Leverage, Risk and Regulatory Capital in Latin American Banks

Gabriel Moreno*

Abstract

Regulatory capital plays a central role after the recent banking crisis of 2007-2009. The debate around the level of capital is complex, with opposite views about the optimal level of bank capital. Some researchers claim lower levels of capital because raising them would induce increases in loan rates with negative effects on firms and consumers. Other authors point that these effects are negligible and the benefits are extensive, asking for more capital to be raised. In theory, more capital can decrease the bank risk, which is followed by a reduction in the cost of equity. I test this statement using data from a set of Latin American Banks over a period of 14 years and calibrate the results of doubling the capital to see the expected cost of rising capital into the economy. Over the last 14 years, I find evidence of a small impact on the risk of banks from changes in the capital. The annual GDP growth rate falls between 0.47-0.49%, in the selected countries, half of the value of a similar estimation for the UK case. The size of these effects suggest that Latin American banks face less favourable funding conditions that traduces into higher loan rates that affect the economy. Local regulators should evaluate the benefits from increasing capital to assess the net economic cost before introducing any change in regulatory capital minimums.

Resumen

Los requerimientos de capital juegan un rol central desde la reciente crisis bancaria del 2007-2009. El debate sobre el nivel de capital es complejo, y existen opiniones diferentes acerca de cuál es en nivel adecuado de capital en el sistema bancario. Existen diversas opiniones acerca de cuál es el nivel óptimo de los requerimientos de capital. En teoría, mayores niveles de capital reducen el riesgo bancario, seguido por una reducción en el costo del capital. En este estudio se pone a prueba la teoría usando información de un grupo de bancos latinoamericanos para un periodo de 14 años, y se calibran los resultados de duplicar el nivel de capital para observar el costo esperado sobre la economía. Durante los últimos 14 años se encuentra evidencia de pequeños impactos en el riesgo bancario. La tasa de crecimiento anual del PIB cae entre 0,47% y 0,49% en los países seleccionados, y la mitad del valor estimado en un ejercicio similar para el caso del Reino Unido. El tamaño de este efecto sugiere que los bancos de América Latina enfrentan condiciones de financiación menos favorables, que se traduce en tasas de préstamo más altas, que afectan la economía.

Keywords: Regulatory Capital, Latin America, Economic Growth
Palabras clave: Requerimientos de capital, América Latina, Crecimiento económico
Clasificación JEL: G14, G17, G18

Primera versión recibida el 22 de enero de 2015; versión final aceptada el 19 de marzo de 2015
Coyuntura Económica. Vol. XLV, No. 1, Junio de 2015, pp. 91-130. Fedesarrollo, Bogotá - Colombia

* Dissertation submitted to the Master in Public Administration (MPA) London School of Economics and Political Science.

Volumen XLV | No. 1 | Junio de 2015 | pp. 91-130

I. Introducción

The financial crisis of 2007-2009 has pushed policy makers and researchers to find solutions to reduce the severity and frequency of a banking crisis. Despite the general belief that regulation over the financial industry should be reliable and less costly for society and investors, there is no consensus on how to achieve such goal.

The debate around financial regulation is as complex as the crisis itself. The financial sector has become an intricate system of regulations, authorities and institutions, especially in the banking industry. Banks have become big conglomerates with diverse relations with shareholders, creditors, managers, and intricate operations that required a high level of expertise to understand them. The industry's regulation reflects such complex environment where techniques to regulate and supervise the industry are always evolving.

In this context, the Basel Committee has attempted to overcome such difficulties by setting standards for international banking regulation and supervision. Although capital is a key aspect of the Basel agreement, it is not restrictively focused on it. The third version of the initial agreement (Basel III) promotes a comprehensive approach to financial stability, including a set of standards to improve risk management practices and governance as well as levelling up the transparency and disclosure procedures. Therefore any result derived from the analysis in this document is restricted to one side of the first pillar (capital) of the Basel agreement and does not test the agreement as a whole.

Focusing on capital requirements, it is clear these standards draw a limit to the way banks fund their activities. Capital in its purest form acts as the main cushion when unexpected losses arise, constituting the first line of defence for creditors, depositors and in dramatic situations, taxpayers (Admati *et al.* 2013). Increasing it seems to be a reasonable decision to prevent liquidity crises and protect savers, investors, and the bank itself. This would yield a more stable financial sector, reducing the volatility passed to the overall economy and to all its dependent sectors.

Here is where the debate over capital requirements reaches its acme. Could increasing capital requirements reduce the risk of a bank enough to compensate a reduction in lending volumes or an increase in lending rates?

Most bankers and a group of academics argue that higher capital requirements will unambiguously create a credit crunch that would harm the economy in the long run (Institute of International Finance, 2010). They predict that moving from the current level of capital requirements will decrease GDP in 0.3% in a 10 year period. According to executives from financial institutions this happens because more capital will inevitably reduce the profitability of the bank (ROE), with higher funding costs on loan rates, impacting costumers and firms.

An alternative group of academics argue that higher capital requirements would not necessarily affect the long term rate of growth because the net benefits prove to be higher than the cost of rising more capital. They illustrate that a mandatory increase in capital requirements would barely increase the overall cost of funding, or make them operate at a suboptimal scale (Admati and Hellwig, 2013; Miles *et al.*, 2011). These researchers find a net cost of doubling the capital between 0.06 and 0.15% of annual GDP growth with a present value equivalent to 6% of GDP.

In the heart of the discussion the Bank of International Settlements (BIS) has estimated empirically the overall effect of increasing capital requirements. The impact from tighter capital requirements (1% increase) evidence a low impact in GDP, expecting a reduction of 0.19% of GDP over four years (BIS, 2010). The authors predicted that half of the required change will come from an increase in capital and the rest from a reduction in risk weighted assets (RWA) or reductions in lending.

Other researchers have studied the capital and risk relation, including some theoretical developments. Miles *et al.* (2011) suggests that banks with relatively more capital become less risky. As the risk of the portfolio (or assets) of the bank decreases, the expected return from equity should decline as well. This highlights that debt is inherently cheaper than equity, making the change in the cost funding negligible. Their results are validated by Baker and Wurgler (2013) supporting the idea that banks with higher leverage (or lower capital to assets) have a higher risk.

It is inevitable to think that banks with higher leverage and risk would yield higher returns, but the evidence raises more questions than answers. Using data from the U.S banks, Baker and Wurgler rule out such idea calling it the "low risk anomaly". Lower returns were associated with risky banks in the last 40 years. Making aside the limitations of these results, this conclusion could challenge the argument that additional capital requirements have insignificant effects on the cost of funding because it denies the compensation effect of bearing less risky. Although the low risk anomaly challenges the foundations of many studies, not just this one, it has not been widely proved for many markets, and therefore it constitutes a source for further empirical research.

Besides the empirical literature, standard financial theory gives substantial attention to a famous axiom to solve the dilemma of capital increments: the Modigliani - Miller's (MM) theorem. In its basic premise, the composition of debt and equity of a bank should not have an impact on the overall cost of funding. If the MM holds completely in the banking industry, banks could increase their equity with no negative effects on the cost of funding. However, this study provides evidence that this may not be the case.

Thus, I use Miles' *et al.* approach to assess the costs of increasing capital requirements into the economy. First, I estimate how changes in the capital have an effect on the level of risk of banks. Second, I gauge how risks are translated into the cost of capital and loan rates. Finally, I calibrate the cost in terms of present value and annual GDP growth from the change in loan rates.

In this document I use a dataset of Latin American banks to measure the cost of rising capital into the economy. The countries (Brazil, Colombia, Chile, Mexico and Peru) were selected because their economic relevance in the region, the quality of the information available and the fact that there is limited empirical research on this matter.

Using a sample of 33 banks (from the Bankscope database) from 1998 to 2012, I found that leverage has a statistically significant impact on the level of risk of banks. A 1% increase on the leverage is associated with a 1.4-2% on the level of risk. This result is not far from the estimates by Miles *et al.* (2011) which are in the range of 2% to 6%. This additional risk translates into an average cost of funds and loan rates increase in the Latin American economies of 0.38% and 0.85% respectively (using the base case scenario). In overall the cost for the selected countries in GDP growth reaches an average of 0.47-0.49% annually and 19-21% of GDP in present value. Compared with the UK exercise the cost of increasing capital in Latin American countries is higher for all countries. It is important to mention that these findings should be assessed integrally with an estimation of the benefits from increasing the regulatory capital.

Some conclusions are derived from these results. Matching standards for Basel III capital requirements at the same pace of developed countries might be costly for Latin American economies. Also there are considerable differences in the cost across countries. Colombia and Peru may pursue updates in the Basel agreements without much harm comparatively with their other Latin American peers. Finally, the MM theorem barely holds in Latin American countries, which incentivise no additional capital increments.

This study contributes to the literature of financial regulation in twofold aspects. First, the majority of existing studies for Latin American banks address the effects of regulation over the credit market without performing any estimation of the leverage to risk relation. This estimation allows the financial authorities to have a refined notion of the cost of a frontline update of the regulatory framework of capital requirements. Second, this research characterizes the main channel by which capital variation is translated into the cost of funding of banks assessing the Modigliani-Miller compensation.

The document is organized as follows. The first part will introduce the basic elements of capital and some features for the Latin American financial

sector. The second part will describe the data, the empirical strategy and the results. The third part will include some limitations, caveats and conclusions from this research.

II. Conceptual Framework

A. Capital reserves

Reserves of capital are essential for the banking business, creating confidence among depositors, creditors and investors. Regulators and central banks are called to set the level of capital reserves for most financial institutions. However the debate spins around the optimal amount and quality of capital that banks hold to absorb unexpected losses.

A key piece of this debate relies on the definition of bank's capital. As pointed by Admati *et al.* (2013), there is a public confusion between capital and reserves. To address such misunderstanding, it is worth mentioning first the difference between liquidity and solvency.

According to the Bank of England (2013), liquidity problems occur due to a temporal failure to repay depositors and creditors, while solvency accounts for a permanent issue. On one hand liquidity problems are temporal because the bank holds enough assets to meet these liabilities, but doesn't hold the liquidity on those assets to meet them. If the bank has enough cash, it should not be a problem. In the other hand, solvency problems occur due to permanent insufficiency of assets with respect to its current liabilities. If the bank has enough capital, then the bank it is said to be solvent. Thus from the bank's perspective, a liquidity problem derives from low levels of cash or reserves, while a solvency problem derives from a short level of capital.

Thus, reserves are assets that banks have in the form of cash and are used to facilitate its operation and maintain a level of cash to respond to clients' withdraws when needed. The financial authorities use reserve requirements to avoid liquidity problems as mentioned before; however, it may not be useful to cope with solvency problems. To handle this problem, shareholders provide funds to avoid insolvency in the form of capital.

For the Bank of England (2013) capital is primarily a source of "own" funds. These funds embrace three key characteristics: it absorbs losses, it is perpetual and its repayment is not obligatory.

Regarding its first characteristic, if bank loans perform unexpectedly poor, and the creditors and depositors withdraw their money, the cash is eroded and because of that the liabilities are higher than the assets, and capital is required to absorb those losses. In order to shed more clarity on the purpose of capital, one may distinguish unexpected from expected losses. Using historical information a bank can calculate the portion of

loans that are expected to default. This estimate constitutes the average expected losses for a bank, and is covered with the interest rate it sets for each loan. The difference between the ex-ante expected losses and the actual losses of the banks constitute the unexpected losses. The types of shocks that affect the financial industry make more difficult to calculate the predictions for unexpected losses.

Second, investors must internalize that funds provided to the bank will only be repayable if the bank stops its operations. When a bank is liquidated, the remaining funds after paying other creditors will be allocated to investors. Before that, investors cannot force a bank to repay any funds.

Third, the distribution of the capital will depend on different variables and it is not mandatory. Dividends are given to the investors depending on many factors: level of profits, levels of capital, expansion plans, regulatory frameworks, etc. Compared to other sources of funding, such as debt or deposits, capital funds are in a disadvantage in terms of repayment. Therefore, investors might expect higher returns for this investment.

In summary, capital constitutes a cushion for unexpected losses that should not be confound with the reserves, and that it gives an indication of the capacity of a bank to repay its liabilities. Indeed, regulatory and monetary authorities use capital requirements to ensure a level of stability on that industry and to reduce the systematic risk to the rest of the economy. The following section will provide the key elements of capital requirements.

