assets. As a matter of fact, commercial lending may be reduced to meet the required capital ratios.

Among the two above discussed causes of credit crunch, I will investigate the first one that is the possible reduction in commercial loan supply due a change in capital standards (the possible substitution of Basel 1 with Basel 2) by performing a simulation. For that purpose, the data is made available by Parent Group -established in Italy- that has an increasing market share in Central and Eastern Europe. More specifically, I use the data of Parent Group owned Bank P (Poland) and Bank K[6] (Turkey). These banks are selected for the analysis due to the availability of data and the size of commercial loan portfolios with respect to the others owned by Parent Group in the region (data of the recently

[5] Amato and Furfine (2004); Ayuso, Perez, and Saurina (2004); Segoviano and Lowe (2002); Kashyap and Stein (2004); Altman and Saunders (2001); Resti (2002) investigate the procyclicality effects of internal and external ratings.

[6] In September 2006, Bank K has been acquired by another group bank established in Turkey.

acquired banks is not available). As shown in Table 2 below, since the year 2000, Poland and Turkey have been experiencing solid GDP growth rates[7]. In addition, the change in real personal disposable income and the change in retail sales growth figures prove that currently there is no evidence of a recession. Finally, figures also show banking loan volumes growing which indicate an increasing demand.

**Table 2**

Banking and macroeconomic indicators in Poland and Turkey (2000-2005)

| Series name | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|
| GDP per head ($ at PPP) (USD) | Poland | 9,874 | 10,224 | 10,544 | 11,152 | 11,970 | 12,720 |
| | Turkey | 6,669 | 6,222 | 6,733 | 7,150 | 7,750 | 8,340 |
| GDP (% real change pa) | Poland | 4.00 | 1.00 | 1.40 | 3.80 | 5.40 | 4.00 |
| | Turkey | 7.36 | -7.50 | 7.94 | 5.79 | 8.00 | 5.60 |
| Bank loans (mil USD) | Poland | 46,846 | 52,746 | 58,649 | 67,130 | 89,044 | 100,779 |
| | Turkey | 44,278 | 22,652 | 29,068 | 46,016 | 68,686 | 62,570 |
| Banking assets (mil USD) | Poland | 103,564 | 118,430 | 121,506 | 130,808 | 159,749 | 178,479 |
| | Turkey | 147,691 | 112,947 | 127,098 | 174,839 | 213,188 | 198,064 |
| Loans/assets (%) | Poland | 45.23 | 44.54 | 48.27 | 51.32 | 55.74 | 56.50 |
| | Turkey | 29.98 | 20.06 | 22.87 | 26.32 | 32.22 | 31.60 |
| Real personal disposable income (% change pa) | Poland | 3.53 | 3.66 | -0.34 | 2.76 | 2.20 | 3.70 |
| | Turkey | 7.20 | -5.48 | 4.10 | 7.00 | 9.20 | 6.10 |
| Retail sales growth (% pa) | Poland | 1.00 | 0.20 | 1.90 | 3.40 | 7.10 | 3.01 |
| | Turkey | 3.23 | -7.68 | 6.81 | 6.27 | 3.22 | 3.40 |

*Source: Economic Intelligence Unit*

All in all, the main purpose of my study is to investigate the possible impact of Basel 2 capital requirements on banks' lending[8] to corporate and SME clients located in the above-mentioned emerging countries. More specifically, I will assess the change inrequired capital ratios with the potential implementation of Basel 2 standardized and

[7] Turkish economy contracted by 7.50% in 2001 after having experienced an interest rate shock (over 1000% O/N rates) and a substantial amount of devaluation of the local currency (just under 50% in one day).

[8] Central and Eastern Europe banks are fully consolidated into Parent's balance sheet. The only exception is Bank K that is a subsidiary of a Financial services group in Turkey, which is consolidated as to 50% in the Parent Group's financial results. For the purpose of this study I assume that any reduction in the capital of these banks will not be covered immediately by the parent company.

IRB foundation[9] approaches. Therefore, my research question is:

- Would the sample banks located in Central and Eastern Europe countries face increasing or decreasing capital requirements after the implementation of Basel 2 standardized and IRB foundation approaches?

## 1.2 Contribution and relevance

This study is not the first one in the field to investigate the impact of the new capital standards on commercial lending. Among those in the literature several papers had been inspiring to me to pursue such a study. Carpenter, Whitesell, and Zakrajsek (2001) assess the change in capital requirements as well as any potential cyclicality effects of the standardized approach in the new capital Accord (CP2). Their results suggest that, relative to the Basel 1, the average level of capital required against commercial loans would be lower for banks using the standardized approach. Moreover, the variation in ratings over the business cycle is not substantial enough to create cyclicality in the required capital levels.

A more recent paper by Wyatt (2004) uses 27 national banks data in the New York state that are unlikely to apply the IRB approaches. The author identifies 10 elements of the standardized approach that were subjected to change after Basel 1 and calculates the impact of each of them separately on the sample banks. Afterwards, she investigates the combined effect of these elements on the sample banks and finds that the average required capital for her sample under the standardized approach would be lower than the Basel 1 capital requirements. Wyatt (2004) does not provide detailed data about the portfolio distribution of her sample banks but it is tabulated that the 35% risk weight for

[9] Due to the availability of LGD estimate data by the sample banks the IRB Advanced approach is not considered in this study.

residential mortgages leads to a 6% reduction in the capital requirements. In addition, the combined effects of these elements lead to a reduction of 7% in the capital requirements under the standardized approach. Therefore, as expected the potential benefit of the standardized approach is very much likely to be recognised by banks having more residential mortgages as a percent of total assets in their portfolios.

The last but not the least is a paper by Saurina and Trucharte (2004) that assesses the possible change in bank lending to SMEs in Spain due to the new capital Accord. Their analysis is focused on the standardized approach as well as the IRB approaches under the consultative papers 2 and 3. The authors find that the capital requirements under the proposed standardized and IRB approaches would not be higher than the requirements of the Basel 1 current approach (the differences that exist among individual banks can not be observed since the authors use aggregate credit register data), hence, they do not expect any change in the pattern of bank lending to SME clients in Spain.

In addition to the above-discussed papers there are many others that focus on the impact of Basel Accords (1 and 2) on developed countries[10]. They use data from these country banks and assess the changes in the required capital levels. My study differs by employing emerging country data. To my knowledge, studies using emerging country data to investigate the impact of Basel Accords on credit supply are rare.

Secondly, many of the credit crunch papers use recession period's data[11]. During recessions it is hardly concluded what caused a credit crunch: reduction in supply or reduction in demand. This is a systemic problem that relates to what portion of loan

[10] Ediz, Michael, and Perraudin (1998), Rime (2000), Carpenter, Whitesell, and Zakrajsek (2001), Wyatt (2004), Saurina and Trucharte (2004).

[11] Ito and Sasaki (1998), Hancock and Wilcox (1994), Berger and Udell (1994), Bernanke and Lown (1991), Honda (2002).

volume decrease can be explained by reduced demand or reduced supply[12]. In my analysis, I use a GDP growth period (economic growth) data. Therefore, my study avoids this identification problem by not using recession data.

Lastly, it is possible to generalize the individual bank results in each country based on the assumption that Bank P data and Bank K data are representative of the other banks established in their countries.

## 1.3 Summary

The main purpose of this study is to assess the impact of the change in capital standards on commercial portfolios of the sample banks located in Central and Eastern Europe. Therefore, I analyze Basel 2 from an emerging country perspective. For that purpose, the literature review covers the studies that focus on the possible impact of the new capital regulation on emerging countries.

The next section presents evidence from original contributions to the literature by concentrating on different issues, and in section 3, I present the methodology to be employed to assess my research question while section 4 provides a detailed explanation of data extraction, cleaning, and final samples of Bank P and Bank K. Section 5 includes the RWA calculations under the Standardized and IRB-F approaches for Bank P and Bank K. The additional capital charge for operational risk is also calculated in this section. Finally, in section 6, I present the potential implications of my results and make my remarks to conclude.

[12] Maybe banks do not reduce the supply, but when the prices are increased clients reduce the demand. Brinkmann and Horvitz (1995), Bereger and Udell (1994) face this problem.

## 2. BASEL 2 and EMERGING COUNTRIES[13]

Even though BIS Accords are originally designed for internationally active developed country banks, during the 90s, many emerging country supervisors have decided to adopt the Accord as a general guideline for their banks as well. This section reviews the most important contributions that focus on the Basel Accord implementation in emerging countries.

The Accord implementation requires substantial financial resources for well beyond any other financial regulation. For instance, PWC (PriceWaterhouseCoopers, 2004) estimates that the post-tax Basel 2 implementation costs will average 4 to 6 billion euro per annum for the EU between 2002 and 2006. This figure shows that the total post-tax cost can go up to 30 billion euro till the end of 2006. Another estimation was made by Mercer Oliver Wyman (2003) which states that banks will invest on average a pre-tax amount of 0.01% of loan assets per annum in preparation for Basel 2 over five years, with the larger banks investing 90 to 180 million euro. Estimations reflect the evidence in Europe. Nevertheless, the figures are estimated considering the fact that the costs will be similar for entities with the same size and will vary based on the current level of readiness and the sophistication of risk management. Therefore, for emerging country banks the costs might be similar to the estimates given by Mercer Oliver Wyman. In addition to these high costs, there is some evidence of highly capitalized emerging country banking systems experiencing crisis. Rojas-Suarez (2002) finds that in some of the Latin American countries, in the eve of disastrous crises, the real net equity capital growth was

[13] See footnote 3 for the definition of emerging countries.

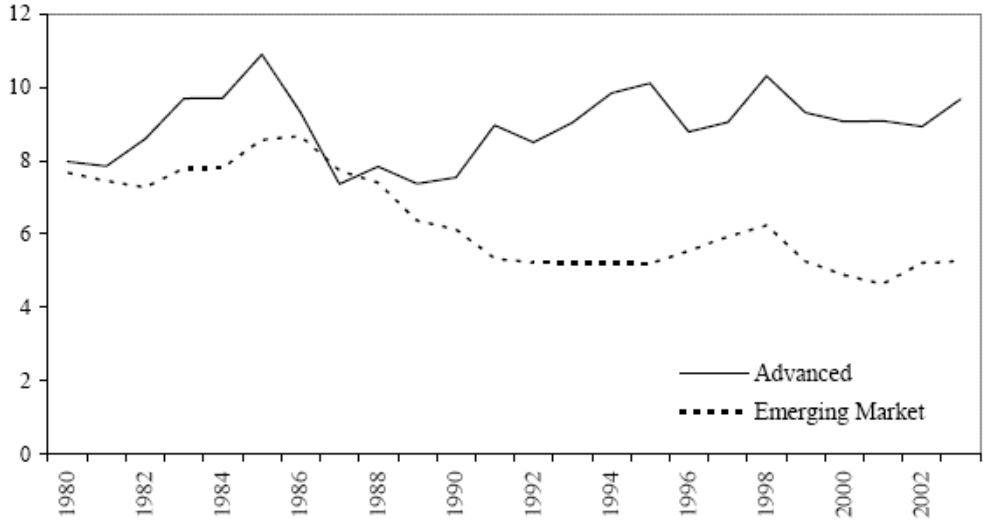
not only positive but also reached very high levels[14]. Interestingly, the same author finds that during the year before the banking crises in Sweden, Norway, and Japan the net equity growth became negative[15]. Actually, this finding might implicitly expose the fact that emerging countries have different macroeconomic structures and political environments than developed countries. At times their economies may become very fragile and unstable. First of all, the volatile macroeconomic environment in emerging countries had been a headache for banks. More specifically, emerging countries face volatility in the GDP growth rates and in the trade volumes due to non-diversified economic structures. Secondly, worldwide small shocks, such as product or sector specific, create major reductions in the volume of exports of emerging countries (Caprio and Honohan, 1999) which may have major implications on the economy. Moreover, emerging country banks face high volatility in consumer prices and the exchange rates which are affected by the monetary policy that is under domestic control (see appendix 1 for detailed country statistics).

In addition, the maturity structure of sovereign debt makes banks in emerging countries more susceptible. The average maturity at issue of sovereign debt (bonds and loans), excluding the Brady bonds, for the emerging[16] country sample is significantly lower than for advanced[17] country sample, and has declined substantially over the past two decades (see figure 1) whereas the maturity of the advanced country sample stayed stable.

[14] In Argentina and in Mexico the real net equity capital growth reached 3 % and 4 % respectively in 1993.
[15] Both in Sweden, Norway the real net equity capital growth had been -3 % in 1991 before the crisis in the Scandinavian countries. In Japan the real net equity capital was – 0.5 % in 1994 again just before the crisis.
16 Argentina, Brazil, Chile, China, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Philippines, Poland, Russia, South Africa, Thailand, Turkey, Venezuela.
17 Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, United Kingdom, United States.

**Figure 1**

Maturity structure of sovereign debt in developed and emerging countries (1980-2002)




*Source: IMF, Sovereign Debt Structure for Crisis Prevention, Research Department, IMF, 2004*

A final important aspect of emerging countries relates to the potential increase in the size of bank portfolios. The evidence in Table 3 shows that for a period from 1999 to 2005 the domestic credit as a percentage of GDP had been substantially higher in the developed countries. For the emerging country sample in the above mentioned period a total of 49.69% of the GDP is provided as domestic loans whereas for the developed country sample this figure is 117.62%. This difference reveals that emerging country banks have potential for expansion in loan volumes (especially in retail lending), as household income rises. However, a rapid expansion might reduce the loan quality as well. In such an environment, Basel 2 implementation gets more critical.

