



The impact of bank regulation on bank lending: a review of international literature

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Accepted: 24 August 2021

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Abstract

This paper reviews the theoretical and empirical literature on the impact of bank regulation on bank lending. It also structures the empirical evidence according to the impact of various bank regulatory measures on bank lending. The surveyed theoretical literature generally indicates that the impact of bank regulation on lending could be asymmetric, depending on the trade-off between the costs and benefits of bank regulation. The evidence from the empirical studies also shows that the impact of bank regulatory measures on lending is ambiguous. Although many studies found the impact to be negative, some established that it was positive while others found it to be insignificant or inconclusive. However, most empirical studies only assumed first-round effects using static and/or dynamic models, whereas the ones incorporating second-round effects using general equilibrium models were limited. Therefore, this systematic review of the literature indicates that policy recommendations regarding the appropriateness and efficacy of bank regulatory measures in influencing bank lending cannot be implemented uniformly across different regions or countries.

Keywords Bank regulation · Bank lending · Bank regulatory measures · Bank credit

JEL Classifications E51 · E58 · G21 · G28

Introduction

Achieving and maintaining financial stability through bank regulation has remained one of the fundamental policies of promoting bank development and economic growth. As a result, various countries across the world have implemented reforms in bank regulation since the introduction of the Basel accords in the late 1980s and following the 2007–2008 global financial crisis [1, 2]. These reforms included measures on minimum reserve requirements, lender of last resort policies, public subsidies and guarantees, deposit insurance systems, entry barriers, restrictions on the mixing of banking and commerce, bank activity restrictions, capital and liquidity regulatory requirements, as well as macroprudential policies. These reforms have, therefore, raised questions regarding the appropriateness and efficacy of bank regulatory

measures in influencing banking activities, including bank lending in both developed and developing economies.

At present, there is sufficient academic literature analysing the impact of different bank regulatory measures on bank lending. However, there is still no consensus on whether the adoption of these measures promotes bank lending. For example, the theoretical literature offers conflicting predictions about the impact of bank regulatory measures on bank lending. Some argue that increasing the stringency of certain measures of bank regulation will promote prudent lending by banks, while others contend that doing so may encourage banks to assume more risk and lead to imprudent lending [1, 3]. It was, therefore, believed that as more data on bank regulatory practices implemented across different countries became available, the empirical assessment of the impact of these measures on bank lending could help in resolving these conflicting predictions.

Unfortunately, in as much as many empirical studies determined the relationship between bank regulation and bank lending, these studies showed that the impact of various bank regulatory measures on bank lending was ambiguous. Even though in many studies, the impact was found

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to be negative, some established that it was positive, while others found it to be insignificant or inconclusive. Nevertheless, most empirical studies only assumed first-round effects using static and/or dynamic models, whereas the ones incorporating second-round effects using general equilibrium models were limited. This, therefore, implies that policy recommendations on the appropriateness and efficacy of bank regulatory measures in influencing bank lending cannot be implemented uniformly across different regions or countries.

With most countries having or still facing pressure to migrate to the Basel III accord, which was introduced after the 2007–2008 global financial crisis to mitigate the weaknesses of the Basel II accord [4, 5], the question of how bank regulations affect bank lending remains relevant even today. Although this migration could promote the resilience and safety of the banking systems in the long run, a trade-off exists between obtaining these benefits and promoting financing via increased bank lending, which could be restricted by intensifying the stringency of bank regulation. These issues, therefore, also necessitate a detailed review of the impact of bank regulatory measures on bank lending to inform bank regulation policy properly.

It is against this background that this paper aims to review the theoretical and empirical literature on the impact of bank regulation on bank lending. It gives a systematic survey of the literature on the impact of various bank regulatory measures on bank lending and structures evidence from the empirical studies according to the impact of these measures. It also distinguishes between empirical studies assuming first-round and second-round effects and provides policy implications regarding the practice of bank regulation and supervision.

The rest of the study is organised as follows: Sect. 2 provides the theoretical literature review on bank regulation and its impact on bank lending. Section 3 presents the empirical evidence on the impact of bank regulation on bank lending. Section 4 gives policy implications, while Sect. 5 offers the concluding remarks.

Impact of bank regulation on bank lending: theoretical literature review

The theoretical literature on the impact of bank regulation on bank lending can be analysed from the perspective of various bank regulatory measures including minimum reserve requirements, lender of last resort policies, public subsidies and guarantees, deposit insurance systems, entry barriers, restrictions on the mixing of banking and commerce, bank activity restrictions, capital and liquidity regulatory requirements as well as macroprudential policies.

Firstly, the minimum reserve requirements are, by design, expected to affect bank lending negatively. This is because

the required reserves are normally not available to be used by the banks and do not earn any interest and, as a result, they reduce the profitability of the banks and their ability to extend lending [6]. Alternatively, other bank regulatory measures such as lender of last resort policies, public subsidies and guarantees as well as deposit insurance systems act as substitutes to minimum reserve requirements when it comes to offering protection to bank depositors. However, they are considered to induce moral hazard by encouraging banks to assume more risk and engage in excessive lending [1, 3].

