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Abstract

The recently finalized Basel Framework continues allowing banks to use internal data and models to define risk estimates and use them for the capital adequacy ratio computation. World-wide there are above two thousand banks running the Basel internal models. However, there are countries that have none of such banks. For them there exists a dilemma. Namely, which transition path to adopt out of the two. The voluntarily one as in the EU or the mandatory one as in the US. Our objective is to take the investor perspective and benchmark those two modes. Thus, we wish to find whether there is a premium for any of them, or perhaps that they are equivalent. The novelty of our research is the robust estimate that investors prefer mandatory transition style to the voluntarily one. Such a preference is reflected in the rise of the mean return and decline in stock volatility for the transited banks in the US and right the opposite consequences in the EU. However, we should be cautious in interpreting our findings. Such a preference may not only be the premium for the breakage of the vicious cycle and the ultimate improvement in the banks' risk-management systems and the overall financial stability. It may also hold true if and only if the mandatory transition for particular institutions is accompanied by a restriction for other banks in the region to transit. Our findings are of value primarily to the emerging economies like Argentine and Indonesia.

JEL Codes: C21, G12, G17, G18, G21.

Key Words: Basel II, Basel III, BCBS, CAR, difference-in-difference, D-SIB, G-SIB, IRB, risk-weight.

1. Motivation

The Basel Committee on Banking Supervision (BCBS) is the world standards setter for the prudential banking regulation. In 1988 it introduced the bank's health check measure. It was called the capital adequacy ratio (CAR). Simplistically, the CAR is the amount of bank own funds (capital, K) divided by the amount of its risks taken. The latter amount is the product of the risk-weight (RW) and the asset amount. This was the essence of the Basel I Accord (BCBS, 1988). Initially, there were several RW categories predefined by the BCBS. This was called a standardized approach (SA). In 1996 there came a prudential revolution. The BCBS allowed banks to define the asset riskiness themselves. This means that banks could utilize own internal data and models to define the RW. This related only to market risk assets. Credit risk ones were still left under the SA. However, soon in around the millennium BCBS started discussing the possibilities for the internal data and models use with respect to credit risk assets. The BCBS finalized its prudential treatment of the credit risk-related internal models in 2006. This was the second prudential revolution. It got the name of Basel II (BCBS, 2006a). The new accord also previewed models for the third risk type. It is the operational one. As (Repullo, 2013) said the idea to implement Basel II was to incentivize the improvements to the risk-management systems of the banks. The financial crisis of 2007-09 brought the need for the third prudential revolution. It got the name of Basel III (BCBS, 2009). Its draft was first announced in December 2009. In essence, Basel III has revisions to the credit and market risk models' treatment. The BCBS lost confidence in the internal models for the operational risks. Ultimately, Basel III was finalized in 2017 (BCBS, 2017). It encourages banks to collect operational risk data. However, it does not allow internal models for that risk.

By 2021 more than two thousand banks operate the Basel internal models. Those include 13 out of the 30 global systemically important banks (G-SIBs). Roughly, 40% of the world-GDP equivalent assets are subject to risk assessment in accordance with the internal models (Penikas, 2020b). Using such models may be beneficial for a bank. As we already stated, the regulator wishes that the banks modernize their risk-management systems and processes. Additionally, in case the bank's own risk assessment is lower than the SA one, the bank may have the opportunity to grant more loans. Such benefits have its costs. First, there are direct expenses to data collection, model development and process revision. Second, to have the opportunity for the prudential treatment in CAR the bank has to pass the validation by the regulator. Thus, there should be a joint concordance in-between the regulator and a bank to use the Basel internal models.

However, there are jurisdictions that still have no banks running the Basel internal models, though local regulation allows for it. For instance, those are Argentine (BCBS, 2016, p. 31) and Indonesia (BCBS, 2016, p. 52). The interested reader may observe the nil number of the banks using advanced approaches there, see Table 2. The reason is that the transition to the internal models is voluntarily there. This was the transition model in the European Union from the start in 2004. On the opposite, there is the United States experience. The local regulator prescribed all domestic systemically important banks (D-SIBs) to mandatorily transit to the internal models in 2014. Thus, the natural question arises. Suppose that we live in a Basel Committee-member country like Argentine or Indonesia. This means that our local regulation is no softer than the BCBS original standards are. In line with the Basel Framework (BCBS, 2019b) we allow our banks to use internal models. We are ready to validate those. But currently we have no applicants for the internal models use. We have two alternatives. The first one is to wait and see like in the EU. We may expect that with the time going on, banks may mature enough or change their strategies and risk appetites so that they become interested in the Basel internal models use. The second one is to mandatory request our D-SIBs to use such models in the next five years, for instance. Such time period is sufficient to collect the minimal data history.

From a libertarian point of view mandatory prescription seems unappealing. However, we should recall the information asymmetry cases dating back to the Akerlof's works (Akerlof, 2001). We need to explain why this is needed. We have strong belief that when a bank regularly uses data and up-to-date models, when its risk-management processes are transparent, the bank is more financially stable. This should be positively perceived by investors. However, our imaginary country lacks experience of banks using the internal models for the prudential purposes. Besides, the implementation process is costly. We know that the investors would eventually reward the banks, the banks' capitalization will rise. However, having no transition precedent, we stay with our 'lemons', like (Akerlof, 2001) could have said, i.e., the Basel internal models' market disappears. The banks just do not transit. Thus, the mandatory transition is a tool to break this vicious cycle and to handle this market failure.

Then there naturally comes a question. Are we right in assuming that the mandatory transition can solve the market failure and result in eventual bank valuation rise? Or we should stick to the individual choice and wait for an individual applicant to come? This becomes our research objective. Due to the rich history collected we wish to verify whether the mandatory transition to the internal models in the US led to greater rise in local banks' valuation all other things being equal compared to the voluntarily transition in the European Union (EU).

