How Bank Regulations Impact Efficiency and Performance?

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This study examines the impact of regulation, and other micro- and macroeconomic factors on banks' productivity growth, in an international sample of 2,155 banks from 93 countries. Results show that high capital requirements enhance productivity growth in North and Latin American banks, but not in European, African or Asian banks. Supervisory powers drive bank productivity growth in all regions except Europe and Central Asia. Restrictions on real estate, insurance, and securities activities impede productivity change in all Income level groups but not in High-Income Economies. Our results also show that market volatility and Z-score drive technological change and scale efficiency growth, but negatively impact pure technical efficiency.

JEL classification: C33, G18, G21, G24, G28

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1. Introduction

The waves of financial distress and corrective regulations date back more than 800 years ago (Reinhart, 2008; Reinhart and Rogoff, 2014). Following the 2008 financial crisis, there have been calls for re-regulation and ring-fencing of financial services (Financial Services Act (2013), Dodd-Frank Act (2010) and Liikanen (2012) report). Recently, in 2018, concerns about the ability to generate profit in the realm of the tightened regulation arose. Banks claim that the new banking regulations, introduced as a response to the 2007-2009 crisis, reduce market liquidity[1] (Walker, 2014). Especially, as it is currently considered to be transforming banks' ability to mitigate risk and instability (Athanasoglou *et al.*, 2014). Specifically, when realising that post-crisis acts have not lead to fundamental changes in banks approaches and practices (Barth *et al.*, 2015; Epstein and Montecino, 2015).

Although there exists a broad consensus on the importance of efficient and healthy banking system, the evidence on how this system should be regulated to function properly diverges. Supporters and contenders of stricter bank regulation claim targeting economic growth through enhancing resilience, operations and functions of the banking industry (Levine, 1997, 2005). The reason being poorly functioning banking systems impede economic progress, exacerbate poverty, and destabilise economies (Barth *et al.*, 2001). However, the literature on banks behaviour and functionality provides evidence on their misconduct and malfunctioning, especially in times of distress. This controversy heightens when examining regulatory responses to the financial crisis, and the following banks and markets perceptions of these regulations. This dialectic reflects mixed evidence in the literature regarding the impact of regulatory reforms on banks productivity, competition, production technology and efficiency improvements. Some studies report improvements in productivity following financial reforms, while others suggest little or negative productivity growth[2]. Henceforth, re-emphasising the regulatory-performance dialectic (Kane, 1981) and motivating research into the impact of renewed regulations on bank performance[3].

[1] Higher capital reserve requirements, that are buffers to cover for business and credit risks, decrease a) funds available for banks for lending and investing which decreases sales volumes and consequently profits and b) dries banks most liquid assets (cash and cash equivalents).

[2] Detailed reviews of the impact of financial reforms on the productivity change of banking systems are analysed in Mukherjee et al, (2001), and Kumbhakar and Sarkar (2003).

[3] Following the early great depression of 1930s, U.S. financial markets witnessed the passage of restricting bank activities regulations that affected commercial bank growth especially those that trade securities directly or via affiliates (Westerfield, 1933). Technological advances and the consolidation wave of the late 1980s in financial and industrial sectors formed a pull pressure on regulators who started permitting limited trading. The Gramm–Leach–Bliley Act (Financial Services Modernisation Act - FSMA) officially annulled most of the acts that limited the

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This paper contributes to the literature by examining the relationship between the implementation of regulatory standards and the performance of the banking sector following a structural model[4] of the banking firm and the concept of optimisation (Hughes and Mester, 2014). Hence, we explore the impact of different regulatory reforms on banks performance of Total Factor Productivity (TFP) and its component efficiencies and its association with bank-specific variables of profitability and equity and with macro-level variables of economy and freedom. More explicitly, the study examines the impact of; (i) regulatory and supervisory policies related to Basel accords pillars of capital and market discipline through private monitoring, (ii) restrictions on bank activities and (iii) Economic and financial freedoms on TFP growth and year-end performance in banking. An additional contribution of this study is that it examines across economies with different levels of income[5] based on the Gross National Income (GNI) per capita. Low-income economies are those with a GNI per capita of $995 or less, lower-middle-income economies are those with a GNI per capita between $996 and $3,895; upper-middle-income economies are those between $3,896 and $12,055, and high-income economies are those with a GNI per capita of $12,055 or more.

The current literature on bank productivity provides mixed results varying over the kind of regulation and their impact. Tirtiroğlu *et al.* (2005) argue that banking restrictions, in the US, decreases productivity growth, while relaxing restrictions on intrastate branching expansion provide a positive long-run influence upon banks' productivity growth. However, Delis *et al.* (2011b) indicate that regulations, in transition economies, that promote private monitoring and allows banks' activities of securities, insurance and real estate have a positive impact on productivity. However, regulations increasing capital requirements and supervisory power do not have a significant impact on productivity. In Europe, strengthening capital restrictions and official supervisory powers improve the efficient operations of banks. Furthermore, Abreu *et al.* (2019)

activities of U.S. banks in 1999 (Yeager *et al.*, 2007). In 1989, Europe also adopted a liberalising strategy through the Second Banking Directive (Romero-Ávila, 2007; Demyanyk *et al.*, 2007). However, following the 2007-2009 crisis, Liikanen *et al.* (2012) reported several recommendations to restrict proprietary trading and other significant trading activities in order to remove support given by deposits and their guarantee to risky trading activities.

[4] The structural model of the banking firm adopts strategies and deploys methods to optimise performance that improve the resilience of firms through enhancement of efficiencies of its inputs and outputs and inline to minimise systemic risk.

[5]The GNI per capita is calculated using the Atlas method which uses the Atlas conversion factor instead of simple exchange rates. The purpose of the Atlas conversion factor is to reduce the impact of exchange rate fluctuations in the cross-country comparison of national incomes. The Atlas conversion factor for any year is the average of a country's exchange rate for that year and its exchange rates for the two preceding years, adjusted for the difference between the rate of inflation in the country and international inflation (Bank, 2019).

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analyse the multitude of bank efficiency literature and highlights the lack of consolidated studies that evaluate efficiency and productivity in association with other macro and micro factors simulaneosly.

Furthermore, in Europe, private monitoring and restricting bank activities can result in higher bank inefficiency levels (Chortareas *et al.*, 2012). Tanna *et al.* (2017) find that the net effect of financial liberalisation enhances bank TFP growth. However, most of the recent empirical literature is on the US, or European and transition economies, highlighting paucity in cross-country evidence, especially accompanying recent developments in financial regulations and markets restructuring. Therefore, this paper seeks not only to associate bank productivity, and incumbent efficiencies, to their determinants, but also to investigate the productivity–regulations nexus from a cross-country perspective, because "Analysing productivity differences across countries may help to identify the success or failure of policy initiatives" (Casu *et al.*, 2004) (p. 2522).

The rest of this paper analyses the relevant literature on bank regulation and productivity in Section 2. Methodology, sample specification and data analysis are in Section 3. Empirical results and a discussion of the results are in Section 4 and a conclusion in Section 5.

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2. Literature review

Regulation in the banking sector is of high interest, to regulators, economists, scholars, and governments, due to its contribution to resilient banking sectors and economies. However, the impact of such regulations is still debatable and uncertain. A well-functioning regulatory and supervisory framework can help minimise moral hazard and discourage excessive risk-taking. Post-2008 crisis, questions arose about the suitability of the current regulatory setting, with several studies indicating weaknesses in regulation and supervision as one of the critical causes of the severity and depth of the crisis (Cihak *et al.*, 2013; Merrouche and Nier, 2014). While efforts to strengthen regulation and supervision are well underway in many countries, there is no evidence that any standard set of rules is universally appropriate for sponsoring well-performing and resilient banks. Reforms that might thrive in some countries may not stand good practice in other countries that have different institutional or economic settings. There is no extensive cross-country evidence as to which of the many different regulations and supervisory practices employed around the world work best to promote financial stability (Barth *et al.*, 2013b).

2.1. The impact of bank regulation and compliance on bank performance

Demirgüç-Kunt and Detragiache (2010) argue that there is no robust association between Basel core principles and bank risk or system-wide risk. However, even rating agencies that were accused of misconduct due to their failure in the assessment of banks and insurance companies (FCIC, 2011), tend to give higher credit ratings for compliant countries, which contradict with Demirgüç-Kunt and Detragiache (2010). Furthermore, Barth *et al.* (2004) argue that regulatory policies that force accurate information disclosure, empower private-sector corporate control and foster incentives for private agents to exert corporate control, work best to promote bank development, performance and stability. They also suggest that countries' specificity added to political, social and legal differences motivates regulations, controlling for regulatory arbitrage[6].

Consequently, they emphasise that banking systems differ among jurisdictions; hence, there is no single rule to apply globally. Barth *et al.* (2004) correspondingly argue that there is no evidence that there is a universal best practice that is appropriate for promoting well-functioning banks". Suggesting that, only empirical evidence can prove the questionable effectiveness of specific regulations and supervision frameworks, by following a methodology that clusters

[6] The inability to efficiently regulate risk-taking by banks when they are able to freely direct their investment flows worldwide (Boyer and Kempf, 2016).

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sampling regions and countries. Hence, the feasibility of global regulatory reforms, such as the Basel accords, and their jurisdictions' adaptation are investigated for their stability, efficiency enhancement and development rather than just compliance.

2.2. Bank regulation and productivity

Banking regulation and performance literature suggest different approaches to study their interdependency. The diversity of these approaches stem from applying different empirical methodologies that are also dependent on a wide array of variables of regulatory and systemic nature. We adopt three different perspectives in analysing bank regulation and productivity (Hendrickson, 2011); ***central banks' policies***, ***regulatory perspective*** and ***economic perspective***.

Bagliano *et al.* (2000), Kindelberger and Aliber (2005) and Agénor and El Aynaoui (2010) hold central banks responsible for their policies' contribution to financial and banking unrests, competitiveness, liquidity and strength of the sector. However, another strand of literature embraces the economic perspective in examining bank regulation and performance. Temin *et al.* (1969), Temin and Norton (1976) and Ramirez (2009) relate bank instability and fragility and their consequences to the sharp drop in public consumption. Such drops lead to a contraction in spending and consequently lending; leading to slower recessionary business cycles and lowered banks' profits, and relatively higher banks fixed costs. Both, the Turner (2009) report in the U.K. and the Financial Crisis Inquiry Commission in the U.S. accuse economic macro-imbalances among countries of big economies[7] for the financial crisis. Calomiris (2009) links the economic response to the regulatory approach through broader governance of market structure. This connection would influence banks' strategies, behaviour, and reaction towards innovations and panics resulting from demand and supply conditions or market imperfections. Furthermore, bank regulations cannot be viewed in isolation from economic variables of inflation and production, Demirgüç-Kunt *et al.* (2003) argue.

Hence, this paper examines the regulatory perspective, as it extends to reflect central bank policies and economic perspectives. We examine the interdependencies and interactions of the several regulatory frameworks on banks performance and productivity growth in a cross-country and multi-period setup.

[7] Between 1998 and 2008, the global economy has seen an explosion of world macro-imbalances (see exhibit in Appendix A); Oil exporting countries, Japan, China, and some other East Asian emerging / developing nations have accumulated large current account surpluses, while large current account deficits have emerged in the USA, the UK, Ireland, Spain and some other emerging markets countries.