B. Regulatory Capital

Broadly speaking after the 2008-2009 financial crisis the level of regulation and how the banks are been scrutinized is being put into revision. Questions have been raised on the level of financial regulation that banks are bearing, hoping that a new regulation could ensure tax payers won't have to swallow a bail out again. It's probable this is one of the main reasons to impose banking regulations, but yet it is not clear why banks are being regulated at all. Dewatripont and Tirole (1994) suggest that although there are many arguments floating over why regulate banks, it's the protection of small depositors the ultimate and most reasonable explanation for bank regulation. Depositors, as creditors to the bank, have no expertise to monitor or discipline banks when moral hazard or adverse section externalities loom from the banking activity.

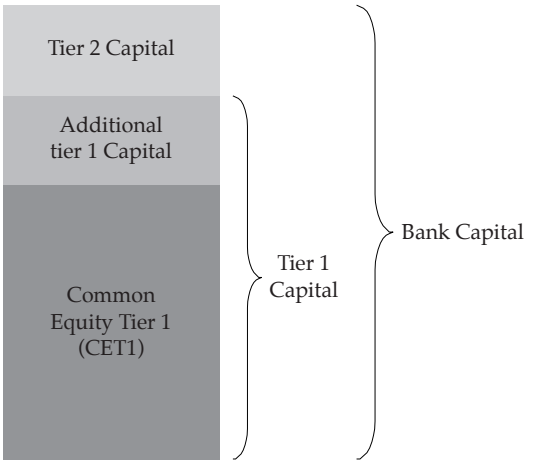
In particular the idea to regulate the bank's capital and set minimum requirements is derived from this premise, with three supporting arguments (Morrison and White, 2005). First, as a moral hazard situation where banks that do not have enough "stake", making decisions that are optimal for the equity holders (or even managers), but suboptimal for society including small depositors. Banks may take excessive risks that maximize their own benefits in the short run, where creditors and deposi-

tors bear the cost if those risk materialise. Second, the "safety net" which has not been formalized yet, predicts that to protect creditors and depositors, banks should have a cushion to absorb unexpected losses. Therefore if the regulators want to prevent spill overs of a bank failure, authorities may need to ensure banks have enough capital to respond in financial distress scenarios. Third, regulators would prefer not to have banks that are untrustworthy and erratic; therefore, they could use capital requirements to select out these banks, solving an adverse selection problem. A banking industry that is been watched closely with optimal requirements of capital may reduce its size but increase its productivity.

International and local financial authorities have developed a framework to regulate capital using these arguments. The conditions to regulate bank capital vary across countries, but mostly rely on the Basel agreement as the standard to define the level of market control. The Basel agreement has delivered three set of rules since its creation in 1988 (Basel I (1988), II (2006), III (2011)), promoting the use of capital requirements and pursuing a "resilient banking sector" (BIS, 2011).

The latest of the Basel agreements (Basel III) divide banks' capital in two categories: Tier 1 and Tier 2. Tier 1 capital is divided between Common Equity Tier 1 (CET1) and the Additional Tier 1. CET1 is formed by retained earnings and ordinary shares, with some deductions (Goodwill and Non –MSR Intangibles) Tier 1 capital is equal to CET1 plus Qualifying hybrid securities and non-controlling interests. Figure 1 shows the categories of regulatory capital. CET1 constitutes the first capital that is depleted if losses arise and if interacted with the level of assets, it constitutes a measure the leverage of the bank.

Figure 1
REGULATORY CAPITAL CATEGORIES



Source: BIS, 2011.

In this context, the Basel committee has made clear that the level of capital should be relative to the level of risk of the portfolio. The actual requirements of capital depend on the level and composition of assets. Initially, the authorities calculated the level of compliance to the regulation with the capital as a portion of the total assets. Yet, this measure was refined in the second revision of the agreements (Basel II, 2006). Such change allowed banks to hold capital according to the level of risk they are exposed. This measure is called the risk weighted assets (RWA).

In particular, the Basel Committee has been using these assets measures to calculate the minimum portion of capital the banks should hold. The capital requirements by category and agreement are illustrated in the following table:

Table 1 shows that the Basel agreements have been tightening the requirements of Tier 1 capital and CET1, but not in the aggregate capital. In addition, according to Galindo *et al.* (2012), Basel III focuses on improving the quality of capital and not necessarily the levels. Particularly, Basel III increases the minimum of CET1 that is the best capital to absorb losses. This trend has permeated local authorities which have been adjusting to these new lineaments. Latin American countries have been adopting the Basel recommendations with some parsimoniously as part of a greater strategy to open their economies and their financial markets.

The next section will briefly discuss some characteristics of the Latin American banks and the degree the implementation of these recommendations in the selected countries of this research.

C. Financial markets and Regulatory Capital in Latin America

The literature on Latin American banks is limited and encompasses some topics related to capital requirements. The IMF (Barajas *et al.*, 2005) estimated the effect of the Basel I recommendations into the Latin American credit market, finding a positive impact on capitalization and lending activities. Brock and Rojas (2000) disaggregate the determinants of spreads in Latin American banks, unveiling that operating costs, non-performing loans and reserve requirements (not capital requirements), have a negative impact on spreads.

The financial sector in Latin America has been evolving rapidly in the last few decades. Boosted by the economic growth of the area, financial institutions have increased their assets, the number of

Table 1
CAPITAL REQUIREMENTS BY CATEGORY

Indicator	Basel II Requirement	Basel III Requirement
Total Capital (+ conserve. Buffer)	8% of Average RWA	10.5% of Average RWA
Tier 2 capital>Tier 1 capital	Yes	Yes
Total Capital Ratio	8% of Average RWA	8% of Average RWA
Tier 1 capital	4% of Average RWA	6% of Average RWA
Common Equity Tier 1	2% of Average RWA	4.5% of Average RWA

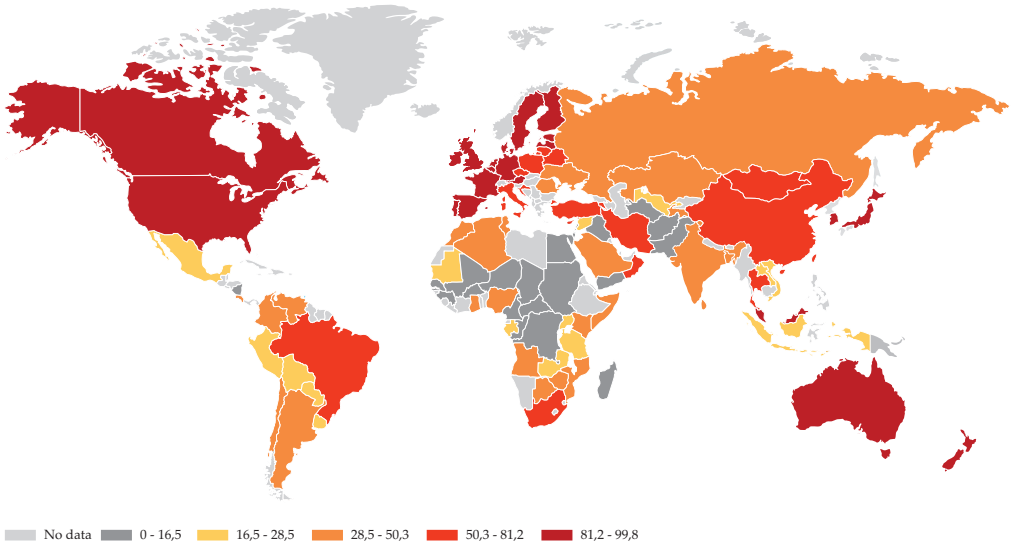
Source: BIS (2011).

customers and have gained cost and operational efficiency (Sosa *et al.*, 2013). However, the region's banking industry is still behind many developed counterparts in the G20, especially in terms of inclusion, margins, and lending penetration (De la Torre *et al.*, 2012). Map 1, shows and indicator of financial inclusion presented by the World Bank (World Bank, 2011). Except for Brazil, the rest of Latin American countries have a reduced access to financial funds.

Chile, Colombia, Mexico, and Peru are in the medium and low ranges of countries with less than 50% of the adult population with access to financial products. Moreover, the amount of loans and deposits are still behind developed markets as illustrated in Map 2. Loans in most of the Latin American countries represent less than 50% whereas, in most of developed countries, it surpasses 100%.

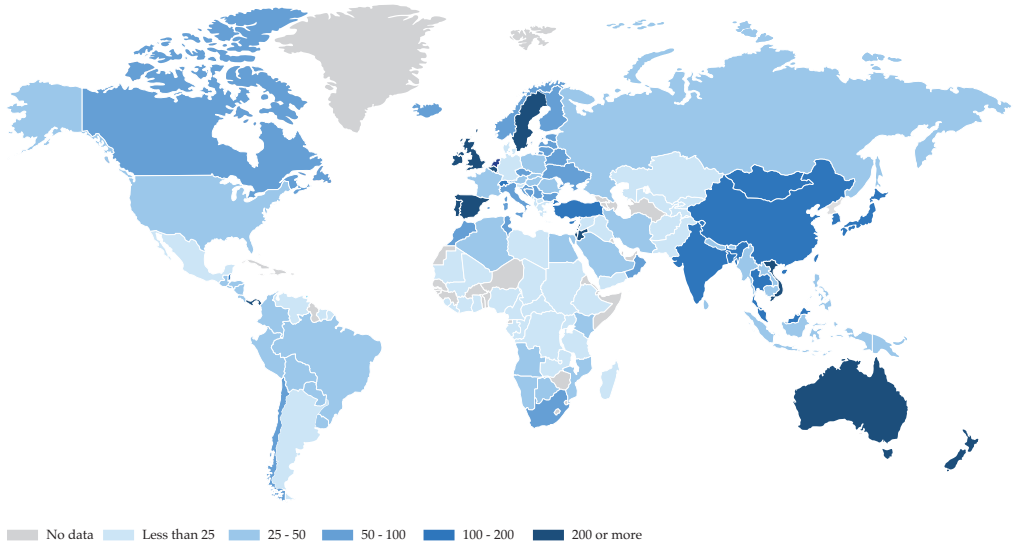
However, Latin American Banks were relatively unharmed to the last financial crisis in the developed world due to institutional factors. New supervisory institutions, macro and micro prudential regulations and a different monetary policy rules, helped the region to overcome the financial distress (Bleger, 2011). In response to these institutional factors, the countries for this study have improved their capital steadily from levels around 9% to 10.5% in average. Colombia outpaced the rest

Map 1
ADULTS WITH AN ACCOUNT AT A FORMAL FINANCIAL INSTITUTION
(2011, %)



Source: World Bank Database, World Development Indicators.

Map 2
OUTSTANDING LOANS FROM COMMERCIAL BANKS
(2012, % of GDP)



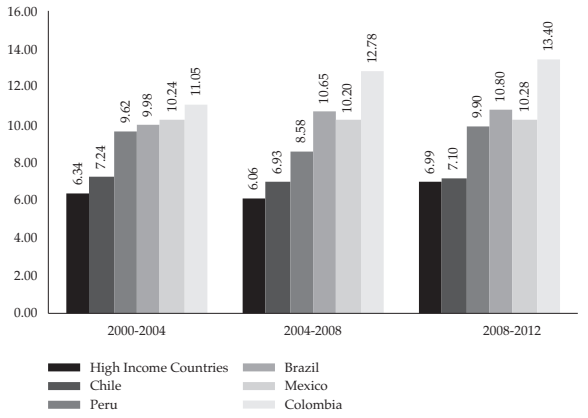
Source: IMF, Financial Access Survey.

of the group by increasing its capital nearly 2.4 in the last 12 years. Brazil had a 0.82 increase in average, while Mexico and Peru achieved 0.28 and 0.04 respectively. Regarding Chile, it has maintained the levels of capital with fairly similar numbers as the OECD countries. Nevertheless, the OECD countries have increases 0.7% their capital ratio. Figure 2 shows the level of capital as a percentage of total assets.

Simultaneously regulators in this group of countries have been changing their capital requirements to meet international standards with the intention to improve the stability of their financial sector. Colombia and Peru are far from Basel III recommendations and capital reconfiguration is still needed to adapt to Basel II (Galindo *et al.*, 2012). Brazil and Mexico adopted Basel II completely and already have a draft to implement the Basel III recommendations. Finally, Chile has been changing its own schedule to adjust to Basel III starting in 2013 until 2019, but the current state of the regulation will make the transition feasible. (KPMG, 2010; IFF, 2010; BIS, 2013).