When it comes to entry barriers into the banking sector, the economic theory shows that they are perceived to limit competition. As postulated by Peltzman [7], imposing entry barriers will help banks to enjoy market power through expansion or mergers and earn above-normal industry profits. As that happens, Keeley [8] argues that the franchise value of banks will increase, and the above-normal profits will act as a cushion during times of crisis. As a result, banks will have fewer incentives to risk failure, and that will enhance prudent lending.

Nonetheless, economic theory also considers entry barriers within the banking industry to bring about harmful effects on lending owing to the reduction in competition [1, 3]. This is because banks are likely to increase the costs of their services, which will reduce the demand for lending. Moreover, in line with Claessens and Klingebiel [9], barriers to foreign entry into the banking sector can deprive domestic banks of gains from foreign expertise as well as productivity improvements as a result of pressure from foreign banks, which can enhance prudent lending.

In the case of restrictions on the mixing of banking and commerce as well as bank activity restrictions, Barth et al. [1] indicate that several theoretical reasons exist for supporting the view that these restrictions limit the risk-taking behaviour of banks and promote prudent lending. First, controlling the mixing of banking and commerce as well as restricting banks from engaging in a broad range of activities can prevent conflict of interests that may arise and limit banks from taking advantage of investors who are not well-informed. Second, these restrictions can protect banks against moral hazard problems as they can persuade firms they control to misallocate borrowed funds so that they can benefit from such risk-taking behaviour. Lastly, the restrictions can prevent banks from being too complex and powerful as this will make them difficult to monitor and discipline or they can limit banks from becoming big financial conglomerates with the power to eliminate competition and all the efficiency benefits that come with it.

Nevertheless, opposing theoretical arguments regarding restrictions on the mixing of banking and commerce as well as bank activity restrictions exist [1, 9]. First, these restrictions are considered to discourage economies of scale and



scope, which can lower banks' operations and information access costs, resulting in increased lending. Second, restrictions on the mixing of banking and commerce as well as bank activity restrictions can limit banks' franchise value, which can arise from increased revenue of cross-selling of various products or services, and can lower incentives to engage in prudent lending. Finally, imposing restrictions on the mixing of banking and commerce as well as on bank activities can prevent banks from diversifying their risk and income streams, which can enable them to remain profitable even in times of disintermediation. This can increase the stability of banks and maintain their ability to engage in prudent lending.

Different theoretical arguments also exist on the impact of capital regulation and liquidity requirements on bank lending. On the one hand, regulatory capital requirements are considered to provide buffers for banks during times of losses and encourage prudent lending by putting more bank capital at risk [1, 10–15]. For instance, Rochet [16] shows that undercapitalised banks can become risk-lovers when limited liability is taken into consideration. As a result, imposing minimum capital requirements may be necessary to reduce the banks' appetite for choosing risky portfolios, thereby reducing the risk of failure and promoting prudent lending [17–19].

However, some studies find that regulatory capital requirements could lead to risk-taking behaviour. According to Thakor [20], this could occur when banks prioritise equity more than deposits as the costs of complying with higher capital requirements increase (also see Sharpe [21]), thus reducing their screening and monitoring efforts on lending when equity becomes expensive. Moreover, Calem and Rob [22] and Blum [23] argue that strict capital requirements can induce risk-taking behaviour by reducing bank profits and leaving them with less to lose in the case of insolvency. Lower profits will further limit the ability of banks to raise equity, and this could force banks to assume more risk by engaging in imprudent lending [24].

On the other hand, liquidity requirements, by definition, increase the cost of doing banking as well as the price of bank lending. Given that the role of banks involves liquidity transformation, higher liquidity regulatory requirements are expected to impact negatively on the provision of bank credit by making the liquidity transformation process more expensive [25]. Nonetheless, these requirements are still imposed to minimise systemic risk in the case of excessive bank deposit withdrawals [26, 27], and, as a result, they can encourage prudent lending over time.

When it comes to macroprudential policies, the theory predicts that its impact on bank lending should be countercyclical. This is because macroprudential policies are meant to promote financial stability by limiting the build-up of systemic risk and eventually curbing excessive credit growth

[28–31]. According to the International Monetary Fund (IMF) [32], the macroprudential instruments can minimise three types of systemic externalities or market failures. The first being the possibility of a credit crunch that can limit new lending and increase the cost of credit by leading to a fire sale of illiquid assets. The second is related to the build-up of financial vulnerabilities owing to interactions between credit and asset market prices, especially in an upswing of a financial cycle that could be followed by a downturn in asset prices. The last is linked to the risk of contagion that could occur when financial institutions are exposed to liquidity risks, with their resulting failures being likely to affect the entire financial system owing to its interconnectedness.

The reviewed theoretical literature generally indicates that the impact of bank regulation on lending could be asymmetric, depending on the trade-off between the costs and benefits of bank regulation. Thus, if the costs of increasing the stringency of bank regulation get relatively higher, banks may move their capital or lending to markets that are less regulated in other countries, thereby enabling them to avoid costly regulations or dodge prudent regulations and assume more risks [33–35]. Furthermore, stringent regulations may shift financial intermediation to other institutions that are not regulated such as non-banks or shadow banks [36]. Although these institutions may provide lending without the issuance of insured liabilities, they might increase risks facing the financial system and lead to a fall in overall welfare [37–43].