To achieve our objective, we proceed with the literature review in section 2. We wish to summarize the previously revealed impact from the transition to the Basel internal models. To briefly say, we do not find a consensus here. That is why our paper is important in contributing to this discussion. Then we describe the available data in section 3. Next, we present our methodology in section 4. First, we employ the difference-in-difference method to the transited and non-transited banks. Thus, we obtain the treatment impact estimate for the EU and the US regions. We compare the estimates to answer the stated research question. Second, we need to properly prepare the EU data sample. The specifics are that the voluntarily transition does not allow to straight-forwardly apply the difference-in-difference approach. The complexity comes from the fact that our treatment group grows in the number of banks, while the control one proportionately shrinks. We follow the (Merika, Merikas, Penikas, & Surkov, 2020) approach to resample our data. We briefly describe the idea for such a resampling. Otherwise, we would have lost the material part of our data sample when departing from the last transition case only. Our findings are given in section 5. Last section 6 concludes.

2. Literature Review

There is no consensus whether the Basel internal models are definitely beneficial or not for the banks. Take, for instance, the credit risk models. Those are called the internal ratings-based (IRB) ones. Hereafter we use IRB as the acronym for the banks that started using any of the Basel internal models. IRB originates from the (Vasicek, 2002) model. From one side, there are its proponents. (Vesalay, 2007) argues that IRB risk-estimates do not exacerbate the economic cycle as the Basel I RW did. (Barkova & Palvia, 2014) support the IRB use by the US banks as it delivers more risk-sensitive estimates than the Basel I RWs. (Cucinelli, Di Battista, Marchese, & Nieri, 2018) claims that IRB transition had positive impact on the EU banks. Specifically, it expectedly led to the decrease in the amount of the total risk-weighted assets.

From another side, (Kupiec, 2009) criticized the IRB models as those do not capture the default frequency. The US Federal Reserve researchers (Niepmann & Stebunovs, 2018) find that the US banks have a fraud incentive in running IRB. By doing so, the US IRB banks obtain lower crisis loss estimates during the prudential stress-tests. (Penikas, History of the Basel internal-ratings-based (IRB) credit risk regulation, 2020a) provides a comprehensive review of the IRB model shortcomings. The Bank of Italy representative (Gallo, 2020) concludes that IRB banks have drastic changes in loan pricing for public companies. Though the Italian IRB banks provide quite favorable terms during good times, they worsen them significantly during bad times. The Italian SA banks do not demonstrate such volatility in pricing and henceforth in credit availability.

Table 1. Concise Literature Review on the internal model transition in the EU and the US.

	positive	**negative**
EU	(Cucinelli, Di Battista, Marchese, & Nieri, 2018)	(Gallo, 2020)
US	(Barkova & Palvia, 2014)	(Niepmann & Stebunovs, 2018)

Thus, we have papers with controversial evidence from the Basel internal models use for the both regions of our interest, i.e., for the EU and for the US. Some papers indicate the switching to internal models is beneficial for a bank (Cucinelli, Di Battista, Marchese, & Nieri, 2018), (Barkova & Palvia, 2014), some argues that the impact is negative (Gallo, 2020), (Niepmann & Stebunovs, 2018). Vivid summary is available in Table 1. For additional references we recommend referring to the literature review in (Merika, Merikas, Penikas, & Surkov, 2020). However, the principal gap is that the investor perception at large scale for the transition to the internal models was not studied. Our previous paper handled a single country of Greece. Now we wish to benchmark the most developed regions in the world: the USA and the EU.

3. Data

The EU banking system is more numerous in terms of the overall bank number compared to the US. An expected outcome is that the total number of banks that moved to IRB in Europe is larger than in the US, i.e., it was 166 by 2014, whereas in the US those were only 15 banks, see Table 2. Another radical difference is the proportions of credit and market risks. The EU banks have more exposure to credit risk in relative terms, whereas the US counterparts have larger share of the market risk-exposed assets. This implies the need to control for the risk share on the bank balance sheet. We will use 'cr' variable for this purpose, see Table 6.

Table 2. High-Level Comparison of the Selected Banking Systems.

Region	**Source**	**Risk Contribution**			**Number of banks**	
		Credit	**Market**	**Operational**	**IRB**	**TOTAL**
Argentine	(BCBS, 2016, p. 31)	73.17	5.28	21.54	**0**	78
EU	(BCBS, 2014c, p. 62)	81.96	6.09	9.88	166	3992
Indonesia	(BCBS, 2016, p. 52)	84.62	0.50	14.88	**0**	118
USA	(BCBS, 2014d, p. 73)	65.76	10.03	19.90	15	1162

Note: Risk Contribution represents the per cent of the total risk-weighted assets, RWA.

The difference in the number of the transited banks may also be the reflection of the transition mode chosen by the local regulators. The EU one allows any bank to voluntarily apply for the IRB use, where the US one obliged the largest banks to transit mandatorily and simultaneously. Another feature here is that the mandatory transition nature in the USA implied also the restriction for other (non-systemically important) banks to transit. Thus, we may assume that though the IRB transition costs project expenses for banks, it might also be the re-allocation of the competitive advantage to the selected banks. This means that non-systemically important banks do not bear IRB project expenses. However, they neither may benefit from lower risk-weights in the future if those could have come from their own Basel internal models. That might be the cause for the preferential treatment of the mandatory transition style by investors. Let us verify this in the forthcoming sections.

When we verify the quote data availability for the IRB banks in the US and the EU, we find the following. All the US IRB banks have publicly listed stocks, whereas the majority of the EU IRB banks are private without publicly listed shares. That is why we decide to focus on the publicly listed banks. Those have stock quotes history. Thus, we may evaluate the IRB transition contribution to the stock performance. Overall, there are close to 40 EU IRB banks and 15 US IRB banks with public stocks. The dynamics of transition by number of banks is available in Figure 1. However, the reliable data including that on financials is available for only 35 EU IRB banks and the 9 US IRB banks. As a benchmark we use 10 EU banks that never moved to IRB and 50 US banks that neither did it. Overall, we have 45 EU banks and 59 US banks. We cover the most extensive time period from the millennium to the end of 2019. We chose such an end date and excluded 2020 to avoid the COVID-related shocks on the stock market.