These changes on the regulatory requirements have an impact on the level of capital that banks inject, with benefits and costs to the society. The next section will illustrate how costly is rising capital in the banking industry from a theoretical perspective.

Figure 2
CAPITAL LEVEL IN SELECTED COUNTRIES
(Total capital % of total assets)



Source: World Bank Database, World Development Indicators.

D. How costly is capital for Banks?

Modigliani & Miller (MM) propose a theoretical framework to understand the structure of capital and the cost of funding for firms. In essence, the authors suggest an explanation for the effect of a variation in the capital structure into the cost of capital (Modigliani & Miller, 1958). The prediction is that rising capital will decrease the volatility of the returns of the equity, which will make debt safer and reducing the required return of equity. Therefore, the cost of funding will remain unchanged only if we accept the assumptions of the theorem: small transactional costs, competitive markets, equal tax treatments and no bankruptcy costs.

In general, MM theorem may not hold 100% because some of these assumptions are too strong. One may mention two arguments to support this statement: taxation of equity and insurance for liabilities (Miles *et al.*, 2011). First, debt payments in the majority of countries are exempt from taxes while dividends are not, creating a clear incentive towards holding more debt-relative to equity changing the capital structure (Cheng and Green, 2008). Second, many countries establish implicit or explicit insurance for deposit and non-deposit liabilities. Deposit liabilities insurance is only common in developed economies. Still, Latin American Governments have bailed out banks in several occasions with large amounts, proving an implicit insurance that secure deposit and non-deposit liabilities (Carstens *et al.*, 2004). This distortion creates a miscalculation over the value of this source of funding, making debt cheaper relative to equity. The fact that the MM may not hold completely implies that changes in the capital will make the cost funding of banks escalate rapidly, translating the cost to the customers and firms through higher rates or less lending volume.

The relevant question then is how changes in capital have an effect on the cost of funding vis-a-vis the MM theorem. In the next section, I use Latin American bank's data to quantify the effects of rising capital on GDP growth in different scenarios depending on the completeness of the MM theorem.

E. Opportunity cost in Banking

The opportunity cost of an investment depends on the future cash future it generates and the risk asso-

ciated with these flows. The standard tool to assess the opportunity cost for financiers, weather they provide debt or equity, is the Weighted Average Cost of Capital (WACC). This approach weights the cost of capital by each source of funding and their relative cost. The weights are derived from the relative weight of each source on the total capital of the company. Most companies split capital between equity and debt, and the cost of each source will depend on factors such as the level of interest rates, the maturity, the expected returns on investments, among others. To make a systematic approach to the estimation of the cost of each source it is common to use a model with a sound theoretical base to calculate it. The Capital Assets Price Model or CAPM is an equilibrium framework that provides a *"description of the relation between risk and return"* for assets or securities (Jensen, *et al.*, 1972, pp:3). In this model the Beta(equity) of a company reflects the risk of a stock compared with the whole market, assuming no transactional costs or asymmetric information among agents. This Beta is then used as an input to determine the expected return on equity, or the cost of equity on the WACC.

The CAPM rely on a set of assumption such neglible transactional costs, asymmetric information among agents, and that investors perfectly diversify their portfolios against non-systematic risks (Villarreal et.al, 2010). Satisfaction of these assumptions vary across different economies, and therefore the results derived from these models should be compared with caution, although the same methodology is being used for all countries. Villarreal and Cordoba (2010) proposed a way to adjust for some of these differences, adding a country risk factor to the model which constitutes a future extension to the estimations derived from our work.

III. Data

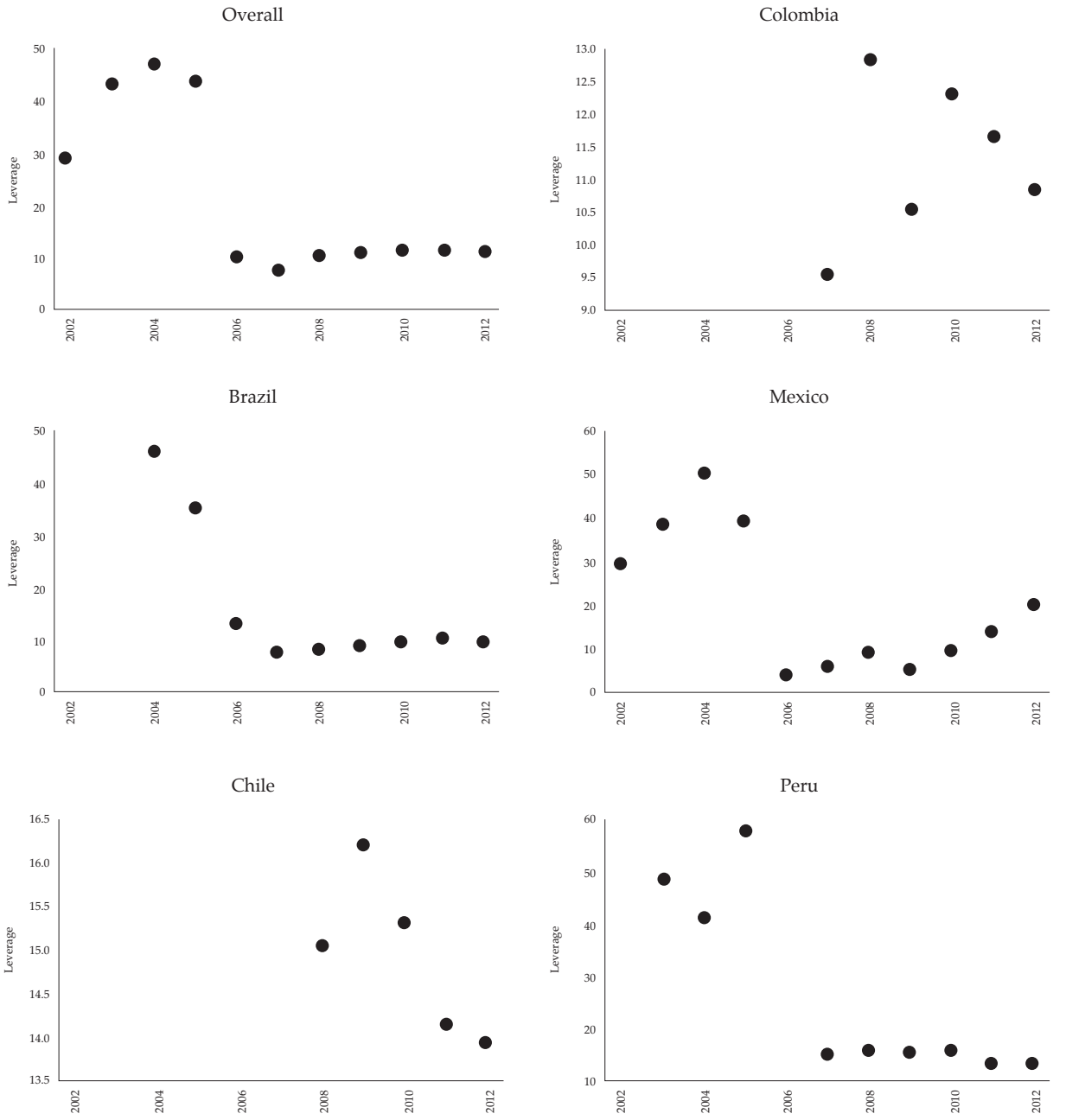
A. Capital

In order to assess the effect on the cost of funding and the GDP growth from changes in the level of capital, we need a measure for capital. There are many measures for capital, and more are developing while this research document is been written. To be consistent with other pieces of literature I decided to follow the methodology proposed by Miles *et al.* (2010), where bank's leverage is a measure to gauge changes in the capital.

Miles calculate leverage as the total assets over the Tier 1 Capital. This measure reflects the potential for losses and profits beyond investing its own funds (D'Hulster, 2009).Moreover, if capital requirements are increased, these measure would reflect such change in the regulation. Higher (lower) levels of leverage mean that the bank is using small (large) amounts of capital, relative to its assets. Figure 3 illustrates the leverage of banks by country and year in the sample.

The graphs in Figure 3 reveal a general trend, where banks have been deleveraging in most of

Figure 3
LEVERAGE
(Assets/Tier 1 Capital)



the countries weather by increasing their capital or by reducing their assets. It is not entirely clear which of these two channels was responsible for the reduction on the deleverage trend of banks. However is possible to infer that an increasing level of equity has been driving leverage down. In general during this period the financial sector expanded, making unlikely a decrease on the level of assets. In all cases, the leverage ratio is calculated using the risk weighted assets in the nominator.

Regarding the denominator, the BIS has pointed that the Common Equity Tier 1 (CET1) is the ultimate capital measure that could absorb unexpected losses for banks. Since this regulation is relatively new, and not all regulators require reporting such value, it was not possible to use this capital measure. Instead, I used Tier 1 Capital, a widespread measure for capital. Tier 1 Capital can be proxy for the CET1 and there is evidence that it tends to move together (Miles *et al.*, 2010). Summary statistics by country for each of the variables that will be used in the model are presented in the table A1 in the annex.

B. Risk

The risk is measured using the CAPM model. This model estimates a Beta for each bank with respect to its own market, using daily prices of bank's stocks and markets on the selected countries for the period. Table A2 in the annex compiles the Beta(equity) estimate for 33 banks in a 12 year period (displaying only index number from banskcope).

C. Cost of Capital

Finally, to estimate the cost of capital at the country level I collected data of risk free rates and market premiums. The risk free rates' data comes from historical series of generic sovereign bonds from each government for the selected countries, with a maturity of 10 years as suggested by Damodaran (2013). The yield of each local currency sovereign bond is averaged for the available data to obtain an estimation for the risk free rate for each country. Second, the market risk premium is obtained from the Damodaran's database for risk premiums. Here the author proposes to calculate the risk premium with the average returns above the risk free rate. This calculus is not done using long historical time series due to its scarcity and low reliability of data, but with the country risk derived from sovereign debt (see annex 3).

IV. Empirical strategy

The empirical strategy follows three steps. First, I estimate the beta(equity) for each bank in the sample and use this estimation to test the effect of leverage on the beta(equity) using an econometric model. Second I use this estimation to calculate the expected changes in the cost of capital and loan rates at the country level. Third, I calibrate these variations in loan rates to predict an estimate change in GDP growth at the country level.

A. Econometric Model

The standard theory of the CAPM predicts that the expected return on a company or security will be proportional to its systematic risk (Baker & Wurgler, 2013). In addition the Beta(asset) is constituted by the Beta(equity) and the Beta(debt) as follows (Miles *et al.*, 2011):

$$\beta_{asset} = \beta_{debt} \left(\frac{Debt}{Asset}\right) + \beta_{equity} \left(\frac{Equity}{Asset}\right) \quad (1)$$

Under the assumption that Beta(debt) is equal to zero, then it is possible to state that the Beta(equity) can be modelled as follows:

$$\beta_{equity} = \beta_{debt} \left(\frac{Asset}{Equity}\right) \quad (2)$$

A zero Beta(debt) means that the bank's liabilities are riskless compared with market movements in accordance with the Hamada's equation that links the MM theorem and the CAPM (Hamada, 1972). Expression *(2)* corresponds to the main model to estimate the leverage (assets/equity) as a linear determinant of the risk of equity or Beta(equity). In this model if the bank's leverage doubles and the Beta(asset) remains unchanged, then the same risk is spread over a larger capital, as explained by Admati *et al.* (2013). The Beta(asset) reflects the level of risk for a firm without any debt considerations. In other words is the level of risk regardless of the capital structure.