**Table 3**

Domestic credit as a percentage of GDP in selected developed and emerging countries

| Emerging Country | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|
| ARGENTINA | 34.72% | 33.70% | 36.56% | 61.93% | 50.33% | 45.15% | 46.42% |
| BRAZIL | 57.03% | 52.75% | 60.31% | 63.76% | 59.73% | 55.35% | 56.87% |
| CZECH REPUBLIC | 55.66% | 50.30% | 46.42% | 43.13% | 49.10% | 45.74% | 44.82% |
| INDONESIA | 56.55% | 61.34% | 53.94% | 51.38% | 48.64% | 48.80% | 45.90% |
| KOREA, REP. OF | 78.01% | 82.88% | 87.65% | 94.31% | 97.38% | 92.70% | 94.18% |
| POLAND | 35.45% | 33.60% | 35.77% | 35.72% | 36.95% | 34.55% | 34.37% |
| ROMANIA | 17.86% | 14.00% | 12.22% | 13.20% | 15.88% | 15.91% | 16.68% |
| TURKEY | 48.84% | 49.85% | 70.27% | 57.96% | 52.73% | 53.32% | 54.02% |
| **Developed Country** | | | | | | | |
| CANADA | 73.72% | 74.85% | 77.70% | 78.55% | 79.26% | 83.53% | 83.68% |
| FRANCE | 103.99% | 103.34% | 105.56% | 102.97% | 105.23% | 105.92% | 106.63% |
| GERMANY | 144.98% | 145.43% | 143.94% | 141.99% | 140.58% | 138.02% | 141.97% |
| ITALY | 95.58% | 98.38% | 99.69% | 99.47% | 105.15% | 106.61% | 105.50% |
| NETHERLANDS | 146.81% | 153.59% | 153.76% | 159.98% | 168.20% | 178.78% | 184.03% |
| UNITED KINGDOM | 125.28% | 133.78% | 139.80% | 145.21% | 150.11% | 159.09% | 168.93% |
| UNITED STATES | 80.41% | 83.13% | 86.04% | 88.52% | 88.67% | 89.00% | 88.16% |

*Source: EIU (Economic Intelligence Unit) country data, series from 1999 to 2005.*

It is possible to extend the statistical evidence shown above. Nevertheless, in short, it is commonly accepted that emerging countries have different macroeconomic structures and political environments than developed countries. Hence, it is important to understand the impact of new capital regulations on emerging countries. The next sections (2.1 to 2.5) focus on this impact through an analysis of the original contributions to the literature.

## 2.1 Bank Lending to Emerging Countries

The Basel 1 Accord distinguished between OECD and non-OECD countries. According to that, any OECD member country have received a risk weight of 0% independent of its relatively low credit standing assigned by external rating agencies (i.e. Turkey). This distinction promoted developing countries to seek OECD membership (i.e. South Korea) and provided an important advantage to OECD member countries in terms of possible pricing advantage. With the new Accord this distinction is eliminated resulting a

remarkable increase in the capital requirements on lending to OECD member borrowers with relatively low ratings. Nevertheless, some critics still argue that there will be rises in the capital requirements for loans to emerging countries as international banks, which are the primary lenders, adopt the most advanced capital calculation methods[18]. Griffith-Jones and Spratt (2001) argue that banks adopting IRB approaches will change their lending behavior to emerging country banks and governments as there is no longer an incentive to hold poor quality loans. They also claim that internationally active banks will price their loans to emerging countries accordingly to reflect the increased capital requirements. Similar views have been stated by Reisen (2001) which indicates that the adoption of IRB-A approach by internationally active banks could result in speculative grade (below BBB-) borrowers being effectively excluded from foreign lending. To support his argument, the author compares the risk adjusted return on capital using current risk weights under Basel 1 with the ones that could result from the standardized and IRB-A approaches. This will allow determining spread change over the predetermined Basel 1 spread needed to maintain the same level of risk adjusted return on capital under the standardized and IRB-A approaches. The author first determines the IRB risk weights for different rating grades using the historical default rates from Moody's Investors Service (with a LGD of 50% and maturity of 3 years). Then he assumes a LIBOR spread for each rating grade under the Basel 1 approach and calculates the risk adjusted returns under different approaches. Using these returns and the LIBOR spread the final break even spreads are calculated for the IRB approach to maintain the

[18] In fact, Quantitative Impact Study 3 (QIS3) revealed that capital requirements would rise by 28% and 47% under the IRB-A and IRB-F approaches respectively for Group 1 banks (these are large, diversified, and internationally active banks with Tier 1 capital above 3 million euro)

same level of return as under the Basel 1 approach. The findings suggest that Basel 2 IRB-A approach would lead to an increase of 1,115 bps and 3,709 bps in the spreads of BB rated and B rated sovereigns respectively. However, this model provides an upper bound for spread movements since it assumes that capital requirements are binding. Similar results have been obtained by Weder and Wedow (2002) which also assume that regulatory capital is binding for calculating the spreads. Using BIS consolidated data for lending to 25 emerging countries between 1993 and 2001, they investigated the potential change in the lending behavior of banks to emerging countries. The authors, in line with the above results, find out that the spreads could increase up to 970 bps and 2,041 bps for B rated and CCC rated sovereigns.

Certainly, the findings of the above papers imply that the cost of credit to many emerging countries will rise after IRB advanced approach implementation while, for some other emerging countries the consequences will be more detrimental. However, these papers make an important assumption. That is banks finance themselves at LIBOR and the spread in excess of LIBOR is expressed as the percentage of capital required (i.e. regulatory capital is binding) for each specific rating grade. On the other hand, the evidence I provide below shows that loan pricing is a function of economic capital. Moreover, in these papers it is also assumed that banks will adjust their spreads under Basel 2 to hold the return on regulatory capital constant. Therefore, the findings of the above papers might have overestimated the impact of Basel 2 on lending to emerging countries.

Bailey (2005) argues the regulatory capital could only be binding if it exceeded the economic capital. Hence, it is important to consider the economic capital while assessing

the potential impact of Basel 2 on emerging country lending. A more recent paper by Liebig et. al (2006) assess whether Basel 2 will induce a change in bank lending to emerging countries by modeling the spreads using both the economic and regulatory capital. The paper computes bank level measures of economic and regulatory capital using data from international German banks that constitute 95% of the foreign lending. It is assumed that the developments in the debt markets are largely affected by supply shifts and hence, the authors model bank lending by a loan offer curve. Based on that the credit decisions depend on an expected yield over a minimum margin that contains risk-free interest rate, handling charges, expected loss, and the opportunity cost. The opportunity cost refers to the regulatory capital if it is binding and otherwise to the economic capital which is measured with unexpected loss. In this model the authors ensure that an increase in capital costs predicted using the Basel 2 risk weight functions will not be relevant for bank lending to emerging countries as they remain below the unexpected loss. Therefore, they start by comparing the means of unexpected loss and the regulatory capital under the IRB Advanced approach. The tests indicate that the latter is not binding since the mean of economic capital is always greater than or equal to the regulatory requirement. Secondly, they test whether the lending decisions are affected by the unexpected loss and find that for large banks' economic capital have determined the lending decisions. In overall, both of their results support the view that banks use economic capital calculations to price their loans to emerging countries. Therefore, bank lending to emerging countries will not be affected by an increase in the regulatory capital requirements.

In sum, the evidence shows that international banks that are more advanced use economic capital rather than regulatory capital to price loans. Therefore, Basel 2 will not have a

significant impact on bank lending to emerging countries even though there is an increase in the regulatory capital requirement of loans to these countries.

## 2.2 Capital Requirements and Credit Crunch

The credit crunch issue has been widely investigated by scholars that used data from developed countries to assess the impact of Basel 1 on bank lending. For instance, the Accord took a vast attention in the U.S where its introduction was followed by the 1990-91 recession. Thus, many papers[19] took consideration whether the capital requirements augmented the recession through forcing banks to reduce the supply of lending. These studies have been the milestones for future assessments globally and have been cited in the most recent papers as well. For this reason, I present these original contributions in the developed country section below. This is followed by the studies using emerging country bank data.

### *2.2.1 Developed Countries*

Brinkmann and Horvitz (1995) assess whether the implementation of Basel 1 caused a credit crunch in the U.S where the new regulations[20] changed the required capital ratios. As an indicator of the change in excess capital caused by new requirements, they calculate the difference between capital required in 1987 under the existing requirements and the amount required under the new requirements. Their results show that many large banks (asset size greater than $300 million) could not meet the new standards or met with

[19] Brinkmann & Horvitz (1995), Berger & Udell (1994), Hancock & Wilcox (1994), and Peek & Rosengren (1995) investigated any possible reduction in the credit supply to commercial clients as a result of the implementation of new capital requirements in the aftermath of U.S. recession. While Hancock & Wilcox (1994) find that Basel 1 did not have any significant impact in the portfolio distribution of U.S banks, the other three studies have suggested credit crunch due to new capital requirements.

[20] While banks were previously required to meet the primary and total capital ratios of 5.5 % and 6% respectively, the Basel 1 required banks to hold Tier 1 capital of 4% and total capital of 8% of the risk weighted assets.

small surpluses. On the other hand, the major part of banks with asset sizes less than $300 million had larger excess capital with the new requirements than the existing ones. Besides all, the authors also find that banks with larger capital surplus under the new requirements increased their loan volume more than the ones that had smaller surplus or the ones that failed the standards. As a result, larger banks that supply the majority of the commercial loans diminished the volume and that could not be balanced by the increased supply of smaller banks. These findings are supported by Berger and Udell (1994) that used the same sample period as Brinkmann and Horvitz (1995) did. They find that large banks that could hardly achieve the CAR levels[21] shifted their portfolios to treasury bills, while smaller banks' loan growth rate had been higher than the asset growth rate in the period (31.9% vs. 26.8%). Overall, commercial loans decreased proportionately.

The findings of both of the above papers show that there had been a reduction in the commercial loan volume. In spite of that, these studies are not conclusive due to a widely encountered problem. Measuring credit crunch is very hard since reduced business activity may reduce the credit demand as well. Naturally, the reduction in the loan volume is not always because of reduced supply of credits in order to meet the required CAR. For that reason the demand schedule should be investigated as well[22]. In fact, in another study assessing the impact of Basel 1 on commercial lending, Hancock and Wilcox (1994) control for the borrowers' long-run demand by using loan contract interest

[21] As of December 1989, largest banks representing one-fourth of total assets in U.S could not meet the required -capital adequacy ratios- CARs (Avery and Berger, 91).

[22] To do that both of the above discussed papers could control the pricing of the loans, since the reduced credit worthiness of the borrowers under recession would decline the effective demand for loans due to increased interest rates for these borrowers. Another way to control the demand is to control for the non-bank funds in the U.S in the same period. Thus, data from bond and equity markets could be used to assess whether bank clients raised funds from these markets as well. The increase of funds that had been raised in bond and equity markets proves that the demand for funds is not reduced.

rate and perceived risks as independent variables and conclude that Basel 1 risk weighted-capital requirements did not have any significant change in the portfolio distribution of U.S banks. In short, the evidence shows that Basel 1 did not cause a reduction in the commercial lending under a controlled long-run demand case.

The credit crunch literature is not limited to papers about the U.S. For instance, Rime (2000) provides an analysis on the Swiss banking system and finds that Swiss banks did not reduce funds to commercial clients, but they increased capital through equity issues after Basel 1 implementation. In the U.K the impact of Basel 1 on commercial lending had been investigated by Ediz, Michael, and Perraudin (1998). They conclude that commercial lending is not reduced (no credit crunch), on the contrary banks boosted their capital ratios through raising new capital. On the other hand, the Japanese data gives different results. Honda (2002) uses a sample period from March 1986 to March 1995 to assess the impact of Basel 1 on bank lending and finds out that the ratio of loan volume growth to total assets growth dropped after the implementation of Basel 1 (see appendix 2 for detailed discussion).

### *2.2.2. Emerging countries*

In addition to the studies using developed country samples, there is limited work on the impact of Basel 1 capital regulations on emerging country banks. Chiuri et.al (2002) constructs a sample of emerging country banks to test whether the enforcement of CARs had shrunk the credit lending causing a credit crunch. In their model, the authors define that the capital shortages maybe a result of either loan losses or changes in capital regulation. To capture any of these changes two scenarios are constructed. The first one is the regulatory restriction case (capital requirements were not only increased but also

enforced) with non-crisis country banks and the second one is the regulatory restriction case with crisis country banks. The authors detected 15 countries (10 crisis countries) from which 572 banks are included in the sample. Moreover, foreign owned banks and domestic banks in these countries are further separated to see the effects of foreign investment in emerging countries. They find that, in the crisis countries case (regulation follows crisis), the credit crunch occurs right after the enforcement (year of implementation of Basel 1) of the capital regulation. Moreover, also in the non-crisis country banks sample, they find evidence of credit crunch. Therefore, both in the crisis and non-crisis countries the enforcement of CARs causes a reduction on the supply of loans in domestic banks. More than that, in countries where the enforcement of the new regulations is followed by the crisis, the negative impact had been stronger. In addition to the above findings, the authors also find that, the adverse impact of more stringent capital requirements had been smaller at foreign owned banks. Having not discussed in detail, it is suggested that the major implication of this finding would be local regulators opening domestic banking to foreign ownership as it might be a way to partly shielding the domestic banking sector from negative shocks. Certainly, the impact of foreign ownership requires further investigation.

Chiuri et.al (2002) focuses on four years as the data period. That is one year before the regulatory enforcement (t-1), the year of enforcement (t), and the succeeding two years (t+1 and t+2). The results reflect the very short-run impact of the Basel 1. Their approach does not allow testing for a structural change regarding banks' overall loan supply and their sensitivity to risk. A test for structural change requires a sufficient number of observations using a long control period before the Basel 1 adoption against which to test

for a change in the lending behavior. In fact Barajas et.al (2005) uses a sample period that reflects a possible structural change in the lending behavior. Mainly, they cover a period from 1987 to 2000 utilizing a large data sample to investigate the credit crunch hypothesis in the Latin American and Caribbean (LAC) countries that have experienced slowdowns in the credit growth since the early 1990s. However, on average, the descriptive statistics show that both the bank capitalization ratio and the lending activities increased after Basel 2 adoption in LAC countries. Moreover, their analysis do not show any evidence that the loan supply curve shifted on average after Basel, but the authors detect some evidence of increased risk sensitivity in LAC banks. This implies that Basel 2 might cause bank credit to become more procyclical as loan supply becomes more sensitive to risk factors that vary with the business cycle.