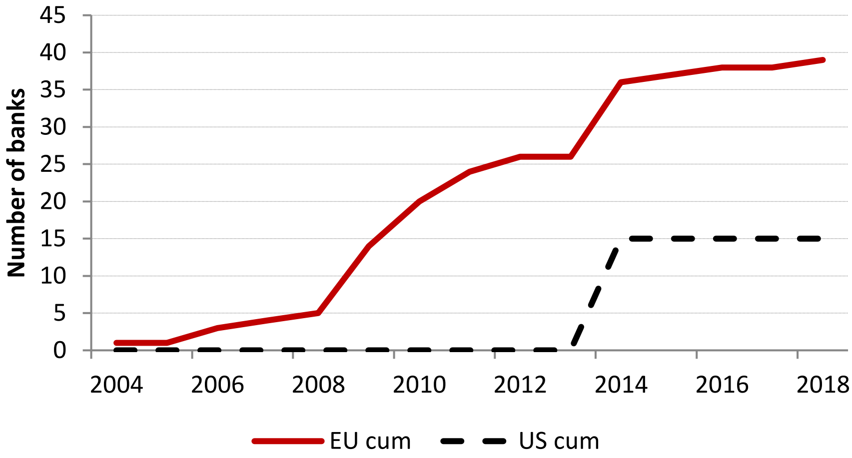

Figure 1. Voluntarily IRB Transition Overpasses the US Mandatory One by Number of the Transited Banks.

A top-level view on the stock performance by bank types and regions does not provide us with the statistically significant conclusions. If we look at Figure 2, we may see that the boxes for the EU banks are longer. This means that the majority of observations is more dispersed, than the stock returns for the US banks. The number of dots outside the box signals for the fat tails of the stock return distributions. This implies that the returns for the IRB banks have fatter tails than that for the non-IRB banks in both regions. The lines within the boxes indicate the median values for the stock returns. We see that on average the median returns for the IRB banks are lower than for the non-IRB ones all else being equal. However, given the overlap of the boxes, we cannot conclude that the return levels are statistically different for the IRB and non-IRB banks neither overall, nor for a particular region (the EU or the USA). This requires us to control for other bank specific performance indicators including the proportion for credit-risk-exposed assets. We described the rationale for this above.

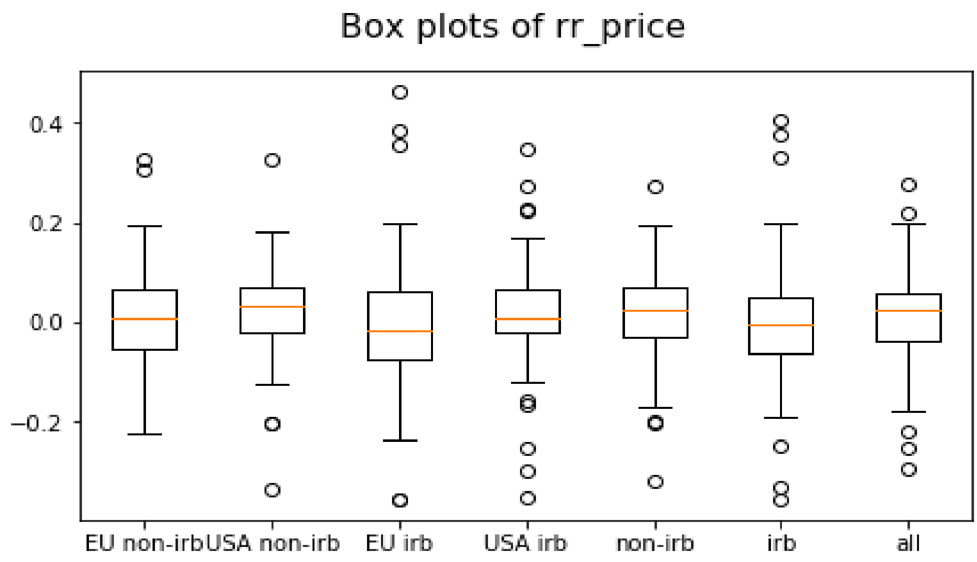

Figure 2. Stock Return Distribution is Wider for the EU Banks, than for the US Ones. It is Flatter for the IRB Banks Overall. The Mean Stock Returns Are on Average Lower for the IRB Banks, than for the non-IRB ones.

When we look at the time series dynamics of the stock returns, we cannot definitely conclude that there is an observable difference in it. For details, please, refer to Figure 3. This requires us again to consider the individual bank controls to properly disentangle the observed differences in the bank performance.

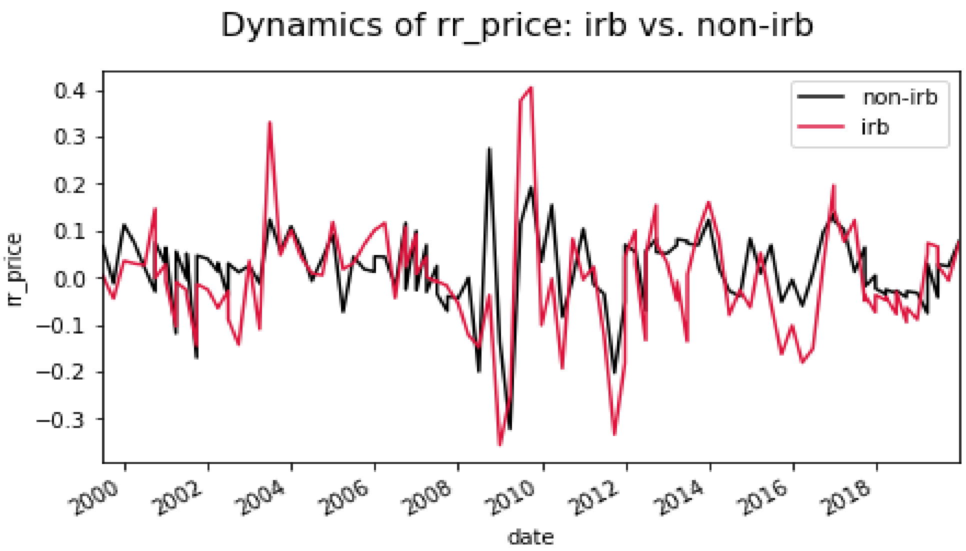

Figure 3. IRB Banks Do Not Outperform Non-IRB Ones Overall.