To assess this model, first I estimate the risk of each bank using its returns in the market and the returns of each market in the overall. The return for the market and the stock of a bank may be obtained as in *(3)*:

$$r_{it} = \frac{p_{it} - p_{i(t-1)}}{p_{i(t-1)}} \quad (3)$$

where r_{it} is the return of each bank in time t and p_{it} is the price of bank's stock i in year t. However, some authors suggest that using logarithm approximations has some advantages related to the normality in price (O'neil, 2011). In consequence equation *(4)* is used to calculate the return of banks and the overall market for each country:

$$log\ (1 + r_{it}) = Log(p_{it}) - Log(p_{it-1}) \quad (4)$$

Using this information, I estimate the bank specific returns and market returns to predict the Beta(equity) of each bank for the 14 year period, taking the average of returns on a year to year basis. The specification follows a linear relation between returns:

$$log\ (1 + rit) = \varphi\ \beta r_{jt} + \varepsilon_i \quad (5)$$

where φ is the constant, β represent the Beta(equity) and ε_i is the error term. The estimates of Beta(equity) are the result of OLS and provide the individual risk of each bank i with respect to the market j. These coefficients are used as a dependent variable to evaluate the average effect of leverage over the risk of a bank. The effect is captured by the following specification:

$$\hat{\beta}_{it} = \gamma + \beta X_{it} + \varepsilon_i \qquad (6)$$

where $\hat{\beta}$ is the Beta(equity), β is the Beta(asset) and X_{it} constitutes a vector that includes the current value of leverage and its lag. A lag is included in order to control for some autocorrelation between the actual level of risk and past level of leverage. According to (McKinnish, 2002), the use of lagged independent variables seeks to correct for omitted variable bias and measurement error. In this case, there may be a simultaneous correlation between the contemporaneous and the lagged level of leverage and the level of risk measured by the Beta(equity). It also reflects the changes in the short and long run conditions that have an effect on the dependent variable. Finally, γ represents the constant or the average change on the risk by a change of 1% on the bank's leverage.

However, omitted variables may reduce the consistency of the estimate due to a plausible correlation between the error term ε_i and the β estimate. The nature of these omitted variables is critical to assess the results. Therefore, the panel data allows to control some of these omitted variables, using time and individual fixed effects. Model *(7)* fulfils such objective as follows:

$$\hat{\beta}_{it} = \gamma + \beta X_{it} + \theta_i + \delta_t + \varepsilon_i \qquad (7)$$

where θ_i represents the fixed effects for each bank which captures all the unobservable characteristics that are specific for each bank, but do not vary over time such as management individualities, organizational and enterprise culture. Finally, δ_t corresponds to the time fixed effects that captures unobserved factors that may have an effect on the bank's risk and vary over time, but do not change across banks. Here one may include macroeconomic factors, such as the GDP cycles, inflation, commodity prices, credit cycles and interest rates, among others.

To verify the robustness of the results I estimate two additional specifications: a first difference estimation *(8)* and a logarithmic transformation *(9)*.The first differences estimation attempt to reduce the problem of non-stationary series. Although it is not obvious in a graphical representation, some series may have trends which induce a spurious regression and bias over the precision of estimates. In statistical terms, stationary series are ones that the mean or the variance do not vary over time. Therefore, a first difference estimation tries to transform non stationary series into stationary series. Although some verification is required, these tests -panel unit root test- force strongly balanced panels, which in this case are difficult to achieve (Wooldridge, 2009).

Second I use a log specification to take into account that the distribution of the data may be non-normal. If log transformation is applied the effects of outliers are less pronounced too. However, log specifications are more widely applied to variables that are originally in levels. In this case, the variables that are used are not in levels, but in relative terms (Wooldridge, 2009).

B. WACC and CAPM

Using the Beta(asset) estimates from the econometric model, I calculate the required return for equity equivalent to that level of risk and the cost of capital or weighted average cost of capital (WACC), for each country in the sample. For such estimation, the CAPM defines the required rate for equity and the WACC as follows:

$$R_m = Rf_m + (\hat{\gamma} + (\beta \frac{asset}{Tier\ 1\ Capital})) Rp_m \qquad (10)$$

$$WACC_m = R_m (\frac{Equity}{Asset})_m Rf_m (1 - (\frac{Equity}{Asset})_m) \qquad (11)$$

where R_m is the required return on equity, Rf_m captures the risk free rate and Rp_m is the risk premium, and country risk in country m. The leverage and equity to asset's ratio are calculated using the average for each country sample. After calculating the required return for equity and the WACC, I create an alternate scenario in which banks have to double their capital or cut the leverage by half. This will give the necessary variation to estimate the degree of compliance of the MM theorem and the variation in the cost of funding that is translated into the economy.

C. Calibration

Finally using the completeness estimation of the MM theorem, I use the calibration equation presented by Miles *et al.* (2011) and the Bank England (2010) to evaluate the effects of variation in the cost of funding into the rates faced by firms and the change in GDP growth at the country level. Using a production function with capital K, labour L, and output Y and constant elasticity of capital, it is expected to see that the cost of funding or borrowing for firms changes the equilibrium of capital stock in the economy, which translates into long run variations in the output. The final response of output to changes in the cost of capital is compounded by three expressions. First, (α) represents the share of total output allocated to capital. Second, (σ) corresponds to the elasticity of substitution between capital and labour. Finally, there is the elasticity of relative price/cost of capital $1/(1 - \alpha)$ derived by Miles. The expression to calibrate these results can be described as follows:

$$\frac{dY}{dP_k} \frac{P_k}{Y} = \alpha\ \sigma\ (1/1 - \alpha) \qquad (12)$$

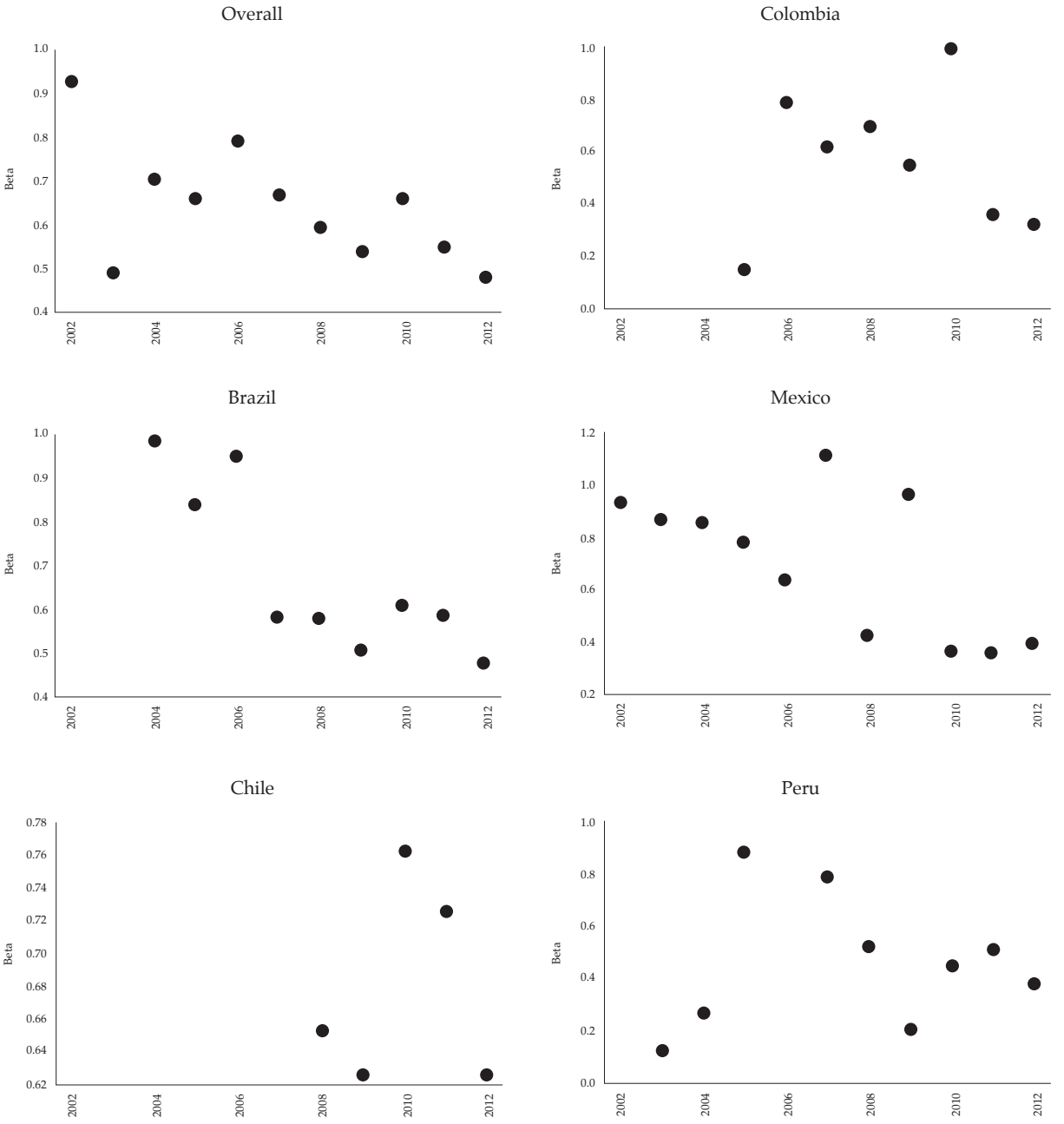
This calibration will deliver the elasticity of GDP growth over the average of cost of capital for the entire economy. Additional assumptions are used to calculate the annual variation in GDP and the present value of this cost. The sources of the inputs used are displayed in the table A4 in the annex.

V. Results

A. Econometric model

First, Figure 4 presents the average Beta(equity) estimates in each country in the sample after run-

Figure 4
BETA ESTIMATES BY COUNTRY
(%)



ning OLS of each market returns over bank returns in each year using daily data. The data was aggregated by country, to show some features. The Betas(equity) show that banks on each country tend to be less risky than the market, with values on a range between zero and some outliers above 1. Some of the countries present a diminishing trend in their Betas(equity), for instance Brazil, Mexico and Peru. The variations in the Beta(equity) may respond to macroeconomic factors and some industry related factors. The improvement over debt profiles of governments and the robust economic growth in that period seems to be reflected in the overall region Beta(equity) estimates in Figure 4.

Second, Table 2 provides the results of the leverage to risk model specifications. In general, all specifications yield a positive estimate with the majority of cases with significant leverage's coefficient. Therefore, a change in the leverage has an impact on the level of risk.

The basic OLS regression *(6)* shows a leverage's coefficient -the Beta(asset)- not different from zero. Model *(7)* and *(7)** include time and fixed effects and additional controls, with a coefficient of 1.4% and 2% respectively. First difference's model *(8)* estimates a coefficient of 3%. Finally, the log model estimates a coefficient of 0.17, still in a different scale, but not significant from zero. Fixed effects' and First differences' models present coefficients that are significant and closely consistent with Miles *et al.* (2011) estimates.

In detail, model (7)* includes some control variables and bank and time fixed effects. Control variables try to avoid any omitted variables bias that cannot be captured by the bank and time fixed effects. These are variables vary over time and across banks and have a dual effect in the dependent and independent variable. In this case, decisions over the risk of the assets may change over time and are different from bank to bank. I use the return of average assets (ROAA), the loan loss reserve ratio and the liquid asset's ratio to control for this omitted variable. First, the return of assets can capture a fragment of the risk the bank is taking. Extreme values are inevitably associated with risk loving banks. Secondly, the loss loan reserve ratio is a proxy for the bank's provisions in the case of getting into riskier assets. Extreme values again, point a concern over the risk of the assets. Third, the liquid ratio gives a notion on how easy is for a bank to sell its assets without any loss. More liquidity implies less risk over time. However, when added to the regression these variables turn out to be not significant with a 90% of confidence.

I tested the main specification (7)* using two robustness checks. I estimated a first differences which supports the results previously described with an average change in risk of 3%, significant at the 1%. The second robustness check is a log specification that yields a variation of 1.2% on the risk (after changing the scale of the result). However, the coefficient is not significant at any level. For this reason, results must be taken with precaution.