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2.3. Bank regulations perspective determinants

Brun *et al.* (2013) argue that a one percentage point increase in capital requirements leads to a reduction in lending by approximately 10% for French banks between 2008 and 2011. Pasiouras (2008) finds a significantly positive correlation between supervision empowerment and banks' productivity enhancement through technical efficiency. Tirtiroglu, Daniels, and Tirtigoglu (2005) examine the impact of U.S. intrastate and interstate deregulations on bank TFP growth and find that intrastate branching liberalisation has a positive long-run impact on productivity growth. Isik (2007) and Aysan and Ceyhan (2008) finds that the productivity of Turkish banking-sector reforms (BSRs) post-2001 improved significantly as the reform process accelerated. In contrast, Tırtıroglu, Daniels, and Tırtıroglu (1998) find a negative relationship between regulatory initiatives and TFP growth in U.S. commercial banking over the period 1946–95[8]. Furthermore, Grifell-Tatje and Lovell (1996) conclude that the relaxation and removal of regulatory constraints in the Spanish savings bank sector, led to an increase in branching and merger activity although this could not explain the magnitude or nature of productivity decline found over the study period.

Censuring securitisation as one of the leading causes and propagators of the 2007 subprime crisis (FCIC, 2011), regulators are re-effecting the Glass-Steagall Act type of restrictions (Saunders *et al.*, 2006) through ring-fencing[9]. Activity restriction investigated in this study includes securitisation and Non-Bank activities such as insurance. Barth *et al.* (2008), in their latest (third) survey (over 300 questions related to banks conduct and application of Basel II guidelines) argue that activity restrictions of securities, insurance, and real estate pose **no** significant impact on banks' risk-taking and hence system stability or fragility. On the contrary, they believe that other activities would enable banks to diversify their income streams and immunise their activities, contributing to resilience against shocks. Diversification might also "increase the franchise value of banks and thereby augment incentives for more prudent behaviour" (Barth *et al.*, 2008). Delis *et al.* (2011b), Chortareas *et al.* (2012) and Tanna *et al.* (2017) arrive at similar results. Therefore, the impact of diversification (securities, insurance, and real estate activities) on bank performance is not yet conclusive. This inconclusiveness provides further motivation for examining the banking sector performance in reaction to regulations and reforms that lead to mergers and or acquisitions.

[8] With the Federal Deposit Insurance Act of 1950, the Competitive Equality Banking Act of 1987, the Depository Institutions Act of 1982, and the Depository Institutions Deregulation and Monetary Control Act of 1980 being the most influential regulatory initiatives.

[9] Ring-fencing regulations aim at restricting Universal Banking (Koetter *et al.*, 2007).

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Typically, the literature that focuses on regulations and productivity tends to; (i) examine individual countries, or group of countries in one policy mechanism (the EU case), (ii) evaluate overall regulatory reforms (usually captured by dummy variables) and productivity change over deregulation periods, and (iii) generally yield conflicting findings. Furthermore, Financial institutions' output variations in response to regulations and business limitations are of interest from a policy perspective. Theoretically, increased banks' productivity leads to enhanced performance, lower prices, improved services for consumers and enhanced safety and soundness. The result will be enhanced capital buffers that help to absorb risk and decrease managers' temptation for risky innovations through improved governance.

The methodological approach of this study aims to shed more light on the regulations–productivity nexus, by using a cross-country setting to focus on specific regulatory indices that relate to the three pillars of Basel accords as well as country-specific stability, freedom and macroeconomic measures.

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3. Data and Methodology

Analysing productivity differences across countries may help to identify the success or failure of policy initiatives or "may highlight different strategies undertaken by banking firms" (Casu *et al.*, 2004). Hence, the purpose of this study to probing banks' Total Factor Productivity (TFP) growth and changes as a response to bank regulations and other macroeconomic factors in 2,155 medium and large banks operating in 93 countries[10]. Following Worthington (1999) and Delis *et al.* (2011a), the Malmquist Output index is utilised to examine how bank regulations impact banks productivity and performance.

3.1. Data set

We examine Total factor productivity of commercial banks in response to regulatory reforms at an international scale. The dataset used in this study comprises bank-level data and country-level data, compiled from several sources;

a) The IMF and World Bank Basel Core Financial Sector Assessment Program (FSAP) database, which includes a detailed assessment of a country's compliance with the Basel Core Principles for Effective Bank Supervision (BCP).
b) The Barth et al. (2004, 2006, 2008, 2012) surveys on bank regulation, supervision, and monitoring.
c) The World Bank Economic Indicators and the Heritage Foundation Freedom data sets.
d) The **Datastream** and **Bloomberg** databases.

Therefore, banks qualifying for examination in this study are all publicly trading[11] commercial banks and bank holding companies from countries that participate in the regulatory surveys and have available data from the IMF and the World Bank. We have not limited our dataset

[10] Argentina, Australia, Austria, Bahrain, Bangladesh, Belgium, Belize, Bosnia And Herzegovina, Botswana, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Finland, France, Gambia, Georgia, Germany, Ghana, Greece, Hong Kong, Hungary, India, Indonesia, Iran, Ireland, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Lebanon, Lithuania, Macedonia, Malawi, Malaysia, Malta, Mauritius, Mexico, Montenegro, Morocco, Namibia, Nepal, Netherlands, New Zealand, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Rwanda, Saudi Arabia, Senegal, Serbia, Singapore, Slovakia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Tanzania, Thailand, Togo, Trinidad & Tobago, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Venezuela, Vietnam and Zambia.

[11] Publicly trading institutions are subject to more stringent regulatory controls and need to comply with international regulations, such as capital regulation, and they follow international accounting standards to report end-of-year accounting variables (Laeven and Levine, 2009).

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to specific bank size or country economy (GDP) to enable drawing insights on productivity change for banks on the relative merits of varying banks sizes (LnAssets) and in different economic capabilities of governing jurisdictions (countries).

Publicly trading institutions are subject to more stringent regulatory controls and need to comply with international regulations, such as capital regulation, and they follow international accounting standards to report end-of-year accounting variables (Laeven and Levine, 2009). To prevent the risk of outliers driving the results, we Winsorise the input and output variables at the 1% level. Our final cross-sectional sample includes 2,155 banks across 95 countries over the period 1999–2017 (Table A1)[12]. U.S. banks account for approximately 25% (296 banks) of the sample. To ensure that our findings are not overly influenced by U.S. banks, we examine results with and without them. Besides, we classify countries into 11 geographical regions (7 groups). The reason being that country-level regulatory data are collected in four survey exercises (1999, 2003, 2007 and 2011), following Barth et al. (2013) we match the data for the regulatory variables as follows: the 1999 survey data for period 1999–2002; the 2003 survey data for period 2003–2006, 2007 survey data for period 2007–2010, and the 2011 survey data used for the period 2011–2017.

3.2. Methodology and Malmquist Index Construction

To estimate the TFP (Total Factor Productivity), we use a non-parametric frontier technique by calculating the Malmquist Output oriented index, following Delis *et al.* (2011a) and (Worthington, 1999). The index has several essential features related to ease of modelling and estimation (Färe *et al.*, 2001). The components of the Malmquist index are ratios of distance functions making its estimation a straightforward technique using activity analysis or Data Envelopment Analysis (DEA) methods. This approach allows controlling for efficiency changes, depending on the reallocation of production frontiers signalling the technical change and the technical efficiency at once (Worthington, 1999).

The Malmquist Output Oriented Index is as follows:

$$\boldsymbol{M_0}(y_s, x_s, y_t, x_t) = \sqrt{\left[\frac{d_0^s(y_t,x_t)}{d_0^s(y_s,x_s)} * \frac{d_0^t(y_t,x_t)}{d_0^t(y_s,x_s)}\right]} \quad (1)$$

[12] The original BCP assessment exercise (2011) examines 158 countries, principalities, and monetary unions; but because of data availability and the incomplete overlap among the four databases, the dataset's global span is reduced to 93 countries. Based on communications initiated between authors of this paper and the World Bank (Demirgüç-Kunt), repeating this study with the updated bank regulation survey expected in Autumn 2019 would be very effective and insightful.

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Where M_0 measures the productivity change between periods s (base period) and t and $d_0^s(y_t, x_t)$ represents the distance from the period t observation to the period s technology. $M_0>1$ indicates positive TFP growth from period S to period t, $M_0<1$ indicates a decline and $M_0=1$ indicates constant TFP growth. This Index is used to assess banks' productivity and efficiency changes, by decomposing the TFP growth into; efficiency change (EFFCH), technological change (TECHCH), pure technical efficiency change (PECH), and scale efficiency change (SECH) using the DEA technique. However, the dynamic version of the Malmquist index was criticised for creating circularity and that the adjacent period indices can give different productivity measures for the same data. This interface is corrected by time neutrality and fixed effects measures as discussed by Pastor and Lovell (2007). Hence, the possibility of having a complex serial correlation in the DEA efficiency study is minimised, especially that we do not generate a single variable of compliance (Ayadi *et al.*, 2016) instead we analyse all four regulation compliance measures beside Capital to Total Assets and Risk Weighted Regulatory Capital real values. This procedure will adjust for the bias in the first stage DEA estimates of bank efficiency. We will then use these bias-corrected efficiency scores to improve statistical efficiency in the second-stage truncated and multivariate regression estimates. We apply a mixture of constant return to scale (**CRS**) and variable returns to scale (**VRS**) under the Data Envelopment technique involving calculation of technical and scale efficiency.

The methodology, hence, has two stages; the first is to calculate the Malmquist output-oriented index by applying equation (1) to estimate the distance changes in inputs and outputs of banks under analysis[13] using a Data Envelopment Analysis procedure[14] (DEA). In the second stage, the outcomes of the Malmquist output-oriented indices are then used in the regression of equation 2 below, along with regulatory compliance factors, Macroeconomic and System risk and stability factors. This procedure helps to deduce how various (bank-specific and country-specific) factors influence the estimated efficiency (Simar and Wilson, 2007). Earlier studies suggest that the impact of regulation and supervision increases with the level of development (Barth *et al.*, 2004; Demirgüç-Kunt *et al.*, 2008). To assess whether regulatory compliance affects banks differently in countries at different levels of development, we re-run separate estimations clustering various markets and income groups;

[13] Namely; deposits, fixed assets, overheads, loans, other earning assets, and non-interest incomes as identified in the intermediation theory.

[14] Using software developed by Coelli (1996) and explained in the Centre for Efficiency and Productivity Analysis working paper No. 8/96.

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$$\boldsymbol{M_{itc}} = a_1 R_{t-1,c} + a_2 B_{itc} + a_3 Z_{tc} + u \quad (2)$$

Where M_{itc} is the TFP growth of bank *i* that operates in country *c* at time *t, R* captures regulatory variables, *B* captures several bank-specific variables, and *Z* captures variables accounting for macroeconomic status common to all banks of a particular jurisdiction, and finally *u* is the error term. TFP growth and component efficiencies change are reported in Table 2 below.

3.2.1. Environmental variables (R);

Regulatory variables are extracted from surveys on regulatory policy and conduct[15] done by Barth *et al.* (2008). Answers are encoded, as explained in Barth *et al.* (2013a), by assigning scores to different answers and then summing up the averages of totals to get a single country regulatory index. This index is later subdivided into Capital Requirements (CAPRQ), Supervisory Power (SPR), Market Discipline and Private Monitoring (PMON), Activity Restrictions (ACTR). Answers to this survey also show the extent of compliance with Basel II guidance. Appendix A details regulatory scores calculation. **Market Structure;** The proxy for the market structure is the concentration (CONC) index. CONC is measured as a ratio of the first five banks (assets size) to the whole sector as compiled by Beck and Demirgüç-Kunt (2009). This study advances to this approach and examines market influence and association with productivity change and regulation through the Lerner Index[16] for market power and market volatility through stock prices volatility[17].

3.2.2. Bank Specific Variables (*B*);

Inputs and outputs for the Malmquist Index calculation follow the financial intermediation model. Deposits and short-term funding are the primary sources of funds inflows. Fixed assets and overheads are used to make banks' production of mostly loans, other earning assets and non-interest income as a proxy for off-balance-sheet activities. We use Datastream and Bloomberg databases to download values of banks inputs and outputs that are tabulated in an order that serves the purpose of this investigation. The same database is used to extract the Equity to Total Assets ratio as a proxy for banks' capitalisation and reinvestment.