Impact of bank regulation on bank lending: empirical evidence

Although many empirical studies attempt to determine the impact of bank regulation on bank lending, they point to different directions. This section presents the empirical studies in favour of the negative, positive and insignificant or inconclusive impact of bank regulation on bank lending in both developing and developed countries. It also distinguishes between studies assuming first-round and second-round effects.

Empirical studies in favour of the negative impact of bank regulation on bank lending

The majority of empirical studies analysing the impact of bank regulation on bank lending found it to be negative. This is mainly supported by studies assuming first-round effects using static and/or dynamic models (such as panel, cross-sectional and time-series data analysis), while evidence from the ones assuming second-round effects using general equilibrium models is limited.

Considering empirical studies using static and/or dynamic models to capture first-round effects, Peek and Rosengren



[44] found that credit from banks facing formal regulatory enforcement actions shrank at a faster rate than the one from banks without such actions in New England during the period 1989–1992. In a different study on the transmission of financial shocks, they also obtained evidence that risk-based capital requirements led to a decline in lending from Japanese banks operating in the United States (US) over the period 1988–1995 [45]. Furthermore, Shrieves and Dahl [46], who determined the causes of the 1990 credit crunch in the US, established that capital regulation through capital-asset ratio adjustments was responsible for a significant decline in bank credit.

Additionally, Aiyar et al. [47–49] found that higher capital requirements are associated with lower cross-border lending and/or domestic credit in the United Kingdom (UK) during the periods 1999–2006 and 1998–2007. Comparable findings regarding the impact of capital requirements on bank lending were also obtained by the following studies: Mésonnier and Monks [50] in the Euro Area (2011–2012); Behn et al. [51] in Germany (2008–2011); Noss and Toffano [52] in the UK (1986–2010); Bressan [53] in the US (2006–2016); Eickmeier et al. [54] in the US (1979–2008); Imbierowicz et al. [55] in Denmark (2007–2014); Kapan and Minoiu [56] in 55 countries (2006–2010); Roulet [57] in 22 European countries (2008–2015); Bams et al. [58] in the US (2005–2010); Gropp et al. [59] in 18 European countries (2007–2013); Fang et al. [60] in Peru (2005–2016); Fraisse et al. [61] in France (2008–2011); Imbierowicz et al. [62] in Germany (2008–2018); and Jonghe et al. [63] in Belgium (2013–2015).

Furthermore, Behn et al. [64] obtained evidence that the impact of higher capital requirements on bank lending in Europe over the period 2014–2016 was different in the short run, which was found to be negative, as compared to the medium to long run, while increased liquidity requirements led to a permanent decline in bank lending. Li [65] also discovered that leverage ratio regulation, as a supplement to capital requirements, inhibited credit expansion in China over the period 2013–2018.

Other empirical studies relied on the World Bank's bank regulation and supervision surveys, macroprudential indices as well as other policy shocks to assess the impact of bank regulatory measures on bank lending. For example, using a worldwide sample of 107 countries over the period 1997–1999, Barth et al. [1] revealed that restrictions on bank activities and the mixing of banking and commerce, as well as limitations on foreign bank entry or ownership, impacted negatively on bank credit, thereby hindering bank development. Merrouche and Nier [66] also established that bank entry barriers had a negative impact on bank credit in 22 Organisation for Economic Cooperation and Development (OECD) countries from 1999 to 2007.

Moreover, Amidu [67] found that stringent capital requirements restricted the delivery of bank credit in 24 Sub-Saharan African (SSA) countries during the period 2000–2007. Likewise, Kořak et al. [68] discovered that more capital regulations and bail-out probability had a negative impact on the growth rate of bank loans in a worldwide sample of countries over the period 2000–2010, while Temesvary [69] provided evidence that the affiliates of the US banks reduced their lending in host countries facing stringent capital regulations between 2003 and 2013. Sum [70] also obtained a negative impact of credit and market risk capital regulations on the growth rate of bank loans in 27 EU countries during the period between 2005 and 2014, while Gumata and Ndou [71], who used the dataset spanning 2001–2014, established that credit growth in South Africa shrank significantly following tight Basel III regulation shocks.

Furthermore, Ibrahim and Rizvi [72] revealed that imposing more restrictions on bank activities and increasing the stringency of capital regulations depressed credit growth of conventional banks in a sample of ten countries with dual-banking systems of Islamic and conventional banks over the period 2005 to 2012. Similarly, Hu and Gong [73], when using the dataset from 19 major economies, spanning 2005 to 2011, established that the impact of bank activity restrictions and capital regulations on the growth rate of bank loans was negative. Hsieh and Lee [74] also found capital regulations to have had a negative impact on bank lending in the case of 30 Asian and Latin American countries during the period 1987–2013.