The findings of Barajas et.al (2005) have been confirmed by Segoviano and Lowe (2002), which concluded that Basel capital requirements might increase the procyclicality of ratings. The authors tested the amount and the cyclicality of capital by using business client data of five Mexican banks (over a period from 1995 to 1999). The primary intention of this study is to understand the behavior of bank rating and its relationship with the capital requirements right after the Mexican crisis at the end of 1994. In order to calculate the capital requirements under the standardized approach, the authors map the internal model PDs to the external ratings by comparing the historical default frequencies of internal grades with the ones of S&P grades. Then the risk weight corresponding to each external rating grade is used to calculate the average sample risk weights. On the other hand, for IRB-Foundation calculations, the authors directly apply the Basel risk

weights[23] (November 2001 version) assuming a LGD of 50% and effective maturity of three years. The authors use a transition matrix to show the movement of ratings from one to another and to test for any procyclicality effect. This makes sense since they simulate the capital requirements at every quarter from 1995 to 1999. In fact, the preliminary analysis shows that the share of borrowers rated in the least risky categories declined throughout 1995 to 1996 and the one of worst rated borrowers increased. Moreover, the average rating quality improved by the end of the decade. In line with this, the average risk weight of the sample under both approaches peak in December 1996 (187% and 214% respectively under standardized and IRB-Foundation). The high capital requirements reflect the relatively high default frequencies over the period as a whole. Moreover, the authors also find some evidence of procyclicality. Mainly, the average risk weight rises from 126% in March 1995 to 214% in December 1996 under the IRB-Foundation approach following the crisis before falling back in 1998 towards March 1995 level. The same cyclical pattern is clear also under the Standardized approach. To sum up, the increase in capital requirements of these Mexican banks might imply a reduction in the bank supply of commercial loans[24].

To conclude, the findings from the above studies show mixed results of credit crunch in emerging countries, which suggest further empirical investigation of the issue following the Basel 2 implementation in emerging countries.

[23] This implies that the risk weights under the IRB-Foundation approach include unexpected loss as well as expected loss coverage.

[24] It should be noted that the findings of Segoviano and Lowe (2002) do not reflect the current situation as expected loss is not covered with capital anymore and the effective maturity is reduced down to 2.5 years under the IRB-Foundation approach.

## 2.3 External Ratings and Country Ceiling

The utilization of external ratings in emerging countries can be a major concern since most of the ratings have been assigned to banks and non-financial corporations in developed countries. Table 4 shows the number of rated banks and non-financial corporations by Moody`s Investors Services worldwide as of December 2005.

**Table 4** (Number of bank and non-bank ratings by Moody's as of December 2005)

| **Emerging Country** | **# of banks rated (LT Bank Deposits Rating)** | **# of non-banks rated (LT Rating)** |
|---|---|---|
| ARGENTINA | 20 | 38 |
| BRAZIL | 29 | 39 |
| BULGARIA | 4 | 4 |
| CHILE | 6 | 25 |
| CHINA | 13 | 4 |
| CROATIA | 2 | 2 |
| CZECH REPUBLIC | 5 | 8 |
| HONG KONG | 20 | 30 |
| HUNGARY | 10 | 4 |
| KOREA | 15 | 26 |
| MALAYSIA | 11 | 12 |
| POLAND | 13 | 11 |
| ROMANIA | 4 | 7 |
| RUSSIA | 50 | 38 |
| SLOVAKIA | 7 | 3 |
| TURKEY | 16 | 8 |
| UKRAINE | 15 | 6 |
| **Developed Country** | **Number of banks rated (LT Bank Deposits Rating)** | **Number of non-banks rated (LT Rating)** |
| AUSTRALIA | 37 | 104 |
| AUSTRIA | 16 | 13 |
| CANADA | 20 | 221 |
| FRANCE | 72 | 99 |
| GERMANY | 46 | 125 |
| ITALY | 46 | 37 |
| JAPAN | 45 | 229 |
| NETHERLANDS | 11 | 221 |
| NORWAY | 9 | 16 |
| SPAIN | 34 | 44 |
| SWEDEN | 7 | 25 |
| SWITZERLAND | 14 | 28 |
| UNITED KINGDOM | 47 | 429 |
| UNITED STATES | 176 | 445 |

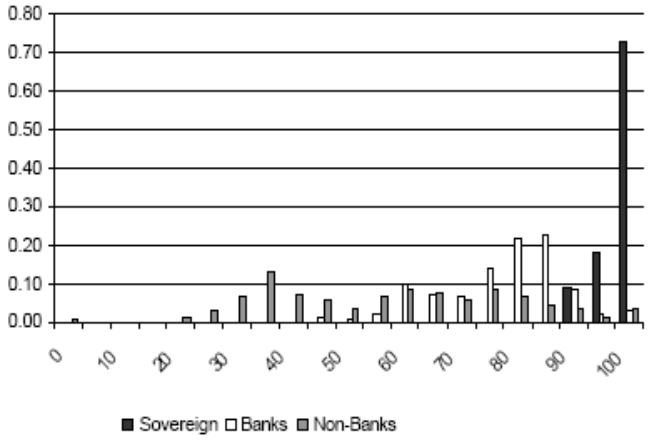
*Source: Moody's Investors Service. End of year 2005 ratings by country*

As seen, there are a limited number of them rated in emerging countries. More than that most of the ratings belong to the banks. The most well-known and experienced external rating agencies do cover only a very small portion of the corporations. This implies that, the standardized approach will not be a risk sensitive approach for emerging country banks. In fact, Powell (2004) states that the standardized approach implemented in emerging countries would not make any change in terms of risk sensitivity after Basel 1 due to above-mentioned low penetration of credit rating agencies.

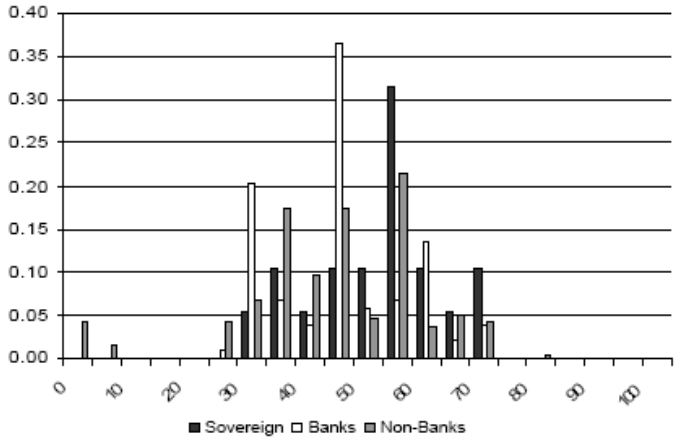
Another major implication of external ratings usage is related to the fact that sovereign ratings have big influence on the determination of the domestic corporation ratings in non-high income countries. For instance, Ferri et.al (2001) assesses the potential impact of the usage of the external ratings in emerging countries. The authors show that the correlation between firms' and sovereign ratings is negligible for G10 countries whereas in upper middle income and middle low income countries the firms' ratings and sovereign ratings exhibit higher correlations (figure 2a, 2b, 2c).

**Figure 2** (Relative rating distribution a. G10, b. upper middle income c. middle low income) *

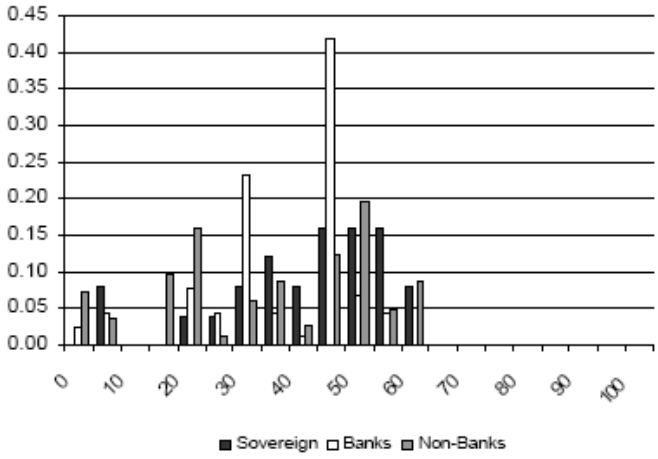
(a)



(b)




(c)




*: y-axis shows the percentage of total number, x-axis shows the numeric equivalent of rating from 0 to 100. The numeric equivalent 100 represents the rating grade AAA and the numeric equivalent 0 represents the rating grade D. In total, there are 20 rating grades (from CCC+ to CCC-, the numeric equivalent is 20).

*Source: The role of rating agency assessments in less developed countries: Impact of the proposed Basel guidelines (2001)*

From the above figures it is evident that the private sector ratings in emerging countries depend more on their sovereign ratings than private sector ratings in G10 countries do. After examining the rating distribution of sovereign and private sector entities, the authors assess the impact of sovereign downgradings on bank CARs through a regression analysis followed by a simulation. The results of the regression show that a 10 point (2

notch) sovereign downgrading translates into a 5.6 point rating change for high income countries' banks and into a 9.6 point rating change for non-high income (upper middle and middle low) countries' banks. Besides to that, this much downgrading in the sovereign rating translates into a 6.9 point downgrading for non-high income firms whereas it does not affect the firms' ratings in high income countries. Using these results, they then perform the simulation by using 11 high and non-high income countries that experienced a downgrading. In the non-high income sample, the bank CARs against loans to rated companies increased by 2.57% on average while in the high income countries the CARs against loans to rated companies increased only by 0.4% on average.

In a more recent paper, Ferri and Liu (2004) compile a dataset containing the credit rating, risk indicators used in firm rating, and the sovereign rating of over 500 firms from developed and emerging countries (firms with ratings BBB or below) in order to investigate the relationship between sovereign and firm ratings (for the sake of analysis the S&P alphanumeric rating grades are converted into numeric ratings). First, they identify the most significant idiosyncratic indicators that affect firm rating, second they use these with the sovereign ratings of OECD and non-OECD countries in another regression. The results of the estimation show that 1% increase in firm specific risk factors raises the firm ratings in OECD countries by 1.26% while; sovereign risks for OECD firms can be ignored. On the other hand, the contribution of firm specific factors to non-OECD firm credit rating is much smaller (1% increase only causes a 0.51% raise) whereas the sovereign risk rating has a big impact on the non-OECD firm rating[25]. These findings show that, dependency on external ratings to calculate regulatory capital might have an important implication for emerging countries. That is, due to the high sensitivity

[25] Similar results have been observed even after controlling the country ceiling effect.

of firm ratings to sovereign risks, in which case banks' required capital ratios in emerging countries should substantially increase following a downgrade of the sovereign rating.

The above cited papers present findings of strong correlation between sovereign and corporate ratings. The same findings have been observed by Durbin and Ng (2005) that use emerging country corporate and sovereign bonds to analyze the correlation. In their sample they have used 108 corporate and 108 sovereign bonds and calculate that the average corporate bond spread is about 40% higher than sovereign spreads. Moreover, they also find that the average sample correlation between sovereign and corporate bonds is 0.80. An important aspect of the relationship between these two types of ratings is the country ceiling that is widely applied by external rating agencies. In addition to the above findings, Durbin and Ng (2005) also observe that the country ceiling is not always considered. In a third of the cases the average yield spread for the firm is lower than that of its host government, showing strong evidence that investors do sometimes find corporations in emerging countries safer than their governments.

In short, the evidence in this section implies that, first, the standardized approach would not be risk sensitive due to very low penetration of ratings in emerging countries, and second, sovereign downgrading might substantially increase bank CARs in emerging countries.

## 2.4 Calibration of IRB Risk Weight Functions

The Basel Committee used a direct or model based approach and a survey based approach to calibrate IRB risk weights. The survey approach benefits from the already conducted research (by banks) through the usage of economic capital requirements from banks' internal economic capital systems. However, this survey data is taken from G10

countries only. Hence, it is crucial to understand whether a calibration done using G10 data would fit to emerging country banks.

According to Stephanou & Mendoza (2005), loss rates are driven by the sensitivity to systemic economic factors of borrowers' ability to repay and by the frequency and severity of financial crisis. In fact, Caprio and Klingebiel (1996) study the main characteristics of banking crisis from 1975 to 1995 and find that banking crisis occurred more frequently in emerging countries than in developed ones during the above period[26]. Moreover, the severity estimations[27] (these are the official estimated total losses or the costs of the crisis reported by individual countries) also present that the impact of these crisis on the GDP of the emerging countries had been substantially higher than the impact on developed countries. In the extreme cases, the cost of the banking crisis in Argentina and in Chile had been 55.3% and 41.2% of the GDP, respectively. Therefore, it is fairly clear that in emerging countries the frequency and severity characteristics of crisis are quite different than in developed countries. From this perspective, IRB risk weight functions that have been calibrated without using emerging country data may underestimate the required capital amounts of emerging country banks which would then increase the possibility of bank insolvencies during downturns due to lower capital held than the necessary amount.

[26] Argentina and Thailand experienced three banking crises, while Brazil, Chile, Malaysia, Mexico, Philippines, Uruguay, and Venezuela experienced two of them in the period from 1975 to 1995. In addition, the severity estimates show that there had been substantial amount of reduction in the GDP of these countries after crises.