Table 1 describes the full sample of 2,155 listed banks operating in 93 countries that belong to various regional and economic areas. It summarises bank-specific data used to synthesise the

[15] As indicated in "Bank Regulation and Supervision Database, World Bank; Barth *et al.*, 2001b, 2006, 2007b.
[16] Lerner Index is defined as the difference between output prices and marginal costs (relative to prices). Prices are calculated as total bank revenue over assets, whereas marginal costs are obtained from an estimated translog cost function with respect to output. Higher values of the Lerner index indicate less bank competition.
[17] Stock price volatility is the average of the 360-day volatility of the national stock market index, Bloomberg.

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Malmquist productivity index (Inputs and outputs) and country-specific economic and regulatory compliance data over 19 years (1999-2017).

3.2.3. Macroeconomic variables (Z);

To control for the countries' economic status due to the direct influence on citizens, creditors, depositors, investment and lending, TFP is also regressed over Gross Domestic Product and Consumer Price Index. Economic freedom (ECFR) and financial freedom (FnFrdm) represent the ease to get into several types of businesses, and the rule of law and corporate governance, are obtained from Miller *et al.* (2000-2017). **Financial Stability indices;** To consider the subject banks' readiness to face any market disturbance and system stability. Banking Sector Z-score (Z) defined as the overall banking sector soundness indicator[18] and Market Volatility (Stock prices volatility) are downloaded from Datastream and the World Bank database, respectively. Z-score might have certain limitations in assessing banks' efficiency and productivity, but it is still seen much competent because it is less affected by country-specific codes of practice in regulation and reporting like Non-Performing Loans, Interest Margins, and Capital Adequacy (Demirgüç-Kunt and Detragiache, 2010).

[18] Since it is calculated on the bases of Return on Assets, and Equity to Assets ratio (capitalisation), where sd is the Standard Deviation; Z= (ROA+(equity/assets))/sd(ROA).

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4. Results

4.1. Summary statistics

Table 1 presents summary statistics of the full sample. Panel 1 describes the mean and standard deviation of each variable, while panel 2 gives an exposition of the median values categorised by economic development through income level. A few prominent features emerge. Bank-level variables in panel 1 illustrate a host of differences between the 93 nations showing variations in banking industry sophistication among countries. The median values suggest that the sample is positively skewed, with a small number of large banks. Furthermore, there is a high degree of full-sample heterogeneity, with values varying widely about their means according to standard deviation figures. From panel **1** the full-sample means of regulatory compliance activities (Activity Restrictions, Private Monitoring, Capital Requirements and Supervisory Power) do not show high levels of dispersion (Means respectively; 9.22, 4.35, 5.34, 10.78; St. Deviation respectively; 2.77, 1.31, 1.57, 2.46).

High-income countries appear to have fewer activities restrictions, less supervisory power and higher private monitoring compared to lower-income countries (Panel 2). This is likely the effect of heavier reliance on private monitoring in high-income countries than in lower-income, in addition to the dilution of regulators' powers in high-income countries and being distorted over several regulatory agencies (Acharya *et al.*, 2009; Boyer and Kempf, 2017; Ayadi *et al.*, 2016) while the opposite is right in the low-income economies where regulators are single agencies. However, regulatory distortion also appears in the efficiency changes. Our result shows that, although high-income jurisdictions enjoy the positive scale and technological efficiencies compared to lower-income ones, pure technical efficiencies and total productivity change appear higher and steadier in medium-high and medium low-income countries. Boyer and Ponce (2012) argue that the use of the two supervisory technologies by one supervisor may imply informational advantages and efficiency gains.

Table 1: Descriptive Statistics; 2,155 banks from 93 Countries

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4.2. Regulation, efficiency and TFP change

Regression results suggest that **bank size** is positively associated with TFP growth. Results also show that bank size (Log of total assets) has a positive coefficient when regressed against market structure controls of concentration, foreign to domestic credit and regulation (Shamshur and Weill, 2019). This outcome is intuitive, since banks are more likely to benefit from economies of scale when becoming large (Delis *et al.*, 2011a) through national M&As, international currencies portfolios and transactions. However, this does not apply to banks from the developed oil-exporting countries which have experienced geographical, and asset expansions and consequently have not necessarily witnessed productivity growth. The main reason for the negative association between bank size and concentration and total productivity growth is competition. Competition exerts a "push force" for institutions to diversify products and expand both locally and internationally (Doan *et al.*, 2018). The result justifies why banks in developing economies have ongoing plans to benefit from economies of scale, which is backed by this study's TFP decomposition showing relatively positive and improving scale efficiency in the upper-middle-income group.

Table 2: Truncated Regression; Log-Likelihood of Total Factor Productivity over Regulatory variables and Bank proxies of efficiency and Size and Market Power.

Capital requirements - CAPRQ Although, under the regulatory paradigm, increased capital provides more confidence to clients and customers, leading to an increase in spending and investments, regressions yield a negative and significant association with TFP. This association confirms the pro-cyclical effect of capital requirements. This result resonates the growing literature on the negative impact of increased capital buffers (Basel 3) and their impact on available funds for lending that forms banks' source of interest income. Cross regions analysis (**Table 4**) shows that South Asia, Sub-Saharan Africa and the MENA countries confirm a negative impact of CAPRQ on productivity change. However, banks in North America and Latin America and the Caribbean do grow productivity with higher capital requirements. An outcome that reflects the level of efficiency of these markets, especially when considering TFPCH concerning the level Income (GNI per Capita) (**Table 5**). For the reason that banks operating in countries imposing high capital requirements have reputational and confidence rewards that outweigh the losses from capital reserves (Fonseca and González, 2010).

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Supervisory power – SPOWER shows high significance across all models (Tables 4&5). Such results contrast with Delis *et al.* (2011a), who argue that, for transition economies, increasing capital requirements and supervisory powers do not influence productivity and its growth. Official supervisory powers by regulators on banks drive productivity growth in all regions except Europe and Central Asia, where SPOWER and TFPCH are negatively associated with up to 10 times stronger influence. The result is justified by analysing this association over the level of income. High-income countries exhibit the only negative high magnitude impact of SPOWER on TFPCH among other income levels (Table 5). This effect emphasises the preference of banks to be free from official supervisory power that enables their diversification and risk-taking initiatives, which usually drives returns and value.

Table 4: The association of Total Factor Productivity change with Regulatory and Macro - Environment Variables — a robust regression by Region.

Activity restrictions – ACTRS, such as restrictions on real estate, insurance, and securities businesses, are negatively associated with productivity change in all Income level groups except banks in High-Income countries (Table 5). Results reflect the fact that most of the sample's economies thrive, expanding towards the newest financial services and innovations. Results are consistent with Barth *et al.* (2004), who suggest that fewer restrictions might provide additional profit opportunities. However, this could also signal banks' efforts to gain a too-big-to-fail status as a guarantee and insurance in times of economic slowdown or crisis (Fonseca and González, 2010). Such efforts are standard practice in developed (High Income) countries, which is why ACTRS positively influence productivity growth in this group and Europe, Central Asia, Latin and North America (Table 4) as risk-averse regions especially following the 2007 crisis.

Table 5: The association of Total Factor Productivity change with Regulatory and Macro - Environment Variables. A robust regression by Countries Income Level.

Private Monitoring – PRMONT Shows negative association with productivity growth in all models, all regions and all income levels groups (Tables 4&5). It could be an indication of the cost of developing and implementing private monitoring practices and how these costs might affect profitability and outputs. A resolution that should not mean that banks are not required to enhance

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private monitoring and incorporate it at a wide scale in all industries. Instead, it explains the existing situation in several financial systems that simulate the political system they operate in and are bureaucratic and volatile in several cases. Such results lead to proposing the promotion of further corporate governance and establishing mechanisms that monitor and award institutions for systems and personnel standardisation self-auditing (Shehzad *et al.*, 2010).

4.3. TFP efficiencies change, regulations and market factors

Decomposing TFP growth, **Table 6** (and table 6.A in the appendix for Income level Categorisation) demonstrate that capital requirements appear to create negative efficiency change (EFFCH), pure technical efficiency change (PECH) and scale efficiency change (SECH), but positive technological change (TECHCH) in high-income countries. However, CAPRQ drives scale efficiency in low and middle lower-income countries. It reflects the general concept that heavily regulated banks in these countries are the larger ones that can capitalise on scale and scope but are also more noticeable to regulators, hence prone to more regulations. Activity restrictions appear to positively and actively drive technological change in high-income countries. A resolution that is theoretically and technically true because banks have innovated towards securitisation as a response to restrictions on branching before the 2007 crisis, along with innovations in the real estate sector. Private monitoring and supervisory power have a similar effect on technological change, however a positive effect on pure efficiency due to the costs associated with their adoption.

In contrast, in low-income countries, official supervisory power actively drives technological change (Drake *et al.*, 2006; Casu *et al.*, 2016). This outcome explains the situation where technological change is brought to the sector by the supervisory agencies themselves to enhance transparency and governance. Similar results are seen in the middle-lower- and middle-upper- income countries.

Table 6: Efficiencies association with Regulatory and Macro-Environment variables

Furthermore, Financial freedom enables scale efficiency change while it impedes technological and pure technical efficiency changes. Such results indirectly hint at the diversification paradigm in the financial sector; encouraging focusing bank activity during growth to enable scaling up output and economies but not adopting new technologies or diversifying

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income resources in a way that require technological change. A practice that is well documented in the merger literature that explores the impact of diversification strategies on bank performance, although the divergence in results. (Curi *et al.*, 2015; Kevork *et al.*, 2017). Concentration (largest five banks by assets) and Lerner's index (a measure of market power) both affect all efficiencies negatively. However, Lerner's index appears to be a much clearer measure than concentration. It shows that higher market powers, and more concentrated markets, adversely affect banks efficiencies despite the general attitude that it decreases its riskiness (Shehzad *et al.*, 2010). A relevant argument resonating post-2007 crisis regulations, particularly against the over the expansion of financial institutions and reaching a too-big-to-discipline status with the motivation of risk aversion excuse.

Market volatility and Z-score appear to both drive technological change and scale efficiency growth, but negatively impact pure technical efficiency. Such results could be a simulation of banks activities attempting to increase returns through diversification that increases its Z-score, as an index of systematic risk, and then propagated into market volatility as a composite index of risk. For the reason that, diversifying activities or geographies are directly related to innovation, technological change and scale efficiency change. Improvements in pure technical efficiency appear to be at the cost of equity value and profitability, resulting from the negative association of PECH with each of equity to assets ratio, ROA and ROE. However, the profitability of ROA accompanies and enable technological change but not scale efficiency and overall efficiency (X-efficiency). This outcome reflects the episode in the banking sector where banks are profitable and can implement technological change, but not successful in generating efficiencies nor benefiting from economies of scale or scope. Primarily due to several other environmental factors like culture, legal and language differences (Bonin *et al.*, 2005; Halkos and Tzeremes, 2011; Kontolaimou *et al.*, 2012). Inflation as in consumer price index representing economic growth appears to drive all bank efficiencies. However, GDP is not enough signal on technological and scale efficiencies change in banks.

4.4. Productivity, regulation and financial crisis

Overall, banks total factor productivity has deteriorated during the 2007-2011 crisis. Chart I and table 7, below, shows that all banks were able to recover productivity growth level back to pre-crisis levels, except banks operating in low-income countries. Mainly because of technological change remained at the crisis levels. A realisation that echoes banks incapacity to implement

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technological change due to funds draining during the crisis and late recovering policies expected from regulators and financial institutions.

Chart I: Productivity Growth and Efficiencies, Crisis and Country's Income Level

The 2007-2011 financial crisis appears to have affected bank regulation influence on productivity growth. Although capital requirement continues to be hindering productivity before and during the crisis, the influence (magnitude) has doubled during the crisis year. This notation justifies banks higher need for funds during the crisis and their preference to utilise in investment and interest-earning activities, rather in reserves and buffers. However, the effect of capital requirements on productivity growth switches to become significantly positive after crisis (2012 onward). This is attributed to the lessons sought from the crisis, and to the investor's confidence in well regulated (reserved/hedged) banks (Deli and Hasan, 2017; Fonseca and González, 2010).