Alternatively, Lim et al. [75] discovered that many of the macroprudential policy instruments, such as countercyclical capital requirements, credit or credit growth ceilings, debt-to-income ratio, loan-to-value ratio, reserve requirements and time-varying or dynamic provisioning, were effective in curbing credit growth in 49 countries during the period 2000 to 2010. The following empirical studies reached similar conclusions about the impact of macroprudential policy measures on bank lending: IMF [32] in a cross-country context; Tillmann [76] in Korea (2000–2012); Zhang and Zoli [77] in 13 Asian economies and 33 other economies (2000–2013); Cerutti et al. [28] in 119 countries (2000–2013); Fendođlu [78] in 18 emerging market economies (2000–2013); Akinci and Olmstead-Rumsey [79] in 57 advanced and emerging market economies (2000–2015); Carreras et al. [80] in 19 OECD countries (2000–2015); Berrospide and Edge [81] in the US (2012–2016); Hu and Gong [73] in 19 major economies (2005–2011); Klingelhöfer and Sun [82] in China (2000–2015); Richter et al. [83] in 56 advanced and emerging market economies (1990–2012); Gómez et al. [84] in Colombia (2006–2009); Kim and Oh [85] in Korea (2009–2019); Revelo et al. [86] in 37 advanced



and emerging economies (2000–2014); and Favara et al. [87] in the US (2014–2017).

In the case of empirical studies incorporating second-round effects using general equilibrium models, calibrated with US data, Covas and Driscoll [88] established that increases in both capital and liquidity requirements resulted in a steady-state decline in bank lending. Mankart et al. [89] also discovered that tightening risk-weighted capital requirements resulted in a reduction in the supply of lending by banks, while Corbae and D’Erasmus [90] revealed that higher capital requirements were associated with a fall in aggregate bank lending both in the short run and long run. Lastly, De Nicolo et al. [91] found that liquidity requirements reduced bank lending, while an inverted U-shaped relationship existed between capital requirements and bank lending, with too stringent capital requirements resulting in a fall in bank lending.

Table 1 provides a summary of the reviewed empirical studies in favour of the negative impact of bank regulatory measures on bank lending.

Empirical studies in favour of the positive impact of bank regulation on bank lending

There is a relatively limited amount of contribution from the empirical literature in favour of the positive impact of bank regulation on bank lending. Several studies still assume first-round effects using static and/or dynamic models, while a few take into account the existence of second-round effects using general equilibrium models.

Regarding studies incorporating only first-round effects by using static and/or dynamic models, Bernanke and Lown [93], Furlong [94], Berrospide and Edge [95], Cornett et al. [96] and Kim and Sohn [97] established that bank capital or capital ratio adjustments impacted positively on bank loan growth rates or bank lending in the US during the periods 1986–1991, 1985–1991, 1992–2009, 2006–2009 and 1993–2010, respectively. Similar findings regarding the impact of bank capital or capital requirements on bank lending were also obtained by Buch and Prieto [98] in Germany (1965–2009), Osei-Assibey and Asenso [99] in Ghana (2002–2012), Gambacorta and Shin [100] in 14 advanced countries (1995–2012), Behn et al. [64] in Europe (2014–2016) but only in the medium to long term, and Thornton and Tommaso [101] in 21 European countries (2007–2017).

Furthermore, Gambacorta and Marques-Ibanez [102] found that increasing tier 1 capital ratio and imposing more bank activity restrictions impacted positively on the growth rate of bank lending in 15 developed countries over the period 1999–2009. Similarly, Amidu [67] discovered that bank activity restrictions and entry barriers promoted the delivery of bank credit within the SSA region. Sum [70] also

revealed that bank activity restrictions had a positive impact on the growth rate of bank gross loans in 27 European Union (EU) countries between 2005 and 2014. A comparable finding was also reported by Hsieh and Lee [74] in 30 Asian and Latin American countries, using sample data ranging from 1987 to 2013.

Moreover, Kořak et al. [68], who used worldwide sample data from 2000 to 2010, discovered that the impact of tier 1 capital ratio and deposit insurance index on the growth rate of bank loans was positive, especially during the period of the crisis. Ghanem [103] also obtained evidence that bank credit growth increased following the implementation of Basel II capital regulations in 5 Middle East and North African countries between 1997 and 2013, while Jiménez et al. [104] established that an increase in capital buffers led to bank credit expansion in Spain during the period 1999–2013.

Concerned about the implications of the Basel III liquidity rules for the growth of bank lending in 38 African countries over the period 2005–2015, Adesina [105] found that the impact of both liquidity coverage and net stable funding ratios on the growth rate of bank loans was positive. Likewise, Polizzi et al. [106] discovered that liquidity coverage, net stable funding and tier 1 capital ratios impacted positively on the growth of bank loans in 117 developed and developing economies during the period 2000–2016, while Roulet [57] established that liquidity regulation indicators had a positive impact on the growth rate of bank lending in 22 European countries over the period 2008–2015.

Concerning empirical studies assuming second-round effects using general equilibrium models, calibrated with US data, Meh and Moran [107] discovered that exogenous shocks leading to a fall in bank capital resulted in a significant decline in bank lending. Furthermore, De Nicolo et al. [91] found that mild capital requirements induced banks to increase bank lending. Similarly, Begenau [108] revealed that higher capital requirements increased bank lending by reducing the cost of capital, while Mankart et al. [89] found that higher leverage requirements increased the supply of credit by banks.