[27] The official estimates might not capture the slowdown in economic growth when resources are driven out of the formal financial sector and stabilization programs are ruined. Moreover, estimates range considerably and in many cases there are no clear, uniform accounting standards; banks can disguise losses for some time by granting additional credit, losses can be apportioned to a variety of groups, and governments can pay for losses in a variety of ways, from injecting funds directly into insolvent banks to helping the borrowers.

One interesting study by Balzarotti et. al (2004) assesses whether the IRB calibration fits the Argentinean public credit registry data (data from 18 largest private banks are used) by comparing the capital requirements calculated using the Credit Risk+[28] of Credit Suisse and Basel 2 October 2002 version risk weight function. One sector model of Credit Risk+ is used since the authors think that the systemic risk is very relevant for emerging countries. The probability of default is calculated as the probability of default in one year period using an estimated probit scoring model. The maturity is fixed at 2 years and the total capital charge under the IRB approach is calculated as 8% of the risk weighted assets. In terms of recoveries, the authors assumed a fixed 50% for any collateralized or guaranteed loan exposure. Using 20% volatility (Credit Risk+) for the default rate, the authors find out that the total charge (capital+ provisions) calculated using IRB approach is very close to Credit Risk+ estimates. But, when the volatility is taken as 50% the results show quite different estimates to the IRB calibration at the time. Therefore, they conclude that the October 2002 curve is too flat for Argentina historical data when higher volatilities are considered. In fact, they also run a regression and show that the minimum capital requirement under the IRB approach that fits well with the Credit Risk+ estimates should be 14.1% when the volatility of default rate is taken as 50%. This result shows that in emerging country banks the G10 calibrated IRB curve

[28] Credit Risk+ is an actuarial model that considers the credit risk inherent in default or in the defined credit risk event. The critical variable in the model is the loan default rate. The general model has several sectors such that each sector has an independent distribution of default rates but within each sector loan default rates are perfectly correlated. For each sector the mean default rate is estimated using a sample of actual defaults and information on loan instrument and the borrower. Moreover, the variance of the default rate can be estimated using a collateral transition probability matrix if data on internal rating or credit risk event is available.

may not provide the desired protection levels where default probabilities and volatility of these default probabilities are higher[29].

In line with the above findings, a more recent study by Majnoni and Powell (2005) concludes that the IRB risk weight function will not provide a 99.9% protection to their sample of emerging countries if the minimum required capital ratio is set to 8%. To achieve this result they used the Public Credit Registry of Argentina, Mexico, and Brazil that store the corporate loans data and applied a bootstrapping[30] technique that enables to mimic the shape of the loss distribution function of any specific loan portfolio. First they extracted the data of performing loans at a particular date and they observed whether a loan is defaulted over a 12 months period (past due 90 days definition). Then they took a sample of 500 loans and they computed the value of losses of this portfolio (recovery rate is assumed as 50%) reflecting the economical conditions in the above mentioned countries[31] (the total loss is the Value at Risk and the unexpected loss is Value at Risk minus the expected losses). This exercise was simulated about 20,000 times to form 20,000 portfolios. Their results show that the amount of capital necessary to cover the unexpected losses up to 99% level protection is in the range of 15% for Mexico and Argentina[32]. Moreover, to achieve a 99.9% level protection the required capital ratios should be 31.64% and 21.80% respectively (Value at Risk minus expected losses) for Mexico and Argentina. These very high ratios do reflect the 2001 recession in Argentina and the slowdown of economic activity in Mexico. Nonetheless, using the Basel 2 risk

[29] It is important to note that October 2002 curve has been modified in the latest versions of Basel Accord.
[30] Bootstrapping can be used to simulate the impact that specific shocks or cyclical impulses have on the frequency distribution of credit losses (Majnoni et.al, 2004).
[31] In Mexico and Argentina the period is from December 2000 to December 2001 while in Brazil the period is from October 2001 to October 2002.
[32] Non- significant results of Brazil are not reported here.

weight function, the same samples require 9.68% and 14.93% capital ratios respectively for Mexico and Argentina which appear to be considerably lower than the authors' simulation results for 99.9% confidence level. This shows that during recessions the Basel 2 risk weight function applied to non-G10 countries may not provide the desired 99.9% protection level. In other words, banks would need a capital ratio much higher than 8% to achieve 99.9% protection.

To conclude, the evidence shows that the minimum capital ratio set to 8% may not provide the desired level of protection in emerging countries due to increased default rates when there is a reduction in the economic activity and due to higher volatility of these default rates at all times.

## 2.5 Home / Host Issue

Among many others, Pillar 2 also focuses on the international supervisory coordination, the so called home-host issue[33]. It suggests setting common capital adequacy approaches between the entities of internationally active banks and it also aims to minimise the differences between approaches of home and host jurisdictions. However, local banks in emerging countries with foreign ownership might have less resources and competence than parent banks established in developed countries which will result in subsidiaries adopting less advanced approaches for capital calculations.

In the table below, I present the implementation plan of six Eastern European banks[34] owned fully or partially by Parent Group[35]. By January 2007, five out of six banks will

[33] Home country supervisors are the ones of the parent company, and host supervisors are the ones of the subsidiaries.
[34] At the moment the implementation plan of RBank is not available.
[35] None of the Eastern European banks were consolidated into the Parent Group in the Quantitative Impact Study 5 that was performed and sent to the Central Bank of Italy in December 2005.

implement the standardized approach. On the other hand, Parent Group parent bank will adopt IRB-F approach.

**Table 5**

Basel 2 implementation plans of six Eastern European banks owned by Parent Group

| Name of the Bank | January 2007 | January 2008 | January 2009 | January 2010 |
|---|---|---|---|---|
| Bank P | Standardized | IRB-F | IRB-A | |
| CZBank | Standardized | Standardized | Standardized | IRB-A |
| Bank K | Standardized | Standardized | IRB-F | IRB-A |
| UBank | Standardized | IRB-F | IRB-A | |
| ZBank | IRB-F | IRB-F | IRB-A | |
| BBank | Standardized | Standardized | IRB-F | IRB-A |

The plan shows that subsidiaries do not always adopt the same approach as the parent bank. In fact, survey (consolidated Basel 2 questionnaire[36]) results from Turkish banks are in line with the implementation plans of Parent Group subsidiaries. They show that banks are at the early stages of Basel 2 compliance. Mainly, 13 banks that are owned fully or partially by foreigners out of 50 in total will adopt the standardized approach by 01/01/2007. This might create some inconsistencies during the implementation phase as Standardized and IRB-F approaches imply different business requirements. Besides, some supervisors do not recognize the others which makes risk weighted assets figures incompatible. Finally, as the subsidiary is not able to compute the requirements under the IRB approaches, consolidated results will be reported only for the standardized approach initially.

In addition to the implications caused by the adoption of different approaches, home and host supervisors will need to collaborate to set a consistent minimum capital ratio for the

[36] Source: Basel 2 survey results by the National Banking Watchdog (December, 2005).

foreign subsidiaries of internationally active developed country banking groups. The national discretion[37] of Italian Central Bank shows that the subsidiaries of Parent Group (i.e. Bank P and Bank K) could have a capital ratio of 7% (can also be reduced to 6%) while at the consolidated level the group should have 8% capital ratio. However, my further investigation also shows that neither the Polish regulator nor the Turkish one has a definition for the distinction of consolidated ratio from the individual subsidiary level ratio. For both of the country banks still a capital ratio of 8% applies. This means that the flexibility provided by the Italian Central Bank will not be supported by the Polish and Turkish regulators, and hence, even the subsidiaries of Parent Group will need to have 8% minimum capital ratio unless home and host supervisors agree otherwise.

[37] Bank of Italy (March 2005). "Schede sulle discrezionalita' nazionali contenute nel nuovo accordo sul capitale ("Basilea 2") e nelle proposte di direttive europee in materia di requisiti patrimoniali delle banche e di adeguatezza patrimoniale delle banche e delle imprese di investimento".

## 3. METHODOLOGY

In this section I present the methodology to calculate the required capital ratios under the standardized and IRB-F approaches for corporate and SME (corporate and retail) segments of Bank P and Bank K[38].

Before presenting the data and explaining the methodology, I want to highlight the results of the most relevant impact studies which assessed the change in the required capital ratios if the standardized and the IRB-F approaches were to be implemented in emerging country banks.

The Quantitative Impact Studies (QIS) by the Basel Committee surely aggregate the largest data samples gathered from many central banks. The results of the QIS4 that was only performed by several developed countries (e.g US, Germany) are not included in this study since they are not relevant. Below, important findings from the QIS3 that was published in May 2003 and QIS5 that has been recently published (June 2006) are presented.

The results of the QIS3 for the "others" group that is composed of banks from 24 countries[39] (most of them are emerging countries) show that, on average, there will be a 12% and 4% increase over the current capital requirement under the standardized and the IRB-F approaches, respectively. Mainly, these increases are due to the consideration of the capital charge for the operational risk and yet, the required capital does not change substantially for neither of the segments (there will be negligible increases in the required capital for the corporate and SME corporate segments with respect to the current

[38] At Bank P commercial exposures (excluding retail) represents roughly 38% of the banking book as of March 2005, while at Bank K this figure is 54% as of September 2005.

[39] It should be mentioned that there are 5 developed countries in this group as well as 19 emerging ones.

approach). However, the results also show that there is a considerable variation in the extent to which capital requirements will raise or fall under the new Accord implemented in different banks. For instance, under the standardized approach the required capital ratio can increase more than 2 times with respect to the current capital ratio at some banks from the "others" group. Moreover, under the IRB-F approach the required capital ratio can decrease by 33% at some banks, while it may increase by 75% at some other banks. It is evident that the current approach is not risk sensitive and thus, for portfolios of lower quality, the increase in the required capital ratio would be striking under the new Accord.

The more extended and recent study, QIS5, by the Basel Committee focuses on three groups of banks. The G10 group results are not of my interest. The second group is called "CEBS" and consisted of 94 banks (80 of these start with the Standardized approach) from 20 countries[40] while the last group is called the other non-G10 countries that included 60 banks (49 of them start with the Standardized approach) from Australia, Bahrain, Brazil, Chile, India, Indonesia, Peru, and Singapore. Moreover, each group has a sub-classification based on the Tier 1 capital amount[41]. The findings of QIS5 is mostly incomparable to those of QIS3 since it includes the most recent changes to the Basel 2 framework, such as the move to a UL-only calculation, 1.06 scaling factor applied to credit risk weighted assets, treatment of revised trading book rules, and different correlation factors for Qualified Revolving Exposures (QRE).

The findings for CEBS group show that the minimum required capital (MRC) could decrease by 3.0% under the standardized, and 16.6% under the IRB-Foundation

[40] These are G10 countries (except U.S) and Bulgaria, Cyprus, Czech Republic, Finland, Greece, Hungary, Ireland, Malta, Norway, Poland, and Portugal.

[41] Group 1 banks are the ones that have over 3 billion euro of Tier 1 capital, a diversified portfolio, and international clients.

approaches while the IRB-Advanced approach leads to the highest reduction (26.6%) relative to the current approach. While these figures reflect reductions, the other non-G10 group results are mixed (for the subclass of banks- 54 of them- with less than 3 billion Euro of Tier 1 capital). Mainly, under the Standardized approach the MRC increases by 38.2%, and under the IRB-Foundation it increases by 11.4%. The IRB-Advanced approach leads to a reduction of 1%. Moreover, the variation in the MRC change is quite substantial for other non-G10 group. Under the standardized approach the MRC increases by 140% for some banks, while under the IRB-Foundation approach MRC change is between +20% to -30%. In fact, it is stated in the results document that, the rather small sample of other non-G10 countries exhibit substantial dispersion both within and between countries mostly due to specialized business profile of certain banks particularities of national implementation.

In short, the impact of the mortgages and operational risk is evident in any approach for both groups of banks, while the corporate and SME corporate segments lead to a reduction in the total MRC amount for both groups with respect to the current approach.

In addition to the QIS3 and QIS5 studies, an internal study that was held for the purpose of QIS3 at Parent Group for its Eastern European subsidiaries demonstrates again that for portfolios of lower quality, the increase in the capital requirements would be substantial. Under the IRB-F approach, the capital requirements of Bank P would increase by 68% over the current approach, while for BBank, UBank, and CZBank this increase would be around 20%.

Furthermore, a study (QIS-TR) that had been done by the Turkish Banking Watchdog (BDDK) covering only the standardized approach reflects similar evidence. The BDDK

included 95% of all the Turkish banking assets owned by 23 banks in the study. Data is used as of July 2003 and calculations are performed by segments. Table 6 shows the banking assets (performing portfolio) as a percentage of total assets in each risk weight class. The results show that, for both corporate and SME segments over 90% of the counterparts will be getting a risk weight of 100% under the standardized approach while under the current approach the ones getting a 100% risk weight presents 51% and 63% of the SME corporate and corporate portfolios respectively. This is due to the fact that under the current approach claims guaranteed by OECD central governments receive a 0% risk weight while the ones guaranteed by the domestic public sector entities receive a risk weight of 0%, 10%, 20%, and 50% at national discretion. Since the OECD distinction is eliminated in the new Accord, under the standardized approach all of these claims guaranteed by the central government or by the domestic public sector entities receive a risk weight of 100%[42].

**Table 6**

The results of the QIS –Turkey published by the Turkish Banking Watchdog (2003)

| Risk Weights | SME Corporate | | Corporate | |
|---|---|---|---|---|
| | Current | Standardized | Current | Standardized |
| 0, 10%, 20% | 28,33% | 0,08% | 21,47% | 0,28% |
| 35% and 50% | 20,64% | 9,23% | 14,60% | 3,04% |
| 100% (including unrated) | 51,03% | 90,69% | 63,92% | 96,09% |
| 150% | 0,00% | 0,00% | 0,00% | 0,59% |

Results from different surveys show that the capital requirements would increase for the low quality portfolios and this would be exacerbated by the capital charge for operational risk. Based on this evidence my hypotheses are:

[42] S&P sovereign rating is BB- as of January 2007.