Table 7: Efficiencies association with Regulatory and Macro-Environment variables around the 2007-2011 financial crisis.

Consistent with recent literature (Casu *et al.*, 2017; Psillaki and Mamatzakis, 2017), a similar perception is witnessed in activity restrictions relationship with productivity growth. Table 7, below, extend this evidence over to High-Income countries banks. However, the opposite is exact for lower- and middle-income countries. It is grounded in two main aspects; **a**) the nature of the 2007 crisis and the countries most affected by it are the high-income countries, and **b**) High-income countries tend to be the developed ones with more efficient markets than other income levels jurisdictions. Hence the speed of adaptation to regulatory and self-corrective measures is faster. Following the financial crisis, concentration and market power (Lerner's Index) become increasingly perceived as productivity deteriorating factors in the banking sector. Representing the paradigm of compliance and investors/clients trust in compliant banks, which would drive investments, transactions and banks profitability. Inflation is no longer a significant (negative) factor affecting bank productivity after the 2007 crisis (Athanasoglou *et al.*, 2014; Ayadi *et al.*, 2016). Productivity growth appears to have switched from being a cost on equity (-ve ROE) but driven by profits (+ve ROA) before the crisis to become highly costly (-ve ROA) after the crisis.

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Essentially emphasising that cost efficiency better measures management quality, while profit efficiency may partially reflect temporary high returns from risky investments during normal times (Assaf *et al.*, 2019).

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5. Conclusion

Following the recent financial crisis (2008-2010), several regulatory reforms have been proposed. Despite the emphasis in banking literature on the regulation, stress, deregulation and re-regulation cycles, it is still inconclusive of how these regulations affect bank performance and productivity.

Our results emphasise the negative impact of high capital buffers (Basel 3) and their impact on available funds for lending that forms banks' source of interest income. However, there exist positive associations in few economies where high capital requirements have reputational and confidence rewards that outweigh the losses from capital reserves like in North and Latin American countries. Official supervisory powers by regulators on banks drive productivity growth in all regions except Europe and Central Asia. Activity restrictions on real estate (Property), insurance, and securities businesses, are negatively associated with productivity change in all Income level groups but High Income. Furthermore, Private Monitoring negatively influences productivity growth in all models, all regions and all income levels, groups. Results that lead to proposing the promotion of further corporate governance and establishing mechanisms that monitor and award institutions for systems and personnel standardisation self-auditing. Concentration and market power affect all efficiencies negatively. Improvements in pure technical efficiency appear to be at the cost of equity value and profitability. Though, ROA appears to accompany and enable technological change but not scale efficiency and overall efficiency.

Therefore, banks, scheduled to implement several regulatory reforms like Basel III along with current updates of the ring-fencing, will have to consider the following factors to enable and promote productivity growth;

- **Operational Risk;** this study suggests investing more in private monitoring. Certain levels of services in financial institutions require a standardisation of definitions. As private information and monitoring affect investment decisions through the quality and standards of accounting (Anne *et al.*, 2010). Improving bank cost efficiency during normal times may promote better financial crisis performance.
- **Securitisation;** Activity restrictions that were negatively associated with banks' productivity suggest modest relief of restrictions to enhance banks' productivity. Hence, financial regulators are required to enable banks' diversification as a

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'productivity enhancement vehicle', but within the ring-fencing measures enacted recently.

- **Regional and Income level sensitivity;** the different levels of association between bank regulation and other variables (economic, risk and volatility) suggest that regulators should avoid regulatory arbitrage and/or umbrella regulating through more regional, rather international, conferences to raise awareness in the regional and income level subgroups of jurisdictions.

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References List

ABREU, E. S. D., KIMURA, H. & SOBREIRO, V. A. 2019. What is going on with studies on banking efficiency? *Research in International Business and Finance,* 47**,** 195-219.

ACHARYA, V. V., WACHTEL, P. & WALTER, I. 2009. International Alignment of Financial Sector Regulation. *Financial Markets, Institutions & Instruments,* 18**,** 188-190.

AGÉNOR, P.-R. & EL AYNAOUI, K. 2010. Excess liquidity, bank pricing rules, and monetary policy. *Journal of Banking and Finance,* 34**,** 923 - 933.

ANNE, B., W., S. L. & JOSEPH, W. 2010. The Effect of Private Information and Monitoring on the Role of Accounting Quality in Investment Decisions*. *Contemporary Accounting Research,* 27**,** 17-47.

ASSAF, A. G., BERGER, A. N., ROMAN, R. A. & TSIONAS, M. G. 2019. Does efficiency help banks survive and thrive during financial crises? *Journal of Banking & Finance,* 106**,** 445-470.

ATHANASOGLOU, P. P., DANIILIDIS, I. & DELIS, M. D. 2014. Bank procyclicality and output: Issues and policies. *Journal of Economics and Business,* 72**,** 58-83.

AYADI, R., NACEUR, S. B., CASU, B. & QUINN, B. 2016. Does Basel compliance matter for bank performance? *Journal of Financial Stability,* 23**,** 15-32.

AYSAN, A. F. & CEYHAN, S. P. 2008. Structural Change and the Efficiency of Banking In Turkey: Does Ownership Matter?

BAGLIANO, F. C., DALMAZZO, A. & MARINI, G. 2000. Bank competition and ECB's monetary Policy. *Journal of Banking and Finance,* 24**,** 967 - 983.

BANK, W. 2019. *The World Bank Atlas method - detailed methodology* [Online]. The World Bank. Available: https://datahelpdesk.worldbank.org/knowledgebase/articles/378832-what-is-the-world-bank-atlas-method [Accessed 15/04/2019 2019].

BARTH, J., CAPRIO, G. J. & LEVINE, R. 2004. Bank regulation and supervision: what works best? 13**,** 205 - 248.

BARTH, J. R., A., P. P. & C., W. 2015. The Dodd-Frank Act: Key Features, Implementation Progress, and, Financial System Impact. *The First Great Financial Crisis of the 21st Century.*

BARTH, J. R., CAPRIO, G., JR. & LEVINE, R. 2008. Bank Regulations Are Changing: For Better or Worse? : World Bank, Development Research Group.

BARTH, J. R., CAPRIO, G. J. & LEVINE, R. 2001. Banking systems around the globe: Do regulations and ownership affect performance and stability? Mishkin: University of Chicago Press.

BARTH, J. R., CAPRIO JR, G. & LEVINE, R. 2013a. Bank regulation and supervision in 180 countries from 1999 to 2011. *Journal of Financial Economic Policy,* 5**,** 111-219.

BARTH, J. R., LIN, C., MA, Y., SEADE, J. & SONG, F. M. 2013b. Do bank regulation, supervision and monitoring enhance or impede bank efficiency? *Journal of Banking & Finance,* 37**,** 2879-2892.

BECK, T. & DEMIRGÜÇ-KUNT, A. 2009. Financial institutions and markets across countries and over time: Data and analysis. World Bank Policy.

BONIN, J. P., HASAN, I. & WACHTEL, P. 2005. Bank performance, efficiency and ownership in transition countries. *Journal of Banking & Finance,* 29**,** 31-53.

BOYER, P. & KEMPF, H. 2016. Regulatory Arbitrage and the Efficiency of Banking Regulation. *BAFFI CAREFIN Centre.*

Journal of Financial Economic Policy

BOYER, P. C. & KEMPF, H. 2017. Regulatory arbitrage and the efficiency of banking regulation. *Journal of Financial Intermediation*.

BOYER, P. C. & PONCE, J. 2012. Regulatory capture and banking supervision reform. *Journal of Financial Stability,* 8**,** 206-217.

BRUN, M., FRAISSE, H. & THESMAR, D. 2013. The Real Effects of Bank Capital Requirements. *Débats économiques et financiers - 8.* Paris: Autorité de Contrôle Prudentiel - Banque de France.

CALOMIRIS, C. 2009. Financial innovation, regulation, and reform. 29.

CASU, B., DENG, B. & FERRARI, A. 2017. Post-crisis regulatory reforms and bank performance: lessons from Asia. *The European Journal of Finance,* 23**,** 1544-1571.

CASU, B., FERRARI, A., GIRARDONE, C. & WILSON, J. O. S. 2016. Integration, productivity and technological spillovers: Evidence for eurozone banking industries. *European Journal of Operational Research,* 255**,** 971-983.

CASU, B., GIRARDONE, C. & MOLYNEUX, P. 2004. Productivity change in European banking: A comparison of parametric and non-parametric approaches. 28**,** 2521 - 2540.

CHORTAREAS, G. E., GIRARDONE, C. & VENTOURI, A. 2012. Bank supervision, regulation, and efficiency: Evidence from the European Union. *Journal of Financial Stability,* 8**,** 292-302.

CIHAK, M., DEMIRGÜÇ-KUNT, A., MARTINEZ PERIA, M. S. & MOHSENI-CHERAGHLOU, A. 2013. Bank regulation and supervision in the context of the global crisis. *Journal of Financial Stability,* 9**,** 733-746.

COELLI, T. J. I. 1996. Aguide to DEAP Version2.1; A Data Envelopment Analysis (computer) Program.

CURI, C., LOZANO-VIVAS, A. & ZELENYUK, V. 2015. Foreign bank diversification and efficiency prior to and during the financial crisis: Does one business model fit all? *Journal of Banking & Finance,* 61**,** S22-S35.

DELI, Y. D. & HASAN, I. 2017. Real effects of bank capital regulations: Global evidence. *Journal of Banking & Finance,* 82**,** 217-228.

DELIS, M., MOLYNEUX, P. & PASIOURAS, F. 2011a. Regulations and productivity growth in banking: evidence from transition economies. *Journal of Money, Credit and Banking,* 43**,** 735 - 764.

DELIS, M. D., MOLYNEUX, P. & PASIOURAS, F. 2011b. Regulations and Productivity Growth in Banking: Evidence from Transition Economies. *Journal of Money, Credit and Banking,* 43**,** 735-764.

DEMIRGÜÇ-KUNT, A. & DETRAGIACHE, E. 2010. Basel Core Principles and Bank Risk; Does compliance matter? *IMF Working Paper.* International Monetary Fund.

DEMIRGÜÇ-KUNT, A., DETRAGIACHE, E. & TRESSEL, T. 2008. Banking on the principles: Compliance with Basel Core Principles and bank soundness. *Journal of Financial Intermediation,* 17**,** 511-542.

DEMIRGÜÇ-KUNT, A., LAEVEN, L. & LEVINE, R. 2003. The Impact of bank regulations, concentration and institutions on bank margins. World Bank Policy Research.

DEMYANYK, Y., OSTERGAARD, C. & SØRENSEN, B. E. 2007. U.S. banking deregulation, small businesses, and interstate insurance of personal income. *Journal of Finance,* 62**,** 2763-2801.

Journal of Financial Economic Policy

DOAN, A.-T., LIN, K.-L. & DOONG, S.-C. 2018. What drives bank efficiency? The interaction of bank income diversification and ownership. *International Review of Economics & Finance,* 55**,** 203-219.

DRAKE, L., HALL, M. J. B. & SIMPER, R. 2006. The impact of macroeconomic and regulatory factors on bank efficiency: A non-parametric analysis of Hong Kong's banking system. *Journal of Banking & Finance,* 30**,** 1443-1466.

EPSTEIN, G. & MONTECINO, J. A. 2015. Reforming the regulation of community banks after Dodd-Frank. *Ind. LJ,* 90**,** 179.

FÄRE, R., FØRSUND, F. R., GROSSKOPF, S., HAYES, K. & HESHMATI, A. 2001. A note on decomposing the Malmquist productivity index by means of subvector homotheticity. *Economic Theory,* 17**,** 239–245.