Table 2 offers a summary of the considered empirical studies in favour of the positive impact of bank regulatory measures on bank lending.

Empirical studies in favour of the insignificant or inconclusive impact of bank regulation on bank lending

The empirical literature in favour of the insignificant or inconclusive impact of bank regulation on bank lending is also limited. The evidence is emanating from studies that only accounted for first-round effects using static and/or



Table 1 Empirical studies in favour of the negative impact of bank regulation on bank lending

Authors	Region/country (period)	Methodology	Bank regulatory measure	Impact
Peek and Rosengren [44]	New England (1989–1992)	Variance components	Formal regulatory enforcement action	Negative
Peek and Rosengren [45]	United States (1988–1995)	Variance components; Fixed effects	Risk-based capital requirements	Negative
Shrieves and Dahl [46]	United States (1985–1991)	Pooled cross-section and time-series regression	Capital-asset ratio adjustment	Negative
Barth et al. [1]	107 countries (1997–1999)	Ordinary least squares; Generalised method of moments	Activity restriction and mixing banking and commerce index	Negative
Lim et al. [75]	49 countries (2000–2010)	Generalised method of moments	Limitations on foreign bank entry or ownership	Negative
			Countercyclical capital requirements	Negative
			Credit or credit growth ceilings	Negative
			Debt-to-income ratio	Negative
			Loan-to-value ratio	Negative
			Reserve Requirements	Negative
IMF [32]	Cross-country context	Dynamic panel regressions	Time-varying or dynamic provisioning	Negative
			Loan-to-value limits	Negative
			Reserve requirements	Negative
			Sectoral risk weights	Negative
			Debt-to-income limits	Negative
Amidu [67]	24 Sub-Saharan African countries (2000–2007)	Random effects	Reserve requirements	Negative
			Capital regulation index	Negative
Aiyar et al. [47]	United Kingdom (1999–2006)	Fixed effects	Capital requirements	Negative
Aiyar et al. [48]	United Kingdom (1998–2007)	Fixed effects	Capital requirements	Negative
Covas and Driscoll [88]	United States (1997–2012)	Dynamic general equilibrium model	Capital requirements	Negative
			Liquidity requirements	Negative
De Nicolo et al. [91]	United States (1983–2009)	Dynamic equilibrium model	Too stringent capital requirements	Negative
			Liquidity requirements	Negative
Kořak et al. [68]	Worldwide sample (2000–2010)	Fixed effects; Instrumental variables	Bail-out probability	Negative
			Capital regulation index	Negative
Mésonnier and Monks [50]	Euro Area (2011–2012)	Ordinary least squares	Core tier 1 capital ratio	Negative
Tillmann [76]	Korea (2000–2012)	Qualitative vector autoregression	Loan-to-value ratio	Negative
Aiyar et al. [49]	United Kingdom (1998–2007)	Fixed effects	Capital requirement ratio	Negative
Behn et al. [51]	Germany (2008–2011)	Fixed effects	Procyclical capital regulation	Negative
Boissay and Collard [92]	United States (1970–2009)	General equilibrium model	Liquidity and capital regulations	Negative
Noss and Toffano [52]	United Kingdom (1986–2010)	Vector autoregression	Capital requirements	Negative
Zhang and Zoli [77]	13 Asian economies and 33 other economies (2000–2013)	Generalised method of moments	Housing-related macroprudential policy index	Negative



Table 1 (continued)

Authors	Region/country (period)	Methodology	Bank regulatory measure	Impact
Sum [70]	27 EU countries (2005–2014)	Cross-sectional model	Credit risk capital regulation	Negative
			Market risk capital regulation	Negative
Cerutti et al. [28]	119 countries (2000–2013)	Generalised method of moments	Macroprudential policy index	Negative
Fendoğlu [78]	18 major emerging market economies (2000–2013)	Generalised method of moments	Borrower-based Macroprudential policy index	Negative
			Domestic reserve requirements	Negative
			Macroprudential policy index with a domestic focus	Negative
Gumata and Ndou [71]	South Africa (2001–2014)	Vector autoregression	Basel III regulation period	Negative
Merrouche and Nier [66]	22 OECD countries (1999–2007)	Fixed effects; Random effects	Entry barrier index	Negative
Akinci and Olmstead-Rumsey [79]	57 advanced and emerging economies (2000–2015)	Generalised method of moments	Housing-related macroprudential policies	Negative
			Non-housing related macroprudential policies	Negative
Bressan [53]	United States (2006–2016)	Pooled ordinary least squares	Risk-weighted capital ratio	Negative
Carreras et al. [80]	19 OECD countries (2000–2015)	Panel vector error-correction; Pooled fully-modified ordinary least squares; Seemingly unrelated regressions	Debt-to-income ratio limits	Negative
			General capital requirements	Negative
			Strict loan-to-value ratios	Negative
			Taxes on financial institutions	Negative
Eickmeier et al. [54]	United States (1979–2008)	Instrumental-variable local projections	Capital requirement tightenings	Negative
Ibrahim and Rizvi [72]	10 dual-banking countries (2005–2012)	Random effects	Activity restriction index	Negative (for conventional banks)
			Capital regulation index	Negative (for conventional banks)
Imbierowicz et al. [55]	Denmark (2007–2014)	Generalised method of moments	Capital requirements	Negative
Kapan and Minoiu [56]	55 countries (2006–2010)	Fixed effects	Capital ratios	Negative
Roulet [57]	22 European countries (2008–2015)	Ordinary least squares	Capital ratios	Negative
Temesvary [69]	75 countries (2003–2013)	Two-stage least squares	Capital regulations	Negative
Bams et al. [58]	United States (2005–2010)	Generalised method of moments	Capital requirements	Negative
Behn et al. [64]	Europe (2014–2016)	Dynamic partial equilibrium model	Capital requirements	Negative (in the short-term)
			Liquidity requirements	Negative
Berrospeide and Edge [81]	United States (2012–2016)	Fixed effects	Stress-test capital buffers	Negative
Corbae and D’Erasmus [90]	United States (1984–2016)	Dynamic equilibrium model	Capital requirements	Negative
Gropp et al. [59]	18 European countries (2007–2013)	Difference-in-differences matching estimator	Capital requirements	Negative