Table 2
BETA AND LEVERAGE

	Dependent variable: Beta(equity)				
Model	**(6) OLS**	**(7) OLS**	**(7)* OLS**	**(8) OLS (FD)**	**(9) OLS (Log)**
$Leverage^{t}$	-0.00	0.014 **	0.020 **		
	(0.00)	(0.01)	(0.01)		
$Leverage_{(t-1)}$	0.00	-0.02 ***	-0.02 ***	0.01	
	(0.01)	(0.00)	(0.01)	(0.01)	
$\Delta Leverage_{t}$				0.03 **	
				(0.01)	
$Log(Leverage_{t})$					0.17
					(0.35)
$ROAA_{t}$			0.01	-0.07	0.02
			(0.02)	(0.02)	(0.04)
Loan Loss Reserve $Ratio_{t}$			0.01	-0.00	-0.00
			(0.02)	(0.02)	(0.06)
Liquid $Ratio_{t}$			-0.00	-0.00	-0.01
			(0.00)	(0.00)	(0.01)
Constant	0.53 ***	0.80 **	0.72 *	-0.43	-0.10
	(0.04)	(0.30)	(0.36)	(0.31)	(1.09)
Observations	117	117	115	80	115
r^2	0.02	0.25	0.34	0.29	0.27
Additional Controls	No	No	Yes	Yes	Yes
Time Fixed Effects	No	Yes	Yes	Yes	Yes
Bank Fixed Effects	No	Yes	Yes	Yes	Yes

Standard errors in parentheses.
* p < 0.1, ** p < 0.05, *** p < 0.01

Note: Clustered errors are used in the all models except the model (6). Clustering is at the bank level, allowing for autocorrelation at the bank level but not across clusters. The change is not significant using clustering errors at the country level.

For these estimates three banks were excluded from the regression: Grupo Financiero Bancomer, Grupo financiero Banorte and Bancolombia. The reported data of these three banks were not consistent with the bankscope database. In addition, distortions derived by mergers and acquisitions can have an impact on the reliability of the information. Bancomer merged with Grupo Financiero BBV-Probursa in 2000 and BBVA S.A Bancomer in 2009. Banorte merged with IXE bank in 2010. Bancolombia merged with Conavi and Corfinsura in 2005.

Betas with a value of less than 0, were dropped. According to Damodaran (2013), negative Betas are uncommon but appear in the regression due to three reasons: first the company derive its activities from a commodity that act as a hedge to the return of the market, such as gold. Second, put options on stock or selling forward contracts may behave similarly. Third, a distortion in the stock drives the result. "Acquisitions battles and extended lawsuits" may create such distortion.

From a raw sample of 4500 observations, only 117 observations are used into the regression. 90% of the sample was not suitable for use because these banks were private companies that had no stock market information. Another 5% corresponds to the banks which do not provide an estimate for the Tier 1 Capital. The rest corresponds to the negative Betas and the three banks with distortions. Despite this reduction, the sample used in the regressions reflects banks that hold 40% of total assets in the raw sample. The banks from this sample correspond to USD2.20 trillion while the total of for the raw sample corresponds to USD5.31 trillion USD. Although this might not represent the average of the market, creating a bias in the estimation, it represents the key players on these markets.

The range of significant estimates in table 2 is between 1.4% and 3.0%. Three out of five models provide a significant coefficient. Fixed effects models and first differences model find significant coefficients. Regarding the significant estimates although apparently low, Miles *et al.* (2011) found a central estimate of 3%. I use 2% as a central estimate but for calibration scenarios 1.4% is computed as well.

B. CAPM and WACC

Table 3 illustrates the calculations for the required return of capital, the WACC and the estimate of the MM compensation - or offset- when the leverage is cut by half. In order to demonstrate the results, I chose one country as example. Using Brazil's risk free rate of 8.7%, a risk premium of 7.5%, an average level of leverage of 10%, the Beta(asset) and the constant previously estimated (0.02 and 0.72, respectively), it is possible to calculate the expected required return on equity and the WACC for the set of banks in Brazil. Applying (10) and (11) this is:

$$R_{brazil} = 8.7\% + (0.72 + (2\%(10\%))\ 7.5\% = 15.9\%$$

$$WACC_{Brazil} = 15.9\% \left(\frac{1}{10\%}\right) + 8.7\%\left(1 - \frac{1}{10\%}\right) = 9.4\%$$

The next step is to calculate the same variables using half of the level of leverage to value the increase in the cost of capital by raising more capital. Applying (10) and (11) again but with a leverage of 5%, this yields a required return on equity of 15.1% and a WACC of 10%. If the MM theorem would not hold completely then changes in the leverage of the bank would not have any impact on the required return on the equity. Then applying (11), the WACC is computed with half the leverage but the return on equity will remain still in 15.9% and not decreased to 15.1%. This produces a WACC of 10.2%. Thus, comparing this 10.2% with the initial 9.4% gives a WACC difference of 0.7 percentage points in a market without any MM theorem compensation. In the other hand, if we compare the WACC of 10% that allows a reduction in the required rate of return and the initial WACC of 9.4, there is a difference of 0.6 percentage points.

A first interpretation of these results implies that in the no MM scenario, the variation of the WACC is higher. Second, the size of the MM offset suggests that effect in the rise of the WACC is 78% of what would be if the MM would not hold at all (0.6/0.7=78%). Rephrasing it, the MM offset in Brazil is 22% of what would be if the MM would hold entirely.

To interpret these results it is important to clarify the notion of MM offset. If the MM offset or compensation is close to zero, then that banking industry is in a scenario where changes in the leverage or increasing the capital have no impact in the required return of equity. In the other extreme, a higher MM offset -close to 1- means that changes in the capital generate large effects on the required level of equity.

Table 3
CAPM AND MM OFFSET
(By country)

				Actual leverage		Leverage Halved		Differences			
Country	**RFR**	**RP**	**Beta**	**Return Equity**	**WACC CC**	**Return Equity**	**WACC**	**WACC (NMM)**	**ΔWACC MM**	**ΔWACC (NMM)**	**MM offset**
Brazil	8.7	7.9	2%	15.9	9.4	15.1	10.0	10.2	0.6	0.7	22%
Chile	6.0	5.9	2%	12.0	6.4	11.1	6.7	6.8	0.3	0.4	29%
Colombia	7.5	8.3	2%	15.4	8.1	14.4	8.6	8.8	0.5	0.7	25%
Mexico	8.2	7.4	2%	16.1	8.6	14.8	8.9	9.1	0.3	0.5	33%
Peru	6.4	7.9	2%	15.6	6.8	13.8	7.1	7.2	0.2	0.4	39%
Average	**7.3**	**7.5**	**2%**	**14.6**	**7.9**	**13.7**	**8.3**	**8.5**	**0.4**	**0.6**	**26%**
UK	5.0	5.0	3%	14.9	5.3	12.6	5.5	5.7	0.2	0.3	46%

Note: RFR refers for the Risk Free Rate, RP as the Risk Premium and WACC as the weighted average cost of capital. All rates are expressed in percentage terms. The Beta(asset) was applied homogeneously with a level of 2% to all countries, due to the lack of enough observations to perform the econometric estimation for each country separately.

The results in Table 3 show that Latin American banks are closer to a no MM setting compared with UK's results estimated by Miles *et al.* (2011). In the average, the MM offset in the Latin American banks sample is 26% while in the UK is 46% for the base case scenario. There are three factors that drive these differences: i) lower levels of leverage ii) the Beta(asset) estimate (3% in the UK vs 2% in this document) and iii) higher risk premiums. First, lower levels of leverage may reflect the quality of this sample, where only major banks were suited for the regressions due to requirements of information (stock market and capital requirements information). Second, the Beta(asset) estimate is lower, presumably because Latin American stock markets have less information available, are less profound and more illiquid compared with developed markets. Thus, investors in these markets follow with less detail the changes in the capital structure. Besides the market response, Latin American markets tend to swing constantly due to foreign investments and commodity prices, introducing distortions into investment decisions. Third, Latin American countries seem to have high premiums, mainly due to political and economic factors.

C. Calibration

Table 4 illustrates the main parameters used and the results derived from the calibration. To assess the impact of halving leverage, I estimate the annual cost of GDP growth and its present value as

a GDP share. It is paramount to highlight here that this estimation only capture the cost of a reduction in the leverage (or an expansion in the capital) via higher interest rates in the economy. The benefits from increasing the capital are mainly through the reduction in the probability of the frequency and severity of a financial crisis. The estimation of the benefits is beyond the scope of this research, however, using previous estimations it would be possible to evaluate the outcome, to get an idea if the benefits outweigh the costs or vice versa.

To obtain the annual cost of GDP growth, I estimate the elasticity of cost of capital to GDP for each country using expression (12), alongside with the parameters in the first two rows of the Table 4. The parameters were obtained from different sources and periods of time (see annex 4). The results show that Colombia and UK have the lowest elasticity whereas Chile and Mexico stand with values higher than 0.6.

The next step is to gauge how the changes in the WACC translate into bank's rates for customers and firms. Here I use the common assumption that a 1% change in the WACC is translated one-to-one into the bank's loan rates. This increase spreads into the firms of the economy depending on the participation of bank credits on the firms' funding. I assume a 1/3 proportion of bank lending, which indicates that rates increases are cut by one third. Again, I use the case of Brazil to clarify the computation of the base case (Beta(asset) of 2.0%). Brazil's increase in WACC is 0.57%, where only a third of it is translated

Table 4
GDP EFFECTS BY COUNTRY
(Beta = 2.0%)

	Brazil	Chile	Peru	Colombia	Mexico	UK
α	0.50	0.50	0.44	0.35	0.56	0.33
σ	0.62	0.62	0.62	0.62	0.62	0.50
Elasticity	0.62	0.64	0.49	0.33	0.79	0.25
Change in WACC %	0.57	0.28	0.25	0.51	0.30	0.18
Debt % of total funding	0.33	0.33	0.33	0.33	0.33	0.33
Cost of capital %	16.6	11.9	14.3	15.8	15.6	10.0
Increase loan rates %	1.14	0.79	0.58	1.08	0.65	0.59
Annual change in GDP %	0.71	0.51	0.28	0.36	0.51	0.15
GDP reduction (PV)%	28.3	20.2	11.3	14.4	20.5	6.0

Note: PV refers to present value. It assumes equal share of debt in funding due to the lack of clear estimates for Latin American countries. The present value of GDP reduction uses a discount rate of 2.5% for all countries, including the UK. Note that the Beta(asset) for the UK base case scenario is 3% and not 2%, but I use it here to compare the results.

into the loan rates (0.19%). This change turns into an increase proportional to the cost of funding of 1.14% (0.19/0.16) The annual GDP growth reduction is 0.71% (1.14%*0.62). Using a discount rate of 2.5%, the cost of deleveraging banks by half is equivalent to 28% of the current Brazilian GDP.

Table 4 and Table A5 in the annex illustrate the different cost estimates for the two scenarios where the Beta(asset) is 1.4% and 2%. The general results show a substantial higher cost for the Latin American economies compared with the results derived for the UK (6%), but with some heterogeneity in the results. Peru and Colombia are the countries that stand closer to UK's permanent loss in GDP with 11.3% and 14.4% respectively, whereas Brazil has the highest cost of the sample, reaching five times the value for the UK.

These results are driven by the value of the elasticity -third row- and the change in the WACC. The selected countries have a higher elasticity of cost of capital to output, which makes the cost of capital more expensive for the economy. Moreover, increases in the WACC pull the cost up too. In sum, most of the Latin American economies have higher costs due the cost of funding and a larger traction from the changes into the economy.

In conclusion, the Latin American banks have higher levels of capital compared with developed economies. Yet, the cost to increase more capital is considerable for these economies. If this is true, one may argue that Latin American banks are in a suboptimal capital structure allocation, and they should not deleverage but increase their debt to reduce their cost of capital, complying only with the minimum regulators demand. However, this could be misleading given the fact that the lack of appropriate cushions to absorb losses was one of the primary causes of the last financial crisis. The benefits from rising capital are yet to be determined, but at some extent these benefits are expected to be large in Latin American countries due to the severity of financial crisis in previous occasions. High volatility of their currencies and fiscal distress enhanced this crisis in the past. An optimal bank capital structure may reduce the instability and volatility of the financial sector enhancing welfare, not only to the banks, but to the whole economy.

D. Limitations

The results above mentioned present some limitations in terms of methodology applied and the interpretation of the results. First, the limitations that may affect the consistency of the estimates are the most problematic. Particularly, omitted variables and regress causality in the econometric model tend to threat the consistency and interpretation of the results. In this case, omitted variables are a source of endogeneity, because the level of leverage is not randomly allocated but a bank decision. Under this scenario, bank's risk aversion is as a possible culprit for an unobservable omitted variable. Risk aversion may change through time and across banks, mak-

ing time and bank fixed effects useless. Three variables were added to capture such omitted variable (ROAA, loan loss reserve ratio and liquid ratio). Although these variables were not significant, risk aversion might have some characteristics that lead to think that it is not an omitted variable.