- Under the standardized approach, the capital requirements (the total for credit and operational risks) for the commercial segments (corporate and SME) of Bank P and Bank K will increase with respect to the current approach. This hypothesis will be accepted depending on the amount of capital charge for operational risks and the capital relief granted to retail portfolios (75% instead of 100%).
- Under the IRB-F approach, the capital requirements (the total for credit and operational risks) for the commercial segments (corporate and SME) of Bank P and Bank K will increase with respect to the current approach. I expect that the risk weighted assets substantially increase due to the impact of PDs on the risk weight function. The increase over the Basel 1 approach would depend on the SME exposures classified as retail as well as the operational risk capital charge.

## 3.1 Portfolio and Segmentation

This study utilizes data from Bank P (Poland) and Bank K (Turkey). These two banks are selected for the simulation for three reasons. Firstly, they are part of the emerging market asset portfolio. Secondly, Bank P and Bank K are superior to others[43] in terms of data availability. Finally, in this study, the focus is on the commercial lending, therefore it is decided to use the most significant portfolios in terms of volume. Bank P has the biggest corporate portfolio volume (including SME corporate) whereas Bank K has the third biggest portfolio[44].

Before moving on to the segmentation definition I would like to emphasize the possible impact of Parent Group's strategy towards Bank P and Bank K on the capital ratios. Prior to the acquisition of Parent Group, Bank P was a pure corporate bank offering loans to

[43] Parent Group owned 6 banks apart from Bank P and Bank K in the Eastern European region.
[44] The subsidiary with the second biggest corporate portfolio had not been considered due to the lack of available data.

the biggest corporate clients in Poland. After acquisition, the Group has started to focus on other segments (i.e. retail) nevertheless, as explained in section 4; the impact had been limited on the portfolio distribution. In the long run the effect of the Group strategy can be more visible. On the other hand, Bank K, prior to Parent Group acquisition, was a small bank offering loans to all segments. Hence, it was not possible to differentiate this bank as a prime lender to one particular segment. Following the acquisition in 2001, this had not changed much and Parent Group maintained a similar strategy. Today Bank K is not inclined towards one segment. Nevertheless, in overall, Bank K has more retail clients as a proportion of total loans than Bank P. In fact, the possible impact of individual bank strategy on the overall capital ratio is further discussed in section 6.

In this study I use the definition of the Basel 2 Accord for segmentation. According to that, a counterpart having an annual turnover (in the most recent year) over 50 million euro is classified as corporate regardless of the exposure amount (para.273 of Basel 2 Accord). Counterparts with lower turnover values are classified as SME corporate. Moreover, exposures towards SME corporate counterparts are treated as a retail[45] exposure whenever the exposure of the banking group to a small business borrower is less than 1 million euro (para.231 of Basel 2 Accord).

## 3.2 Methodology for credit risk

In this section the method for calculating the capital requirements for credit risk is explained[46]. The data is taken at two different dates for Bank P and at one date for Bank K. The advantage of two different dates is being able to compare the change in the capital

[45] The granularity criterion stated in the article 70 of the new Accord is ignored in this study.
[46] I utilized the spreadsheet produced by the Basel Committee for the capital requirements calculation.

requirements under the same approach. Unfortunately, due to short time span, Bank K data is not available at two dates.

As illustrated in the table 7, for the retail exposures under the standardized approach a risk weight of 75% is applied resulting a 6% capital ratio. Moreover, under the same approach, SME corporate and corporate exposures receive a 100% risk weight since I assume all of the counterparts as unrated. In addition to that, R1, R2, and R3 represent the capital adequacy ratios (CARs) that will be calculated for different segments under the IRB-F approach.

**Table 7**

Ratios to be calculated for comparison

| | SME Retail | SME Corporate | Large Corporate |
|---|---|---|---|
| **Basel 1 (current)** | 8% | | |
| **Basel 2 SA approach** | 6% | 8% | |
| **Basel 2 IRB-F** | **R1** | **R2** | **R3** |

By utilising the RWAs, the required capital ratios will be calculated for the entire samples (Bank P and Bank K) under the standardized and IRB-F approaches which then will be compared with the current Basel 1 capital requirement, which is 8%.

For the purpose of IRB-F approach calculation for credit risk, three risk weight functions are used for three segments. In fact SME corporate function is differentiated from the corporate function by applying a slightly different correlation function. The formulas below are used for the derivation of risk weighted assets[47]:

[47] Source: Basel Committee on Banking Supervision (2004). International Convergence of Capital Measurement and Capital Standards, a Revised Framework.

*Corporate segment*

Correlation (R)= 0.12 * (1- EXP (-50 * PD)) / (1- EXP (-50)) +
0.24 * [1 – (1 – EXP (-50 * PD))/(1- EXP (-50))]

Maturity adjustment (b)= (0.11852 – 0.05478 * ln (PD))^ 2

Capital requirement (K)= [LGD * N [(1 – R) ^-0.5 * G (PD) + (R / (1 – R))^0.5 *
G (0.999)] – PD * LGD] * (1 – 1.5 *b)^-1 * (1 + (M – 2.5) * b)

Risk-weighted assets (RWA)= K * 12.5 * EAD

where M, ln, and EXP denote the effective maturity for a given exposure, the natural logarithm, and the exponential function respectively. Moreover, N (x) denotes the cumulative distribution function for a standard normal random variable. G (z) denotes the inverse cumulative distribution function for a standard normal random variable.

*Firm- size adjustment for SME corporate segment*

Correlation (R)= 0.12 * (1- EXP (-50 * PD)) / (1- EXP (-50)) +
0.24 * [1 – (1 – EXP (-50 * PD))/(1- EXP (-50))] – 0.04 * (1 – (S-5)/45)

where S denotes the annual turnover value of the counterpart. For the sake of correlation calculations, any counterpart with a turnover from 1 to 5 million euros will be considered as having 5 million euro turnover as defined in Basel 2.

*SME Retail segment (other retail)*

Correlation (R)= 0.03 * (1- EXP (-35 * PD)) / (1- EXP (-35)) +
0.16 * [1 – (1 – EXP (-35 * PD))/(1- EXP (-35))]

Capital requirement (K)= [LGD * N [(1 – R) ^-0.5 * G (PD) + (R / (1 – R))^0.5 *
G (0.999)] – PD * LGD

Risk-weighted assets (RWA)= K * 12.5 * EAD

where EXP denotes the exponential function, N (x) denotes the cumulative distribution function for a standard normal random variable, and G (z) denotes the inverse cumulative distribution function for a standard normal random variable.

### *3.2.1 Probability of default (PD)*

Both Bank P and Bank K have 17 rating classes for corporate and SME corporate segments. The average PD of one rating class is calculated as the average of the PDs of the counterparts that are in the same rating class. Moreover, the data of the defaulted assets are cleaned out from the entire dataset since it is not relevant for the calculations.

### *3.2.2 Loss given default (LGD)*

All exposures are assumed to be senior under the Foundation approach and a 45% LGD is assigned[48]. I am not able to use own LGD estimates since collateral data is not available. This also means that the use of credit risk mitigation (CRM) techniques to reduce the capital charge is not possible. Nevertheless, a sensitivity analysis is performed in section 5 to assess the change in the required capital ratios with respect to a change in the LGD value.

### *3.2.3 Exposure at default (EAD)*

For Bank P, portfolio the RWAs will be calculated for drawn as well as for undrawn committed exposures. For that purpose, variables corresponding to the total approved limits and to the drawn exposures are extracted from the database. Under the standardized approach a CCF (credit conversion factor) of 50% will be applied to undrawn exposures whereas under the IRB-F approach CCF will be 75%. In addition to that, since I can not differentiate cash and non-cash loans, off-B/S exposures in Bank P sample will be

[48] Article 287 of the new Accord states that under the IRB-F approach, senior claims on corporations, sovereigns, and banks not secured by recognised collateral will be assigned a 45% LGD.

considered automatically as on B/S drawn or undrawn exposure. The above mentioned CCFs are applied to these off- B/S exposures.

On the other hand, for the Bank K sample the case is quite different. At the moment, it is not possible to differentiate between drawn and undrawn parts of a credit line since the current systems of Bank K does not allow it. Therefore, all the on-B/S credit lines are treated as drawn with a CCF of 100%. Moreover, the distinction between cash and non-cash loans in the Bank K sample is not clear (100% CCF applies at all times).

### *3.2.4 Maturity (M) and Turnover (S)*

For Bank P I define the maturity as the time frame between the starting and the expiry dates of any credit line (floor and threshold do not apply) which actually, corresponds to original term to maturity rather than remaining effective maturity. On the other hand, for Bank K, effective maturity is taken as 2.5 years (as in the Foundation approach) since the contract duration data is inaccurate.

Turnover data is retrieved from both Bank P and Bank K samples to be utilised for SME corporate RWA calculations.

## 3.3 Operational risk

QIS 3 results show that for different groups of banks, the capital charge for operational risk considerably adds on to the current capital charges. I utilise the Standardized Approach (TSA) for operational risk capital calculation defined in the new Accord. Based on that, for 2002, 2003, and 2004 the total gross income figure from commercial banking business unit is multiplied by 15% to find the capital charge for that unit. The capital required for the operational risk is the average of the capital charges for the years 2002, 2003, and 2004 under the TSA.

# 4. DATA SAMPLES

## 4.1 Bank P

The corporate and SME customers data in Bank P is extracted from two different databases. The first one, "INES", contains monthly behavioral and transaction data on contract level spanning the period from January 2004 until December 2005. The second database is called "ACE" from which the rating data and the financial statements data are extracted (see appendix 3 for INES and ACE variables).

In Table 8, I present a basic description of the data from the INES database. The first row shows the initial total observations whereas the final row shows the number of observations after a substantial cleaning for all spurious records. Based on that, March 2004 sample is consisted of 3982 observations after data cleaning (elimination of observations with missing granted amount and regular principal as well as observations with wrong or no expiry dates for the credit lines). A similar approach is followed for March 2005 data and at the end of data cleaning 3576 observations are left in the sample.

**Table 8**

Number of observations from INES database as of March 2004 and March 2005

| | **March 2004** | **March 2005** |
|---|---|---|
| # of initial observations | 8386 | 6677 |
| # of obs. with missing granted amount and regular principal | 3034 | 2490 |
| # of obs. with expiry date after 01/03/2004 or 2005 | 1092 | 564 |
| # of obs. with no expiry dates | 278 | 47 |
| # of final observations from INES | **3982** | **3576** |

Unlike the INES data that is monthly, ACE database contains aggregate observations. That means that using the unique identification number (regon_id) from the INES database, I selected the observations from ACE that are included in March 2004 and

March 2005 samples. The first sub database in ACE is the "rating" one from which I obtained PD, final rating (based on year end financial statements data), FS date, and default flag variables; and the second sub database is the "accountancy" one from which I extracted the turnover (based on the year end financial statements) and FS date variables. As a result, before the merge of ACE and INES data samples, I obtained the samples shown below.

**Table 9**

Number of observations from ACE database as of March 2004 and March 2005

| | **March 2004** | **March 2005** |
|---|---|---|
| # of observations from "rating" | **2534** | |
| #of observations from "accountancy" | **11302** | |
| # of observations from INES | 3982 | 3576 |

The unique identification number (regon_id) is used to merge INES with the two ACE datasets. I deleted 249 observations from the March 2004 sample and 202 observations from the March 2005 sample (data cleaning was performed to delete repeated observations). The final data samples after cleaning include 3733 and 3374 observations. In order to find the number of credit lines in each segment based on Basel 2 definitions the following steps are taken:

1. Credit lines towards counterparts with turnover above 50 million euro are defined as corporate segment.
2. Among the remaining ones after step 1, the credit lines of which the volume do not exceed 1 million euro are defined as SME retail exposure.
3. All of the remaining credit lines are defined as SME corporate. Turnover value is relevant for these exposures to calculate the IRB-F capital requirement.

4. Credit lines with missing turnover values are identified. There are 214 and 219 observations without turnover amount respectively in March 2004 and March 2005 samples. These are assumed to be SME corporates (could be also corporate) and a turnover value of 5,000,000 euro is assigned.

The description of final samples is in the below table:

**Table 10**

Description of the final sample

| | March 2004 | March 2005 |
|---|---|---|
| # of obs. after data cleaning | **3733** | **3374** |
| Corporate segment | 241 | 324 |
| SME corporate segment: | 1319 | 1205 |
| SME retail | 2173 | 1845 |
| Total volume of exposures (PLN)* | **21,133,127,766** | **22,720,315,928** |
| Total volume of drawn exposures (PLN) | 17,279,271,565 | 18,403,653,849 |
| Total volume of undrawn exposures (PLN) | 3,853,856,201 | 4,316,662,079 |

***:** *The volumes are in PLN to be consistent with the real data. 1 Euro was equal to 4.81 PLN and 3.88 PLN in March 2004 and March 2005 respectively. Therefore, the total volume of exposures is equal to 4.49 billion and 5.92 billion euros respectively in March 2004 and March 2005.*

It is important to note that in the final samples some rating and PD data were missing for corporate segment exposures (241 and 324). A substitute PD value separately for the samples is utilized. I have assigned a PD of 1.66% and 1.36% to these exposures respectively in March 2004 and March 2005 samples[49]. Based on the PDs all of the 241 exposures are classified in the rating class 5 and all of the 324 exposures are classified in the rating class 3 of the respective samples in the table below.

[49] Based on the internal reports of Parent Group and Bank P, the average PD of the large corporate segment had been 1,66% and 1,36% respectively in March 2004 and March 2005.