Table 1 (continued)

Authors	Region/country (period)	Methodology	Bank regulatory measure	Impact
Hu and Gong [73]	19 major economies (2005–2011)	Fixed effects	Activity restriction index	Negative
			Capital regulation index	Negative
			Macroprudential policy index	Negative
Klingelhöfer and Sun [82]	China (2000–2015)	Structural vector autoregression	Housing policy index	Negative
			Reserve requirements	Negative
			Supervision pressure index	Negative
			Window guidance index	Negative
Richter et al. [83]	56 countries – both advanced and emerging market economies (1990–2012)	Local projection method	Loan-to-value ratio	Negative
Fang et al. [60]	Peru (2005–2016)	Ordinary least squares	Capital requirements	Negative
Fraisse et al. [61]	France (2008–2011)	Fixed effects	Capital requirements	Negative
Gómez et al. [84]	Colombia (2006–2009)	Fixed effects	Aggregate macroprudential policy	Negative
			Countercyclical reserve requirement	Negative
			Dynamic provisions	Negative
			Capital regulation index	Negative
Hsieh and Lee [74]	30 Asian and Latin American countries (1987–2013)	Instrumental variables	Capital regulation index	Negative
Jonghe et al. [63]	Belgium (2013–2015)	Fixed effects	Capital requirements	Negative
Kim and Oh [85]	Korea (2003–2019)	Structural vector autoregression	Debt-to-income ratio	Negative
			Loan-to-value ratio	Negative
Li [65]	China (2013–2018)	Generalised method of moments	Leverage ratio	Negative
Mankart et al. [89]	United States (1990–201)	Dynamic structural model	Risk-weighted capital requirements	Negative
Revelo et al. [86]	37 advanced and emerging economies (2000–2014)	System general method of moments	Macroprudential policy index	Negative
Favara et al. [87]	United States (2014–2017)	Fixed effects	Capital surcharges	Negative
Imbierowicz et al. [62]	Germany (2008–2018)	Generalised method of moments	Bank-specific capital requirement ratio	Negative

dynamic models, while the ones incorporating second-round effects using general equilibrium models are non-existent.

For example, interested in modelling the relationship between risk-based capital and bank credit in the US over the period 1979–1992, Berger and Udell [109] established that the impact of risk-based capital ratios on bank lending was not consistently stronger during the early 1990s. They further discovered that tier 1 and total risk-based capital ratios counteracted each other in their impact on the allocation of bank credit. Moreover, Carlson et al. [110] discovered that the impact of risk-adjusted tier 1 and total risk-adjusted capital ratios on bank lending was significant and positive during the time of the recent global financial crisis and shortly after that period, but it became insignificant during the other

years preceding the crisis. Additionally, Müller and Uhde [111] provided evidence that higher capital buffers limited cross-border lending in 13 OECD countries, but not during the time preceding the dot-com bubble burst and when the borrowing countries were sharing a common lender, while Bridges et al. [112] found that capital requirements affected domestic bank credit with heterogeneous responses across various economic sectors in the UK over the period 1990–2011.

When evaluating the effects of bank regulation and supervision on bank lending in 107 countries during the period 1997–1999, Barth et al. [1] established that the impact of capital regulations and bank entry barriers on bank credit was insignificant. Likewise, Cottarelli et al. [113] revealed



Table 2 Empirical studies in favour of the positive impact of bank regulation on bank lending