There is evidence that supports that risk aversion might change over time rapidly, mainly due to general economic factors that affect everyone in the same way (Guiso *et al.*, 2011). Then theses changes in risk aversion are common across banks, which allow a causal interpretation between leverage and risk. Further research should be carried out to understand the nature and characteristics of risk aversion across banks.

Reverse causality may also bias the estimation because the level of risk of a bank may determine its leverage simultaneously. It could be argued that the level of leverage may depend on the level of risk because managers may decide to increase capital if they think the bank is taking larger risks and prefer to be conservative reducing the probability of insolvency. It could also be argued that banks may reduce their capital if they are overexposed to risks and a default is almost inevitable. Thus, rising capital is innocuous to the continuity of the bank. Implicit or explicit guarantees over banks liabilities may induce bankers to become more aggressive in their investments, looking for higher bonuses and remunerations in the short term. In the end, the decision may also depend on the regulatory authorities, which set the regulation ex ante, reducing the endogeneity of the decision over the amount of capital.

Second, the sample used might limit the scope and external validity of the results. Given the fact that 33 banks were used in the regression from a 300 banks raw sample, there is the possibility for sample selection bias. The sample includes the largest banks in the selected countries which have better accountability, more transparency, enough stock market and capital information. Smaller banks in Latin America tend to be privately held with less information available. Then the results suit better to large banks and the results are comparable to previous estimations in the developed world, where only large banks have survived. Moreover, the bank sample represents 40% of the total assets in the raw sample, allowing, at least, a good representation of the whole banking system. Applying these results to countries with small banks may not be suitable.

Finally, limitations regarding the precision of the results are derived from measurement error, either on the level of risk or the leverage. On the risk side, it is possible that market investors miscalculate it which could increase the variance of the estimate. However, this is not a concern because in the worst case scenario the standard errors reported, including this measurement error, are already low. Still, more problematic could be a measurement error in right hand side of the equation, particularly over the leverage levels. However, some institutions

that clearly misreported the level of capital due to mergers and acquisitions were not included in the sample.

VI. Conclusions

This study aims to assess the cost from increasing capital in Latin American banks, exploring the relation between leverage and risk and the completeness of the MM theorem. The findings show that rising capital has an impact on the level of risk of banks close to 2%. A bank with more capital -and less debt- has a lower risk and requires lower equity returns, compensating the switch to a more expensive source of funds (compared with debt). However, this compensation is small since banks in Latin America are closer to a scenario where the MM theorem does not hold at all. Thus, increasing capital is onerous for Latin American countries compared with the UK. In the average, the Latin American countries have a cost in the range between 0.47% and 0.49% of annual GDP growth. The average veneers high differences within the selected countries, where Colombia and Peru have half of the effect it has on Brazil. Still, the difference between these two countries and the UK is almost double.

Several channels drive this cost. First, Latin American countries have a higher elasticity of borrowing rates to output, compared with the UK. Small increases in the cost of borrowing for banks are translated rapidly into loan rates and to the cost of funds to do investments in the economy. Given that the stock capital is scarce in this countries and the productivity of labour with respect to capital is low, the response of output to changes in cost of funds is higher compared with developed economies. Second, the elasticity of leverage to risk is lower in Latin American countries which suggest that investors in Latin America do not internalize all the risk factors of banks probably because they face less liquid markets and have less information available.

These results are crucial to decide the optimal level and the quality of the capital for Latin American banks. Regulators, however, should have in mind that updating capital requirements at the same path as the developed countries could be costly for the economy. These banks may face different funding conditions and the use of debt as a disciplinary tool may not be feasible.

Further research is required in three fields. First, the benefits of increasing capital are required to be assessed, estimating the reduction of the frequency and severity of a banking crisis. Second, the model that is presented in this document assumes that a decrease in the risk of a bank is associated with a lower required return of equity, as the standard finance theory predicts. However, the paper by Baker and Wurgler (2013) found that the risk-return relation may not hold, which could change the results of our model. Finally, tax effects, quantity of loans and country risks should be included in the estimation of costs of raising capital, addressing the problem in a wider perspective.

Bibliografía

Admati, A. R., DeMarzo, P. M., Hellwig, M. F., & Pfleiderer, P. (2011). Fallacies, irrelevant facts, and myths in the discussion of capital regulation: why bank equity is not expensive (2013 ed.). Bonn: Max Planck Inst. for Research on Collective Goods.

Admati, A. R., & Hellwig, M. F. (2013). The bankers' new clothes: what's wrong with banking and what to do about it. Princeton: Princeton University Press.

Arias, E., Manuelli, R. E., & Blyde, J. S. (2005). Sources of growth in Latin America what is missing? Washington, DC: Inter-American Development Bank, Office of External Relations.

Baker, M., & Wurgler, J. (2013). Do strict capital requirements raise the cost of capital? banking regulation and the low risk anomaly. Cambridge, Mass.: National Bureau of Economic Research.

Barajas, A., Chami, R., & Cosimano, T. (2005). Did the Basel Accord cause a credit slowdown in Latin America? Washington, D.C: International Monetary Fund.

Barrel, R., Davis, P., Fic, T., Holland, D., Kirby, S., & Liadze, I. (2009). Optimal regulation of bank capital and liquidity: how to calibrate new international standards. National Institute of Economic and Social Research, Brunel University and FSA. Retrieved December 18, 2013, from http://www.fsa.gov.uk/pubs/occpapers/op38.pdf

Bleger, L. (2011). Latin America in Better Conditions to Face the Global Crisis: Financial Regulations in Argentina, Brazil, Chile, Colombia, Mexico and Peru. Iniciativa para la Transparencia Financiera. Retrieved December 4, 2013, from http://www.itf.org.ar/pdf/documentos/83-2011.pdf

Basel II: International Convergence of Capital Measurement and Capital Standards: A Revised Framework (2006). BIS - Basel Committee on Banking Supervision.

Basel III: A global regulatory framework for more resilient banks and banking systems - revised version June 2011. BIS - Basel Committee on Banking Supervision. Retrieved March 3, 2014, from http://www.bis.org/publ/bcbs189.htm

Brock, P. L., & Rojas-Suarez, L. (2000). Understanding the behavior of bank spreads in Latin America. Washington DC, US: Journal of Development Economics.

Carranza, E., Fernandez-Baca, J., & MorÃ³n, E. (2005). Peru: Markets, Government and the Sources of Growth. Universidad del Pacifico. Retrieved February 11, 2014, from http://www.lacea.org/country_studies/peru.pdf

Carstens, A. G., Hardy, D. C., & Pazarbasioglu, C. (2004). Banking crises in latin america and the political economy of financial sector policy. IDB/IMF - Seminar : Gobierno y Bancos, Responsabilidades y Limites

Caruana, J. (2010). Why Basel III matters for Latin American and Caribbean financial markets. Antigua, Guatemala: BIS.

Dewatripont, M., Tirole J. (1994). The Prudential Regulation of Banks. Journal of Economic Literature, Vol. 34, No. 3, pp. 1365-1366.

Cheng, Y., & Green, C. J. (2008). Taxes And Capital Structure: A Study Of European Companies. Manchester School, 76, 85-115.

Damodaran, A. (2013). Equity Risk Premiums (ERP): Determinants, Estimation and Implications Post-Crisis Update. Financial Markets, Institutions & Instruments, 18(5), 289-370.

D'Hulster, K. (2009, December 1). The Leverage Ratio. Crisis Response, 11. Retrieved February 11, 2014, from The World Bank.

Farag, M., Harland, D., & Nixon, D. (2013). Bank capital and liquidity. Bank of England - Quarterly Bulletin, 3(4). Retrieved January 13, 2014, from http://www.bankofengland.co.uk/publications/Pages/quarterlybulletin/2013/a13prerelease.aspx

Final report: assessing the macroeconomic impact of the transition to stronger capital and liquidity requirements. (2010). Basel, Switzerland: Bank for International Settlements.

Financial Inclusion Data. World Bank. Retrieved March 27, 2014, from http://datatopics.worldbank.org/financialinclusion/

(2010). Financial Stability Report. Bank of England, 1(27). Retrieved October 30, 2013, from http://www.bankofengland.co.uk/publications/Documents/fsr/2010/fsrfull1006.pdf

Fuentes, R., Larraín, M., & Schmidt-Hebbel, K. (2004). Fuentes del crecimiento y comportamiento de la productividad total de factores en chile. Central Bank of Chile - Working Papers, 1(287). Retrieved February 23, 2014

Galindo, A., Rojas-Suarez, L., & Valle, M. d. (2012). Capital Requirements under Basel III in Latin America: The Cases of Bolivia, Colombia, Ecuador and Peru. The Center for Global Development, 1(296). Retrieved January 16, 2014, from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2102766

Galindo, A., Rojas-Suarez, L., & Valle, M. d. (2012). Capital Requirements under Basel III in Latin America: The Cases of Bolivia, Colombia, Ecuador and Peru. Washington, DC: Center for Global Development.

Goodhart, C. A. (2013). The optimal financial structure. London: London School of Economics and Political Science.

Guiso, L., Sapienza, P., & Zingales, L. (2011). Time Varying Risk Aversion. PEGGED- Working paper series). Retrieved October 11, 2013, from https://fisher.osu.edu/blogs/efa2011/files/HHF_0_1.pdf

Hamada, R. S. (1972). The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks. The Journal of Finance, 27(2), 435.

Hamann, F., Lozano, I., & Mejía, L. F. (2011). Sobre el Impacto Macroeconómico de los Beneficios Tributarios al Capital. Borradores de Economia - Banco de la Republica, (668). Retrieved February 2, 2014.

Interim report assessing the macroeconomic impact of the transition to stronger capital and liquidity requirements. (2010). Basel, Switzerland: Bank for International Settlements.

(1998). International convergence of capital measurement and capital standards. BIS - Basle Committee on Banking Supervision. Retrieved March 3, 2014, from http://www.bis.org/publ/bcbs04a.htm

Can emerging market central banks bail out banks? a cautionary tale from Latin America. Washington, D.C.: International Monetary Fund.

Jensen, M. C., Black, F., & Scholes, M. S. (1972). The Capital Asset Pricing Model: Some Empirical Tests. Studies in the Theory of Capital Markets. Retrieved October 24, 2013, from http://ssrn.com/abstract=908569

Kaminsky, G. L., & Reinhart, C. M. (1998). Financial crises in Asia and Latin America: then and now. Estados Unidos: American Economic Review.

KPMG - internal report- Kview, 1(1). Retrieved January 15, 2014, from https://www.kpmg.com/CL/es/IssuesAndInsights/ArticlesPublications/Documents/2010-12-kpmg-tax-kview-basilea-03.pdf

Liu, S. (2008). Capital Share and Growth in Less Developed Countries. CCER Economic Papers. Retrieved April 1, 2014.

Mariathasan, M., & Merrouche, O. (2012). The Manipulation of Basel Risk-Weights. Evidence from 2007-10. Department of Economics Discussion Paper Series. Retrieved October 25, 2013, from http://www.economics.ox.ac.uk/Department-of-Economics-Discussion-Paper-Series/the-manipulation-of-basel-risk-weights-evidence-from-2007-10

Martinez, R. G. (2012). Bayesian MC2 estimation of the capital-labor substitution elasticity in developing countries. Unidad de Análisis de Políticas Sociales y Económicas de Bolivia. Retrieved February 18, 2014.

McKinnish, T. G. (2002). Interpreting Lagged Effects of the Independent Variable: How does the Local Economy Affect Welfare Caseloads? Department of Economics - Working Paper, 1(1). Retrieved October 23, 2013, from http://stripe.colorado.edu/~mckinnis/spectest081202.pdf

Miles, D. K., Marcheggiano, G., & Yang, J. (2011). Optimal bank capital. London: Centre for Economic Policy Research.

Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance, and the theory of investment.

Morrison, A. D., & White, L. (2005). Crises and Capital Requirements in Banking. American Economic Review, 95(5), 1548-1572.

Myerson, R. B. (2013). Rethinking the principles of bank regulation: A review of Admati and Hellwig's Bankers new clothes. Chicago, US: University of Chicago.

O'Neil, C. (2011, August 30). Why log returns?. mathbabe. Retrieved January 22, 2014, from http://mathbabe.org/2011/08/30/why-log-returns.