**Table 11**

Average PD per rating class as of March 2004 and March 2005

| Rating Class | Average PD (March 2004) | # of exposures as a percent of total (March 2004) | Average PD (March 2005) | # of exposures as a percent of total (March 2005) |
|---|---|---|---|---|
| 1 | 0,213% | 5,04% | 0,269% | 6,43% |
| 2 | 0,536% | 2,41% | 0,813% | 3,20% |
| 3 | 0,857% | 2,14% | 1,370% | 16,80% |
| 4 | 1,239% | 2,44% | 1,814% | 5,90% |
| 5 | 1,675% | 14,63% | 2,175% | 6,76% |
| 6 | 2,326% | 11,06% | 2,698% | 8,48% |
| 7 | 3,272% | 13,55% | 3,474% | 14,02% |
| 8 | 3,893% | 3,59% | 4,127% | 6,58% |
| 9 | 4,153% | 9,13% | 4,620% | 4,30% |
| 10 | 4,663% | 2,76% | 5,064% | 2,96% |
| 11 | 5,124% | 4,98% | 5,288% | 4,27% |
| 12 | 5,601% | 2,68% | 5,767% | 3,14% |
| 13 | 6,416% | 6,05% | 6,331% | 2,64% |
| 14 | 7,329% | 8,71% | 6,859% | 5,75% |
| 15 | 10,592% | 7,90% | 9,377% | 5,13% |
| 16 | 20,086% | 2,57% | 17,617% | 3,32% |
| 17 | 43,878% | 0,35% | 40,109% | 0,33% |
| **Sample** | **4,604%** | **100,00%** | **4,028%** | **100,00%** |

In addition to the above PD figures, it is also calculated that for the corporate segment the simple average PD has been 1.66% and 1.36%; for the SME corporate it has been 5.91% and 5.13%; for the SME retail it has been 4.14% and 3.77% respectively in March 2004 and March 2005.

## 4.2 Bank K

The corporate and SME customers data of Bank K is extracted from two different datasets. The first one is the behavioral dataset (BEH) that contains behavioral data on contract level (individual product level), and the second one is ACE that contains the rating and financial statements data (see appendix 3 for BEH and ACE variables). ACE is composed of many other sub datasets. I used two sub datasets to

extract the ACE variables. These are the so called "client records" and "turnover" sub datasets.

The "client records" dataset is composed of 4186 observations, and the "turnover" dataset contains 14603 observations from which the year end 2003 and the year end 2004 turnovers will be utilized. To merge these datasets, the client_id variable is used.

**Table 12**

Number of observations in different Bank K datasets

| Dataset Name | # of observations in each dataset |
|---|---|
| Client Records | **4186** |
| Turnover | **14603** |
| Year 2001 | 2081 |
| Year 2002 | 5059 |
| Year 2003 | 5616 |
| Year 2004 | 1847 |
| BEH | **16383** |

The BEH dataset contains the client_id as the unique identifier, the start and end date variables and the approved amount of exposure. The start date and end date variables are used for the purpose of identifying which exposures are included in the risk weighted asset calculations being an active exposure for the portfolio at the time of calculation (the snapshot date). On the other hand, the approved amount (of the credit line) is used as a total drawn since it was not possible to differentiate between drawn and undrawn portions of the credit line.

The last step before any calculations is to merge the "client records" dataset including turnover figures and the BEH dataset. This is done by using the client_id attribute. The merged sample includes 19421 observations with a total approved amount of 7,103,616,669 YTL (as of September 2005, 1 Euro was equal to 1.6 YTL). However, in this sample there are 6282 observations with missing PDs and missing total approved

amounts. Then there are also many repetitions of the same credit lines of the same client. Hence, I had to clean my sample from these observations as well. There are 1448 of them. At the end I am left with 11664 observations.

**Table 13**

Final data cleaning

| | Remaining # of observations |
|---|---|
| # of observations from "client records" with "turnover" | 4186 |
| # of observations from BEH dataset | 16383 |
| # of observations after merge | 19421 |
| # of observations with missing PDs and missing total approved amounts | 6282 |
| # of observations with missing other attributes | 27 |
| # of repeated observations | 1448 |
| **# of final observations before date of calculation selection** | **11664** |

The total approved amount is 5,542,959,153 YTL for 11664 observations. Due to the deletion of 6282 observations without PDs there is a reduction of about 1.6 billion YTL in the approved amount.

The first start date of the observations is 21/05/2004 and the last start date is 06/07/2005. While selecting the date for calculation I considered the total approved amount values published quarterly as well. Moreover, the first end date of observations is 02/11/2004 and the last end date is 06/07/2010. If a very recent date for calculation had been selected (such as end of June 2006) then most of the credit lines in my sample would have been expired already. With these considerations in mind I picked the calculation date as end of September 2005. Therefore, any credit line with an ending date that is before the end of September is eliminated from the sample**.** In addition to that, the above mentioned time

span of the Bank K data sample does not allow for a dynamic approach. Mainly, the RWA calculations are not performed for two dates as in the Bank P sample.

After the above eliminations the final sample is consisted of 9660 observations. This sample is further divided into segments (corporate, SME corporate, and SME retail) based on the segmentation criteria per Basel 2. In order to find the number of credit lines in each segment the following steps are taken:

1. Credit lines towards counterparts with turnover above 50 million euro are defined as corporate segment.
2. Among the remaining ones after step 1, the credit lines of which the volume do not exceed 1 million euro are defined as SME retail exposures.
3. All of the remaining credit lines are defined as SME corporates. Turnover value is relevant for these exposures to calculate the IRB-F capital requirement.
4. Credit lines with missing turnover values are identified. There are 1815 observations without turnover amount by September 2005. All of these clients are SME retail clients for which the turnover rate is not relevant for calculations.

The description of final samples is in the below table:

**Table 14**

Number and volume of observations by segment

| | # of observations as of September 2005 | Total volume (YTL)* |
|---|---|---|
| Corporate segment | 373 | 1,286,353,372 |
| SME Corporate segment | 297 | 1,398,136,134 |
| SME Retail segment | 8990 | 1,853,455,321 |
| **Total** | **9660** | **4,537,944,826** |

** As of September 2005, 1 Euro was equal to 1.6 YTL.*

The above figures show that, SME retail segment constitutes 40.8% of the total exposures while the rest of Bank K portfolio is equally shared between corporate and SME corporate segments.

Similar to Bank P, Bank K's current corporate rating model has 17 rating grades. The table below shows the average PD of each rating grade and the distribution of exposures over these grades.

**Table 15**

Average PD per rating class as of September 2005

| Rating Class | Average PD (as of September 2005) | # of exposures as a percent of total (as of September 2005) |
|---|---|---|
| 1 | 0.51% | 0.43% |
| 2 | 0.73% | 1.44% |
| 3 | 0.86% | 1.05% |
| 4 | 1.01% | 2.34% |
| 5 | 1.17% | 18.24% |
| 6 | 1.32% | 8.14% |
| 7 | 1.49% | 15.87% |
| 8 | 1.76% | 12.28% |
| 9 | 2.03% | 6.08% |
| 10 | 2.13% | 5.08% |
| 11 | 2.83% | 6.42% |
| 12 | 3.86% | 3.57% |
| 13 | 5.34% | 5.47% |
| 14 | 7.47% | 6.72% |
| 15 | 10.47% | 3.60% |
| 16 | 14.59% | 2.27% |
| 17 | 20.07% | 1.01% |
| **Sample** | **3.08%** | **100.00%** |

In addition to the above average PD, it is also calculated that for the corporate segment, the simple average PD has been 1.52%; for the SME corporate it has been 2.58%; for the SME retail it has been 3.16% as of September 2005.

# 5. RESULTS

## 5.1 Bank P

The capital adequacy ratio of the commercial segment calculated for the new Accord reflects any possible changes in the overall capital requirement of a bank. In this study, the CARs are calculated for the commercial segment of Bank P at two dates including the capital charge for operational risk. In any case, we have to be cautious with regards to the conclusions because of the assumptions made. These are listed below:

1- CRM is not applied, and all exposures are assumed to be senior.

2- CCFs are utilized as 50% and 75% for the undrawn exposures under the standardized and IRB-F approaches.

3- Missing turnover values are assumed as 5,000,000 PLN (214 and 219 exposures in March 2004 and March 2005 samples respectively).

4- Corporate counterparts with missing PD and rating data are all assigned a unique PD (1.66% and 1.36% in March 2004 and March 2005 samples, respectively).

The results in Table 16 show that CARs in March 2004 and March 2005 will be 7.93% and 7.94% respectively for the entire commercial portfolio under the standardized approach. This means that there is only a slight reduction of required capital ratio with respect to the current approach of the Basel 1. On the contrary, the IRB-F approach translates into an increase in capital requirements over the Basel 1. In March 2004 and March 2005 there is 2.08% and 1.58% increase respectively in CARs over the current approach. It is important to note that the firm size adjustment for SME corporate exposures did not result a very distinct capital ratio than the corporate segment one. This is purely because of the higher PD of the SME corporate segment. On the contrary, the

capital requirements substantially decrease for the SME retail segment. The CARs under the IRB-F approach for both samples are lower than 6%, which is the required capital ratio under the standardized approach for SME retail segment. Nevertheless, the volume of the SME retail segment is about 7% to 7.5% of the corporate and the SME corporate segments. Therefore, the capital adequacy ratio of the entire portfolio is not affected substantially by the low CAR of the SME retail segment.

**Table 16**

RWAs and Capital Adequacy Ratios per segment and per approach

| **Corporate** | **March 2004** | **March 2005** |
|---|---|---|
| exp1 | 9,276,846,263 | 10,030,595,613 |
| RWA Standardized | 9,276,846,263 | 10,030,595,613 |
| CAR | 8,00% | 8,00% |
| exp2 | 9,583,603,621 | 10,461,510,135 |
| RWA IRB-Foundation | 12,415,785,337 | 12,965,558,341 |
| **R3** | **10.36%** | **9.91%** |
| **SME Corporate** | | |
| exp1 | 9,238,594,291 | 9,929,783,164 |
| RWA Standardized | 9,238,594,291 | 9,929,783,164 |
| CAR | 8,00% | 8,00% |
| exp2 | 9,858,019,137 | 10,539,353,513 |
| RWA IRB-Foundation | 12,556,026,765 | 12,557,799,765 |
| **R2** | **10.19%** | **9.53%** |
| **SME Retail** | | |
| exp1 | 690,759,112 | 601,606,111 |
| RWA Standardized | 518,069,334 | 451,204,583 |
| CAR | 6,00% | 6,00% |
| exp2 | 728,040,958 | 640,286,761 |
| RWA IRB-Foundation | 438,444,404 | 380,423,395 |
| **R1** | **4.82%** | **4.75%** |
| **Total Sample** | | |
| exp1 | 19,206,199,666 | 20,561,984,888 |
| RWA Standardized | 19,033,509,888 | 20,411,583,361 |
| **CAR** | **7.93%** | **7.94%** |
| exp2 | 20,169,663,716 | 21,641,150,408 |
| RWA IRB-Foundation | 25,410,256,507 | 25,903,781,500 |
| **CAR** | **10.08%** | **9.58%** |

* All exposures are in PLN (zloty) absolute values. Exp1 and exp2 represent total exposure under the standardized and IRB-F approaches respectively and vary due to the usage of different CCFs.

By looking at these results, it is clear that there should not be a substantial change in the capital requirements if Bank P adopts the standardized approach. However, there are no incentives, in terms of required capital, for Bank P to adopt the IRB-F approach versus the standardized approach. The former approach might require lower capital only for portfolios with lower average PDs than the ones of Bank P (e.g SME corporate).

In addition to the above results, under the new Accord, capital requirements will increase further due to additional capital for the operational risk. Before calculating the capital charge for operational risk, I would like to present a LGD sensitivity analysis to show how the risk weighted assets might change due to a higher or lower LGD than 45%.

Under the IRB-Foundation approach using the same amount of exposure, I am only adjusting the LGD value to test the RWA sensitivity to different LGD figures. This is important since, the recovery rate of emerging country defaulted assets might be much lower than 55%. The table below shows the capital calculations with 30%, 45%, 60%, and 75% LGD value.

**Table 17**

LGD sensitivity analysis

| **Total Sample** | **LGD=45%** | **LGD=30%** | **LGD=60%** | **LGD=75%** |
|---|---|---|---|---|
| *Data as of March 2004* | | | | |
| exposure | 20,169,663,716 | 20,169,663,716 | 20,169,663,716 | 20,169,663,716 |
| RWA IRB-Foundation | 25,410,256,507 | 16,940,171,004 | 33,880,342,009 | 42,350,427,511 |
| **CAR** | **10,08%** | **6,72%** | **13,44%** | **16,80%** |
| | | | | |
| *Data as of March 2005* | | | | |
| exposure | 21,641,150,408 | 21,641,150,408 | 21,641,150,408 | 21,641,150,408 |
| RWA IRB-Foundation | 25,903,781,500 | 17,269,187,666 | 34,538,375,333 | 43,172,969,166 |
| **CAR** | **9,58%** | **6,39%** | **12,78%** | **15,97%** |

As seen in the above table, the capital adequacy ratio goes up to 15.97% if an average LGD of 75% is applied to the entire portfolio. Moreover, I would like to add the capital charge against the operational risk on top of the base LGD case. According to my

calculations the capital amount required for operational risk under TSA approach will be 90,615,050 PLN (Table 18) considering the total gross income of the commercial banking division in 2002, 2003, and 2004.

**Table 18**

Total Gross Income for operational risk calculation

| Year | Total Gross Income (PLN) (Commercial Banking Division) | Beta Factor |
|---|---|---|
| 2002 | 652,017,000 | 15% |
| 2003 | 611,750,000 | 15% |
| 2004 | 548,534,000 | 15% |
| | **Total capital required for the division:** | 90,615,050 |

Under the standardized and IRB-F approaches, the amount of capital required for the operational risk is the same. Based on that, in March 2004, under the standardized approach the above capital requirement implies a 0,47% increase in the overall CAR, bringing it up to 8,40%, whereas under the IRB-F approach the overall CAR including the operational risk capital requirement goes up to 10,53%. Hence, the impact of the operational risk capital on the overall capital adequacy ratio is about 50 basis points. The same capital charge is applied to the sample of March 2005 as seen in Table 19.