FCIC, F. 2011. The Financial Crisis Inquiry Report: Final Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States 1er éd. *Public Affairs*.

FONSECA, A. R. & GONZÁLEZ, F. 2010. How bank capital buffers vary across countries: The influence of cost of deposits, market power and bank regulation. *Journal of Banking & Finance,* 34**,** 892-902.

GRIFELL-TATJE, E. & LOVELL, C. K. 1996. Deregulation and productivity decline: The case of Spanish savings banks. *European Economic Review,* 40**,** 1281-1303.

HALKOS, G. E. & TZEREMES, N. G. 2011. Modelling the effect of national culture on multinational banks' performance: A conditional robust nonparametric frontier analysis. *Economic Modelling,* 28**,** 515-525.

HENDRICKSON, J. M. 2011. *Regulation and Instability in U.S. Commercial Banking, AHistory of Crises,* Hampshire, England, Palgrave Macmillan.

HUGHES, J. P. & MESTER, L. J. 2014. Measuring the performance of banks,theory, practice, evidence, and some policy implications. *In:* WILSON, J. O. S., MOLYNEUX, P. & BERGER, A. N. (eds.) *Handbook of Banking.* Oxford University Press: Oxford University.

ISIK, I. 2007. Bank ownership and productivity developments: evidence from Turkey. *Studies in Economics and Finance,* 24**,** 115-139.

KANE, E. J. 1981. Accelerating inflation, technological innovation, and the decreasing effectiveness of banking regulation. *The Journal of Finance,* 36.

KEVORK, I. S., PANGE, J., TZEREMES, P. & TZEREMES, N. G. 2017. Estimating Malmquist productivity indexes using probabilistic directional distances: An application to the European banking sector. *European Journal of Operational Research,* 261**,** 1125-1140.

KINDELBERGER, C. & ALIBER, R. 2005. *Manias, Panics, and Crashes,* New Jersey, Wiley & Sons Inc.

KOETTER, M., BOS, J. W. B., HEID, F., KOLARI, J. W., KOOL, C. J. M. & PORATH, D. 2007. Accounting for distress in bank mergers. *Journal of Banking & Finance,* 31**,** 3200-3217.

KONTOLAIMOU, A., KOUNETAS, K., MOURTOS, I. & TSEKOURAS, K. 2012. Technology gaps in European banking: Put the blame on inputs or outputs? *Economic Modelling,* 29**,** 1798-1808.

LEVINE, R. 1997. Financial Development and Economic Growth: Views and Agenda. *Journal of Economic Literature,* 35**,** 688-726.

LEVINE, R. 2005. Finance and growth: theory and evidence. *Handbook of economic growth,* 1**,** 865-934.

LIIKANEN, E., BÄNZIGER, H., CAMPA, J. M., GALLOIS, L., GOYENS, M., KRAHNEN, J. P., MAZZUCCHELLI, M., SERGEANT, C., TUMA, Z., VANHEVEL, J. & WIJFFELS,

Journal of Financial Economic Policy

H. 2012. High-level Expert Group on reforming the structure of the EU banking sector. *In:* LIIKANEN, E. (ed.). Brussels, 2 October 2012: High-level Expert Group on reforming the structure of the EU banking sector

MERROUCHE, O. & NIER, E. W. 2014. The Global Financial Crisis What Drove the Build-Up?

MILLER, T., KIM, A. B. & HOLMES, K. 2000-2017. 2015 Index of economic Freedom. *Washington DC: The Heritage Foundation*.

PASIOURAS, F. 2008. International evidence on the impact of regulations and supervision on banks technical efficiency: an application of two-stage data envelopment analysis. 30**,** 187 - 223.

PASTOR, J. & LOVELL, K. 2007. Circularity of the Malmquist productivity index. *Economic Theory,* 33**,** 591–599.

PSILLAKI, M. & MAMATZAKIS, E. 2017. What drives bank performance in transitions economies? The impact of reforms and regulations. *Research in International Business and Finance,* 39**,** 578-594.

RAMIREZ, C. D. 2009. Bank fragility,"money under the mattress", and long-run growth: US evidence from the "perfect" Panic of 1893. *Journal of Banking & Finance,* 33**,** 2185-2198.

REINHART, C. 2008. Eight hundred years of financial folly.

REINHART, C. M. & ROGOFF, K. S. 2014. Recovery from Financial Crises: Evidence from 100 Episodes. *American Economic Review,* 104**,** 50-55.

ROMERO-ÁVILA, D. 2007. Finance and growth in the EU: New evidence from the harmonisation of the banking industry. *Journal of Banking & Finance,* 31**,** 1937-1954.

SAUNDERS, A., CORNETT, M. M. & MCGRAW, P. A. 2006. *Financial institutions management: A risk management approach,* McGraw-Hill/Irwin.

SHAMSHUR, A. & WEILL, L. 2019. Does bank efficiency influence the cost of credit? *Journal of Banking & Finance,* 105**,** 62-73.

SHEHZAD, C. T., DE HAAN, J. & SCHOLTENS, B. 2010. The impact of bank ownership concentration on impaired loans and capital adequacy. *Journal of Banking & Finance,* 34**,** 399-408.

SIMAR, L. & WILSON, P. W. 2007. Estimation and inference in two-stage, semi-parametric models of production processes. *Journal of Econometrics,* 136**,** 31-64.

TANNA, S., LUO, Y. & DE VITA, G. 2017. What is the net effect of financial liberalization on bank productivity? A decomposition analysis of bank total factor productivity growth. *Journal of Financial Stability,* 30**,** 67-78.

TEMIN, P., JACKSON, A. & ÁLLAMOK, A. E. 1969. *The Jacksonian Economy*, Norton New York.

TEMIN, P. & NORTON, W. 1976. *Did monetary forces cause the Great Depression?*, Norton New York.

TIRTIROĞLU, D., DANIELS, K. N. & TIRTIROĞLU, E. 2005. Deregulation, intensity of competition, industry evolution, and the productivity growth of US commercial banks. *Journal of Money, Credit and Banking***,** 339-360.

TURNER, A. 2009. *The Turner Review: A regulatory response to the global banking crisis*, Financial Services Authority London.

WALKER, S. 2014. *Treasuries surge is most volatile since 2013 on fed rate bets* [Online]. www.bloomberg.com/news/: Bloomberg.com. Available:

Journal of Financial Economic Policy

http://www.bloomberg.com/news/2014-10-18/treasuries-surge-is-most-volatile-since-2013-on-fed-rate-bets.html [Accessed 18 October 2014].

WESTERFIELD, R. B. 1933. The Banking Act of 1933. *The Journal of Political Economy*, 721-749.

WORTHINGTON, A. C. 1999. Malmquist indices of productivity change in Australian financial services. *Journal of International Financial Markets, Institutions and Money,* 9, 303-320.

YEAGER, T. J., YEAGER, F. C. & HARSHMAN, E. 2007. The Financial Services Modernization Act: Evolution or revolution? *Journal of Economics and Business,* 59, 313-339.

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***Table 1**: Describes the full sample of 2,155 banks in 94 countries that belongs to various regional and economic areas. The full sample of 94 countries and 35 bank specific and country specific variables cumulated 1,786 observations. TFP growth is decomposed into Technical Efficiency (relative to CRS Technology), Technological Change, Pure Technical Efficiency (relative to VRS Technology), Scale Efficiency Change, and Total Factor Productivity Change. Source: Own Calculation on DEAP Software.*

	Panel 1: Full sample summary statistics			Panel 2: Median values by Income Level				
	Mean	Median	SD	High Income - non OECD (304 Banks)	High Income - OECD (513 Banks)	Upper Middle income (513 Banks)	Lower Middle Income (304 Banks)	Low Income (152 Banks)
Bank level variables								
Inputs (Mil $)								
Deposits and short-term funding	2.60E+08	3.45E+10	2.34E+11	2.96E+08	2.68E+08	3.35E+08	1.83E+08	2.11E+08
Overheads	3.39E+09	3.19E+07	2.28E+10	4.17E+07	3.61E+07	3.14E+07	2.60E+07	2.12E+07
Fixed Assets	6.47E+08	5.69E+06	5.16E+09	5.93E+06	4.74E+06	6.58E+06	4.97E+06	5.56E+06
Outputs (Mil $)								
Net Loans	2.95E+10	2.53E+08	2.22E+11	3.19E+08	2.48E+08	3.28E+08	1.67E+08	2.48E+08
Non-interest income	6.97E+08	5.09E+06	5.70E+09	3.14E+06	5.21E+06	5.48E+06	2.74E+06	5.22E+06
Bank Characteristics								
Total assets (Mil $)	5,340,000	62,000	40,400,000	60,400	68,200	51,900	65,100	56,900
Credit to Deposit	108.092	93.989	75.608	95.883	93.377	92.4292	94.334	93.057
Equity to assets	9.7577	9.3637	4.6443	10.5580	7.1130	9.6483	9.3869	10.9296
Return on equity	16.6819	14.8529	18.1570	14.4246	14.6918	14.8087	14.9642	16.7256
Return on Assets	1.5923	1.3472	2.6332	1.3412	1.3286	1.3891	1.3173	1.3450
Lerner Index	0.2687	0.2611	0.1483	0.2503	0.2702	0.2476	0.2703	0.2718
Country level variables								
Regulatory variables								
ACTRS	9.22	9.00	2.77	9.00	9.00	9	10.00	9.50
PRMONT	4.35	4.00	1.31	4.00	4.00	4	4.00	4.00
CAPRQ	5.34	5.00	1.57	5.00	6.00	5	5.00	6.00
SPOWER	10.78	11.00	2.46	11.00	11.00	11	11.00	11.00
Efficiency Variables								
effch	1.1940	1.0000	0.8211	1.0000	0.9960	1.0000	1.0000	1.0000
techch	1.3704	1.0000	3.5050	1.0000	1.0000	0.9950	0.9905	0.9995
pech	1.1242	1.0000	0.7580	1.0000	1.0000	1.0000	1.0000	1.0000
sech	1.0895	1.0000	0.4633	1.0040	1.0000	1.0000	1.0000	1.0000
tfpch	1.6879	1.0000	6.5484	1.0000	1.0000	1.0000	1.0000	1.0000
Stability Variables								
Regulatory Capital to Risk Weighted Assets	15.7007	15.5000	4.4246	15.7000	15.6000	15.5	15.4500	15.2000

Liquid Assets to Deposits	33.5685	29.2886	18.0996	29.3465	28.3625	30.0036	30.0599	28.9693
Market Volatility	20.6235	19.2106	10.5059	19.6423	18.1112	19.2106	19.4702	19.7208
Zscore	11.1742	9.1172	8.0433	9.1010	9.2672	8.8080	9.7466	8.3475
Sector-specific and Macroeconomic variables								
Concentration	82.594	86.840	16.481	87.958	87.725	85.615	87.409	86.179
Economic Freedom	63.549	63.500	9.776	62.600	63.830	63.450	64.100	63.250
Financial Freedom	56.215	50.000	18.343	50.000	50.000	50.000	60.000	60.000
CPI	93.040	95.035	30.370	92.995	95.111	94.213	95.277	95.210
GDP ($USD Mil)	577,496.2	115,000.0	1,721,454.0	120,000.0	120,000.0	100,000.0	120,000.0	100,000.0

Table 2*: Truncated Regression; Log Likelihood of Total Factor Productivity over Regulatory variables and Bank proxies of efficiency and Size and Market Power. ** and * denotes significance levels of 1% and 5% consecutively (Confidence levels of 99% and 95%).*