Pinheiro, A. C., Gill, I. S., Servén, L., & Thomas, M. R. (2004). Brazilian economic growth, 1900-2000: lessons and policy implications. Economic and Social Studies Series, Retrieved February 17, 2014.

Progress report on implementation of the Basel regulatory framework (2013). BIS - Basel Committee on Banking Supervision. Retrieved April 13, 2014, from http://www.bis.org/publ/bcbs247.htm

Sosa, S., Tsounta, E., & Kim, H. S. (2013). Is the Growth Momentum in Latin America Sustainable?. IMF - Working paper series. Retrieved February 6, 2014, from http://www.imf.org/external/pubs/ft/wp/2013/wp13109.pdf

Suttle, P. (2010). Interim Report on the cumulative impact on the global economy of proposed changes in the banking regulatory framework. Washington, D.C.: Institute of International Finance.

Torre, A. d., & Ize, A. (2012). Financial development in Latin America and the Caribbean: the road ahead. Washington, D.C: World Bank.

Turner, A. (2009). The Turner review a regulatory response to the global banking crisis. London: Financial Services Authority.

Turner, A. (2009). The Turner review a regulatory response to the global banking crisis. London: Financial Services Authority.

Villarreal, J. E. and Córdoba, M. J. A Consistent Methodology for the Calculation of the Cost of Capital in Emerging Markets. Retrieved April 15, 2015 from: http://ssrn.com/abstract=1663845 or http://dx.doi.org/10.2139/ssrn.1663845

Wooldridge, J. M. (2009). Introductory econometrics: a modern approach (4th ed., international student ed.). Mason (OH): South-Western, Cengage Learning.

Yang, J., & Tsatsaronis, K. (2012). Bank stock returns, leverage and the business cycle. Basel, Switzerland: BIS Quarterly Review.

Annex 1

Table A1
SUMMARY STATISTICS

Country	Stats	Beta	Leverage %	Total Assets	Tier 1 Capital	LLR Ratio %	ROAA %	Liquid Ratio %
Brazil	N	81	81	81	81	81	81	81
	mean	0.57	10.0	144,108,700	11,595,666	4.94	1.90	36.36
	sd	0.28	6.4	278,030,607	21,478,536	2.51	1.66	17.21
	min	0.07	2.1	1,724,400	153,300	0.71	-3.12	3.79
	max	1.25	45.3	1,150,486,200	76,769,400	13.34	11.05	103.54
Chile	N	29	28	29	28	29.00	29.00	29.00
	mean	0.68	15.0	13,180,670,724	984,190,714	2.15	1.45	20.88
	sd	0.37	3.3	7,043,548,361	634,272,470	0.60	0.50	12.87
	min	-	11.6	4,173,242,000	197,789,000	1.25	0.54	6.72
	max	1.24	22.6	24,759,888,000	2,135,660,000	3.11	2.37	50.18
Colombia	N	28	18	28	18	28.00	27.00	26.00
	mean	0.60	11.7	41,667,245,929	2,892,711,111	3.99	2.01	20.04
	sd	0.39	1.8	32,538,327,810	2,014,327,837	0.85	0.52	4.78
	min	0.14	8.5	7,339,200,000	769,600,000	2.75	0.98	13.59
	max	1.70	15.8	127,289,300,000	7,213,300,000	6.10	3.18	38.08
Mexico	N	21	17	21	17	21.00	21.00	21.00
	mean	0.59	17.6	157,267,810	14,848,207	7.96	1.67	47.35
	sd	0.46	15.1	172,591,184	17,237,072	4.46	0.99	22.76
	min	0.05	4.0	18,287,000	918,000	1.51	0.06	17.39
	max	1.99	50.1	687,883,000	46,588,000	14.27	4.00	94.24
Peru	N	13	13	13	13	13.00	13.00	13.00
	mean	0.43	22.7	39,561,869	2,428,715	4.32	2.25	29.60
	sd	0.30	15.6	24,056,094	1,893,411	1.33	0.61	10.25
	min	0.08	12.3	18,292,200	471,325	3.16	1.28	14.23
	max	0.87	58.0	90,397,200	6,132,300	8.05	3.13	49.26
Total	N	172	157	172	157	172.00	171.00	170.00
	mean	0.59	12.9	9,095,419,012	514,964,215	4.64	1.84	32.07
	sd	0.34	9.0	20,146,515,885	1,176,706,290	2.84	1.25	17.94
	min	-	2.1	1,724,400	153,300	0.71	-3.12	3.79
	max	1.99	58.0	127.289.300.000	7,213,300,000	14.27	11.05	103.54

Note: * All values for Assets and Capital are in local currencies. Table 2 reflects the summary statistics for the variables used in the econometric model and does not intend to reflect all the variables used in the results. LLR refers to Loan Loss Ratio. ROAA refers to Return of Average Assets.

Volumen XLV | No. 1 | Junio de 2015 | pp. 91-130

Annex 2

Table A2
BETA ESTIMATES
(1998-2012)

Index Number	Beta	Standard Errors	T	Index Number	Beta	Standard Errors	T
	1998				**1999**		
16277	0.65	0.17	3.784	45111	0.68	0.45	1.50
16664	0.70	0.04	17.77	45443	0.20	0.21	0.93
17131	0.31	0.43	0.72	45598	0.22	0.14	1.56
30901	0.98	0.08	12.08	45703	0.53	0.07	7.01
32034	0.50	0.05	9.37	45720	0.31	0.09	3.66
33974	0.53	0.14	3.78	46590	0.09	0.07	1.30
35873	0.02	0.10	0.25	47707	1.56	0.09	16.90
40697	0.32	0.23	1.37	48480	0.28	0.11	2.50
41090	0.54	0.06	8.83	49150	1.27	0.09	13.92
45110	0.16	0.02	7.32	50005	0.06	0.22	0.28
45111	0.15	0.24	0.62				
45443	0.31	0.11	2.84		**2000**		
45598	0.45	0.12	3.85				
45703	0.68	0.08	8.88	16277	0.91	0.56	1.62
45720	0.51	0.07	6.93	16664	0.71	0.07	10.15
46590	0.37	0.07	5.55	17131	-0.01	0.03	-0.33
47707	1.91	0.11	17.95	30010	0.68	0.78	0.87
48480	0.86	0.13	6.44	30901	0.45	0.13	3.38
49150	1.18	0.09	12.94	32034	0.73	0.08	9.46
50005	-0.24	0.07	-3.28	33974	0.34	0.12	2.83
				35873	0.02	0.15	0.13
	1999			40697	0.17	0.14	1.17
				41090	0.52	0.06	8.12
16277	0.74	0.24	3.02	45110	0.33	0.05	7.01
16664	0.58	0.05	11.32	45111	0.84	0.34	2.45
17131	0.27	0.15	1.82	45443	0.32	0.15	2.15
30010	1.27	1.11	1.14	45598	-0.02	0.11	-0.18
30901	0.94	0.16	5.93	45703	0.41	0.06	7.36
32034	0.47	0.06	7.52	45720	0.33	0.10	3.27
33974	0.51	0.11	4.72	46590	0.15	0.10	1.50
35873	0.05	0.10	0.50	47707	1.04	0.08	12.44
40697	0.15	0.32	0.48	48480	0.33	0.13	2.65
41090	0.64	0.05	11.83	49150	0.94	0.08	11.44
45110	0.21	0.03	6.54	50005	0.63	0.54	1.18

Table A2
BETA ESTIMATES
(1998-2012) *(Continuación)*

Index Number	Beta	Standard Errors	T	Index Number	Beta	Standard Errors	T
		2001				**2002**	
16277	-0.82	1.28	-0.64	32034	0.79	0.06	12.76
16664	0.77	0.06	13.42	33974	0.24	0.14	1.76
17131	0.04	0.06	0.62	35873	0.05	0.09	0.55
30010	-0.40	0.51	-0.78	40276	0.01	0.03	0.18
30047	0.40	1.11	0.36	40697	-	-	-
30076	0.29	0.14	2.12	41090	1.14	0.08	14.71
30901	1.07	0.24	4.52	45110	0.38	0.04	9.44
32034	0.78	0.06	13.37	45111	0.49	0.68	0.72
33974	0.42	0.12	3.37	45443	0.04	0.18	0.23
35873	0.33	0.09	3.84	45598	0.43	0.11	4.08
40276	-0.03	0.03	-1.04	45703	0.92	0.08	11.18
40697	-0.99	0.65	-1.52	45720	0.49	0.11	4.49
41090	0.90	0.08	10.59	46407	0.78	0.50	1.57
45110	0.31	0.04	7.52	46590	0.25	0.06	3.86
45111	-0.14	0.69	-0.21	47707	1.16	0.07	16.39
45443	0.32	0.13	2.40	47740	0.14	0.13	1.07
45598	0.20	0.13	1.53	48480	0.07	0.09	0.83
45703	0.84	0.08	11.08	49150	0.98	0.08	11.63
45720	0.36	0.10	3.45	50005	0.19	0.37	0.51
46407	0.20	1.36	0.14				
46590	0.67	0.12	5.60			**2003**	
47707	1.19	0.08	15.59	16277	1.61	0.53	3.06
47740	0.46	0.49	0.94	16664	0.70	0.06	10.99
48480	0.34	0.14	2.40	17131	0.26	0.13	2.02
49150	1.06	0.09	11.66	30010	0.08	0.47	0.17
50005	0.49	0.61	0.80	30047	-1.25	1.30	-0.96
				30076	0.62	0.05	12.48
		2002		30654	0.58	0.09	6.11
16277	-2.53	1.45	-1.75	30901	0.12	0.13	0.92
16664	0.91	0.06	14.66	32034	0.67	0.06	10.50
17131	-0.08	0.09	-0.93	33974	0.30	0.12	2.57
30010	-0.03	0.20	-0.14	35873	0.19	0.16	1.23
30047	-	-	-	40276	0.15	0.09	1.72
30076	0.76	0.08	9.58	40697	-0.89	2.58	-0.34
30654	0.58	0.33	1.78	41090	0.79	0.09	9.32
30901	0.19	0.24	0.78	45110	0.48	0.05	9.56

Table A2
BETA ESTIMATES
(1998-2012) *(Continuación)*

Index Number	Beta	Standard Errors	T	Index Number	Beta	Standard Errors	T
	2003				**2005**		
46407	1.04	0.11	9.89	16277	0.36	0.17	2.09
46590	0.47	0.07	6.47	16664	0.83	0.06	14.23
47707	0.82	0.08	10.33	17131	-0.09	0.08	-1.12
48480	0.16	0.14	1.11	30010	3.14	1.62	1.93
49150	0.83	0.10	8.07	30047	0.14	0.39	0.37
50005	-1.20	2.19	-0.55	30076	0.61	0.06	9.92
				30654	0.46	0.06	7.70
	2004			30901	0.87	0.13	6.80
				32034	0.76	0.07	10.10
16277	0.43	0.21	2.06	33974	0.60	0.10	5.97
16664	0.76	0.05	15.70	35873	-0.05	0.11	-0.42
17131	0.06	0.09	0.67	40276	0.80	0.10	7.65
30010	0.85	1.43	0.59	40697	-1.45	1.96	-0.74
30047	0.18	0.15	1.21	41090	0.84	0.08	10.72
30076	0.81	0.06	14.01	45111	0.16	0.50	0.33
30654	0.41	0.07	5.80	45443	-0.14	0.16	-0.92
30901	0.26	0.15	1.79	45598	0.42	0.08	5.26
32034	0.73	0.05	14.04	45703	0.77	0.09	8.81
33974	0.14	0.07	2.07	45720	0.87	0.11	8.08
35873	0.09	0.07	1.15	46407	1.14	0.07	16.95
40276	0.45	0.09	5.34	46590	0.50	0.08	6.08
40697	-0.36	0.66	-0.54	48480	0.21	0.07	2.94
41090	0.99	0.06	17.40	49150	0.80	0.08	9.70
45111	0.63	0.57	1.10	50005	0.10	0.23	0.42
45443	0.28	0.23	1.25				
45598	0.66	0.10	6.56		**2006**		
45703	0.85	0.11	8.09				
45720	0.62	0.10	5.98	16277	0.34	0.17	2.07
46407	1.13	0.05	20.71	16664	1.15	0.06	20.54
46590	0.49	0.08	5.88	17131	0.07	0.14	0.47
47707	0.27	0.09	2.92	30010	0.81	0.61	1.33
48480	0.11	0.23	0.48	30047	0.78	0.28	2.78
49150	0.86	0.10	8.73	30076	0.83	0.04	19.56
50005	3.80	5.30	0.72	30654	0.82	0.09	9.21