4. Methodology

4.1. Difference in difference method

We wish to find the determinants for the bank valuation. More specifically, to the growth in its valuation, i.e., for the stock return variable, see 'rr_price' in Table 6. We wish to extend the conventional list of the bank value drivers by the IRB-transition dummy variables. In this way we reproduce the methodology used in (Merika, Merikas, Penikas, & Surkov, 2020). We employ a difference-in-difference method (Wooldridge, 2009) as follows:

$$Y_{it} = \beta_0 + \beta_1 \cdot d\_t_i + \beta_2 \cdot d\_irb_i + \beta_3 \cdot \left(d\_t_i \cdot d\_irb_i\right) + \sum_{k=1}^{K} \gamma_k \cdot z_{kit} + u_{it}\ , \tag{1}$$

where Y_{it} – dependent variable (stock return), z_{kit} – k-th bank control variable, i - bank, t - year, u_{it} - i.i.d. disturbance term, and

$$d\_irb_i = \begin{cases} 1, bank\ moved\ to\ IRB\left(pilot; treatment\ group\right) \\ 0,\ otherwise\left(control\ group\right) \end{cases},$$

$$d\_t_i = \begin{cases} 1, IRB\ transition\ year\ and\ onwards \\ 0,\ year\ prior\ to\ IRB\ transition \end{cases}.$$

The coefficient β_3 corresponds to the interaction dummy $d\_t_i \cdot d\_irb_i = d\_t_i\_irb_i$. This dummy equals to one when a bank shifts to IRB in a particular year and onwards. When β_3 is statistically significant and positive, the IRB transition pays off. Namely, the investors start valuing the IRB transited banks more all else being equal. When β_3 is statistically significant and negative, the IRB transition does not pay off. It implies the under-valuation of a bank on average by investors after moving to the Basel internal models. Full list of variables under consideration is available in Annex 1.

4.2. Chow

Evaluating regression in the form of formula [1] is not sufficient to respond to our research question. We wish to know whether the voluntarily transition format to IRB in the EU produced any advantages to the bank valuation compared to the mandatory transition one in the USA. This actually means that we need to obtain the separate β_3 coefficient estimates for the EU and the US banks. Obtaining such estimates is neither sufficient. We need to run a statistical procedure to verify where β_3 for the EU is statistically different from β_3 in the USA. For this reason, we modify our regression specification [1] in the following way:

$$\begin{aligned} & Y_{it} = \beta_0 + \sum_{k=1}^{K} \gamma_k \cdot z_{kit} + u_{it} + \\ & + \beta_{11} \cdot d\_t_{i\_EU} + \beta_{21} \cdot d\_irb_{i\_EU} + \boldsymbol{\beta_{31}} \cdot d\_t_i\_irb_{i\_EU} + , \\ & + \beta_{12} \cdot d\_t_{i\_USA} + \beta_{22} \cdot d\_irb_{i\_USA} + \boldsymbol{\beta_{32}} \cdot d\_t_i\_irb_{i\_USA} \end{aligned} \tag{2}$$

By using specification [2], we differentiate the coefficients for the EU and the US banks. This enables us to implement a Chow test procedure (Chow, 1960). Its idea is to check whether two subsamples may be merged and whether a pooled regression should be estimated, i.e.:

$$\begin{aligned} & H_0 : \beta_{31} = \beta_{32} \\ & H_1 : \beta_{31} \neq \beta_{32} \end{aligned}. \tag{3}$$

In case the coefficients from the hypothesis testing [3] occur to be statistically equal, we may conclude that the transitory mode does not matter. Equivalently, investors do not privilege neither the mandatory one, nor the voluntarily one. However, whence we find the statistically significant difference, we may argue that investors welcome a particular transitory mode.

4.3. Resampling

The complexity in estimating the regression [2] and running the hypothesis testing [3] comes from the control group attrition. This is typical for the EU banks. When the number of banks transiting to IRB rises, the number of non-IRB banks drops, respectively. When we mark all the banks that ultimately transited to the IRB as $d\_irb_i = 1$, we lose information from the times when those banks were still non-

IRB while some other banks already used IRB. When some of them were already IRB prior to the transition of the former ones, the late-movers could act as a control group. The conventional difference-in-difference setting does not allow us to do this.

We faced this challenge first during the investigation of the Greek banks transition to IRB. Our findings are described in (Merika, Merikas, Penikas, & Surkov, 2020). To overcome the challenge, we use the data resampling approach. The idea is to create quasi-observations to delineate cases when the not yet transited IRB-banks were control ones for the other IRB-banks. By doing so, we resample our EU banks dataset from 45 banks to 3191 banks, see Table 3. More details on the resampling techniques are available in (Penikas, Skarednova, Surkov, & Festa, 2021).

As for the US banks, we do not have such an obstacle. We do not need to resample the US banks. They all transited in the same moment in time. However, another challenge comes in when we pool the two regional subsets together. If we do not replicate the US banks' sample, the proportion of the US banks becomes lower compared to the number of the EU-resampled banks. This is the "set I" in Table 3. To resolve the obstacle, we proportionately replicate the number of the US banks. The number of EU banks in the original sample equals to 76% of the number of the US banks (i.e., 45 to 59). Then after EU banks' resampling, we wish to have so many US banks that the proportion of 76% holds. That is why we create 4071 clones of the US banks to have the ultimate number of 4130. This is "set II" in Table 3.