	Coefficient	P Value
effch	0.9523224	0.0000**
techch	1.7898930	0.0000*
pech	0.0753482	0.6280
Capital to T. Assts	-0.0350692	0.03*
Bank Overheads	0.0000000	0.000**
Bank Fixed Assets	0.0000000	0.000**
Ln Total Assets	0.0382011	0.023*
CAPRQ	-0.0049375	0.8610
PRMONT	0.0122571	0.7270
ACTRS	-0.0344955	0.037*
SPOWER	-0.0045220	0.8020
Credit to Deposits	0.0013660	0.033*
Concentration (5 Largest Banks)	-0.0075643	0.007**
Lerner Index	2.5089680	0.000**
GDP Current (USD Mil.)	0.0000000	0.018*
Market Volatility	0.042986	0.005**

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***Table 3**: Total factor productivity change regression, using Generalised Linear Model regression, and Market Power Index Behaviour among different models using Mixed effect Log Likelihood and Gaussian Parametric Generalised Linear model as efficiencies and TFP and Lerner's Index are calculated in a parametric technique while Regulatory variables are not. The regression optimises on the bases of Gaussian and Poisson maximum likelihood and the standard errors are log linked and adjusted to reflect clusters of income groups differences.*

Generalised Linear Model				
	No. of obs	1770	**Scale Parameter**	38.01722
Maximum Likelihood	**Residual Df**	1766	Link function:	g(u)=ln(u){Log]
Deviance	66948.32663	(1/df) Deviance	37.90958	
Pearson	66948.32663	(1/df) Pearson	37.90958	
Log pseudolikelihood	-5726.674459	Variance function:	V(u)=1	
Gaussian, Log Link	**TFPch**		**Coef.**	
		CAPRQ	-0.1306171	
		PRMONT	-0.6630489***	
		ACTRS	1.097247***	
		SPOWER	-0.2632406***	
		ECFRDM	-0.088079	
		FINFRDM	0.0533063	
		CONC_5	-0.052275***	
		Lerner Index	-6.688768***	
		_cons	0.1484265	
	Log pseudolikelihood	-4297.924328	**(1/df) Deviance**	**2.81E+00**
	Deviance	**4970.52801**	**(1/df) Pearson**	**10.51959**
	Pearson	**18577.59037**	**BIC**	**-8236.918**
			AIC	**4.860931**
Poisson, Log Link	**TFPch**	CAPRQ	-0.0393738	
		PRMONT	-0.0992684	
		ACTRS	0.1270106***	
		SPOWER	-0.0470102	
		ECFRDM	-0.0286679*	
		FINFRDM	0.0062831	
		CONC_5	-0.0020732	
		Lerner Index	-1.834859***	
		_cons	2.507637***	

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Table 4: *The association of Total Factor Productivity change with Regulatory and Macro - Environment Variables. A robust regression by* ***Region,*** *with bias correction term of 1/(1-h)^2 best for homoskedasticity is conducted. Results are Relatively Identical under Bias terms 1/(1-h) and similar Under OLS regression. Frequency weight of Countries is implemented. *, **, *** denotes the level of significance at confidence levels of 90%, 95% and 99% respectively.*

TFPCH in:	**East Asia and Pacific**	**Europe & Central Asia**	**Latin America & Caribbean**	**Middle East & North Africa**	**North America**	**South Asia**	**Sub-Saharan Africa**
Prob>F	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
R-Squared	**0.0482**	**0.0695**	**0.0892**	**0.0443**	**0.6216**	**0.0249**	**0.0694**
No. of Obs	**9,863**	**28,435**	**8,422**	**12,502**	**1,866**	**4,275**	**18,682**
CAPRQ	-0.0124481	0.0061944	0.0274179***	-0.1550421***	0.0977562**	-0.1125271**	-0.0710285***
ACTRS	-0.0204827***	0.6640191***	0.0289661***	-0.0090338**	0.1568396***	0.0969313*	0.0383555***
PRMONT	-0.0600068***	-0.8276725***	-0.0407646***	-0.1419552***	-0.8726402***	-0.0154476	-0.0207647**
SPOWER	0.0555532***	-0.5026279***	0.0243067***	0.0415967***	0.0935077***	0.0614292***	0.0694784***
Financial Freedom	-0.0004684	-0.0194631***	0.0017352***	-0.0257563***	-0.0043653**	0.0180329***	-0.0009033
Concentration(5)	0.0087628***	-0.0859154***	0.0148842***	0.0042909***	0.053115***	0.0153545***	0.0053048***
Lerner Index	-0.3310266***	-4.648467***	-0.0880018	-2.70189***	-4.925682***	-1.030027**	-3.755018***
Market Volatility	-0.0019507	0.082255***	0.0166009***	0.0066668**	0.0918879***	0.0230578*	-0.0226273***
Z-Score	0.0027075*	0.0687584***	-0.0084884***	0.002415	-0.0181208***	0.0385487***	0.0217775***
CPI	-0.0013101***	0.0230227***	0.0107606***	0.0042222***	0.0567945***	0.000253	0.0008435
GDP	0.000000082***	-0.000000357***	0.000000081***	0.0000000711***	0.00000052***	1.9E-09	-0.0000000416***
Equity/T. Assets Ratio	-0.0137372***	0.0258656***	0.0495891***	-0.0636119***	0.1044632***	-0.0643084***	-0.0226274***
ROA	-0.0024448	-0.0842105***	-0.0679872***	0.032682***	-0.2416159***	-0.3290062***	-0.0130655***
ROE	-0.0009276	0.0183066***	0.0082205***	-0.0237556***	0.0489663***	0.0379495***	0.004642**
_cons	0.8942904	9.685678	-2.302562	4.803142	-8.736987	-2.014146	1.806957

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Table 5: *The association of Total Factor Productivity change with Regulatory and Macro - Environment Variables. A robust regression by* ***Countries Income Level****, with bias correction term of 1/(1-h)^2 best for homoskedasticity is conducted. Results are Relatively Identical under Bias terms 1/(1-h) and similar Under OLS regression. Frequency weight of Countries is implemented. *, **, *** denotes the level of significance at confidence levels of 90%, 95% and 99% respectively.*

TFPCH in:	**High Income**	**Low Income**	**Lower Middle Income**	**Upper Middle Income**
Prob>F	**0.000**	**0.000**	**0.000**	**0.000**
R-Squared	**0.0558**	**0.0745**	**0.0473**	**0.0971**
No. of Obs	**36,037**	**7,348**	**14,752**	**25,908**
CAPRQ	0.0801142***	0.1060539***	-0.1254284***	-0.146406***
ACTRS	0.5618506***	-0.0098752	-0.0252869***	-0.0505968***
PRMONT	-0.6282729***	-0.1752638***	-0.0132055	-0.0667945***
SPOWER	-0.4108346***	0.24821***	0.0699386***	0.0252005***
Financial Freedom	-0.0198732***	-0.0394193***	-0.0027844***	0.0023363***
Concentration(5)	-0.0476908***	0.0230605***	0.0075428***	0.0022277***
Lerner Index	-6.06324***	-5.640942***	0.7492304***	-0.7880182***
Market Volatility	0.0712176***	0.0107521**	-0.0200437***	0.0002213
Z-Score	0.0739795***	0.0135172***	-0.0087965***	-0.0054071***
CPI	0.0158714***	0.0047633***	-0.0017331***	0.0013285***
GDP	-0.000000258***	-0.0000000555***	0.0000000305***	0.000000149***
Equity/T. Assets Ratio	-0.0202285***	-0.0543367*	0.0079746***	-0.0175084***
ROA	-0.0687841***	-0.2089763***	-0.0045999***	-0.0137855***
ROE	0.0090713***	-0.0301204***	-0.0106073***	0.0026577***
_cons	6.823406	1.735721	1.699725	2.470435

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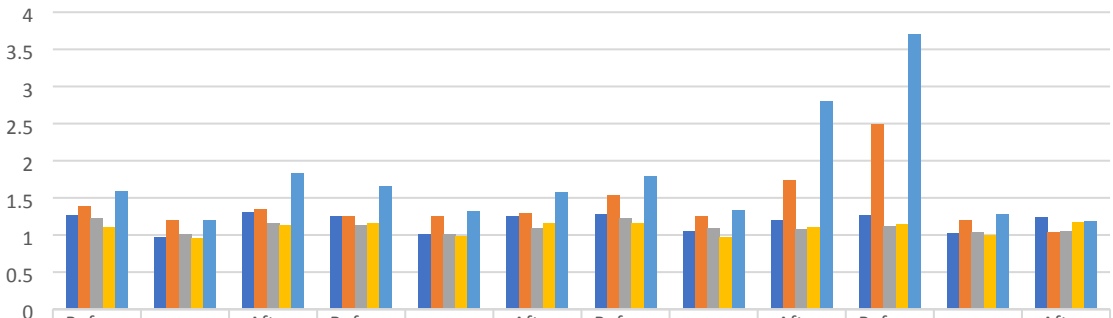
***Table 6**: Efficiencies association with Regulatory and Macro-Environment variables categorised over Countries as frequency weights using Robust regression with bias correction term of 1/(1-h)^2 that is best for homoskedasticity. Results are Relatively Identical under Bias terms 1/(1-h) and similar Under OLS regression. Frequency weight of Countries is implemented. *, **, *** denotes the level of significance at confidence levels of 90%, 95% and 99% respectively. **See Table 6.A** in Appendix for Income Level Categorisation.*

Efficiencies	**EFFCH**	**TECHCH**	**PECH**	**SECH**
Obs	84,045	84,045	84,045	84,045
Parms	15	15	15	15
RMSE	0.8332515	3.542737	0.8210089	0.4828239
R-sq	0.0598	0.028	0.0734	0.034
F	381.9961	172.6522	475.1145	211.115
P	0	0	0	0
CAPRQ	-0.0584364***	0.0119948	-0.0630663***	-0.0150025***
ACTRS	-0.0253861***	0.1565718***	-0.0335865***	0.0051061***
PRMONT	0.0036832	-0.1911179***	0.0601771***	-0.0563874***
SPOWER	0.0066167***	-0.0737626***	0.0245749***	-0.0059834***
Financial Freedom	0.0005345***	-0.0059502***	-0.0010325***	0.0009776***
Concentration(5)	-0.0018888***	-0.0039793***	0.0015173***	-0.0026187***
Lerner Index	-0.3250326***	-1.817922***	0.0713533***	-0.3755752***
Market Volatility	-0.0010711***	0.0156774***	-0.0015974***	0.0004679***
Z-Score	0.005186***	0.008984***	-0.0012229***	0.0045164***
CPI	0.0006141***	0.0050359***	0.0006075***	0.0001987***
GDP	0.0000000908***	-0.0000000587***	0.00000011***	-1.88E-10
Equity/T. Assets Ratio	-0.0069119***	-0.013819***	-0.0057624***	0.002556***
ROA	-0.0072469***	0.0364647***	-0.003271**	-0.0077687***
ROE	0.0021384***	-0.0034636***	-0.0002024	0.0027126***
_cons	1.788062***	1.902219***	1.185681***	1.556809***

Chart I: Productivity Growth and Efficiencies, Crisis and Country's Income Level



	Before Crisis	Crisis	After Crisis	Before Crisis	Crisis	After Crisis	Before Crisis	Crisis	After Crisis	Before Crisis	Crisis	After Crisis
	High income	Upper middle income	Lower middle income	Low income								
effch	1.261003	0.97307	1.302163	1.247403	1.008496	1.256142	1.282523	1.046425	1.20126	1.263281	1.027775	1.235208
techch	1.381375	1.194205	1.346969	1.250287	1.252622	1.292685	1.538331	1.247012	1.732698	2.485781	1.201275	1.035583
pech	1.23173	1.01194	1.152233	1.135051	1.015874	1.089167	1.228165	1.090688	1.077771	1.113516	1.0351	1.056813
sech	1.098157	0.955721	1.130326	1.154782	0.976667	1.159321	1.152638	0.971963	1.109604	1.148156	1.000575	1.177438
tfpch	1.58625	1.194074	1.824678	1.661153	1.319719	1.577698	1.785906	1.339212	2.80101	3.702469	1.2824	1.188917