**Table 19**

CAR including the operational risk

| CAR including credit and operational risks | March 2004 | March 2005 |
|---|---|---|
| Standardized Approach | **8,40%** | **8,38%** |
| IRB- Foundation Approach | **10,53%** | **9,99%** |

However, for both samples under the IRB-F approach the required capital ratio is about 2% to 2.5% higher than the current requirements when we account for the operational risk capital charge.

My final analysis before concluding this section considers any possible reduction in the commercial portfolio of Bank P. By looking at the IRB-F capital adequacy ratios in Table 16 (base cases), it is clear that Bank P will be capital constraint. Based on my previous calculations, the CAR was found to be 10.08% and 9.58% for the March 2004 and March 2005 samples, respectively. In order to reduce the risk weighted asset amount, Bank P may drop out the most risky clients from its portfolio (given the same capital amount). The table below shows what percentage of the portfolio would be dropped out to avoid an increase in the absolute amount of regulatory capital required. Unfortunately, the corporate segment can not be included in this analysis since a fixed 1.36% PD was assigned to each exposure and therefore, all of these exposures are in the rating class 3. On the other hand, I drop out the most risky exposures from the SME segments (SME corporate and retail) to meet the 8% capital adequacy ratio under the Basel 1 approach.

**Table 20**

Capital Adequacy Ratios after elimination of the most risk clients

| **SME corporate and SME retail segments only** | **March 2004** | **March 2005** |
|---|---|---|
| Total exposure | 10,586,060,095 | 11,179,640,074 |
| RWA | 12,994,471,169 | 12,938,223,160 |
| Capital Ratio (excluding operational risk capital charge) | 9.82% | 9.26% |
| Adjusted total exposure | 7,229,379,834 | 9,359,712,277 |
| Adjusted RWA | 7,432,173,831 | 9,537,657,457 |
| Adjusted CAR | 8.22% | 8.15% |

From both samples Bank P could drop out the most risky client exposures from the portfolio. Based on that in March 2004, eliminating the SME exposures in rating grades 15, 16, and 17 would reduce the CAR to 8.22% from 9.82% whereas in March 2005, the same type of exposures in rating grades 16 and 17 should have been eliminated to avoid

an increase in the absolute amount of regulatory capital requirement. These figures show that 16.3% and 31.7% of the SME exposures would have to be dropped from the March 2004 and March 2005 samples (see section 6 for the implications of these results).

## 5.2 Bank K

The segmentation analysis shows that most of the Bank K's exposures are "SME retail" types and this will certainly be reflected positively in the total required capital calculations. In any case, we have to be cautious with regards to the conclusions because of the assumptions made. These are listed below:

1. Due to the deletion of 6282 observations without PDs there is a reduction of about 1.6 billion YTL in the total approved amount of the sample considered.
2. CRM is not applied, and all exposures are assumed to be senior.
3. Different CCFs are not utilized for drawn/undrawn exposures and cash/non-cash exposures as they were not distinguishable in the system as of the date of data extraction.

The results in the table below show that CARs as of September 2005 are lower than 8% under the standardized and IRB-Foundation approaches. This means that there is a reduction of required capital ratio with respect to the current approach of the Basel 1. Especially, the results for the SME retail segment are striking. Under the IRB-Foundation approach the capital adequacy ratio goes down to 4.59%. Moreover, the large proportion of SME retail exposures in the entire sample reduces the overall CAR to 6.15%.

**Table 21**

RWAs and Capital Adequacy Ratios per segment and per approach

| **Corporate** | **Results as of September 2005** |
|---|---|
| exposure | 1,286,353,372 |
| RWA Standardized | 1,286,353,372 |
| CAR | **8,00%** |
| exposure | 1,286,353,372 |
| RWA IRB-Foundation | 1,213,354,850 |
| **R3** | **7,55%** |
| **SME Corporate** | |
| exposure | 1,398,136,134 |
| RWA Standardized | 1,398,136,134 |
| CAR | **8,00%** |
| exposure | 1,398,136,134 |
| RWA IRB-Foundation | 1,212,019,347 |
| **R2** | **6,94%** |
| **SME Retail** | |
| exposure | 1,853,455,321 |
| RWA Standardized | 1,390,091,491 |
| CAR | **6,00%** |
| exposure | 1,853,455,321 |
| RWA IRB-Foundation | 1,063,153,056 |
| **R1** | **4,59%** |
| **Total Sample** | |
| exposure | 4,537,944,826 |
| RWA Standardized | 4,074,580,997 |
| **CAR** | **7,18%** |
| exposure | 4,537,944,826 |
| RWA IRB-Foundation | 3,488,527,252 |
| **CAR** | **6,15%** |

* All exposures are in YTL (new Turkish Lira) absolute values.

The above results reflect that the required capital ratio for the commercial segment will be capped by the 8% floor limit. Based on that, Bank K will not be capital constraint under any of the Basel 2 approaches. However, Bank K average PD figures mentioned in section 4.2 do not seem to reflect the real default rates in the country. Hence, at the end of this section (5.2), an analysis is performed to calculate RWAs based on upper confidence bands. Before that, I would like to make a sensitivity analysis as performed for Bank P.

Under the IRB-Foundation approach using the same amount of exposure I am only adjusting the LGD value to test the RWA sensitivity to different LGD figures. The table below shows the capital calculations with 30%, 45%, 60%, and 75% LGD value.

**Table 22**

LGD sensitivity analysis

| **Corporate** | **LGD=45%** | **LGD=30%** | **LGD=60%** | **LGD=75%** |
|---|---|---|---|---|
| exposure | 1,286,353,372 | 1,286,353,372 | 1,286,353,372 | 1,286,353,372 |
| RWA IRB-Foundation | 1,213,354,850 | 808,903,233 | 1,617,806,467 | 2,022,258,083 |
| **R3** | **7.55%** | **5.03%** | **10.06%** | **12.58%** |
| **SME Corporate** | | | | |
| exposure | 1,398,136,134 | 1,398,136,134 | 1,398,136,134 | 1,398,136,134 |
| RWA IRB-Foundation | 1,212,019,347 | 808,012,898 | 1,616,025,795 | 2,020,032,244 |
| **R2** | **6.94%** | **4.63%** | **9.25%** | **11.57%** |
| **SME Retail** | | | | |
| exposure | 1,853,455,321 | 1,853,455,321 | 1,853,455,321 | 1,853,455,321 |
| RWA IRB-Foundation | 1,063,153,056 | 708,768,704 | 1,417,537,408 | 1,771,921,760 |
| **R1** | **4.59%** | **3.06%** | **6.12%** | **7.65%** |
| **Total Sample** | | | | |
| exposure | 4,537,944,826 | 4,537,944,826 | 4,537,944,826 | 4,537,944,826 |
| RWA IRB-Foundation | 3,488,527,252 | 2,325,684,835 | 4,651,369,670 | 5,814,212,087 |
| **CAR** | **6.15%** | **4.10%** | **8.20%** | **10.25%** |

By comparing the above results with the standardized approach ones, it is clear that the capital charge will go up to 10.25% under the IRB-Foundation approach using an average 75% LGD value. To better assess the Bank K case, we need to calculate the capital requirements for operational risk. The below figures reflect the operational income of the entire Bank K portfolio rather than only the commercial banking division[50]. According to my calculations the capital amount required for operational risk under TSA approach will be 89,558,600 YTL (Table 23) considering the total gross income of the commercial banking division in 2002, 2003, and 2004.

[50] Bank K was not public, and the annual reports do not show the operational income per business division.

**Table 23**

Total Gross Income for operational risk calculation

| Year | Total Gross Income (YTL) | Beta Factor |
|---|---|---|
| 2002 | 418,508,000 | 15% |
| 2003 | 593,654,000 | 15% |
| 2004 | 779,010,000 | 15% |
| **Total capital required for the division:** | | 89,558,600 YTL |

Under the standardized and IRB-F approaches, the amount of capital required for the operational risk is the same. Based on that, in September 2005, under the standardized approach the above capital requirement implies a 1.98% increase in the overall CAR bringing it up to 9.16% (base case LGD), whereas under the IRB-F approach the overall CAR including the operational risk capital requirement goes up to 8.13%. Hence, the impact of the operational risk capital (considering the operational income of the entire Bank K portfolio) on the overall capital adequacy ratio is about 200 basis points. The same capital charge is applied to the sample of March 2005 as seen in Table 24.

**Table 24**

CAR including the operational risk

| CAR including credit and operational risks | September 2005 |
|---|---|
| Standardized Approach | **9.16%** |
| IRB- Foundation Approach | **8.13%** |

The results show that under the standardized and IRB-F approaches the capital adequacy ratios exceed the current 8% requirement when the operational risk is considered.

Before concluding, I would like to present my final analysis that show the impact of PDs on risk weighted assets. Here, I estimate upper and lower confidence bands for each Bank K rating class and then recalculate the RWA for PDs based on the upper and lower confidence levels in each rating class.

Using the methodology from Hanson and Schuermann (2005) I apply the cohort approach to calculate the confidence interval (analytical confidence intervals for cohort based PDs) which assumes that default is a binomial random variable. This approach is suitable since Bank K dataset only contains beginning of period PDs. The standard Wald confidence interval $CI_w$ is:

$$CI_w = PD_R \pm K * \sqrt{\frac{PD_R(1-PD_R)}{N_R}}$$

where $N_R$ is the total number of firms that began the year in rating $R$, $PD_R$ is the one-year probability of default for a firm with rating $R$, and $K$ is the $1-\alpha/2$ quantile of the standard normal distribution ($\alpha$ = 5%, $K$ = 1.96). This equation assumes that the probability of default does not vary systematically across time or industry, and that the likelihood of default for firm $i$ in year $t$ is independent of firm $j$ in the same year. Using the above formula the lower and upper confidence intervals are calculated as below. The second column shows the average PD of the rating class and the third column shows the corresponding observations. The fourth and the fifth columns show the lower and upper confidence bands calculated through the above technique (the last two columns are in percentage). Length of the interval is the difference between upper and lower bands.

**Table 25**

Upper and Lower confidence band PDs

| Rating Class | PD | # of Firms | lower | upper | length | % | % |
|---|---|---|---|---|---|---|---|
| 1 | 0.510% | 42 | -0.01656 | 0.026762 | 0.043325 | -1.656 | 2.676 |
| 2 | 0.730% | 139 | -0.00685 | 0.021447 | 0.028294 | -0.685 | 2.145 |
| 3 | 0.860% | 101 | -0.00937 | 0.02657 | 0.035940 | -0.937 | 2.657 |
| 4 | 1.010% | 226 | -0.00294 | 0.023135 | 0.026070 | -0.294 | 2.314 |
| 5 | 1.170% | 1762 | 0.006679 | 0.016721 | 0.010042 | 0.668 | 1.672 |
| 6 | 1.320% | 786 | 0.005223 | 0.021177 | 0.015955 | 0.522 | 2.118 |
| 7 | 1.490% | 1533 | 0.008835 | 0.020965 | 0.012129 | 0.884 | 2.096 |
| 8 | 1.760% | 1186 | 0.010117 | 0.025083 | 0.014966 | 1.012 | 2.508 |
| 9 | 2.030% | 587 | 0.008895 | 0.031705 | 0.022811 | 0.889 | 3.171 |
| 10 | 2.130% | 491 | 0.008525 | 0.034075 | 0.025549 | 0.853 | 3.407 |
| 11 | 2.830% | 620 | 0.015249 | 0.041351 | 0.026103 | 1.525 | 4.135 |
| 12 | 3.860% | 345 | 0.018268 | 0.058932 | 0.040664 | 1.827 | 5.893 |
| 13 | 5.340% | 528 | 0.03423 | 0.07257 | 0.038340 | 3.423 | 7.257 |
| 14 | 7.470% | 649 | 0.054475 | 0.094925 | 0.040450 | 5.448 | 9.492 |
| 15 | 10.470% | 348 | 0.072521 | 0.136879 | 0.064358 | 7.252 | 13.688 |
| 16 | 14.590% | 219 | 0.099176 | 0.192624 | 0.093447 | 9.918 | 19.262 |
| 17 | 20.070% | 98 | 0.121224 | 0.280176 | 0.158952 | 12.122 | 28.018 |

One important observation is that for rating classes with low number of observations the Wald interval can not be estimated accurately. Based on the above results, instead of the upper and lower confidence band PDs, for the first four rating classes the ones in column 2 of the above table are used to calculate RWAs.

The new RWAs and the corresponding capital adequacy ratios under the IRB approach are presented below. Based on that, the total CAR using the upper confidence PD is about 0.5% higher than the standard RWA. This increase is mostly due to an increase in the RWAs of SME corporate (9.65%) and SME retail (9.33%) segments.

**Table 26**

RWAs based on upper confidence band PDs

| Total Sample | Results as of September 2005 |
|---|---|
| exposure | 4,537,944,826 |
| RWA IRB-Foundation (avg. PD) | 3,488,527,252 |
| **CAR** | **6.15%** |
| RWA IRB-Foundation (lower confidence PD) | 3,016,507,119 |
| **CAR** | **5.32%** |
| RWA IRB-Foundation (upper confidence PD) | 3,752,676,252 |
| **CAR** | **6.62%** |

*: All exposures are in YTL (new Turkish Lira) absolute values

The results presented for Bank P and Bank K might have different implications for emerging countries and banks. The next section discusses these implications.