However, sets I and II may have a shortcoming. They have different proportions of the IRB and non-IRB banks. The number in the EU IRB banks is almost four times larger than the number of the EU non-IRB ones. Same time the US IRB banks form a fifth of the US non-IRB ones. That is why we wish to have a sample where the proportion of the IRB to non-IRB banks is comparable for the EU and the US regions. We have no reliable data to extend the EU banks' sample. This is why we decide to reduce the number of the US non-IRB banks. We preserve the ratio of around three to four as the proportion of the IRB banks' number to the non-IRB ones in both regions. This is "set III" in Table 3.

Table 3. The Data Sets Composition By IRB and Non-IRB Banks.

	IRB			Non-IRB			Total:	Total:	EU /	IRB / Non-IRB	
	EU	USA	Total	EU	USA	Total	EU	USA	USA	EU	USA
(a) -I,II	35	9	44	10	50	60	45	59	0.76	3.50	0.18
set I	2342	9	2351	849	50	899	3191	59		2.76	0.18
setII	2342	630	2972	849	3500	4349	3191	4130	0.77	2.76	0.18
(b)-III	35	9	44	10	3	13	45	12	3.75	3.50	3.00
setIII	2342	624	2966	849	226	1075	3191	850	3.75	2.76	2.76

Using the described sets II and III is a way to run robustness check of our findings based on "set I". If we come to the similar conclusions for all the three sets in terms of β_3 coefficients equality for the EU and the US subsamples, then we may be sure that our findings are trustworthy.

5. Empirical Findings

We present the core regression estimates in Table 4. Alternative specification is available in Annex, see Table 8. The goodness-of-fit measure is not high. The adjusted R-squared is around 3-5%. We are satisfied with it for two reasons. First, this is a typical situation for the empirical research. For instance, (Titova, Penikas, & Gomayun, 2020, p. Table 5) demonstrate 9%. Second, here we are interested neither in the goodness-of-forecast, not in the goodness-of-fit of the model. We wish to disentangle the impact of the bank specific variables and the indicators of the IRB transition. This means that we target obtaining and interpreting the regression coefficients. In case the latter ones are statistically significant, we may derive conclusions upon the dependence sign (if t-values are in-between one and two) or upon the quantitative scale (if t-values exceed two). That is why we proceed with the precise focus on analyzing the regression coefficients' statistical significance.

We find that the investors prefer taking on the market risk than the credit one. We conclude this by observing the negative coefficient for the proportion of credit risk-exposed assets on the balance. The coefficient for ROE is statistically positive. As one may intuitively expect the more profitable the bank is, the larger its stock grows. On average every ten percentage points in equity returns add another one percentage point of stock return growth per annum. This corresponds to the previous findings (Merika, Merikas, Penikas, & Surkov, 2020, pp. Table 9, variable - roa).

The larger the bank is, the less its stock grows. We conclude this from observing the statistically negative sign for the logarithm of total assets variable (lnTA). First, this coincides to the previously revealed stylized facts about banks. For instance, see (Titova, Penikas, & Gomayun, 2020, pp. Table 3, variable - size) or (Merika, Merikas, Penikas, & Surkov, 2020, pp. Table 9, variable - ta). Second, in essence this might be the investors' reflection of a systemic risk cost. This means the larger the bank is, the more systemic risk is allocated to it. That is why it is less systemically stable compared to its smaller peers.

Let us look at the IRB transition indicators. All else being equal joining the IRB cohort reduces the stock returns by around one to two percent per annum for the EU banks, see 'q_irb_eu' coefficients. As for the US IRB banks there is no such a distinct group effect. The overall time trend is slightly positive. On average stock returns augment by around 0.5 to one percent per annum, though the estimate is not robust. This holds true for both regions of the EU and the US, see coefficients 'q_t'.

The most interesting is the IRB interaction dummy. First of all, it is significant in mostly all specifications at 1% confidence level. Second, the coefficient signs are persistent per regions for all the three subsets. The key finding is that it is negative for the EU banks and positive for the US counterparts. The voluntarily IRB transition in the EU subtracts around two per cent per annum from the transited banks' stock returns. On opposite, the mandatory IRB transition in the US adds around 0.6 per cent to the transited banks' stock returns all else being equal.

The finding on the EU banks in Table 4 coincides with our conclusions for its subset. Namely, we also found negative impact for a single EU country, i.e., for Greece (Merika, Merikas, Penikas, & Surkov, 2020). However, the finding about the US banks is novel.

Table 4. Switching to Internal Models Implies Growth in Stock for Mandatorily Transition in the USA and Negative One in the EU.

	rr_price, %		
	set I	set II	set III
No. Obs	88063	408085	149948
Adj. R-sq	0.016	0.018	0.018
Intercept	6.0389***	1.4337***	-1.2985***
	(0.8138)	(0.2320)	(0.4910)
q_irb_eu	-1.7307***	-3.3537***	-1.9710***
	(0.1410)	(0.1018)	(0.1288)
q_irb_usa	-0.1829	-0.5466***	-0.1413
	(0.6259)	(0.1169)	(0.1349)

q_t_eu	0.7737	0.1377	-0.0922
	(0.6982)	(0.6078)	(0.6353)
q_t_usa	0.4476	0.5218***	0.4035***
	(0.4456)	(0.0532)	(0.0626)
q_t_irb_eu	-1.6315**	-0.5443	-1.4930**
	(0.7764)	(0.7280)	(0.7402)
q_t_irb_usa	0.4476	0.5218***	0.4035***
	(0.4456)	(0.0532)	(0.0626)
lnTA	0.3495***	-0.1874***	0.5399***
	(0.0511)	(0.0231)	(0.0415)
cr	-0.0787***	-0.0139***	-0.0179***
	(0.0079)	(0.0020)	(0.0026)
roe	0.1044***	0.1160***	0.1005***
	(0.0090)	(0.0049)	(0.0079)
car	-0.2006***	0.0981***	-0.0361
	(0.0326)	(0.0057)	(0.0260)

Standard errors in parentheses.
* p<.1, ** p<.05, ***p<.01

As discussed, we run a Chow test to verify whether the IRB interaction dummy's coefficients are statistically different for the EU and the US banks. We confirm the statistical difference. This means that the mandatory IRB transition is better perceived by the investors in the bank stocks. However, this is the mean level (or so to say, return) perspective. Let us cross-check our findings in terms of the risk-return paradigm. In case higher returns got associated with higher risk, then actually there is no improvement in the risk-return ratio.