	Overall Crisis Effect			High Income Countries			Upper Middle-Income Countries			Lowe Middle Income Countries			Low Income Countries		
TFPCH in:	**Before 2007 Crisis**	**During Crisis 2007-2011**	**After Crisis**	**Before 2007 Crisis**	**During Crisis 2007-2011**	**After Crisis**	**Before 2007 Crisis**	**During Crisis 2007-2011**	**After Crisis**	**Before 2007 Crisis**	**During Crisis 2007-2011**	**After Crisis**	**Before 2007 Crisis**	**During Crisis 2007-2011**	**After Crisis**
Prob>F	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
R-Squared	**0.0379**	**0.046**	**0.0653**	**0.0748**	**0.0974**	**0.1305**	**0.2506**	**0.0936**	**0.131**	**0.2418**	**0.1772**	**0.098**	**0.147**	**0.3045**	**0.2981**
No. of Obs	**35,720**	**21,693**	**26,632**	**15,191**	**9,425**	**11,421**	**10,783**	**7,089**	**8,036**	**6,272**	**3,471**	**5,009**	**3,474**	**1,708**	**2,166**
CAPRQ	*-0.0706537***	*-0.1427015****	*0.5727657****	*-0.0641511****	*-0.2077542****	*1.062233****	*-0.1269238****	*-0.0881237****	*-0.0315668****	*-0.0245691****	*0.0053244*	*-0.1679741****	*0.2810146****	*-0.2037022****	*-0.0003385*
ACTRS	*-0.0128114**	*0.0222871****	*0.7417314****	*0.1396044****	*0.0011651*	*1.530434****	*-0.1103534****	*0.0526768****	*-0.0188317****	*-0.0992986****	*0.2096458****	*-0.0158063**	*-0.0304039*	*0.1252174****	*-0.0659269****
PRMONT	*0.1392567****	*0.003932*	*-0.5383968****	*0.2620659****	*0.0912148****	*-0.8430085****	*0.0072842*	*-0.0112313*	*-0.1273547****	*0.2070105****	*-0.3839363****	*-0.1456193****	*-0.1858645*	*0.030159*	*-0.0448948**
SPOWER	*0.0751974****	*0.0727708****	*-0.5054999****	*0.0874747****	*0.0636012****	*-0.9922983****	*0.0483137****	*0.0484534****	*-0.0071795**	*0.0927276****	*0.3091576****	*-0.0379906****	*0.3237262****	*-0.0283413****	*-0.0043934*
Financial Freedom	*-0.0147951****	*0.0057576****	*-0.0259861****	*-0.0055437****	*0.0062071****	*-0.0489936****	*-0.0020449**	*-0.0002532*	*0.0009217**	*0.0014439**	*0.0087646****	*-0.0051178****	*-0.0882194****	*0.0227174****	*-0.0309258****
Concentration(5)	*0.02331*****	*0.0007067*	*-0.0801796****	*0.0199055****	*-0.0083449****	*-0.1786366****	*0.0190585****	*0.0039618****	*-0.0093475****	*0.0074744****	*0.0289969****	*-0.0089114****	*0.0844155****	*-0.0058625****	*-0.0168817****
Lerner Index	*-2.865354****	*-0.4987647****	*-5.596091****	*-3.563328****	*-2.326623****	*-9.145204****	*-1.4871****	*0.2867906****	*-0.5258686****	*0.011887*	*-0.6777283*	*0.0499379*	*-13.72636****	*0.9974477****	*-4.190638****
Market Volatility	*0.0266122****	*-0.0164453****	*0.0592193****	*0.0622229****	*-0.0318955****	*0.1217514****	*0.0024256**	*-0.0010517*	*0.0014372**	*-0.0008242*	*-0.0298022****	*-0.0146014****	*0.0038585*	*-0.0293649****	*-0.0520089****
Z-Score	*-0.0089054****	*-0.0055491****	*0.1451866****	*0.0139253****	*0.0098511****	*0.2620184****	*-0.0209474****	*-0.009138****	*0.0128983****	*-0.0176949****	*-0.0500615****	*0.0212758****	*-0.1044056****	*-0.020991****	*0.1587487****
CPI	*0.0094137****	*0.002043****	*0.0058684****	*0.0179232****	*-0.0018831**	*0.0106456****	*0.0005357*	*0.0058245****	*-0.0010673****	*-0.0006782*	*0.0100062****	*-0.0014563****	*0.0350048****	*0.0095988****	*-0.001478**
GDP	*0.000000159****	*-0.000000376****	*-0.00000038****	*0.0000000909****	*-0.00000027*****	*-0.00000077*****	*0.000000595****	*-0.00000028*****	*-0.00000002260****	*0.000000154****	*-0.00000122*****	*-0.00000008370****	*0.000000182*	*0.000000666****	*-0.00000023*****
Equity/T. Assets Ratio	*-0.0142878****	*-0.0146493****	*-0.0931217****	*-0.0295909****	*0.0140077****	*-0.0722048**	*-0.0193488****	*-0.0408866****	*0.0006977*	*0.0328494****	*-0.0213968**	*-0.0184085****	*-0.0550481**	*0.0601335****	*-0.1025489****
ROA	*0.0447118****	*-0.0092595*	*-0.3553489****	*0.1219131****	*-0.0400197****	*-1.441986****	*-0.0422555****	*-0.012353***	*-0.0229087****	*-0.0035431*	*-0.3228468****	*0.0567105**	*0.1494385*	*0.0317266*	*0.1529113****
ROE	*-0.0005518*	*-0.0070426****	*0.0491979****	*0.0053228**	*0.0055829***	*0.1169822****	*0.0105196****	*-0.0080828****	*0.0059796****	*-0.0003706*	*-0.0160115***	*-0.0117114****	*-0.0590937****	*0.0117587****	*-0.0116885****
_cons	*-1.05136*****	*1.417111****	*6.625184****	*-4.96994*	*2.800036*	*12.00967*	*1.356848*	*0.5616531*	*2.897903*	*-0.5341324*	*-0.9752844*	*4.989643*	*-1.367546*	*-0.91394*	*7.07406*

*Table 7: Efficiencies association with Regulatory and Macro-Environment variables **around the 2007-2011 financial crisis**; categorised over Countries as frequency weights using Robust regression with bias correction term of 1/(1-h)^2 that is best for homoskedasticity. Results are Relatively Identical under Bias terms 1/(1-h) and similar Under OLS regression. Frequency weight of Countries is implemented. *, **, *** denotes the level of significance at confidence levels of 90%, 95% and 99% respectively. See Table 6.A in Appendix for Income Level Categorisation. See Table 7 Appendix (Table7.A) for the impact of regulatory variables of productivity during periods preceding, during and post2007-2011 crisis)*

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Appendix A. Information on the dataset

Variable	Description and sources
Stage 1: Estimation of total factor productivity	
A. Bank inputs	
Fixed assets	Assets related to physical capital (Source: Datastream and Bloomberg).
Deposits and short-term funding	Incoming funds used to generate bank outputs (Source: Datastream and Bloomberg).
Overheads	Operating expenses used in the production process of bank outputs (Source: Datastream and Bloomberg).
B. Bank outputs	
Net loans (loans)	Bank gross loans net of reserves for impaired loans/NPLs (Source: Datastream and Bloomberg).
Non-interest income	(Source: Datastream and Bloomberg)
Stage 2: Determinants of total factor productivity change	
A. Banks' Internal determinants	
Logarithm of total assets (LNAS)	Proxy for bank size (Source: Datastream and Bloomberg and own calculation).
Ratio of equity to total assets (EQAS)	Proxy for bank capitalization (Source: Datastream and Bloomberg).
B. Banks' External determinants	
I. Regulatory conditions	
Capital requirements (CAPRQ)	This variable is determined by adding 1 if the answer is yes to questions 1-6 and 0 otherwise, and the opposite occurs for questions 7 and 8 (i.e., yes=0, no=1). The questions are: (1) Is the minimum required capital asset ratio (risk-weighted) in line with Basel guidelines? (2) Does the ratio vary with market risk? (3-5) Before determining minimum capital adequacy, are any of the following deducted from the book value of capital? (a) market value of loan losses not realized on the financial statements (b) unrealized losses on securities portfolios (c) unrealized foreign exchange losses. (6) Have regulatory/supervisory authorities verified the sources of funds to be used as capital? (7) Can assets other than cash or government securities provide the initial or subsequent injections of capital? (8) Can borrowed funds provide the initial disbursement of capital? (Source: Bank Regulation and Supervision Database, World Bank; Barth *et al.*, 2001b, 2006, 2007b).
Supervisory power (SPOWER)	This variable is determined by adding 1 if the answer is yes and 0 otherwise, for each of the following 14 questions: (1) Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? (2) Are auditors legally required to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? (3) Can supervisors take legal action against external auditors for negligence? (4) Can the supervisory authorities force a bank to change its internal organizational structure? (5) Does the institution disclose off-balance-sheet items to supervisors? (6) Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? (7) Can the supervisory agency suspend directors' decisions to distribute dividends? (8) Can the supervisory agency suspend directors' decisions to distribute bonuses? (9) Can the supervisory agency suspend directors' decisions to distribute management fees? (10) Can the supervisory agency supersede bank shareholder rights and declare the bank insolvent? (11) Does banking law allow a supervisory agency or any other government agency (other than a court) to suspend some or all ownership rights at a problem bank? (12) Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency (other than a court) supersede shareholder rights? (13) Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency (other than a court) remove and replace management? (14) Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency (other than a court) remove and replace directors? (Source: Bank Regulation and Supervision Database, World Bank; Barth *et al.*, 2001b, 2006, 2007b)

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Market discipline and private monitoring (PRMONT)	This variable is determined by adding 1 if the answer is yes to questions 1-7 and 0 otherwise, and the opposite occurs for questions 8 and 9 (i.e., yes=0, no=1). (1) Is subordinated debt allowed (or required) capital? (2) Are financial institutions required to produce consolidated accounts covering all bank and any nonbank financial subsidiaries? (3) Are off-balance-sheet items disclosed to the public? (4) Must banks disclose their risk-management procedures? (5) Are directors legally liable for erroneous/misleading information? (6) Do regulations require credit ratings for commercial banks? (7) Is an external audit by certified/licensed auditor mandatory for banks? (8) Does accrued, unpaid interest/principal on nonperforming loans appear on the income statement? (9) Is there an explicit deposit-insurance protection system? (Source: Bank Regulation and Supervision Database, World Bank; Barth *et al.*, 2001b, 2006, 2007b)
Activity restrictions (ACTRS)	The score for this variable is determined on the basis of the level of regulatory restrictiveness for bank participation in: (1) securities activities, (2) insurance activities, (3) real estate activities, and (4) bank ownership of nonfinancial firms. These activities can be unrestricted, permitted, restricted, or prohibited and receive values of 1, 2, 3, or 4, respectively. We create an overall index by calculating the average value of the four categories. (Source: Bank Regulation and Supervision Database, World Bank; Barth *et al.*, 2001b, 2006, 2007b)
II. Market structure	
Concentration (CONC)	5-bank concentration ratio (Source: 2017 update of Financial Development and Structure Database, World Bank,2017).
III. Macroeconomic conditions	
GDP	Real GDP growth (Source: World Bank,2017).
CPI	CPI inflation (Source: World Bank,2017).
IV. Financial and institutional development	
Ratio of foreign claims to the banking sector over GDP	Proxy for the development of the banking sector (Source: Global Market Information Database).
Economic freedom AND Financial Freedom	Proxies for the financial sector freedom and the overall level of economic freedom. They are composite indices that are calculated by considering: business freedom, trade freedom, fiscal freedom, government spending, monetary freedom, investment freedom, financial freedom, property rights, freedom from corruption, labour freedom (Source: Heritage Foundation).
VI. Financial Stability Scores	
Regulatory Capital to Risk weighted Assets	Proxy for credit risk (Source: International Monetary Fund; various Global Financial Stability Reports).
Liquid Assets to Deposits	Raw data are from Datatream. Liquid Assets /Deposits and Short-Term Funding. Numerator and denominator are first aggregated on the country level before division.
Credit to Deposits	The financial resources provided to the private sector by domestic money banks as a share of total deposits. Domestic money banks comprise commercial banks and other financial institutions that accept transferable deposits, such as demand deposits. Total deposits include demand, time and saving deposits in deposit money banks. International Financial Statistics (IFS), International Monetary Fund (IMF) , 2017.
Banking Sector Z-score	Stock price volatility; the average of the 360-day volatility of the national stock market index. Bloomberg.
Market Volatility	Indicator of the overall soundness of the banking sector. It is calculated as (ROA+(equity/assets))/sd(ROA), with the standard deviation of ROA, sd(ROA), being estimated over a 5-year moving window (Source: 2010 update of Financial Development and Structure Database, World Bank, 2017).