Table A2
BETA ESTIMATES
(1998-2012) *(Continuación)*

Index Number	Beta	Standard Errors	T	Index Number	Beta	Standard Errors	T
	2006				**2007**		
30901	0.25	0.07	3.58	40276	0.55	0.06	9.07
32034	0.93	0.06	14.44	40697	1.99	1.24	1.60
33974	0.32	0.07	4.83	41090	0.95	0.06	15.06
35873	-0.01	0.09	-0.07	43536	0.46	0.21	2.18
40276	0.78	0.05	16.13	43654	0.42	0.22	1.94
40697	0.70	0.63	1.12	43950	0.42	0.14	2.93
41090	1.12	0.10	11.10	44002	0.81	0.11	7.19
45111	0.79	0.29	2.75	45111	0.48	0.14	3.43
45443	0.08	0.13	0.63	45443	0.01	0.03	0.34
45598	0.57	0.07	7.74	45598	0.68	0.07	9.46
45703	0.56	0.07	7.53	45703	0.23	0.08	2.69
45720	1.07	0.10	11.07	45720	0.78	0.04	17.48
46407	0.67	0.04	17.92	46406	0.77	0.09	8.25
46590	0.64	0.07	9.24	46407	0.89	0.08	11.24
48480	0.38	0.07	5.68	46590	0.69	0.05	13.07
49150	1.00	0.08	12.80	46818	0.68	0.12	5.79
50005	-0.14	0.07	-2.15	48108	0.72	0.21	3.47
				48480	0.40	0.06	6.67
	2007			49150	1.03	0.08	13.57
				50005	-0.00	0.03	-0.02
15994	0.46	0.11	4.30				
16277	0.46	0.21	2.24		**2008**		
16664	1.02	0.05	22.61				
17131	0.20	0.16	1.30	15994	0.49	0.06	7.82
27649	0.43	0.09	4.84	16277	0.26	0.08	3.33
30010	0.52	0.14	3.82	16664	1.07	0.04	24.53
30047	0.22	0.53	0.43	17131	0.34	0.21	1.62
30076	0.30	0.05	6.59	27649	0.60	0.07	9.17
30078	1.39	0.70	2.00	30010	0.53	0.07	7.13
30654	0.65	0.07	9.74	30047	0.26	0.27	0.98
30901	0.42	0.07	6.23	30076	0.76	0.05	14.73
32034	0.82	0.05	15.52	30078	0.80	0.06	14.28
33974	0.78	0.05	16.13	30654	0.50	0.05	10.18
35873	0.33	0.10	3.35	30901	0.20	0.04	4.42

Table A2
BETA ESTIMATES
(1998-2012) *(Continuación)*

Index Number	Beta	Standard Errors	T	Index Number	Beta	Standard Errors	T
		2008				**2009**	
32034	0.86	0.04	21.91	30078	0.52	0.08	6.57
33974	0.52	0.04	12.54	30654	0.64	0.08	7.89
35873	0.31	0.06	5.11	30901	0.08	0.05	1.48
40276	0.96	0.06	17.03	31681	-0.73	1.18	-0.62
40697	0.50	0.35	1.44	32034	0.85	0.04	20.14
41090	1.11	0.05	23.42	33974	0.37	0.05	7.38
43536	0.68	0.08	8.71	35873	-0.00	0.10	-0.03
43654	0.69	0.08	9.06	40276	0.87	0.07	11.76
43950	0.37	0.06	5.84	40697	0.93	0.96	0.97
44002	0.85	0.07	12.36	41090	0.91	0.06	15.41
45111	0.13	0.06	2.28	43536	0.48	0.09	5.44
45443	0.01	0.01	0.65	43654	0.60	0.09	6.69
45598	0.92	0.05	17.10	43950	0.41	0.09	4.77
45703	0.41	0.07	6.30	44002	0.68	0.07	9.41
45720	1.10	0.07	16.13	45111	0.09	0.11	0.80
46406	0.74	0.06	12.32	45443	-0.04	0.03	-1.35
46407	1.10	0.06	19.80	45598	0.70	0.07	10.31
46590	0.73	0.05	13.39	45703	0.96	0.08	11.52
46818	0.60	0.07	8.72	45720	1.19	0.08	14.03
48108	0.46	0.07	6.75	46406	0.48	0.08	6.18
48480	0.39	0.06	6.10	46407	1.21	0.07	17.79
49150	1.31	0.09	14.47	46590	0.91	0.08	11.63
50005	-0.06	0.02	-2.60	46818	0.51	0.08	6.19
				48108	0.68	0.10	7.09
		2009		48480	0.29	0.09	3.05
				49150	1.49	0.11	13.60
15994	0.34	0.10	3.46	50005	0.04	0.06	0.63
16277	0.28	0.15	1.81				
16664	1.10	0.05	23.86			**2010**	
17131	-0.01	0.10	-0.14				
27649	0.32	0.09	3.41	10458	0.23	0.07	3.33
30010	0.63	0.17	3.78	15994	0.53	0.09	5.68
30047	0.27	0.93	0.29	16277	0.29	0.12	2.34
30076	0.51	0.08	6.72	16664	1.03	0.05	20.30

Table A2
BETA ESTIMATES
(1998-2012) *(Continuación)*

Index Number	Beta	Standard Errors	T	Index Number	Beta	Standard Errors	T
	2010				2011		
17131	0.05	0.03	1.50	10458	0.17	0.04	4.30
27649	0.68	0.07	10.03	15994	0.38	0.07	5.82
30010	0.77	0.15	5.15	16277	0.29	0.14	2.15
30047	1.70	0.58	2.92	16664	1.03	0.05	21.86
30076	0.62	0.08	7.62	17131	0.05	0.01	3.11
30078	0.39	0.09	4.48	27649	0.80	0.06	13.15
30654	0.97	0.12	7.99	30010	1.25	0.17	7.55
30901	0.20	0.07	2.80	30047	0.17	0.25	0.68
31681	-4.20	1.74	-2.41	30076	0.20	0.06	3.65
32034	0.90	0.05	18.03	30078	0.53	0.11	4.65
33974	0.67	0.07	10.01	30654	0.83	0.06	13.42
35873	0.39	0.12	3.28	30901	0.21	0.05	4.72
40276	0.99	0.09	11.03	31681	0.88	0.71	1.25
40697	-0.67	1.93	-0.34	32034	0.91	0.04	20.85
41090	0.93	0.06	14.64	33974	0.95	0.04	22.84
43536	0.79	0.10	8.22	35873	0.25	0.15	1.67
43654	0.89	0.15	5.95	40276	0.47	0.08	5.74
43950	0.54	0.07	7.70	40697	-0.59	1.24	-0.47
44002	0.34	0.08	4.20	41090	0.95	0.05	19.42
45111	0.46	0.13	3.51	43536	0.74	0.08	9.24
45443	-0.05	0.15	-0.32	43654	0.47	0.13	3.64
45598	0.87	0.10	8.63	43950	0.15	0.09	1.72
45703	1.10	0.11	10.11	44002	0.35	0.09	3.93
45720	1.24	0.11	10.92	45111	0.20	0.07	2.84
46301	1.25	0.41	3.02	45443	-	-	
46406	0.35	0.07	5.11	45598	0.79	0.05	16.73
46407	1.11	0.07	15.95	45703	0.83	0.09	8.91
46590	0.95	0.11	8.59	45720	1.00	0.06	16.87
46818	0.79	0.11	7.19	46301	0.39	0.05	8.21
48108	0.72	0.09	7.79	46406	0.48	0.09	5.57
48480	0.49	0.13	3.64	46407	0.85	0.06	13.17
49150	0.99	0.10	9.62	46590	1.02	0.06	18.35
50005	0.04	0.16	0.27	46818	0.75	0.08	9.06
50075	0.05	0.27	0.20	48108	0.46	0.09	5.26

Table A2
BETA ESTIMATES
(1998-2012) *(Continuación)*

Index Number	Beta	Standard Errors	T	Index Number	Beta	Standard Errors	T
	2011				**2012**		
48480	0.71	0.07	9.82	35873	0.29	0.20	1.49
49150	1.27	0.08	15.42	40276	0.46	0.08	5.67
50005	-0.01	0.01	-0.69	40697	-1.14	1.40	-0.81
50075	-0.45	0.27	-1.67	41090	0.98	0.08	12.75
				43536	0.54	0.10	5.44
	2012			43654	0.55	0.08	6.99
				43950	0.22	0.10	2.12
10458	0.18	0.10	1.88	44002	0.39	0.10	3.92
15994	0.30	0.07	4.26	45111	0.09	0.12	0.75
16277	0.11	0.14	0.82	45443	0.10	0.17	0.60
16327	0.45	0.08	5.30	45598	0.77	0.08	9.07
16664	0.97	0.06	16.72	45703	0.59	0.16	3.78
17131	0.02	0.05	0.52	45720	0.96	0.11	8.89
27649	0.67	0.10	6.72	46301	0.31	0.07	4.35
30010	0.81	0.20	4.00	46406	0.27	0.07	4.07
30047	-0.94	0.79	-1.20	46407	0.68	0.06	10.59
30076	0.18	0.05	3.35	46590	0.90	0.10	9.11
30078	0.30	0.18	1.64	46818	0.70	0.08	8.25
30654	0.75	0.13	5.90	48108	0.07	0.12	0.60
30901	0.08	0.10	0.78	48480	0.27	0.15	1.89
31681	0.65	1.18	0.55	49150	1.14	0.14	8.25
32034	0.71	0.06	11.13	50005	-0.02	0.02	-0.87
33974	0.72	0.07	10.90	50075	-0.04	0.34	-0.12
33974	0.72	0.07	10.90				

Annex 3
RISK PREMIUM

According to Damodaran (2013), the risk premium can be calculated using the risk premium of a mature equity market and the risk premium. The market premium and country risk premium can be defined as follows:

Risk Premium = Mature risk premium + country risk premium

Country risk premium = Rating Based default spread(volatility adjustment)*

The rating default spreads are based on the current ratings for sovereign debt. The assessment of sovereign debt is attached to a default spread that ranges from 70 to 1000 basic points. The ratings are provided by Standar & Poors and Moodys. The default spread is calculated for bonds denominated in US dollars. Then it estimates a typical default spread for a bond with a specific rating. In addition to the default risk, an adjustment is suggested for the volatility in the equity market. The adjustment in volatility captures the relative volatility of the equity market with respect to the volatility of the sovereign bond. For the risk premium calculation it assumed a volatility adjustment of 1.5, which is the average for 42 countries.

Annex 4

Table AA
SOURCES OF PARAMETERS

Country / Parameter	α	σ
Brazil	Castelar *et al.* (2001)	Gonzales-Martínez (2012)
Chile	Fuente *et al.* (2004)	Gonzales-Martínez (2012)
Colombia	Hamman *et al.* (2011)	Gonzales-Martínez (2012)
Mexico	Liu (2008)	Gonzales-Martínez (2012)
Peru	Carranza *et al.* (2001)	Gonzales-Martínez (2012)

Volumen XLV | No. 1 | Junio de 2015 | pp. 91-130

Annex 5

Table A5
GDP EFFECTS BY COUNTRY
(Beta = 1.4%)

	Brazil	Chile	Peru	Colombia	Mexico	UK
α	0.5	0.507	0.44	0.35	0.56	0.33
σ	0.62	0.62	0.62	0.62	0.62	0.50
Elasticity	0.62	0.64	0.49	0.33	0.79	0.25
Change in WACC %	0.63	0.31	0.28	0.57	0.34	0.18
Debt % of total funding	0.33	0.33	0.33	0.33	0.33	0.33
Share of rate increase %	16.6	11.9	14.3	15.8	15.6	10.0
Increase loan rates %	1.26	0.88	0.65	1.20	0.72	0.59
Annual change in GDP %	0.79	0.56	0.32	0.40	0.57	0.15
GDP reduction (PV)%	31.44	22.51	12.64	16.08	22.82	5.94

Note: PV refers to present value. It assumes equal share of debt in funding due to the lack of clear estimates for Latin American Countries. The present value of GDP reduction uses a discount rate of 2.5% for all countries, including the UK.