That is why we use our regression specification and substitute the dependent variable with the standard deviation of the stock quotes for the selected banks. We report the estimates in Table 5. As we can see, the switch to the internal models (see coefficient for 'q_t_irb_...') is significantly positive for the EU and negative for the US. That said, the American bank stock became not only more yielding all else being equal, but also less risky than investing in the equities of their EU counterparts. Let us also note that the explained variance for risk (stock quote standard deviation) as an explanatory variable rose materially to above 20% in terms of the adjusted R-squared compared to the level of around 1% for the levels (In Annex 4 we additionally estimate baseline regressions for the quote levels and we see that the low explanatory power is an attribute of the conventional bank value drivers).

Table 5. Switching to Internal Models Is Associated with Decline In Stock Price Volatility in the USA and Rise in the EU.

	rr_price_std, %		
	set I	set II	set III
No. Obs	87988	407941	149874
Adj. R-sq	0.244	0.191	0.266
Intercept	0.4064	10.7557***	4.6717***
	(0.6560)	(0.2893)	(0.4268)
q_irb_eu	3.1490***	2.8758***	3.2324***
	(0.1155)	(0.1059)	(0.1176)
q_irb_usa	-0.1006	1.8898***	0.4093***
	(0.9103)	(0.1357)	(0.1470)

q_t_eu	-2.1623***	1.7672***	-1.5126**
	(0.6616)	(0.6139)	(0.6265)
q_t_usa	-3.1881***	-2.4507***	-3.1739***
	(0.5499)	(0.0648)	(0.0721)
q_t_irb_eu	2.1997***	0.9127	1.6278**
	(0.7646)	(0.7258)	(0.7395)
q_t_irb_usa	-3.1881***	-2.4507***	-3.1739***
	(0.5499)	(0.0648)	(0.0721)
lnTA	1.2907***	0.4474***	1.2850***
	(0.0394)	(0.0204)	(0.0356)
cr	0.0375***	0.0153***	0.0123***
	(0.0062)	(0.0023)	(0.0029)
roe	-0.3661***	-0.4277***	-0.4505***
	(0.0071)	(0.0067)	(0.0071)
car	0.4158***	-0.0546***	0.2457***
	(0.0265)	(0.0076)	(0.0220)

Standard errors in parentheses.
* p<.1, ** p<.05, ***p<.01

We wish to schematically present the estimated coefficients from the three subsets we looked at for the risk and returns effects after transiting to the internal models, see Figure 4. Those are coefficients for ‘q_t_irb_’ variables from Table 4 and Table 5. We may see a drastic divergence in effects from transiting to the internal models.

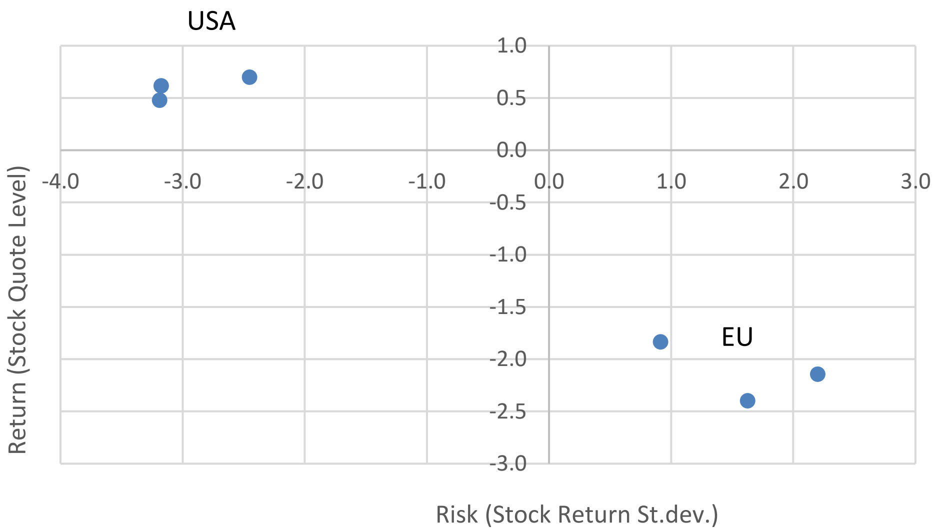

Figure 4. Mandatorily Switching to Internal Models in the USA Led to Improvement in Risk-Return Ratio Compared to EU Counterparts (in the US risk declined whereas the level rose in reference to the EU).

6. Discussion and Conclusions

The COVID crisis has recaptured much attention from the topics being important on its eve. The implementation of the Basel III and the Basel Framework was a noticeable stage in the world of the prudential banking regulation prior to 2020. The Basel Framework continues the Basel II concept. It allows banks to use internal models for the credit and market risk assessment. To make use of such models, banks have to apply to a local regulator. Then they pass the prudential validation and may exercise all the benefits associated with such transition. The immeasurable benefit is the improvement of the risk management systems. The quite tangible one might be the reduction of the prudential risk weights and the consequent possibility to transact larger business. It may be corporate lending or the investment banking one. However, the particular local regulator decides how banks may apply and transit. It may be the voluntary style adopted in the EU. Alternatively, it may be the mandatory one implemented in the USA.

Though the amount of the banking assets covered by the Basel internal models is around 40% of the world GDP, there are still countries that are compliant with the Basel regulation, but have no banks running the internal models. More often those are emerging market economies. Take Argentine and Indonesia as an example. Then the natural question is whether such countries should push for the IRB adoption by their home banks in a mandatory fashion or should leave it in a voluntary form.