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Banking Crisis Dummy	A banking crisis is defined as systemic if two conditions are met: a. Significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations), b. Significant banking policy intervention measures in response to significant losses in the banking system. The first year that both criteria are met is considered as the year when the crisis start becoming systemic. The end of a crisis is defined the year before both real GDP growth and real credit growth are positive for at least two consecutive years. (Laeven and Fabián, 2012), "Systemic Banking Crises Database: An Update", IMF WP/12/163
OECD Countries	Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

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	High Income				Low Income			
Efficiencies	EFFCH	TECHCH	PECH	SECH	EFFCH	TECHCH	PECH	SECH
Obs	**36,037**	**36,037**	**36,037**	**36,037**	**7,348**	**7,348**	**7,348**	**7,348**
Parms	15	15	15	15	15	15	15	15
RMSE	0.8227078	5.082041	0.8648172	0.4862833	0.7008946	1.714519	0.5714704	0.424376
R-sq	**0.0949**	**0.0681**	**0.0988**	**0.0502**	**0.0931**	**0.0604**	**0.1664**	**0.1448**
F	269.8647	187.896	282.1821	135.8557	53.75573	33.65723	104.537	88.6832
P	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CAPRQ	-0.0697601***	0.1061839***	-0.0810998***	-0.0133809***	-0.0033928	0.0200942	-0.0228435***	0.0078634**
ACTRS	-0.0087425***	0.3539783***	-0.027616***	0.007041***	0.0122408***	-0.0214678**	0.0380562***	-0.0153651***
PRMONT	-0.0161775***	-0.3113438***	0.0427563***	-0.0631097***	-0.0187725**	-0.0465049**	0.028296***	-0.0318208***
SPOWER	0.0119129***	-0.2170182***	0.0270795***	0.0001675	-0.0564532***	0.1325492***	-0.0207595***	-0.0267246***
Financial Freedom	0.0010209***	-0.0121449***	-0.0008149***	0.001451***	-0.001501***	-0.0088282***	-0.0039211***	0.0015857***
Concentration(5)	-0.0018062***	-0.013931***	0.0024646***	-0.003452***	-0.0012425**	0.0061663***	-0.0051259***	0.0038196***
Lerner Index	-0.4087321***	-3.545247***	0.0155221	-0.4674596***	-0.455474***	-1.677718***	-0.3915213***	-0.0696939
Market Volatility	0.0008455*	0.0441159***	0.0015141***	0.0006436**	-0.0047932***	-0.0040143*	-0.0127983***	0.0067355***
Z-Score	0.0097251***	0.0307628***	0.0014172**	0.0060104***	-0.0024025*	0.0087009***	-0.0057922***	-0.0006107
CPI	0.0006265***	0.0106837***	0.0004259***	0.000667***	0.0002748	-0.0000348	-0.0002667	0.0009249***
GDP	0.000000108***	-0.000000178***	0.000000134***	-2.51E-09	0.0000000192***	-0.000000048***	-6.03E-09	0.0000000256***
Equity/T. Assets Ratio	-0.0199537***	0.0018007	-0.0112624***	-0.0061903***	0.013106***	-0.025087***	0.0050399***	0.0151059***
ROA	-0.020588***	0.0230595	-0.0171895***	-0.005245***	0.0127859	-0.101926***	-0.0327815***	0.0512377***
ROE	0.0030529***	-0.0015925	0.0009794**	0.0017239***	-0.0093401***	-0.0037619*	-0.0063498***	-0.0054022***
_cons	1.746427	2.037119	1.179797	1.594889	2.175499	1.062339	2.174642	0.8650418

	Middle Lower Income				Middle Upper Income			
Efficiencies	EFFCH	TECHCH	PECH	SECH	EFFCH	TECHCH	PECH	SECH
Obs	**14,752**	**14,752**	**14,752**	**14,752**	**25,908**	**25,908**	**25,908**	**25,908**
Parms	15	15	15	15	15	15	15	15
RMSE	0.6528808	1.246564	0.5968163	0.4128381	0.9116245	1.106603	0.8633545	0.5059234
R-sq	**0.1967**	**0.0627**	**0.3174**	**0.0561**	**0.0727**	**0.1078**	**0.0601**	**0.0656**
F	257.6768	70.45822	489.4136	62.52546	145.0248	223.4463	118.1649	129.787
P	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CAPRQ	-0.0485309***	-0.0210836***	-0.0463096***	0.0066282**	-0.0606559***	-0.1619709***	-0.0588996***	-0.0243228***
ACTRS	0.0063242***	-0.0158136***	-0.0012726	0.0082694***	-0.0632572***	-0.0018156	-0.0683688***	0.00833***
PRMONT	0.081184***	-0.1323214***	0.1199157***	-0.0470507***	-0.022171***	-0.0589813***	0.0322297***	-0.0538313***

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SPOWER	0.0040266*	0.0350106***	0.0180994***	-0.0143455***	0.013476***	0.017375***	0.0286354***	-0.0041897***
Financial Freedom	-0.0012922***	0.0015357**	-0.0000763	-0.0018862***	0.0026436***	-0.0009918**	0.0005893*	0.0015746***
Concentration(5)	0.0035059***	0.005064***	0.0051021***	-0.0016824***	-0.0051691***	0.0068056***	-0.0010556***	-0.0031523***
Lerner Index	0.4400164***	0.1292094	0.7024908***	-0.301678***	-0.6001344***	-0.5396479***	-0.2273028***	-0.2612827***
Market Volatility	-0.005117***	-0.013601***	-0.0041592***	-0.0015977***	0.0020122***	-0.0022028***	0.000623	0.0006575**
Z-Score	0.0061957***	-0.0150797***	0.0011734	0.0046753***	0.0015753*	-0.0097337***	-0.0029232***	0.0037277***
CPI	-0.0005183**	-0.0003934	0.0005924***	-0.0008619***	0.0015413***	0.0011173***	0.0011505***	-0.0000827
GDP	0.00000012***	-0.0000000231***	0.000000181***	-0.0000000187***	0.0000000182***	0.000000176***	-8.35E-10	0.0000000118***
Equity/T. Assets Ratio	0.0214817***	-0.0229368***	0.0170734***	0.0081329***	-0.0049617***	-0.0172285***	-0.0103893***	0.008321***
ROA	-0.0083184***	0.0031126	-0.0107374***	0.0004101	-0.0229346***	0.018833***	0.0078202**	-0.0502953***
ROE	0.004776***	-0.009738***	0.0039364***	0.0023062***	0.0048447***	-0.0043023***	-0.0005044	0.0074329***
_cons	0.3380056	2.09689	-0.3036156	1.61225	2.336186	1.934271	1.796118	1.492529

***Table 6.A**: Efficiencies association with Regulatory and Macro-Environment variables categorised over Countries as frequency weights and Income levels categories using Robust regression with bias correction term of 1/(1-h)^2 that is best for homoskedasticity. Results are Relatively Identical under Bias terms 1/(1-h) and similar Under OLS regression. Frequency weight of Countries is implemented. *, **, *** denotes the level of significance at confidence levels of 90%, 95% and 99% respectively. N.B. Low-income: GNI per capita= $995 or less; lower middle-income: GNI per capita between $996 and $3,895; upper middle-income GNI per capita between $3,896 and $12,055; high-income: GNI per capita of $12,055 or more.*

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Mixed-effects	GLM	Family:	Poisson	Link:	log	TFPCH
			Before Crisis <2007			
Wald chi2(7)	=	385.42	Number Of Observation	752		
Log likelihood	=	-1875.9761	Prob>Chi2	=	0.0000	
	Coef.	***Std. Err.***	***z***	***P>|z|***	***[95% Conf. Interval]***	
CAPRQ	-0.117425	0.0179623	-6.54	0.000	-0.1526304	-0.0822196
ACTRS	0.2064694	0.0215507	9.58	0.000	0.1642308	0.2487079
PRMONT	0.0277077	0.0108334	2.56	0.011	0.0064746	0.0489408
SPOWER	0.0558573	0.0132378	4.22	0.000	0.0299117	0.0818029
Ecn.Fr	-0.0310297	0.0049267	-6.3	0.000	-0.0406858	-0.0213735
Fin.Frdm	0.0031035	0.0025237	1.23	0.219	-0.0018429	0.0080499
Conc5	0.0212096	0.0020209	10.49	0.000	0.0172486	0.0251706
_cons	-0.6120893	0.3177547	-1.93	0.054	-1.234877	0.0106984
			During Crisis 2007>=&<=2011			
Wald chi2(7)	=	29.86	Number Of Observation	462		
Log likelihood	=	-643.91596	Prob>Chi2	=	0.0001	
	Coef.	***Std. Err.***	***z***	***P>|z|***	***[95% Conf. Interval]***	
CAPRQ	-0.065396	0.0278552	-2.35	0.019	-0.1199912	-0.0108007
ACTRS	0.0274208	0.0323674	0.85	0.397	-0.0360181	0.0908597
PRMONT	0.0149751	0.0162081	0.92	0.356	-0.0167922	0.0467424
SPOWER	0.0307574	0.0182801	1.68	0.092	-0.0050709	0.0665857
Ecn.Fr	-0.0281808	0.0086959	-3.24	0.001	-0.0452245	-0.011137
Fin.Frdm	0.0147942	0.0040213	3.68	0.000	0.0069127	0.0226758
Conc5	0.0023759	0.0027677	0.86	0.391	-0.0030486	0.0078004
_cons	0.7327651	0.6038068	1.21	0.225	-0.4506744	1.916205
			After Crisis >2011			
Wald chi2(7)	=	1072.35	Number Of Observation	556		
Log likelihood	=	-1472.541	Prob>Chi2	=	0.0000	
	Coef.	***Std. Err.***	***z***	***P>|z|***	***[95% Conf. Interval]***	
CAPRQ	0.2324353	0.0271597	8.56	0.000	0.1792032	0.2856674
ACTRS	-0.257046	0.0315867	-8.14	0.000	-0.3189548	-0.1951372
PRMONT	0.2469603	0.0138139	17.88	0.000	0.2198855	0.2740352
SPOWER	-0.1836591	0.0134318	-13.67	0.000	-0.2099849	-0.1573333

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Ecn.Fr	-0.003024	0.0049011	-0.62	0.537	-0.01263	0.006582
Fin.Frdm	-0.0012813	0.0029638	-0.43	0.666	-0.0070903	0.0045277
Conc5	-0.0191553	0.0016759	-11.43	0.000	-0.0224401	-0.0158706
_cons	1.452187	0.3676792	3.95	0.000	0.731549	2.172825

Table 7.A: A Log Likelihood GLM regression of TFP change and Regulatory variables around the 2007-2011 financial crisis. Interval of confidence at 95% are presented along with the p Values and coefficients. This table presents the variation of impact of the regulatory variables on productivity change over the different phases of the 2007-2011 financial crisis.

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