# 6. IMPLICATIONS OF RESULTS AND DISCUSSION

In this study I perform a simulation analysis by using a pre- Basel 2 sample from two emerging country banks in order to investigate any possible increase in the capital adequacy ratios. The results from Bank P and Bank K samples will have different implications as well as some common ones.

Bank P results show that under the Foundation approach the CAR can go up to 15.97% when the LGD is set as 75%. Moreover, the CAR will increase about 0.5% on top of the base case due to the consideration of the capital charge for operational risk. Therefore, it is fairly clear that the capital requirement will exceed the current 8% requirement. Bank P, in order to reduce the capital adequacy ratio, might increase the government securities in its portfolio as a percentage of the total bank assets and decrease the commercial lending (given that there is no capital injection). In fact, my further analysis in section 5.1 shows that the capital adequacy ratio (9.82%) under the Foundation approach as of March 2004 will reduce to 8.22% if Bank P shrinks its SME portfolio by at least 16% through cutting lending to its most risk clients in rating grades 15, 16, and 17. This result shows that some emerging country banks might have to cut commercial lending after Basel 2 implementation and increase the percentage of less risky assets in their portfolios.

Another implication of my findings is related with the proportion of SME retail exposures (exposures less than 1 million euro in amount) in the commercial segment. It is evident that the capital adequacy ratio calculations are substantially affected (ratio being reduced) by the SME retail exposures in the portfolio. Mainly, the descriptive analysis shows that almost 40% of all Bank K commercial exposures is classified as SME retail while this ratio is only 3.6% for Bank P. As a result the total CAR of Bank K under the

base case (LGD=45%) is only 6.15%. In fact, the capital ratios also reflect the strategies set for Bank P and Bank K by Uncredit Group (see section 3.1). Having not focused on retail segments, Bank P did not achieve a reduction in the overall capital ratio. This result implies that emerging country banks holding risky assets might increase the percentage of SME retail exposures in their portfolios in order to reduce the total CAR.

The analysis of Bank K data also prove that bank supervisors in emerging countries should ensure the usage of sound and accurate rating models. After having compared the average PDs presented in section 4 for Bank P and Bank K I made an additional analysis to estimate the upper confidence band PDs for each Bank K rating grade and recalculated the RWAs. Upper confidence band PDs increased the capital adequacy ratio from 6.15% to 6.62%. This implies that emerging country supervisors should ensure that banks consider such factors while allocating capital. Moreover, supervisors should also encourage banks to improve their internal rating models.

While doing my empirical analysis, I was obliged to make several assumptions due to the data quality. Especially, the accuracy of Bank K capital ratios has been highly affected by the poor quality data. For instance, I have excluded 6282 observations with missing PDs assuming that the sample used is representative of the excluded observations. In this sense, the Bank K data might have been slightly biased. Nevertheless, if we consider the capital ratios calculated under the Foundation approach with a LGD of 75% and include the capital charge for operational risk, it is clear that both of the banks will be capital constrained. Based on my analysis, the change in the capital ratios will be mostly affected by high LGDs, percentage of SME retail clients in the commercial portfolio, the accurate calculation of PDs and the inclusion of the capital charge for operational risk.

To conclude, this study only reflects the impact of Basel 2 on a pre- Basel 2 sample. Both of the hypotheses are somewhat accepted, however, a structural change of the lending behaviour of these banks could only be fully captured using a long time span data including years after the implementation of the new Accord.

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# APPENDIX 1

## Country Statistics

1. Standard Deviation and average for various macroeconomic indicators in selected developed and emerging countries (1992-2005)

| | GDP (% real change pa) | | Trade balance (b $) | | Total exports (b $) | |
|---|---|---|---|---|---|---|
| **Emerging Country** | STA.DEV. | AVG. | STA.DEV. | AVG. | STA.DEV. | AVG. |
| ARGENTINA | 6.48 | 3.12 | 7497.92 | 4134.76 | 7204.63 | 24443.90 |
| BRAZIL | 2.03 | 2.68 | 14390.34 | 8831.87 | 21586.84 | 58493.73 |
| BULGARIA | 4.59 | 1.78 | 1340.62 | -1167.09 | 2476.33 | 5669.12 |
| CHILE | 3.33 | 5.55 | 3385.32 | 1962.51 | 7739.88 | 18685.74 |
| CHINA | 2.25 | 9.68 | 25228.34 | 33883.20 | 198128.92 | 270541.22 |
| CROATIA | 5.55 | 2.25 | 2568.61 | -4586.59 | 1613.71 | 5182.87 |
| CZECH REPUBLIC | 2.57 | 2.15 | 1601.61 | -2537.67 | 20666.19 | 34305.29 |
| INDONESIA | 5.38 | 4.27 | 7560.07 | 15766.91 | 12138.40 | 52918.68 |
| KOREA, REP. OF | 4.03 | 5.18 | 18183.93 | 13336.08 | 57348.22 | 151927.08 |
| MEXICO | 3.33 | 2.91 | 7473.07 | -7024.41 | 52785.34 | 124967.80 |
| POLAND | 1.79 | 4.28 | 4563.65 | -6770.87 | 22449.72 | 35637.17 |
| ROMANIA | 5.24 | 1.98 | 2361.04 | -2854.97 | 7334.53 | 11611.31 |
| SLOVAKIA | 3.32 | 3.97 | 829.68 | -1397.98 | 9022.73 | 14236.46 |
| TURKEY | 5.60 | 4.06 | 7118.19 | -13392.79 | 17057.25 | 32084.97 |
| TUNISIA | 1.96 | 4.73 | 262.92 | -2118.34 | 1962.09 | 6295.66 |
| | **GDP (% real change pa)** | | **Trade balance (b $)** | | **Total exports (b $)** | |
| **Developed Country** | STA.DEV. | AVG. | STA.DEV. | AVG. | STA.DEV. | AVG. |
| CANADA | 1.43 | 3.15 | 15.48 | 30.35 | 60.91 | 230.28 |
| FRANCE | 1.19 | 1.86 | 13.33 | 6.13 | 68.73 | 307.30 |
| GERMANY | 1.09 | 1.42 | 54.74 | 92.16 | 180.06 | 591.78 |
| ITALY | 1.14 | 1.29 | 15.79 | 22.64 | 57.74 | 250.48 |
| NETHERLANDS | 1.55 | 2.18 | 4.99 | 20.96 | 62.83 | 215.71 |
| UNITED KINGDOM | 1.00 | 2.67 | 34.32 | -49.22 | 51.96 | 267.25 |
| UNITED STATES | 1.08 | 3.31 | 218.09 | -352.53 | 133.14 | 669.30 |

*Source: EIU (Economic Intelligence Unit) country data, series from 1992 to 2005.*

2. Standard Deviation and average for selected macroeconomic indicators in selected developed and emerging countries (1992-2005)

| | Consumer prices (% change pa) | | Exchange rate LCU:US$ (av) | |
|---|---|---|---|---|
| **Emerging Country** | STA.DEV | AVG. | STA.DEV | AVG. |
| ARGENTINA | 9.12 | 6.72 | 0.92 | 1.56 |
| BRAZIL | 737.16 | 363.93 | 1.06 | 1.60 |
| BULGARIA | 275.75 | 111.40 | 0.89 | 1.20 |
| CHILE | 4.35 | 6.16 | 115.00 | 509.96 |
| CHINA | 7.79 | 5.61 | 0.98 | 7.93 |
| CROATIA | 416.97 | 126.85 | 1.98 | 5.95 |
| CZECH REPUBLIC | 5.51 | 6.88 | 4.57 | 30.33 |
| INDONESIA | 23.67 | 7.80 | 3548.05 | 6181.85 |
| KOREA, REP. OF | 1.74 | 4.19 | 218.24 | 1036.79 |
| MEXICO | 10.41 | 13.50 | 2.93 | 8.00 |
| POLAND | 14.59 | 15.82 | 0.93 | 3.18 |
| ROMANIA | 80.85 | 77.36 | 1.37 | 1.57 |
| SLOVAKIA | 3.21 | 7.84 | 6.86 | 36.17 |
| TURKEY | 29.90 | 60.12 | 0.64 | 0.62 |
| TUNISIA | 1.28 | 3.57 | 0.18 | 1.16 |
| **Developed Country** | **Consumer prices (% change pa)** | | **Exchange rate LCU:US$ (av)** | |
| CANADA | 0.70 | 1.86 | 0.11 | 1.39 |
| FRANCE | 0.55 | 1.68 | 0.12 | 0.89 |
| GERMANY | 1.29 | 1.99 | 0.12 | 0.89 |
| ITALY | 1.23 | 3.08 | 0.12 | 0.89 |
| NETHERLANDS | 0.76 | 2.41 | 0.12 | 0.89 |
| UNITED KINGDOM | 0.87 | 1.88 | 0.05 | 0.62 |
| UNITED STATES | 0.55 | 2.60 | 0.00 | 1.00 |

*Source: EIU (Economic Intelligence Unit) country data, series from 1992 to 2005.*

# APPENDIX 2

**Impact of Basel 1 on bank lending in developed countries**

Rime (2000) provides an analysis on the Swiss banking system to show whether the regulatory capital forced banks to increase their capital levels. In his model he uses the risk weighted CAR and the non-risk weighted ratio to show whether banks achieved the Basel 1 requirements through reducing the amount of riskier assets or by improving the capital base. He finds that the regulatory changes did not affect capital to RWA ratio while significantly affected the non-risk weighted ratio. Thus, he concludes that Swiss banks did not reduce funds to commercial clients, but they increased capital through equity issues.

In the U.K the impact of Basel 1 on commercial lending had been investigated by Ediz, Michael, and Perraudin (1998) focusing on the same issue as Peek and Rosengren (1995). In their model, the authors differentiate between the regulatory forces and own internal capitals target and conclude that the capital requirements do seem to affect the bank behavior over and above the influence of banks' own capital ratio targets. However, commercial lending is not reduced (no credit crunch), on the contrary banks boosted their capital ratios through raising new capital. Therefore, the Basel 1 capital requirements appear to serve as a tool to reinforce the stability of the banking system without changing the lending choices. In this paper the authors use independent variables such as fee income, deposit amount, profit and loss items, and provisions. However, the macroeconomic conditions in the U.K during the period of data sample are not explained in the paper. The change in the risk weighted capital ratios may also be due to the macroeconomic variables such as the GDP growth rates. For instance, during recessions, new capital might be raised by banks to cover the unexpected losses rather than to respond to the new capital requirements.

The results of Ediz et.al (1998) and Rime (2000) show that the bank behavior in the U.K and Switzerland had been very similar. On the other hand, the Japanese data gives different results. Honda (2002) uses a sample period from March 1986 to March 1995 during which there had been only one major regulation of the bank capital, which is the new guidelines based on the Basel 1. The methodological strength of this study comes from the fact that it uses several variables to control for the demand shocks (reduction in loan volume maybe caused by a reduction in demand). These are the unemployment rate that captures the general business condition, the size variable (total assets) to take the loan demand structure into account, and the individual dummy variables to control the bank specific shocks. As a result, the author finds out that the ratio of loan volume growth to total assets growth dropped after the implementation of Basel 1. Hence, there is an evidence of credit crunch in Japan.

Another important study that focuses on Japan is by Ito and Sasaki (1998) which examined the lending behavior of major Japanese banks (segmented as city, regional, and trust) after the implementation of the Accord. The authors used a sample of 87 banks[51] covering a period from 1990 to 1993 and find that city banks increased subordinated debt issues to keep Tier 2 capital (due to the stock market collapse in Japan hidden reserves that are counted as Tier decreased sharply) and reduced lending to risky clients whereas, trust and regional banks did not reduce lending but issued more debt to meet the capital ratio levels. Therefore, Ito and Sasaki (1998) find partial credit crunch evidence in Japan.

[51] In fact, it had been very challenging for Japanese banks to comply with the new capital requirements since the stock market dependent Tier 2 capital (unrealized capital gains from long-term stock holdings were included) of Japanese banks had been shrinking in the early 90s due to sharp decrease in the stock index. On the other hand, the other developed country banks (e.g. the U.S and the U.K) did not hold the stocks of companies with which they had business relationship. Therefore, the Japanese banks faced a drawback that the others did not counter.

# APPENDIX 3

### Extracted variables from Bank P datasets

| Variable Name | Database Name | Explanations |
|---|---|---|
| client id | ACE | |
| regon id | ACE, INES | Unique identification number |
| PD | ACE | |
| final rating | ACE | |
| granted amount | INES | (Drawn + Undrawn) exposure |
| regular principal | INES | Drawn exposure |
| open_limit | INES | Undrawn exposure |
| Turnover (S) | ACE | Year end 2003 or 2004 |
| Start | INES | Starting date of contract |
| Expiry | INES | Ending date of contract |
| Contract_dur (M) | INES | Maturity of the credit line |
| contract num | INES | Unique contract number. Identifies different credit lines of every client. |
| FS_date | ACE | Year end 2003 or 2004 |
| Name | ACE, INES | Name of the client |

### Extracted variables from Bank K datasets (1)

| Variable Name | Database Name | Notes |
|---|---|---|
| Client id | ACE | Unique identification number |
| Client | ACE | Client name |
| Group id | ACE | If the client belongs to a group |
| Rating | ACE | |
| PD | ACE | |
| Proposal id | ACE | Unique proposal number |
| Client id | ACE | Unique identification number |
| Proposal id | ACE | Unique proposal number |
| Reference year | ACE | FS date |
| Currency | ACE | Currency of turnover |
| YTL Turnover | ACE | |
| Turnover (EURO) | ACE | |
| Client id | BEH | Unique identification number |
| Loan number | BEH | Unique loan number (one client may have more than one loan number) |
| Start Date | BEH | Starting date of contract |
| End Date | BEH | Ending date of contract |
| Proposal id | BEH | Unique proposal number |
| Approved amount (YTL) | BEH | Drawn + Undrawn amount |
| | | |