Our paper presents the novel result by answering this question. We employ difference-in-difference method for a population of the EU and the US banks. We explain the data resampling done in order to capture the increase in the number of the IRB transited banks in the EU. Finally, we obtain robust results. Generally, bank investors favor the mandatory IRB transition more, than the voluntarily one. This conclusion specifically comes from the risk and return implications. First, we find that all else being equal the US IRB bank stock returns rise after the mandatory transition by 0.6 per cent per annum more compared to its non-IRB peers, whereas its EU IRB counterparts lose around two per cent per annum after the voluntarily transition benchmarked to local non-IRB banks. Second, all else being equal such a transition to internal models is associated by investors with decline in stock price fluctuations in the US and its rise in the EU all else being equal. Thus, the quotes of the US banks with the internal models start to yield higher returns and lower risks than banks without such models. We may say that the former banks quotes get more prestige with the investors. As for the EU, the situation is right the opposite. The quotes of banks with the approved internal models for the prudential use start yielding less and their volatility rises compared to the stock of banks that did not transit. We acknowledge that the revealed effects might be in part driven by the liquidity of the selected bank quotes. However, controlling for this is a separate research path that we plan to undertake in the future as it requires substantial extra data download.

When discussing our findings, we need to admit that we are unable to disentangle two probable causes for it. From one side, we strongly believe that the positive perception of the mandatory IRB transition comes from the vicious cycle breach. Investors know that moving to IRB improves the risk-management and the bank stability overall. This implies that they can discount the future cash flows from this bank by a lower discount rate. Thus, the valuation gets higher. However, such calculations may be accompanied with side-effects. Those are the absence of the transition precedent in a given country and the uncertainty in the project costs given the permanent banking regulation evolution. Thus, like with Akerlof's 'lemons' the IRB market does not appear. Banks do not transit. Then to offset for such a market failure the regulator's prescription to deliberately transit adds certainty and allows benefiting from the improved risk-management processes.

Nevertheless, such a rationale is only a single side of a coin. For a fair assessment we need to consider another side of it. We need to recall that the mandatory transition in the US took place only for the systemically important banks, whereas all the other banks were forbidden from applying and running the IRB models. This means that the US domestic systemically important banks got not only the extra burden of the IRB project expenses, but they also got the unique prospect of extra business and henceforth extra profits when the lower risk-weights from the internal models are in use instead of the higher standardized ones.

From here we may derive a recommendation for the emerging market economies like Argentine and Indonesia. In case the regulators wish the banks do gain in value when starting running the Basel internal models, they should design the mandatory transition for the selected group (for instance, for the domestic systemically important ones). Such a step should be accompanied by a limitation for the banks outside the selected group to apply for an equivalent IRB transit. Otherwise, when the mandatory transition for the D-SIBs is in place together with the possibility of the other players to voluntarily apply for the Basel internal models we may except that there is no valuation premium like the one that we revealed in our research.

Annex 1. Variables Description.

Table 6. List of Variables Considered During the Research.

No.	variable	unit	description	Source
1.	t_a	bn. USD	BS total assets	Bloomberg
2.	lnTA	ln(USDbn)	Logarithm of total assets	Calculated
3.	t_e	bn. USD	BS total equity	Bloomberg
4.	cash	bn. USD	BS cash and near cash item	Bloomberg
5.	n_i	bn. USD	BS net income	Bloomberg
6.	non_i_i	bn. USD	BS non-interest income	Bloomberg
7.	i_i	bn. USD	BS interest income	Bloomberg
8.	t_loans	bn. USD	BS total loans (gross)	Bloomberg
9.	n_loans	bn. USD	BS total loans (net)	Bloomberg
10.	cash_seq	bn. USD	BS cash and marketable securities	Bloomberg
11.	car	pp.	BS tier 1 capital adequacy ratio	Bloomberg
12.	roe	pp.	Return on equity	Bloomberg
13.	roa	pp.	Return on assets	Bloomberg
14.	pe	pp.	Price to equity ratio	Bloomberg
15.	pb	pp.	Price to book ratio	Bloomberg
16.	price	USD	Market share price	Bloomberg
17.	close	USD	Market share price	Yahoo Fin.
18.	rr_price	pp.	$(Price_t/Price_{t-1} - 1)$	Calculated
19.	rr_close	pp.	$(Close_t/Close_{t-1} - 1)$	Calculated
20.	d_irb	dummy	1 - for IRB (IM) banks,0 - else	Calculated
21.	d_t	dummy	1 - for quarter when bank transited to IRB (IM),0 - else	Calculated
22.	d_region	dummy	1 - for EU,0 - USA	Calculated
23.	cr	pp.	Credit risk exposure proxy = (t_loans)/(t_loans-cash_seq-cash)	Calculated

Note: pp. – percentage points; BS – balance sheet.

Annex 2. Visual Representation and Descriptive Statistics.

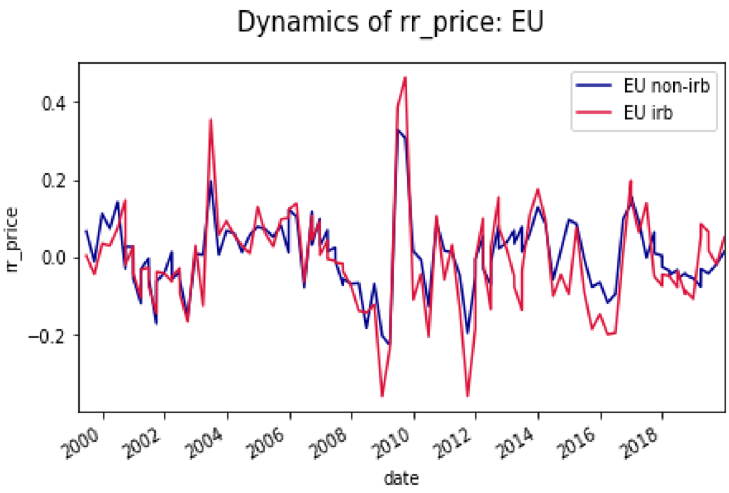

Figure 5. EU IRB Banks Do Not Outperform That of the Non-IRB Peers on Average.