Authors	Region/country (period)	Methodology	Bank regulatory measure	Impact
Bernanke and Lown [93]	United States (1986–1991)	Cross-sectional regression	Bank capital	Positive
Furlong [94]	United States (1985–1991)	Pooled regression	Capital-asset ratio adjustment	Positive
Berrospide and Edge [95]	United States (1992–2009)	Fixed effects	Total risk-based capital ratio Tier 1 risk-based capital ratio	Positive Positive
Meh and Moran [107]	United States (1990–2005)	Dynamic stochastic general equilibrium model	Bank capital	Positive
Cornett et al. [96]	United States (2006–2009)	Fixed effects	Bank capital	Positive
Gambacorta and Marques-Ibanez [102]	15 developed countries (1999–2009)	Generalised method of moments	Activity restriction index Tier 1 capital ratio	Positive Positive
Amidu [67]	24 Sub-Saharan African countries (2000–2007)	Random effects	Activity restriction index Entry barrier index	Positive Positive
Buch and Prieto [98]	Germany (1965–2009)	Panel error-correction	Bank capital	Positive
De Nicolo et al. [91]	United States (1983–2009)	Dynamic equilibrium model	Mild capital requirements	Positive
Košak et al. [68]	Worldwide sample (2000–2010)	Instrumental variables	Deposit insurance index Tier 1 capital ratio	Positive Positive
Osei-Assibey and Asenso [99]	Ghana (2002–2012)	Generalised method of moments	Net minimum capital ratio	Positive
Sum [70]	27 European Union countries (2005–2014)	Cross-sectional model	Activity restriction index	Positive
Jiménez et al. [104]	Spain (1999–2013)	Fixed effects	Capital buffers	Positive
Ghanem [103]	5 Middle East and North African countries (1997–2013)	Fixed effects	Basel II implementation	Positive
Kim and Sohn [97]	United States (1993–2010)	Fixed effects	Capital ratio	Positive
Gambacorta and Shin [100]	14 advanced countries (1995–2012)	Generalised method of moments	Bank capital	Positive
Roulet [57]	22 European countries (2008–2015)	Ordinary least squares	Liquidity indicators	Positive
Adesina [105]	38 African countries (2005–2015)	Generalised method of moments; Quasi-maximum likelihood	Liquidity coverage ratio Net stable funding ratio	Positive Positive
Behn et al. [64]	Europe (2014–2016)	Dynamic partial equilibrium model	Capital requirements	Positive (in the medium to long term)
Begenau [108]	United States (1999–2016)	Dynamic general equilibrium	Capital requirements	Positive
Hsieh and Lee [74]	30 Asian and Latin American countries (1987–2013)	Instrumental variables	Activity restriction index	Positive
Mankart et al. [89]	United States (1990–201)	Dynamic structural model	Leverage requirements	Positive
Polizzi et al. [106]	117 developed and developing countries (2000–2016)	Two-stage least squares	Liquidity coverage ratio Net stable funding ratio Tier 1 capital ratio	Positive Positive Positive
Thornton and Tommaso [101]	21 European countries (2007–2017)	Unbalanced panel regressions with fixed effects	Tier 1 capital ratio	Positive

that barriers to bank entry had no significant impact on bank credit in 24 non-transition developing and industrialised countries from Central and Eastern Europe and in the Balkans over the period 1973–1996. Fratzscher et al. [114]

and Sum [70] also found that capital regulations exerted no impact on the growth rate of bank credit in 50 advanced and emerging market economies, spanning over the period 2003–2013, and in 27 EU economies during the period



2005–2014, respectively. Similarly, Merrouche and Nier [66] discovered that bank activity restrictions and capital regulations had no significant impact on bank credit in 22 OECD during the period 1999–2007. Comparable findings were also obtained by Ibrahim and Rizvi [72] in the case of Islamic banks in ten countries with dual-banking systems of Islamic and conventional banks over the period 2005 to 2012.

Although Deli and Hasan [115] established that the stringency of capital regulations had a weak negative impact on the growth rate of bank loans in 125 countries across the world during the period 1998–2011, that impact ceased to be apparent when banks held relatively higher capital levels. The same ambiguity was observed by Ibrahim [116], who found that smaller banks reduced their lending when capital regulations were tightened in 13 countries with both Islamic and conventional banking systems over the period 2000–2014, but this impact became muted or reversed for larger banks. Kim and Katchova [117] also discovered that the implementation of Basel III regulations reduced the growth rates of agricultural bank loans, but increased their volumes, in the US over the period 2008–2017.

Additionally, Greenwood-Nimmo and Tarassow [118] found evidence that macroprudential policy shock had only a short run negative impact on credit to output, but an insignificant one on the ratio of business credit to internal funds in the US between 1960 and 2007. Even though Carreras et al. [80] discovered that concentration, foreign currency lending and interbank exposure limits were effective in controlling household credit in 19 OECD economies from 2000 to 2015, they also indicated that the results of the same macroprudential policies were insignificant in some of the estimated models. Moreover, Zhang and Zoli [77] revealed that the impact of non-housing related macroprudential policy instruments on bank credit growth was insignificant in the case of 13 Asian economies and 33 other economies over the period 2000 to 2013, while Banerjee and Mio [119] found that tightening liquidity guidance requirements did not reduce bank lending towards the non-financial sector in the UK during the period 2000–2015.

Table 3 gives a summary of the discussed empirical studies in favour of the insignificant or inconclusive impact of bank regulatory measures on bank lending.

Policy implications

This systematic survey of the existing literature on the impact of bank regulation on bank lending provided several observations with important policy implications for the practice of bank regulation and supervision. First, bank regulation has become more complex over time, as indicated by its distinctive measures, which may have either counteractive

or reinforcing effects on bank lending. As a result, policy-makers should exercise caution when implementing various reforms in bank regulation in order to ensure that they do not yield unintended negative effects on bank lending.