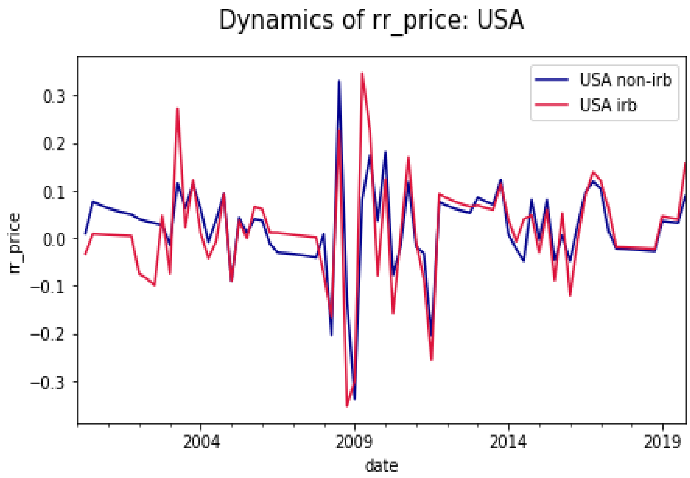

Figure 6. The US IRB Banks, On Opposite, Do Outperform on Average.

Table 7. Descriptive Statistics for the Banks in the Sample.

No.	VarName	EU	USA	Total
1	t_a	1 027.04	140.02	466.25
		57.09	6.35	21.95
3	t_e	80.95	2.25	35.27
		6.46	0.10	2.76
4	cash	63.12	4.29	25.80
		5.11	0.25	1.90
5	n_i	2.62	0.30	1.15
		0.32	0.02	0.12
6	non_i_i	4.07	0.77	1.97
		0.33	0.04	0.12
7	i_i	13.82	1.00	5.35
		1.24	0.05	0.43
8	t_loans	603.61	61.87	260.83
		41.02	2.60	15.46
9	n_loans	573.74	60.64	249.35
		38.25	2.55	14.45
10	cash_seq	148.44	22.37	68.45
		8.73	1.30	3.37
11	car	11.43	12.17	11.91
		0.08	0.05	0.04
12	roe	5.68	10.42	8.74
		0.29	0.11	0.13
13	roa	0.32	1.04	0.78
		0.02	0.01	0.01
14	pe	26.13	17.92	20.81
		1.90	0.32	0.70
15	pb	1.17	1.64	1.47
		0.02	0.01	0.01
16	price	2 502.15	39.49	945.20
		285.77	0.71	106.00
17	Close	1 101.63	32.18	411.90
		95.35	0.63	34.38
18	rr_price	-0.97%	2.12%	0.99%
		0.19%	0.39%	0.18%
19	rr_close	-0.78%	2.51%	1.34%
		0.36%	0.16%	0.16%
23	cr%	86.66	92.86	90.60
		0.21	0.21	0.16

Note: first line presents the mean values; the second row stands for the standard error. Number in first column is put for convenient correspondence with Table 6.

Annex 3. Alternative Regression (High-Level View, No Bank Controls).

The model in Table 8 regresses the overall stock return over a set of dummy variable. Latter stand for the essence of the difference-in-difference method. Such a simplified approach corresponds to the work of the ECB researchers where they decomposed the EU sovereign bonds yield over the key dummy-style determinants (Horny, Manganelli, & Mojon, 2018).

Table 8. Simplified Regression for Robustness Check.

	Rr_price		
	set I	set II	set III
No. Obs	118321	439171	180821
Adj. R-sq	0.001	0.006	0.004
Intercept	0.0022**	0.0201***	0.0058***
	(0.0009)	(0.0002)	(0.0008)
q_irb_eu	-0.0099***	-0.0278***	-0.0135***
	(0.0012)	(0.0009)	(0.0011)
q_irb_usa	0.0095	-0.0085***	0.0059***
	(0.0058)	(0.0007)	(0.0010)
q_t_eu	0.0090*	-0.0090*	0.0053
	(0.0052)	(0.0052)	(0.0052)
q_t_usa	0.0055	0.0055***	0.0055***
	(0.0042)	(0.0005)	(0.0005)
q_t_irb_eu	**-0.0303*** **	**-0.0123***	**-0.0266*** **
	(0.0066)	**(0.0066)**	**(0.0066)**
q_t_irb_usa	**0.0055**	**0.0055*** **	**0.0055*** **
	(0.0042)	**(0.0005)**	**(0.0005)**

Standard errors in parentheses.

* p<.1, ** p<.05, ***p<.01

Annex 4. Baseline Bank Valuation Regressions.

As we may see from Table 9 below, the conventional value drivers do not explain the major variance in bank stock quotes. However, we find significant factors for the bank size (logarithm of total assets, lnTA) and the bank profitability (return on equity, ROE). Capital adequacy ratio is statistically significant for the EU banks only. However, it has the same positive sign for the American banks also. ROE positively contributes to the bank valuation in both countries. Nevertheless, the bank size has a divergent impact. It is positively related to the American bank stock performance, but negatively to the EU ones.

Table 9. Simplified Bank Valuation Models for the USA and the EU.

	rr_price, %	
	usa	eu
No. Obs	4638	2344
Adj. R-sq	0.005	0.019
Intercept	-3.4782	1.1620
	(4.1520)	(1.7451)
lnTA	0.5329*	-0.2812**
	(0.2943)	(0.1247)
cr	-0.0365	-0.0076
	(0.0418)	(0.0145)
roe	0.1700***	0.0893**
	(0.0515)	(0.0399)
car	0.1169	0.1269***
	(0.1132)	(0.0413)

Standard errors in parentheses.
* p<.1, ** p<.05, ***p<.01

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