Secondly, bank regulation involves costs and benefits, and its impact on bank lending could be asymmetric depending on whether the benefits outweigh the costs or the other way round. It is, therefore, vital for bank regulators or supervisors not to impose a linear relationship between bank regulation and bank lending when assessing the impact of the former on the latter as this could induce a bias in the estimated parameters and lead to wrong policy implications.

Thirdly, even though many empirical studies analysing the impact of bank regulation on bank lending assumed first-round effects using static and/or dynamic models, in other studies, the importance of accounting for second-round effects using general equilibrium models has been highlighted. Therefore, when introducing bank regulatory reforms, policymakers should take into consideration the fact that second-round effects of such changes in bank regulatory measures could exacerbate, constrain or reverse first-round effects.

Lastly, increasing the stringency of bank regulation may give rise to the provision of lending by non-banks or lead to more cross-border bank lending. Given that this could result in risk-taking behaviour that may put the global financial system at risk due to its interconnectedness, bank regulators or supervisors should strive for more cooperation at the international level, as well as the harmonisation of their financial regulatory frameworks.

Conclusion

This paper reviews the theoretical and empirical literature on the impact of bank regulation on bank lending. It gives a systematic survey of the literature on the impact of various bank regulatory measures on bank lending and structures the evidence from the empirical studies according to the impact of these measures. It also distinguishes between empirical studies assuming first-round and second-round effects and offers policy implications regarding the practice of bank regulation and supervision. The surveyed theoretical literature generally indicates that the impact of bank regulation on lending could be asymmetric, depending on the trade-off between the costs and benefits of bank regulation. It also shows that if the costs of increasing the stringency of bank regulation become relatively higher, banks may move their capital or lending to markets that are less regulated in other countries, or financial intermediation can shift to other institutions that are not regulated, such as shadow banks. On the other hand, the empirical literature revealed that the impact of bank regulatory measures on lending was ambiguous.



Table 3 Empirical studies in favour of the insignificant or inconclusive impact of bank regulation on bank lending

Authors	Region/country (period)	Methodology	Bank regulatory measure	Impact
Berger and Udell [109]	United States (1979–1992)	Pooled ordinary least squares	Risk-based capital ratios	Inconclusive
Barth et al. [1]	107 countries (1997–1999)	Ordinary least squares; Generalised method of moments	Capital regulatory index	Insignificant
Cottarelli et al. [113]	24 non-transition developing and industrialised countries (1973–1996)	Random effects	Entry barrier index Entry barrier index	Insignificant Insignificant
Carlson et al. [110]	United States (2001–2011)	Fixed effects	Risk-adjusted tier 1 capital ratio Total risk-adjusted capital ratio	Inconclusive Inconclusive
Müller and Uhde [111]	13 OECD countries (1993–2007)	Random effects	Capital buffers	Inconclusive
Bridges et al. [112]	United Kingdom (1990–2011)	Fixed effects	Capital requirements	Inconclusive
Fratzscher et al. [114]	50 advanced and emerging market economies (2003–2013)	Difference-in-difference	Capital regulation index	Insignificant
Greenwood-Nimmo and Tarassow [118]	United States (1960–2007)	Sign restricted vector autoregression	Macroprudential shock	Inconclusive
Sum [70]	27 EU countries (2005–2014)	Cross-sectional model	Overall capital regulatory index	Insignificant
Zhang and Zoli [77]	13 Asian economies and 33 other economies (2000–2013)	Generalised method of moments	Non-housing related macroprudential policy index	Insignificant
Deli and Hasan [115]	125 countries (1998–2011)	Generalised method of moments	Capital regulation index	Inconclusive
Merrouche and Nier [66]	22 OECD countries (1999–2007)	Fixed effects; Random effects	Activity restriction index	Insignificant
Banerjee and Mio [119]	United Kingdom (2008–2012)	Local projections; Difference-in-difference	Capital regulation index Individual liquidity guidance requirement	Insignificant Insignificant
Carreras et al. [80]	19 OECD countries (2000–2015)	Panel vector error-correction; Pooled fully-modified ordinary least squares; Seemingly unrelated regressions	Concentration limits	Inconclusive
			Limits on foreign currency lending	Inconclusive
			Limits on interbank exposures	Inconclusive
Ibrahim and Rizvi [72]	10 dual-banking countries (2005–2012)	Random effects	Activity restriction index	Insignificant (for Islamic banks)
			Capital regulation index	Insignificant (for Islamic banks)
Ibrahim [116]	13 dual-banking countries (2000–2014)	Generalised method of moments	Capital regulation index	Inconclusive
Kim and Katchova [117]	United States (2008–2017)	Ordinary least squares	Post-Basel III regulation period	Inconclusive

Although many studies found the impact to be negative, some established that it was positive while others found it to be insignificant or inconclusive. Nonetheless, most empirical

studies only incorporated first-round effects using static and/or dynamic models, whereas the ones accounting for second-round effects using general equilibrium models were limited.



Based on this systematic review of the literature, it can be concluded that policy recommendations on the appropriateness and efficacy of bank regulatory measures in influencing bank lending cannot be implemented uniformly across different regions or countries.

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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